NOAA Technical Report NOS NGS 57

Local Tie Information Report

IERS Network Site: Fort Davis, Texas (USA)

Kendall L. Fancher
Steven E. Breidenbach
Charles E. Geoghegan

Date of Survey: February 2013
Date of Report: July 2013
Revised: April 2014

UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
NATIONAL GEODETIC SURVEY
GEODETIC SERVICES DIVISION
INSTRUMENTATION & METHODOLOGIES BRANCH

INTERNATIONAL EARTH ROTATION & REFERENCE SYSTEMS SERVICE

LOCAL TIE INFORMATION REPORT
IERS NETWORK SITE: Fort Davis, Texas (USA)

Kendall L. Fancher
Steven E. Breidenbach
Charles E. Geoghegan

Date of Survey: February 2013
Date of Report: July 2013
Revised: April 2014

April 2014 revision, Table 10: ILRS provided axis offset value for MLRS

Contents

Introduction 3
1. Site description 4
2. Instrumentation 5
2.1. Tacheometers, EDMI, Theodolites 5
2.1.1. Description 5
2.1.2 Calibrations 5
2.1.3 Auxiliary Equipment 5
2.2 GPS units 6
2.2.1 Receivers 6
2.2.2 Antennas 6
2.2.3 Analysis software, mode of operation 6
2.3 Leveling 6
2.3.1 Leveling instruments 6
2.3.2 Leveling rods 6
2.3.3 Checks carried out before measurements 6
2.4 Tripods 7
2.5 Forced centering devices 8
2.6 Targets, reflectors 9
3. Measurement Setup 9
3.1 Ground network 10
3.1.1 Listing 11
3.1.2 Maps of Network 13
3.2 Representation of Technique Reference Points 16
3.2.1 VLBI 16
3.2.2 SLR 17
3.2.3 GPS 18
3.2.4 DORIS (N/A) 19
3.2.5 GLONASS (N/A) 19
4. Observations 19
4.1 Conventional Survey 19
4.2 Leveling 19

4.3 GPS 20
4.4 General Comments 20
5. Data Analysis and Results 22
5.1 Terrestrial Survey 22
5.1.1 Analysis software 22
5.1.2 Topocentric coordinates and covariance 23
5.1.3 Correlation matrix 23
5.1.4 Reference temperature of radio telescope at Fort Davis NRAO [for thermal expansion] 23
5.2 GPS Observations 24
5.2.1 Analysis Software 24
5.2.2 Results 25
5.3 Additional Parameters 24
5.4 Transformation 27
5.5 Description of SINEX generation 28
5.6 Discussion of Results 29
5.7 Comparison with Previous Surveys 34
6. Planning Aspects 35
7. References 36
7.1 Name of person responsible for observations 36
7.2 Name of person(s) responsible for analysis 36
7.3 Location of observation data and results archive 36
ATTACHMENTS 37
A. GPS Geocentric Coordinates and Covariances 37
B. SINEX File NGSFTDV1302GA.snx 48
C. IERS ITRS Product Center SINEX File 51

Introduction

In the spirit of scientific cooperation, the U.S. National Oceanic and Atmospheric Administration's (NOAA) National Geodetic Survey (NGS) contributes to future realizations of the International Terrestrial Reference Frame (ITRF) by providing the International Earth Rotation and Reference Systems Service (IERS) with local tie information for geodetic techniques co-located at IERS Network Sites considered a priority by that service. Within NOAA, these types of surveys are the responsibility of the NGS's IERS Site Survey (ISS) program.

During February of 2013, the NGS ISS program conducted a local tie vector survey at IERS network site FORT DAVIS. Three space geodetic technique (SGT) instruments are co-located at this site, consisting of a very long baseline interferometry (VLBI) radio telescope, a satellite laser ranging (SLR) system and one GNSS station. The radio telescope is a component of the National Radio Astronomy Observatory (NRAO) array and is known as the Fort Davis VLBA. The SLR, known as McDonald Laser Ranging System (MLRS), is operated by the University of Texas. The IGS tracking station at the McDonald Observatory Site is owned and operated by the U.S. National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory (JPL).

This report documents the instrumentation, procedures, data analysis, and local tie information results associated with this survey.

1. Site description

IERS network site FORT DAVIS is located in the United States of America on two different land tracts near Fort Davis, Texas. The SLR and GNSS instruments are located at the McDonald Observatory on Mount Fowlkes, N30°-41'/W104°-01'. The VLBA radio telescope is located at the Fort Davis National Radio-Astronomy Observatory (NRAO) within Sproul Ranch near the town of Fort Davis, Texas, N30°-41'/W104°-01'.

Figure 1: Location map for Fort Davis

SGT Instrument	Name	DOMES#	Description/a.k.a.	Code/ 4-CID
IGS Tracking Station	MCDONALD CORS MONUMENT	40442M012	GPS Mark 4011-S JPL GPS 4011-S	MDO1
McDonald Laser Ranging System	7080	40442M006	MLRS mark 7080 1988 CDP STATION 7080	7080
N/A	7850	40442M008	Mobile VLBI and SLR mark 7850 1988 CDP STATION 7850	7850
N/A	7851	40442M011	SLR MARK 7851 CDP STATION 7851	7851
VLBA (VLBI)	FT DAVIS VLBA CRP	40442S017	VLBA antenna reference point VLBA REF PT (CDP 7613)	7613

Table 1 – IERS Network site information can be found at http://itrf.ign.fr/doc_ITRF/iers_sta_list.txt

2. Instrumentation

2.1. Tacheometers, EDMI, Theodolites

2.1.1. Description

Two (2) Leica TDM5005 Electronic Tacheometer, S/Ns: 441698 and 441773 (Fig. 2)

<u>Specifications</u>

Angular measurement uncertainty: ± 0.7”

Distance standard deviation of a single measurement: 1 mm + 2 ppm

Figure 2: Leica TDM5005

2.1.2 Calibrations

Tacheometers calibrated by Leica Geosystem AG Heerbrugg, Switzerland.

Inspection date: 08/15/2008 / 08/20/2008

Both instruments were found to be within factory specifications

2.1.3 Auxiliary Equipment

Wild NL Collimator, S/N: 40145

Pointing accuracy, 1: 200,000 (Fig. 3)

Figure 3: Leica NL collimator

Hygrometer: Omega RH83 (Fig. 4).

Figure 4: Omega RH83

Thermometer: Digital thermometer, thermistor sensor, assembled by NGS (Fig. 5)

Barometer: Leitz AIR-HB-1L, S/N: 1L1890 (Fig. 6)

Figure 5: NGS Digital Thermometer

Figure 6: Leitz AIR-HB-1L

2.2 GPS units

2.2.1 Receivers

Four (4) Trimble NetR5 GPS L1 C/A Code, L2C, L1/L2/L51 Full Cycle Carrier, GLONASS L1 C/A Code, L1 P Code, L2 P Code, L1/L2 Full Cycle Carrier with Maxwell™ Custom Survey GNSS Chip (Fig. 7)
P/N: 62800-00, S/Ns: 4619K01307, 4624K01584, 4624K01631 and 4624K01648

Specifications for Static GPS Surveying:
Horizontal: +/- 5 mm + 0.5 ppm RMS
Vertical: +/- 5 mm + 1 ppm RMS

Figure 7: NetR5

2.2.2 Antennas

Four (4) TPSCR.G3, Topcon GPS/GLONASS/Galileo choke ring antenna, model CR-G3 (Fig. 8)
P/Ns: 1-044301-01, S/Ns 383-1613, -1614, -1626 and -1628

Figure 8: CR-G3

2.2.3 Analysis software, mode of operation

Post-processing and adjustment were undertaken using NGS's beta version of Online Positioning User Service (OPUS) Projects, an interactive web page. Data is tagged with a project identifier and on the OPUS web page and uploaded normally. OPUS Projects sorts the data into sessions. User must log in, select a session and reconfigure it if desired before starting the processing. Processing reports are generated and interactive tables display a summary of results. Processed base lines are made available for the adjustment phase. The user is allowed limited flexibility in setting adjustment parameters. Processing and adjustment results are automatically forwarded to user via email.

2.3 Leveling

2.3.1 Leveling instruments

Leica DNA03 digital level, P/N: 723289, S/N: 332228. (Fig. 9)
Height measurement accuracy, +/-0.3 mm per km, double-run.

Figure 9: DNA03

2.3.2 Leveling rods

Leica GWCL92 92-cm Invar Bar Code Rod
S/N: 30721 (Fig. 10)

Leica GPCL3 3-m Invar Bar Code Rod
S/N: 27226 (Fig. 11)

Figure 10: GWCL92 92 cm

Figure 11: GPCL3 3 meters

2.3.3 Checks carried out before measurements

Daily instrument collimation test procedures were undertaken on-site prior to data collection. Leveling rod bubbles were checked daily, prior to use.

2.4 Tripods

Chosen for high stability, low co-efficient of thermal expansion and ease of use, wooden stands were constructed and anchored into place by the survey team over the seven main scheme, ground network station marks; 7851, MLRS-TLRS, 7850 RM 2, NGS 1, FT DAVIS VLBA RMs 1, 2 and 3. The design is the one used by the U.S. Coast and Geodetic Survey for first-order work instead of conventional tripods (Figure 12).

Adjustable aluminum plates were fastened to the tops of each stand and a Leica tribrach was attached and centered precisely over the survey mark using a Leica NL4 collimator. The tribrach was "leveled up" with a Leica carrier with a longitudinal bubble. Heights above the survey mark were then measured using a Leica DNA03 digital level instrument and barcode rod to the top of a tribrach adapter set into the tribrach. To compute the height of a tacheometer or target that has been set into the tribrach, a height constant of 0.1675 m is added to the leveled height.

Some points were not needed in the determination of SGT tie vectors, but were included because of their presence in prior site surveys. These supplemental points were not occupied, but rather measurements were made to them from main scheme network stations. Custom-made aluminum trivets were used to center targets/reflectors over these five survey marks; 7080, 7850 RM 3, 7850, CAL PIER 3 and JPL 4010 S over (Fig. 13). Target/reflector heights were measured by differential leveling using a method similar to previously described.

Figure 12: Typical U.S Coast and Geodetic Survey wooden stand built over FT DAVIS VLBA RM 2. The three-legged stand is anchored solidly into the ground. The stones are "extra." The stand is surrounded by a completely detached observer's platform.

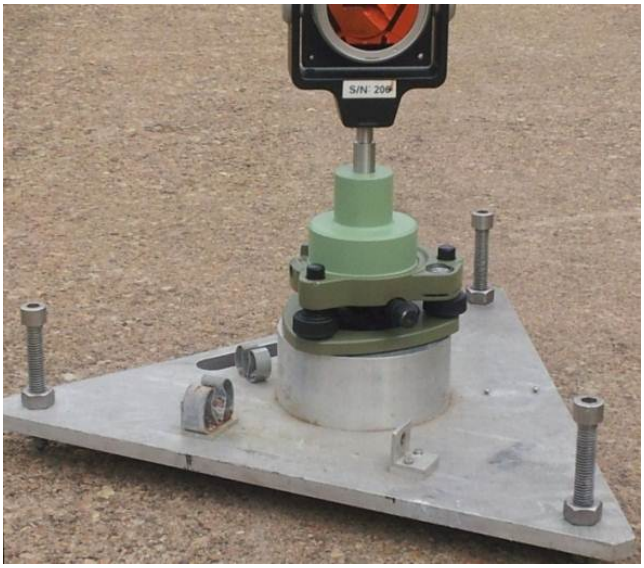

Figure 13: NGS trivet used on supplemental points

2.5 Forced centering devices

Leica GDF321 tribrachs (Fig. 14) were fastened to centering plates that were attached to the tops of the wooden stands for the duration of the project. In this fashion, tribrachs were plumbed precisely over the survey disk using the NL Collimator (Fig. 15).

Figure 14: GDF321 Tribrach without Plummet

Figure 15: NL Collimator used to center the tribrach

The tribrach was "leveled up" using a GZR3 carrier with longitudinal bubble (Fig. 16). That is, the carrier's standing axis was brought into alignment with the local gravity vector using the tribrach's footscrews. A tribrach adapter (Fig. 17) was used as a vertical point of reference in determining instrument and target height above the mark. Digital leveling equipment was used to determine this height. An offset constant of 0.1675 m has been determined from the top of the tribrach adapter to 1) the center of the tilt axis of the tacheometer's telescope and 2) the center of the GPH1A target.

Figure 16: GZR3 Precision Carrier

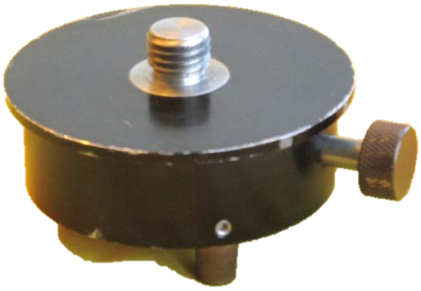

Figure 17: Top of tribrach adapter used for setup's vertical point of reference

2.6 Targets, reflectors

Except for the intersection observations at the IGS tracking station, MCDONALD CORS MONUMENT (MDO1), Leica GPH1P precision reflectors (Fig. 18) were used as needed for tacheometer observations, acting as both target and reflector. For each reflector, the manufacturer-provided offset values of -34.4 mm were validated prior to the survey. The target, when attached to a carrier and seated in a tribrach, was an additional 0.1675 meter higher than the measured height to the top of the tribrach adapter.

Figure 18: GPH1P Precision surveying monitoring prism

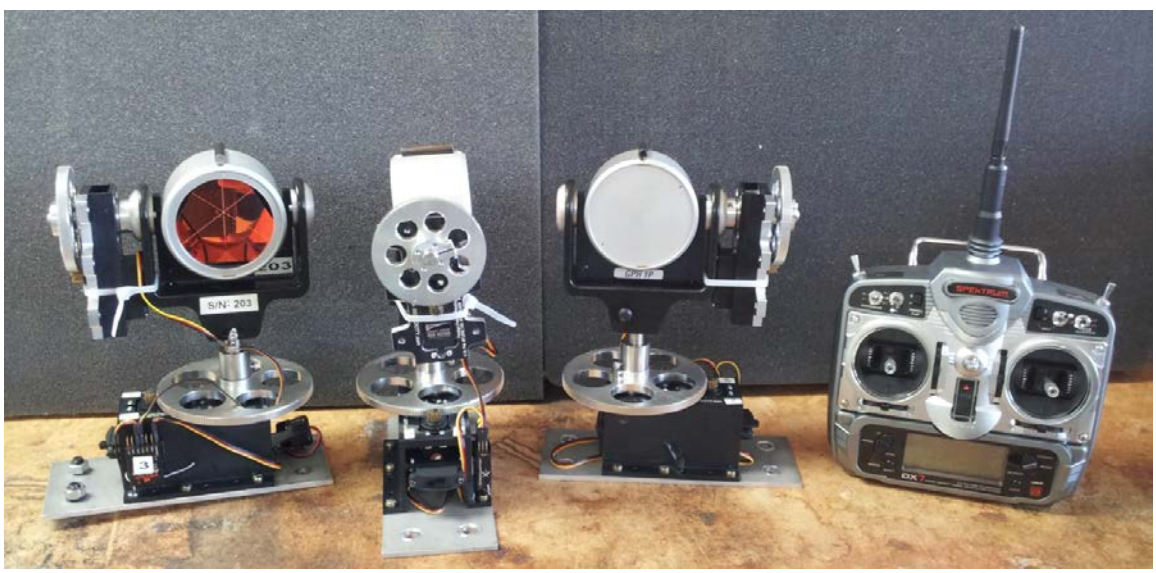

Figure 19 – GPH1P outfitted with two R/C servos (pan and tilt axes) to allow precise pointing of target from remote location (tacheometer).

To minimize the loss of precision in distance measurement, the GPH1P are precisely pointed back to the tacheometer. To that end, the GPH1Ps used on the SLR and radio telescope measurements were mounted to sturdy, radio-controlled, pan-tilt units (Fig. 19). The pan-tilt units were then remotely pointed to the tacheometer by the observer after each motion of the SLR/radio telescope.

3. Measurement Setup

3.1 Ground network

The ground network consists of two categories of marks; main scheme and supplemental. Main scheme marks are tied together in a local coordinate system with repeated and extremely precise horizontal and vertical angle measurements and distance measurements. These marks are used to tie the SGT instruments directly to the network, and indirectly, to each other. Supplemental marks are accurately positioned relative to the network, but do little or nothing to enhance the network. Supplemental marks may be reference marks for the SGT instruments, marks of special interest, or marks from a previous site survey. Tying to marks from previous surveys provides additional information about past and present ground networks.

The following marks were found in a SINEX file (Table 2) stored at the IERS web site (http://itrf.ign.fr/ties/40442.snx). Of the 10 points listed, four were recovered and included in the current survey. The remaining six had either been destroyed or are inaccessible for various reasons.

```
+FILE/COMMENT
* File created on  February 6, 2001 by software ratmix version 1.00
* CONTACT            altamimi@ensg.ign.fr
-FILE/COMMENT
*-----------------------------------------------------------------------------
-
+SITE/ID
*CODE PT __DOMES__ T _STATION DESCRIPTION__ APPROX_LON_ APPROX_LAT_ _APP_H_
 7086  A 40442M001                          255 59 02.6  30 40 37.3  1961.5
 7885  A 40442M005                          255 59 02.6  30 40 37.3  1961.5
 7080  A 40442M006                          255 59 05.2  30 40 48.9  2004.3
 7850  A 40442M008                          255 59 05.6  30 40 49.7  2004.2
 7900  A 40442M009                          256 03 09.5  30 38 08.8  1583.4
 MDO1  A 40442M012                          255 59 06.0  30 40 49.8  2004.5
 7086  B 40442S001                          255 59 02.8  30 40 37.1  1963.5
 7206  A 40442S002                          255 58 40.8  30 40 18.3  2058.3
 7216  A 40442S003                          256 03 09.8  30 38 12.2  1595.1
 7613  A 40442S017                          256 03 18.6  30 38 06.1  1606.4
```

Table 2: Site information can be found at http://itrf.ign.fr/ties/40442.snx. Only highlighted points still exist or were accessible and within the proximity of one or more SGT instruments

3.1.1 Listing

Current Survey Main-Scheme Marks	DOMES 40442	IERS 4-char code	Current Survey 4-char Code	Previous ASTS Survey Point Name	ASTS Adjustment Name	NGS PID
7850 RM 2	n/a	n/a	50R2	7850 RM2 (1988)	same	AC5720
7851	M011	7851	7851	CDP STATION 7851 (1988)	same	AC5718
MLRS TLRS	n/a	n/a	MLRS	MLRS-TLRS	same	AC5722
NGS A	n/a	n/a	NGSA	n/a	n/a	n/a
FT DAVIS VLBA RM 1	n/a	n/a	FDV1	FT. DAVIS VLBA RM1	same	n/a
FT DAVIS VLBA RM 2	n/a	n/a	FDV2	FT. DAVIS VLBA RM2	same	n/a
FT DAVIS VLBA RM 3	n/a	n/a	FDV3	FT. DAVIS VLBA RM3	same	n/a
Supplemental Marks						
7850	M008	7850	7850	CDP STATION 7850 (1988)	same	n/a
7850 RM 3	n/a	n/a	50R3	7850 RM3 (1988)	same	AC5721
CAL PIER 3	n/a	n/a	CALP	7850 CALIBRATION PIER 3	same	n/a
JPL 4010 S	n/a	n/a	JPL4	JPL 4010-S (1993)	same	n/a
Conventional Reference Marks						
MCDONALD VLBI STA CORS ARP	n/a	n/a	MARP	n/a	n/a	AF9514
McDonald LRS CRP (IVP_1)	n/a	n/a	LRSM	n/a	n/a	n/a
VLBA conv ref pt (IVP_6)	S017	7613	7613	VLBA REF PT (CDP 7613)	same	n/a
SGT Instrument Reference Marks						
MCDONALD CORS MONUMENT	M012	MDO1	MDO1	JPL GPS 4011-S (1993)	same	AF9515
7080	M006	7080	7080	CDP STATION 7080 (1988)	same	n/a

Table 3: Cross-referenced Listing of Points. Information regarding previous surveys was provided by Allied Signal Technical Services (ASTS).

Main-Scheme Marks

7851 is a NASA control mark set in top of a mobile SLR pad and was originally established to serve as a reference mark for the associated SLR instrument.

7850 RM 2 is a NASA control reference mark set in outcropping bedrock and was originally established to serve as a reference mark for the associated SLR instrument.

MLRS TLRS is a rod mark driven to an unknown depth inside a grease-filled sleeve of unknown depth inside of a PVC pipe with logo cap established by NASA to serve as a reference mark for the McDonald Laser Ranging System (MLRS) telescope's CRP.

NGS A is a survey disk set in the top NE corner of a concrete vault projecting 40 cm above the ground. It was set at this time as the third ground network mark needed to properly tie the MCDONALD CORS MONUMENT (MDO1) to the network.

FT DAVIS VLBA RM 1 is a rod mark driven to an unknown depth inside a grease filled sleeve of unknown depth inside of a PVC pipe with logo cap established by the National Aeronautical and Space Administration (NASA) to serve as a reference mark for the NRAO VLBA radio telescope CRP.

FT DAVIS VLBA RM 2 and FT DAVIS VLBA RM 3 are NASA survey disks reported to have been set in bedrock which is about 0.5 m below the surrounding ground depth. Access to these marks is had through a PVC pipe with log cap. NASA established these marks to serve as reference marks for the NRAO VLBA radio telescope CRP.

Supplemental Marks

7850 is a NASA control mark set in top of a mobile SLR pad and was originally established to serve as a reference mark for the associated SLR instrument.

7850 RM 3 is a NASA control reference mark set in outcropping bedrock and was originally established to serve as a reference marks for the associated SLR instrument.

CAL PIER 3 is a forced centering device set in the top center of a concrete pier monument established by NASA to support calibration of the MLRS instrument.

JPL 4010 S is a stainless steel disk set in top of a concrete pier monument at the VLBA site. The Jet Propulsion Laboratory (JPL) set this monument originally to serve as a GNSS station, but that plan has not come to fruition.

SGS Instrument Reference Marks

7080 is a NASA control mark set in a mobile SLR pad directly beneath Mirror #6 and at the south edge of the northern-most leveling jack of the McDonald Laser Ranging Station (MLRS) instrument. The mark has served as the reference mark for the MLRS.

MCDONALD CORS MONUMENT (MDO1) is the center point of a stainless steel plate, 30 cm in diameter, set in the top of a 50 cm in diameter concrete post projecting 20 cm above the ground. The mark is enclosed in a transparent radome.

Figure 20: MDO1 w/choke ring antenna

3.1.2 Maps of Network

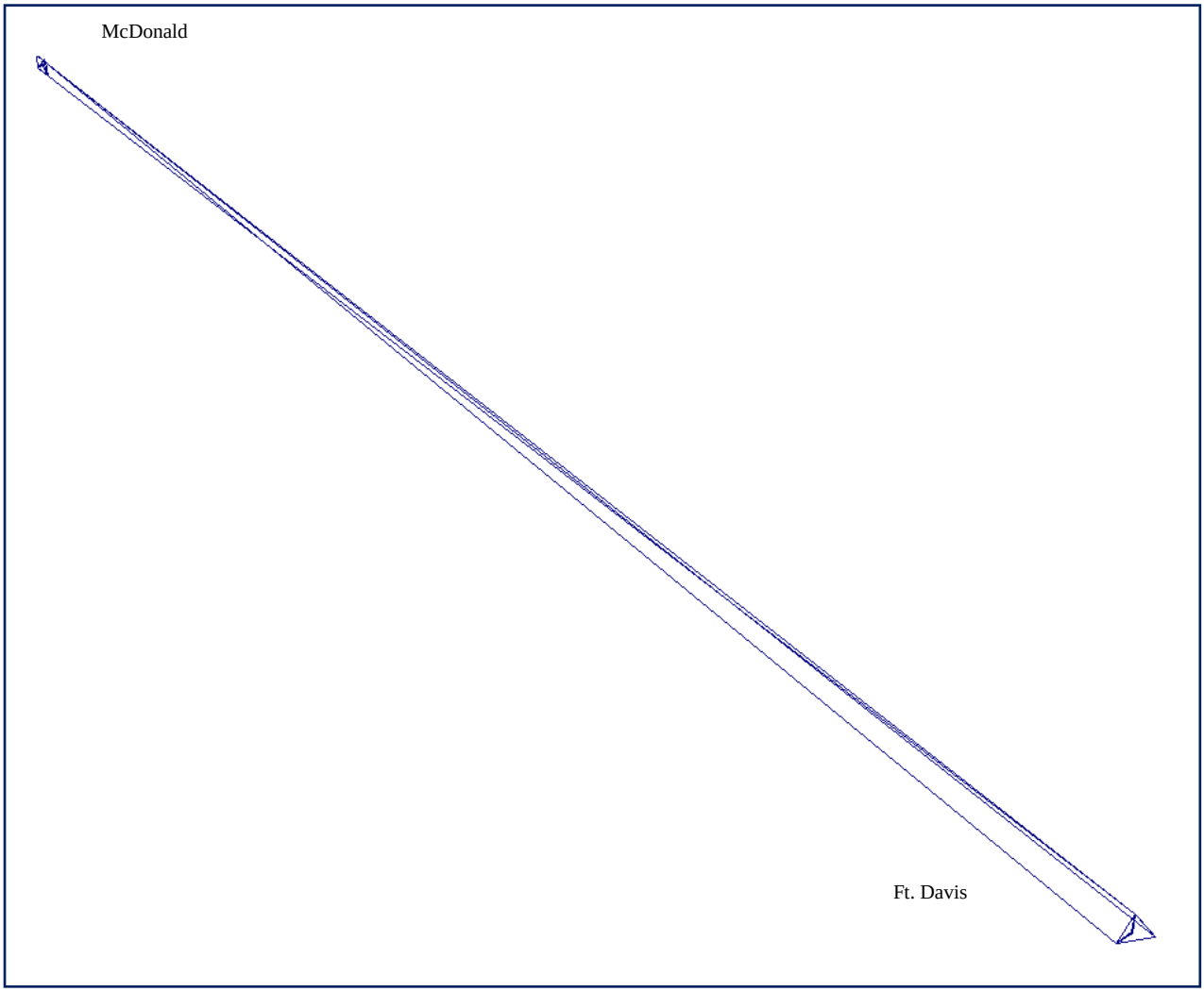

Figure 21: Sketch showing GPS vectors tying two sub-networks together, which are approximately 8 km apart.

McDonald Sub-network

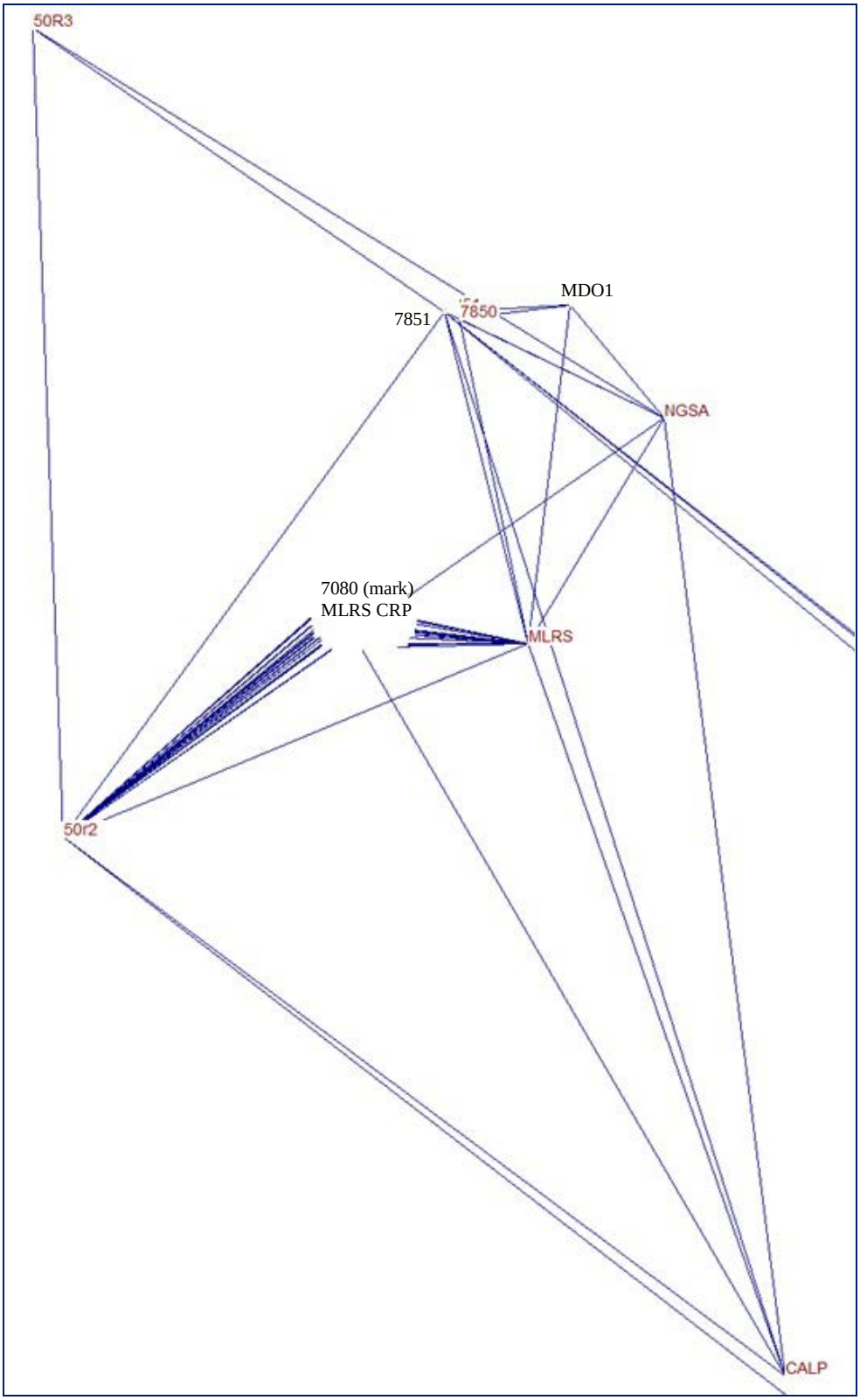

Figure 22: McDonald sub-network sketch. Ground network points 7850 RM 2 (50r2), 7851 and MLRS-TLRS (MLRS) were tied to the Fort Davis sub-network using GPS. MDO1 was not used in the tie because of uncertainties associated with its uncalibrated radome.

Fort Davis Sub-network

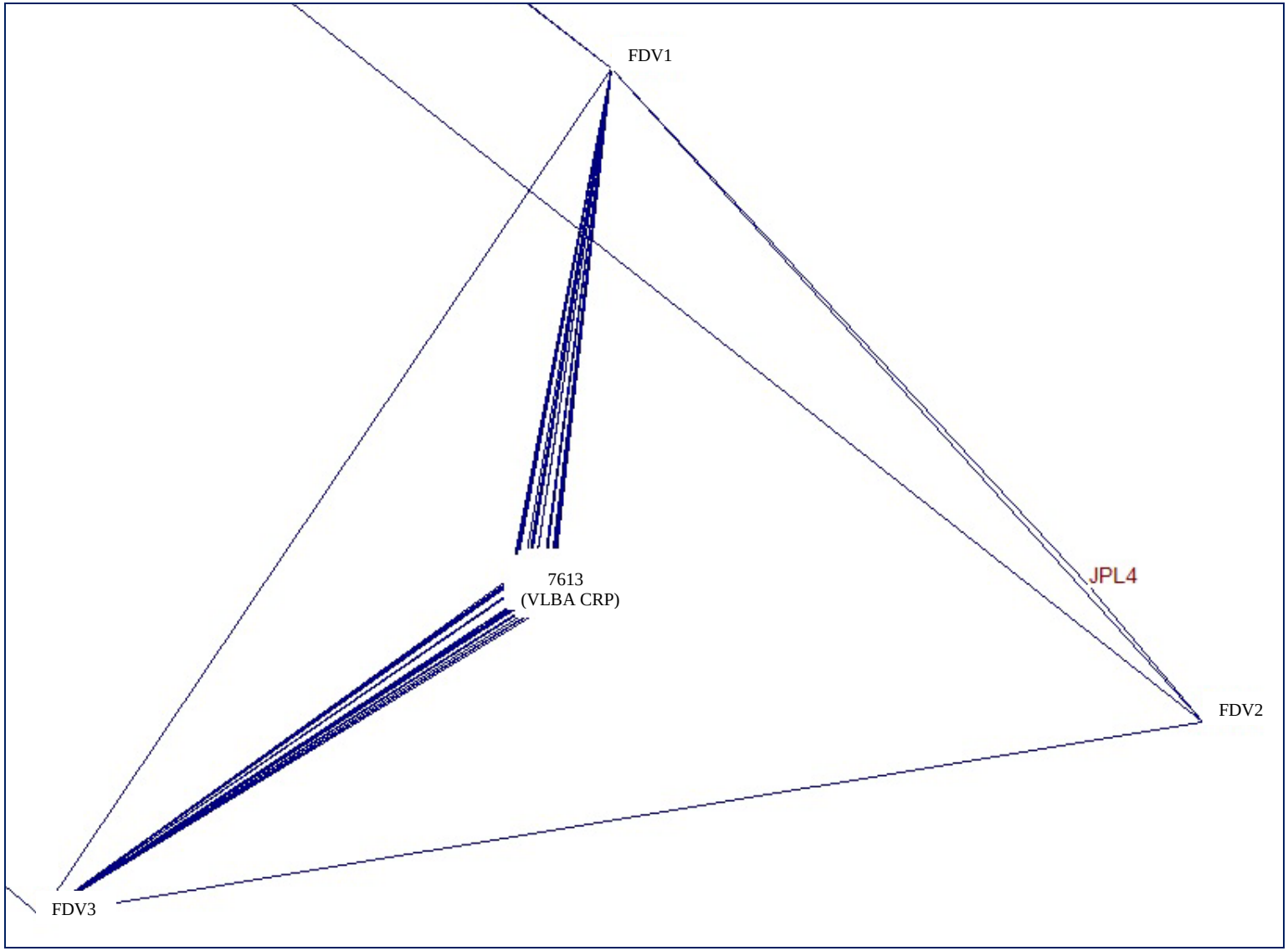

Figure 23: Ft. Davis sub-network sketch. FT DAVIS VLBA RMs 1, 2 and 3 (FDV1, FDV2 and FDV3, respectively), were tied to the McDonald sub-network using GPS.

3.2 Representation of Technique Reference Points

The conventional reference point (CRP), a.k.a. invariant reference point (IVP), is a theoretical point and is defined as the intersection of the azimuth axis with the common perpendicular of the azimuth and elevation axis (Johnston et al, 2004).

3.2.1 VLBI

The National Radio Astronomy Observatory (NRAO) maintains the radio telescope, which has a 25-meter in diameter parabolic antenna on an az-el mount. An indirect approach was used to determine the CRP, a.k.a. 7613. This instrument does not have a reference mark.

Figure 24: Ft. Davis VLBA

3.2.2 SLR

NASA maintains the SLR instrument at the McDonald site. The instrument is a Coude telescope on an XY mount. The indirect approach to measuring the CRP was used. The reference mark for this instrument is 7080.

Figure 23. SLR w/target bar mounted vertically to the telescope. Attached targets were positioned as they scribed circles about the y axis.

The International Laser Ranging Service (ILRS) publishes site information for the the SLR operating at the McDonald Laser Ranging Station (MDOL) at http://ilrs.gsfc.nasa.gov/network/stations/active/MDOL_sitelog.html

Table 4 compares the offset values found in the site log to the results of the current survey. The site log values agree with previous survey information provided by Allied Signal Technical Services Corp.

Sources:	Current Survey (m)	ILRS Site Log (m)	Diff. (cm)
7080 to MCDONALD CORS MONUMENT (MDO1) (dX)	22.3961	+22.394	+0.2
(dY)	8.4818	+8.481	0.1
(dZ)	23.4043	+23.406	-0.2
7080 to Ft Davis VLBA CRP (7613) (dX)	6011.9422	+6011.941	+0.1
(dY)	-3780.0998	-3780.155	+5.5
(dZ)	-4518.3196	-4518.317	-0.3
7080 to 7850 (dX)	+12.8749	+12.873	+0.2
(dY)	+10.2780	+10.276	+0.2
(dZ)	+21.9217	+21.922	0.0
7080 to 7851 (dX)	+11.5993	+11.596	+0.3
(dY)	+10.8975	+10.896	+0.2
(dZ)	+22.4327	+22.433	0.0

Table 4 – Offset comparison. Differences are listed in a new-minus-old format, where Diff. = Current Survey – IVS Offset.

3.2.3 GPS

NASA maintains the GNSS antenna, which is centered over reference mark MCDONALD CORS MONUMENT (MDO1). For the site log, go to ftp://igs.org/pub/station/log/mdo1_20130222.log.

Figure 24: AOA GPS choke ring antenna plumbed over MCDONALD CORS MONUMENT (MDO1). Pictured with radome removed for survey observations.

MCDONALD CORS MONUMENT (MDO1) hosts an AOA choke ring antenna with an uncalibrated radome. At the time of the survey, the radome was removed to facilitate the survey and to allow for an eight-week radome-off data set to be collected and analyzed. Leveling observations included MDO1 (top of stainless steel plate).

Table 5 compares the offset values found in the site log to the results of the current survey. The site log values agree with previous survey information provided by Allied Signal Technical Services Corp.

Sources:		Current Survey (m)	IGS Site Log (m)	Diff. (mm)
MDO1 to MCDONALD VLBI STA CORS ARP	(dE)	0.0000	0.000	0
	(dN)	0.0000	0.000	0
	(dU)	+0.0606	+0.061	0
MDO1 to 7080	(dX)	-22.3952	-22.3939	-1.3
	(dY)	-8.4809	-8.4807	-0.2
	(dZ)	-23.4054	-23.4064	+1.0
MDO1 to 7850	(dX)	-9.5210	-9.5212	+0.2
	(dY)	1.7964	1.7953	+1.1
	(dZ)	-1.4829	-1.4841	+1.2
MDO1 to 7851	(dX)	-10.7967	-10.7976	+0.9
	(dY)	2.4158	2.4155	+0.3
	(dZ)	-0.9721	-0.973	+0.9

Table 5 – Offset comparison. Differences are listed in a new-minus-old format, where Diff. = Current Survey – IGS Offset.

3.2.4 DORIS (N/A)

A DORIS instrument was not co-located at this site.

3.2.5 GLONASS (N/A)

A dedicated GLONASS instrument was not co-located at this site.

4. Observations

4.1 Conventional Survey

A complete list of unadjusted and adjusted tacheometer field observations consisting of directions, zenith distances, slope distances, and instrument and target heights are available in FortDavis.lst compressed in a zip file under Fort Davis Data Products at http://www.ngs.noaa.gov/corbin/iss/index.shtml.

4.2 Leveling

A NGS level line exists between McDonald Observatory and Fort Davis NRAO. Ties to this level line were made at this time to current ground network points at each sub-network according to first-order, class II specifications of the U.S. Federal Geodetic Control Subcommittee (FGCS).

The leveling at the McDonald Observatory began with the comparison of new height difference information between bench marks C 1097, VALIDATION RM 3, and P 1098. Analysis concluded that the original leveling to C 1097 was no longer valid. Additional leveling was conducted to include bench mark N 1098. From VALIDATION RM 3, leveling continued through the ground network's main scheme and supplemental points; 7850 RM 3, 7851, 7850, MCDONALD CORS MONUMENT (MDO1), MCDONALD VLBI STA CORS ARP, NGS A, MLRS-TLRS, CAL PIER 3, 7080, 7850 RM 2, and closing back on 7850 RM 3. The leveling between these ground network points adhered to FGCS first-order, class I specifications resulting in highly precise height differences. Leveling data was processed using the NGS program TRANSLEV 4.15. Leveling observational data file, McDonald.hgz, is found in the compressed (zip) file under Fort Davis Data Products at http://www.ngs.noaa.gov/corbin/iss/index.shtml.

The leveling at the Fort Davis NRAO began with the comparison of new height difference information between bench marks P 1097, Q 1097, and R 1097. Analysis concluded that the original leveling to R 1097 was no longer valid. Additional leveling was conducted to include bench mark N 1097. From Q 1097, leveling continued through the ground network's main scheme and supplemental points; FT DAVIS VLBA RM 3, FT DAVIS VLBA RM 1, JPL 4010 S, and closing back on FT DAVIS VLBA RM 3. The leveling between these ground network points adhered to FGCS first-order, class I specifications resulting in highly precise height differences. Leveling data was processed using the NGS program TRANSLEV 4.15. Leveling observational data file, FtDavis1.hgz, is found in the compressed (zip) file under Fort Davis Data Products at http://www.ngs.noaa.gov/corbin/iss/index.shtml.

4.3 GPS

GPS data were collected on six main-scheme points and retrieved from seven IGS tracking stations. A large amount of data was required to support the data analysis strategy described in Section 5.6 Discussion of Results. The tables below break down the GPS observation sets to provide information about how data was collected for specific purpose. Table 6 shows data collected to produce vectors that connected the two sub-networks.

Session (day of yr)	047	048	049	053	054	055	056	057	058	059
Minimum hours	22.0	22.0	17.0	12.0	3.0	21.0	15.0	20.5	24.0	17.5
7850 RM 2	X	X	X					X	X	X
7851	X	X	X	X	X	X	X	X	X	X
FT DAVIS VLBA RM 1	X	X	X	X	X	X	X	X	X	X
FT DAVIS VLBA RM 3	X	X	X	X	X	X	X	X	X	X

Table 6: GPS session summary for vector ties between sub-networks

Tables 7 and 8 show data collected in support of Method #1.

Session (day of yr)	047	048	049A	049B	050	051	052	057	058	059
Minimum hours	24.5	23.0	22.0	4.5	20.0	24.0	23.0	20.5	25.5	18.0
7850 RM 2	X	X	X	X	X	X	X	X	X	X
7851	X	X	X	X	X	X	X	X	X	X
MLRS-TLRS				X	X	X	X			

Table 7: GPS session summary for points within the McDonald Observatory sub-network

Session (day of yr)	047	048	049	053	054	055	056	057	058	059
Minimum hours	22.5	22.0	17.0	14.0	3.0	21.5	23.5	22.0	24.5	23.0
FT DAVIS VLBA RM 1	X	X	X	X	X	X	X	X	X	X
FT DAVIS VLBA RM 2				X	X	X	X			
FT DAVIS VLBA RM 3	X	X	X	X	X	X	X	X	X	X

Table 8: GPS session summary for points within the Fort Davis NRAO sub-network

4.4 General Comments

Data collection software GeoObs v1.04.02 was used for recording field measurements and for data quality checks.

Star*Net least-squares software was used to analyze thousands of extremely precise tacheometer measurements to precision targets from the seven main-scheme ground network points. The result was a very tight, very clean network of marks based in a local coordinate system.

As noted earlier, determining the local coordinates of the SLR and radio telescope's CRP requires an indirect approach. The theory is straight-forward. A point, as it revolves about an axis, scribes a perfect arc. The arc defines a perfect circle and a plane simultaneously. The axis can

then be seen as it passes through the center of the circle, orthogonal to the plane. By assigning coordinates to the points observed along an arc rotated about an axis, one can assign parameters to the axis relative to an established local coordinate system. Tacheometer measurements project coordinates from the local ground network to the target attached to a telescope as it moves about the telescope axis, thereby providing the necessary information to locate a single axis. The same must be done for the opposing axis of the telescope in the same local coordinate system. The point along the primary axis that is orthogonal to the secondary axis is the conventional reference point of the telescope.

The minimum number of points needed to define a circle, and therefore an axis, is three. The minimum number of measurements needed to extend local coordinates to three points is ten (four horizontal directions, three vertical angles, and three slope distances). Twenty measurements will define two axes and provide local coordinates for the CRP.

In practice, a complex system of precise observations involving three targets secured to the telescope, measurements from two ground network marks, and at least 1,080 total measurements per axis ensure sub-millimeter results. At least 2,160 measurements are run through Star*Net and into AXIS software to determine one CRP. CRPs for the VLBI instrument and two SLR instruments were determined in this manner

Another indirect approach, intersection, allows certain SGT instruments to continue uninterrupted operation while the tie to their reference mark is made. This approach was used on MCDONALD CORS MONUMENT (MDO1) and MCDONALD VLBI STA CORS ARP. The horizontal ties to these points were made by intersection from at least three ground network marks. At 7851, MLRS-TLRS, and NGS A, horizontal directions were observed to the left and right tangents of the symmetrically cylindrical pin used to center the choke ring antenna above MDO1. Tangent observations were later reduced to the center of the standoff (averaged), which is coincident to the gravity vector passing through MDO1. Heights for these MDO1 and the ARP were determined by differential leveling.

Figure 25 – Intersection observations to MDO1 and the ARP were made to the left and right side of the centering pin (left and right tangent observations) to determine the horizontal direction. Each set of left and right tangent observations are averaged together in lieu of a single observation to the center.

Differential leveling was also conducted through all ground network marks. Leveled height differences were used in conjunction with GPS-derived ellipsoid heights to learn more about the local geoid, and also check the quality of trigonometric leveling observations between network stations. The ability to compare trig leveling against a standard (differential leveling) while observing the SLR and radio telescope targets in the same local reference system provided quality assurance for those observations.

5. Data Analysis and Results

5.1 Terrestrial Survey

5.1.1 Analysis software

A 3-D least squares adjustment was conducted on the terrestrial survey data using commercially available software Star*Net version 7.2.2.7. The adjustment included leveled height differences. Results were reviewed for outliers in the survey observations and also used to verify the precision of the survey.

The 3-D adjustment consisted of terrestrial observations of all ground network marks, intersection stations, and intermediate target points on the SLR and radio telescope, producing local coordinates estimates for all. See http://www.ngs.noaa.gov/corbin/iss/index.shtml for terrestrial 3-D adjustment results found in the Star*Net output file FortDavis.lst, located in a compressed file under "Fort Davis Data Products."

AXIS Software, developed by Geoscience Austrailia (GA), was used to determine the SLR and radio telescope CRP. Coordinates for each target were computed during the 3-D adjustment, at each orientation of the radio telescope. These points were used to derive 3-D circles in space, which were used to determine axes parameters and subsequently, the CRPs. The following excerpt was taken from a GA site survey report and edited to reflect the particular circumstances of this survey. In the following excerpt, the term IVP is interchangeable with CRP.

> The StarNet .dmp file, generated by the 3-D adjustment, included the full variance-covariance matrix required by AXIS. The .dmp file was placed into a directory with the AXIS software along with a setup.axs file. The setup file was edited repeatedly to derive estimates of circle parameters for each target and each rotation sequence. Once initial estimates were refined for all target rotation sequences, geometric constraints were added. Initial constraints introduced included:
>
> CDIST – used to constrain target coordinates so that target-to-target distances remain constant over all rotational sequences. ;
> ENORMAL, NNORMAL, UNORMAL – used to constrain normal parameters together;
> CENTRE – used to constrain together centre to centre distances (azimuth axis only)
> RADIUS – used to constrain circle arc radius parameters together
>
> With updated circle parameter estimates for each target rotation sequence, IVP coordinates were derived. Additional constraints were introduced to constrain separate IVP realizations. Constraints applied included:
>
> OFFSET – used to constrain the computed offset to be identical for independent IVP estimates;
> ORTHOG – used to constrain the orthogonality between three axes;
> UIVP – used to constrain the individual IVP determination in the UP component together.

CRP computation results can be found at http://www.ngs.noaa.gov/corbin/iss/index.shtml in the AXIS file output.axs, Section 3.19 COMPUTED SOLUTION PARAMETER SUMMARY, located in a compressed file under "Fort Davis Data Products."

5.1.2 Topocentric coordinates and covariance

For topocentric coordinates and covariance information used in CRP computations, go to http://www.ngs.noaa.gov/corbin/iss/index.shtml, AXIS file output.axs, Section 2. INPUT SOLUTION.

5.1.3 Correlation matrix

For computed correlation matrix information, see Attachment B. SINEX File NGSFTDV1302GA.snx.

5.1.4 Reference temperature of radio telescope at Fort Davis NRAO [for thermal expansion]

A height correction for the CRP of the Fort Davis VLBA was computed based on the following procedure:

i) Compute a mean survey temperature and see to what extent it differs from the reference.
ii) Multiply the CRP height by 0.000012 and by the temperature difference
iii) Correct the CRP height if it is needed.

- **Telescope reference temperature: +15.5 ^{O}C** from Antenna Information File Format Version of 2008.04.22 found at http://vlbi.geod.uni-bonn.de/Analysis/Thermal/antenna-info.txt.
- **Estimated fixed axis temperature: +11 ^{O}C** (Estimate based on average actual air temperatures during tacheometer observations with a 1 hour delay to allow for heat gain/loss delays of the structure. No air temperatures were used in the computation that fell within 30 minutes of any daily high or low air temperatures.)
- **Estimated temperature difference** (reference - observed): **+5 ^{O}C**
- **Height of elevation axis, concrete foundation: 0.5 m**
  - **Thermal coefficient of expansion: 1.0E-5 m/m ^{O}C**
    See http://vlbi.geod.uni-bonn.de/Analysis/Thermal/antenna-info.txt
- **Height of elevation axis, fixed axis: 13.7 m**
  - **Thermal coefficient of expansion: 1.2E-5 m/m ^{O}C**
    See http://vlbi.geod.uni-bonn.de/Analysis/Thermal/antenna-info.txt

$[500 \text{ mm } (1.0\times10^{-5} \text{ m/ m } ^{O}\text{C}) + 13{,}700 \text{ mm } (1.2\times10^{-5} \text{ m/m } ^{O}\text{C})] \times (+5\ ^{O}\text{C}) =$ **+0.8 mm**

The correction is provided for informational purposes and was not applied to the telescope.

5.2 GPS Observations

5.2.1 Analysis Software

NGS's beta version of Online Positioning User's Service (OPUS) Projects was used to post-process and analyze GPS data and to compute least-squares 3-D estimates of point positions.

OPUS Projects uses NGS's PAGE5 v1203.27 for post-processing. Default settings were used with two exceptions; 1) a hub was set up at each sub-network; 7851 at McDonald Observatory and FT DAVIS VLBA RM 1 at Fort Davis NRAO, and 2) the cutoff elevation for processing was lowered to 10°. The remaining default settings resulted in:

- the use of IGS08.atx absolute antenna calibration file.
- the use of IGS orbits (+/- 2 cm).
- the use of IGS08solution coordinate reference system with coordinates updated to date of observations using velocities.
- the use of default (modeled) meteorological values.
- the use of dual-frequency ionospheric correction.
- time parameters solved in data reduction.
- a double-difference, ionosphere-free (IF) combination solution, where

$$IF = \{f_{21}/(f_{21} - f_{22})\}L_1 - \{f_1 f_2/(f_{21} - f_{22})\}L_2$$

- not all integer biases being determinable, further resulting in partial, fixed integer estimate of biases.

Intended accuracy of vectors is 0.1 ppm plus 0.5 cm (FCGS A-order). All base lines were measured at least twice, once on each of two days. Redundant vectors were checked against each other to ensure precision.

OPUS Projects uses the program GPSCOM v1203.15, a simple Helmert Blocking normal equation processor which combines multiple GPS data sets that have initially been processed by the program PAGES, to form and partially reduce normal equations eliminating numerous nuisance parameters which are not generally of interest in a large global adjustment. The normal equation elements for the global parameters, those to be passed on to a combined adjustment, are written by PAGES into a normal equation file which becomes the basic input data for the program GPSCOM. One or more of these files as well as its own output normal equation files can then be processed by GPSCOM to provide a combined adjustment of the global parameters. This program was written in FORTRAN. Predominantly ANSI standard FORTRAN, a few isolated routines query the operating system for time and date, user and system identification. These "system" routines are inherently non-portable but, should be easily modified or disabled. For more information, go to http://www.ngs.noaa.gov/GRD/GPS/DOC/gpscom/gpscom.html

In the end, all data were processed in a single OPUS-Projects solution with the coordinates of the seven tracking stations constrained. To combine the two sub-networks into one, vectors from four base lines between the sub-networks were extracted and added to the combined terrestrial observation set and run through Star*Net.

# of vectors	McDonald Observatory		Fort Davis NRAO
8	7851	–	FT DAVIS VLBA RM 1
3	7851	–	FT DAVIS VLBA RM 2
9	7851	–	FT DAVIS VLBA RM 3
5	7850 RM 2	–	FT DAVIS VLBA RM 1

The coordinates for the tracking stations been extracted from the ITRF website, http://itrf.ensg.ign.fr/, in ITRF2008 (epoch date of survey). All points are correlated as seen in Attachment A. GPS Geocentric Coordinates and Covariances. The result was ITRF2008 coordinates for the current survey epoch date for the six ground network points. Position solutions for all six main-scheme ground network points were used in a single transformation of the entire project.

5.2.2 Results

Table 9 summarizes redundant GPS vectors and shows how well the repeated measurements agree. In the final adjustment, all vectors were reprocessed and weighted based on OPUS-Projects' estimate of quality.

DOY	Points	ΔX (m)	σ_X (mm)	ΔY (m)	σ_Y (mm)	ΔZ (m)	σ_Z (mm)
047	7851 - FDV1	6030.9748	0.3	-3724.6716	1.1	-4457.1083	0.7
058	7851 - FDV1	6030.9776	0.3	-3724.6699	1.0	-4457.1106	0.6
048	7851 - FDV1	6030.9824	0.5	-3724.6564	1.4	-4457.1181	0.9
059	7851 - FDV1	6030.9806	0.6	-3724.6403	2.0	-4457.1370	1.3
055	7851 - FDV1	6030.9769	0.4	-3724.6679	1.3	-4457.1090	0.8
057	7851 - FDV1	6030.9720	0.5	-3724.6749	1.6	-4457.1172	1.0
056	7851 - FDV1	6030.9680	0.7	-3724.6654	2.2	-4457.1110	1.4
054	7851 - FDV1	6030.9776	0.8	-3724.6689	2.7	-4457.1156	1.7
	$\bar{x}$ (all vectors) =	**6030.9762**		**-3724.6644**		**-4457.1159**	
	σ (all vectors) =	**0.0046**		**0.0112**		**0.0093**	
049	7851 - 50R2	-36.2635	0.3	-13.4684	1.1	-41.9570	0.7
050	7851 - 50R2	-36.2638	0.3	-13.4679	1.0	-41.9575	0.7
049	7851 - 50R2	-36.2637	0.4	-13.4682	1.2	-41.9571	0.7
051	7851 - 50R2	-36.2636	0.4	-13.4675	1.2	-41.9577	0.7
052	7851 - 50R2	-36.2640	0.4	-13.4689	1.2	-41.9566	0.8
057	7851 - 50R2	-36.2651	0.4	-13.4694	1.4	-41.9561	0.9
	$\bar{x}$ (all vectors) =	**-36.2640**		**-13.4684**		**-41.9570**	
	σ (all vectors) =	**0.0006**		**0.0007**		**0.0006**	
047	FDV1 - 50R2	-6067.2389	0.3	3711.2038	1.1	4415.1509	0.7
058	FDV1 - 50R2	-6067.2417	0.3	3711.2041	1.0	4415.1519	0.6
049	FDV1 - 50R2	-6067.2425	0.4	3711.2039	1.2	4415.1503	0.8
048	FDV1 - 50R2	-6067.2419	0.6	3711.1994	1.7	4415.1521	1.0
059	FDV1 - 50R2	-6067.2398	1.1	3711.1868	3.4	4415.1648	2.3
	$\bar{x}$ (all vectors) =	**-6067.2410**		**3711.1996**		**4415.1540**	
	σ (all vectors) =	**0.0015**		**0.0074**		**0.0061**	
053	FDV1 - FDV3	-131.3980	0.5	-64.4400	1.6	-150.6349	1.0
049	FDV1 - FDV3	-131.3964	0.4	-64.4292	1.3	-150.6481	0.8
	$\bar{x}$ (all vectors) =	**-131.3972**		**-64.4346**		**-150.6415**	
	σ (all vectors) =	**0.0011**		**0.0076**		**0.0093**	

Table 9: (continued on next page)

Table 9 continued from previous page

DOY	Points	ΔX (m)	σ_X (mm)	ΔY (m)	σ_y (mm)	ΔZ (m)
058	FDV3 - 7851	-5899.5800	0.3	3789.1017	1.0	4607.7570
053	FDV3 - 7851	-5899.5844	0.4	3789.1015	1.3	4607.7618
055	FDV3 - 7851	-5899.5798	0.4	3789.1007	1.3	4607.7540
047	FDV3 - 7851	-5899.5753	0.5	3789.1022	1.5	4607.7560
048	FDV3 - 7851	-5899.5848	0.5	3789.0889	1.6	4607.7637
057	FDV3 - 7851	-5899.5777	0.6	3789.1044	1.8	4607.7571
056	FDV3 - 7851	-5899.5756	0.8	3789.1011	2.5	4607.7491
054	FDV3 - 7851	-5899.5812	1.1	3789.0955	3.2	4607.7602
059	FDV3 - 7851	-5899.5792	1.1	3789.0844	3.5	4607.7675
	$\bar{x}$ (all vectors) =	**-5899.5798**		**3789.0978**		**4607.7585**
	σ (all vectors) =	**0.0034**		**0.0068**		**0.0055**
047	MDO1 - 7851	-10.7960	0.3	2.4204	1.1	-0.9667
049	MDO1 - 7851	-10.7960	0.3	2.4191	1.1	-0.9669
058	MDO1 - 7851	-10.7938	0.3	2.4194	1.0	-0.9628
049	MDO1 - 7851	-10.7960	0.4	2.4183	1.2	-0.9665
052	MDO1 - 7851	-10.7962	0.4	2.4197	1.2	-0.9667
053	MDO1 - 7851	-10.7953	0.4	2.4184	1.3	-0.9654
048	MDO1 - 7851	-10.8035	0.5	2.4018	1.6	-0.9571
059	MDO1 - 7851	-10.7928	0.5	2.4204	1.9	-0.9648
055	MDO1 - 7851	-10.8024	0.6	2.4115	1.8	-0.9599
057	MDO1 - 7851	-10.7971	0.6	2.4120	1.8	-0.9581
056	MDO1 - 7851	-10.7947	1.0	2.4189	3.0	-0.9617
054	MDO1 - 7851	-10.7963	1.1	2.4093	3.5	-0.9602
	$\bar{x}$ (all vectors) =	**-10.7971**		**2.4145**		**-0.9623**
	σ (all vectors) =	**0.0035**		**0.0063**		**0.0037**
050	MLRS - 7851	-4.4581	0.3	16.7732	1.1	24.6631
051	MLRS - 7851	-4.4584	0.4	16.7726	1.2	24.6636
052	MLRS - 7851	-4.4579	0.4	16.7732	1.2	24.6633
049	MLRS - 7851	-4.4539	0.8	16.7822	2.4	24.6585
	$\bar{x}$ (all vectors) =	**-4.4571**		**16.7753**		**24.6621**
	σ (all vectors) =	**0.0021**		**0.0046**		**0.0024**
055	FDV2 - 7851	-6135.3067	0.4	3827.4669	1.3	4564.3039
056	FDV2 - 7851	-6135.3022	0.8	3827.4690	2.5	4564.2978
054	FDV2 - 7851	-6135.3081	0.9	3827.4623	3.0	4564.3092
	$\bar{x}$ (all vectors) =	**-6135.3057**		**3827.4661**		**4564.3036**
	σ (all vectors) =	**0.0031**		**0.0034**		**0.0057**

Table 9: Redundant vectors compared well with each other. OPUS-Projects weighted estimates used in the final adjustment based on vector quality.

The final GPS coordinates were computed independently using NGS's OPUS-Projects web-based software. See Attachment A. GPS Geocentric Coordinates and Covariances for the OPUS Projects output SINEX file. AXIS output Section 5 Frame Alignment, (http://www.ngs.noaa.gov/corbin/iss/index.shtml), reflects a high level of precision between the GPS and terrestrial surveys.

5.3 Additional Parameters

In addition to the CRPs, AXIS software computed an azimuthal/elevation axes offset value for the two telescopes included in the current survey. The offsets can be found in Section 3.7 of the AXIS output file available at http://www.ngs.noaa.gov/corbin/iss/index.shtml and are provided in Table 10.

The International VLBI Service (IVS) reports the length of the axis offset to be **2.1324meters** (A. Nothnagel, 2009), a change of -2.6 mm. Likewise, the International Laser Ranging Service (ILRS) reports the length of the axis offset to be +0.0762 meters, a change of -0.4 mm.

CRP for:	Axis Offset Provided by Service (m)	Offset from current survey (m)	Difference (mm)
7613 (Fort Davis VLBA)	+2.1324	+2.1298 ±0.0029	-2.6
McDonald LR Station	+0.076 ±0.002	+0.0758 ±0.0009	0

Table 10: Telescope Axes Offsets.

5.4 Transformation

The GPS data collected on marks near the four corners of the project were used for transformation from a local reference frame to ITRF2008(epoch date of survey). NGS's OPUS-Projects GNSS processing and adjustment utility produced geocentric coordinates propagated to ITRF2008 (epoch date of survey). The integrity of the terrestrial survey is maintained throughout the transformation process.

The following is the AXIS summary of the transformation:

```
TRANSFORMATION PARAMETERS: ARBITRARY TO GLOBAL (OR REFERENCE SET)

CARTESIAN SYSTEM         : CENTROID ORIGIN

VARIANCE FACTOR          :          4.71596e-07

SIGMA                    :          6.86729e-04

          TX         TY         TZ         RX         RY         RZ

           M          M          M         AS         AS         AS

      -0.0007    -0.0001    -0.0009      -5.61       3.45       4.18
```

Table 11: AXIS Transformation Summary. T represents translation in meters and R is rotation in arc-seconds.

5.5 Description of SINEX generation

The SINEX file was directly generated by AXIS. For details, see AXIS output file, output.axs, Section 6.1 USER INPUT SINEX INFORMATION at http://www.ngs.noaa.gov/corbin/iss/index.shtml. The following SINEX naming convention, adopted by GSA for local survey data, was also used for this survey.

XXXNNNNYYMMFV.SNX

Where:

XXX is a three-character organization designation
NNNN is a four-character site designation
YY is the year of the survey
MM is the month of the survey
F is the frame code (G for global, L for local)
V is the file version

See Attachment B. for SINEX file NGSFTDV1302GA.SNX.

A concerted effort was made to tie to all points at the site that currently have DOMES numbers, along with the CRPs of the two SGT instruments. The following seven points are included in the SINEX file.

Code	DOMES#	Description	Longitude	Latitude	Ht.
7080	40442M006	MLRS mark 7080 1988	-104 00 54.7	30 40 49.0	2004.3
7850	40442M008	Mobile VLBI/SLR mark	-104 00 54.3	30 40 49.8	2004.2
7851	40442M011	SLR MARK 7851	-104 00 54.4	30 40 49.8	2004.2
MDO1	40442M012	GPS Mark 4011-S	-104 00 54.0	30 40 49.8	2004.5
(MARP)	---------	GPS antenna ref pt	-104 00 54.0	30 40 49.8	2004.5
(LRSM)	---------	McDonald LRS CRP	-104 00 54.7	30 40 48.9	2006.0
7613	40442S017	VLBA conv ref pt	-103 56 41.4	30 38 06.1	1606.4

Table 12: SINEX File Listing. Includes any/all surveyed points with DOMES numbers and/or SGT instrument CRPs.

5.6 Discussion of Results

Because the two sub-networks (McDonald Observatory and Fort Davis NRAO) were 8 km apart, a good geoid model and deflection-of-the-vertical model were essential to align the sub-networks into the same reference frame. NGS's Geoid12A and Deflec12A models were used to accomplish this. During this survey, steps were taken to validate these models. For the geoid model, geodetic leveling results were compared against GPS-derived orthometric heights. See Table 13 for results.

Ground Network Points	Adjusted Diff. Leveling Orthometric Hts.	Adjusted GPS-derived Orthometric Hts.	Difference (cm)
7851 (constrained)	2026.555	2026.555	0.0
MCDONALD CORS MONUMENT	2026.818	2026.817	-0.1
7850 RM 2	2023.939	2023.938	-0.1
MLRS TLRS	2027.039	2027.039	0.0
FT DAVIS VLBA RM 1	1609.616	1609.612	-0.4
FT DAVIS VLBA RM 2	1619.197	1619.192	-0.5
FT DAVIS VLBA RM 3	1613.901	1613.900	-0.1

Table 13: GPS heights using Geoid12A hybrid geoid model compared favorably to leveled heights.

For deflection values, the results from two different methods of deriving ITRF coordinates from topocentric measurements were compared against each other. Both methods used results from a single GPS network solution in slightly different ways. In Method #1, the two sub-networks were adjusted separately using coordinates from the single GPS solution for the purpose of transforming from their local reference frames into ITRF2008 (epoch date of survey). No geoid or deflection values were needed or used. Method #2 combined the two sub-networks using vectors from the GPS solution in a single geodetic adjustment. This adjustment required geoid and deflection values. Coordinates from the GPS network solution were used to transform to ITRF2008 (epoch date of survey). See Table 14 for comparison of the results of the two methods.

Ground Network Points		Results from Method #1	Results from Method #2		Diff. Geocentric (mm)		Diff. Topocentric (mm)
MDO1 MCDONALD CORS MONUMENT	X	-1329998.8706	-1329998.8706	x	0.0	n	0.0
	Y	-5328393.3529	-5328393.3529	y	0.0	e	0.0
	Z	3236504.1179	3236504.1179	z	0.0	u	0.0
7850 RM 2	X	-1330045.9316	-1330045.9331	x	-1.5	n	+0.7
	Y	-5328404.4055	-5328404.4072	y	-1.7	e	-1.1
	Z	3236461.1879	3236461.1900	z	+2.1	u	+2.8
7850 RM 3	X	-1330041.7426	-1330041.7426	x	0.0	n	+0.7
	Y	-5328367.0409	-5328367.0413	y	-0.4	e	+0.1
	Z	3236521.5587	3236521.5597	z	+1.0	u	+0.8
7080 (McDonald LRS ref. mk.)	X	-1330021.2658	-1330021.2667	x	-0.9	n	+0.4
	Y	-5328401.8338	-5328401.8347	y	-0.9	e	-0.6
	Z	3236480.7125	3236480.7136	z	+1.1	u	+1.5
7851	X	-1330009.6673	-1330009.6674	x	-0.1	n	+0.3
	Y	-5328390.9371	-5328390.9373	y	-0.2	e	-0.1
	Z	3236503.1459	3236503.1463	z	+0.4	u	+0.4
7850	X	-1330008.3916	-1330008.3918	x	-0.3	n	+0.1
	Y	-5328391.5565	-5328391.5568	y	-0.3	e	-0.2
	Z	3236502.6351	3236502.6353	z	+0.2	u	+0.4
MLRS TLRS	X	-1330005.2094	-1330005.2102	x	-0.8	n	+0.1
	Y	-5328407.7110	-5328407.7116	y	-0.6	e	-0.6
	Z	3236478.4822	3236478.4828	z	+0.6	u	1.0
CAL PIER 3	X	-1329988.9007	-1329988.9029	x	-2.2	n	-0.3
	Y	-5328444.3243	-5328444.3252	y	-0.9	e	-1.9
	Z	3236423.3747	3236423.3751	z	+0.4	u	+1.3
MCDONALD VLBI STA CORS ARP	X	-1329998.8832	-1329998.8832	x	+0.0	n	0.0
	Y	-5328393.4035	-5328393.4034	y	+0.1	e	-0.1
	Z	3236504.1488	3236504.1488	z	+0.0	u	0.0
McDonald LRS CRP	X	-1330021.8224	-1330021.8232	x	-0.8	n	-0.4
	Y	-5328404.1791	-5328404.1798	y	-0.7	e	-0.3
	Z	3236480.0936	3236480.0936	z	-0.1	u	1.0
NGS A	X	-1329991.8678	-1329991.8680	x	-0.1	n	+0.1
	Y	-5328400.8178	-5328400.8176	y	+0.1	e	-0.1
	Z	3236496.2058	3236496.2058	z	+0.0	u	-0.2
7613	X	-1324009.3224	-1324009.3237	x	-1.3	n	+0.7
	Y	-5332181.9320	-5332181.9330	y	-0.9	e	-1.0
	Z	3231962.3912	3231962.3927	z	+1.5	u	+1.8
FT DAVIS VLBA RM 1	X	-1323978.6887	-1323978.6889	x	-0.1	n	+0.2
	Y	-5332115.6022	-5332115.6016	y	+0.7	e	-0.3
	Z	3232046.0303	3232046.0302	z	-0.1	u	-0.6
FT DAVIS VLBA RM 2	X	-1323874.3582	-1323874.3595	x	-1.3	n	+0.2
	Y	-5332218.3949	-5332218.3979	y	-3.1	e	-0.5
	Z	3231938.8309	3231938.8331	z	+2.2	u	+4.0
FT DAVIS VLBA RM 3	X	-1324110.0864	-1324110.0870	x	-0.6	n	+0.4
	Y	-5332180.0357	-5332180.0360	y	-0.2	e	-0.6
	Z	3231895.3854	3231895.3860	z	+0.6	u	+0.6
JPL 4010 S	X	-1323894.5144	-1323894.5155	x	-1.0	n	+0.3
	Y	-5332197.7465	-5332197.7492	y	-2.7	e	-0.3
	Z	3231961.5593	3231961.5614	z	+2.1	u	+3.5

Table 14: Positional differences show DEFLEC12A performed well in correcting for vertical deflections.

Method #2 and the following least-squares strategies were used to produce the final SINEX data.

Least-Squares Estimates of Terrestrial Observations

A minimally constrained, 3-D adjustment of tacheometer observations was run in ITRF2008 (epoch date of survey) using Star*Net 7.2.2.7. GPS-derived 3-D coordinates for two ground control network points were loosely constrained, along with GPS-derived azimuths to provide orientation. 7851 was selected at the McDonald Observatory sub-network with an azimuth to MLRS-TLRS. At the Fort Davis NRAO, FT DAVIS VLBA RM 1 was chosen with an azimuth to FT DAVIS VLBA RM 3. Leveled height differences between all ground network points at each sub-network were weighted heavily. Zenith distance observations between ground network points were unconstrained. As a matter of practice, observations to each target consisting of one direct and one reverse (face I and face II) were repeated at least three times. The direct and reverse observations were averaged together in the data collection software to produce a single repetition. All repetitions were evaluated individually in the least-squares adjustment output.

- The residuals of the distances, zenith distances and directions were highly consistent among the vast majority of points; "fringe" values were not rejected, but simply assigned an appropriately higher standard error estimate instead.
- Star*Net reports the sum squares of standard residuals is 1335.191 with a total error factor of 0.985, passing the Chi-square test at 5 % level.

For additional details, see the Star*Net output file FortDavis.lst at http://www.ngs.noaa.gov/corbin/iss/index.shtml, found in a compressed "zip" file under Fort Davis Data Products.

Least-Squares Estimates of Conventional Reference Points

AXIS solved for two SGT instrument CRPs using position and variance-covariance estimates from Star*Net. AXIS reports the following solution statistics:

```
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
        3.2 SOLUTION STATISTICS
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++


LEAST SQUARES SOLUTION

# OF TARGETS                  :                    19
# OF IVP ESTIMATES            :                     6
# OF COORDINATE-OBSERVATIONS  :                   378
# OF UNKNOWNS                 :                   187
# OF CONDITIONS               :                   232
# OF CONSTRAINTS              :                    67
# OF ADD. CONSTRAINTS         :                    85
# OF CONSTRAINTS TOTAL        :                   152
DEGREES OF FREEDOM            :                   575

ITERATIONS TO COMPLETE        :                     3
MAXIMUM RESIDUAL (METRE)      :               0.00455
VARIANCE (CONDITIONS)         :               2.75250
VARIANCE (CONSTRAINTS)        :               0.25358
VARIANCE (APRIORI)            :               0.00000
VARIANCE FACTOR               :               3.00608
SIGMA                         :               1.73381
```

Table 15: AXIS Least-squares Summary.

CRP model [circle] fit residuals were 0.5 mm Root Mean Square Error (RMS) for the in-plane residuals and 0.9 mm for the out-of-plane residuals.

For additional details, see Section 3. LEAST SQUARES ESTIMATION in the AXIS output file outputFTDV.axs, found in a compressed "zip" file at http://www.ngs.noaa.gov/corbin/iss/index.shtml under Fort Davis Data Products.

Final Coordinate Listing

Table 16 contains a complete listing of final geocentric coordinate estimates from the current survey in supplementary SINEX file NGSAll1302GA.snx found in a compressed "zip" file at http://www.ngs.noaa.gov/corbin/iss/index.shtml under Fort Davis Data Products.

Point Name	X (meters)	Y (meters)	Z (meters)	Xσ (m)	Yσ (m)	Xσ (m)
7080 (McDonald LRS ref. mk.)	-1330021.2667	-5328401.8347	3236480.7136	0.0007	0.0004	0.0004
7613 (Ft Davis VLBA CRP)	-1324009.3242	-5332181.9347	3231962.3939	0.0011	0.0005	0.0008
7850	-1330008.3918	-5328391.5568	3236502.6353	0.0005	0.0003	0.0004
7851	-1330009.6674	-5328390.9373	3236503.1463	0.0005	0.0003	0.0004
7850 RM 2	-1330045.9331	-5328404.4072	3236461.1900	0.0008	0.0006	0.0006
7850 RM 3	-1330041.7426	-5328367.0413	3236521.5597	0.0008	0.0004	0.0007
CAL PIER 3	-1329988.9029	-5328444.3252	3236423.3751	0.0019	0.0004	0.0006
FT DAVIS VLBA RM 1	-1323978.6889	-5332115.6016	3232046.0302	0.0010	0.0004	0.0008
FT DAVIS VLBA RM 2	-1323874.3595	-5332218.3979	3231938.8331	0.0020	0.0004	0.0013
FT DAVIS VLBA RM 3	-1324110.0870	-5332180.0360	3231895.3860	0.0026	0.0015	0.0019
JPL 4010 S	-1323894.5155	-5332197.7492	3231961.5614	0.0025	0.0006	0.0018
McDonald LRS CRP	-1330021.8205	-5328404.1791	3236480.0931	0.0006	0.0004	0.0004
MCDONALD VLBI STA CORS ARP	-1329998.8832	-5328393.4034	3236504.1488	0.0005	0.0004	0.0005
MDO1 MCDONALD CORS MONUMENT	-1329998.8706	-5328393.3529	3236504.1179	0.0005	0.0003	0.0005
MLRS-TLRS	-1330005.2102	-5328407.7116	3236478.4828	0.0007	0.0004	0.0004
NGS A	-1329991.8680	-5328400.8176	3236496.2058	0.0006	0.0004	0.0005

Table 15: Adjusted coordinates transformed to ITRF08 (epoch date of survey) using AXIS software.

Table 17 lists tie-vectors determined in the current survey. The vectors emanate from the current IGS tracking station, MDO1, to all marks with DOMES numbers and to the CRPs of both SGT instruments.

From	MDO1, MCDONALD CORS MONUMENT, DOMES #40442M012				
To	7080 (McDonald LRS ref. mk.) DOMES #40442M006	ΔX ΔY ΔZ	-22.3961 -8.4818 -23.4043	ΔN ΔE ΔU	-27.0948 -19.6753 -0.2000
To	7613 (Fort Davis VLBA CRP) DOMES #40442S017	ΔX ΔY ΔZ	5989.5464 -3788.5818 -4541.7240	ΔN ΔE ΔU	-5041.4510 6728.7547 -403.6169
To	7850 DOMES #40442M008	ΔX ΔY ΔZ	-9.5212 1.7962 -1.4826	ΔN ΔE ΔU	-1.5624 -9.6728 -0.2722
To	7851 DOMES #40442M011	ΔX ΔY ΔZ	-10.7968 2.4157 -0.9716	ΔN ΔE ΔU	-0.9739 -11.0604 -0.2627
To	MCDONALD VLBI STA CORS ARP (no DOMES#)	ΔX ΔY ΔZ	-0.0126 -0.0505 0.0309	ΔN ΔE ΔU	0.0000 0.0000 0.0606
To	McDonald LRS CRP (no DOMES#)	ΔX ΔY ΔZ	-22.9526 -10.8269 -24.0244	ΔN ΔE ΔU	-28.8577 -19.6470 1.5566

Table 17: Vector information from current survey in ITRF2008 (epoch date of survey).

Local Vector Comparisons: Survey-derived Versus IERS-derived

Table 18 contains the topocentric vectors derived from the current survey compared against those vectors derived from coordinates extracted from the IERS ITRS Product Center web site (see Attachment C. IERS ITRS Product Center SINEX File). The Product Center provided coordinates in ITRF2008, propagated to the epoch date of the current survey. NGS's program INVERS3D (http://www.ngs.noaa.gov/PC_PROD/Inv_Fwd/) was then used to derive the local vectors. The comparisons suggest discrepancies greater than 5 mm to all three points, most notably 7080, the reference mark for the McDonald LRS. It might be worth noting that the MDO1 position determined from the GPS data analysis (as the IERS uses, from the IGS) could be affected by the normal presence of an uncalibrated radome. That could affect all the vector comparisons in the table to some extent.

From	MDO1, MCDONALD CORS MONUMENT DOMES #40442M012		IERS-derived	Current Survey	Diff. (mm)	IERS Reported Discrepancy* (mm)
To	7080 (McDonald LRS ref. mk.) DOMES #40442M006	ΔN ΔE ΔU	-27.1018 -19.6765 -0.2192	-27.0948 -19.6753 -0.2000	+7.0 +1.2 +19.2	-0.2 -7.6 +16.5
To	7850 DOMES #40442M008	ΔN ΔE ΔU	-1.5706 -9.6753 -0.2606	-1.5624 -9.6728 -0.2722	+8.2 +2.5 -11.6	n/a n/a n/a
To	7613 (Fort Davis VLBA CRP) DOMES #40442S017	ΔN ΔE ΔU	-5041.4551 6728.7565 -403.6134	-5041.4511 6728.7548 -403.6190	+4.0 -1.7 -5.6	+2.0 -9.8 +7.3

Table 18: Topocentric Vector Comparisons. Differences are listed in a new-minus-old format, where Diff. = Current Survey – IERS-published. For an additional comparison, the last column shows the discrepancy currently recognized by the ITRS, where Residual = Space Geodesy – Terrestrial Tie.
***http://itrf.ensg.ign.fr/ITRF_solutions/2008/doc/ITRF2008-Tie-Residuals.dat.**

5.7 Comparison with Previous Surveys

Allied Signal Technical Services (ASTS, currently Honeywell Technology Solutions, Inc.), provided output files from two least-squares adjustments that used data from previous surveys dating as far back as 1979. One adjustment compiled older observations made by both ASTS and the NGS into a single network. The other adjustment contains more recent observations made by ASTS between old ground network points to newer points set in support of 7613, the CRP of the VLBA. It is rather unfortunate that no currently recoverable points are common to both data sets, causing the comparison to the current survey to be presented in two tables. All vectors emanate from the MDO1, MCDONALD CORS MONUMENT.

From	MDO1, MCDONALD CORS MONUMENT DOMES #40442M012		**ASTS-Provided Vector Data**	**Current Survey**	**Diff. (cm)**
To	7080 (McDonald LRS ref. mk.) DOMES #40442M006	ΔN	-27.096	-27.095	+0.1
		ΔE	-19.674	-19.675	-0.1
		ΔU	-0.202	-0.202	+0.0
To	7850 DOMES #40442M008	ΔN	-1.564	-1.562	+0.2
		ΔE	-9.672	-9.673	-0.1
		ΔU	-0.272	-0.273	-0.1
To	7850 RM 2	ΔN	-48.209	-48.208	+0.1
		ΔE	-42.984	-42.983	+0.1
		ΔU	-2.878	-2.881	-0.3
To	7850 RM 3	ΔN	22.727	22.728	+0.1
		ΔE	-47.969	-47.968	+0.1
		ΔU	-4.125	-4.127	-0.2
To	7851	ΔN	-0.975	-0.974	+0.1
		ΔE	-11.060	-11.060	0.0
		ΔU	-0.263	-0.263	0.0
To	CAL PIER 3	ΔN	-93.446	-93.443	+0.3
		ΔE	22.015	22.017	+0.2
		ΔU	-0.743	-0.744	-0.1
To	MLRS-TLRS	ΔN	-29.939	-29.939	0.0
		ΔE	-2.675	-2.673	+0.2
		ΔU	0.221	0.220	-0.1

Table 19: Differences between results of the current survey and data provided by Allied Signal Technical Services compare favorably. Vectors emanate from MDO1, MCDONALD CORS MONUMENT. Diff. = current survey minus ASTS-provided data.

From	7613 (Fort Davis VLBA CRP) DOMES #40442S017		ASTS-Provided Vector Data	Current Survey	Diff. (mm)
To	FT DAVIS VLBA RM 1	ΔN	108.5321	108.5308	-1.3
		ΔE	13.7462	13.7462	0.0
		ΔU	-19.1232	-19.1224	+0.8
To	FT DAVIS VLBA RM 2	ΔN	-21.7305	-21.7312	-0.7
		ΔE	139.7733	139.7737	+0.4
		ΔU	-9.5429	-9.5417	+1.2
To	FT DAVIS VLBA RM 3	ΔN	-69.0891	-69.0898	-0.7
		ΔE	-98.2525	-98.2513	+1.2
		ΔU	-14.8437	-14.8338	+9.9
To	JPS 4010 S	ΔN	5.5615	5.5615	0.0
		ΔE	115.2364	115.2355	-0.9
		ΔU	-11.0235	-11.0235	0.0

Table 20: Differences between results of the current survey and data provided by Allied Signal Technical Services compare favorably. Vectors emanate from the CRP of the radio telescope at Fort Davis NRAO. Diff. = current survey minus ASTS-provided data.

6. Planning Aspects

Establish a point-of-contact (POC) at McDonald Observatory and Fort Davis NRAO to coordinate access to the site and schedule time on the SLR and VLBA instruments.
At the time of the current survey, the onsite POC at the McDonald Observatory was:

Mr. Jerry Wiant
McDonald Observatory
House 9
Highway 118
Fort Davis, TX 79734
Phone 432-426-3668
Fax 432-426-3803
Email jrw@astro.as.utexas.edu

At the time of the current survey, the onsite POC at the Fort Davis NRAO was:

Mr. Jason Candelara
NRAO Fort Davis VLBA Station
PO Box 2008
Fort Davis, TX 79734
Phone 915-426-3517
Email jcandela@nrao.edu

Recommendations:

- Do not remove radome at MDO1, MCDONALD CORS MONUMENT, without permission from the IGS Tracking Station Responsible Agency Primary Contact. Contact information is provided in the IGS Tracking Station Site Log for station MDO1undre Section 12 at http://igscb.jpl.nasa.gov/igscb/station/log/mdo1_20130222.log. The responsible agency at the time of the current survey was the Jet Propulsion Laboratory. The primary contact at the time of the survey was David Stowers, Jet Propulsion Laboratory/Caltech, Product Delivery Manager, Global Observing System – GNSS, Tracking Systems and Applications Section - 3350

4800 Oak Grove Drive, M/S 238-600, Pasadena, CA, USA
Tel. +1 818-354-7055, fax +1 818-393-4965, E-mail dstowers@jpl.nasa.gov

- Coordinate in advance with the on-site technicians to take advantage of radio telescope maintenance down time. Site personnel drives the radio telescope under survey team direction during observations.
- Suggestions for optimizing surveying conditions:
    - Plan measurements over longer lines to be observed earlier in the day to mitigate heat shimmer on targets.
    - Consideration should be given to installing wooden observing stands.
    - The SLR's electronics are very sensitive to precipitation and must be completely enclosed in advance of inclement weather. Also, it can be deemed too windy to open the cover on the telescope. Consult with operator to schedule access to instrument.

7. References

Axel Nothnagel (2009) Conventions on thermal expansion modelling of radio telescopes for geodetic and astrometric VLBI; Journal of Geodesy, Vol. 83(3), 787-792, DOI: 10.1007/s00190-008-0284-z

Johnston, G., Dawson, J. and Naebkhil, S., 2004. The 2003 Mount Stromlo Local Tie Survey. *Geoscience Austrailia Record*, 2004/20, 25pp. *Available online: http://www.ga.gov.au/image_cache/GA5653.pdf*

7.1 Name of person responsible for observations

Kendall Fancher
National Geodetic Survey
P.O. Box 190
Corbin, VA 22446
Phone – (540) 373-1243
Email – Kendall.Fancher@noaa.gov

7.2 Name of person(s) responsible for analysis

Kendall Fancher (Kendall.Fancher@noaa.gov)
Steven Breidenbach (Steven.Breidenbach@noaa.gov)
Charles Geoghegan (Charles.Geoghegan@noaa.gov)
National Geodetic Survey
15351 Office Drive
Woodford, VA 22580
Phone – (540) 373-1243

7.3 Location of observation data and results archive

National Geodetic Survey
Instrumentation & Methodologies Branch
15351 Office Drive
Woodford, VA 22580
Phone – (540) 373-1243
http://www.ngs.noaa.gov/corbin/iss/index.shtml

ATTACHMENTS

A. GPS Geocentric Coordinates and Covariances

```
%=SNX 1.00 NOA 13:134:50937 NOA 13:047:74640 13:060:71520 P    42 2 X - -
*-------------------------------------------------------------------------------
+FILE/REFERENCE
 DESCRIPTION    OPUS-Projects : NOAA/NOS/NGS
 OUTPUT         network-2hub_IGStracking
 CONTACT        steve.breidenbach@noaa.gov
 SOFTWARE       pages.e & gpscom.e
 HARDWARE       fermi (SunOS i86pc)
 INPUT          Ft Davis Co-Location Survey GNSS data
-FILE/REFERENCE
*-------------------------------------------------------------------------------
+FILE/COMMENT
 This combined adjustment was made from internal NGS files
 of partially reduced normal equations (information matricies).
 The data sets included in this solution are shown below.
     ../13047/Results/2013-047-nohub.nrm                            0
     ../13048/Results/2013-048-nohub.nrm                            0
     ../13049/Results/2013-049-nohub_B.nrm                          0
     ../13049/Results/2013-049-nohub_a.nrm                          0
     ../13050/Results/2013-050-nohub.nrm                            0
     ../13051/Results/2013-051-nohub.nrm                            0
     ../13052/Results/2013-052-nohub.nrm                            0
     ../13053/Results/2013-053-nohub.nrm                            0
     ../13054/Results/2013-054-nohub.nrm                            0
     ../13055/Results/2013-055-nohub.nrm                            0
     ../13056/Results/2013-056-nohub.nrm                            0
     ../13057/Results/2013-057-nohub.nrm                            0
     ../13058/Results/2013-058-nohub.nrm                            0
     ../13059/Results/2013-059-nohub.nrm                            0
-FILE/COMMENT
*-------------------------------------------------------------------------------
+SOLUTION/STATISTICS
 NUMBER OF OBSERVATIONS                        1097627.
 NUMBER OF UNKNOWNS                                5587
 NUMBER OF CONSTRAINT EQUATIONS                      21
 NUMBER OF DEGREES OF FREEDOM                  1092061.
 VARIANCE FACTOR                     0.691045385202163
-SOLUTION/STATISTICS
*-------------------------------------------------------------------------------
+SITE/ID
*CODE PT DOMES____ T STATION DESCRIPTION___ APPROX_LON_ APPROX_LAT_ _APP_H_
 50r2  - --------- P 50r2                  255 59  4.4  30 40 48.3  2001.6
 7851  - --------- P 7851                  255 59  5.6  30 40 49.8  2004.2
 fdv1  - --------- P fdv1                  256  3 19.2  30 38  9.6  1587.3
 fdv3  - --------- P fdv3                  256  3 15.0  30 38  3.9  1591.6
 AMC2  A 40472S004 P Colorado Springs, U.S. 255 28 31.5  38 48 11.2  1911.4
 BLYT  A 40479M001 P BLYTHE, USA           245 17  6.5  33 36 37.5    85.9
 GOLD  B 40405S031 P Goldstone, USA        243  6 38.7  35 25 30.6   986.7
```

```
 INEG  A 40507M001 P Aguascalientes, Mexico 257 42 56.9  21 51 22.2  1888.0
 MDO1  A 40442M012 P Fort Davis, USA        255 59  6.0  30 40 49.8  2004.5
 PIE1  A 40456M001 P Pie Town, USA          251 52 51.9  34 18  5.4  2347.7
 SCUB  A 40701M001 P Santiago de Cuba, Cuba 284 14 15.7  20  0 43.4    20.9
 WES2  A 40440S020 P Westford, USA          288 30 24.0  42 36 48.0    85.0
 mlrs  - --------- P mlrs                   255 59  5.9  30 40 48.9  2004.7
 fdv2  - --------- P fdv2                   256  3 23.9  30 38  5.4  1596.9
-SITE/ID
*------------------------------------------------------------------------------
+SITE/RECEIVER
*SITE PT SOLN T DATA_START__ DATA_END____ DESCRIPTION_________ S/N__ FIRMWARE___
 50r2  -    1 P 13:047:00000 13:060:86399 ----------------     ----- -----------
 7851  -    1 P 13:047:00000 13:060:86399 ----------------     ----- -----------
 fdv1  -    1 P 13:047:00000 13:060:86399 ----------------     ----- -----------
 fdv3  -    1 P 13:047:00000 13:060:86399 ----------------     ----- -----------
 AMC2  A   12 P 13:047:00000 13:060:86399 ASHTECH Z-XII3T      RT920 IL01-1D04-M
 BLYT  A   13 P 13:047:00000 13:060:86399 TRIMBLE NETRS        49271 1.2-5
 GOLD  B    9 P 13:047:00000 13:060:86399 JPS EGGDT            LT238 2.7.0
 INEG  A    8 P 13:047:00000 13:060:86399 TRIMBLE 5700         02202 1.24
 MDO1  A   16 P 13:047:00000 13:060:86399 ASHTECH UZ-12        UC120 CQ00
 PIE1  A   17 P 13:047:00000 13:060:86399 ASHTECH UZ-12        UC120 CQ00
 SCUB  A    5 P 13:047:00000 13:060:86399 ASHTECH Z-XII3       LP007 1D02-CD00
 WES2  A   22 P 13:047:00000 13:060:86399 LEICA GRX1200GGPRO   35125 8.20/IME3.0
 mlrs  -    1 P 13:049:00000 13:053:86399 ----------------     ----- -----------
 fdv2  -    1 P 13:053:00000 13:057:86399 ----------------     ----- -----------
-SITE/RECEIVER
*------------------------------------------------------------------------------
+SITE/ANTENNA
*SITE PT SOLN T DATA_START__ DATA_END____ DESCRIPTION_________ S/N__
 50r2  -    1 P 13:047:00000 13:060:86399 ----------------     -----
 7851  -    1 P 13:047:00000 13:060:86399 ----------------     -----
 fdv1  -    1 P 13:047:00000 13:060:86399 ----------------     -----
 fdv3  -    1 P 13:047:00000 13:060:86399 ----------------     -----
 AMC2  A   12 P 13:047:00000 13:060:86399 AOAD/M_T        NONE KW5-0
 BLYT  A   13 P 13:047:00000 13:060:86399 ASH701945B_M    ENCL CR519
 GOLD  B    9 P 13:047:00000 13:060:86399 AOAD/M_T        NONE 401-B
 INEG  A    8 P 13:047:00000 13:060:86399 TRM29659.00     NONE 02201
 MDO1  A   16 P 13:047:00000 13:060:86399 AOAD/M_T        JPLA 130
 PIE1  A   17 P 13:047:00000 13:060:86399 ASH701945E_M    NONE CR520
 SCUB  A    5 P 13:047:00000 13:060:86399 ASH700936C_M    SNOW 11976
 WES2  A   22 P 13:047:00000 13:060:86399 AOAD/M_TA_NGS   NONE 343
 mlrs  -    1 P 13:049:00000 13:053:86399 ----------------     -----
 fdv2  -    1 P 13:053:00000 13:057:86399 ----------------     -----
-SITE/ANTENNA
*------------------------------------------------------------------------------
+SITE/GPS_PHASE_CENTER
* Antenna information is from the file
*     /home/OPUS/files/ngs08.atx
* abbreviated below as  ant.info
*                            UP___  NORTH EAST_  UP___  NORTH  EAST_
*DESCRIPTION_________ S/N__ L1->ARP(m)__________ __L2->ARP(m)________ AZ_EL
 NONE            NONE ----- 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000   ant.info
 NONE            NONE ----- 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000   ant.info
 NONE            NONE ----- 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000   ant.info
 NONE            NONE ----- 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000   ant.info
 AOAD/M_T        NONE KW5-0 0.0918 0.0006 -.0004 0.1203 -.0001 -.0006   ant.info
```

```
 ASH701945B_M    NONE CR519 0.0918 0.0006 -.0004 0.1203 -.0001 -.0006   ant.info
 AOAD/M_T        NONE 401-B 0.0918 0.0006 -.0004 0.1203 -.0001 -.0006   ant.info
 TRM29659.00     NONE 02201 0.0910 0.0002 0.0002 0.1204 -.0000 -.0000   ant.info
 AOAD/M_T        NONE 130   0.0918 0.0006 -.0004 0.1203 -.0001 -.0006   ant.info
 ASH701945E_M    NONE CR520 0.0905 0.0011 -.0001 0.1190 0.0000 0.0006   ant.info
 ASH700936C_M    SNOW 11976 0.0904 -.0001 -.0005 0.1201 -.0004 0.0004   ant.info
 AOAD/M_TA_NGS   NONE 343   0.0918 0.0006 -.0004 0.1203 -.0001 -.0006   ant.info
 NONE            NONE ----- 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000   ant.info
 NONE            NONE ----- 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000   ant.info
-SITE/GPS_PHASE_CENTER
*------------------------------------------------------------------------------
+SITE/ECCENTRICITY
*SITE PT SOLN T DATA_START__ DATA_END____ AXE ARP->BENCHMARK(m)_________
 50r2  -    1 P 13:047:00000 13:060:86399 UNE   0.0000   0.0000   0.0000
 7851  -    1 P 13:047:00000 13:060:86399 UNE   0.0000   0.0000   0.0000
 fdv1  -    1 P 13:047:00000 13:060:86399 UNE   0.0000   0.0000   0.0000
 fdv3  -    1 P 13:047:00000 13:060:86399 UNE   0.0000   0.0000   0.0000
 AMC2  A   12 P 13:047:00000 13:060:86399 UNE   0.0000   0.0000   0.0000
 BLYT  A   13 P 13:047:00000 13:060:86399 UNE   0.0332   0.0000  -0.0000
 GOLD  B    9 P 13:047:00000 13:060:86399 UNE   0.0254   0.0000  -0.0000
 INEG  A    8 P 13:047:00000 13:060:86399 UNE   0.0705   0.0000  -0.0000
 MDO1  A   16 P 13:047:00000 13:060:86399 UNE   0.0610   0.0000  -0.0000
 PIE1  A   17 P 13:047:00000 13:060:86399 UNE   0.0610   0.0000  -0.0000
 SCUB  A    5 P 13:047:00000 13:060:86399 UNE   0.0460   0.0000  -0.0000
 WES2  A   22 P 13:047:00000 13:060:86399 UNE   0.0000   0.0000   0.0000
 mlrs  -    1 P 13:049:00000 13:053:86399 UNE   0.0000   0.0000   0.0000
 fdv2  -    1 P 13:053:00000 13:057:86399 UNE   0.0000   0.0000   0.0000
-SITE/ECCENTRICITY
*------------------------------------------------------------------------------
+SOLUTION/EPOCHS
*SITE PT SOLN T _DATA_START_ __DATA_END__ _MEAN_EPOCH_
 50r2  -    1 P 13:047:00000 13:060:86399 13:052:57456
 7851  -    1 P 13:047:00000 13:060:86399 13:053:42406
 fdv1  -    1 P 13:047:00000 13:060:86399 13:054:73047
 fdv3  -    1 P 13:047:00000 13:060:86399 13:054:71113
 AMC2  A   12 P 13:047:00000 13:060:86399 13:053:12112
 BLYT  A   13 P 13:047:00000 13:060:86399 13:053:57466
 GOLD  B    9 P 13:047:00000 13:060:86399 13:053:56844
 INEG  A    8 P 13:047:00000 13:060:86399 13:054:22079
 MDO1  A   16 P 13:047:00000 13:060:86399 13:053:75089
 PIE1  A   17 P 13:047:00000 13:060:86399 13:053:31812
 SCUB  A    5 P 13:047:00000 13:060:86399 13:054:38530
 WES2  A   22 P 13:047:00000 13:060:86399 13:054:20332
 mlrs  -    1 P 13:049:00000 13:053:86399 13:052:20095
 fdv2  -    1 P 13:053:00000 13:057:86399 13:055:70352
-SOLUTION/EPOCHS
*------------------------------------------------------------------------------
+SOLUTION/ESTIMATE
*INDEX TYPE   CODE PT SOLN _REF_EPOCH__ UNIT S  __ESTIMATED VALUE___ _STD_DEV___
     1 STAX   50r2  -    1 13:054:29879 m    2 -.133004593177485E+07 .110009E-03
     2 STAY   50r2  -    1 13:054:29879 m    2 -.532840440642795E+07 .350990E-03
     3 STAZ   50r2  -    1 13:054:29879 m    2 0.323646118908037E+07 .220339E-03
     4 STAX   7851  -    1 13:054:29879 m    2 -.133000966792976E+07 .913777E-04
     5 STAY   7851  -    1 13:054:29879 m    2 -.532839093832720E+07 .285510E-03
     6 STAZ   7851  -    1 13:054:29879 m    2 0.323650314630713E+07 .180047E-03
     7 STAX   fdv1  -    1 13:054:29879 m    2 -.132397869009426E+07 .113123E-03
```

```
     8 STAY   fdv1  -    1 13:054:29879 m    2 -.533211560369143E+07 .362896E-03
     9 STAZ   fdv1  -    1 13:054:29879 m    2 0.323204603005627E+07 .225881E-03
    10 STAX   fdv3  -    1 13:054:29879 m    2 -.132411008686559E+07 .136453E-03
    11 STAY   fdv3  -    1 13:054:29879 m    2 -.533218003609970E+07 .437716E-03
    12 STAZ   fdv3  -    1 13:054:29879 m    2 0.323189538723097E+07 .275330E-03
    13 STAX   AMC2  A   12 13:054:29879 m    0 -.124859631156898E+07 .378126E-04
    14 STAY   AMC2  A   12 13:054:29879 m    0 -.481942820370266E+07 .469762E-04
    15 STAZ   AMC2  A   12 13:054:29879 m    0 0.397650595699822E+07 .461088E-04
    16 STAX   BLYT  A   13 13:054:29879 m    0 -.222320682610339E+07 .377842E-04
    17 STAY   BLYT  A   13 13:054:29879 m    0 -.483029978612690E+07 .474168E-04
    18 STAZ   BLYT  A   13 13:054:29879 m    0 0.351058756513647E+07 .456674E-04
    19 STAX   GOLD  B    9 13:054:29879 m    0 -.235361445275239E+07 .398983E-04
    20 STAY   GOLD  B    9 13:054:29879 m    0 -.464138527335373E+07 .456164E-04
    21 STAZ   GOLD  B    9 13:054:29879 m    0 0.367697640734496E+07 .449677E-04
    22 STAX   INEG  A    8 13:054:29879 m    0 -.126043569240876E+07 .299411E-04
    23 STAY   INEG  A    8 13:054:29879 m    0 -.578854699791745E+07 .610023E-04
    24 STAZ   INEG  A    8 13:054:29879 m    0 0.236033995173687E+07 .418433E-04
    25 STAX   MDO1  A   16 13:054:29879 m    2 -.132999887190471E+07 .113572E-03
    26 STAY   MDO1  A   16 13:054:29879 m    2 -.532839335700748E+07 .365701E-03
    27 STAZ   MDO1  A   16 13:054:29879 m    2 0.323650411129596E+07 .230946E-03
    28 STAX   PIE1  A   17 13:054:29879 m    0 -.164091701614137E+07 .370326E-04
    29 STAY   PIE1  A   17 13:054:29879 m    0 -.501478119814766E+07 .475808E-04
    30 STAZ   PIE1  A   17 13:054:29879 m    0 0.357544705908849E+07 .453548E-04
    31 STAX   SCUB  A    5 13:054:29879 m    0 0.147453805048225E+07 .417910E-04
    32 STAY   SCUB  A    5 13:054:29879 m    0 -.581124326519165E+07 .522282E-04
    33 STAZ   SCUB  A    5 13:054:29879 m    0 0.216895885621327E+07 .418951E-04
    34 STAX   WES2  A   22 13:054:29879 m    0 0.149223311973852E+07 .419615E-04
    35 STAY   WES2  A   22 13:054:29879 m    0 -.445808949979515E+07 .474888E-04
    36 STAZ   WES2  A   22 13:054:29879 m    0 0.429604606815308E+07 .472882E-04
    37 STAX   mlrs  -    1 13:054:29879 m    2 -.133000521078751E+07 .174501E-03
    38 STAY   mlrs  -    1 13:054:29879 m    2 -.532840771136139E+07 .562734E-03
    39 STAZ   mlrs  -    1 13:054:29879 m    2 0.323647848354853E+07 .350908E-03
    40 STAX   fdv2  -    1 13:054:29879 m    2 -.132387435857707E+07 .228901E-03
    41 STAY   fdv2  -    1 13:054:29879 m    2 -.533221839560029E+07 .734674E-03
    42 STAZ   fdv2  -    1 13:054:29879 m    2 0.323193883221281E+07 .463243E-03
-SOLUTION/ESTIMATE
*-----------------------------------------------------------------------------
+SOLUTION/APRIORI
*INDEX TYPE   CODE PT SOLN _REF_EPOCH__ UNIT S  __A-PRIORI VALUE____ _STD_DEV___
    13 STAX   AMC2  A   12 13:054:29879 m    0 -.124859619300037E+07 .149245E+05
    14 STAY   AMC2  A   12 13:054:29879 m    0 -.481942821100604E+07 .149245E+05
    15 STAZ   AMC2  A   12 13:054:29879 m    0 0.397650599699846E+07 .149245E+05
    16 STAX   BLYT  A   13 13:054:29879 m    0 -.222320670399745E+07 .168343E+06
    17 STAY   BLYT  A   13 13:054:29879 m    0 -.483029979600214E+07 .168343E+06
    18 STAZ   BLYT  A   13 13:054:29879 m    0 0.351058762399772E+07 .168343E+06
    19 STAX   GOLD  B    9 13:054:29879 m    0 -.235361431800452E+07 .149245E+05
    20 STAY   GOLD  B    9 13:054:29879 m    0 -.464138532700057E+07 .149245E+05
    21 STAZ   GOLD  B    9 13:054:29879 m    0 0.367697642999810E+07 .149245E+05
    22 STAX   INEG  A    8 13:054:29879 m    0 -.126043567099708E+07 .576111E+07
    23 STAY   INEG  A    8 13:054:29879 m    0 -.578854724100010E+07 .576111E+07
    24 STAZ   INEG  A    8 13:054:29879 m    0 0.236034007800287E+07 .576111E+07
    28 STAX   PIE1  A   17 13:054:29879 m    0 -.164091689999692E+07 .184584E+05
    29 STAY   PIE1  A   17 13:054:29879 m    0 -.501478119199754E+07 .184584E+05
    30 STAZ   PIE1  A   17 13:054:29879 m    0 0.357544709499605E+07 .184584E+05
    31 STAX   SCUB  A    5 13:054:29879 m    0 0.147453809199783E+07 .153751E+05
    32 STAY   SCUB  A    5 13:054:29879 m    0 -.581124326899903E+07 .153751E+05
```

```
    33 STAZ   SCUB  A    5 13:054:29879 m    0 0.216895882199945E+07 .153751E+05
    34 STAX   WES2  A   22 13:054:29879 m    0 0.149223324799923E+07 .149245E+05
    35 STAY   WES2  A   22 13:054:29879 m    0 -.445808948900299E+07 .149245E+05
    36 STAZ   WES2  A   22 13:054:29879 m    0 0.429604603499779E+07 .149245E+05
-SOLUTION/APRIORI
*-----------------------------------------------------------------------------
+SOLUTION/MATRIX_ESTIMATE U COVA
     1     1 0.121019862402386E-07 0.288031424791810E-07 -.164207506969448E-07
     1     4 0.207122593788745E-08 0.408638988665405E-08 -.245738481031621E-08
     1     7 0.145095850731307E-08 0.266890147789633E-08 -.160574573218154E-08
     1    10 0.170722784356634E-08 0.328365289827085E-08 -.196830682353262E-08
     1    13 0.363866221443970E-09 0.254546560100457E-10 0.408541052531799E-10
     1    16 0.222869159547438E-09 0.256336977413344E-10 0.508908934847694E-10
     1    19 0.193011935631724E-09 0.348110523010325E-10 0.855375880505666E-10
     1    22 0.195386371320041E-09 0.416752682781694E-10 -.780254925989848E-10
     1    25 0.197646302665147E-08 0.389236954040969E-08 -.236425655258169E-08
     1    28 0.320898683803253E-09 0.127456016751555E-10 0.199696371773727E-10
     1    31 0.237184946372906E-09 0.316993829414869E-10 -.431479487154891E-10
     1    34 0.185242953999892E-09 0.100090756498378E-10 -.439860677459920E-10
     1    37 0.231652837510702E-08 0.473011990829257E-08 -.282183247704101E-08
     1    40 0.000000000000000E+00 0.000000000000000E+00 0.000000000000000E+00
     2     2 0.123194121109658E-06 -.698415444276795E-07 0.406629486579167E-08
     2     5 0.181391611717819E-07 -.102454111440253E-07 0.267951437774273E-08
     2     8 0.128849331516684E-07 -.717349881757079E-08 0.325767366457782E-08
     2    11 0.149304371360178E-07 -.835263640101932E-08 -.746317438121650E-10
     2    14 0.426366258064347E-09 0.800815418907268E-10 -.166899807296165E-09
     2    17 0.444705379524266E-09 0.452369274033001E-10 -.284608665288893E-09
     2    20 0.468277291617726E-09 0.128781004216431E-09 0.861871598268052E-10
     2    23 0.334718605213746E-09 -.168831955161303E-09 0.387668631142529E-08
     2    26 0.174190936396464E-07 -.993286864051848E-08 -.701598144730791E-10
     2    29 0.433049194788834E-09 -.375958077013461E-11 0.417223308117985E-09
     2    32 0.636100771583607E-10 -.831922200091781E-10 0.267062274236386E-09
     2    35 0.170463082797697E-09 0.670504290608503E-10 0.473172332260267E-08
     2    38 0.213480081671422E-07 -.121108635663053E-07 0.000000000000000E+00
     2    41 0.000000000000000E+00 0.000000000000000E+00
     3     3 0.485491388730212E-07 -.245140863681546E-08 -.102682546962748E-07
     3     6 0.758314303195556E-08 -.161431981224021E-08 -.719024052179860E-08
     3     9 0.532814535876904E-08 -.195633589187341E-08 -.836595958841060E-08
     3    12 0.620819130984939E-08 0.343899066038322E-10 -.182865027455693E-10
     3    15 0.252880098483193E-09 0.161691311705853E-09 -.304083525686861E-10
     3    18 0.346065942107373E-09 0.240281049360880E-09 -.702026277283154E-10
     3    21 0.243375817723519E-09 -.527433128510036E-10 -.531658477078398E-10
     3    24 0.472676723084198E-09 -.235668960507898E-08 -.992757003460047E-08
     3    27 0.739420211557585E-08 0.617041784581777E-10 -.137789684128774E-10
     3    30 0.372446044010712E-09 -.231278173746326E-09 0.107420669727975E-09
     3    33 0.387968887994421E-09 -.219695853884293E-09 0.359703278425239E-10
     3    36 0.130993388417686E-09 -.281126222376957E-08 -.120755980950234E-07
     3    39 0.886515804141396E-08 0.000000000000000E+00 0.000000000000000E+00
     3    42 0.000000000000000E+00
     4     4 0.834988767078804E-08 0.192849908100615E-07 -.110636464232039E-07
     4     7 0.154106619597405E-08 0.276299005655063E-08 -.167012714014996E-08
     4    10 0.212915655470249E-08 0.431295737761639E-08 -.257816858012741E-08
     4    13 0.379163372927858E-09 0.274010077723010E-10 0.434776725780122E-10
     4    16 0.219790620923927E-09 0.312182798963481E-10 0.477200229687079E-10
     4    19 0.183274404944931E-09 0.450738011394216E-10 0.851948141643380E-10
     4    22 0.190107912166175E-09 0.355078031595041E-10 -.725214547761905E-10
```

4	25	0.227484408600935E-08	0.447877388932879E-08	-.275028933454672E-08
4	28	0.348239986045403E-09	0.132245940937526E-10	0.165152577244571E-10
4	31	0.222983990172697E-09	0.280408354140800E-10	-.433810364844910E-10
4	34	0.177894935580421E-09	0.389615568820255E-11	-.469944771620419E-10
4	37	0.183915034972056E-08	0.359718581109521E-08	-.216753373981934E-08
4	40	0.225183048973859E-08	0.461583992020944E-08	-.272826615764406E-08
5	5	0.815158562669553E-07	-.461614335028559E-07	0.280324806763090E-08
5	8	0.129058678595405E-07	-.715281803847743E-08	0.429067623031128E-08
5	11	0.188303269343744E-07	-.105784726991353E-07	-.851971041791352E-10
5	14	0.430561747281232E-09	0.643932681334807E-10	-.159247266303800E-09
5	17	0.459289315329825E-09	0.560733940419534E-10	-.275716322434091E-09
5	20	0.477630802482384E-09	0.137425149684570E-09	0.830705741239271E-10
5	23	0.304686124351592E-09	-.151926208198984E-09	0.447072180961247E-08
5	26	0.194205623576367E-07	-.110625636717886E-07	-.441943956029660E-10
5	29	0.452761902220790E-09	-.165122247210980E-10	0.398186023149259E-09
5	32	0.570578346269211E-10	-.895488836668985E-10	0.250185549530625E-09
5	35	0.162374969397482E-09	0.648158659597040E-10	0.361528536733605E-08
5	38	0.163862744456480E-07	-.928011146807113E-08	0.458932668748414E-08
5	41	0.195140328358946E-07	-.109705375839545E-07	
6	6	0.324169270260792E-07	-.169090093076029E-08	-.714713570517550E-08
6	9	0.533519840590434E-08	-.256508819048013E-08	-.105704237768798E-07
6	12	0.769779133779149E-08	0.270231591420379E-10	-.188610622297164E-10
6	15	0.262327210752993E-09	0.167165487101585E-09	-.328067377249609E-10
6	18	0.355834290626428E-09	0.248439196346654E-09	-.787669830579138E-10
6	21	0.245506566840410E-09	-.529198758712326E-10	-.405851800392986E-10
6	24	0.444691276546941E-09	-.273552008934159E-08	-.110145671680678E-07
6	27	0.820423613590201E-08	0.434575322116774E-10	-.132685600011515E-10
6	30	0.401902965424447E-09	-.220679769259024E-09	0.104841250705063E-09
6	33	0.376789723991856E-09	-.210513945179490E-09	0.385507879016777E-10
6	36	0.130741980003758E-09	-.216732228908922E-08	-.924346729804116E-08
6	39	0.688240442207313E-08	-.271934800287581E-08	-.109679023347160E-07
6	42	0.785344979351860E-08		
7	7	0.127968358010983E-07	0.294329676381658E-07	-.166469809744571E-07
7	10	0.236560760271765E-08	0.463941150252975E-08	-.274921892203063E-08
7	13	0.270921561265034E-09	0.158123846628268E-10	0.370564359510223E-10
7	16	0.164425692099995E-09	0.108932714811779E-10	0.387223616038334E-10
7	19	0.143356955394487E-09	0.179572240509608E-10	0.617052525410548E-10
7	22	0.265661880135059E-09	0.704655323978991E-10	-.546171432483729E-10
7	25	0.158925896138367E-08	0.292135103825223E-08	-.176338587349911E-08
7	28	0.241738348613287E-09	0.411712542226761E-11	0.215755314412060E-10
7	31	0.304461313314920E-09	0.471000261697793E-10	-.448728229287896E-11
7	34	0.264752973923769E-09	-.249149612115094E-10	-.844698899131101E-10
7	37	0.684086979548106E-09	0.945519054732815E-09	-.588603206188692E-09
7	40	0.332605024675261E-08	0.654719826320977E-08	-.385243172065999E-08
8	8	0.131693193546820E-06	-.742003274838573E-07	0.459034336873012E-08
8	11	0.215185954318158E-07	-.120029125107401E-07	-.113400912847357E-09
8	14	0.360451716416432E-09	0.121832009251476E-09	-.206247584471796E-09
8	17	0.355036176376737E-09	0.565006470955367E-10	-.286626447502084E-09
8	20	0.380534716392135E-09	0.110842544447594E-09	0.547791687216768E-10
8	23	0.501619346082649E-09	-.238419917413308E-09	0.290133379427657E-08
8	26	0.137177776902924E-07	-.765939853480694E-08	-.128400589316273E-09
8	29	0.360847626547494E-09	0.490391584913315E-10	0.576920805284810E-09
8	32	0.485255253909215E-10	-.175219640168563E-09	0.372233455226745E-09
8	35	0.278383940750890E-09	0.163853490777014E-09	0.909554422024179E-09
8	38	0.488063551305356E-08	-.264126983619727E-08	0.637952817579520E-08
8	41	0.305100116766817E-07	-.172479704570075E-07	

9	9	0.510221749385937E-07	-.271556917048588E-08	-.119855543188002E-07
9	12	0.862724709156547E-08	0.474751302518200E-10	-.311637087910221E-10
9	15	0.154520251738333E-09	0.162025114227711E-09	-.342393343609410E-10
9	18	0.241368789936569E-09	0.214065341447135E-09	-.680052071830249E-10
9	21	0.170298198073152E-09	-.250903849588942E-10	-.128222981730355E-09
9	24	0.562161535528180E-09	-.174825380596171E-08	-.762997342192955E-08
9	27	0.569134112419751E-08	0.816279880400000E-10	-.225883920703488E-10
9	30	0.252108493470317E-09	-.272797491683108E-09	0.179665710348637E-09
9	33	0.565384704739403E-09	-.295584643980719E-09	0.800728696465359E-10
9	36	0.198380882287103E-09	-.572865179283334E-09	-.262684367483803E-08
9	39	0.219391531032086E-08	-.378978831350061E-08	-.172975046449769E-07
9	42	0.123573972457889E-07		
10	10	0.186195062871998E-07	0.446323860092444E-07	-.253660207185714E-07
10	13	0.348718817105418E-09	0.299833227279735E-10	0.459351972394415E-10
10	16	0.205113135255378E-09	0.245764414205715E-10	0.486481760642798E-10
10	19	0.177949001516480E-09	0.324479608784813E-10	0.800879879277446E-10
10	22	0.214500137065639E-09	0.469823498791869E-10	-.698101272891036E-10
10	25	0.223279038514773E-08	0.451965247732553E-08	-.271795128148690E-08
10	28	0.311285426000495E-09	0.138304692666482E-10	0.223480631309827E-10
10	31	0.237730638093283E-09	0.287940370694650E-10	-.406713145027450E-10
10	34	0.205512781392859E-09	-.785883689292040E-12	-.586999467607399E-10
10	37	0.849062644568055E-09	0.128982501422421E-08	-.800625413689205E-09
10	40	0.387402558835559E-08	0.816183621383961E-08	-.473698415394153E-08
11	11	0.191595161969110E-06	-.109837184608059E-06	-.698034279386404E-10
11	14	0.422228174155390E-09	0.965764308291510E-10	-.176209717873710E-09
11	17	0.427585780019217E-09	0.535636523890644E-10	-.280756745289851E-09
11	20	0.445431968514058E-09	0.127462785286214E-09	0.857002360549574E-10
11	23	0.371131190828735E-09	-.180441760636803E-09	0.455126026266321E-08
11	26	0.199214568837662E-07	-.113518746534146E-07	-.740206899224551E-10
11	29	0.431383431939825E-09	0.851009979013006E-11	0.424112457533059E-09
11	32	0.473864368826610E-10	-.118593180234278E-09	0.280910473347807E-09
11	35	0.195730685213329E-09	0.850133477585525E-10	0.129980381246511E-08
11	38	0.633417754859223E-08	-.348581692774849E-08	0.810677027238362E-08
11	41	0.349972420231055E-07	-.198099700453248E-07	
12	12	0.758065539292134E-07	0.272243588956648E-10	-.246734057949074E-10
12	15	0.229073532983633E-09	0.165359416668059E-09	-.357716352392793E-10
12	18	0.316098746349052E-09	0.235003752024191E-09	-.708882064220344E-10
12	21	0.223436131846454E-09	-.506428402476120E-10	-.657845623680301E-10
12	24	0.491415563941109E-09	-.272846916603169E-08	-.113085455737221E-07
12	27	0.828647346686243E-08	0.618436401350712E-10	-.184928039172278E-10
12	30	0.352893410476251E-09	-.223238131453067E-09	0.125115675760701E-09
12	33	0.426582250577008E-09	-.236126639105755E-09	0.466103759546103E-10
12	36	0.152721034379820E-09	-.803369627839487E-09	-.346990331895493E-08
12	39	0.280590473088528E-08	-.472291158215520E-08	-.198348889441916E-07
12	42	0.139551499356009E-07		
13	13	0.142978936712805E-08	0.241420754996790E-09	-.363532623284084E-10
13	16	0.859798724171715E-10	-.217273576668644E-10	0.181857568820237E-10
13	19	0.848469820399215E-10	-.183144269312746E-10	0.251249210718646E-10
13	22	0.553781553950344E-10	-.102426968207376E-10	-.779324239483152E-11
13	25	0.381511513348777E-09	-.641050111243971E-10	0.128816078016348E-10
13	28	0.129228651146466E-09	-.285418321736927E-10	0.161183481045009E-10
13	31	0.487927755120055E-10	0.100733240233719E-10	0.137283761969138E-12
13	34	0.414467824998925E-10	-.438060821574811E-11	-.141596568093006E-10
13	37	0.366605817702212E-09	-.636554603040727E-10	0.379381556035846E-10
13	40	0.273388460502720E-09	-.115759159345877E-09	0.485871575775483E-10
14	14	0.220676420737902E-08	-.281991660498909E-09	-.294605238052555E-10

14	17	0.617259836113352E-10	0.579169747408012E-10	-.335848255142190E-10
14	20	0.656051511835209E-10	0.551965683119394E-10	-.603518811849860E-11
14	23	0.211658181532107E-10	0.267467771901142E-10	0.275768986049076E-10
14	26	0.438006550946647E-09	-.186859025574616E-10	-.266888999728113E-10
14	29	0.626722974640182E-10	0.645982457402855E-10	0.179843022166544E-10
14	32	0.178238894692973E-10	0.223943404064682E-10	0.139416516514777E-11
14	35	0.295567154726475E-10	0.290480130987912E-10	0.254343352284290E-10
14	38	0.405294751367914E-09	-.954448889360303E-12	0.249304077861446E-10
14	41	0.405734225283923E-09	-.431817181771180E-10	
15	15	0.212602068597543E-08	-.494242643771562E-11	0.603058432966037E-10
15	18	0.817416858676815E-10	-.671261256510541E-11	0.651398419105697E-10
15	21	0.792565363190542E-10	0.663527648150664E-11	0.192662881908973E-10
15	24	0.403514817124670E-10	0.408978927959568E-10	0.814015475029826E-10
15	27	0.258235563493896E-09	0.668612213896299E-11	0.592204770132726E-10
15	30	0.915188037762481E-10	0.263788295180553E-10	0.262889469556249E-10
15	33	0.373006715195255E-10	0.550146160604175E-11	0.326948308986459E-10
15	36	0.323705411627597E-10	0.384212593778027E-10	0.485153968661727E-10
15	39	0.282483429574317E-09	0.440186147763597E-10	0.148170381292549E-09
15	42	0.156026725505964E-09		
16	16	0.142764293635200E-08	0.475472837315851E-09	-.176082663945320E-09
16	19	0.153678547582846E-09	-.590994369484691E-10	0.286508430883111E-10
16	22	0.379382046030094E-10	0.288167110353865E-11	0.346354167879012E-10
16	25	0.219117662960856E-09	-.154470108129370E-09	0.165956833325024E-09
16	28	0.107508591721336E-09	-.277356159168253E-10	0.137280244892384E-10
16	31	0.211490148214687E-11	0.975960110903684E-11	0.369426197393084E-10
16	34	0.714457945403097E-11	-.132056192232784E-10	-.108052886406952E-10
16	37	0.214597165599754E-09	-.198834932931457E-09	0.170568043658698E-09
16	40	0.177702163660744E-09	-.213390057394323E-09	0.168872163932930E-09
17	17	0.224835640120882E-08	-.400555493503170E-09	-.536637751012995E-10
17	20	0.847631631914169E-10	0.591354852838509E-10	-.610751446073359E-11
17	23	0.206023970149032E-10	0.243636564236738E-10	0.331983891058712E-10
17	26	0.458920228670294E-09	-.402430025921255E-10	-.312006667449921E-10
17	29	0.628261173782089E-10	0.606577386957106E-10	0.194764577298181E-10
17	32	0.162991840545635E-10	0.194260396868976E-10	0.255615528615773E-11
17	35	0.269104247565837E-10	0.261953323960641E-10	0.218552673465553E-10
17	38	0.441580132324894E-09	-.319235973895423E-10	0.165859199684618E-10
17	41	0.397360087010688E-09	-.372647015591009E-10	
18	18	0.208551473827402E-08	0.328796172045953E-10	0.619618744274031E-10
18	21	0.108600712035046E-09	0.104197129512553E-10	0.256161322078642E-10
18	24	0.655885821408644E-10	0.502210237261637E-10	0.502161968642702E-10
18	27	0.349983388378572E-09	0.224179178464885E-10	0.582757272762589E-10
18	30	0.992003783686884E-10	0.129092344192081E-10	0.285874359913177E-10
18	33	0.591149016662255E-10	-.395523262213928E-11	0.272063785363189E-10
18	36	0.312961927094395E-10	0.513445812920799E-10	0.496999303470639E-10
18	39	0.329410721144726E-09	0.401756536851742E-10	0.547428633709908E-10
18	42	0.276726405384343E-09		
19	19	0.159187619970703E-08	0.307645516586061E-09	-.133984051716243E-09
19	22	0.367138135095865E-10	0.322626595057475E-11	0.417725694461997E-10
19	25	0.183274364164654E-09	-.269955011371288E-09	0.248395704269971E-09
19	28	0.110594679261628E-09	-.313799991814392E-10	0.141144029059230E-10
19	31	-.483596210963886E-11	0.104253355347068E-10	0.448993034976571E-10
19	34	0.222417208438327E-11	-.143537637218452E-10	-.102132304252531E-10
19	37	0.187827124551789E-09	-.303473883245316E-09	0.237352043711646E-09
19	40	0.148113597998593E-09	-.289507489067813E-09	0.215229961104981E-09
20	20	0.208085689220577E-08	-.243644379426195E-09	-.544308028820620E-11
20	23	0.174211844790962E-10	0.131545846259799E-10	0.451769169472520E-10

20	26	0.469674414109623E-09	-.818966344785206E-10	-.346582525260632E-10
20	29	0.636180472883315E-10	0.594311416990663E-10	0.255898853118895E-10
20	32	0.144068695790523E-10	0.875900291049132E-11	0.768302841989908E-11
20	35	0.275895856939001E-10	0.246057701379655E-10	0.278922405939301E-10
20	38	0.456086288231077E-09	-.608195538940230E-10	0.255974606668897E-10
20	41	0.410574524934095E-09	-.673159223434668E-10	
21	21	0.202209253381555E-08	0.124563726583836E-10	0.223556669509162E-10
21	24	0.520720101384089E-10	0.855610258802385E-10	0.127132181780784E-09
21	27	0.243998244032689E-09	0.250175965977899E-10	0.532042367283363E-10
21	30	0.888900533148536E-10	0.173229785558305E-10	0.251419238287388E-10
21	33	0.475626928443722E-10	0.126948775462585E-11	0.249238172942618E-10
21	36	0.265254234706591E-10	0.788809530278107E-10	0.113968592279858E-09
21	39	0.242800220509793E-09	0.665136280793692E-10	0.120541904010965E-09
21	42	0.190157394988131E-09		
22	22	0.896470309485088E-09	0.641960559035630E-09	-.203582555463373E-09
22	25	0.184177856206142E-09	0.758993414259693E-10	-.506069198414143E-10
22	28	0.506739225759938E-10	-.842167724567591E-11	0.696915728078983E-11
22	31	0.323483335298187E-10	0.495009558278095E-11	-.447944616046976E-11
22	34	0.266259287401759E-10	-.695524865785631E-11	-.127343886372433E-10
22	37	0.204942686603717E-09	0.946586869490682E-10	-.558898978332573E-10
22	40	0.281511903990880E-09	0.119408171596071E-09	-.602219096062934E-10
23	23	0.372127583387839E-08	-.999776358090710E-09	0.353859279975571E-10
23	26	0.306468860524545E-09	-.451872948754333E-10	-.430146978498869E-11
23	29	0.237506249340328E-10	0.252830430945749E-10	-.100065587588390E-11
23	32	0.165604520853839E-10	0.470055331315655E-10	-.102797292824017E-10
23	35	0.176535278742154E-10	0.224762040958970E-10	0.449095256719224E-10
23	38	0.353418954047116E-09	-.562125955337656E-10	0.715416210829052E-10
23	41	0.485227146291598E-09	-.113870914347882E-09	
24	24	0.175085782165522E-08	-.724523010060427E-10	-.152529560200320E-09
24	27	0.437040749465383E-09	0.103478555666201E-10	0.339026012395567E-10
24	30	0.649802854866786E-10	-.368142961186842E-10	0.408058899762398E-10
24	33	0.142490570806048E-09	-.431897511303488E-10	0.208576631499916E-10
24	36	0.406893149817200E-10	-.838076046969592E-10	-.160771854731859E-09
24	39	0.496160780242835E-09	-.543360886307949E-10	-.219118128549733E-09
24	42	0.564699002726152E-09		
25	25	0.128986093500190E-07	0.315421494457688E-07	-.182724395133141E-07
25	28	0.364769726518036E-09	0.169590034319587E-10	0.174365969298279E-10
25	31	0.215050968857853E-09	0.252309567952398E-10	-.418829817247250E-10
25	34	0.179863259257582E-09	0.140669227356976E-11	-.499860663598689E-10
25	37	0.141198139793692E-08	0.256063950881255E-08	-.158692776113439E-08
25	40	0.174501042985321E-08	0.335582991587090E-08	-.201005516589867E-08
26	26	0.133737109342552E-06	-.770276048063613E-07	-.305368618948596E-10
26	29	0.469518199630788E-09	-.181111447717943E-10	0.372877446102892E-09
26	32	0.478238704999425E-10	-.876867309400151E-10	0.247409997933817E-09
26	35	0.161784435944615E-09	0.640443213061513E-10	0.257767908821620E-08
26	38	0.119882666420815E-07	-.678581016349119E-08	0.333777864709951E-08
26	41	0.155666581762386E-07	-.864502207199845E-08	
27	27	0.533361712946819E-07	0.374761197781070E-10	-.110709877119949E-10
27	30	0.420503056458652E-09	-.207881500108287E-09	0.108636647999159E-09
27	33	0.373856112150613E-09	-.209389807086161E-09	0.444740122702327E-10
27	36	0.138030120417007E-09	-.158853486449771E-08	-.676484715685965E-08
27	39	0.517607526805713E-08	-.201162718662658E-08	-.867539266479435E-08
27	42	0.638390085595077E-08		
28	28	0.137141630722544E-08	0.337173533545822E-09	-.101102316662012E-09
28	31	0.298745373701943E-10	0.940007086626404E-11	0.152529396891338E-10
28	34	0.281406800190488E-10	-.946980267680231E-11	-.141264724959238E-10

```
    28    37 0.320345340567026E-09 -.654388633214418E-10 0.605744631188751E-10
    28    40 0.251270010633915E-09 -.119715961371646E-09 0.771371967649272E-10
    29    29 0.226393695277604E-08 -.373937025261115E-09 0.117910349315979E-10
    29    32 0.176600010649858E-10 0.288975487632426E-10 -.402508399279566E-11
    29    35 0.265740521361828E-10 0.283907719684575E-10 0.155919067144401E-10
    29    38 0.435099832825309E-09 -.146440803834289E-10 0.105087108142935E-10
    29    41 0.398206647463740E-09 -.258852170642576E-10
    30    30 0.205705616093187E-08 0.153445568530766E-10 0.299178229740680E-10
    30    33 0.584233804926769E-10 -.410676901552668E-11 0.312505900330167E-10
    30    36 0.354748277204896E-10 0.210368860006281E-10 -.146027359833398E-10
    30    39 0.381223176697891E-09 0.231988350976552E-10 0.563146464199129E-10
    30    42 0.275455971527928E-09
    31    31 0.174648664752433E-08 -.278280054595684E-09 0.513386778656963E-10
    31    34 0.656221906025130E-10 0.225380704079245E-10 0.641244703341379E-12
    31    37 0.246492002896712E-09 0.447220022543768E-09 -.250967534024100E-09
    31    40 0.269905328546945E-09 0.494314090068937E-09 -.238484643502570E-09
    32    32 0.272778490080056E-08 -.467115863008461E-09 0.122100139049720E-11
    32    35 0.240958295930978E-10 0.276549455112009E-10 0.350674769624709E-10
    32    38 0.794086692744945E-10 0.957481203909777E-10 0.383838776704615E-10
    32    41 0.455269057992767E-10 0.156315192313113E-09
    33    33 0.175520157387425E-08 -.428605206915138E-10 0.288251670763640E-10
    33    36 0.509464933574411E-10 -.403603072521979E-10 -.490760372093698E-10
    33    39 0.361555424885669E-09 -.257090876481467E-10 -.161544691298434E-09
    33    42 0.504591468648305E-09
    34    34 0.176076918033670E-08 -.115520374231206E-09 0.909236751911759E-10
    34    37 0.168067866846967E-09 0.261192486560271E-09 -.202712203901278E-09
    34    40 0.234459353258490E-09 0.324589815770257E-09 -.254286896205432E-09
    35    35 0.225518667908285E-08 -.157809789115199E-09 0.175756147218383E-10
    35    38 0.167306062040404E-09 0.207456803123518E-10 -.182499827480256E-10
    35    41 0.198262441152702E-09 0.722757199370102E-10
    36    36 0.223617312976716E-08 -.324688905855721E-10 0.649153608834029E-10
    36    39 0.111157750249749E-09 -.803386273282263E-10 0.727195793547600E-10
    36    42 0.189783325790536E-09
    37    37 0.304507052672864E-07 0.735605100436777E-07 -.414158743891004E-07
    37    40 0.747568504787277E-09 0.109072538957946E-08 -.675222626871278E-09
    38    38 0.316669683405312E-06 -.178070804807553E-06 0.110280782647468E-08
    38    41 0.536412730085833E-08 -.290781163185221E-08
    39    39 0.123136713156563E-06 -.682219032791614E-09 -.292470718013967E-08
    39    42 0.237646684402882E-08
    40    40 0.523956884120618E-07 0.127017978258307E-06 -.718890725660321E-07
    41    41 0.539745959273326E-06 -.312430529689256E-06
    42    42 0.214593844074041E-06
-SOLUTION/MATRIX_ESTIMATE U COVA
*-----------------------------------------------------------------------------
+SOLUTION/MATRIX_APRIORI U COVA
    13    13 0.195732655451618E-08 0.147625170078564E-09 -.172778309493036E-25
    14    14 0.248889566009873E-08 -.130456906769360E-24
    15    15 0.252714172968485E-08
    16    16 0.181635211481201E-08 0.406736225706777E-09 -.620386800752971E-10
    17    17 0.251285133302652E-08 -.134789746534458E-09
    18    18 0.257543604193484E-08
    19    19 0.207925405020642E-08 0.190768066938047E-09 0.494716598903615E-26
    20    20 0.235871627304626E-08 -.137096581078290E-25
    21    21 0.245545342347542E-08
    22    22 0.101107786004798E-08 0.650164452449313E-09 -.197709280681118E-09
    23    23 0.385538598656888E-08 -.907979522892870E-09
```

```
    24    24 0.205297240541152E-08
    28    28 0.186295195947694E-08 0.245362551292634E-09 -.300120433491705E-10
    29    29 0.253251430432960E-08 -.917193656797560E-10
    30    30 0.253717296410298E-08
    31    31 0.195156206359720E-08 -.239657279146996E-09 0.787633535851579E-10
    32    32 0.283525529598526E-08 -.310411064079559E-09
    33    33 0.213340498475241E-08
    34    34 0.197643219433515E-08 -.171339851758812E-09 -.113380162069414E-10
    35    35 0.243096313158976E-08 0.338726436628962E-10
    36    36 0.249428031216543E-08
-SOLUTION/MATRIX_APRIORI U COVA
*-------------------------------------------------------------------------------
%ENDSNX
```

B. SINEX File NGSFTDV1302GA.snx

```
%=SNX 1.00 AUS 14:317:39420 AUS 13:054:00000 13:055:00000 C 00021 2 X
+FILE/REFERENCE
 DESCRIPTION        Terrestrial Survey Tie
 OUTPUT             SSC SINEX
 CONTACT            ____________________________________________
 SOFTWARE           axis version 1.07
 HARDWARE           ____________________________________________
 INPUT              Terrestrial Survey Solution
-FILE/REFERENCE
+FILE/COMMENT
* axis software by John Dawson Geoscience Australia
-FILE/COMMENT
+SITE/ID
 7080  A 40442M006 C MLRS mark 7080 1988    -104  0 54.7  30 40 49.0  2004.3
 7850  A 40442M008 C Mobile VLBI/SLR mark   -104  0 54.3  30 40 49.8  2004.2
 7851  A 40442M011 C SLR MARK 7851          -104  0 54.4  30 40 49.8  2004.2
 MDO1  A 40442M012 C GPS Mark 4011-S        -104  0 54.0  30 40 49.8  2004.5
 MARP  A --------- C GPS antenna ref pt     -104  0 54.0  30 40 49.8  2004.5
 LRSM  A --------- C McDonald LRS CRP       -104  0 54.7  30 40 48.9  2006.0
 7613  A 40442S017 C VLBA conv ref pt       -103 56 41.4  30 38  6.1  1606.4
-SITE/ID
+SITE/DATA
 7080  A    1 7080  A    1 13:054:00000 13:055:00000 --- 13:054:43200
 7850  A    1 7850  A    1 13:054:00000 13:055:00000 --- 13:054:43200
 7851  A    1 7851  A    1 13:054:00000 13:055:00000 --- 13:054:43200
 MDO1  A    1 MDO1  A    1 13:054:00000 13:055:00000 --- 13:054:43200
 MARP  A    1 MARP  A    1 13:054:00000 13:055:00000 --- 13:054:43200
 LRSM  A    1 LRSM  A    1 13:054:00000 13:055:00000 --- 13:054:43200
 7613  A    1 7613  A    1 13:054:00000 13:055:00000 --- 13:054:43200
-SITE/DATA
+SOLUTION/EPOCHS
 7080  A    1 C 13:054:00000 13:055:00000 13:054:43200
 7850  A    1 C 13:054:00000 13:055:00000 13:054:43200
 7851  A    1 C 13:054:00000 13:055:00000 13:054:43200
 MDO1  A    1 C 13:054:00000 13:055:00000 13:054:43200
 MARP  A    1 C 13:054:00000 13:055:00000 13:054:43200
 LRSM  A    1 C 13:054:00000 13:055:00000 13:054:43200
 7613  A    1 C 13:054:00000 13:055:00000 13:054:43200
-SOLUTION/EPOCHS
+SOLUTION/STATISTICS
 VARIANCE FACTOR                3.006080528474793e+00
 SQUARE SUM OF RESIDUALS        1.728496303873006e+03
 NUMBER OF OBSERVATIONS                           596
 NUMBER OF UNKNOWNS                                21
-SOLUTION/STATISTICS
+SOLUTION/ESTIMATE
     1 STAX   7080  A    1 13:054:43200 m    2 -1.33002126669162e+06 6.98682e-04
     2 STAY   7080  A    1 13:054:43200 m    2 -5.32840183472124e+06 4.17870e-04
     3 STAZ   7080  A    1 13:054:43200 m    2  3.23648071360483e+06 4.47997e-04
     4 STAX   7850  A    1 13:054:43200 m    2 -1.33000839182290e+06 5.27239e-04
     5 STAY   7850  A    1 13:054:43200 m    2 -5.32839155676364e+06 3.33524e-04
     6 STAZ   7850  A    1 13:054:43200 m    2  3.23650263526958e+06 4.29027e-04
     7 STAX   7851  A    1 13:054:43200 m    2 -1.33000966739691e+06 5.18661e-04
     8 STAY   7851  A    1 13:054:43200 m    2 -5.32839093726561e+06 3.17645e-04
```

```
     9 STAZ   7851  A    1 13:054:43200 m    2  3.23650314629408e+06 4.19835e-04
    10 STAX   MDO1  A    1 13:054:43200 m    2 -1.32999887058163e+06 5.28517e-04
    11 STAY   MDO1  A    1 13:054:43200 m    2 -5.32839335292019e+06 3.49294e-04
    12 STAZ   MDO1  A    1 13:054:43200 m    2  3.23650411790899e+06 4.70358e-04
    13 STAX   MARP  A    1 13:054:43200 m    2 -1.32999888319009e+06 5.28760e-04
    14 STAY   MARP  A    1 13:054:43200 m    2 -5.32839340344960e+06 3.54157e-04
    15 STAZ   MARP  A    1 13:054:43200 m    2  3.23650414882058e+06 4.71678e-04
    16 STAX   LRSM  A    1 13:054:43200 m    2 -1.33002182047926e+06 5.59847e-04
    17 STAY   LRSM  A    1 13:054:43200 m    2 -5.32840417912273e+06 3.70433e-04
    18 STAZ   LRSM  A    1 13:054:43200 m    2  3.23648009310967e+06 4.19348e-04
    19 STAX   7613  A    1 13:054:43200 m    2 -1.32400932452999e+06 1.08536e-03
    20 STAY   7613  A    1 13:054:43200 m    2 -5.33218193456772e+06 4.86091e-04
    21 STAZ   7613  A    1 13:054:43200 m    2  3.23196239398506e+06 8.45594e-04
-SOLUTION/ESTIMATE
+SOLUTION/MATRIX_ESTIMATE U COVA
     1     1  4.88156411812604e-07 -2.55754107801850e-07 -2.57531835276104e-07
     1     4  2.62262592081068e-07 -1.47342969382372e-07 -1.90307618870365e-07
     1     7  2.59750931419151e-07 -1.48038009162803e-07 -1.90885708746132e-07
     1    10  2.63097474844878e-07 -1.44090838754994e-07 -1.91728609688813e-07
     1    13  2.63118579908011e-07 -1.44082760592889e-07 -1.91706793953541e-07
     1    16  2.60866341182175e-07 -1.59634908861642e-07 -1.82593734869026e-07
     1    19  3.34196970778147e-07 -1.60790649215324e-07 -8.40333995352474e-08
     2     2  1.74615658201882e-07  1.57140528585403e-07 -1.60483556760631e-07
     2     5  1.03638182665678e-07  1.31451180863819e-07 -1.60966914257162e-07
     2     8  1.00800861704582e-07  1.31815486947122e-07 -1.61047280960529e-07
     2    11  1.01427110159700e-07  1.32392250524256e-07 -1.61061552386006e-07
     2    14  1.01421677885405e-07  1.32377547984772e-07 -1.59604891773990e-07
     2    17  1.11957988466191e-07  1.26269581301032e-07 -2.23969202589123e-07
     2    20  1.02799011296489e-07  4.82675814077777e-08
     3     3  2.00701633398208e-07 -1.85056768069961e-07  1.17221587637496e-07
     3     6  1.66338308091284e-07 -1.85640436123043e-07  1.17750632273818e-07
     3     9  1.63499669917371e-07 -1.85733431379861e-07  1.14556768086091e-07
     3    12  1.67454867173751e-07 -1.85750572527193e-07  1.14550192689145e-07
     3    15  1.67437125191366e-07 -1.84034175639715e-07  1.27266376383773e-07
     3    18  1.60105169390709e-07 -2.68731982640977e-07  1.20928691610498e-07
     3    21  5.26826328852014e-08
     4     4  2.77980785843199e-07 -1.49933929181048e-07 -1.93245724975957e-07
     4     7  2.61685904441460e-07 -1.49133754522779e-07 -1.92431701660740e-07
     4    10  2.65059729935339e-07 -1.45097354428457e-07 -1.93308468746257e-07
     4    13  2.65081157518382e-07 -1.45089153814630e-07 -1.93286321258749e-07
     4    16  2.62797309475171e-07 -1.60880025333374e-07 -1.84036202421433e-07
     4    19  3.37874337123645e-07 -1.61674147684444e-07 -8.34540190083492e-08
     5     5  1.11238244065968e-07  1.20425561804688e-07 -1.48928089247482e-07
     5     8  9.40816209215265e-08  1.21366713494703e-07 -1.48858019011021e-07
     5    11  9.53353382181337e-08  1.21679835960620e-07 -1.48869604382538e-07
     5    14  9.53309231669552e-08  1.21667892121381e-07 -1.47631883625282e-07
     5    17  1.03852118988203e-07  1.16671223096744e-07 -1.87578084033391e-07
     5    20  1.01772040075287e-07  6.52472152776935e-08
     6     6  1.84064302921537e-07 -1.92420626807788e-07  1.21544132238785e-07
     6     9  1.69306000136688e-07 -1.92600169384300e-07  1.18003707020218e-07
     6    12  1.73404681558487e-07 -1.92618759166048e-07  1.17996582834552e-07
     6    15  1.73385451463064e-07 -1.90781159460246e-07  1.31797651800898e-07
     6    18  1.65452025654806e-07 -2.87951812701277e-07  1.21929006931260e-07
     6    21  4.43823216247932e-08
     7     7  2.69009663232013e-07 -1.49661049874772e-07 -1.92986790409163e-07
     7    10  2.62530147654969e-07 -1.45637042873395e-07 -1.93854576431324e-07
```

```
     7    13  2.62551492650911e-07 -1.45628876387757e-07 -1.93832518426856e-07
     7    16  2.60284101015461e-07 -1.61361927414508e-07 -1.84623987392203e-07
     7    19  3.36777149028915e-07 -1.61147552094705e-07 -8.30005755863747e-08
     8     8  1.00898284455542e-07  1.22010435534963e-07 -1.49605842514606e-07
     8    11  9.22454019630867e-08  1.22350923249832e-07 -1.49617773433658e-07
     8    14  9.22408418045448e-08  1.22338601227820e-07 -1.48334994804333e-07
     8    17  1.01021317289257e-07  1.17182842664469e-07 -1.87658638655128e-07
     8    20  1.01518624752870e-07  6.44321391590479e-08
     9     9  1.76261069888329e-07 -1.93158440726131e-07  1.18499836895917e-07
     9    12  1.70499313238619e-07 -1.93176857362215e-07  1.18492786361899e-07
     9    15  1.70480274181195e-07 -1.91354728511185e-07  1.32158557860299e-07
     9    18  1.62622197439878e-07 -2.87253896352012e-07  1.21452217612140e-07
     9    21  4.39451720198347e-08
    10    10  2.79330527356976e-07 -1.43375540459417e-07 -1.92521967710188e-07
    10    13  2.65936188688864e-07 -1.45518118912277e-07 -1.94030702741803e-07
    10    16  2.63637090524203e-07 -1.61447218338884e-07 -1.84704132793560e-07
    10    19  3.40342674352207e-07 -1.61772715448669e-07 -8.23464147894722e-08
    11    11  1.22006327657238e-07  1.35493893834175e-07 -1.45537228426675e-07
    11    14  9.36659509021835e-08  1.18729991577389e-07 -1.44359840880870e-07
    11    17  1.01626989889838e-07  1.14041735803520e-07 -1.77410317711707e-07
    11    20  1.01567830512584e-07  7.01051566740974e-08
    12    12  2.21236940382103e-07 -1.94071909620998e-07  1.18733938681481e-07
    12    15  1.74606004443119e-07 -1.92209479583952e-07  1.32743965771302e-07
    12    18  1.66555313884330e-07 -2.91483230211447e-07  1.22314534774180e-07
    12    21  4.31555863069494e-08
    13    13  2.79587397061863e-07 -1.42522192164273e-07 -1.93041911461306e-07
    13    16  2.63658320493508e-07 -1.61461578161500e-07 -1.84721051467745e-07
    13    19  3.40405784455028e-07 -1.61774974008043e-07 -8.23177154641370e-08
    14    14  1.25427167107176e-07  1.33378585437211e-07 -1.44351715445298e-07
    14    17  1.01621524140945e-07  1.14035244677300e-07 -1.77386412727158e-07
    14    20  1.01566861698020e-07  7.01159057640377e-08
    15    15  2.22480142451433e-07 -1.92187535612021e-07  1.32729172446982e-07
    15    18  1.66537800423012e-07 -2.91418405324170e-07  1.22312029609714e-07
    15    21  4.31848664754087e-08
    16    16  3.13428660303802e-07 -1.39361025232550e-07 -1.98241199663313e-07
    16    19  3.35922235752150e-07 -1.60797626258481e-07 -8.31692309287554e-08
    17    17  1.37220551881514e-07  1.15301662338858e-07 -2.25168059801809e-07
    17    20  1.02831032445090e-07  4.77057187991964e-08
    18    18  1.75853093014074e-07 -2.65742666833708e-07  1.20813949241311e-07
    18    21  5.40340036175273e-08
    19    19  1.17801332796094e-06 -4.44937067668510e-08  4.72699304401753e-07
    20    20  2.36284028391105e-07  2.83896238819632e-07
    21    21  7.15028884130605e-07
-SOLUTION/MATRIX_ESTIMATE U COVA
%ENDSNX
```

C. IERS ITRS Product Center SINEX File

```
%=SNX 1.00 IGN 13:72:00000 IGN 13:054:00000 00:000:00000 C 66 2 X V
*------------------------------------------------------------------------------
+FILE/REFERENCE
 DESCRIPTION       IGN/ENSG/LAREG: IERS ITRS Product Center
 OUTPUT            ITRF2008 station positions and velocities
 CONTACT           Zuheir Altamimi (altamimi@ensg.ign.fr)
 SOFTWARE          CATREF
 INPUT             ITRF2008 solution

-FILE/REFERENCE
*------------------------------------------------------------------------------
+FILE/COMMENT
*
*
*
-FILE/COMMENT
*------------------------------------------------------------------------------
+SITE/ID
*CODE PT __DOMES__ T _STATION DESCRIPTION__ APPROX_LON_ APPROX_LAT_ _APP_H_
 7613  A 40442S017  FD-VLBA  VLBA at Ft. D  256  3 18.6  30 38  6.1   999.9
 MDO1  A 40442M012  Fort Davis, USA         255 59  6.0  30 40 49.8   999.9
 7216  A 40442S003  HRAS 085 HRAS at Fort   256  3  9.8  30 38 12.2   999.9
 7080  A 40442M006  7080                    255 59  5.2  30 40 48.9   999.9
 7850  A 40442M008  7850                    255 59  5.6  30 40 49.7   999.9
-SITE/ID
*------------------------------------------------------------------------------
+SOLUTION/ESTIMATE
*INDEX TYPE__ CODE PT SOLN _REF_EPOCH__ UNIT S __ESTIMATED VALUE____ _STD_DEV___
     1 STAX   7080  A    1 13:054:00000 m    2 -.133002127455559E+07  .20917E-02
     2 STAY   7080  A    1 13:054:00000 m    2 -.532840185289888E+07  .20359E-02
     3 STAZ   7080  A    1 13:054:00000 m    2  .323648070662388E+07  .18306E-02
     4 VELX   7080  A    1 13:054:00000 m/y  2 -.128216233419829E-01  .10308E-03
     5 VELY   7080  A    1 13:054:00000 m/y  2  .424185096156960E-03  .11132E-03
     6 VELZ   7080  A    1 13:054:00000 m/y  2 -.510775811309969E-02  .98380E-04
     7 STAX   7080  A    2 13:054:00000 m    2 -.133002127398811E+07  .15008E-02
     8 STAY   7080  A    2 13:054:00000 m    2 -.532840184645767E+07  .15688E-02
     9 STAZ   7080  A    2 13:054:00000 m    2  .323648070187816E+07  .13359E-02
    10 VELX   7080  A    2 13:054:00000 m/y  2 -.128216341587632E-01  .10307E-03
    11 VELY   7080  A    2 13:054:00000 m/y  2  .424621146984245E-03  .11131E-03
    12 VELZ   7080  A    2 13:054:00000 m/y  2 -.510806403226784E-02  .98367E-04
    13 STAX   7080  A    3 13:054:00000 m    2 -.133002127059944E+07  .12160E-02
    14 STAY   7080  A    3 13:054:00000 m    2 -.532840183935605E+07  .13538E-02
    15 STAZ   7080  A    3 13:054:00000 m    2  .323648069865500E+07  .10810E-02
    16 VELX   7080  A    3 13:054:00000 m/y  2 -.128217306132677E-01  .10311E-03
    17 VELY   7080  A    3 13:054:00000 m/y  2  .424418517898463E-03  .11134E-03
    18 VELZ   7080  A    3 13:054:00000 m/y  2 -.510778276043627E-02  .98403E-04
    19 STAX   7080  A    4 13:054:00000 m    2 -.133002127056555E+07  .10732E-02
    20 STAY   7080  A    4 13:054:00000 m    2 -.532840183415762E+07  .12559E-02
    21 STAZ   7080  A    4 13:054:00000 m    2  .323648069897962E+07  .96465E-03
    22 VELX   7080  A    4 13:054:00000 m/y  2 -.128217518314011E-01  .10314E-03
    23 VELY   7080  A    4 13:054:00000 m/y  2  .424426389735563E-03  .11137E-03
    24 VELZ   7080  A    4 13:054:00000 m/y  2 -.510776412770957E-02  .98441E-04
```

```
    25 STAX   7850  A    1 13:054:00000 m    2 -.133000840361472E+07  .26203E-02
    26 STAY   7850  A    1 13:054:00000 m    2 -.532839158221684E+07  .25317E-02
    27 STAZ   7850  A    1 13:054:00000 m    2  .323650263544556E+07  .22493E-02
    28 VELX   7850  A    1 13:054:00000 m/y  2 -.128217518755008E-01  .10318E-03
    29 VELY   7850  A    1 13:054:00000 m/y  2  .424427282228451E-03  .11141E-03
    30 VELZ   7850  A    1 13:054:00000 m/y  2 -.510776413930612E-02  .98480E-04
    31 STAX   MDO1  A    1 13:054:00000 m    2 -.132999887645687E+07  .77957E-03
    32 STAY   MDO1  A    1 13:054:00000 m    2 -.532839338138402E+07  .12922E-02
    33 STAZ   MDO1  A    1 13:054:00000 m    2  .323650412509909E+07  .99114E-03
    34 VELX   MDO1  A    1 13:054:00000 m/y  2 -.126398972598356E-01  .42871E-04
    35 VELY   MDO1  A    1 13:054:00000 m/y  2 -.674836104933762E-03  .88634E-04
    36 VELZ   MDO1  A    1 13:054:00000 m/y  2 -.424347156928850E-02  .64727E-04
    37 STAX   MDO1  A    2 13:054:00000 m    2 -.132999887691320E+07  .75825E-03
    38 STAY   MDO1  A    2 13:054:00000 m    2 -.532839337320708E+07  .12062E-02
    39 STAZ   MDO1  A    2 13:054:00000 m    2  .323650412294403E+07  .94621E-03
    40 VELX   MDO1  A    2 13:054:00000 m/y  2 -.126399446778092E-01  .42875E-04
    41 VELY   MDO1  A    2 13:054:00000 m/y  2 -.674801108166993E-03  .88636E-04
    42 VELZ   MDO1  A    2 13:054:00000 m/y  2 -.424343103414880E-02  .64730E-04
    43 STAX   MDO1  A    3 13:054:00000 m    2 -.132999887628362E+07  .74842E-03
    44 STAY   MDO1  A    3 13:054:00000 m    2 -.532839336799747E+07  .11634E-02
    45 STAZ   MDO1  A    3 13:054:00000 m    2  .323650412061806E+07  .92450E-03
    46 VELX   MDO1  A    3 13:054:00000 m/y  2 -.126399817127938E-01  .42880E-04
    47 VELY   MDO1  A    3 13:054:00000 m/y  2 -.674774089323787E-03  .88638E-04
    48 VELZ   MDO1  A    3 13:054:00000 m/y  2 -.424339938186388E-02  .64733E-04
    49 STAX   MDO1  A    4 13:054:00000 m    2 -.132999887652904E+07  .74886E-03
    50 STAY   MDO1  A    4 13:054:00000 m    2 -.532839336522607E+07  .11658E-02
    51 STAZ   MDO1  A    4 13:054:00000 m    2  .323650411912180E+07  .92550E-03
    52 VELX   MDO1  A    4 13:054:00000 m/y  2 -.126399803787968E-01  .42885E-04
    53 VELY   MDO1  A    4 13:054:00000 m/y  2 -.674773608568127E-03  .88641E-04
    54 VELZ   MDO1  A    4 13:054:00000 m/y  2 -.424339347939629E-02  .64736E-04
    55 STAX   7216  A    1 13:054:00000 m    2 -.132421120289534E+07  .11823E-02
    56 STAY   7216  A    1 13:054:00000 m    2 -.533202313429983E+07  .19553E-02
    57 STAZ   7216  A    1 13:054:00000 m    2  .323211828071802E+07  .14703E-02
    58 VELX   7216  A    1 13:054:00000 m/y  2 -.126619959048342E-01  .51526E-04
    59 VELY   7216  A    1 13:054:00000 m/y  2  .339720116768070E-03  .84920E-04
    60 VELZ   7216  A    1 13:054:00000 m/y  2 -.467559096977887E-02  .69109E-04
    61 STAX   7613  A    1 13:054:00000 m    2 -.132400932964000E+07  .10285E-02
    62 STAY   7613  A    1 13:054:00000 m    2 -.533218195235932E+07  .12964E-02
    63 STAZ   7613  A    1 13:054:00000 m    2  .323196239330983E+07  .10389E-02
    64 VELX   7613  A    1 13:054:00000 m/y  2 -.126619694292345E-01  .51516E-04
    65 VELY   7613  A    1 13:054:00000 m/y  2  .339734294480741E-03  .84915E-04
    66 VELZ   7613  A    1 13:054:00000 m/y  2 -.467553719056606E-02  .69102E-04
-SOLUTION/ESTIMATE
*-----------------------------------------------------------------------------
+SOLUTION/MATRIX_ESTIMATE L COVA
*PARA1 PARA2 ____PARA2+0__________ ____PARA2+1__________ ____PARA2+2__________
     1     1  .437527020116749E-05
     2     1 -.114085302364021E-06  .414495760794196E-05
     3     1 -.558531624448412E-08  .289067879415856E-06  .335115421193851E-05
     4     1  .197790196467859E-06 -.170737370339164E-08 -.116013370246259E-09
     4     4  .106268775696014E-07
     5     1 -.487818195537397E-08  .204042854069202E-06  .897087275141673E-08
     5     4  .136173127972568E-09  .123921988283807E-07
     6     1  .124702251087332E-08  .116589915977539E-07  .167685835241521E-06
     6     4 -.208206994368945E-09 -.609913776529108E-09  .967864960978131E-08
     7     1  .297080147091354E-05 -.215285291614532E-07 -.597187217068790E-07
```

7	4	.138075932969294E-06	-.458434921793602E-09	-.161791167318049E-08
7	7	.225267794862808E-05		
8	1	-.241949633532111E-07	.303323065764957E-05	-.768384447995985E-07
8	4	.168973956303928E-08	.156403569062251E-06	-.393832477484864E-08
8	7	.218845323844095E-07	.246126500777170E-05	
9	1	-.582953813937395E-07	-.649399055878587E-07	.231787478483386E-05
9	4	-.239779027265573E-08	-.510324818759981E-08	.123067610652978E-06
9	7	-.890415674535487E-07	-.243532133772880E-06	.178473415597832E-05
10	1	.197698579571350E-06	-.170882205179937E-08	-.115423027703173E-09
10	4	.106221791402200E-07	.136136792153032E-09	-.208199713424432E-09
10	7	.138116284828907E-06	.168917987410389E-08	-.239767157255480E-08
10	10	.106252480430017E-07		
11	1	-.488160999310428E-08	.203946539443141E-06	.897875307849706E-08
11	4	.136023780009040E-09	.123872692599905E-07	-.609527474558636E-09
11	7	-.460708169194343E-09	.156440712826386E-06	-.509824224069148E-08
11	10	.135987310887688E-09	.123901066406656E-07	
12	1	.124858983505014E-08	.116681792744900E-07	.167585534194162E-06
12	4	-.208139078360315E-09	-.609422253474640E-09	.967347988479457E-08
12	7	-.161703047762415E-08	-.393193982795881E-08	.123101807471914E-06
12	10	-.208131693242169E-09	-.609035490113656E-09	.967607698588432E-08
13	1	.209572954366820E-05	.530580785773551E-07	-.104042862812280E-06
13	4	.936290636124185E-07	.394435521747996E-08	-.425149838885321E-08
13	7	.159281405097777E-05	.842257920328502E-07	-.124269574022231E-06
13	10	.936552275535895E-07	.394270329486919E-08	-.425091154974213E-08
13	13	.147874602403133E-05		
14	1	.390438434765270E-07	.233249797858466E-05	-.297878330541349E-06
14	4	.489947658703237E-08	.120769063051748E-06	-.157653219547600E-07
14	7	.738827721396999E-07	.193540168921924E-05	-.415604820986060E-06
14	10	.489954394208044E-08	.120793384904790E-06	-.157612027705688E-07
14	13	.946985497665250E-07	.183282107388165E-05	
15	1	-.977597746560599E-07	-.273634594087934E-06	.165369677825845E-05
15	4	-.449146700552807E-08	-.156174714914345E-07	.884794164859557E-07
15	7	-.120237822857970E-06	-.403763070114333E-06	.128141586683392E-05
15	10	-.449167065157679E-08	-.156146591009914E-07	.885011315875788E-07
15	13	-.129085563043380E-06	-.428601099758858E-06	.116863546954362E-05
16	1	.197692199650779E-06	-.170862125177703E-08	-.115293895885472E-09
16	4	.106218530467084E-07	.136154109257457E-09	-.208195751406046E-09
16	7	.138111944090846E-06	.168936690145739E-08	-.239758883934823E-08
16	10	.106249218452051E-07	.136004624074287E-09	-.208127723034475E-09
16	13	.937169787259239E-07	.489972000461107E-08	-.449156037612849E-08
16	16	.106323642477284E-07		
17	1	-.488142948714508E-08	.203939965131642E-06	.897949647809853E-08
17	4	.136028303739792E-09	.123869329121394E-07	-.609491517114305E-09
17	7	-.460546710738499E-09	.156436259769713E-06	-.509774342579481E-08
17	10	.135991831410241E-09	.123897701636130E-07	-.608999497229005E-09
17	13	.394276165937607E-08	.120855249640814E-06	-.156144535841507E-07
17	16	.136009119314809E-09	.123972021670382E-07	
18	1	.124870281799039E-08	.116690933574045E-07	.167578921244838E-06
18	4	-.208133449688475E-09	-.609375704195237E-09	.967313541612871E-08
18	7	-.161696877176501E-08	-.393130882977912E-08	.123097265343698E-06
18	10	-.208126057327736E-09	-.608988904746058E-09	.967573238346737E-08
18	13	-.425069397897685E-08	-.157607461541170E-07	.885632533352850E-07
18	16	-.208122056880559E-09	-.608952747366015E-09	.968315622868928E-08
19	1	.155136970780320E-05	.984393568105853E-07	-.137105392555901E-06
19	4	.659569962480822E-07	.696125840810770E-08	-.626310072782228E-08
19	7	.122299761610453E-05	.119344128506166E-06	-.147369455281338E-06

19	10	.659743280252452E-07	.695994983694942E-08	-.626277472086107E-08
19	13	.982674187924524E-06	.135570359981455E-06	-.158373250333205E-06
19	16	.660146027093778E-07	.696015179842261E-08	-.626305289083018E-08
19	19	.115180991321953E-05		
20	1	.767539018775336E-07	.189691285453731E-05	-.436905640590140E-06
20	4	.648466901756857E-08	.984987648714098E-07	-.232252136430805E-07
20	7	.101638878565162E-06	.164129385911081E-05	-.511865406862435E-06
20	10	.648507181384028E-08	.985150540917911E-07	-.232224881348115E-07
20	13	.128170940927850E-06	.145250938500124E-05	-.566993938036626E-06
20	16	.648520275369691E-08	.985552873464731E-07	-.232221988322337E-07
20	19	.133989443606523E-06	.157752978143868E-05	
21	1	-.125505197461498E-06	-.401598284261937E-06	.123503898849220E-05
21	4	-.603732791658893E-08	-.221471140650018E-07	.665593902606136E-07
21	7	-.139037047656681E-06	-.489133930432745E-06	.993441272503192E-06
21	10	-.603780356398455E-08	-.221456579030643E-07	.665732688958889E-07
21	13	-.154038875459359E-06	-.556321322479917E-06	.805801666987761E-06
21	16	-.603798928371153E-08	-.221454490129151E-07	.666133015770257E-07
21	19	-.152493813205532E-06	-.499846393792660E-06	.930553915214963E-06
22	1	.197690015042668E-06	-.170849416151353E-08	-.115288328454508E-09
22	4	.106217390253837E-07	.136162722477758E-09	-.208195426280343E-09
22	7	.138110460019117E-06	.168947378718551E-08	-.239758206566678E-08
22	10	.106248077872919E-07	.136013237010983E-09	-.208127396249417E-09
22	13	.937159982291909E-07	.489979989986870E-08	-.449155478835954E-08
22	16	.106322501022814E-07	.136017727344150E-09	-.208121723435227E-09
22	19	.660560079505384E-07	.648526917381757E-08	-.603818514859898E-08
22	22	.106399047193629E-07		
23	1	-.488123716960908E-08	.203937665771649E-06	.897973937466552E-08
23	4	.136036369521199E-09	.123868119869031E-07	-.609478066421280E-09
23	7	-.460391203353458E-09	.156434711322623E-06	-.509758631738721E-08
23	10	.135999897729475E-09	.123896491918928E-07	-.608986034135585E-09
23	13	.394286875936726E-08	.120854240152579E-06	-.156143667049038E-07
23	16	.136017180757385E-09	.123970810634537E-07	-.608939226527745E-09
23	19	.696037786560519E-08	.985966457143022E-07	-.221453491519763E-07
23	22	.136025783726761E-09	.124047286767441E-07	
24	1	.124863884330716E-08	.116694448156273E-07	.167576698408619E-06
24	4	-.208136812313452E-09	-.609356995226695E-09	.967301892523094E-08
24	7	-.161701941257310E-08	-.393106850119883E-08	.123095737087024E-06
24	10	-.208129418979839E-09	-.608970182600520E-09	.967561584728044E-08
24	13	-.425071719239514E-08	-.157605779534221E-07	.885622636069021E-07
24	16	-.208125411878794E-09	-.608933967466387E-09	.968303955575752E-08
24	19	-.626339097175590E-08	-.232220561880124E-07	.666545604843804E-07
24	22	-.208125071456212E-09	-.608920386876485E-09	.969069159388786E-08
25	1	.407338371458723E-05	-.898765822437977E-07	-.168782901890785E-07
25	4	.190712383369453E-06	-.430464931698726E-08	.104845410397757E-08
25	7	.288991247984652E-05	-.188930643183585E-07	-.600626875186618E-07
25	10	.190770764830445E-06	-.430740041955135E-08	.104953580562059E-08
25	13	.203873536089143E-05	.432429563018909E-07	-.990361045339660E-07
25	16	.190919617973819E-06	-.430718124739448E-08	.104961233264510E-08
25	19	.151533526852846E-05	.795874710847351E-07	-.125910091211968E-06
25	22	.191072513863181E-06	-.430695065824846E-08	.104951959452813E-08
25	25	.686617598555459E-05		
26	1	-.856088420756216E-07	.391830398069250E-05	.168545029547271E-06
26	4	-.898054393978306E-09	.199034479190029E-06	.829711953444313E-08
26	7	-.126423227775076E-07	.297707458614644E-05	-.104284097213777E-06
26	10	-.899068490891944E-09	.199088408487569E-06	.830537858079167E-08
26	13	.600411644505269E-07	.229354605182264E-05	-.301501779494320E-06

26	16	-.898851464759319E-09	.199237082985084E-06	.830636731805406E-08
26	19	.103599510535282E-06	.187334186578676E-05	-.419247102725558E-06
26	22	-.898695990925318E-09	.199389923491976E-06	.830673792539147E-08
26	25	-.270624331047995E-06	.640957910713367E-05	
27	1	-.186106409538635E-07	.174449980416766E-06	.317024098816160E-05
27	4	-.309826753374769E-09	.565526670661206E-08	.164568202172786E-06
27	7	-.618595411100926E-07	-.115407482308527E-06	.228371884253894E-05
27	10	-.309483913097151E-09	.566224070156249E-08	.164619004026850E-06
27	13	-.105950457937994E-06	-.325837725296748E-06	.163065854248882E-05
27	16	-.309357043234387E-09	.566311116701823E-08	.164767445614055E-06
27	19	-.138589782385397E-06	-.455382637133464E-06	.122228479145987E-05
27	22	-.309355917979480E-09	.566342159211723E-08	.164920210073001E-06
27	25	.108937115389844E-06	.875947912241637E-06	.505958398127101E-05
28	1	.197689999160244E-06	-.170861292374042E-08	-.115168352168813E-09
28	4	.106217366295343E-07	.136151603792301E-09	-.208185877054505E-09
28	7	.138110436706653E-06	.168934777154109E-08	-.239747011609499E-08
28	10	.106248053910047E-07	.136002118026220E-09	-.208117846954433E-09
28	13	.937159672269907E-07	.489966743116339E-08	-.449144998841650E-08
28	16	.106322477062230E-07	.136006608538848E-09	-.208112173692121E-09
28	19	.660559708166956E-07	.648513308130867E-08	-.603808544841935E-08
28	22	.106399023234082E-07	.136014665022534E-09	-.208115521479945E-09
28	25	.191227498110500E-06	-.898778404269187E-09	-.309240260588906E-09
28	28	.106476687796417E-07		
29	1	-.488118950746913E-08	.203937628020481E-06	.897992798182573E-08
29	4	.136038805204833E-09	.123868063880342E-07	-.609465558286916E-09
29	7	-.460360469063574E-09	.156434650023462E-06	-.509743088233060E-08
29	10	.136002333584941E-09	.123896435928312E-07	-.608973525381364E-09
29	13	.394288694204452E-08	.120854157138931E-06	-.156142398999907E-07
29	16	.136019617702643E-09	.123970754655348E-07	-.608926715324380E-09
29	19	.696039007959288E-08	.985965487160245E-07	-.221452404193307E-07
29	22	.136028221237615E-09	.124047230794007E-07	-.608907874399770E-09
29	25	-.430686085863706E-08	.199544962977590E-06	.566364061596241E-08
29	28	.136017102547420E-09	.124124863342416E-07	
30	1	.124855580075072E-08	.116691716240791E-07	.167576783048647E-06
30	4	-.208143199669075E-09	-.609378940892080E-09	.967302794961172E-08
30	7	-.161709609521074E-08	-.393133174004964E-08	.123095841411096E-06
30	10	-.208135806899569E-09	-.608992129068974E-09	.967562487119912E-08
30	13	-.425078933311045E-08	-.157608345302091E-07	.885623832290791E-07
30	16	-.208131800532729E-09	-.608955914641154E-09	.968304857821354E-08
30	19	-.626346282944678E-08	-.232223082999980E-07	.666546901858470E-07
30	22	-.208131460473510E-09	-.608942334377698E-09	.969070061553178E-08
30	25	.104940757601816E-08	.830646075753571E-08	.165075253232081E-06
30	28	-.208121910460452E-09	-.608929821844364E-09	.969847848934398E-08
31	1	.105951001378669E-06	.103747401217598E-07	-.201067795882602E-07
31	4	.107779960429135E-07	.854839799181341E-08	-.627215885935049E-08
31	7	.106351306580844E-06	.108307210605684E-07	-.176463441285964E-07
31	10	.107768623423387E-07	.854765090919846E-08	-.627206774754847E-08
31	13	.100529916305096E-06	.887973554419313E-08	-.182902265969020E-07
31	16	.107767907733896E-07	.854758840575626E-08	-.627203079939828E-08
31	19	.977581957543587E-07	.587453615638899E-08	-.186752553819340E-07
31	22	.107767755082186E-07	.854758009084326E-08	-.627203526322662E-08
31	25	.111110569054053E-06	.122113810501851E-07	-.193842970778113E-07
31	28	.107767453153948E-07	.854757507543409E-08	-.627207938622474E-08
31	31	.607742281919849E-06		
32	1	.350496319128727E-06	.804426809758410E-06	-.497813895516084E-06
32	4	.151801006981800E-07	.557521126325907E-07	-.325632159489274E-07

32	7	.355111141554271E-06	.801602353914038E-06	-.489745989748772E-06
32	10	.151811883433582E-07	.557508700269234E-07	-.325628852118563E-07
32	13	.364227660021518E-06	.792738706126308E-06	-.489044876602355E-06
32	16	.151812603177803E-07	.557508036066365E-07	-.325628244356190E-07
32	19	.369882995074544E-06	.792092151268906E-06	-.487453297385819E-06
32	22	.151813005652527E-07	.557508352018581E-07	-.325628183326253E-07
32	25	.350662393522228E-06	.808662788341572E-06	-.498583355439174E-06
32	28	.151811662321451E-07	.557507432637505E-07	-.325630457541765E-07
32	31	.322198284059122E-06	.167002712491352E-05	
33	1	-.173806388054113E-06	-.658404034742293E-06	.523559538114447E-06
33	4	-.891427126985002E-08	-.357890718924833E-07	.305305224228096E-07
33	7	-.175405233735986E-06	-.661446742254025E-06	.517491044268162E-06
33	10	-.891507789025875E-08	-.357899612015872E-07	.305290317134837E-07
33	13	-.180571869654981E-06	-.668792309051038E-06	.505428284659239E-06
33	16	-.891512551032043E-08	-.357900008128866E-07	.305289104973392E-07
33	19	-.185462037545782E-06	-.675063542990157E-06	.496795943331850E-06
33	22	-.891515156210001E-08	-.357900417682465E-07	.305288951293092E-07
33	25	-.172990366107652E-06	-.656134646629364E-06	.528516341692627E-06
33	28	-.891504989159733E-08	-.357899597870227E-07	.305290433014243E-07
33	31	-.328304572702318E-07	-.722338771668415E-06	.982373297645792E-06
34	1	.132119739718965E-07	.904120273081603E-08	-.554148155808987E-08
34	4	.107110001155766E-08	.674081552533890E-09	-.451096211128813E-09
34	7	.123945470948118E-07	.876884324579387E-08	-.555788846054010E-08
34	10	.107102357429367E-08	.674031481051661E-09	-.451076719321375E-09
34	13	.113555070825154E-07	.845625890082550E-08	-.568272270634111E-08
34	16	.107101651433524E-08	.674023273524994E-09	-.451074702198716E-09
34	19	.108593745335957E-07	.796046354701522E-08	-.582252005853145E-08
34	22	.107101712109187E-08	.674021428802921E-09	-.451075005013864E-09
34	25	.135839653870952E-07	.918207723139339E-08	-.551765922238660E-08
34	28	.107101553043927E-08	.674021110389626E-09	-.451078814391687E-09
34	31	.211758507801696E-07	.202051879400506E-07	-.106074316593013E-07
34	34	.183794220948449E-08		
35	1	.130069270851570E-07	.572973161232280E-07	-.323520791285255E-07
35	4	.118736863126212E-08	.475197364302232E-08	-.266741410052667E-08
35	7	.138496867884490E-07	.564475753643426E-07	-.317682421094106E-07
35	10	.118744084552458E-08	.475189872013075E-08	-.266737352494809E-08
35	13	.147386858515622E-07	.553439771106687E-07	-.317957082065382E-07
35	16	.118745078435931E-08	.475188774853691E-08	-.266736931455722E-08
35	19	.156836868148738E-07	.547772435038020E-07	-.318162926835155E-07
35	22	.118745449754136E-08	.475188729642280E-08	-.266736886019636E-08
35	25	.130458163275504E-07	.576649929364258E-07	-.324913500420046E-07
35	28	.118744321079713E-08	.475188002776705E-08	-.266738786560709E-08
35	31	.207885895747947E-07	.953750316970205E-07	-.506275653950041E-07
35	34	.163618704987237E-08	.785605308049587E-08	
36	1	-.711116521383303E-08	-.340084892277469E-07	.326958137824238E-07
36	4	-.699147812964623E-09	-.296198723539523E-08	.271764020924101E-08
36	7	-.776237821470935E-08	-.346442870280352E-07	.317001616100635E-07
36	10	-.699202213511756E-09	-.296205446229874E-08	.271752644929029E-08
36	13	-.839138276667242E-08	-.355352486094437E-07	.303228468382057E-07
36	16	-.699207953859728E-09	-.296205824460428E-08	.271751537138963E-08
36	19	-.902695773639415E-08	-.361345135204138E-07	.294453558102911E-07
36	22	-.699208680822764E-09	-.296205905278346E-08	.271751307612930E-08
36	25	-.709835861246650E-08	-.338158881827414E-07	.331809403939304E-07
36	28	-.699200112327417E-09	-.296205199695522E-08	.271752564140444E-08
36	31	-.111437466042464E-07	-.509117768864737E-07	.489512898609103E-07
36	34	-.884012264128733E-09	-.418378481159956E-08	.418959370157575E-08

37	1	.104240353515809E-06	.821332288619571E-08	-.196784832774166E-07
37	4	.106888103206808E-07	.841071540699155E-08	-.623848449584890E-08
37	7	.105355914508049E-06	.946528556272203E-08	-.174572070815465E-07
37	10	.106877036735690E-07	.841002021245790E-08	-.623843270191529E-08
37	13	.999704151996831E-07	.801327115778384E-08	-.182845455566726E-07
37	16	.106876364902690E-07	.840996503885616E-08	-.623840163001703E-08
37	19	.975014772767218E-07	.534849660985750E-08	-.187996491088604E-07
37	22	.106876227553352E-07	.840995944368856E-08	-.623840795222234E-08
37	25	.109493505180718E-06	.101165449705407E-07	-.189312644446617E-07
37	28	.106875925702375E-07	.840995440737740E-08	-.623845198878513E-08
37	31	.581232007587449E-06	.280441817546792E-06	-.804096593381274E-08
37	34	.192378129672360E-07	.177151278814305E-07	-.929657181366740E-08
37	37	.574946321936724E-06		
38	1	.347596564309981E-06	.794851056665355E-06	-.496067274878975E-06
38	4	.150431961435954E-07	.551743420650517E-07	-.324356936583302E-07
38	7	.353071226082297E-06	.795643390944184E-06	-.488871888991904E-06
38	10	.150443347169871E-07	.551733147984796E-07	-.324355185682381E-07
38	13	.362656151170952E-06	.789075976167812E-06	-.488856355488693E-06
38	16	.150444137420876E-07	.551732797282399E-07	-.324354799564429E-07
38	19	.368644251816498E-06	.789990384213269E-06	-.487746470041394E-06
38	22	.150444560837069E-07	.551733231370077E-07	-.324354813828832E-07
38	25	.347865398337058E-06	.799413303704048E-06	-.496717653869311E-06
38	28	.150443217952831E-07	.551732310650418E-07	-.324357085322607E-07
38	31	.279569297451476E-06	.149185160972575E-05	-.625290173688370E-06
38	34	.171285537812003E-07	.822499798370728E-07	-.436884630727347E-07
38	37	.270348992561976E-06	.145505110106447E-05	
39	1	-.172071651388148E-06	-.653380267508549E-06	.521466454206102E-06
39	4	-.883117421079504E-08	-.354805246549277E-07	.304070499743190E-07
39	7	-.174189132980770E-06	-.658259717683783E-06	.516338140857331E-06
39	10	-.883201082538207E-08	-.354815379654214E-07	.304056649706125E-07
39	13	-.179644673078037E-06	-.666767162360185E-06	.504971340767729E-06
39	16	-.883206314390853E-08	-.354815953142747E-07	.304055606996953E-07
39	19	-.184745436149739E-06	-.673813682434914E-06	.496849887283345E-06
39	22	-.883209048785606E-08	-.354816429107392E-07	.304055505959773E-07
39	25	-.171319582900000E-06	-.651251569164457E-06	.526397169351686E-06
39	28	-.883198880339851E-08	-.354815608451206E-07	.304056985784517E-07
39	31	-.713641477319474E-08	-.623818894667837E-06	.910319206417143E-06
39	34	-.875022784939547E-08	-.433786870175850E-07	.435959014834344E-07
39	37	-.176002960334066E-08	-.604294169975643E-06	.895318468601023E-06
40	1	.132119556175135E-07	.904120421879953E-08	-.554148380194727E-08
40	4	.107109899697894E-08	.674081525040426E-09	-.451096292151989E-09
40	7	.123945380112014E-07	.876884448369571E-08	-.555789077348391E-08
40	10	.107102255994129E-08	.674031453612010E-09	-.451076800388999E-09
40	13	.113555036731566E-07	.845626001416261E-08	-.568272483962682E-08
40	16	.107101550002581E-08	.674023246088988E-09	-.451074783275441E-09
40	19	.108593750121014E-07	.796046446574351E-08	-.582252230041834E-08
40	22	.107101610679676E-08	.674021401367803E-09	-.451075086097560E-09
40	25	.135839481719947E-07	.918207861264671E-08	-.551766146167421E-08
40	28	.107101451614404E-08	.674021082954269E-09	-.451078895475413E-09
40	31	.211755935231208E-07	.202051740413265E-07	-.106074165040398E-07
40	34	.183792154042161E-08	.163618589803119E-08	-.884010915851014E-09
40	37	.192407677283863E-07	.171285543478536E-07	-.875022597026882E-08
40	40	.183832462697848E-08		
41	1	.130069275534618E-07	.572973006870651E-07	-.323520855428855E-07
41	4	.118736867706557E-08	.475197274338164E-08	-.266741433960354E-08
41	7	.138496863119353E-07	.564475660446650E-07	-.317682460550116E-07

41	10	.118744089133191E-08	.475189782068972E-08	-.266737376407737E-08
41	13	.147386848216376E-07	.553439714573118E-07	-.317957110378028E-07
41	16	.118745083015992E-08	.475188684913480E-08	-.266736955367066E-08
41	19	.156836851104587E-07	.547772408314231E-07	-.318162939000299E-07
41	22	.118745454333759E-08	.475188639703594E-08	-.266736909929654E-08
41	25	.130458166638646E-07	.576649782402872E-07	-.324913560070690E-07
41	28	.118744325659382E-08	.475187912838000E-08	-.266738810470695E-08
41	31	.207886018048794E-07	.953748283874857E-07	-.506275801263927E-07
41	34	.163618811922468E-08	.785603668459788E-08	-.418378595735584E-08
41	37	.177151339600042E-07	.822529615667487E-07	-.433786932261646E-07
41	40	.163618697336011E-08	.785644406552304E-08	
42	1	-.711116409778444E-08	-.340084920451431E-07	.326957960196479E-07
42	4	-.699147748446164E-09	-.296198735826284E-08	.271763935878077E-08
42	7	-.776237718245461E-08	-.346442881837127E-07	.317001506912757E-07
42	10	-.699202149005303E-09	-.296205458526582E-08	.271752559907696E-08
42	13	-.839138152808294E-08	-.355352490758828E-07	.303228397479975E-07
42	16	-.699207889367262E-09	-.296205836757866E-08	.271751452126192E-08
42	19	-.902695703504989E-08	-.361345125541839E-07	.294453529733364E-07
42	22	-.699208616339372E-09	-.296205917575856E-08	.271751222604612E-08
42	25	-.709835751960370E-08	-.338158905083105E-07	.331809231574879E-07
42	28	-.699200047843509E-09	-.296205211993048E-08	.271752479132092E-08
42	31	-.111437348912317E-07	-.509117530084094E-07	.489510485933449E-07
42	34	-.884011310374967E-09	-.418378295265881E-08	.418957416968957E-08
42	37	-.929656755318966E-08	-.436884549244695E-07	.435988704052212E-07
42	40	-.884009964765143E-09	-.418378411200991E-08	.418997839973643E-08
43	1	.103490188595166E-06	.735871890548190E-08	-.195158029102964E-07
43	4	.106488242350956E-07	.835680401627704E-08	-.622637051237933E-08
43	7	.104919400769253E-06	.895365023667852E-08	-.174031116985295E-07
43	10	.106477279897003E-07	.835612910941109E-08	-.622633412718680E-08
43	13	.997187395724401E-07	.772086775207521E-08	-.182996983043755E-07
43	16	.106476626575852E-07	.835607705683891E-08	-.622630532151038E-08
43	19	.973841328144197E-07	.519225512705466E-08	-.188917945661336E-07
43	22	.106476495801907E-07	.835607259832176E-08	-.622631250442763E-08
43	25	.108781992470914E-06	.928902189518957E-08	-.187584550137584E-07
43	28	.106476193925176E-07	.835606753664137E-08	-.622635652295684E-08
43	31	.571446777181135E-06	.265213629703428E-06	.104223321763451E-08
43	34	.184574356592347E-07	.164908174339267E-07	-.855445949527338E-08
43	37	.560789880999332E-06	.247358243477347E-06	.117234252508667E-07
43	40	.184596141986703E-07	.164908252354615E-07	-.855444768600872E-08
43	43	.560139760865419E-06		
44	1	.346343254963325E-06	.790854749042622E-06	-.495298707832939E-06
44	4	.149823046008510E-07	.549323303201360E-07	-.323804346763287E-07
44	7	.352186143042977E-06	.793198130252784E-06	-.488485911210359E-06
44	10	.149834621539057E-07	.549313847372025E-07	-.323803193963112E-07
44	13	.361959521634694E-06	.787615942914253E-06	-.488745203642619E-06
44	16	.149835440341449E-07	.549313629539828E-07	-.323802896767648E-07
44	19	.368111620815252E-06	.789170256461713E-06	-.487882918355597E-06
44	22	.149835873496098E-07	.549314112487628E-07	-.323802944175012E-07
44	25	.346654676794150E-06	.795553055222988E-06	-.495899297545537E-06
44	28	.149834530797782E-07	.549313191122539E-07	-.323805214648281E-07
44	31	.263905617768381E-06	.142668047463042E-05	-.589747835961669E-06
44	34	.158966636522325E-07	.770095412620584E-07	-.407923799126131E-07
44	37	.246928398905884E-06	.135450298029404E-05	-.549774585652426E-06
44	40	.158966652867605E-07	.770117439733561E-07	-.407923577515075E-07
44	43	.246503775341277E-06	.135364812232579E-05	
45	1	-.171300910937517E-06	-.651299696580400E-06	.520493262979717E-06

45	4	-.879323991824808E-08	-.353527797725503E-07	.303500495488631E-07
45	7	-.173647089150550E-06	-.656967288156956E-06	.515787744217867E-06
45	10	-.879408773943992E-08	-.353538407418985E-07	.303487046671002E-07
45	13	-.179213135589303E-06	-.665988704506347E-06	.504685315749491E-06
45	16	-.879414191672330E-08	-.353539055981524E-07	.303486067589621E-07
45	19	-.184437458460258E-06	-.673326510111942E-06	.496861236846347E-06
45	22	-.879416996610985E-08	-.353539559404647E-07	.303485991848508E-07
45	25	-.170575911443061E-06	-.649229023679613E-06	.525413580606307E-06
45	28	-.879406827496460E-08	-.353538738433166E-07	.303487470988501E-07
45	31	.239652149839448E-08	-.587662524719294E-06	.883762597930735E-06
45	34	-.799855661557589E-08	-.404737575641562E-07	.414358426715127E-07
45	37	.121694440591023E-07	-.549151194265870E-06	.855243126890802E-06
45	40	-.799854997029858E-08	-.404737628684144E-07	.414380262650253E-07
45	43	.124956270188480E-07	-.548748980221127E-06	.854701622335722E-06
46	1	.132119419274063E-07	.904120551354422E-08	-.554148552876223E-08
46	4	.107109825399040E-08	.674081515396881E-09	-.451096361992470E-09
46	7	.123945314312623E-07	.876884553052920E-08	-.555789258973200E-08
46	10	.107102181712867E-08	.674031444009549E-09	-.451076870265660E-09
46	13	.113555014741583E-07	.845626089336327E-08	-.568272661173950E-08
46	16	.107101475724595E-08	.674023236489092E-09	-.451074853161970E-09
46	19	.108593757525876E-07	.796046520164249E-08	-.582252411809058E-08
46	22	.107101536402719E-08	.674021391768644E-09	-.451075155990791E-09
46	25	.135839353432170E-07	.918207981619984E-08	-.551766318956161E-08
46	28	.107101377337432E-08	.674021073354938E-09	-.451078965368738E-09
46	31	.211753981391414E-07	.202051651458900E-07	-.106074042134682E-07
46	34	.183790584106379E-08	.163618515996812E-08	-.884009830582919E-09
46	37	.192406484612393E-07	.171285486617075E-07	-.875021922282458E-08
46	40	.183830890285594E-08	.163618623997865E-08	-.884008881317359E-09
46	43	.184618197209314E-07	.158966694094161E-07	-.799854435660447E-08
46	46	.183871694186089E-08		
47	1	.130069279196034E-07	.572972890888281E-07	-.323520902166855E-07
47	4	.118736870944765E-08	.475197206689611E-08	-.266741450707682E-08
47	7	.138496859065980E-07	.564475590621302E-07	-.317682488985848E-07
47	10	.118744092371443E-08	.475189714435569E-08	-.266737393159019E-08
47	13	.147386839282605E-07	.553439672936315E-07	-.317957129866464E-07
47	16	.118745086253607E-08	.475188617283070E-08	-.266736972116785E-08
47	19	.156836837349383E-07	.547772388641412E-07	-.318162947556198E-07
47	22	.118745457570922E-08	.475188572074354E-08	-.266736926677936E-08
47	25	.130458169245330E-07	.576649671967219E-07	-.324913603463792E-07
47	28	.118744328896583E-08	.475187845208746E-08	-.266738827218952E-08
47	31	.207886121286668E-07	.953746743720786E-07	-.506275904519551E-07
47	34	.163618901368629E-08	.785602425846484E-08	-.418378675981684E-08
47	37	.177151398793779E-07	.822528678794800E-07	-.433787000710412E-07
47	40	.163618787250269E-08	.785643163080517E-08	-.418378492465778E-08
47	43	.164908325379156E-07	.770139685026032E-07	-.404737663394089E-07
47	46	.163618714385790E-08	.785684297559731E-08	
48	1	-.711116308946305E-08	-.340084939788825E-07	.326957829668282E-07
48	4	-.699147688521603E-09	-.296198744819964E-08	.271763874362229E-08
48	7	-.776237628779654E-08	-.346442889694073E-07	.317001427374155E-07
48	10	-.699202089092865E-09	-.296205467528179E-08	.271752498410738E-08
48	13	-.839138056287469E-08	-.355352493215245E-07	.303228347700686E-07
48	16	-.699207829467951E-09	-.296205845759966E-08	.271751390636359E-08
48	19	-.902695641002382E-08	-.361345118559349E-07	.294453509735404E-07
48	22	-.699208556449983E-09	-.296205926577969E-08	.271751161119027E-08
48	25	-.709835653742561E-08	-.338158920866625E-07	.331809104902835E-07
48	28	-.699199987953674E-09	-.296205220995168E-08	.271752417646485E-08

48	31	-.111437243066311E-07	-.509117334333490E-07	.489508669824151E-07
48	34	-.884010449860693E-09	-.418378142852664E-08	.418955946128551E-08
48	37	-.929656097463730E-08	-.436884424783331E-07	.435987592190248E-07
48	40	-.884009106071820E-09	-.418378259806437E-08	.418996367169489E-08
48	43	-.855443630355822E-08	-.407923375938844E-07	.414402357788256E-07
48	46	-.884008024463669E-09	-.418378342101441E-08	.419037271198035E-08
49	1	.102982754991794E-06	.675279080366498E-08	-.193964274854703E-07
49	4	.106215058021863E-07	.831650504547622E-08	-.621620228396195E-08
49	7	.104625954469602E-06	.858246371838923E-08	-.173542202022290E-07
49	10	.106204163148786E-07	.831584353342359E-08	-.621617623639663E-08
49	13	.995519927385619E-07	.749722540990102E-08	-.183005588738592E-07
49	16	.106203522176103E-07	.831579366172046E-08	-.621614918065059E-08
49	19	.973027539347637E-07	.507157554532958E-08	-.189244530651432E-07
49	22	.106203395555605E-07	.831579001728225E-08	-.621615704688850E-08
49	25	.108300308360547E-06	.870142980651822E-08	-.186320784153839E-07
49	28	.106203093770743E-07	.831578494601656E-08	-.621620104020398E-08
49	31	.564591069861665E-06	.254563829359012E-06	.727223395383783E-08
49	34	.179097585389543E-07	.156318386397104E-07	-.804404566682864E-08
49	37	.556585670643731E-06	.240864567893225E-06	.154694655908381E-07
49	40	.179113910881736E-07	.156318404185821E-07	-.804404283511780E-08
49	43	.553352717713533E-06	.235333427194575E-06	.188102905073759E-07
49	46	.179130437884485E-07	.156318419225670E-07	-.804404039603688E-08
49	49	.560798434362311E-06		
50	1	.345442162978749E-06	.788100077550967E-06	-.494761619585020E-06
50	4	.149358555010292E-07	.547613119001505E-07	-.323391860449223E-07
50	7	.351541360436217E-06	.791505868323828E-06	-.488207153009164E-06
50	10	.149370259619336E-07	.547604210094928E-07	-.323391111246368E-07
50	13	.361448403573579E-06	.786594372258700E-06	-.488658422591769E-06
50	16	.149371099102368E-07	.547604083293755E-07	-.323390878678152E-07
50	19	.367695879495113E-06	.788603772000100E-06	-.487927858008488E-06
50	22	.149371539210169E-07	.547604599627221E-07	-.323390950037112E-07
50	25	.345783062868064E-06	.792890747936030E-06	-.495328568023845E-06
50	28	.149370196817943E-07	.547603677907201E-07	-.323393219540824E-07
50	31	.252952474528510E-06	.138139669692536E-05	-.565244078628390E-06
50	34	.150320496351743E-07	.733598849806933E-07	-.387913112891976E-07
50	37	.240138801798434E-06	.132691647459176E-05	-.534997187048195E-06
50	40	.150320397793457E-07	.733615358448590E-07	-.387913020595505E-07
50	43	.235040280674551E-06	.130521754002616E-05	-.522914575807741E-06
50	46	.150320317810162E-07	.733632031455908E-07	-.387912945567684E-07
50	49	.247229833796522E-06	.135909195116530E-05	
51	1	-.170772137189567E-06	-.649893895083278E-06	.519829043886630E-06
51	4	-.876548228161874E-08	-.352640966125119E-07	.303097643723935E-07
51	7	-.173272644410603E-06	-.656096807642688E-06	.515411546475800E-06
51	10	-.876633765273437E-08	-.352651894243078E-07	.303084467427209E-07
51	13	-.178917583328410E-06	-.665461057468297E-06	.504500590497675E-06
51	16	-.876639320461694E-08	-.352652594769956E-07	.303083539782686E-07
51	19	-.184199578395604E-06	-.673029022527313E-06	.496815763955066E-06
51	22	-.876642175225751E-08	-.352653117566408E-07	.303083485046924E-07
51	25	-.170065037869123E-06	-.647862146994068E-06	.524742852707601E-06
51	28	-.876632006937954E-08	-.352652296432225E-07	.303084963641303E-07
51	31	.892114752400693E-08	-.562748483677960E-06	.865416893433479E-06
51	34	-.748229238241823E-08	-.384668069258379E-07	.399404404626103E-07
51	37	.162086960714746E-07	-.533961058321711E-06	.844138356443992E-06
51	40	-.748228814029326E-08	-.384668122796735E-07	.399420777505626E-07
51	43	.191033342728665E-07	-.522505437398512E-06	.835614959454577E-06
51	46	-.748228459482121E-08	-.384668163336723E-07	.399437343792836E-07

51	49	.123915293690843E-07	-.551029143150907E-06	.856566784841543E-06
52	1	.132119410014192E-07	.904120568177418E-08	-.554148556815667E-08
52	4	.107109820126669E-08	.674081518515872E-09	-.451096360911123E-09
52	7	.123945309775217E-07	.876884566492789E-08	-.555789264692821E-08
52	10	.107102176441669E-08	.674031447130617E-09	-.451076869186754E-09
52	13	.113555013166324E-07	.845626099971374E-08	-.568272669033283E-08
52	16	.107101470453604E-08	.674023239610165E-09	-.451074852082267E-09
52	19	.108593757706533E-07	.796046530500562E-08	-.582252417587696E-08
52	22	.107101531131774E-08	.674021394889608E-09	-.451075154909849E-09
52	25	.135839344694018E-07	.918207997523905E-08	-.551766323172838E-08
52	28	.107101372066490E-08	.674021076475895E-09	-.451078964287819E-09
52	31	.211753849387856E-07	.202051648224932E-07	-.106074031837648E-07
52	34	.183790477924233E-08	.163618513136312E-08	-.884009741504593E-09
52	37	.192406404474045E-07	.171285484397527E-07	-.875021863396810E-08
52	40	.183830783935635E-08	.163618621171422E-08	-.884008792326237E-09
52	43	.184618138688284E-07	.158966691768453E-07	-.799854394785393E-08
52	46	.183871587666197E-08	.163618711593830E-08	-.884007935560669E-09
52	49	.179147541686271E-07	.150320276598902E-07	-.748228387064162E-08
52	52	.183913859788868E-08		
53	1	.130069279119806E-07	.572972881858011E-07	-.323520905871079E-07
53	4	.118736871024897E-08	.475197201324998E-08	-.266741452202317E-08
53	7	.138496858418704E-07	.564475584822984E-07	-.317682491358581E-07
53	10	.118744092451568E-08	.475189709072000E-08	-.266737394653922E-08
53	13	.147386838192239E-07	.553439669222781E-07	-.317957131296226E-07
53	16	.118745086333738E-08	.475188611919710E-08	-.266736973611859E-08
53	19	.156836836135050E-07	.547772386230682E-07	-.318162948728612E-07
53	22	.118745457651085E-08	.475188566711085E-08	-.266736928173222E-08
53	25	.130458169110932E-07	.576649663313500E-07	-.324913606935713E-07
53	28	.118744328976745E-08	.475187839845474E-08	-.266738828714231E-08
53	31	.207886129073894E-07	.953746635287226E-07	-.506275909717881E-07
53	34	.163618908068453E-08	.785602338403170E-08	-.418378679928251E-08
53	37	.177151403138384E-07	.822528612745674E-07	-.433787004169845E-07
53	40	.163618793984136E-08	.785643075578200E-08	-.418378496481183E-08
53	43	.164908327995229E-07	.770139636062392E-07	-.404737665709761E-07
53	46	.163618721154128E-08	.785684209997741E-08	-.418378346186492E-08
53	49	.156318416304061E-07	.733649175806731E-07	-.384668178769576E-07
53	52	.163618718398095E-08	.785726501192956E-08	
54	1	-.711116300834748E-08	-.340084941745517E-07	.326957819190220E-07
54	4	-.699147682161768E-09	-.296198745673892E-08	.271763868948174E-08
54	7	-.776237623697236E-08	-.346442891062874E-07	.317001420669913E-07
54	10	-.699202082734227E-09	-.296205468382793E-08	.271752492998088E-08
54	13	-.839138053375098E-08	-.355352494146224E-07	.303228343706556E-07
54	16	-.699207823109143E-09	-.296205846614633E-08	.271751385223697E-08
54	19	-.902695637481553E-08	-.361345119302549E-07	.294453506950883E-07
54	22	-.699208550090564E-09	-.296205927432627E-08	.271751155706083E-08
54	25	-.709835646022827E-08	-.338158922611148E-07	.331809094688662E-07
54	28	-.699199981594286E-09	-.296205221849832E-08	.271752412233546E-08
54	31	-.111437230131520E-07	-.509117310193411E-07	.489508539198449E-07
54	34	-.884010346121266E-09	-.418378123534797E-08	.418955840100720E-08
54	37	-.929656018200380E-08	-.436884410389529E-07	.435987512756999E-07
54	40	-.884009002419711E-09	-.418378240557394E-08	.418996261007771E-08
54	43	-.855443574785986E-08	-.407923366212636E-07	.414402300221054E-07
54	46	-.884007920899750E-09	-.418378322922038E-08	.419037164900830E-08
54	49	-.804404111243883E-08	-.387912932791598E-07	.399454444523260E-07
54	52	-.884007832085385E-09	-.418378327079063E-08	.419079437282502E-08
55	1	.335869442937745E-06	-.522936619500643E-07	.117776067228352E-08

55	4	.170115382790563E-07	.672599821110805E-08	-.521151471836962E-08
55	7	.294977322689021E-06	-.567538293218465E-07	.567275783867138E-08
55	10	.170079898356965E-07	.672414507798124E-08	-.521055818503904E-08
55	13	.263024127405106E-06	-.622520801359660E-07	.640739276648010E-08
55	16	.170075893276545E-07	.672400895594942E-08	-.521043233291192E-08
55	19	.233536766889507E-06	-.661457079151617E-07	.770675353104846E-08
55	22	.170073948959728E-07	.672399117858721E-08	-.521040628510890E-08
55	25	.335800242210834E-06	-.506520176619087E-07	.115707610864246E-08
55	28	.170073712257736E-07	.672398934517863E-08	-.521044068292904E-08
55	31	.391499161119406E-06	.994071732935292E-07	.671151929183986E-07
55	34	.150196379447054E-07	.103447723656884E-07	-.497848971956745E-08
55	37	.391502190745990E-06	.981876471018370E-07	.677407496037963E-07
55	40	.150196427506081E-07	.103447694840351E-07	-.497848946692777E-08
55	43	.391432225350427E-06	.976098801011475E-07	.680529669567909E-07
55	46	.150196463902299E-07	.103447673591280E-07	-.497848911913671E-08
55	49	.391432451630566E-06	.972148377514668E-07	.682635687366014E-07
55	52	.150196466234110E-07	.103447671785589E-07	-.497848913523239E-08
55	55	.139786237463506E-05		
56	1	.304071934465434E-06	.858283861672685E-06	-.430721246765181E-06
56	4	.153487072881211E-07	.673605007285521E-07	-.346108234030449E-07
56	7	.303689475313998E-06	.793330915810642E-06	-.417942016402501E-06
56	10	.153486132859849E-07	.673515721039902E-07	-.346064770069493E-07
56	13	.310993361862248E-06	.740081363167980E-06	-.413134584502973E-06
56	16	.153486381610605E-07	.673509017826998E-07	-.346061074511524E-07
56	19	.316747688013765E-06	.705970006072334E-06	-.408619213451805E-06
56	22	.153486937613882E-07	.673506661429068E-07	-.346059779530198E-07
56	25	.303767217945872E-06	.856738581003215E-06	-.433663686112550E-06
56	28	.153485580309980E-07	.673505691824139E-07	-.346062143502325E-07
56	31	.144929783160254E-06	.933124498263057E-06	-.371365611875529E-06
56	34	.121628526291644E-07	.626361394910529E-07	-.336802493584280E-07
56	37	.144387392289045E-06	.931311966694373E-06	-.370146993366060E-06
56	40	.121628510525026E-07	.626361385977913E-07	-.336802467906970E-07
56	43	.144133242281629E-06	.930392330630051E-06	-.369549172890752E-06
56	46	.121628496898539E-07	.626361380597621E-07	-.336802446534798E-07
56	49	.144001362109695E-06	.929926644825202E-06	-.369243151547462E-06
56	52	.121628496701738E-07	.626361379374659E-07	-.336802446289314E-07
56	55	.390149390069256E-06	.382338681891421E-05	
57	1	-.168232715028444E-06	-.655050580187943E-06	.563209132397799E-06
57	4	-.100932445777787E-07	-.413111291472374E-07	.364829407197940E-07
57	7	-.164744798733992E-06	-.638792063398406E-06	.536267326624635E-06
57	10	-.100931595388604E-07	-.413083771637624E-07	.364774815538884E-07
57	13	-.167022100228927E-06	-.633095819844067E-06	.506235100752560E-06
57	16	-.100931415752175E-07	-.413081572526559E-07	.364770409119456E-07
57	19	-.168769803295267E-06	-.630647190035970E-06	.484153608895515E-06
57	22	-.100931541588995E-07	-.413080930902880E-07	.364769054726953E-07
57	25	-.167026469492425E-06	-.651771214050541E-06	.568048143308590E-06
57	28	-.100930425137591E-07	-.413080031457778E-07	.364770631422475E-07
57	31	.415396668215994E-07	-.393790168131172E-06	.673437154250640E-06
57	34	-.648302533922116E-08	-.346475923136574E-07	.368775993352260E-07
57	37	.414322190970815E-07	-.393946651842148E-06	.673678431230740E-06
57	40	-.648302726738112E-08	-.346475912052258E-07	.368776008462253E-07
57	43	.413898476745646E-07	-.393940835588911E-06	.673681761589887E-06
57	46	-.648302870502012E-08	-.346475902791974E-07	.368776022293945E-07
57	49	.413528843791899E-07	-.393985590364435E-06	.673718357226284E-06
57	52	-.648302874286788E-08	-.346475903052703E-07	.368776021714582E-07
57	55	-.253367103504664E-06	-.175370905437258E-05	.216182018867548E-05

58	1	.191445916182763E-07	.549295746774181E-08	-.346712643586437E-08
58	4	.130952890309276E-08	.332113559789872E-09	-.245213970710281E-09
58	7	.163483910268811E-07	.513055920674043E-08	-.346513026701557E-08
58	10	.130929089269051E-08	.332014328921148E-09	-.245158291125357E-09
58	13	.138975752906835E-07	.473388212735057E-08	-.356572207658773E-08
58	16	.130927207571496E-08	.332004396987106E-09	-.245154182869454E-09
58	19	.124139038709080E-07	.423176322268052E-08	-.368917898826374E-08
58	22	.130926791934841E-08	.332002240304541E-09	-.245153873791407E-09
58	25	.192667733490777E-07	.562874861977617E-08	-.346913805376156E-08
58	28	.130926708728326E-08	.332002633974627E-09	-.245156224998723E-09
58	31	.141454840812908E-07	.826193033329595E-08	-.377819312319859E-08
58	34	.131515130267301E-08	.657685768508395E-09	-.291395138930207E-09
58	37	.141662281744364E-07	.824178140434559E-08	-.376907649097609E-08
58	40	.131515176741558E-08	.657685640767351E-09	-.291395098721811E-09
58	43	.141693581617309E-07	.822978191793978E-08	-.376226667642935E-08
58	46	.131515212352709E-08	.657685543851990E-09	-.291395060398265E-09
58	49	.141756306961364E-07	.821973621894779E-08	-.375668687573647E-08
58	52	.131515214564022E-08	.657685535425635E-09	-.291395059316720E-09
58	55	.381229910606576E-07	.173099577323213E-07	-.115558487742305E-07
58	58	.265492910470519E-08		
59	1	.108065110269760E-07	.594512630739833E-07	-.290083728075601E-07
59	4	.100402793799479E-08	.462988231579532E-08	-.236667743351715E-08
59	7	.115693328774035E-07	.559672534017256E-07	-.284778347948322E-07
59	10	.100404907843617E-08	.462943565946879E-08	-.236646324507751E-08
59	13	.124268212045586E-07	.529255800685947E-07	-.284165941472914E-07
59	16	.100405722215842E-08	.462940244773566E-08	-.236644831568941E-08
59	19	.133759987949927E-07	.511005821067053E-07	-.283678835485371E-07
59	22	.100406075938200E-08	.462939355340423E-08	-.236644389479253E-08
59	25	.108325372529985E-07	.595452703910623E-07	-.292829769117760E-07
59	28	.100405102424003E-08	.462938716783454E-08	-.236646079635611E-08
59	31	.105410456842971E-07	.542635059463658E-07	-.287444304089695E-07
59	34	.826164796987197E-09	.457374145787218E-08	-.238907140193733E-08
59	37	.105199849692663E-07	.542259788787663E-07	-.287081813246914E-07
59	40	.826164575623844E-09	.457374154688193E-08	-.238907124526592E-08
59	43	.105098447764446E-07	.542034886529498E-07	-.286899239046747E-07
59	46	.826164399568911E-09	.457374161932744E-08	-.238907111378564E-08
59	49	.105049397040555E-07	.541978671651527E-07	-.286831983070522E-07
59	52	.826164393243679E-09	.457374161880630E-08	-.238907111195058E-08
59	55	.171845627878228E-07	.121174040524924E-06	-.601994561631370E-07
59	58	.882464300518147E-09	.721156226206404E-08	
60	1	-.713076897297197E-08	-.350935283686996E-07	.364170336779766E-07
60	4	-.689652225220301E-09	-.298403882741618E-08	.295509370798755E-08
60	7	-.773096453451034E-08	-.350285292880379E-07	.347310808722969E-07
60	10	-.689672710863983E-09	-.298394955436063E-08	.295476825196211E-08
60	13	-.826412215016979E-08	-.355758228067691E-07	.322908817745756E-07
60	16	-.689675843440425E-09	-.298394471725350E-08	.295474192959080E-08
60	19	-.879209106209189E-08	-.360215938912788E-07	.306450408368804E-07
60	22	-.689675716663315E-09	-.298394248026450E-08	.295473414835554E-08
60	25	-.711807972547699E-08	-.348435862707799E-07	.369197830601105E-07
60	28	-.689666915087565E-09	-.298393530690252E-08	.295474638053070E-08
60	31	-.595954393981598E-08	-.315359670871875E-07	.349400092856596E-07
60	34	-.473298630687306E-09	-.263770674211879E-08	.307945383167332E-08
60	37	-.595750336428640E-08	-.315295472764226E-07	.349536982861810E-07
60	40	-.473298622766471E-09	-.263770660152959E-08	.307945408887499E-08
60	43	-.595712703451699E-08	-.315257900237714E-07	.349553082531573E-07
60	46	-.473298621139344E-09	-.263770648720492E-08	.307945429867223E-08

60	49	-.595645028682524E-08	-.315248769349928E-07	.349584674410181E-07
60	52	-.473298616309873E-09	-.263770648759695E-08	.307945429625052E-08
60	55	-.115266231446224E-07	-.625026986117768E-07	.699075784047376E-07
60	58	-.546296833594075E-09	-.359234064956393E-08	.477613770802762E-08
61	1	.311739443840680E-06	-.897504673035690E-07	.207455667325484E-07
61	4	.155712445300402E-07	.389679113611761E-08	-.367498771541474E-08
61	7	.276929530746576E-06	-.900821186949453E-07	.235545867178230E-07
61	10	.155682192945004E-07	.389556507263260E-08	-.367446834131239E-08
61	13	.249146133578708E-06	-.925495019787475E-07	.233298118543976E-07
61	16	.155678535995586E-07	.389547050683870E-08	-.367437203336877E-08
61	19	.222311486172807E-06	-.944917725342884E-07	.240880221917559E-07
61	22	.155676708457692E-07	.389546735622666E-08	-.367435520519416E-08
61	25	.312404634753283E-06	-.878667837288385E-07	.208341823410827E-07
61	28	.155676519287085E-07	.389546975462641E-08	-.367438024637879E-08
61	31	.386265404006096E-06	.762314006483639E-07	.831485109910780E-07
61	34	.144882531865621E-07	.827078400567343E-08	-.356847626678546E-08
61	37	.386314978434676E-06	.751630139523052E-07	.836865359353375E-07
61	40	.144882582128525E-07	.827078123565988E-08	-.356847615444354E-08
61	43	.386267072892704E-06	.746588556047118E-07	.839550025855834E-07
61	46	.144882620097523E-07	.827077917855472E-08	-.356847593321943E-08
61	49	.386281112916914E-06	.743075636786287E-07	.841372218447500E-07
61	52	.144882622487242E-07	.827077900260946E-08	-.356847595890593E-08
61	55	.111807980973283E-05	.227496382744503E-07	-.225914787934903E-08
61	58	.332714469058798E-07	.103046727036254E-07	-.705733099824888E-08
61	61	.105799725127867E-05		
62	1	.270183032929835E-06	.703612942849492E-06	-.363812771569553E-06
62	4	.128340757580186E-07	.559506225140221E-07	-.292648370769362E-07
62	7	.274909178518934E-06	.658945498825034E-06	-.356525946173875E-06
62	10	.128346080956275E-07	.559444082540952E-07	-.292620540017378E-07
62	13	.285035846247165E-06	.621262755349732E-06	-.354302098574929E-06
62	16	.128346674437460E-07	.559439244649105E-07	-.292617908540779E-07
62	19	.292351646429882E-06	.597130438860641E-06	-.351173578999461E-06
62	22	.128347332272079E-07	.559437578947857E-07	-.292616995302431E-07
62	25	.270446388697956E-06	.703817834528215E-06	-.366399400543477E-06
62	28	.128346168818868E-07	.559436752413610E-07	-.292619020264712E-07
62	31	.125626225228770E-06	.846692623262441E-06	-.319636452491076E-06
62	34	.103370788503939E-07	.547006721240604E-07	-.289854746864808E-07
62	37	.125217059130751E-06	.845448901123348E-06	-.318747439259617E-06
62	40	.103370769514040E-07	.547006719732983E-07	-.289854727904864E-07
62	43	.125026691104162E-06	.844824314042030E-06	-.318328179959942E-06
62	46	.103370754315976E-07	.547006719199408E-07	-.289854711837623E-07
62	49	.124935070416078E-06	.844555496865215E-06	-.318144164159004E-06
62	52	.103370754063989E-07	.547006718406472E-07	-.289854711750726E-07
62	55	.242082660812539E-07	.202889551291381E-05	-.705341317773561E-06
62	58	.105428263543892E-07	.920897788003301E-07	-.458028356351729E-07
62	61	-.589803525800233E-07	.168078664743315E-05	
63	1	-.150505481039349E-06	-.590097482103777E-06	.522377573197324E-06
63	4	-.887261990420791E-08	-.365356230899110E-07	.337256844981249E-07
63	7	-.150866156542433E-06	-.582879754226354E-06	.503944717934485E-06
63	10	-.887294400485055E-08	-.365343908858937E-07	.337215456280216E-07
63	13	-.154964480477958E-06	-.584727012385558E-06	.478173948378423E-06
63	16	-.887294915539397E-08	-.365342763024430E-07	.337211889820817E-07
63	19	-.157784496385804E-06	-.587196230016581E-06	.458396125717682E-06
63	22	-.887296814434117E-08	-.365342513075887E-07	.337210816581830E-07
63	25	-.149661158521902E-06	-.587309269718776E-06	.527250117590500E-06
63	28	-.887286319559223E-08	-.365341674011451E-07	.337212256869972E-07

63	31	.493045397178810E-07	-.361382011651442E-06	.654023111675417E-06
63	34	-.566258444965590E-08	-.315590766915832E-07	.349938652274461E-07
63	37	.491172341465925E-07	-.361878239325315E-06	.654475833111243E-06
63	40	-.566258619057896E-08	-.315590758779928E-07	.349938674295726E-07
63	43	.490335184023327E-07	-.362052869317392E-06	.654598665328187E-06
63	46	-.566258756277834E-08	-.315590751621235E-07	.349938692696049E-07
63	49	.489716279747955E-07	-.362218390941116E-06	.654714930248715E-06
63	52	-.566258759187950E-08	-.315590752175127E-07	.349938692141071E-07
63	55	-.468966286785713E-08	-.732578222128071E-06	.123210495001569E-05
63	58	-.742942344789187E-08	-.455745008157653E-07	.569394271999733E-07
63	61	.478482012765322E-07	-.534015759184827E-06	.107934227578219E-05
64	1	.191398566243623E-07	.549327994772025E-08	-.346736824759068E-08
64	4	.130928268524649E-08	.332130897238334E-09	-.245226290761977E-09
64	7	.163451860216610E-07	.513079900125324E-08	-.346530134839961E-08
64	10	.130904479514672E-08	.332031669233565E-09	-.245170611109260E-09
64	13	.138955011973818E-07	.473403719231804E-08	-.356583162328958E-08
64	16	.130902598642071E-08	.332021737024565E-09	-.245166502851139E-09
64	19	.124125320907868E-07	.423187196516526E-08	-.368924382799768E-08
64	22	.130902183299311E-08	.332019580117089E-09	-.245166193661637E-09
64	25	.192622306818631E-07	.562905605760168E-08	-.346937115399700E-08
64	28	.130902100091781E-08	.332019973706314E-09	-.245168544815497E-09
64	31	.141456141438566E-07	.826193728211675E-08	-.377817709040485E-08
64	34	.131516217825828E-08	.657686590131222E-09	-.291393608266095E-09
64	37	.141663616249015E-07	.824179144665739E-08	-.376906284871038E-08
64	40	.131516264304796E-08	.657686462380525E-09	-.291393568063884E-09
64	43	.141694928666581E-07	.822979332827825E-08	-.376225407188395E-08
64	46	.131516299919480E-08	.657686365457720E-09	-.291393529745516E-09
64	49	.141757663959721E-07	.821974846526124E-08	-.375667489780942E-08
64	52	.131516302131025E-08	.657686357030870E-09	-.291393528664338E-09
64	55	.380966678426186E-07	.173102711331110E-07	-.115562675379555E-07
64	58	.265391092825604E-08	.882463158715322E-09	-.546307946042297E-09
64	61	.332725355667674E-07	.105427636292048E-07	-.742957295698311E-08
64	64	.265398967985947E-08		
65	1	.108071256177633E-07	.594474238528573E-07	-.290096035804323E-07
65	4	.100406352047221E-08	.462968006261252E-08	-.236673948366968E-08
65	7	.115698179279622E-07	.559646426606310E-07	-.284786530658118E-07
65	10	.100408466007937E-08	.462923353035634E-08	-.236652530127997E-08
65	13	.124271856326876E-07	.529238780147454E-07	-.284171079703805E-07
65	16	.100409280334599E-08	.462920032703631E-08	-.236651037262309E-08
65	19	.133762892640845E-07	.510994529336260E-07	-.283682062738370E-07
65	22	.100409634034226E-08	.462919143582480E-08	-.236650595207148E-08
65	25	.108331340659637E-07	.595415737095758E-07	-.292841222713622E-07
65	28	.100408660518758E-08	.462918505020404E-08	-.236652285355362E-08
65	31	.105411595759137E-07	.542636706133152E-07	-.287443648122507E-07
65	34	.826174436629660E-09	.457375178808742E-08	-.238906592436818E-08
65	37	.105201027702397E-07	.542261576955908E-07	-.287081235505504E-07
65	40	.826174215276000E-09	.457375187711553E-08	-.238906576769724E-08
65	43	.105099639672359E-07	.542036731721709E-07	-.286898691939104E-07
65	46	.826174039228385E-09	.457375194957469E-08	-.238906563621723E-08
65	49	.105050600832130E-07	.541980560207877E-07	-.286831459253355E-07
65	52	.826174032903483E-09	.457375194905463E-08	-.238906563438224E-08
65	55	.171853323648027E-07	.121148651361157E-06	-.602006048488139E-07
65	58	.882505545294466E-09	.721055707804450E-08	-.359238055433558E-08
65	61	.103052082876965E-07	.920910321696819E-07	-.455750484314554E-07
65	64	.882504418064997E-09	.721064887138775E-08	
66	1	-.713096651779136E-08	-.350946774595047E-07	.364133468283332E-07

```
    66      4 -.689663597498057E-09 -.298409184969722E-08  .295490291437926E-08
    66      7 -.773110044954034E-08 -.350292406380330E-07  .347285760285140E-07
    66     10 -.689684084029588E-09 -.298400258409861E-08  .295457759114557E-08
    66     13 -.826420318265665E-08 -.355762198528077E-07  .322892598596917E-07
    66     16 -.689687216809959E-09 -.298399774781069E-08  .295455127751305E-08
    66     19 -.879213195096563E-08 -.360217959379320E-07  .306439770004668E-07
    66     22 -.689687090044091E-09 -.298399551111603E-08  .295454349927208E-08
    66     25 -.711827130919936E-08 -.348446355009863E-07  .369161980093014E-07
    66     28 -.689678288532217E-09 -.298398833791069E-08  .295455573148891E-08
    66     31 -.595952890428425E-08 -.315357845783047E-07  .349400586518620E-07
    66     34 -.473298435484750E-09 -.263769240498335E-08  .307945902383707E-08
    66     37 -.595748938480760E-08 -.315293676153328E-07  .349537513366153E-07
    66     40 -.473298427567203E-09 -.263769226438159E-08  .307945928107008E-08
    66     43 -.595711344612473E-08 -.315256115280404E-07  .349553627857863E-07
    66     46 -.473298425942801E-09 -.263769215004739E-08  .307945949089060E-08
    66     49 -.595643706957282E-08 -.315246995111618E-07  .349585231897061E-07
    66     52 -.473298421113571E-09 -.263769215043891E-08  .307945948847038E-08
    66     55 -.115268920044214E-07 -.625038822255661E-07  .698814771843811E-07
    66     58 -.546304179588762E-09 -.359236652160719E-08  .477510373445458E-08
    66     61 -.705739287061901E-08 -.458031882883746E-07  .569402343853887E-07
    66     64 -.546315294233220E-09 -.359240644628420E-08  .477516672206818E-08
-SOLUTION/MATRIX_ESTIMATE L COVA
%ENDSNX
```