ILRS Governing Board Meeting
Agenda

GFZ
October 09, 2016; 15:00-19:00 Hours

• Opening Remarks	G. Bianco	10 min
• Workshop Overview	L. Grunwaldt	10 min
• ILRS CB Report/ILRS Status	M. Pearlman	10 min
• ILRS Future Planning (initial discussion)	M. Pearlman	20 min
• Standing Committee/Study Group/Board Reports (focus on what's new)		
– Analysis SC	E. Pavlis/C. Luceri	10 min
– Missions SC	T. Otsubo/S. Wetzel	10 min
– Data Formats and Procedures SC	H. Mueller/R. Ricklefs	10 min
– Networks and Engineering SC	M. Wilkinson/G. Kirchner	10 min
– Transponder SC	U. Schreiber/J. McGarry, J. Degnan	10 min
– Space Debris Study Group	G. Kirchner	10 min
– Quality Control Board	M. Pearlman	5 min
• GGOS Activities/Role of the ILRS	M. Pearlman	10 min
• Future Workshops	C. Noll	5 min
• Other Business and Discussion	G. Bianco/M. Pearlman	

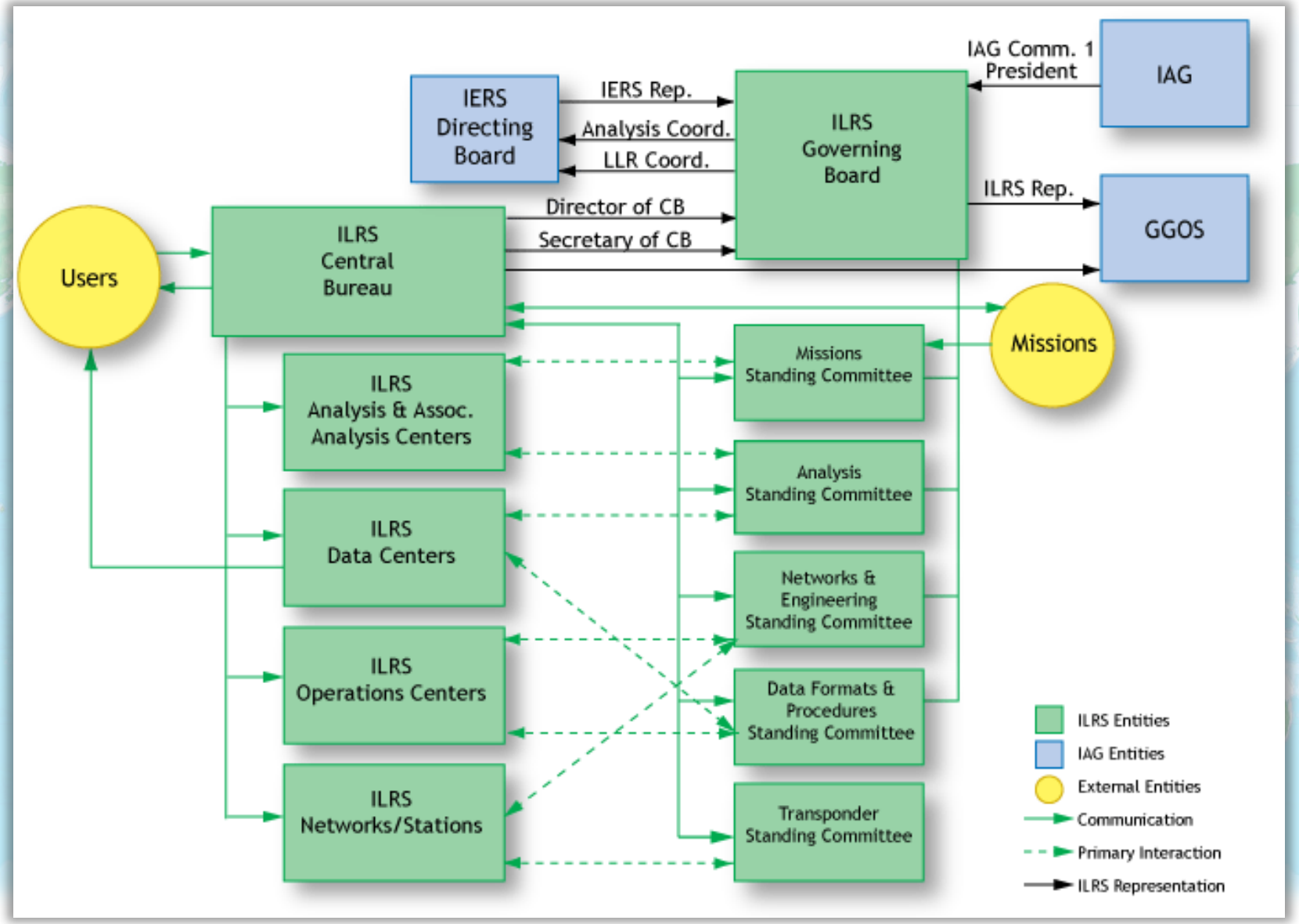
International Laser Ranging Service

Overview

Michael Pearlman
Carey Noll
ILRS Central Bureau

October 9, 2016
ILRS Governing Board Meeting
Potsdam, Germany

ILRS organization



ILRS governing board

Ex officio members:	Michael Pearlman	Director, Central Bureau
	Carey Noll	Secretary, Central Bureau
	Geoffrey Blewitt	President of IAG Commission 1
Appointed members:	Daniela Thaller	IERS representative to ILRS
	Giuseppe Bianco	Eurolas Network Representative, Chair
	Georg Kirchner	Eurolas Network Representative
	James Bennett	WPLTN Network Representative
	Toshimichi Otsubo	WPLTN Network Representative
	David McCormick	NASA Network Representative
	Jan McGarry	NASA Network Representative
Elected members:	Vincenza Luceri	Analysis Center Representative
	Erricos Pavlis	Analysis Center Representative
	Horst Mueller	Data Center Representative
	Ludwig Combrinck	LLR Representative
	Matt Wilkinson	At Large Representative
	Ulrich Schreiber	At Large Representative
Past chairs:	Graham Appleby	2010-2013
	Werner Gurtner	2002-2009
	John Degnan	1998-2001

ILRS standing committees, study groups

Standing Committee (SC)/Study Group (SG)	Chairs, Co-Chairs
Analysis SC	Erricos Pavlis, Cinzia Luceri
Data Formats and Procedures SC	Horst Mueller, Randy Ricklefs
Missions SC	Toshi Otsubo, Scott Wettzell
Networks and Engineering SC	Matt Wilkinson, Georg Kirchner
Transponder SC	Ulli Schreiber, Jan McGarry/John Degnan
Space Debris SG	Georg Kirchner, Ludwig Grunwaldt

Current successes (1 of 2)

- Continue to coordinate, develop global standards/specifications and encourages international adherence to its conventions;
- Update of ILRS Terms of Reference now underway
- Network of tracking stations expanding and upgrading
  - New Russian overseas stations enhancing spatial and temporal coverage
  - NASA's Space Geodesy Project upgrading current stations and adding new stations to enhance global network
  - Other stations in process and in upgrading
- List of target satellites continues to expand as new missions utilize SLR for orbit determination and other applications;
- New ILRS pass performance standard adopted: 3500 passes/year
- New data Quality Control Board established to address laser ranging data quality issues; evaluation and diagnosis of systematic errors

Recent successes (2 of 2)

- Early use of optical receivers in space improve timing accuracy (T2L2, ACES) and as a step toward optical transponder for extended range
- Official orbital data product on LAGEOS and Etalon satellites now operational (ASC)
- Implementation of ITRF2014 (SLRF2014) in ILRS operational products (ASC)
- Evaluation of the Systematic Error Monitoring Pilot Project and adoption of procedures for development of future operational products (ASC)
- Instituted new leap second procedure for stations (DFPSC)
- Updated Mission Support Request form to include more information (MSC)
- Created Networks and Engineering SC Forum to provide a facility to share ideas, questions, news, and advice (NESC)
- Number of stations routinely tracking space debris targets (SDSG)
- Multi-static and multi-wavelength SLR to non-cooperative targets

Recent news

- LAGEOS anniversary celebration
  - 40 years: launch May 04, 1976
- Ajisai anniversary
  - 30 years: launch August 13, 1986
- 19th International Workshop on Laser Ranging
  - Sponsored by NASA, SAO, and ILRS in Annapolis MD, October 2014
  - "Celebrating 50 Years of SLR: Remembering the Past and Planning for the Future"
  - Introduction of station clinic sessions
- 2015 Technical Workshop
  - Sponsored by ASI in Matera Italy, October 2015
  - "Network Performance and Future Expectations for ILRS Support of GNSS, Time Transfer and Space Debris Tracking"

ILRS network

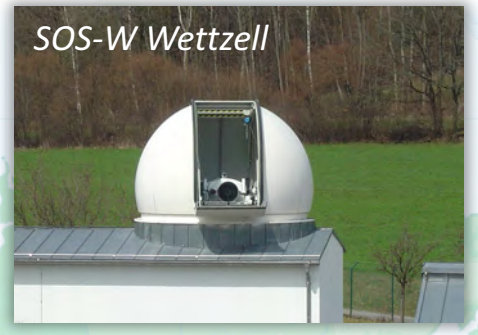
In spite of the progress, we still have large geographic gaps

ILRS ToR

- Not updated since formation of the ILRS in 1998
- Major changes:
  - **Modified ILRS GB membership from 16 to 18; added two At-Large members appointed by elected GB members**
  - Clarified ILRS GB nomination and election process
  - Clarified ILRS representatives to IERS Directing Board
  - Changed Working Groups to Standing Committees and added Transponder Standing Committee
  - Added Quality Control Board
  - Added ILRS Ex-Officio Correspondents
  - Changed frequency of GB Meetings and requirement for ILRS General Assembly meetings
- Updates approved by ILRS GB
- Submitted to IAG for review (August 2016)

Network developments (1 of 3)

- New systems operational in 2016:
  - SOS-W (BKG) at Wettzell (core site)
  - KASI system at Sejong (core site)
  - Rebuilt systems in Boroweiz and Riga
- Activities in the Russian network:
  - Primary objective GLONASS and LAGEOS, expanding to other GNSS and LEO
  - New station in Hartebeesthoek now in process; planned for late 2016
  - Plans underway for a station at Ensenada, Mexico
  - Discussions underway with CNES for station in Tahiti
  - Other sites being examined
- Activities in the NASA SGP
  - Working deployment plans for core sites in Texas and Hawaii (2018 – 19 timeframe); other sites being explored
  - NMA working with NASA on deployment of SLR system to Ny-Ålesund Core Site (~2019)



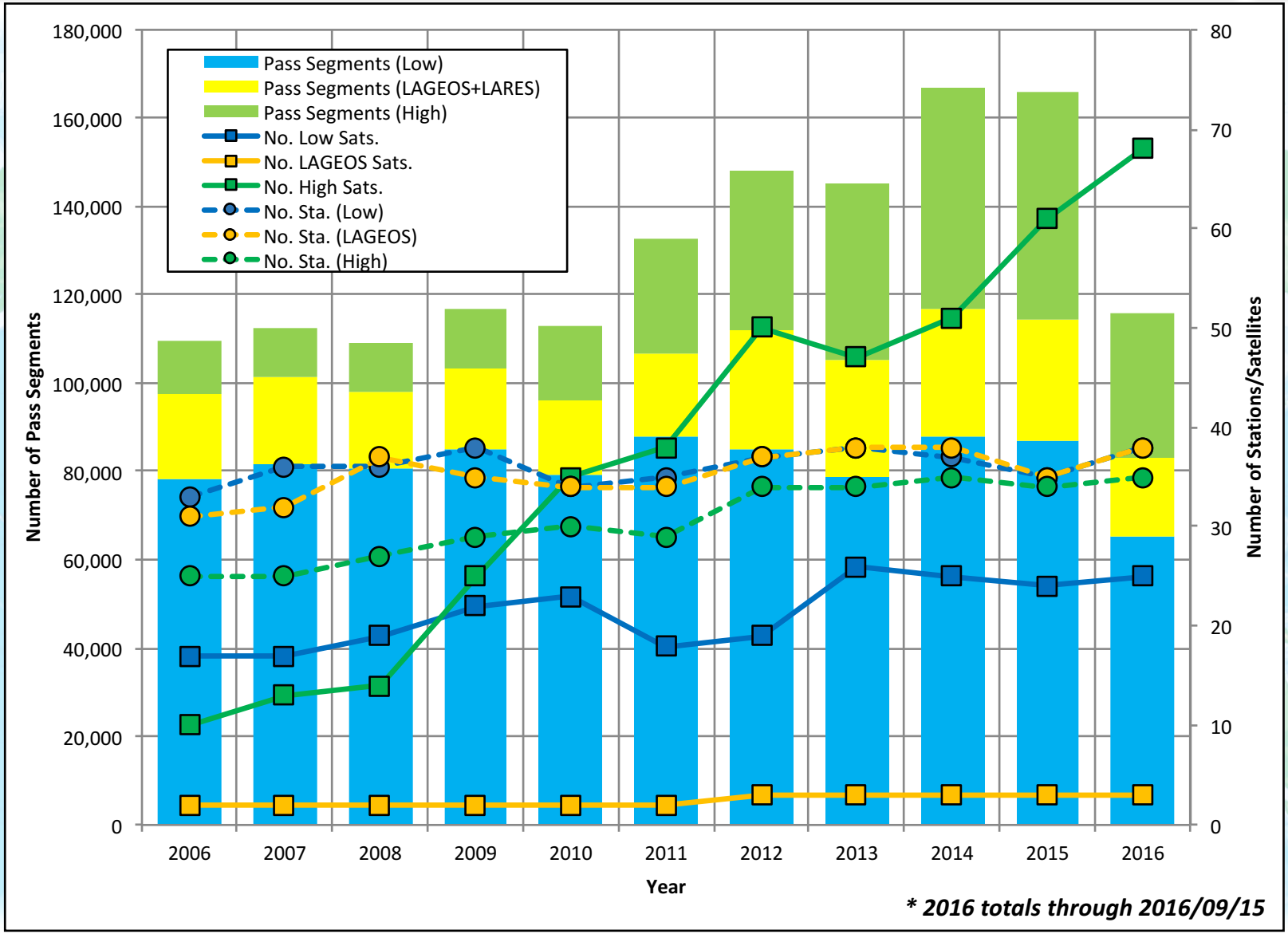
Network status (2 of 3)

- Activities in the Chinese Network
  - San Juan being repaired and upgraded; should be operational in 2017 with Khz ranging
  - Wuhan being repaired and upgraded, should be operational in 2017
  - Shanghai has a 10KHz system and a newly implemented Super-Conducting Nanowire Single Photon Detector (SNSPD): the SNSPD also in use at Kunming;
  - One meter aperture telescope under development at Wuhan; plans to deploy a one of these systems in Xinjian Province in NW China
- Current systems being upgraded or moved:
  - BKG AGGO (formerly TIGO in Concepcion) being setup in La Plata Observatory (core site)

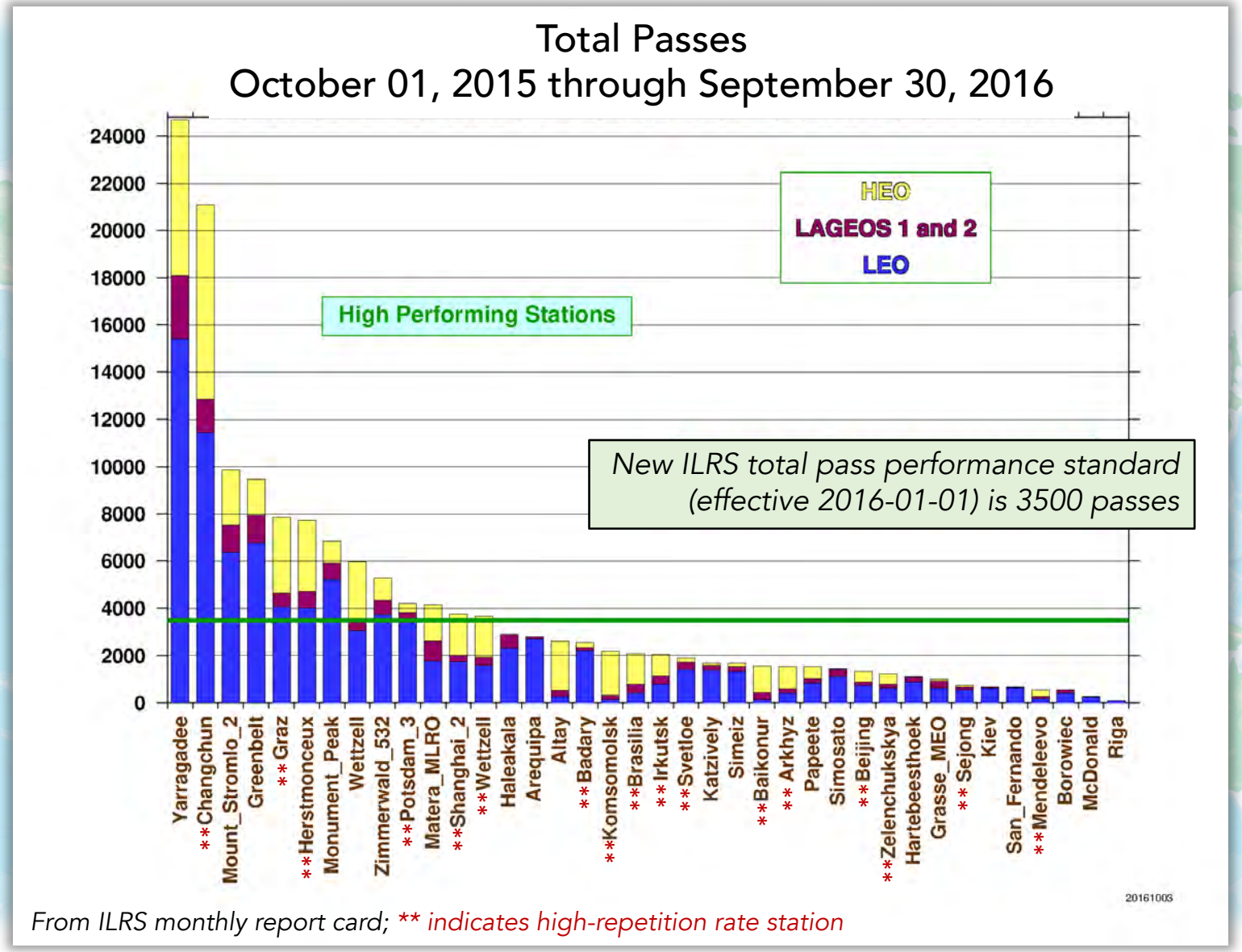
Network status (3 of 3)

- New SLR systems underway:
  - Metsahovi (Core Site)
  - Yebes (Core Site)
  - Mt Abu and Ponmundi in India (2016 – 17); formal ILRS connection need to be made
- Several sites are now working routinely at kHz rates; others planned:
  - Current: Herstmonceux, Sejong, Wettzell (SOS-W), Changchun, Beijing, Shanghai, Potsdam, Graz
  - Future: SGSLR (McDonald, Ny Ålesund, Hawaii, …), others?
- Riyadh station not operational;

Yearly pass segment totals (by satellite type)

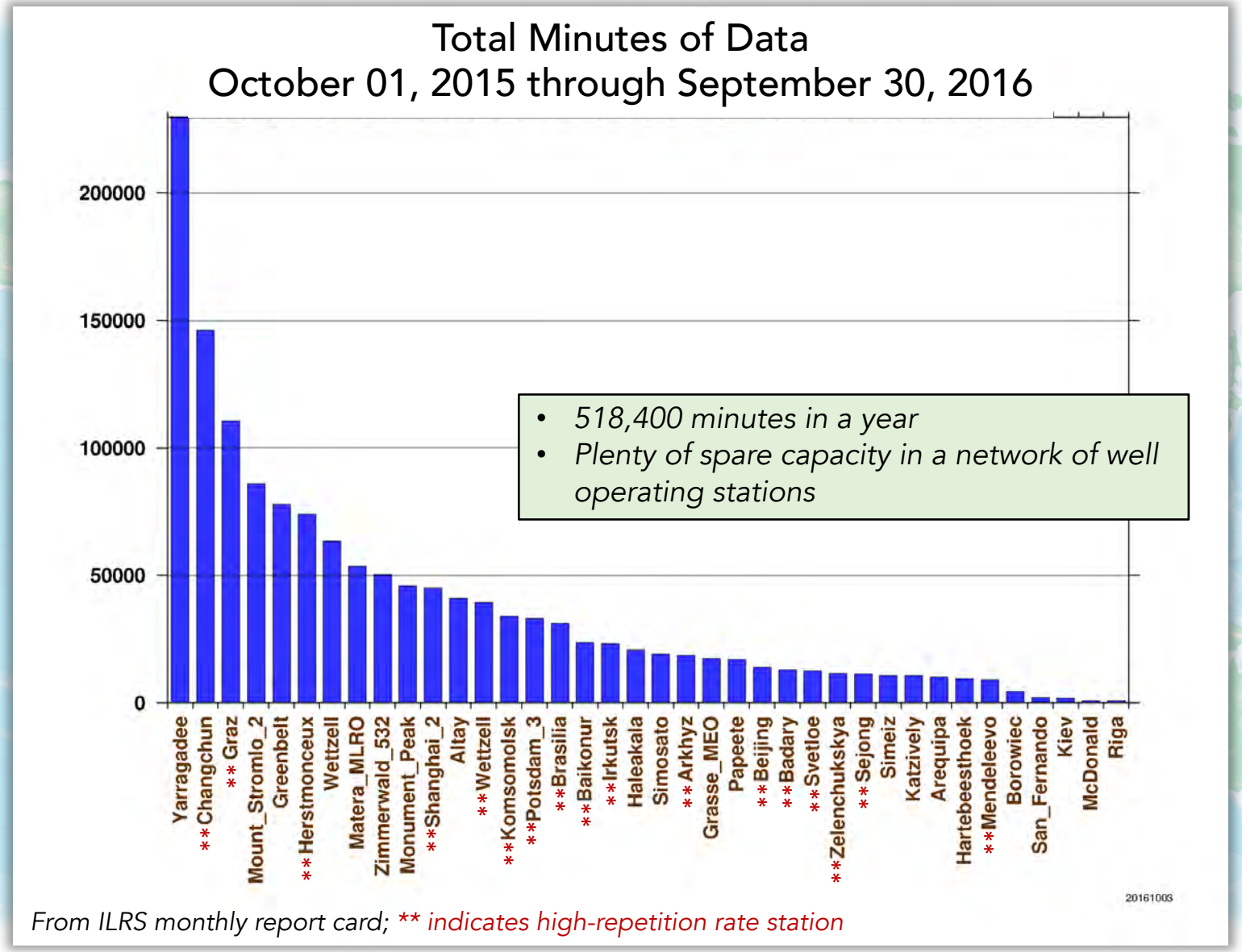


Network performance (1 of 2)



*From ILRS monthly report card; ** indicates high-repetition rate station*

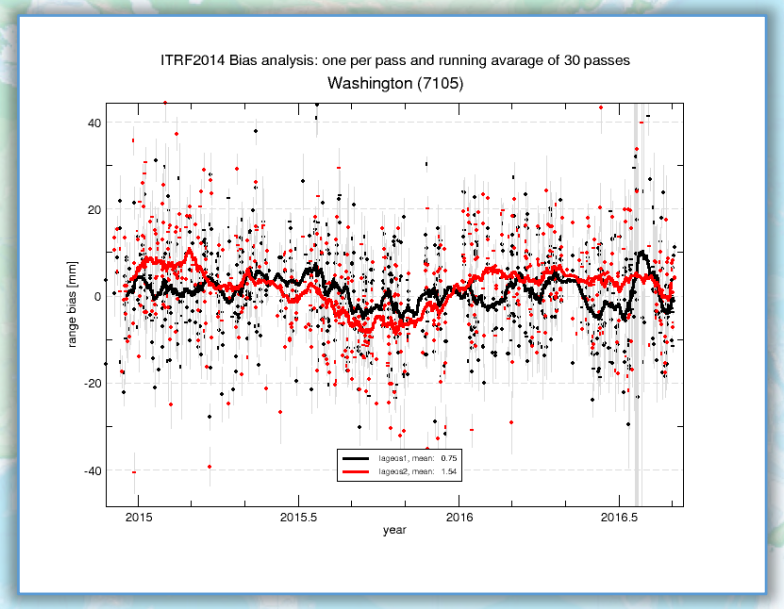
Network performance (2 of 2)



*From ILRS monthly report card; ** indicates high-repetition rate station*

Quality control board (1 of 2)

- QCB organized as a result of discussions at the 19th International Workshop on Laser Ranging
- Formed to address SLR systems biases and other data issues that have have degraded the ILRS data and products
- Joint activity under the ASC and the NESC
- http://ilrs.gsfc.nasa.gov/science/qcb/index3.html
- Monthly telecons
- General actions in areas:
  - Analysis QC tools
  - Station diagnostic tools
  - Communication between stations, OCs, and ACs



Quality control board (2 of 2)

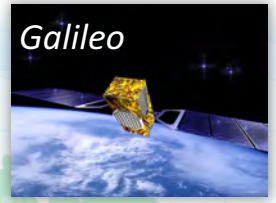
- Rapid feedback to the stations from
  - Hitotsubashi University (Toshi Otsubo)
  - Technical University of Munich (Horst Mueller)
  - They rely on feedback from you on how they improve their products
- On-line Quarterly Report Card (Mark Torrence)
  - E. Pavlis working on a web facility to display and compare quantities appearing on he QC repots from all of the groups participating in the report card generation (DGFI, HITO-Univ., JCET, MCC, NSGF, SHAO) as well as historical reports from UT/CSR.
- Station Systematic Pilot Project underway (ASC)
- Longer term diagnostic reports and tools available on station bias histories, network performance, etc.
  - DGFI, JCET, HU, NSGF, SHAO
  - **The task is developing a "reasonable" on-line tool for the stations, analysts, and other users**
- On-going activity to identify parameters and displays that will be useful diagnostics for the stations (e.g., range bias errors, isolation of biases on spherical satellites, etc.
- Improved stations diagnostic tools for early identification of issues
- Use of an on-line Forum Tool to faster exchange of information for diagnostic help

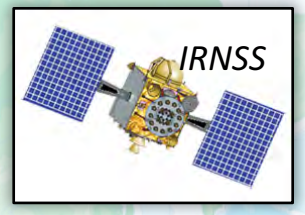
Retroreflector array developments

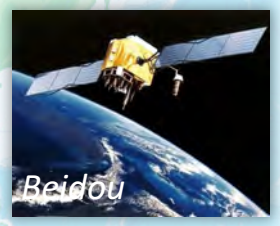
- Arrays for GNSS satellites
  - Improved station quality may allow lower quality, less expensive corner cubes to be used
  - Investigation of specialized designs for increase cross-section …..
- Arrays for LEO satellites
  - Work shows "pyramid" type arrays (e.g., Lomonosov) are lightweight, inexpensive, and have the required accuracy (0.5 mm)
- Geodetic satellites
  - D. Arnold looking at array designs for LEO spherical satellites to reduce cost and improve performance
  - BLITS-M type satellites have minimal target error; workshop talks will discuss possibilities (e.g., BLITS-Geo/5000 km vs. BLITS-M/1500 km)

Mission developments

- List of satellites on ILRS tracking roster continues to grow
  - Routinely tracked over 90 satellites in 2016 (too many)
- In last year, new satellites included:
  - Jason-3
  - Galileo-211 and -212
  - GREAT campaign (Galileo-201)
  - Sentinel-3A (restricted)
  - Lomonosov (restricted)
  - IRNSS-1E and -1F
  - Compass-I6B
  - STPSat-2 second tracking campaign
- Future missions:
  - Additional Beidou/Compass, Galileo, etc.
  - PN constellation (China) (2016?)
  - Sentinel-3B (2016?)
  - HY-2C, SWOT, NISAR, COSMIC-2, and IceSAT-2







Issues & challenges

- Increasing global coverage of laser ranging stations; many geographic gaps still exist primarily in Latin America and Africa
- Implementing new systems and upgrades to overcome the present mix of new and old technologies; trying to get more standardization in system hardware and operations
- Improving data quality (reducing system biases) as the ILRS strives for mm accuracy
- Supporting an ever increasing list of targets, many now at GNSS and synchronous altitudes
  - Need to implement more effective tracking strategies
  - Be more selective on the targets
- Supporting new missions in order to contribute to a broader range of scientific and operational applications
- Developing new retroreflector designs to increase range accuracy and signal link

ILRS

- The ILRS provides Satellite and Lunar Ranging data and related products (what are these) to support
  - Support geodetic, geophysical and other Earth, Lunar, and Space-based scientific research and applications;
  - Provide the center of mass and along with VLB,I the scale for the the maintenance and improvement of an accurate and stable International Terrestrial Reference Frame (ITRF);
- Established Service within Section II Advanced Space Technology, of the International Association of Geodesy (IAG);
- Key contributor to the Global Geodetic Observing System (GGOS);
- The service also develops and maintains the necessary standards/specifications and encourages international adherence to its conventions.

ILRS Objectives

The ILRS collects, merges, archives, and distributes Satellite Laser Ranging (SLR) and Lunar Laser Ranging (LLR) observation datasets of sufficient accuracy to satisfy the objectives of a wide-range of scientific, engineering, and operational applications and experimentation. These data are used by the ILRS to generate a number of scientific and operational products including:

- Centimeter-accuracy satellite ephemerides
- Earth orientation parameters (polar motion and length of day)
- Three-dimensional coordinates and velocities of the ILRS tracking stations
- Time-varying geocenter coordinates
- Static and time-varying coefficients of the Earth's gravitational field
- Fundamental physical constants
- Lunar ephemerides and librations
- Lunar orientation parameters

Role of the ILRS

The accuracy of SLR/LLR data products is sufficient to support a variety of scientific and operational applications including:

- Realization and maintenance of the ITRF
- Access to Earth's center of mass relative to the global network and its time variations
- Monitoring three dimensional deformations of the solid Earth
- Monitoring Earth rotation and polar motion
- Monitoring the long-wavelength static and dynamic components of Earth's gravitational field
- Supporting, via precise ranging to altimeter satellites, the monitoring of variations in the topography of the liquid and solid Earth (ocean circulation, mean sea level, ice sheet thickness, wave heights, vegetation canopies, etc.)
- Calibration and validation of microwave tracking techniques (e.g., GPS, GLONASS, Galileo, BeiDou, and DORIS)
- Picosecond global time transfer experiments
- Determination of non-conservative forces acting on satellites
- Astrometric observations including determination of the dynamic equinox, obliquity of the ecliptic, and the precession constant
- Gravitational and general relativistic studies including Einstein's Equivalence Principle, gravitomagnetic frame-dragging, the Robertson-Walker beta (β) parameter, and temporal variations of the gravitational constant, G
- Lunar physics, including the dissipation of rotational energy, shape of the core-mantle boundary (Love number k_2), and free librations and stimulating mechanisms
- Solar System ties to the International Celestial Reference Frame (ICRF)

Questions

- Is the role of the ILRS articulated properly?
  - Are we doing it?
  - What are we not doing?
  - What else should we be doing?
- Should the role be updated?
- Is the structure of the ILRS effectively supporting that role?
  - E.g., do we have the right standing committees?
- Are we properly representing the ILRS community?
- Do we need a strategic plan?

Site Name	GRACE	Jason	Star+Stel	LARES	LAGEOS	Etalon	Ajisai	Galileo	GLONASS	Compass	Other Sats.	Totals	Sta.
Altay	2	2	28	118	250	49	14	158	1,841	21	134	2,617	1879
Arequipa	64	253	590	137	111	0	459	0	0	0	1,377	2,991	7403
Arkhyz	0	76	82	76	194	39	112	79	835	6	54	1,553	1886
Badary	49	232	446	153	124	3	383	0	231	0	944	2,565	1890
Baikonur	0	0	1	2	60	3	0	26	141	6	5	244	1887
Beijing	37	114	127	60	150	22	100	41	319	49	252	1,271	7249
Borowiec	16	56	54	74	120	0	39	3	3	0	185	550	7811
Brasilia	2	46	100	50	404	0	79	280	1,030	20	94	2,105	7407
Changchun	586	1,695	1,665	938	1,528	423	1,080	1,785	5,143	1,244	6,129	22,216	7237
Grasse	0	482	0	0	305	14	0	221	0	0	30	1,052	7845
Graz	172	643	626	378	613	163	393	849	2,190	64	1,736	7,827	7839
Greenbelt	368	908	1,007	469	1,342	203	658	468	1,011	39	3,614	10,087	7105
Haleakala	61	300	396	163	607	0	254	0	0	0	1,189	2,970	7119
Hartebeesthoek	18	122	153	94	222	9	145	16	27	0	376	1,182	7501
Herstmonceux	205	712	457	374	706	193	302	834	1,969	104	1,919	7,775	7840
Irkutsk	3	112	187	121	363	27	166	68	808	7	186	2,048	1891
Katzively	17	142	238	138	214	20	196	15	42	3	527	1,552	1893
Kiev	4	78	118	48	59	0	145	0	0	0	220	672	1824
Komsomolsk	0	3	6	63	177	36	12	70	1,523	14	21	1,925	1868
Matera	24	226	470	224	898	320	245	763	651	61	586	4,468	7941
McDonald	0	28	48	16	27	0	34	5	6	0	125	289	7080
Mendeleevo	9	39	15	28	106	14	17	20	245	8	51	552	1874
Monument Peak	371	1,298	646	304	687	77	638	404	585	31	3,205	8,246	7110
Mount Stromlo	222	848	1,397	459	1,228	118	1,026	946	1,230	110	2,647	10,231	7825
Potsdam	160	588	413	335	382	10	301	91	271	1	1,505	4,057	7841
Riga	2	0	11	16	19	1	11	2	0	0	33	95	1884
San Fernando	10	30	91	12	15	0	111	0	20	0	415	704	7824
Sejong	0	55	195	62	147	0	179	5	100	2	178	923	7394
Shanghai	93	187	324	146	277	92	247	324	1,117	228	834	3,869	7821
Simeiz	14	204	239	139	218	7	205	7	116	7	492	1,648	1873
Simosato	15	107	233	111	308	5	241	0	26	0	447	1,493	7838
Svetloe	33	211	174	196	307	2	144	18	170	2	647	1,904	1888
Tahiti	34	115	159	86	183	64	116	171	268	30	324	1,550	7124
Wettzell	75	333	255	223	367	117	149	429	1,216	30	548	3,742	7827
Wettzell	51	547	581	281	412	180	463	829	1,561	34	1,080	6,019	8834
Yarragadee	1,579	3,640	2,426	1,067	3,181	984	1,781	2,846	3,036	661	9,645	30,846	7090
Zelenchukskaya	4	57	126	77	182	18	108	27	399	0	235	1,233	1889
Zimmerwald	206	507	607	343	640	83	390	273	638	47	1,641	5,375	7810
Totals:	4,506	14,996	14,691	7,581	17,133	3,296	10,943	12,073	28,768	2,829	43,630	160,446	38
Number of Sats.	2	2	2	1	2	2	1	14	30	9	33	98	

ILRS Analysis Standing Committee Report

ILRS Governing Board Meeting

Potsdam, Germany,

October 9, 2016

Erricos C. Pavlis and Cinzia Luceri

Analysis Coordinators

ILRS ASC Activities

- D**aily** & Weekly products delivered from six ACs:
  - **ASI** (AC & CC), DGFI, ESA, GFZ, **JCET**(AC & CC), & NSGF
  - Absent temporarily: **BKG** & **GRGS (coming back soon!)**
  - Finalized the 4-sat orbital product (eight ACs are already submitting SP3 files, **BKG** & **GRGS temporarily offline**)
- Seven ACs contributed to the evaluation of ITRF2014P (*only GRGS absent*)
- The official ITRS “breaks” at the SLR sites are now adopted for use until further notice
- The Station Systematic Error Monitoring PP completed the first phase with results from FIVE ACs agreeing within the error of the estimates
  - the three remaining ACs have agreed to submit their results ASAP

ILRS ASC Future Activities

- PP for systematic error estimation will move to next phase:
  - Reanalysis of the data since ~2010 will deliver starting error estimates to be adopted in the analysis of current/future data
- Implementation of ITRF2014 model is now planned for early 2017, with tests underway in November 2016
- PP for low-degree harmonic estimation and the incorporation of LARES in the operational data product planned for next spring
- Finally, PP for observational-level modeling of loading corrections for stations and corresponding gravitational corrections in orbit (operational product) [summer 2017???]

Network Support

- New & old stations validated & accepted in 2016 so far:
  - Riga, SOS-Wettzell, Hartebeesthoek, Katzively, Zimmerwald, Baikonur, Riga, Mt. Stromlo
  - Riga, Tanegashima and San Fernando are currently in quarantine
- The ASC has reviewed the online site logs and found several eccentricity discrepancies with the ASC-maintained files:
  - we need stations to make it a habit to look after their site logs and report corrections/changes!

Publications & Meetings

- **IERS Annual Report 2015 (ILRS contribution):**
  - It was submitted by September 12, 2016, under IERS CB review
- **Special Issue on Laser Ranging in the Journal of Geodesy:**
- We are restarting the submission process:
  - Will contact the new editor of JoGeod. to set things up
  - Re-publicizing of the Call for Papers over the next couple of weeks
  - Revised abstracts and authors lists before the end of the year
  - Expecting the first drafts by February/March 2017.
- **Future Meetings:**
  - The next Spring meeting of the ASC will take place in Vienna, on Saturday, April 22, before the week of EGU 2017

Missions (WG →) SC Report

@ ILRS GB Meeting
9 Oct 2016

Toshimichi Otsubo

and

Scott Wetzel

Missions (WG →) SC Report

@ ILRS GB Meeting
11 Oct 2016

Toshimichi Otsubo

and

Scott Wetzel

Missions SC Agenda (11 Oct 2016)

International Laser Ranging Service

(1) Opening/Welcome/Membership

(2) Renaming; WG->SC

(3) Revised Mission Support Request (MSR) Form

(4) Ongoing/Future Missions (5 min each)

- ICESAT-2 (Wetzel)
- QZS (Ohshima)
- BLITS-M (Sokolov)
- Lomonosov (Sokolov)
- GRACE Follow-On (Grunwaldt)
- PAZ (Grunwaldt)
- ACES-ELT (-> transponder+interplanetary session)
- Others (?)

(5) Other issue?

(6) Closure

(1) MWG Members

- Graham Appleby/NERC Space Geodesy Facility
- Giuseppe Bianco/Agenzia Spaziale Italiana (ASI)
- John J. Degnan/Sigma Space Corporation
- Julie E. Horvath/HTSI/SLR
- Georg Kirchner/Space Res. Inst., Austrian Acad. of Sci.
- Hiroo Kunimori/NICT
- John Mck. Luck/.
- David McCormick/NASA GSFC
- Jan F. McGarry/NASA GSFC
- Carey E. Noll/NASA GSFC
- Ron Noomen/Delft University of Technology
- (chair) Toshimichi Otsubo/Hitotsubashi University
- Erricos C. Pavlis/GEST/UMBC
- Michael R. Pearlman/Harvard-Smithsonian Center for Astrophy.
- Luca Porcelli/Istituto Nazionale di Fisica Nucleare
- Ulrich Schreiber/BKG/Geodaetisches Observatorium Wettzell
- Peter J. Shelus/University of Texas at Austin/CSR
- Andrey Sokolov/SRI for Precision Instrument Engineering
- Vladimir P. Vasiliev/SRI for Precision Instrument Engineering
- (cochair) Scott L. Wetzel/HTSI/SLR
- Zhongping Zhang/Shanghai Data Center

All members are requested to respond when we ask a vote for a mission etc.

Updated: 13-Sep-2016 23:00:03

http://ilrs.gsfc.nasa.gov/missions/mwg/mwg_members.html

(2) WG → SC

- **Based on IAG's request**

  Working group: to be used for a short, limited-time body (< 4 years).

  All ILRS Working Groups are now Standing Committees.

- **"Missions Standing Committee"**

  Everything should be updated.

  But the mailing list "ilrs-mwg" unchanged.

(3) MSR Form & Approval

- **Revision plan accepted.**

  ← Missions WG (Dec 2015), ILRS CB (Mar 2016)

  Easy to fill in & easy to read.

  Eliminate ambiguous questions.

  Incremental submission (for follow-on missions).

- **Use the new form!**

  Newest version (April 2016)

  http://ilrs.gsfc.nasa.gov/docs/2016/ilrsmsr_1604.pdf

- **"Automatic approval" for series/follow-on missions restricted.**

  New/Incremental MSRF submission is required for:

  Different LRA

  Significantly different mission objectives/parameters

ILRS SLR MISSION SUPPORT REQUEST FORM (version: April, 2016)

SUBMISSION STATUS:

◉ New Submission (default)

○ Incremental Submission (accepted only for a follow-on mission; fill-in new information only)

(provide the reference mission and the date approved by the ILRS: _____)

SECTION I: MISSION INFORMATION:

General Information:

Satellite Name: _____

Satellite Host Organization: _____

Web Address: _____

Contact Information:

Primary Technical Contact Information:

Name: _____

Organization and Position: _____

Deutsches Geodätisches Forschungsinstitut
Ingenieurfakultät Bau Geo Umwelt
Technische Universität München

DF&P SC Report

- CPF :Issues
- New Leap Second Procedure
- Data harmonization between OCs
- ILRS mailing list
- New proposal to facilitate station and history site log entry
- Restricted tracking
- Re-use of software study group

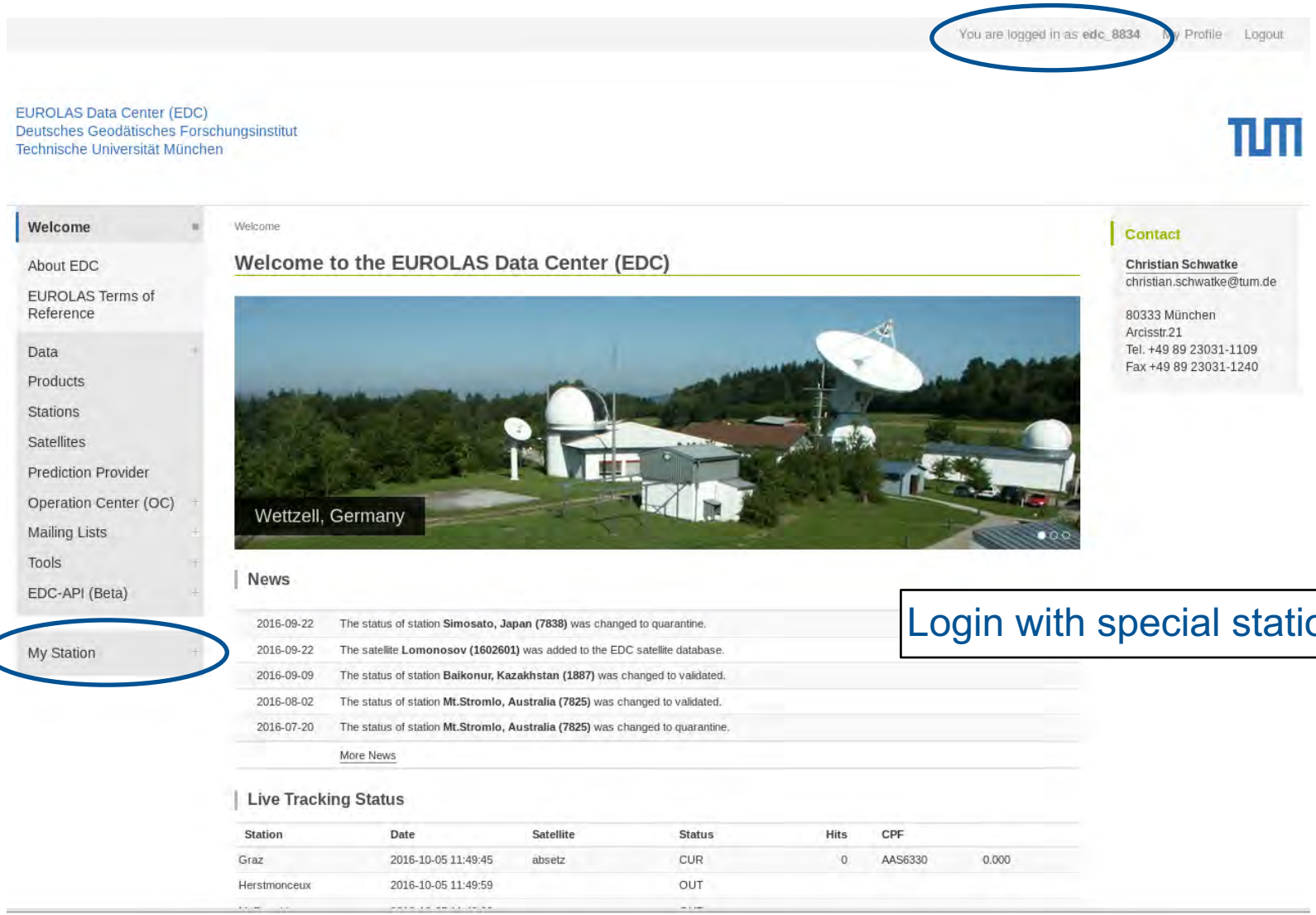
CPF Issues – ELT data

- Transponder clock needs to have offset and drift
- Current H4 has transponder oscillator drift rate, but no epoch, which they need
- The record has not been used by any other project, so impact will be minimal if the field is added to the end of the record
- Could be handled with separate file like LRO?

CPF/CRD issues – longer term

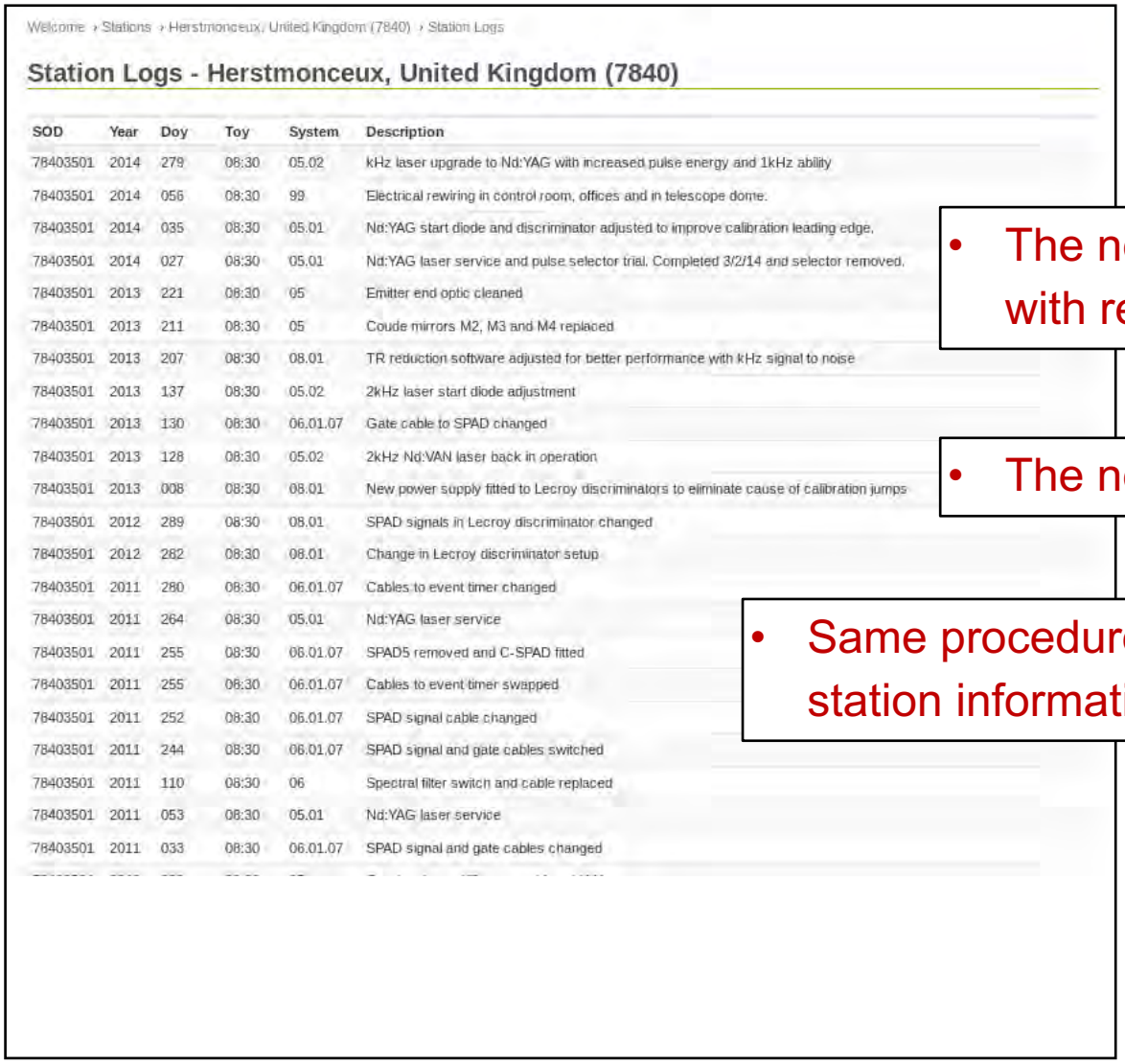
- Several possible updates
  - CRD
    - Time continues past 86400 seconds without wrapping (approved at last Annapolis meeting)
    - Several lunar additions
    - Software version configuration record
  - CPF
    - Rewrite manual without emphasis on transition from TIVs
    - Inertial vector option not used
- Would like to form a study group to workout changes for next meeting in 1-2 years

New Proposal



Login with special station account

New Proposal



Welcome › Stations › Herstmonceux, United Kingdom (7840) › Station Logs

Station Logs - Herstmonceux, United Kingdom (7840)

SOD	Year	Doy	Toy	System	Description
78403501	2014	279	08:30	05.02	kHz laser upgrade to Nd:YAG with increased pulse energy and 1kHz ability
78403501	2014	056	08:30	99	Electrical rewiring in control room, offices and in telescope dome.
78403501	2014	035	08:30	05.01	Nd:YAG start diode and discriminator adjusted to improve calibration leading edge.
78403501	2014	027	08:30	05.01	Nd:YAG laser service and pulse selector trial. Completed 3/2/14 and selector removed.
78403501	2013	221	08:30	05	Emitter end optic cleaned
78403501	2013	211	08:30	05	Coude mirrors M2, M3 and M4 replaced
78403501	2013	207	08:30	08.01	TR reduction software adjusted for better performance with kHz signal to noise
78403501	2013	137	08:30	05.02	2kHz laser start diode adjustment
78403501	2013	130	08:30	06.01.07	Gate cable to SPAD changed
78403501	2013	128	08:30	05.02	2kHz Nd:VAN laser back in operation
78403501	2013	008	08:30	08.01	New power supply fitted to Lecroy discriminators to eliminate cause of calibration jumps
78403501	2012	289	08:30	08.01	SPAD signals in Lecroy discriminator changed
78403501	2012	282	08:30	08.01	Change in Lecroy discriminator setup
78403501	2011	280	08:30	06.01.07	Cables to event timer changed
78403501	2011	264	08:30	05.01	Nd:YAG laser service
78403501	2011	255	08:30	06.01.07	SPAD5 removed and C-SPAD fitted
78403501	2011	255	08:30	06.01.07	Cables to event timer swapped
78403501	2011	252	08:30	06.01.07	SPAD signal cable changed
78403501	2011	244	08:30	06.01.07	SPAD signal and gate cables switched
78403501	2011	110	08:30	06	Spectral filter switch and cable replaced
78403501	2011	053	08:30	05.01	Nd:YAG laser service
78403501	2011	033	08:30	06.01.07	SPAD signal and gate cables changed

- The new procedure is fail-safe with respect to the user
- The new data transfer is optimized
- Same procedure can also be used for updating station information such as contact etc.

NETWORKS AND ENGINEERING STANDING COMMITTEE

AGENDA

CHAIR: MATTHEW WILKINSON

CO-CHAIR: GEORG KIRCHNER

AGENDA

- Beam Divergence Procedure
- NESC Forum
- What stations require to identify and eliminate systematics.
- Site log review
  - Stations Changes File proposal (Christian Schwatke)

BEAM DIVERGENCE MEASUREMENTS

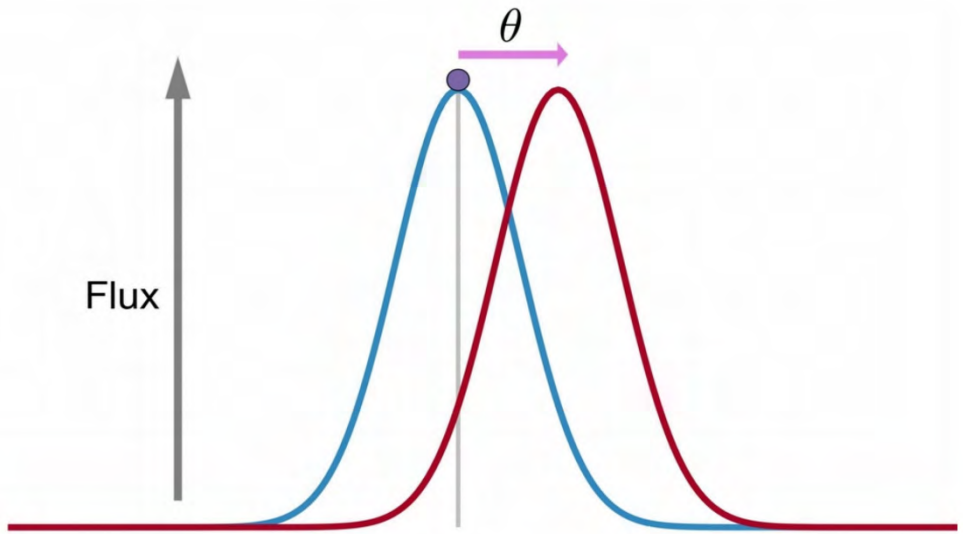
NETWORKS AND ENGINEERING STANDING COMMITTEE

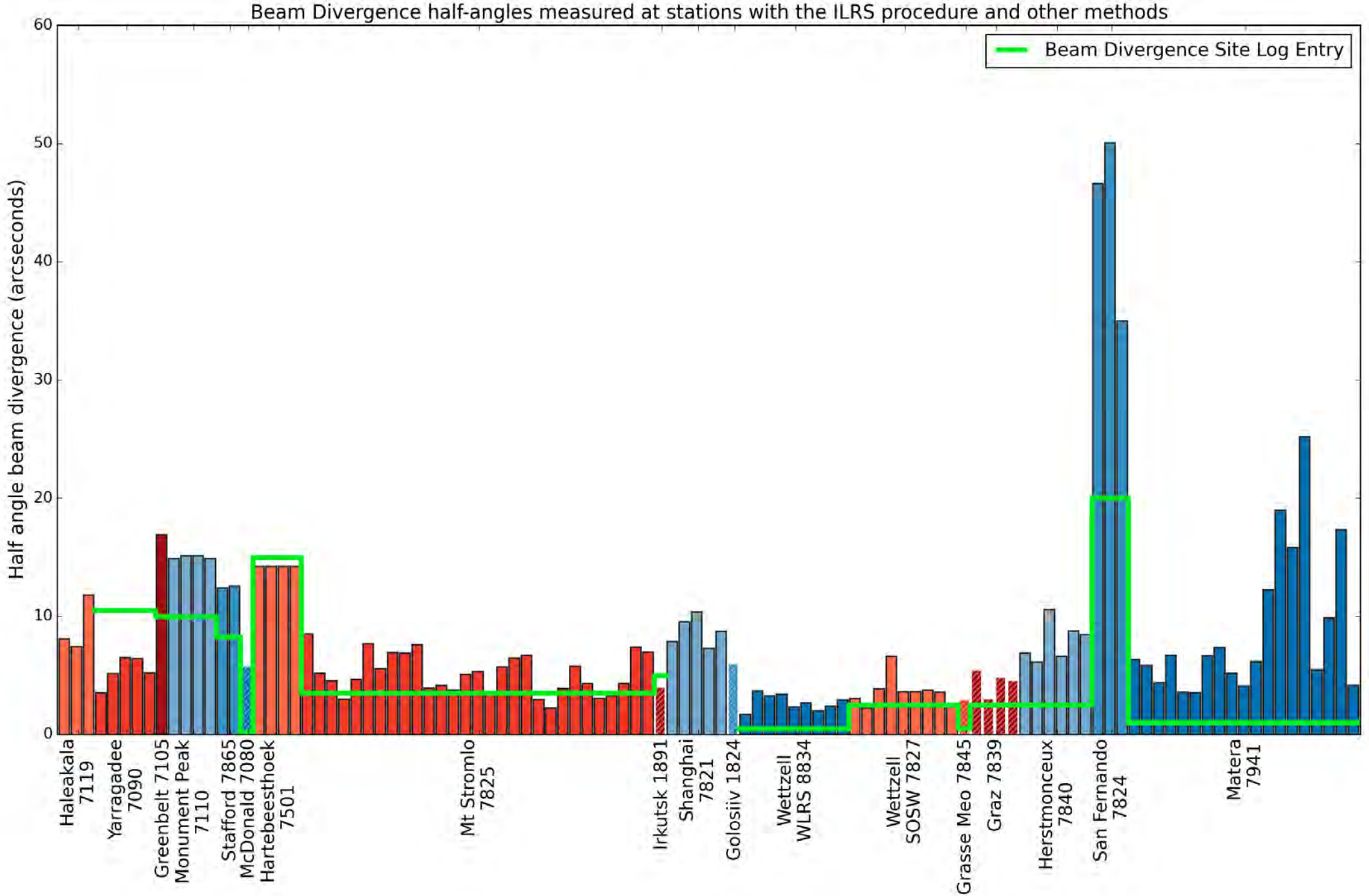
ENERGY DENSITY AT SATELLITE HEIGHTS

- A number of missions operators have asked questions about the laser energy densities incident on their satellite.
- Calculations of energy density can be made from the laser pulse energy, the beam divergence angle and the satellite height
- The upcoming ACES experiment onboard the ISS adds additional importance to determining these values.

BEAM DIVERGENCE PROCEDURE

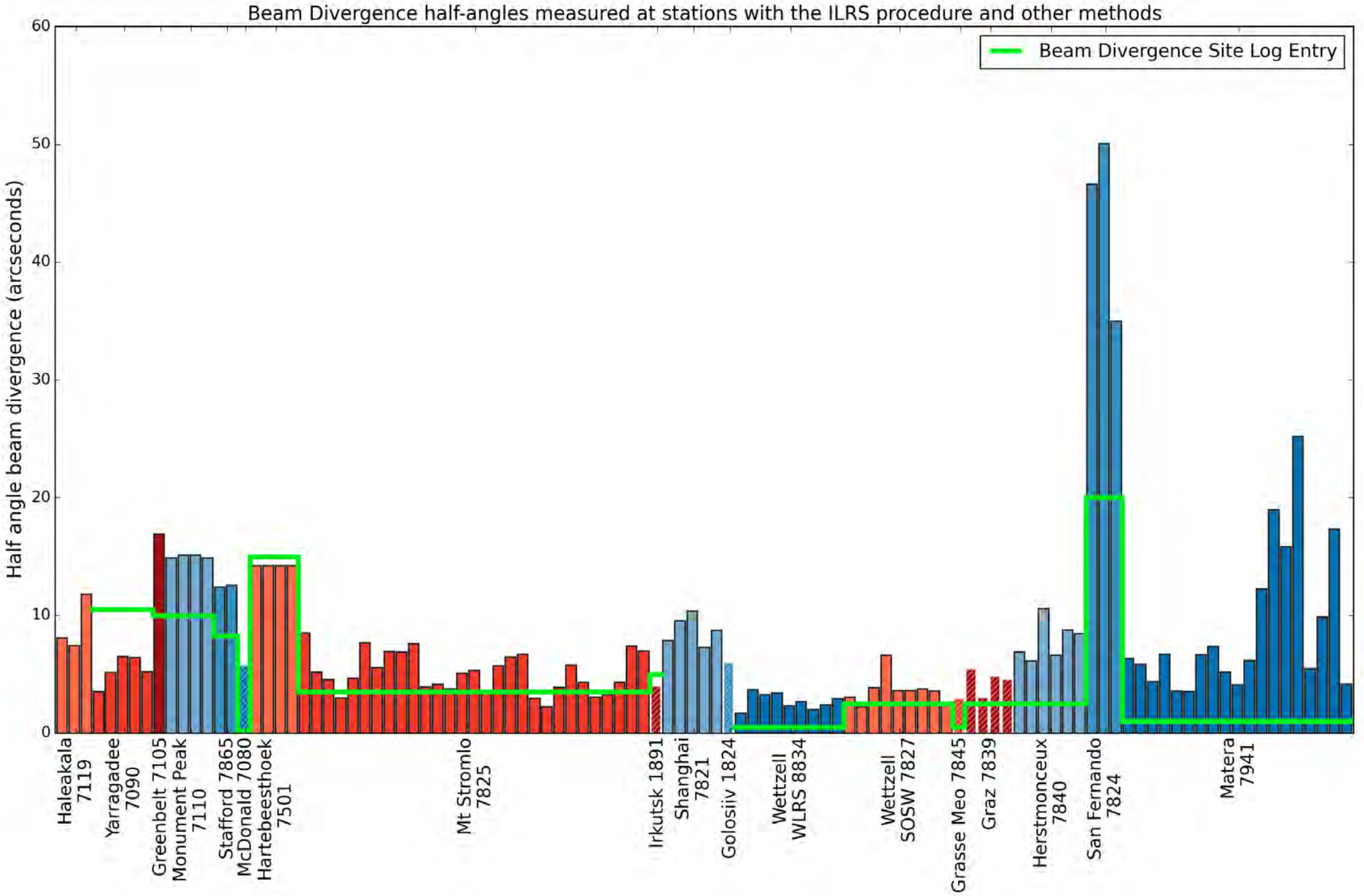
- Building on the work of M. Davis, R. Burris and J. Rodriguez, a beam divergence procedure was designed and provided to the ILRS community on the ILRS website.
- The procedure involves scanning the satellite to find the point of extinction and then finding the energy reduction required to match the extinction.
- In the run up to the ILRS Workshop I have been in contact with ILRS stations to request that they carry out the beam divergence measurement procedure.




Beam Divergence half-angles measured at stations with the ILRS procedure and other methods
Beam Divergence Site Log Entry
Half angle beam divergence (arcseconds)
0
10
20
30
40
50
60
Haleakala 7119
Yarragadee 7090
Greenbelt 7105
Monument Peak 7110
Stafford 7865
McDonald 7080
Hartebeesthoek 7501
Mt Stromlo 7825
Irkutsk 1891
Shanghai 7821
Golosiiv 1824
Wettzell WLRS 8834
Wettzell SOSW 7827
Grasse Meo 7845
Graz 7839
Herstmonceux 7840
San Fernando 7824
Matera 7941

NOT A PROCEDURE FOR ALL

- The stations are hashed in white are those that did not carry out the procedure but did provide alternative information.
  - **Graz** provided satellite scan data
  - **Grasse** have developed an alternative satellite scan method
  - **McDonald** provided beam divergence calculations from ray tracing
  - **Golosiv** and **Irkutsk** calculate divergence by measuring the beam diameter in the focal plane.
- **McDonald** and **Golosiv** could not perform the procedure due to limited pointing accuracy of their telescope**. San Fernando** have same problem but performed measurement anyway.
- **Borowiec** do not have a working energy meter
- **Riga** had a problem with the threshold of their timer
- Some stations have technical problems (**Zimmerwald**, **Simosato**)


Beam Divergence half-angles measured at stations with the ILRS procedure and other methods
Beam Divergence Site Log Entry
Half angle beam divergence (arcseconds)
0
10
20
30
40
50
60
Haleakala 7119
Yarragadee 7090
Greenbelt 7105
Monument Peak 7110
Stafford 7865
McDonald 7080
Hartebeesthoek 7501
Mt Stromlo 7825
Irkutsk 1891
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Graz 7839
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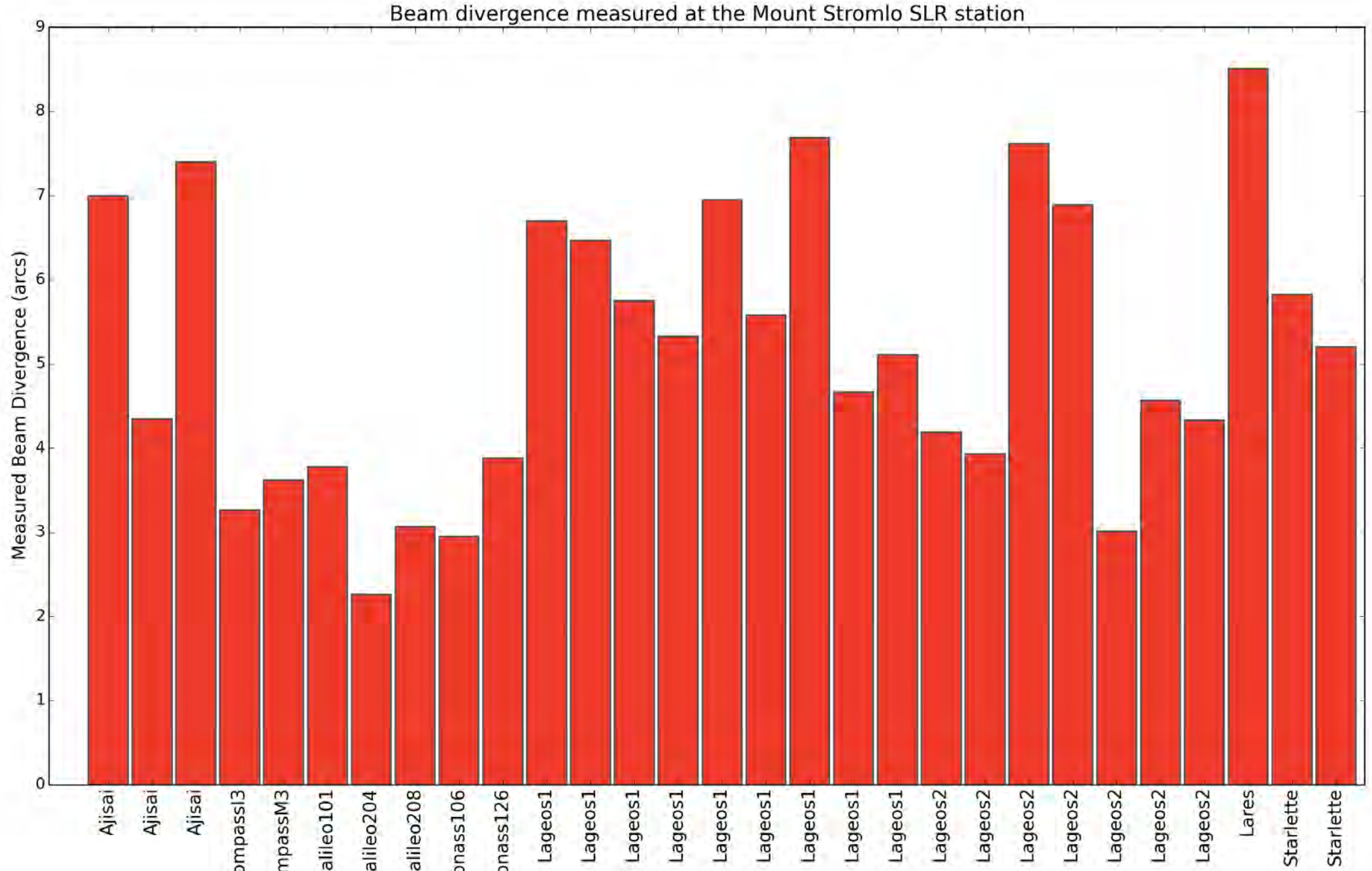
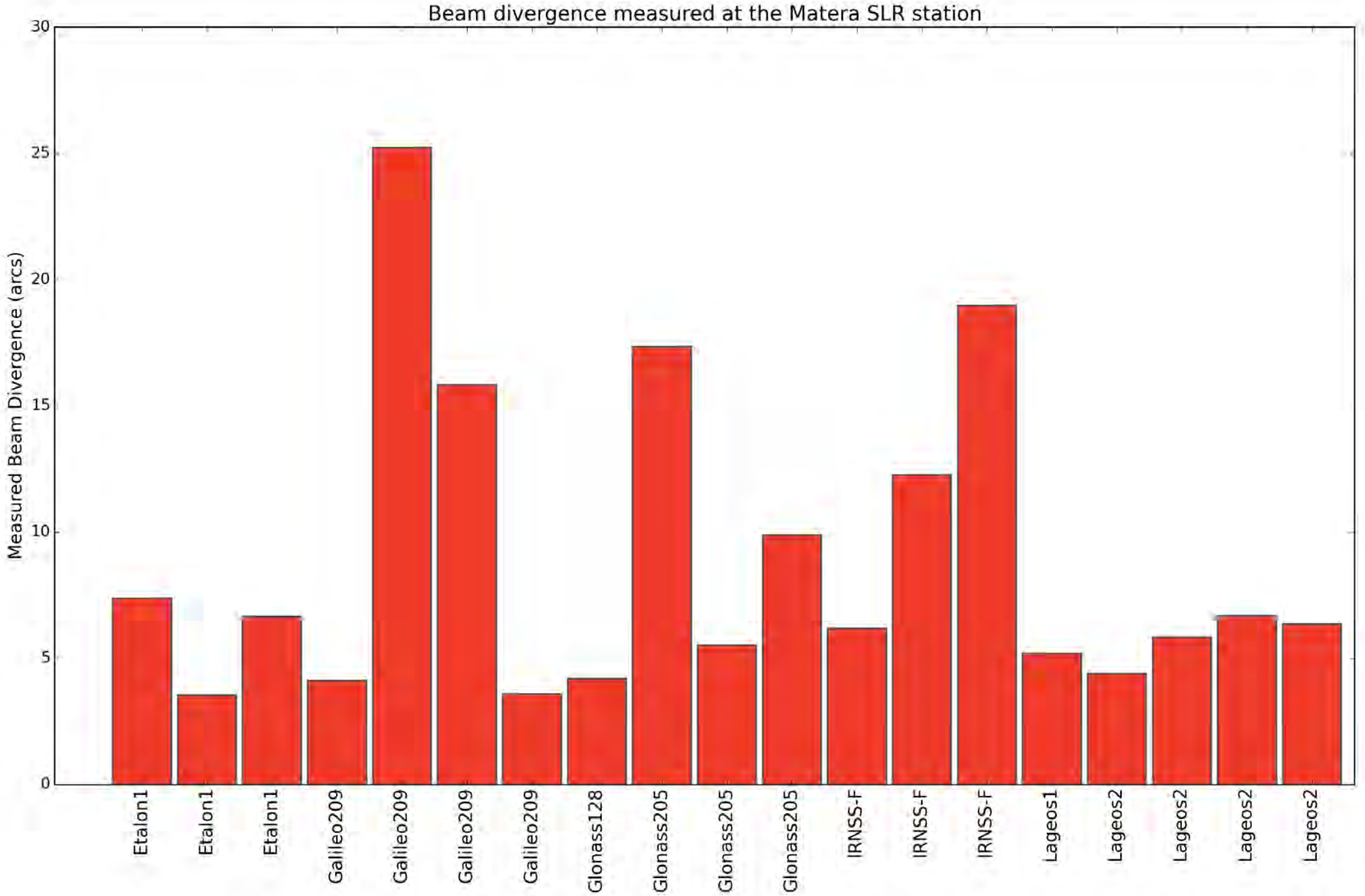
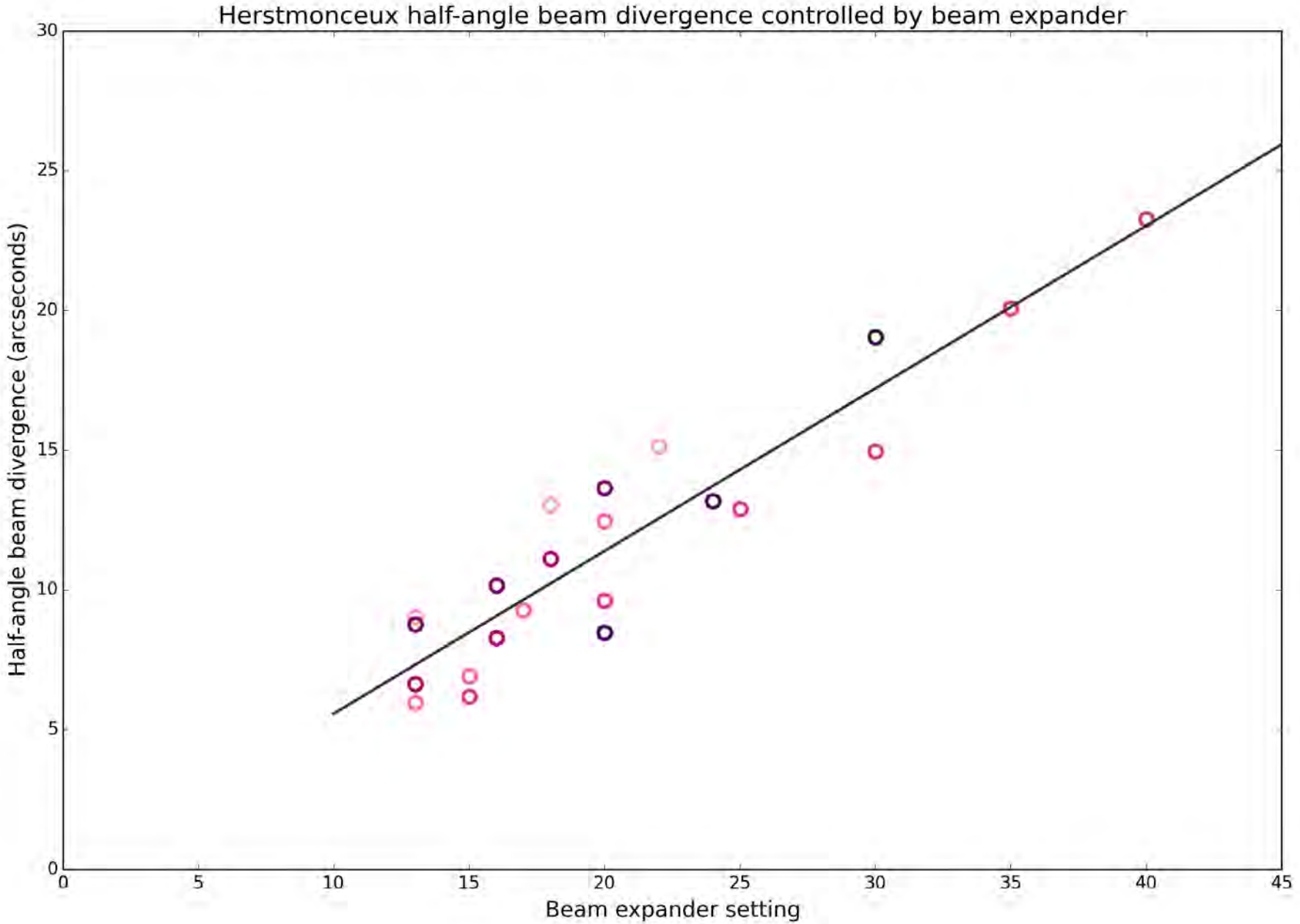
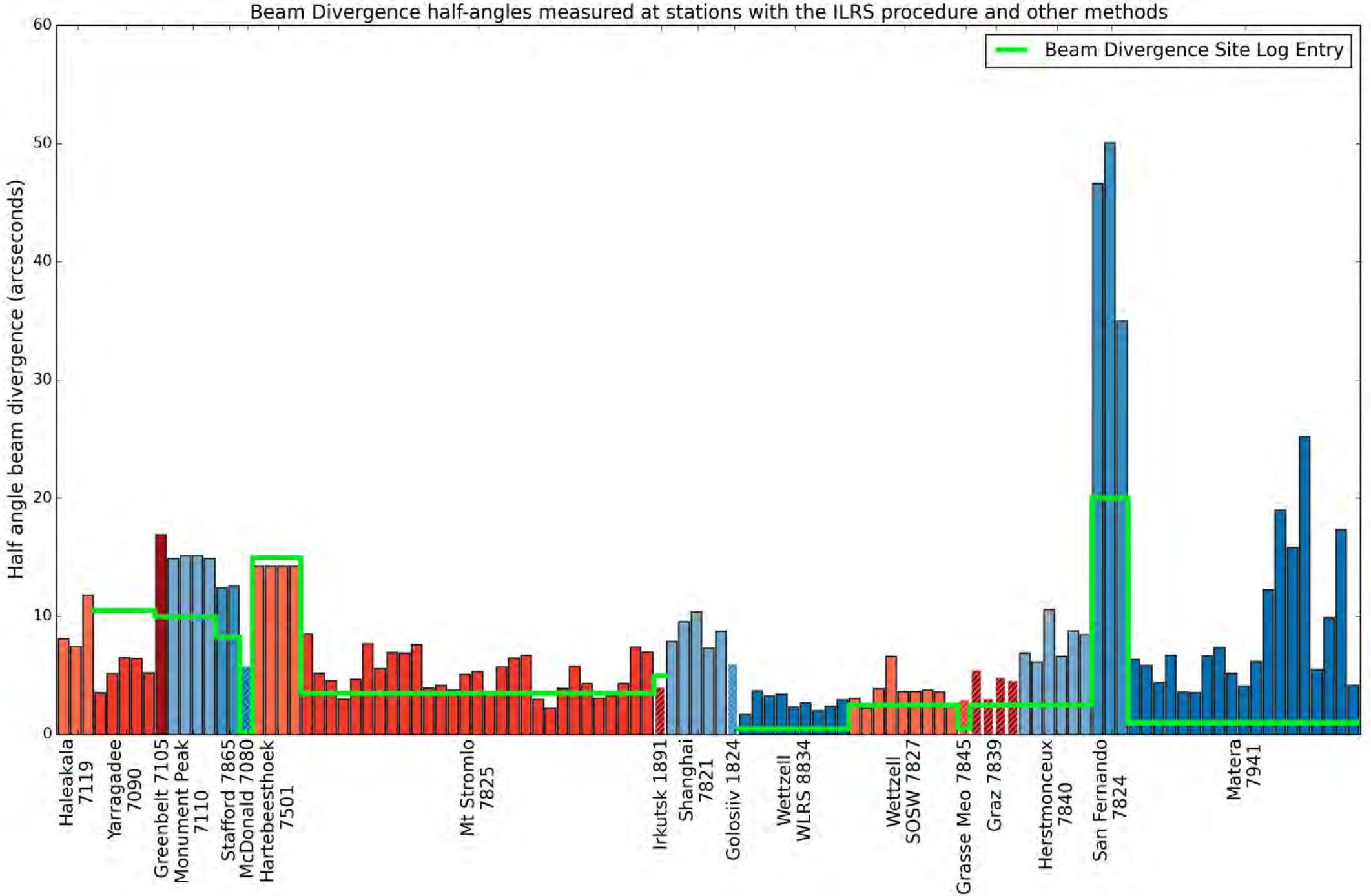
Matera 7941


Beam divergence measured at the Mount Stromlo SLR station
Measured Beam Divergence (arcs)
0
1
2
3
4
5
6
7
8
9
Ajisai
Ajisai
Ajisai
CompassI3
CompassM3
Galileo101
Galileo204
Galileo208
Glonass106
Glonass126
Lageos1
Lageos1
Lageos1
Lageos1
Lageos1
Lageos1
Lageos1
Lageos1
Lageos1
Lageos2
Lageos2
Lageos2
Lageos2
Lageos2
Lageos2
Lageos2
Lares
Starlette
Starlette


Beam divergence measured at the Matera SLR station
Measured Beam Divergence (arcs)
0
5
10
15
20
25
30
Etalon1
Etalon1
Etalon1
Galileo209
Galileo209
Galileo209
Galileo209
Glonass128
Glonass205
Glonass205
Glonass205
IRNSS-F
IRNSS-F
IRNSS-F
Lageos1
Lageos2
Lageos2
Lageos2
Lageos2


Herstmonceux half-angle beam divergence controlled by beam expander
Half-angle beam divergence (arcseconds)
Beam expander setting
0
5
10
15
20
25
30
35
40
45


Beam Divergence half-angles measured at stations with the ILRS procedure and other methods
Beam Divergence Site Log Entry
Half angle beam divergence (arcseconds)
0
10
20
30
40
50
60
Haleakala 7119
Yarragadee 7090
Greenbelt 7105
Monument Peak 7110
Stafford 7865
McDonald 7080
Hartebeesthoek 7501
Mt Stromlo 7825
Irkutsk 1891
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Wettzell WLRS 8834
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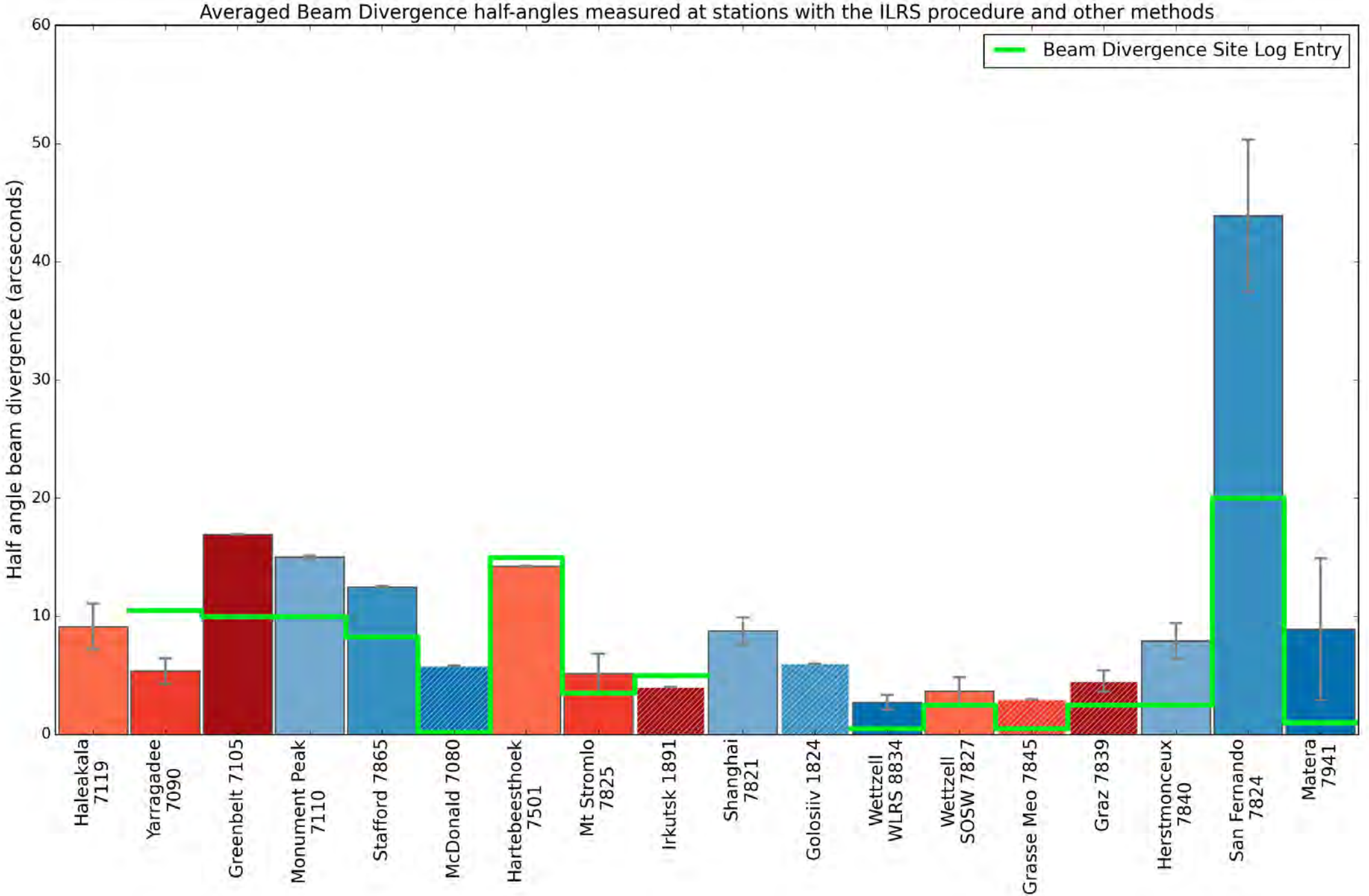
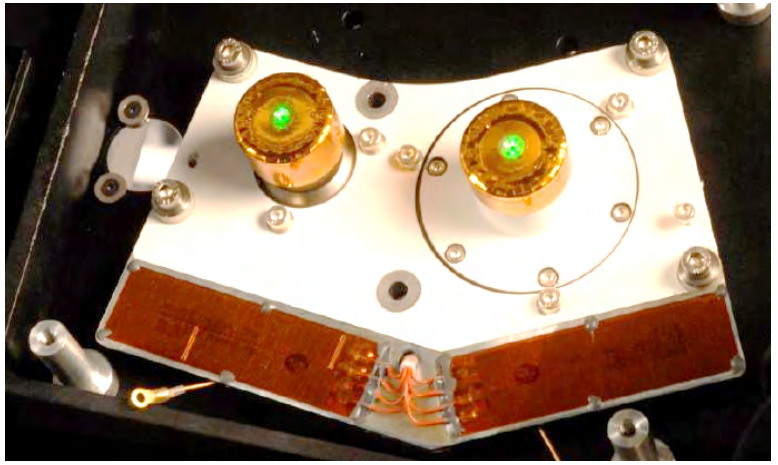
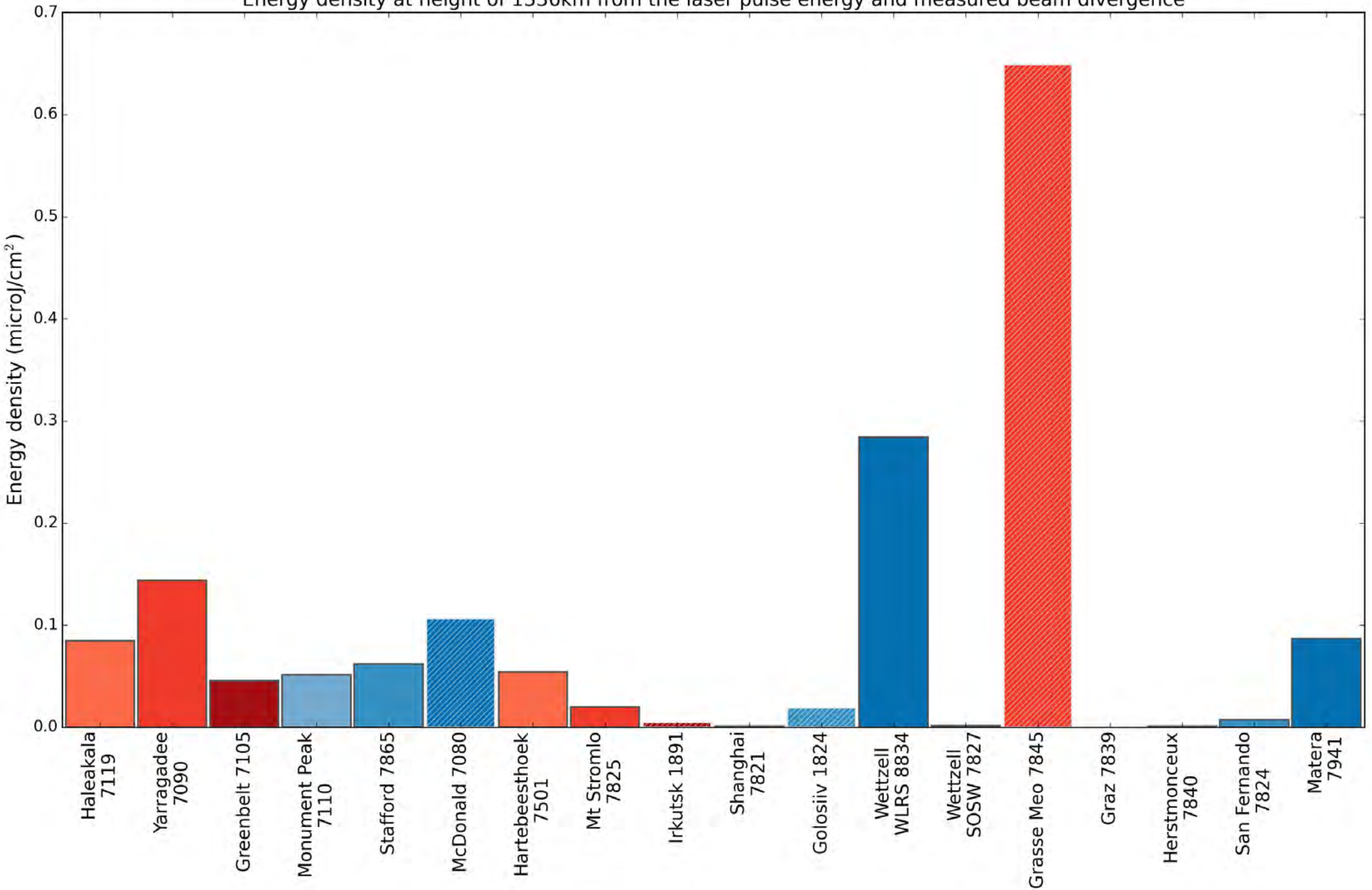
Matera 7941


Averaged Beam Divergence half-angles measured at stations with the ILRS procedure and other methods
Beam Divergence Site Log Entry
Half angle beam divergence (arcseconds)
0
10
20
30
40
50
60
Haleakala 7119
Yarragadee 7090
Greenbelt 7105
Monument Peak 7110
Stafford 7865
McDonald 7080
Hartebeesthoek 7501
Mt Stromlo 7825
Irkutsk 1891
Shanghai 7821
Golosiiv 1824
Wettzell WLRS 8834
Wettzell SOSW 7827
Grasse Meo 7845
Graz 7839
Herstmonceux 7840
San Fernando 7824
Matera 7941

JASON2 ENERGY DENSITITES

- From its launch in 2008, as part of the OCA/CNES time transfer by laser link (T2L2) payload, Jason-2 recorded energy densities of incoming SLR laser pulses.
- The raw data is corrected for this filter to give a measure of J/m^2, in the plane perpendicular to the line of sight.
- Using the Site Log laser pulse energy and measured beam divergences, I calculated the energy density at Jason2 height of 1336km.
- Pierre Exertier provided pulse energies recorded at Jason2 for the year 2015.




Energy density at height of 1336km from the laser pulse energy and measured beam divergence
Energy density (microJ/cm^2)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Haleakala 7119
Yarragadee 7090
Greenbelt 7105
Monument Peak 7110
Stafford 7865
McDonald 7080
Hartebeesthoek 7501
Mt Stromlo 7825
Irkutsk 1891
Shanghai 7821
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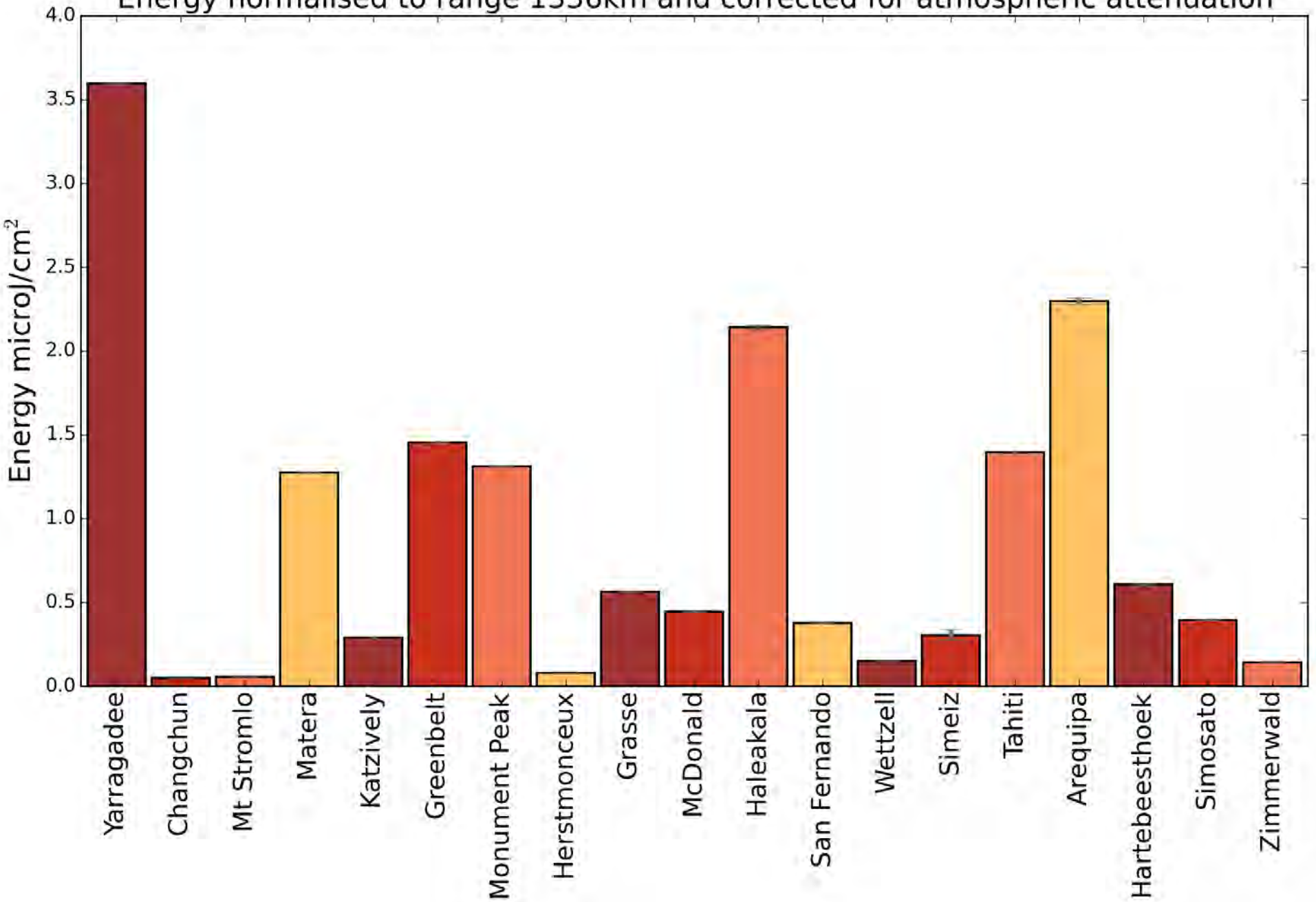
Matera 7941



With thanks to OCS and CNES colleagues for providing this data.

CONCLUSIONS

- The beam divergence procedure works well for many stations, but it does not work for all stations.
- Recommend that an entry "Measured Beam Divergence" section is added to the Site Log.
- This method can inform the Missions SC questions on energy densities at satellite heights.

NESC ONLINE FORUM

NETWORKS AND ENGINEERING STANDING COMMITTEE

ILRS NESC FORUM

- The new NESC forum aims to:
  - Strengthen the connection, communication and collaboration between international colleagues.
  - Exploit the wealth of experience and knowledge in the ILRS network to address problems that are common to multiple stations.

http://sgf.rgo.ac.uk/forumNESC

ILRS NESC FORUM

- Online now and open to the ILRS community
- Register as a member to:
  - Post topics
  - Post replies
  - Get notifications by email
  - See attachments

http://sgf.rgo.ac.uk/forumNESC

Networks and Engineering Standing Committee Forum

Welcome

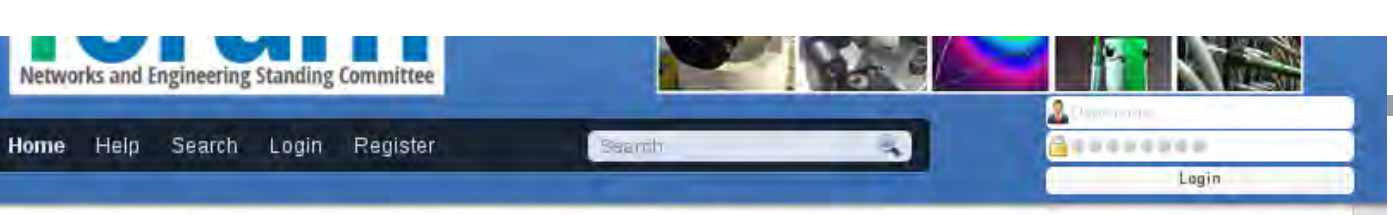
Welcome to the ILRS NESC Forum
This Forum is open to ILRS Networks and Engineering Standing Committee members and to the wider satellite laser ranging community. It is provided so that colleagues can discuss issues, develop ideas, pose questions and ask for or provide advice. Please do what you can to make this an lively and enjoyable forum that proves to be an important tool for the NESC and the ILRS community.

3 Posts
1 Topics

Last post by Matt_SGFHx
in Re: NESC Forum - Please ...
on June 27, 2016, 11:05:05 AM

General Topics

Open a Discussion Bring up an issue for the attention of the NESC Forum	2 Posts 1 Topics	**Last post** by jose_sgf in Re: Anybody know Arnold ... on July 22, 2016, 09:36:53 AM
Ideas What bright ideas have you had recently?	4 Posts 1 Topics	**Last post** by Matt_SGFHx in Re: Making satellites vi... on September 21, 2016, 08:17:53 AM
Detecting and Minimising Station Range Bias Discuss here techniques for detecting sources of range bias at SLR stations and ways to minimise these errors.	0 Posts 0 Topics	
Station Performance Discuss the performance of stations in terms of data quality and quantity.	4 Posts 3 Topics	**Last post** by Toshimichi Otsubo in Station performance char... on September 20, 2016, 04:03:20 PM
Station Updates and News Let the community know what's happening at your SLR station	1 Posts 1 Topics	**Last post** by serna_yebes in Hello from Yebes Observa... on June 20, 2016, 10:31:57 AM



Networks and Engineering Standing Committee Forum › Statistics Center

Networks and Engineering Standing Committee Forum - Statistics Center

General Statistics

Total Members:	47	Average registrations per day:	0.26
Total Posts:	23	Average posts per day:	0.21
Total Topics:	13	Average topics per day:	0.10
Total Categories:	3	Total Boards:	14
Users Online:	3	Latest Member:	Hiroo Kunimori
Most Online:	36 - July 01, 2016, 05:48:34 AM	Average online per day:	2.95
Online Today:	3	Male to Female Ratio:	8:1
Total page views:	3426	Average page views per day:	15.29

Top 10 Posters

Matt_SGFHx	9
Manuel	2
Toshimichi Otsubo	2
delpino@riga	1
shaosir	1
Luis Manuel Cortina	1
Iglg	1
Evan GSFC	1
serna_yebes	1
Georg	1

Top 10 Boards

Ideas	4
Station Operational Questions	4
Station Performance	4
Welcome to the ILRS NESC Forum	3
Data Handling Questions	2
Open a Discussion	2
Station Equipment Questions	1
Station Updates and News	1
Lasers	1
In-Sky Safety	1

Top 10 Topics (by Replies)

Making satellites visible during daylight ranging	3
NESC Forum - Please read on joining the forum	2
Normal Points software	2

Top 10 Topics (by Views)

Making satellites visible during daylight ranging	313
SLR Hit Rate 2015	259
NESC Forum - Please read on joining the forum	237

Author | **Topic: Making satellites visible during daylight ranging (Read 308 times)**

May 06, 2016, 10:16:32 AM

Georg
Newbie
Posts: 1

Making satellites visible during daylight ranging
« **on:** May 06, 2016, 10:16:32 AM »

Quote Modify Remove Split Topic

Hi everybody from Graz !

During our last visit at Potsdam SLR station in March 2016, Lutz Grunwaldt showed us CCD images of short visible flashes of Envisat during a daylight tracking session - a surprise for us !

We have now installed a proper CCD in our detection package, and have started to visualize at least large targets during daylight tracking; we expect it to be quite useful when tracking e.g. debris using TLE with larger TB values etc....

We have started now to fill a list, which targets we have seen already during daylight... maybe I can report more about, when I am back from a 3 week holiday, which will start tomorrow :-)

Any other experiences with that ?

Georg

Report to moderator 193.170.87.144 (?)

July 05, 2016, 05:14:04 PM **Reply #1**

iglg
Newbie
Posts: 1

Re: Making satellites visible during daylight ranging
« **Reply #1 on:** July 05, 2016, 05:14:04 PM »

Quote Modify Remove Split Topic

I, too, once in the daytime saw GLONASS, when the satellite was well illuminated by the sun. I think that should be visible Ajisai.

Post reply

Subject: Re: Making satellites visible during daylight ranging

Message icon: Standard

Font Face | Font Size | Change Color

Attachments and other options

shortcuts: hit shift+alt+s to submit/post or shift+alt+p to preview

Post Preview

Topic Summary

Posted by: Matt_SGFHx

« **on:** September 21, 2016, 08:17:53 AM »

Insert Quote

Hi Georg

Do you have any more details on how to do this? What equipment do you use? And can you post an image?

Matt

ILRS NESC FORUM

- Notifications
  - In order to get email notifications of new posts or daily or weekly summaries it is necessary to select 'NOTIFY' on the topics or boards that you want to follow.

AGENDA

- Beam Divergence Procedure
- NESC Forum
- What stations require to identify and eliminate systematics.
- Site log review
  - Stations Changes File proposal (Christian Schwatke)

Transponder SC

U. Schreiber, J. Mcgarry, J. Degnan

Agenda:

Status of the T2L2 experiment on Jason 2	C. Courde
Status of the ELT experiment on ACES	U. Schreiber
ELT (Laser Safety on operational aspects)	J. Eckl
ELT Data Center	A. Schlicht
LRO-LR	J. McGarry / Dandan Mao
Lunar Occultation Experiment	J. McGarry / Xiaoli Sun

Other business

Status report about T2L2 /Jason-2

Pierre Exertier

« astrogeo » team, OCA-CNRS

Laser Ranging Workshop, Potsdam, October 10-15, 2016

Operations & data

T2L2 is still acquiring laser ranging Full Rate data (via EDC); there is an opportunity for SLR stations from Russia to participate in the tracking in order to be included in time transfer activites and in particular the time bias estimation process that is currently in progress.

Current campaign (Europe – Asia) : time transfer in non-common-view

A time transfer campaign is currently in operation between Herstmonceux/Grasse and Changchun/Shanghai; the goal is to compare the ground-to-ground calibrated links provided by GPS and T2L2 (in non common view).

Synergies from T2L2

- DORIS (OUS) & IDS : a better understanding of the frequency response of the USO (radiations) en Jason-2, using the precise read of the frequency variations provided by the ground-to-space time transfer ;

- Time Bias per station for ILRS analyses : estimation of the time bias of SLR stations participating in the T2L2/Jason-2 tracking ; reduction of measurement biases, even small, is one of the main goal for the ILRS contribution to ITRF ;

- Laser received energy, and trasmission through the atmosphere ; a better understanding of the laser beam transmission through atmosphere : energy, divergence, etc.

- ELT / Fundamental physics : synergies about ground time&frequency technologies, about data processing (time transfer by laser ranging), etc.

We made, end of 2015, a proposal to extend the T2L2 mission in 2017; the goal was to ensure continued progress in geodesy thanks to the space co-located techniques, DORIS and laser, through T2L2.

Recently, CNES decided to end the T2L2 mission at the end of 2016. It was for all of us a very surprising decision, but we should recognize that CNES is supporting the mission for more than 8 years.

ELT Laser Safety Functions - Installation Report

Technische Universität München
Forschungseinrichtung Satellitengeodäsie
Geodätisches Observatorium Wettzell

Author: Ulrich Schreiber

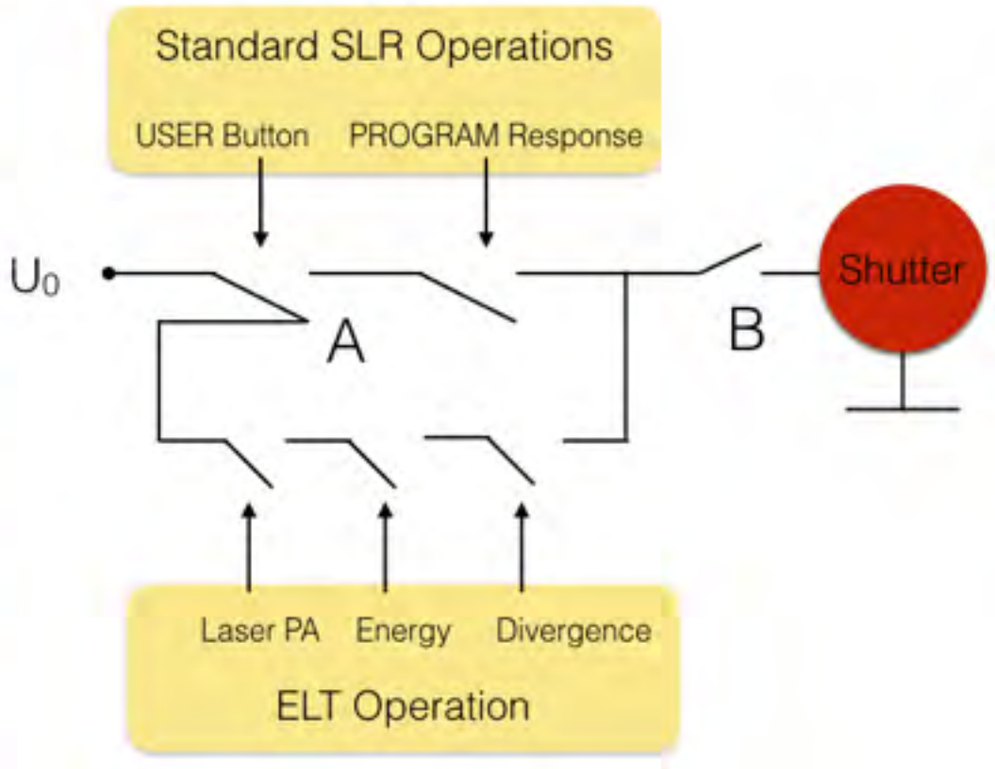
Date: 17. 8. 2016

Signature: .....

Document Number: WLRS-Implementation-1
Version: 1

- Installation Report delivered to ASTRIUM in August, 2016
- Approval from ESA, NASA pending
- Test operation in preparation

- Concept deals with 2 ranging modes
- eye-safe and non eye safe aspects have to be separated sufficiently



The heart of the system is a realtime energy monitor with inhibit (shutter)

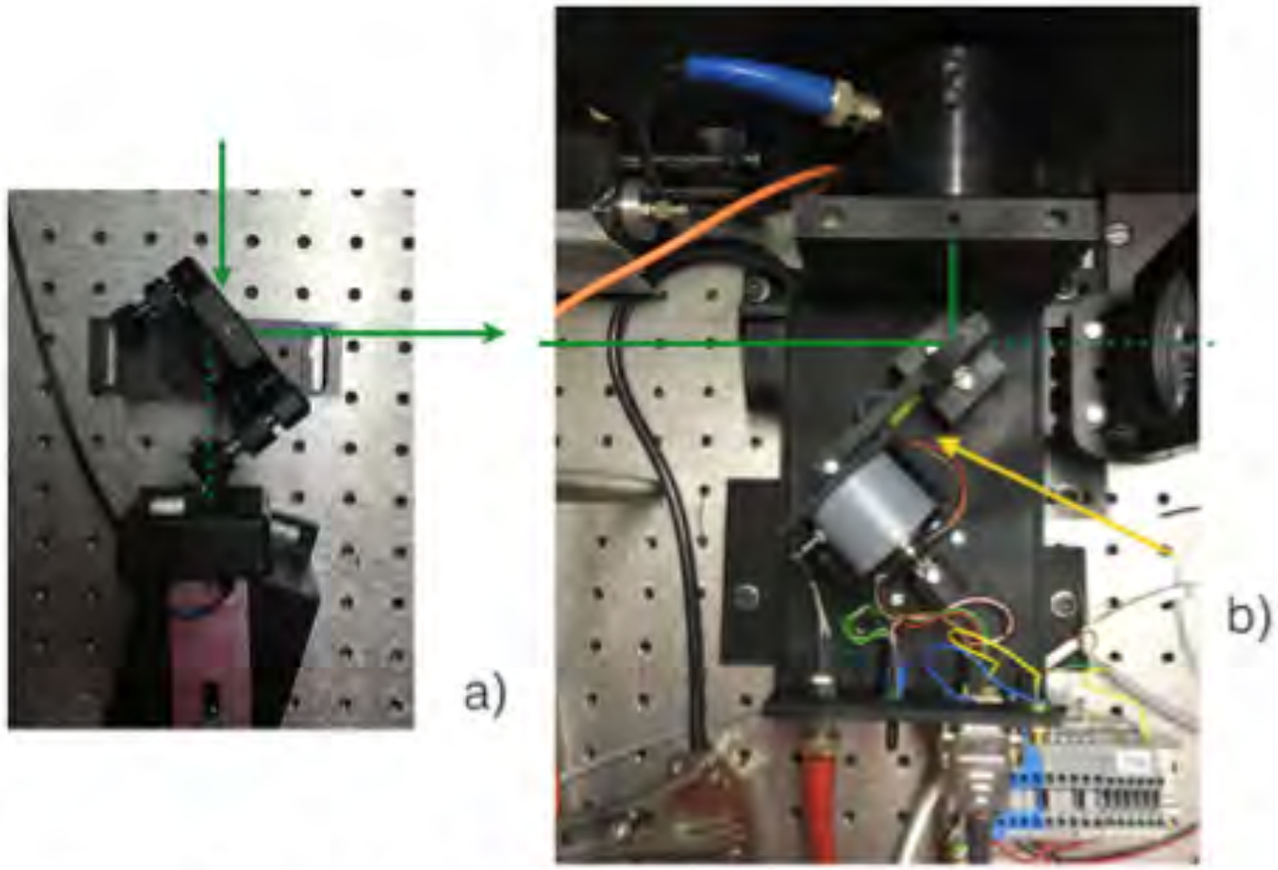


Fig. 8: *Laser Beam Power Control – The light leakage through a turning mirror is measured a). When the corresponding detected voltage is within a predefined range a motor lifts the physical beam block out of the beam path, physically connecting the telescope to the laser. Every time the conditions are not met, the beam block is dropping back into the beam path.*

ELT support from ILRS

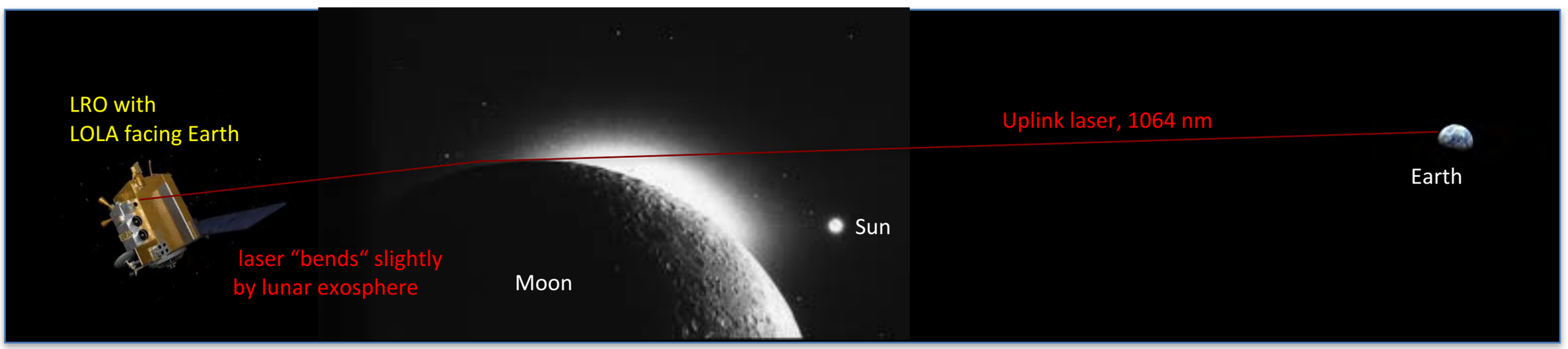
- WLRS is test case for ISS ranging (ESA point of view)
- Once we are approved the same concept can be applied to other stations **without extra pain.** There is word of an annex document per station.
- ILRS tracking request is prepared and waits for safety approval.
- Stations under discussion are: Yarragadee, Greenbelt, NRL, Herstmonceux, Zimmerwald, Graz, Borowiec, Matera…
- High priority would have NICT because it is a National Standards Lab, but that is in Limbo
- NIST and PTB are "only" connected indirectly via TWSTFT
- The ELT-DC provides the link with the mission and the ILRS and is on track

Lunar Laser Occultation Tests

- Update for LRO Project Scientists, 9/21/2016

Xiaoli Sun, NASA Goddard Space Flight Center

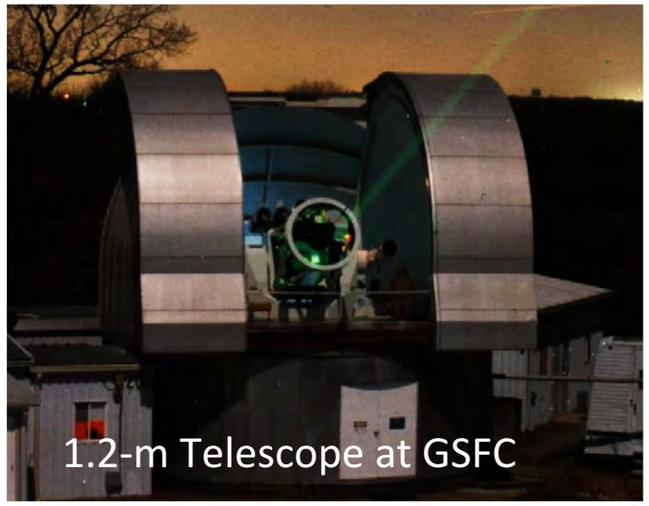
- **Objective:** Study lunar dust and exosphere via their optical properties to laser beams
- **Observations:** Laser forward scattering/refraction by lunar dust and exosphere
  - Beam a 1064 nm laser from the 1.2 m telescope facility at the NASA GSFC to LRO in lunar orbit about occultation before and during meteor showers
  - Aim the LOLA receivers at NASA GSFC to measure the times of arrival and amplitude of the uplink and downlink laser pulses during occultation
    (need LRO to point its nadir deck to Earth and scan a small area, as in 2009 and 2014)



Test Setup and Plan Forward

Status of the Ground Station Setup at GSFC

- Received funding late FY16 for the ground station test setup and agreement with LRO to pay for operation cost in FY17
- Ground station setup on-going and to be completed in Oct. 2016
- Agreement to share a 4kHz laser with another project for the high resolution measurement from Dec. 2016 and on.


1.2-m Telescope at GSFC

Plan Forward

- Working with LRO MOC on the LOLA-Earth scan design as in 2014 but hopefully with a longer dwell time (Nov. 2016)
- Repeat the laser uplink and downlink tests using the existing 50Hz laser to check out the LOLA lasers and the ground station equipment (Nov.-Dec. 2016)
- Conduct the laser occultation tests with the 50Hz laser and then the 4 kHz laser (Dec. 2016 and on, as funding allows)


Delgado, SPIE 0044, 1974

TRANSPONDER STANDING COMMITTEE MEETING: POTSDAM, GERMANY 9-14 October 2016

➢Two very recent publications on laser ranging to LRO:

1) D. Mao et al., The laser ranging experiment of the Lunar Reconnaissance Orbiter: Five years of operations and data analysis, Icarus (2016), http://dx.doi.org/10.1016/j.icarus.2016.07.003

2) S. Bauer et al., Demonstration of orbit determination for the Lunar Reconnaissance Orbiter using one-way laser ranging data, Planetary and Space Science 129 (2016), http://dx.doi.org/10.1016/j.pss.2016.06.005

ILRS GB Meeting - SDSG

GFZ

October 09, 2016; 15:00-19:00 Hours

- Number of Stations tracking Space Debris (Laser + Light Curves) increased significantly:
  - Graz
  - Wettzell
  - Zimmerwald
  - Borowiec
  - San Fernando
  - Shanghai, + several other Chinese stations
  - Stromlo
  - Stuttgart
  - ????

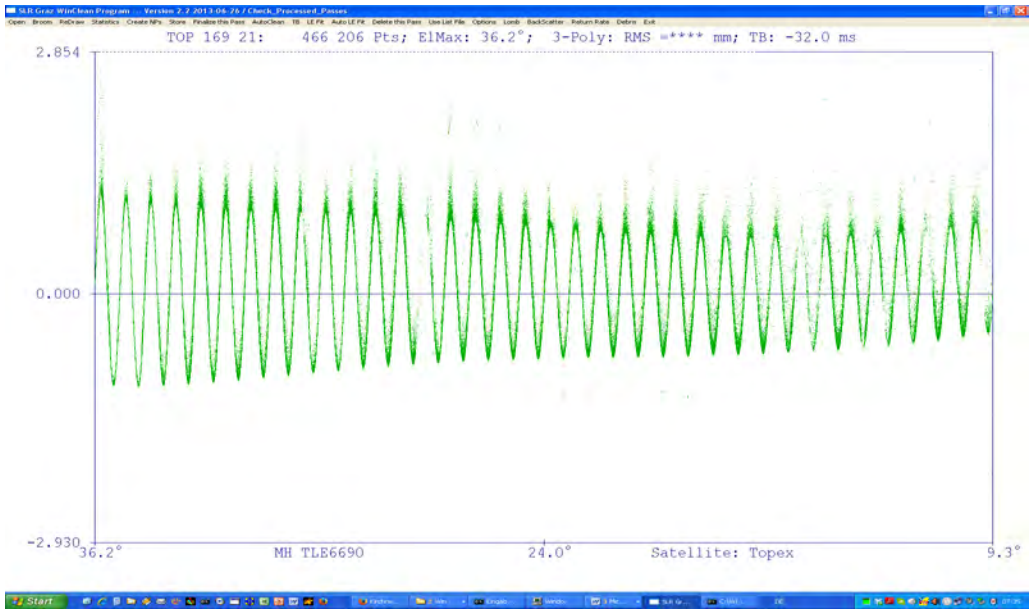
- Planned SD operation:
  - Metsahovi
  - Yebes
  - ESA;

ILRS GB Meeting - SDSG

GFZ

October 09, 2016; 15:00-19:00 Hours

- TOPEX Campaign delivered excellent results
  - Several ILRS stations participating; data stored at SDSG Debris server Graz
  - Graz calculated perfect CPF predictions (< 1 ms TB)
  - Analyis of Topex spin parameters: 11 s period; accelerating;
  - Solar Radiation pressure identified as pushing force (Daniel)
  - Topex solar panels final orientation determined via that (Daniel)

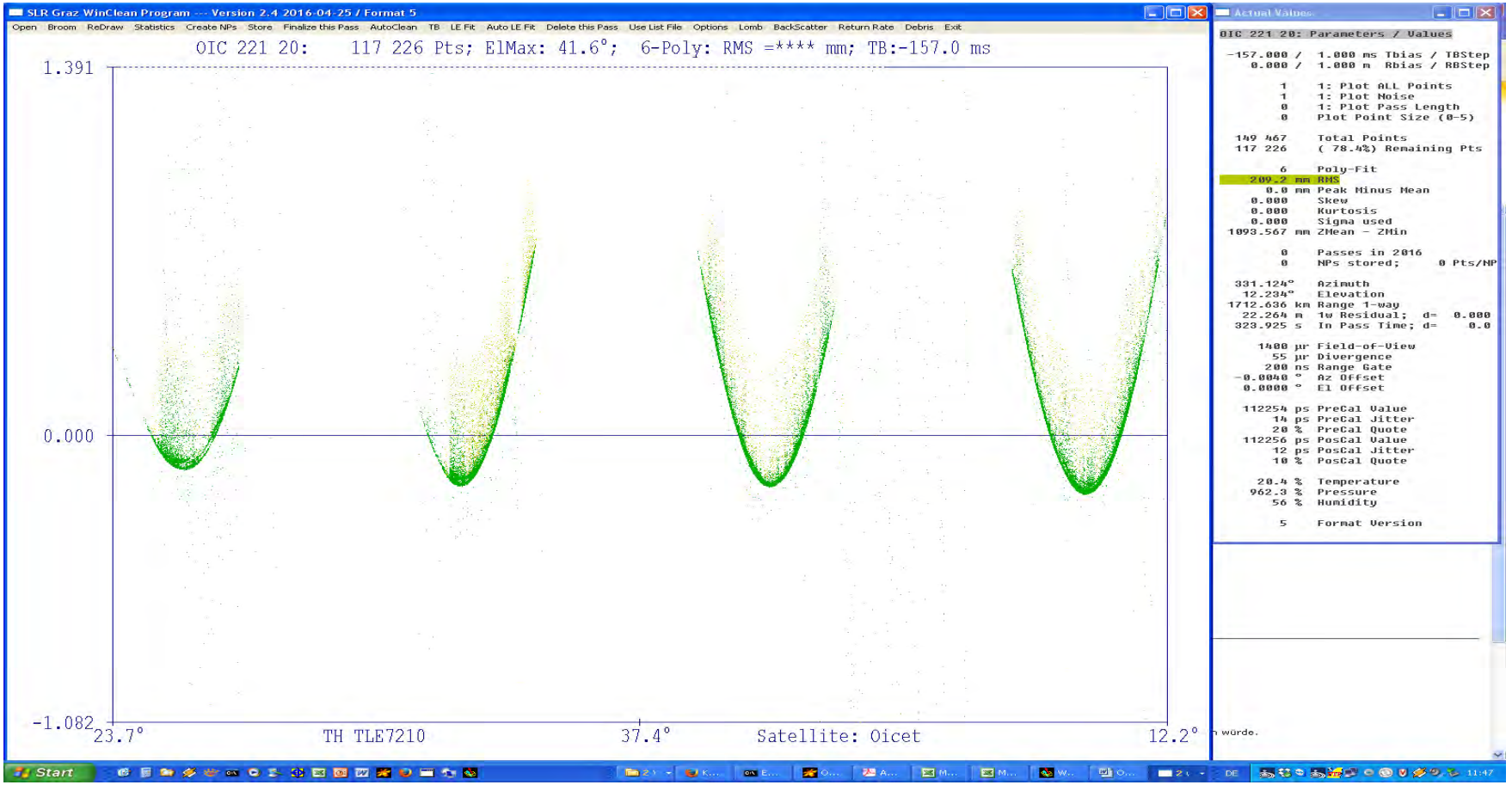


ILRS GB Meeting - SDSG

GFZ

October 09, 2016; 15:00-19:00 Hours

- OICETS, ADEOS-2 Campaigns started



- Attitude Motion Determination Projects ongoing