



17th International Workshop on Laser Ranging

In Bad Kötzing
16-20 May 2011

Lunar Laser Ranging: Tools for assisting observers

Service Polac / SYRTE / Observatoire de Paris
INPOP Team / IMCCE / Observatoire de Paris
MeO Station / GeoAzur / Observatoire de la Côte d'Azur

Lunar Laser Ranging: Tools for assisting observers

Contents

Why are we developing these LLR tools?

Tools quick overview:

- Tools for pointing towards the Moon's retro-reflectors.
- Tools for the First Validation of LLR normal Points.
 - 1- Test with Apache Point LLR Normal Points (2006-2010)
 - 2- Test with February LLR normal Points of MeO station

Planned improvements.

Why are we developing these LLR tools?

- Informal discussion between staff of Matera station and F. Deleflie (MeO/IMCCE) at the last ILRS meeting.
- To facilitate the Moon's pointing at MeO station.
- To validate MeO's LLR data before their submission at ILRS (G.F.).
- To help Some SLR stations to reach the Moon : Koganei, Wettzell, ... (in future more and more SLR stations will be able to reach the Moon.)
- To provide directly the right ascension & declination of lunar targets for not SLR station (temporary experiments).

Tools quick overview

<http://polac.obspm.fr/PaV/>





Applications Raccourcis Système Mozilla Firefox lun. 7 févr., 19:41

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http://polac.obspm.fr/PaV/ la mediterranee paris

Courriel Meteor Dico Astro Reservations Pagesjaunes Cinema Cartes Les Roches - La Ma... MissionCNRS Transport Nara

http://polac.obspm.fr/PaV/ apercu - Dictionnaire Fran... http://polac.o...dexValid.html



Lunar Laser Ranging Service

Paris Observatory Lunar Analysis Center

Beta Version

[Prediction for future LLR Observations](#) [Validation of past LLR Observations](#)

[HELP](#) [HOME](#)

Developed by : C. Barache, S. Bouquillon, T. Carlucci, F. Deleflie, D. Feraudy, G. Francou, H. Manche, E. Samain, J-M. Torre & W. Zerhouni
Acknowledgments to Randall Ricklefs & to Pierre Tessandier for their helps.

Terminé

[bouquillon@pcbouqu... [BERN2011 - Navigat... [ISSI_2011.odp - Open... [Courrier entrant - Mo... Mozilla Firefox [JSR2010 - Navigateur...

Pointing towards the Moon.



Applications Raccourcis Système Mozilla Firefox lun. 7 févr., 19:31

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http://polac.obsprm.fr/PaV/IndexPred.html la mediterranee paris

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http://polac...ndexPred.html http://faciliter - Dictionnaire Fran... http://polac...ndexPred.html

 **Lunar Laser Ranging Service** 

Paris Observatory Lunar Analysis Center

Prediction for future LLR Observations :

Ephemerides : ELP96 INPOP10a

Sites : GRASSE

Targets : APOLLO 15

Year : 2011

Month : 2

Day : 14

Hour : 19

Minute : 0

Second : 0

Step : 30 (min)

Number of Points : 20

Temperature (°C) : Default (7.1)

Pressure (hPa) : Default (852.5)

Humidity (%) : Default (32)

Wavelength (nm) : Default (532)

Default Values

HELP HOME

GO

LLR SERVICE / PREDICTION - Ref : ELP96 #1101.00 FIT IERS02CEP

Site : GRASSE
Target : APOLLO 15
Pressure : 852.5 milliBar
Temperature : 7.1 degrees Celsius
Humidity : 32.0 %
Wavelength : 0.532 micrometers

RESULTS TPF (TOPOCENTRIC PREDICTION FORMAT) :

/ Number / Date / Time (UTC) / Modified Julian Date at 0h / Seconds of Day (UT
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00001	2011/02/14	19:00:00	55606	68400.0	-48399786.632	336508507.319	140355
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[Download Prediction with cpf format \(right click and save as ...\)](#)

[Download Prediction with tpf format \(right click and save as ...\)](#)

Current Predictions Repositories : CPF TPF

Terminé

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Pointing towards the Moon.

The screenshot shows the Lunar Laser Ranging Service website interface. The main heading is "Lunar Laser Ranging Service" with the Paris Observatory Lunar Analysis Center logo. The page is titled "Prediction for future LLR Observations :".

Form Fields:

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- Sites: GRASSE
- Targets: APOLLO 15
- Year: 2011
- Month: 2
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- Wavelength (nm): Default (532)

GO button

Table:

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Submission area

Pointing towards the Moon.



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Results area

Pointing towards the Moon.

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Observatoire SYRTE *Ace* **Lunar Laser Ranging Service** Observatoire GeO AZUR

Paris Observatory Lunar Analysis Center

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HELP HOME

bsprm.fr

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Submission area

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Pointing towards the Moon.

- sites currently available in the web interface

MeO, Caussols, France



Wettzell, Germany



Koganei, Japan

Mc Donald, Texas, USA



Apollo, New Mexico, USA



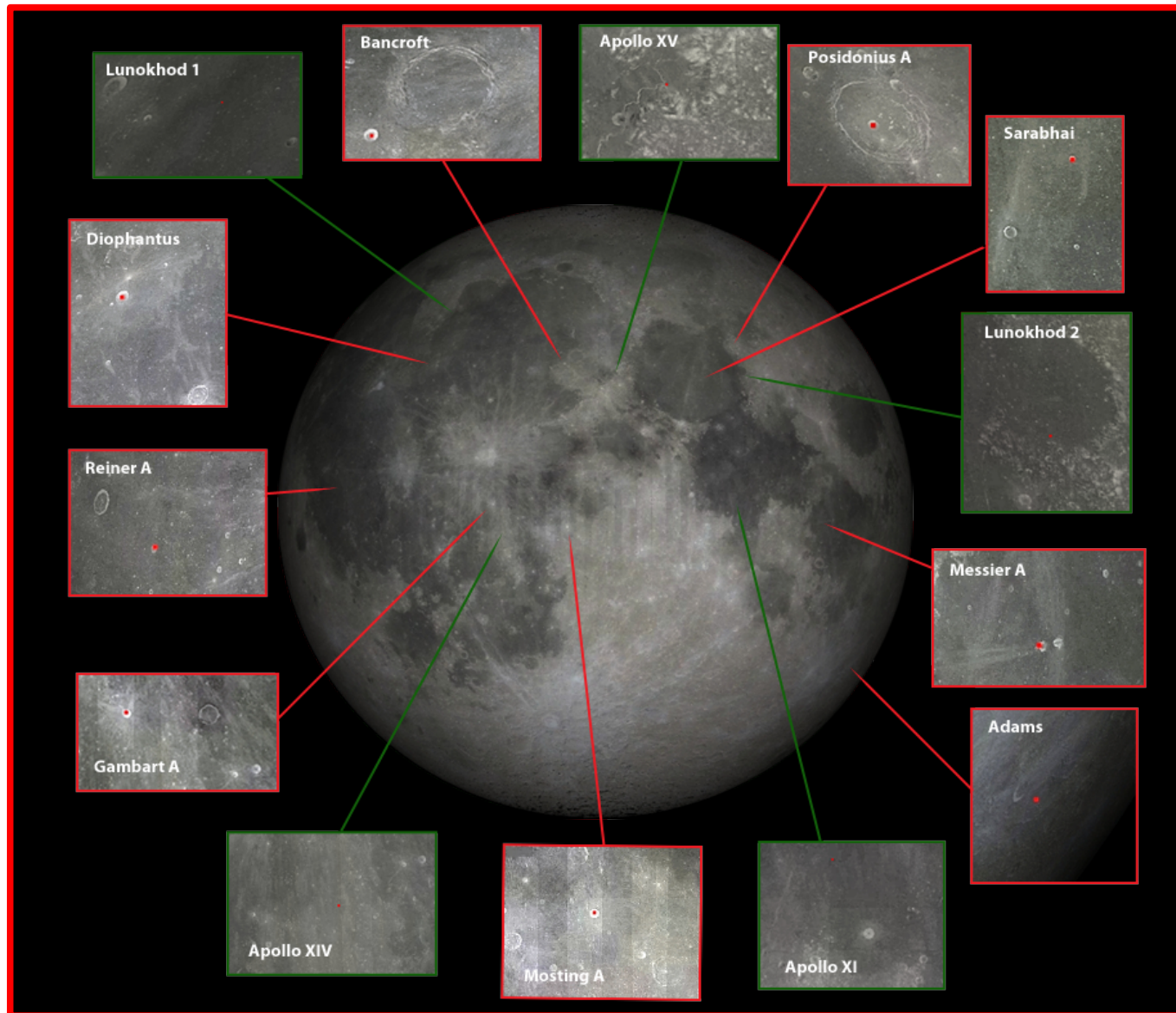
©1994 Dan Long



Matera, Italy

Pointing towards the Moon.

- Reflectors and Craters currently available in the web interface



Pointing towards the Moon.

- Lunar solutions & reduction models available to compute predictions:

ELP96: The ephemerides are given by an improved version of the analytical solution of the Moon ELP2000-82B (Chapront-Touzé & Chapront, A&A1983, A&A1988, Celest.Mech.1997). The numerical ephemeris DE245 (JPL) is used for numerical complements to the lunar libration and orbital motion and for the motion of the Earth-Moon barycenter.

Initially, the lunar coordinates given by this solution are referred to the dynamical mean ecliptic of the date. The change to the equatorial frame of the Celestial Ephemeris Pole (J2000) is carried out by analytical expressions of the precession-nutation. The solution ELP96 is fitted to the Lunar Laser Ranging observations made from 1972 until 2010.

INPOP10-a: INPOP solutions are numerical ephemerides fitted on planetary and lunar observations. They are described in "INPOP06: a new numerical planetary ephemeris" (Fienga et al., 2008) and "INPOP08, a 4-D planetary ephemeris: from asteroid and time-scale computations to ESA Mars Express and Venus Express contributions" (Fienga et al. 2009).

They are available at www.imcce.fr/inpop.

LLR observations are reduced with a model consistent with IERS Conventions 2003, including tectonic plate motion, solid tides effects, ocean and atmospheric loading, polar tide, relativistic light deviation and tropospheric time delay.

NOT YET AVAILABLE

Pointing towards the Moon.



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HELP HOME

GO

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Results area

Pointing towards the Moon.

Lunar Laser Ranging Service
Paris Observatory Lunar Analysis Center

Prediction for future LLR Observations :

Preview area:
In this area, a preview of the prediction requested by the user of this web interface is displayed. The format of this prediction is a format we developed recently and that we named **TPF** (for **T**opocentric **P**rediction **F**ormat.)

GO

```
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```

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Pointing towards the Moon.

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Default Values

HELP HOME

Current Predictions Repositories : CPF TPF

Critics and suggestions are welcome (polac.contact at obspm.fr)

Area for downloading prediction:

In this area, the prediction requested can be downloaded under **TPF** or **CPF** format.

Pointing towards the Moon.

The screenshot shows the Lunar Laser Ranging Service website interface. The main heading is "Lunar Laser Ranging Service" with the Paris Observatory Lunar Analysis Center logo. The page is titled "Prediction for future LLR Observations :".

Parameters:

- Ephemerides: ELP96 INPOP10a
- Sites: GRASSE
- Targets: APOLLO 15
- Year: 2011
- Month: 2
- Day: 14
- Hour: 19
- Minute: 0
- Second: 0
- Step: 30 (min)
- Number of Points: 20
- Temperature (°C): Default (7.1)

GO

LLR SERVICE / PREDICTION - Ref : ELP96 #1101.00 FIT IERS02CEP

Site : GRASSE
Target : APOLLO 15
Pressure : 852.5 milliBar
Temperature : 7.1 degrees Celsius
Humidity : 32.0 %
Wavelength : 0.532 micrometers

RESULTS TPF (TOPOCENTRIC PREDICTION FORMAT) :
/ Number / Date / Time (UTC) / Modified Julian Date at 0h / Seconds of Day (UT)
/ Rectangular coordinates X, Y, Z in the Equatorial Frame J2000 (meter) /
/ Right Ascension (degree) / Declination (degree) / Azimuth (degree) /
/ Zenith Distance (degree) / Refraction (degree) /
/ Light Time for the reflectors (second) /

00001	2011/02/14	19:00:00	55606	68400.0	-48399786.632	336508507.319	140355
00002	2011/02/14	19:30:00	55606	70200.0	-49638668.317	336128805.761	140054
00003	2011/02/14	20:00:00	55606	72000.0	-50867763.560	335819574.259	139751
00004	2011/02/14	20:30:00	55606	73800.0	-52097430.508	335581263.446	139443
00005	2011/02/14	21:00:00	55606	75600.0	-53337996.916	335412958.492	139132
00006	2011/02/14	21:30:00	55606	77400.0	-54599581.666	335312394.819	138818
00007	2011/02/14	22:00:00	55606	79200.0	-55891919.877	335275997.045	138500
00008	2011/02/14	22:30:00	55606	81000.0	-57224194.616	335298940.477	138179
00009	2011/02/14	23:00:00	55606	82800.0	-58604878.105	335375234.105	137854
00010	2011/02/14	23:30:00	55606	84600.0	-60041585.158	335497823.668	137525
00011	2011/02/15	00:00:00	55607	0.0	-61540941.365	335658713.010	137194

[Download Prediction with cpf format \(right click and save as ...\)](#)
[Download Prediction with tpf format \(right click and save as ...\)](#)

Current Predictions Repositories :

Current predictions repositories:

In this area, daily predictions are available under CPF or TPF format for all the lunar targets. They are computed for 3 days since the current date with a step of 30min and they are updated each day at 10:30am (Paris Local time) just after the **EOP** daily solution produced by IERS EOP product center.

Pointing towards the Moon.

- About the Prediction Formats :

- The **TPF** format gives the topocentric coordinates, that is to say, the direction of a lunar target from the terrestrial site of observations. A prediction with this format is different for each terrestrial sites.
- The **CPF** format gives the geocentric coordinates of a lunar target. A prediction under this format is the same for all terrestrial sites but each user has to make an adjustment for taking into account his local position.

Pointing towards the Moon.

- About the Prediction Formats (*description extracted from the HELP of the Web Interface*) :

Format TPF : Topocentric coordinates

In this format there is at first a summary of the characteristics of the prediction (records 1 to 17): Ephemerides, Site, Target and Parameters. The actual results start at the record 18. The user can save these results with the commands Copy/Paste (or Ctrl-C/Ctrl-V). These data allow to determinate which is the direction to point from the selected site of observation for reaching the selected target on the surface of the Moon.

These results are displayed in the following order (see Annex 1):

- Number of the point,
- Date (Year, Month, Day),
- Time UTC (Hour, Minute, Second),
- Modified Julian Date at 0h,
- Seconds of Day UTC,
- Topocentric Rectangular coordinates in meter (Equatorial Frame J2000),
- Topocentric Right Ascension & Declination in degree,
- Azimuth & Zenith Distance (without refraction) in degree,
- Light Time in second when the target is a reflector.

Everyday day, these data are computed for 3 days: 150 points since the current date 0h with an interval of 30 minutes (1800 seconds). They are available in directories corresponding to the stations: APOLLO, GRASSE, MLRS2, MATERA, KOGANEI, WETTZELL in files with the generic name: "lir_serv_TargetName-Day-Month-Year.tpf".

The user can get them with the key: Current Predictions Repositories TPF.

Pointing towards the Moon.

- About the Prediction Formats (*description extracted from the HELP of the Web Interface*) :

Format CPF : Geocentric coordinates

The prediction can also be computed with the format CPF (acronym for Consolidated Laser Ranging Prediction Format) created by the ILRS Predictions Formats Study Group for satellite laser ranging and lunar laser ranging. For using CPF format (documentation and sample code for local adjustments), see at this address:

http://ilrs.gsfc.nasa.gov/products_formats_procedures/predictions/index.html

For Lunar Laser Ranging, the sequence of records is typically as follows (see Annex 2):

- 00 Comments.
- H1 Header Type 1: Ephemeris source, Date of ephemeris production, Target name.
- H2 Header Type 2: Target index, Starting date and time, Ending date and time.
- H9 Header Type 9: End of File Footer.
- 10 Record Type 10: MJD, Seconds of Day, Geocentric rectangular positions (Transmit / Receiver).
- 30 Record Type 30: Stellar aberration, Relativistic range correction (Transmit).
- 99 Record Type 99: Ephemeris trailer.

Everyday day, these data are computed for 3 days: 150 points since the current date 0h with an interval of 30 minutes (1800 seconds).

They are available in files with the generic name: "llr_serv_*TargetName-Day-Month-Year*.tpf".

The user can get them with the key: Current Predictions Repositories CPF.





Applications Raccourcis Système Mozilla Firefox lun. 7 févr., 19:41

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http://polac.obspm.fr/PaV/ apercu - Dictionnaire Fran... http://polac.o...dexValid.html



Lunar Laser Ranging Service

Paris Observatory Lunar Analysis Center

Beta Version

[Prediction for future LLR Observations](#) [Validation of past LLR Observations](#)

[HELP](#) [HOME](#)

Developed by : C. Barache, S. Bouquillon, T. Carlucci, F. Deleflie, D. Feraudy, G. Francou, H. Manche, E. Samain, J-M. Torre & W. Zerhouni
Acknowledgments to Randall Ricklefs & to Pierre Tessandier for their helps.

Terminé

[bouquillon@pcbouqu... [BERN2011 - Navigat... [ISSI_2011.odp - Open... [Courrier entrant - Mo... Mozilla Firefox [JSR2010 - Navigateur...

First Validation of LLR normal Points.



Applications Raccourcis Système Mozilla Firefox lun. 7 févr., 19:32

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http://polac...ndexPred.html W faciliter - Dictionnaire Fran... http://polac.o...dexValid.html

 **Lunar Laser Ranging Service** 

Paris Observatory Lunar Analysis Center

Validation of past LLR Observations :

Ephemerides : ELP96 INPOP10a
Format : MINI CSTG CRD

Please, enter your LLR normal points in the area below :

5119871012233117486916126297157660987401910	6	05201105	85300	50	0	5320a
5119871012235004873258726280567766329401910	4	07608	35	85300	5072	5320a
5119871013011307053117126217469840300401910	9	05709	67	85300	5255	5320a
5119871013014819685043226197305667975401910	9	05409	60	85300	5255	5320a
5119871013021559908215326184811743533401910	12	05805100	85300	5055	5320a	
5119871013023252626434326178753673865401910	5	07100	18	85300	5055	5320a
5119871013032007786105626168512771693401910	7	06006	36	85300	5055	5320a
5119871013034055826281126167279062366401910	6	06401	21	85300	5055	5320a
5119871013235221763810426539151442103401910	6	5300	42	85700	10053	5320a
5119871014041711895746926365591980764401910	3	6100450	85700	9658	5320a	
5119871014044734172282426363465928185401910	19	5100120	85700	7975	5320a	

GO

Clear

Generate an exemple of LLR Normal Points file with format MINI

Generate an exemple of LLR Normal Points file with format CSTG

Generate an exemple of LLR Normal Points file with format CRD

HELP HOME

Critics and suggestions are welcome (polac.contact at obsprm.fr)

LLR SERVICE / RESIDUALS - Ref : ELP96 #1101.00 FIT IERS02CEP

00001	1987/10/12	23h 31m 17s4869161	Lunakhod 2	Grasse	-0.043 m	-0.284 ns
00002	1987/10/12	23h 50m 04s8732587	Lunakhod 2	Grasse	0.043 m	0.290 ns
00003	1987/10/13	01h 13m 07s0531171	Lunakhod 2	Grasse	-0.017 m	-0.115 ns
00004	1987/10/13	01h 48m 19s6850432	Lunakhod 2	Grasse	-0.007 m	-0.049 ns
00005	1987/10/13	02h 15m 59s9082153	Lunakhod 2	Grasse	-0.081 m	-0.538 ns
00006	1987/10/13	02h 32m 52s6264343	Lunakhod 2	Grasse	-0.044 m	-0.294 ns
00007	1987/10/13	03h 20m 07s7861056	Lunakhod 2	Grasse	-0.133 m	-0.886 ns
00008	1987/10/13	03h 40m 55s8262811	Lunakhod 2	Grasse	-0.170 m	-1.133 ns
00009	1987/10/13	23h 52m 21s7638104	Lunakhod 2	Grasse	0.026 m	0.175 ns
00010	1987/10/14	04h 17m 11s8957469	Lunakhod 2	Grasse	-0.080 m	-0.535 ns
00011	1987/10/14	04h 47m 34s1722824	Lunakhod 2	Grasse	-0.134 m	-0.894 ns
00012	1987/10/17	04h 09m 01s1112443	Apollo 15	Grasse	0.095 m	0.637 ns
00013	1987/10/17	04h 30m 47s4253015	Apollo 15	Grasse	0.128 m	0.856 ns
00014	1987/10/17	05h 02m 29s3328607	Apollo 15	Grasse	0.099 m	0.662 ns
00015	1987/10/17	05h 34m 50s0082027	Apollo 15	Grasse	0.085 m	0.570 ns
00016	1987/10/18	03h 12m 14s4013468	Apollo 15	Grasse	-0.042 m	-0.283 ns
00017	1987/10/18	03h 34m 46s1977089	Apollo 15	Grasse	0.110 m	0.733 ns
00018	1987/10/18	03h 47m 29s1821324	Apollo 15	Grasse	0.090 m	0.604 ns
00019	1987/10/18	03h 59m 54s8907994	Lunakhod 2	Grasse	0.072 m	0.479 ns
00020	1987/10/18	04h 21m 50s2436903	Apollo 15	Grasse	0.075 m	0.498 ns

Normal Points : 00020
Valid : 00020
Wrong (***) : 00000 Limit: 1.000 m

[\(O-C\) graphics interface](#)

Terminé

[bouquillon@pcbou... [BERN2011 - Naviga... [ISSI_2011.odp - Op... [Courrier entrant - M... Mozilla Firefox [JSR2010 - Navigate... [*llr_residuals_1990... Residuals.png-4.0 (R...

First Validation of LLR normal Points.

Applications Raccourcis Système Mozilla Firefox

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Observatoire SYRTE *Ace* Lunar Laser Ranging Service Observatoire GeAZUR

Paris Observatory Lunar Analysis Center

Validation of past LLR Observations :

Ephemerides : ELP96 INPOP10a
Format : MINI CSTG CRD

Please, enter your LLR normal points in the area below :

5119871012233117486916126297157660987401910	6	05201105	85300	50	0	5320a
5119871012235004873258726280567766329401910	4	07608	35	85300	5072	5320a
5119871013011307053117126217469840300401910	9	05709	67	85300	5255	5320a
5119871013014819685043226197305667975401910	9	05409	60	85300	5255	5320a
5119871013021559908215326184811743533401910	12	05805100	85300	5055	5320a	
5119871013023252626434326178753673865401910	5	07100	18	85300	5055	5320a
5119871013032007786105626168512771693401910	7	06006	36	85300	5055	5320a
5119871013034055826281126167279062366401910	6	06401	21	85300	5055	5320a
5119871013235221763810426539151442103401910	6	5300	42	85700	10053	5320a
5119871014041711895746926365591980764401910	3	6100450	85700	9658	5320a	
5119871014044734172282426363465928185401910	19	5100120	85700	7975	5320a	

GO

Clear

Generate an exemple of LLR Normal Points file with format MINI

Generate an exemple of LLR Normal Points file with format CSTG

Generate an exemple of LLR Normal Points file with format CRD

HELP HOME

Critics and suggestions are welcome (polac.contact at obsprm.fr)

Submission area

```
LLR SERVICE / RESIDUALS - Ref : ELP96 #1101.00 FIT IERS02CEP
00001 1987/10/12 23h 31m 17s4869161 Lunakhod 2 Grasse -0.043 m -0.284 ns
00002 1987/10/12 23h 50m 04s8732587 Lunakhod 2 Grasse 0.043 m 0.290 ns
00003 1987/10/13 01h 13m 07s0531171 Lunakhod 2 Grasse -0.017 m -0.115 ns
00004 1987/10/13 01h 48m 19s6850432 Lunakhod 2 Grasse -0.007 m -0.049 ns
00005 1987/10/13 02h 15m 59s9082153 Lunakhod 2 Grasse -0.081 m -0.538 ns
00006 1987/10/13 02h 32m 52s6264343 Lunakhod 2 Grasse -0.044 m -0.294 ns
00007 1987/10/13 03h 20m 07s7861056 Lunakhod 2 Grasse -0.133 m -0.886 ns
00008 1987/10/13 03h 40m 55s8262811 Lunakhod 2 Grasse -0.170 m -1.133 ns
00009 1987/10/13 23h 52m 21s7638104 Lunakhod 2 Grasse 0.026 m 0.175 ns
00010 1987/10/14 04h 17m 11s8957469 Lunakhod 2 Grasse -0.080 m -0.535 ns
00011 1987/10/14 04h 47m 34s1722824 Lunakhod 2 Grasse -0.134 m -0.894 ns
00012 1987/10/17 04h 09m 01s1112443 Apollo 15 Grasse 0.095 m 0.637 ns
00013 1987/10/17 04h 30m 47s4253015 Apollo 15 Grasse 0.128 m 0.856 ns
00014 1987/10/17 05h 02m 29s3328607 Apollo 15 Grasse 0.099 m 0.662 ns
00015 1987/10/17 05h 34m 50s0082027 Apollo 15 Grasse 0.085 m 0.570 ns
00016 1987/10/18 03h 12m 14s4013468 Apollo 15 Grasse -0.042 m -0.283 ns
00017 1987/10/18 03h 34m 46s1977089 Apollo 15 Grasse 0.110 m 0.733 ns
00018 1987/10/18 03h 47m 29s1821324 Apollo 15 Grasse 0.090 m 0.604 ns
00019 1987/10/18 03h 59m 54s8907994 Lunakhod 2 Grasse 0.072 m 0.479 ns
00020 1987/10/18 04h 21m 50s2436903 Apollo 15 Grasse 0.075 m 0.498 ns

Normal Points : 00020
Valid : 00020
Wrong (***) : 00000 Limit: 1.000 m
```

(O-C) graphics interface

Terminé

[bouquillon@pcbouq... [BERN2011 - Naviga... [ISSI_2011.odp - Op... [Courrier entrant - M... Mozilla Firefox [JSR2010 - Navigate... [*llr_residuals_1990... Residuals.png-4.0 (R...

First Validation of LLR normal Points.

Applications Raccourcis Système Mozilla Firefox lun. 7 févr., 19:32

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http://polac...ndexPred.html http://faciliter - Dictionnaire Fran... http://polac.o...dexValid.html

Lunar Laser Ranging Service

Paris Observatory Lunar Analysis Center

Validation of past LLR Observations :

Ephemerides : ELP96 INPOP10a

Format : MINI CSTG CRD

Please, enter your LLR normal points in the area below :

5119871012233117486916126297157660987401910	6	05201105	85300	50	0	5320a
5119871012235004873258726280567766329401910	4	07608	35	85300	5072	5320a
5119871013011307053117126217469840300401910	9	05709	67	85300	5255	5320a
5119871013014819685043226197305667975401910	9	05409	60	85300	5255	5320a
5119871013021559908215326184811743533401910	12	05805100	85300	5055	5320a	
5119871013023252626434326178753673865401910	5	07100	18	85300	5055	5320a
5119871013032007786105626168512771693401910	7	06006	36	85300	5055	5320a
5119871013034055826281126167279062366401910	6	06401	21	85300	5055	5320a
5119871013235221763810426539151442103401910	6	5300	42	85700	10053	5320a
5119871014041711895746926365591980764401910	3	6100450	85700	9658	5320a	
5119871014044734172282426363465928185401910	19	5100120	85700	7975	5320a	

GO

Clear

Generate an exemple of LLR Normal Points file with format MINI

Generate an exemple of LLR Normal Points file with format CSTG

Generate an exemple of LLR Normal Points file with format CRD

HELP HOME

Critics and suggestions are welcome (polac.contact at obsprm.fr)

LLR SERVICE / RESIDUALS - Ref : ELP96 #1101.00 FIT IERS02CEP

00001	1987/10/12	23h 31m 17s4869161	Lunakhod 2	Grasse	-0.043 m	-0.284 ns
00002	1987/10/12	23h 50m 04s8732587	Lunakhod 2	Grasse	0.043 m	0.290 ns
00003	1987/10/13	01h 13m 07s0531171	Lunakhod 2	Grasse	-0.017 m	-0.115 ns
00004	1987/10/13	01h 48m 19s6850432	Lunakhod 2	Grasse	-0.007 m	-0.049 ns
00005	1987/10/13	02h 15m 59s9082153	Lunakhod 2	Grasse	-0.081 m	-0.538 ns
00006	1987/10/13	02h 32m 52s6264343	Lunakhod 2	Grasse	-0.044 m	-0.294 ns
00007	1987/10/13	03h 20m 07s7861056	Lunakhod 2	Grasse	-0.133 m	-0.886 ns
00008	1987/10/13	03h 40m 55s8262811	Lunakhod 2	Grasse	-0.170 m	-1.133 ns
00009	1987/10/13	23h 52m 21s7638104	Lunakhod 2	Grasse	0.026 m	0.175 ns
00010	1987/10/14	04h 17m 11s8957469	Lunakhod 2	Grasse	-0.080 m	-0.535 ns
00011	1987/10/14	04h 47m 34s1722824	Lunakhod 2	Grasse	-0.134 m	-0.894 ns
00012	1987/10/17	04h 09m 01s1112443	Apollo 15	Grasse	0.095 m	0.637 ns
00013	1987/10/17	04h 30m 47s4253015	Apollo 15	Grasse	0.128 m	0.856 ns
00014	1987/10/17	05h 02m 29s3328607	Apollo 15	Grasse	0.099 m	0.662 ns
00015	1987/10/17	05h 34m 50s0082027	Apollo 15	Grasse	0.085 m	0.570 ns
00016	1987/10/18	03h 12m 14s4013468	Apollo 15	Grasse	-0.042 m	-0.283 ns
00017	1987/10/18	03h 34m 46s1977089	Apollo 15	Grasse	0.110 m	0.733 ns
00018	1987/10/18	03h 47m 29s1821324	Apollo 15	Grasse	0.090 m	0.604 ns
00019	1987/10/18	03h 59m 54s8907994	Lunakhod 2	Grasse	0.072 m	0.479 ns
00020	1987/10/18	04h 21m 50s2436903	Apollo 15	Grasse	0.075 m	0.498 ns

Normal Points : 00020
Valid : 00020
Wrong (***) : 00000 Limit: 1.000 m

(O-C) graphics interface

Results area

Terminé

[bouquillon@pcbou... [BERN2011 - Naviga... [ISSI_2011.odp - Op... [Courrier entrant - M... Mozilla Firefox [JSR2010 - Navigat... [*llr_resid

First Validation of LLR normal Points.

Applications Raccourcis Système Mozilla Firefox lun. 7 févr., 19:32

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http://polac...ndexPred.html W faciliter - Dictionnaire Fran... http://polac.o...dexValid.html

Observatoire *SYRTE* *Ace* **Lunar Laser Ranging Service** Observatoire *Ge* *AZUR*

Paris Observatory Lunar Analysis Center

Validation of past LLR Observations :

Ephemerides : ELP96 INPOP10a

Format : MINI CSTG CRD

Please, enter your LLR normal points in the area below :

5119871012233117486916126297157660987401910	6	05201105	85300	50	0	5320a
5119871012235004873258726280567766329401910	4	07608	35	85300	5072	5320a
5119871013011307053117126217469840300401910	9	05709	67	85300	5255	5320a
5119871013014819685043226197305667975401910	9	05409	60	85300	5255	5320a
5119871013021559908215326184811743533401910	12	05805100	85300	5055	5320a	
5119871013023252626434326178753673865401910	5	07100	18	85300	5055	5320a
5119871013032007786105626168512771693401910	7	06006	36	85300	5055	5320a
5119871013034055826281126167279062366401910	6	06401	21	85300	5055	5320a
5119871013235221763810426539151442103401910	6	5300	42	85700	10053	5320a
5119871014041711895746926365591980764401910	3	6100450	85700	9658	5320a	
5119871014044734172282426363465928185401910	19	5100120	85700	7975	5320a	

GO

Clear

Generate an exemple of LLR Normal Points file with format MINI

Generate an exemple of LLR Normal Points file with format CSTG

Generate an exemple of LLR Normal Points file with format CRD

LLR SERVICE / RESIDUALS - Ref : ELP96 #1101.00 FIT IERS02CEP

00001	1987/10/12	23h 31m 17s4869161	Lunakhod 2	Grasse	-0.043 m	-0.284 ns
00002	1987/10/12	23h 50m 04s8732587	Lunakhod 2	Grasse	0.043 m	0.290 ns
00003	1987/10/13	01h 13m 07s0531171	Lunakhod 2	Grasse	-0.017 m	-0.115 ns
00004	1987/10/13	01h 48m 19s6850432	Lunakhod 2	Grasse	-0.007 m	-0.049 ns
00005	1987/10/13	02h 15m 59s9082153	Lunakhod 2	Grasse	-0.081 m	-0.538 ns
00006	1987/10/13	02h 32m 52s6264343	Lunakhod 2	Grasse	-0.044 m	-0.294 ns
00007	1987/10/13	03h 20m 07s7861056	Lunakhod 2	Grasse	-0.133 m	-0.886 ns
00008	1987/10/13	03h 40m 55s8262811	Lunakhod 2	Grasse	-0.170 m	-1.133 ns
00009	1987/10/13	23h 52m 21s7638104	Lunakhod 2	Grasse	0.026 m	0.175 ns
00010	1987/10/14	04h 17m 11s8957469	Lunakhod 2	Grasse	-0.080 m	-0.535 ns
00011	1987/10/14	04h 47m 34s1722824	Lunakhod 2	Grasse	-0.134 m	-0.894 ns
00012	1987/10/17	04h 09m 01s1112443	Apollo 15	Grasse	0.095 m	0.637 ns
00013	1987/10/17	04h 30m 47s4253015	Apollo 15	Grasse	0.128 m	0.856 ns
00014	1987/10/17	05h 02m 29s3328607	Apollo 15	Grasse	0.099 m	0.662 ns
00015	1987/10/17	05h 34m 50s0082027	Apollo 15	Grasse	0.085 m	0.570 ns
00016	1987/10/18	03h 12m 14s4013468	Apollo 15	Grasse	-0.042 m	-0.283 ns
00017	1987/10/18	03h 34m 46s1977089	Apollo 15	Grasse	0.110 m	0.733 ns
00018	1987/10/18	03h 47m 29s1821324	Apollo 15	Grasse	0.090 m	0.604 ns
00019	1987/10/18	03h 59m 54s8907994	Lunakhod 2	Grasse	0.072 m	0.479 ns
00020	1987/10/18	04h 21m 50s2436903	Apollo 15	Grasse	0.075 m	0.498 ns

Normal Points : 00020
Valid : 00020
Wrong (***) : 00000 Limit: 1.000 m

[\(O-C\) graphics interface](#)

HELP HOME

Critics and suggestions are welcome (polac.contact at obsprm.fr)

Submission area

Terminé

[bouquillon@pcbouq... [BERN2011 - Naviga... [ISSI_2011.odp - Op... [Courrier entrant - M... Mozilla Firefox [JSR2010 - Navigate... [*llr_residuals_1990... Residuals.png-4.0 (R...

First Validation of LLR normal Points.



Applications Raccourcis Système Mozilla Firefox lun. 7 févr., 19:32

Fichier Edition Affichage Historique Marque-pages Outils Aide

http://polac.obsprm.fr/PaV/indexValid.html la mediterranee paris

Courriel Meteo Dico Astro Reservations PagesJaunes Cinema Cartes Les Roches - La Ma... MissionCNRS Transport Nara

http://polac...ndexPred.html http://faciliter - Dictionnaire Fran... http://polac.o...dexValid.html

 **Lunar Laser Ranging Service** 

Paris Observatory Lunar Analysis Center

Validation of past LLR Observations :

Ephemerides : ELP96 INPOP10a

Format : MINI CSTG CRD

Please, enter your LLR normal points in the area below :

5119871012233117486916126297157660987401910	6	05201105	85300	50	0	5320a
5119871012235004873258726280567766329401910	4	07608	35	85300	5072	5320a
5119871013011307053117126217469840300401910	9	05709	67	85300	5255	5320a
5119871013014819685043226197305667975401910	9	05409	60	85300	5255	5320a
5119871013021559908215326184811743533401910	12	05805100	85300	5055	5320a	
5119871013023252626434326178753673865401910	5	07100	18	85300	5055	5320a
5119871013032007786105626168512771693401910	7	06006	36	85300	5055	5320a
5119871013034055826281126167279062366401910	6	06401	21	85300	5055	5320a
5119871013235221763810426539151442103401910	6	5300	42	85700	10053	5320a
5119871014041711895746926365591980764401910	3	6100450	85700	9658	5320a	
5119871014044734172282426363465928185401910	19	5100120	85700	7975	5320a	

GO

Clear

Generate an exemple of LLR Normal Points file with format MINI

Generate an exemple of LLR Normal Points file with format CSTG

Generate an exemple of LLR Normal Points file with format CRD

HELP HOME

Critics and suggestions are welcome (polac.contact at obsprm.fr)

Available Lunar solutions

LLR SERVICE / RESIDUALS - Ref : ELP96 #1101.00 F11 IERS02CEP

00001	1987/10/12	23h 31m 17s4869161	Lunakhod 2	Grasse	-0.043 m	-0.284 ns
00002	1987/10/12	23h 50m 04s8732587	Lunakhod 2	Grasse	0.043 m	0.290 ns
00003	1987/10/13	01h 13m 07s0531171	Lunakhod 2	Grasse	-0.017 m	-0.115 ns
00004	1987/10/13	01h 48m 19s6850432	Lunakhod 2	Grasse	-0.007 m	-0.049 ns
00005	1987/10/13	02h 15m 59s9082153	Lunakhod 2	Grasse	-0.081 m	-0.538 ns
00006	1987/10/13	02h 32m 52s6264343	Lunakhod 2	Grasse	-0.044 m	-0.294 ns
00007	1987/10/13	03h 20m 07s7861056	Lunakhod 2	Grasse	-0.133 m	-0.886 ns
00008	1987/10/13	03h 40m 55s8262811	Lunakhod 2	Grasse	-0.170 m	-1.133 ns
00009	1987/10/13	23h 52m 21s7638104	Lunakhod 2	Grasse	0.026 m	0.175 ns
00010	1987/10/14	04h 17m 11s8957469	Lunakhod 2	Grasse	-0.080 m	-0.535 ns
00011	1987/10/14	04h 47m 34s1722824	Lunakhod 2	Grasse	-0.134 m	-0.894 ns
00012	1987/10/17	04h 09m 01s1112443	Apollo 15	Grasse	0.095 m	0.637 ns
00013	1987/10/17	04h 30m 47s4253015	Apollo 15	Grasse	0.128 m	0.856 ns
00014	1987/10/17	05h 02m 29s3328607	Apollo 15	Grasse	0.099 m	0.662 ns
00015	1987/10/17	05h 34m 50s0082027	Apollo 15	Grasse	0.085 m	0.570 ns
00016	1987/10/18	03h 12m 14s4013468	Apollo 15	Grasse	-0.042 m	-0.283 ns
00017	1987/10/18	03h 34m 46s1977089	Apollo 15	Grasse	0.110 m	0.733 ns
00018	1987/10/18	03h 47m 29s1821324	Apollo 15	Grasse	0.090 m	0.604 ns
00019	1987/10/18	03h 59m 54s8907994	Lunakhod 2	Grasse	0.072 m	0.479 ns
00020	1987/10/18	04h 21m 50s2436903	Apollo 15	Grasse	0.075 m	0.498 ns

Normal Points : 00020
Valid : 00020
Wrong (***) : 00000 Limit: 1.000 m

[\(O-C\) graphics interface](#)

Terminé

[bouquillon@pcbou... [BERN2011 - Naviga... [ISSI_2011.odp - Op... [Courrier entrant - M... Mozilla Firefox [JSR2010 - Navigat... [*llr_residuals_1990... Residuals.png-4.0 (R...

First Validation of LLR normal Points.

The screenshot shows the 'Lunar Laser Ranging Service' website from the Paris Observatory Lunar Analysis Center. The page is titled 'Validation of past LLR Observations :'. It features a form for entering LLR normal points, with a 'GO' button and a 'Clear' button. Below the form are three buttons to generate example files in MINI, CSTG, and CRD formats. A 'HELP' and 'HOME' button are also present. The page includes logos for Observatoire de Paris, SYRTE, and GeO AZUR. A text box on the right side of the page contains a table of LLR SERVICE / RESIDUALS data for the reference ELP96 #1101.00 FIT IERS02CEP. The table lists observation numbers, dates, times, station names, and residual values in meters and nanoseconds. A red box highlights the 'User's data capture area' where users paste their own data. A red arrow points from this box to the input area of the form. The page footer includes the text 'Critics and suggestions are welcome (polac.contact at obspm.fr)' and a 'Terminé' status.

Lunar Laser Ranging Service
Paris Observatory Lunar Analysis Center

Validation of past LLR Observations :

Ephemerides : ELP96 INPOP10a
Format : MINI CSTG CRD

Please, enter your LLR normal points in the area below :

5119871012233117486916126297157660987401910	6	05201105	85300	50	0	5320a
5119871012235004873258726280567766329401910	4	07608	35	85300	5072	5320a
5119871013011307053117126217469840300401910	9	05709	67	85300	5255	5320a
5119871013014819685043226197305667975401910	9	05409	60	85300	5255	5320a
5119871013021559908215326184811743533401910	12	05805100	85300	5055	5320a	
5119871013023252626434326178753673865401910	5	07100	18	85300	5055	5320a
5119871013022007786105626168512771693401910	7	06006	36	85300	5055	5320a
5119871013034055826281126167279062366401910	6	06401	21	85300	5055	5320a
5119871013235221763810426539151442103401910	6	5300	42	85700	10053	5320a
5119871014041711895746926365591980764401910	3	6100450	85700	9658	5320a	
5119871014044734172282426363465928185401910	19	5100120	85700	7975	5320a	

GO

Clear

Generate an exemple of LLR Normal Points file with format MINI

Generate an exemple of LLR Normal Points file with format CSTG

Generate an exemple of LLR Normal Points file with format CRD

HELP HOME

Critics and suggestions are welcome (polac.contact at obspm.fr)

Terminé

LLR SERVICE / RESIDUALS - Ref : ELP96 #1101.00 FIT IERS02CEP

00001	1987/10/12	23h 31m 17s4869161	Lunakhod 2	Grasse	-0.043 m	-0.284 ns
00002	1987/10/12	23h 50m 04s8732587	Lunakhod 2	Grasse	0.043 m	0.290 ns
00003	1987/10/13	01h 13m 07s0531171	Lunakhod 2	Grasse	-0.017 m	-0.115 ns
00004	1987/10/13	01h 48m 19s6850432	Lunakhod 2	Grasse	-0.007 m	-0.049 ns
00005	1987/10/13	01h 57m 59s9931373	Lunakhod 2	Grasse	0.001 m	0.030 ns
00006	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00007	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00008	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00009	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00010	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00011	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00012	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00013	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00014	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00015	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00016	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00017	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00018	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00019	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns
00020	1987/10/13	02h 00m 00s0000000	Lunakhod 2	Grasse	0.000 m	0.000 ns

Normal Points :
Valid :
Wrong (***) : 00000 Limit: 1.000 m

(O-C) graphics interface

First Validation of LLR normal Points.



Applications Raccourcis Système Mozilla Firefox lun. 7 févr., 19:32

Fichier Edition Affichage Historique Marque-pages Outils Aide

http://polac.obsprm.fr/PaV/indexValid.html la mediterranee paris

Courriel Meteo Astro Reservations PagesJaunes Cinema Cartes Les Roches - La Ma... MissionCNRS Transport Nara

http://polac...ndexPred.html http://polac.o...dexValid.html

 **Lunar Laser Ranging Service** 

Paris Observatory Lunar Analysis Center

Validation of past LLR Observations :

Ephemerides : ELP96 INPOP10a
Format : MINI CSTG CRD

Please, enter your LLR normal points in the area below :

5119871012233117486916126297157660987401910	6	05201105	85300	50	0	5320a
5119871012235004873258726280567766329401910	4	07608	35	85300	5072	5320a
5119871013011307053117126217469840300401910	9	05709	67	85300	5255	5320a
5119871013014819685043226197305667975401910	9	05409	60	85300	5255	5320a
5119871013021559908215326184811743533401910	12	05805100	85300	5055	5320a	
5119871013023252626434326178753673865401910	5	07100	18	85300	5055	5320a
5119871013032007786105626168512771693401910	7	06006	36	85300	5055	5320a
5119871013034055826281126167279062366401910	6	06401	21	85300	5055	5320a
5119871013235221763810426539151442103401910	6	5300	42	85700	10053	5320a
5119871014041711895746926365591980764401910	3	6100450	85700	9658	5320a	
5119871014044734172282426363465928185401910	19	5100120	85700	7975	5320a	

GO

Clear

Generate an exemple of LLR Normal Points file with format MINI

Generate an exemple of LLR Normal Points file with format CSTG

Generate an exemple of LLR Normal Points file with format CRD

HELP HOME

Critics and suggestions are welcome (polac.contact at obsprm.fr)

LLR SERVICE / RESIDUALS - Ref : ELP96 #1101.00 FIT IERS02CEP

00001	1987/10/12	23h	31m	17s4869161	Lunakhod 2	Grasse	-0.043 m	-0.284 ns
00002	1987/10/12	23h	50m	04s8732587	Lunakhod 2	Grasse	0.043 m	0.290 ns
00003	1987/10/13	01h	13m	07s0531171	Lunakhod 2	Grasse	-0.017 m	-0.115 ns
00004	1987/10/13	01h	48m	19s6850432	Lunakhod 2	Grasse	-0.007 m	-0.049 ns
00005	1987/10/13	02h	15m	59s9082153	Lunakhod 2	Grasse	-0.081 m	-0.538 ns
00006	1987/10/13	02h	32m	52s6264343	Lunakhod 2	Grasse	-0.044 m	-0.294 ns
00007	1987/10/13	03h	20m	07s7861056	Lunakhod 2	Grasse	-0.133 m	-0.886 ns
00008	1987/10/13	03h	40m	55s8262811	Lunakhod 2	Grasse	-0.170 m	-1.133 ns
00009	1987/10/13	23h	52m	21s7638104	Lunakhod 2	Grasse	0.026 m	0.175 ns
00010	1987/10/14	04h	17m	11s8957469	Lunakhod 2	Grasse	-0.080 m	-0.535 ns
00011	1987/10/14	04h	47m	34s1722824	Lunakhod 2	Grasse	-0.134 m	-0.894 ns
00012	1987/10/17	04h	09m	01s1112443	Apollo 15	Grasse	0.095 m	0.637 ns
00013	1987/10/17	04h	30m	47s4253015	Apollo 15	Grasse	0.128 m	0.856 ns
00014	1987/10/17	05h	02m	29s3328607	Apollo 15	Grasse	0.099 m	0.662 ns
00015	1987/10/17	05h	34m	50s0082027	Apollo 15	Grasse	0.085 m	0.570 ns
00016	1987/10/18	03h	12m	14s4013468	Apollo 15	Grasse	-0.042 m	-0.283 ns
00017	1987/10/18	03h	34m	46s1977089	Apollo 15	Grasse	0.110 m	0.733 ns
00018	1987/10/18	03h	47m	29s1821324	Apollo 15	Grasse	0.090 m	0.604 ns
00019	1987/10/18	03h	59m	54s8907994	Lunakhod 2	Grasse	0.072 m	0.479 ns
00020	1987/10/18	04h	21m	50s2436903	Apollo 15	Grasse	0.075 m	0.498 ns

Normal Points : 00020
Valid : 00020
Wrong (***) : 00000 Limit: 1.000 m

(O-C) graphics interface

Sample of Data Submission with MINI, CSTG or CRD format.

Terminé

[bouquillon@pcbouq... [BERN2011 - Naviga... [ISSI_2011.odp - Op... [Courrier entrant - M... Mozilla Firefox [JSR2010 - Navigate... [*llr_residuals_1990... Residuals.png-4.0 (R...

First Validation of LLR normal Points.

- About the Normal Points Formats (*description extracted from the Help of the Web Interface*) :

Format MINI

This format is used since the 1980's for the LLR observations performed by the McDonald Laser Ranging Station (Texas, USA), by the Lunar Laser Ranging Experiment (LURE) Observatory (Haleakala, Hawaii) between 1984 and 1990 and by CERGA (Grasse, France). It is also used presently by the Apache Point Observatory (New Mexico, USA).

The specifications of this format are given at this address:

http://www.physics.ucsd.edu/~tmurphy/apollo/norm_pts.html

Format CSTG

This format is recommended since 1990 and officially adopted by ILRS in 1999 for the SLR and LLR observations (revised in March 1997 and August 2004). There are two types of record: Header and Data records.

The specifications of this format are given at this address:

http://ilrs.gsfc.nasa.gov/products_formats_procedures/normal_point/np_format.html

Format CRD

This format has been built recently by R.L. Ricklefs (University of Texas, Austin) and C.J. Moore (EOS Sapce System Pty. Ltd.) under the name Consolidated Laser Ranging Data Format. There are three types of record: Header, Configuration and Data records.

The specifications of this format are given at this address:

http://ilrs.gsfc.nasa.gov/products_formats_procedures/crd.html

First Validation of LLR normal Points.

Mozilla Firefox

http://polac.obspm.fr/PaV/IndexValid.html

LUNAR LASER RANGING SERVICE

Paris Observatory Lunar Analysis Center

Validation of past LLR Observations :

Ephemerides : ELP96 INPOP10a

Format : MINI CSTG CRD

Please, enter your LLR normal points in the area below :

```
99999
0000103000137845780153200016425400003001942764103991391
731186731431513503242764000039908732271005500260223000
99999
000010300014708024195320-00017470000002202463104725071
066240862323490806689182000047308099279804500050260394
99999
0000103000157845780153200016429900003002242764103901351
751151309259436075570206000039008768274406300740221500
99999
0000103000157845780153200016433300003002272764103621261
```

GO

Clear

Generate an exemple of LLR Normal Points file with format MINI

Generate an exemple of LLR Normal Points file with format CSTG

HELP HOME

Developed by : C. Barache, S. Bouquillon, T. Carucci, F. Deleffie, D. Feraudy, G. Francou, H. Manche, E. Samain & J-M. Torre

```
00006 1910 3 20000116 184600.3949065 2.4017942374030s 0.0049m 0.0325ns
00007 1910 2 20000116 185710.3422887 2.4010547531250s 0.0233m 0.1557ns
00008 1910 3 20000116 190851.0404788 2.4009653197260s 0.0183m 0.1223ns
00009 1910 3 20000116 192754.9054263 2.4004875736110s 0.0102m 0.0681ns
00010 1910 2 20000116 193906.0778061 2.399873773040s 0.0176m 0.1174ns
00011 1910 2 20000116 200235.6093546 2.3998015859340s 0.0370m 0.2465ns
00012 1910 3 20000116 201306.5335845 2.4001330005080s 0.0080m 0.0536ns
00013 1910 3 20000116 203823.8612687 2.4004048179700s 0.0177m 0.1181ns
00014 1910 2 20000116 205105.0878678 2.4003363724220s 0.0079m 0.0526ns
00015 1910 3 20000116 210122.1450114 2.4009348195420s 0.0025m 0.0167ns
00016 1910 3 20000116 221121.16229576 2.4040937863280s -0.0090m -0.0602ns
00017 71112 3 20000117 072108.2244945 2.4012100681630s 0.3111m 2.0757ns
00018 1910 3 20000117 182653.4376673 2.3781317753930s -0.0052m -0.0347ns
00019 1910 3 20000117 185124.3903713 2.3764394383790s 0.0046m 0.0309ns
00020 1910 2 20000117 190642.4202007 2.3752609587180s 0.0072m 0.0478ns
```

Normal Points : 20 obs.
Valid : 19 obs.
Wrong (***) : 1 obs. Limit: 0.750 m

Reflector 2 : 5 obs. Bias: 0.019 m St.dev.: 0.011 m
0.124 ns 0.073 ns

Reflector 3 : 14 obs. Bias: 0.032 m St.dev.: 0.079 m
0.211 ns 0.529 ns

Global : 19 obs. Bias: 0.028 m St.dev.: 0.069 m
0.188 ns 0.457 ns

[\(O-C\) graphics interface](#)

Results area

Terminé

First Validation of LLR normal Points.

LUNAR LASER RANGING SERVICE
Paris Observatory Lunar Analysis Center

Validation of past LLR Observations :

Ephemerides : ELP96 INPOP10a
Format : MINI CSTG CRD

Please, enter your LLR normal points in the area below :

```
99999
0000103000137845780153200016425400003001942764103991391
731186731431513503242764000039908732271005500260223000
99999
000010300014708024195320-00017470000002202463104725071
066240862323490806689182000047308099279804500050260394
99999
0000103000157845780153200016429900003002242764103991351
751151309259436075570206000039008768274406300740221500
```

00006	1910	3	20000116	184600.3949065	2.4017942374030s	0.0049m	0.0325ns
00007	1910	2	20000116	185710.3422887	2.4010547531250s	0.0233m	0.1557ns
00008	1910	3	20000116	190851.0404788	2.4009653197260s	0.0183m	0.1223ns
00009	1910	3	20000116	192754.9054263	2.4004875736110s	0.0102m	0.0681ns
00010	1910	2	20000116	193906.0778061	2.3999873773040s	0.0176m	0.1174ns
00011	1910	2	20000116	200235.6093546	2.3998015859340s	0.0370m	0.2465ns
00012	1910	3	20000116	201306.5335845	2.4001330005080s	0.0080m	0.0536ns
00013	1910	3	20000116	203823.8612687	2.4004048179700s	0.0177m	0.1181ns
00014	1910	2	20000116	205105.0878678	2.4003363724220s	0.0079m	0.0526ns
00015	1910	3	20000116	210122.1450114	2.4009348195420s	0.0025m	0.0167ns
00016	1910	3	20000116	221121.6229576	2.4040937863280s	-0.0090m	-0.0602ns
00017	71112	3	20000117	072108.2244945	2.4012100681630s	0.3111m	2.0757ns
00018	1910	3	20000117	182653.4376673	2.3781317753930s	-0.0052m	-0.0347ns
00019	1910	3	20000117	185124.3903713	2.3764394383790s	0.0046m	0.0309ns
00020	1910	2	20000117	190642.4202007	2.3752609587180s	0.0072m	0.0478ns

nts : 20 obs.
: 19 obs.
) : 1 obs. Limit: 0.750 m
2 : 5 obs. Bias: 0.019 m St.dev.: 0.011 m
 0.724 ns 0.073 ns
3 : 14 obs. Bias: 0.032 m St.dev.: 0.079 m
 0.211 ns 0.529 ns
: 19 obs. Bias: 0.028 m St.dev.: 0.069 m
 0.188 ns 0.457 ns

[Physics interface](#)

Results of validation process:

The lines in this area are the results of validation process for each submitted LLR observation.

Each line contains :

- Number of processed observation according to submission order,
- Station ID,
- Reflector Number,
- Date,
- Time,
- Observed round-trip light time in second,
- (Observed light time - Computed light time) in meter,
- (Observed light time - Computed light time) in nanosecond.

First Validation of LLR normal Points.

LUNAR LASER RANGING SERVICE
Paris Observatory Lunar Analysis Center

Validation of past LLR Observations :

Ephemerides : ELP96 INPOP10a
Format : MINI CSTG CRD

Please, enter your LLR normal points in the area below :

```
99999
0000103000137845780153200016425400003001942764103991391
731186731431513503242764000039908732271005500260223000
99999
000010300014708024195320-00017470000002202463104725071
066240862323490806689182000047308099279804500050260394
99999
0000103000157845780153200016429900003002242764103901351
751151309259436075570206000039008768274406300740221500
```

00006	1910	3	20000116	184600.3949065	2.4017942374030s	0.0049m	0.0325ns
00007	1910	2	20000116	185710.3422887	2.4010547531250s	0.0233m	0.1557ns
00008	1910	3	20000116	190851.0404788	2.4009653197260s	0.0183m	0.1223ns
00009	1910	3	20000116	192754.9054263	2.4004875736110s	0.0102m	0.0681ns
00010	1910	2	20000116	193906.0778061	2.3998873773040s	0.0176m	0.1174ns
00011	1910	2	20000116	200235.6093546	2.3998015859340s	0.0370m	0.2465ns
00012	1910	3	20000116	201306.5335845	2.4001330005080s	0.0080m	0.0536ns
00013	1910	3	20000116	203823.8612687	2.4004048179700s	0.0177m	0.1181ns
00014	1910	2	20000116	205105.0878678	2.4003363724220s	0.0079m	0.0526ns
00015	1910	3	20000116	210122.1450114	2.4009348195420s	0.0025m	0.0167ns
00016	1910	3	20000116	221121.6229576	2.4040937863280s	-0.0090m	-0.0602ns
00017	71112	3	20000117	072108.2244945	2.4012100681630s	0.3111m	2.0757ns
00018	1910	3	20000117	182653.4376673	2.3781317753930s	-0.0052m	-0.0347ns
00019	1910	3	20000117	185124.3903713	2.3764394383790s	0.0046m	0.0309ns
00020	1910	2	20000117	190642.4202007	2.3752609587180s	0.0072m	0.0478ns

Statistic results:

This area gives for the LLR observations selected by the user the bias and the standard deviation of the residuals for all the retro-reflectors and for each one of them.

Normal Points :	20 obs.			
Valid :	19 obs.			
Wrong (***) :	1 obs.	Limit:	0.750 m	
Reflector 2 :	5 obs.	Bias:	0.019 m	St.dev.: 0.011 m
			0.124 ns	0.073 ns
Reflector 3 :	14 obs.	Bias:	0.032 m	St.dev.: 0.079 m
			0.211 ns	0.529 ns
Global :	19 obs.	Bias:	0.028 m	St.dev.: 0.069 m
			0.188 ns	0.457 ns

[\(O-C\) graphics interface](#)

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Terminé

First Validation of LLR normal Points.

Mozilla Firefox

http://gbot/fov/llrObs/IndexValid.html 7837 SHANGHAI LLR

Courriel, Meteo, Dico, Astro, Reservations, PagesJaunes, Cinema, Cartes, free Les Roches - La Ma..., MissionCNRS, Transport

LUNAR LASER RANGING SERVICE

Paris Observatory Lunar Analysis Center

Validation of past LLR Observations :

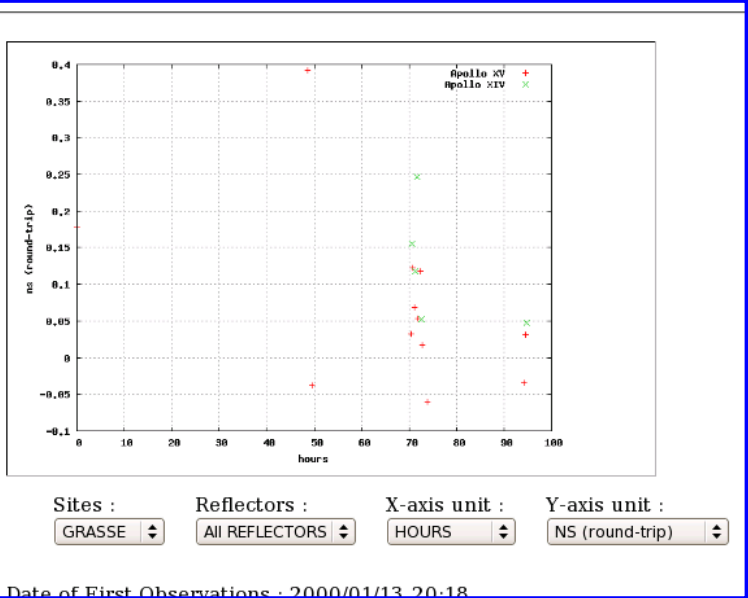
Ephemerides : ELP96 INPOP08c

Format : MINI CSTG CRD

Please, enter your LLR normal points in the area below :

```
99999
0000103000137845780153200016425400003001942764103991391
731186731431513503242764000039908732271005500260223000
99999
000010300014708024195320-000174700000002202463104725071
066240862323490806689182000047308099279804500050260394
99999
0000103000157845780153200016429900003002242764103901351
751151309259436075570206000039008768274406300740221500
99999
0000103000157845780153200016433300003002272764103621261
```

GO



The scatter plot shows residuals (NS (round-trip)) on the Y-axis (ranging from -0.1 to 0.4) against time in hours on the X-axis (ranging from 0 to 100). Data points are categorized by site (GRASSE) and reflector (ALL REFLECTORS). The plot shows two distinct groups of points, one for Apollo XIV (marked with 'x') and one for Apollo XV (marked with '+'). The residuals for both missions are clustered around zero, indicating high precision in the LLR observations.

Sites : GRASSE Reflectors : ALL REFLECTORS X-axis unit : HOURS Y-axis unit : NS (round-trip)

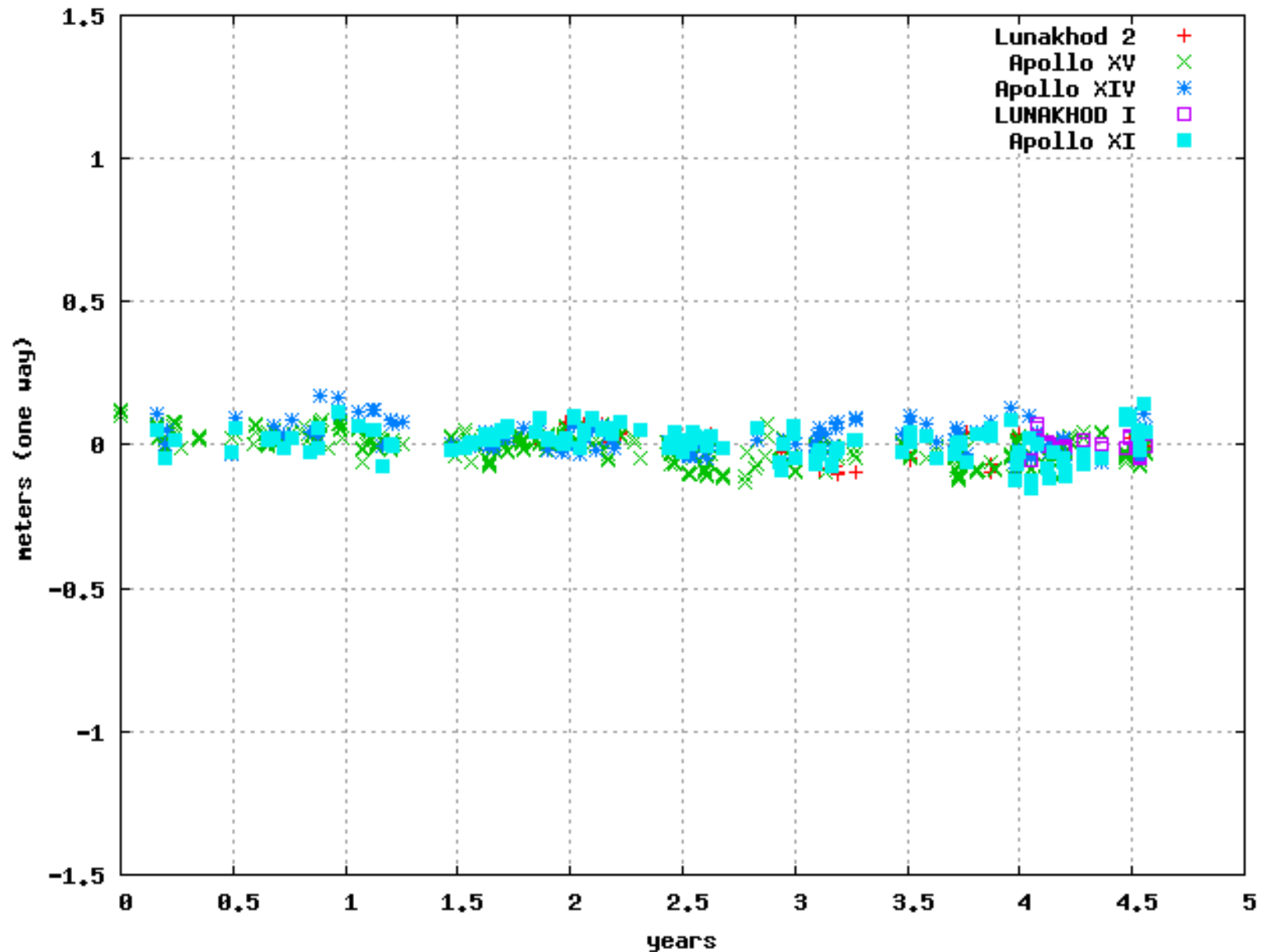
Date of First Observations : 2000/01/13_20:18
[\(O-C\) numerical results](#)

Graphs of residuals:

Residuals are displayed according to the sites, the reflectors, the time and residuals units.

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First Validation of LLR normal Points: Test with Apache Point LLR Normal Points (2006–2010)



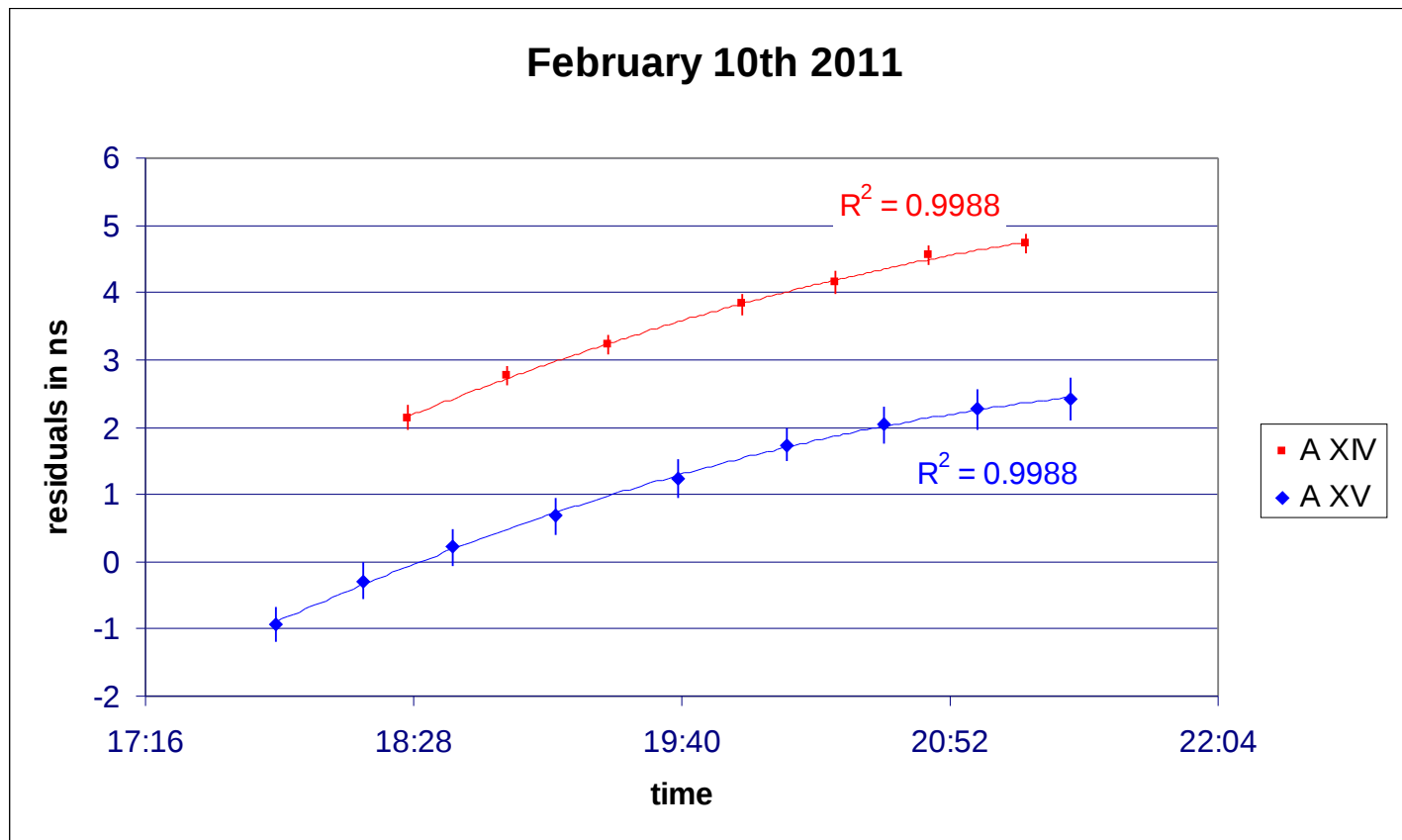
First Validation of LLR normal Points: Test with Apache Point LLR Normal Points (2006-2010)

Statistics:

Normal Points	: 00942			
Valid	: 00942			
Wrong (***)	: 00000	Limit:	1.000 m	
R0 Apollo 11	: 00176	Bias:	0.014 m	St.dev.: 0.051 m
R1 Lunokhod 1	: 00029	Bias:	0.000 m	St.dev.: 0.023 m
R2 Apollo 14	: 00180	Bias:	0.027 m	St.dev.: 0.048 m
R3 Apollo 15	: 00506	Bias:	-0.008 m	St.dev.: 0.048 m
R4 Lunokhod 2	: 00051	Bias:	0.006 m	St.dev.: 0.054 m
Global	: 00942	Bias:	0.004 m	St.dev.: 0.050 m

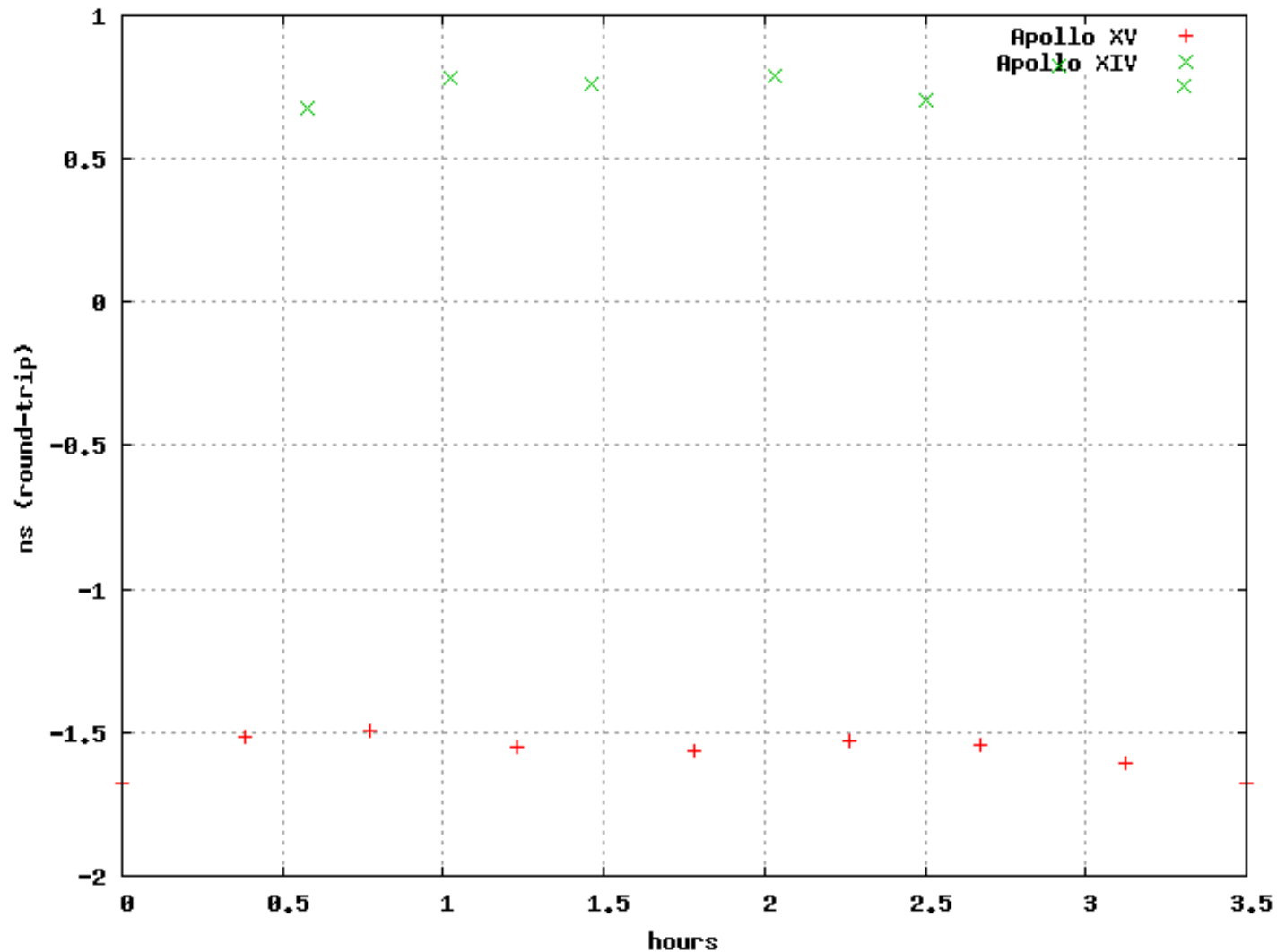
First Validation of LLR normal Points: Test with February LLR Normal Points of MeO

- Residuals computed at the MeO station at the end of the night



First Validation of LLR normal Points: Test with February LLR Normal Points of MeO

- Residuals computed two days later with the web interface



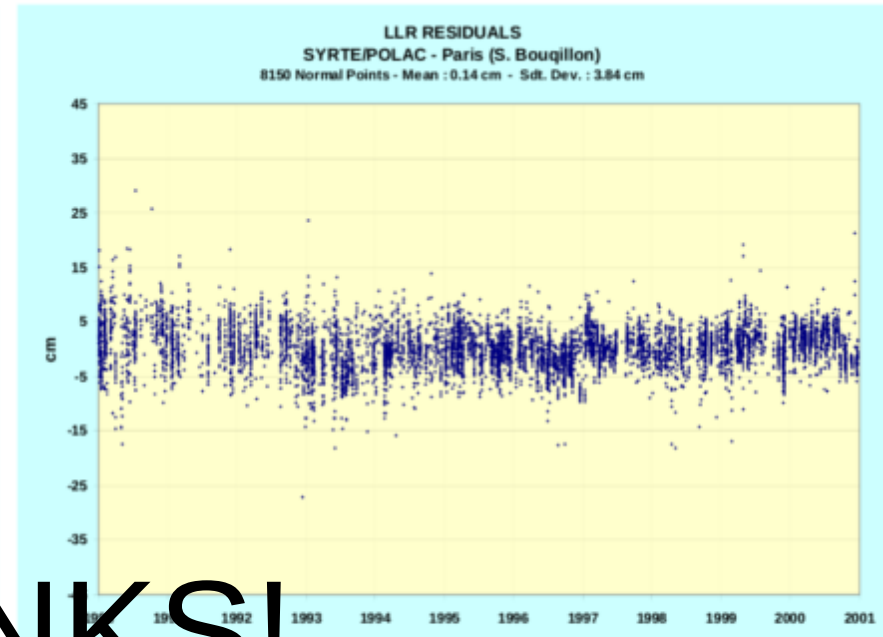
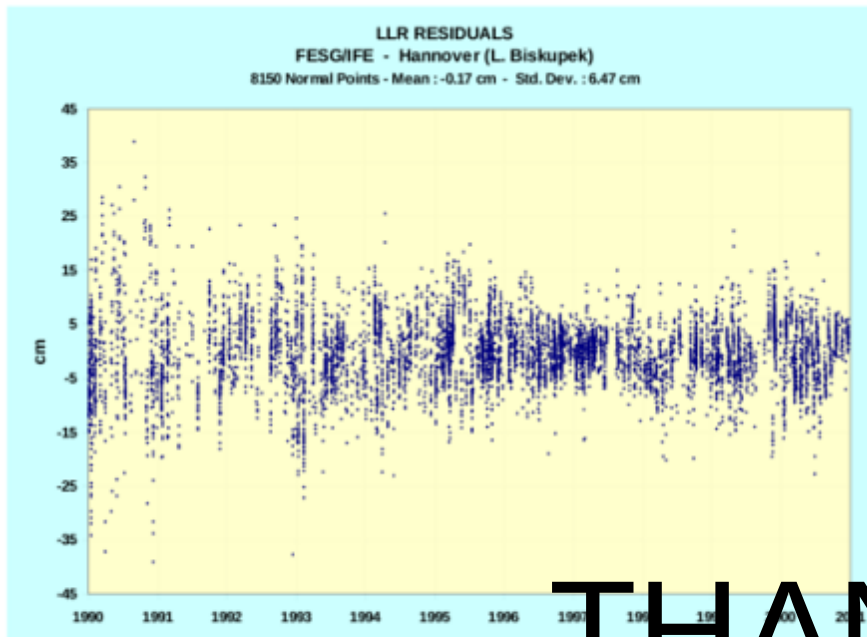
Planned improvements.

- I. Updating our LLR observations reduction models
(New convention + new ITRF solution + ...)
- III. Integration of a new system of weight to determine the difference of quality between all the sets of LLR data.
- IV. Implementation of other lunar solutions or other reduction process:
 - INPOP Lunar solution and H. Manche reduction process?
 - JPL lunar solution (DE421) ?
 - FESG/IFE Lunar solution?

=> Useful for unification of LLR observation reduction process

=> Useful for comparison of different lunar solutions

Modification of these tools for LLR solutions comparisons.



THANKS!

