

ILRS TECHNICAL WORKSHOP 2019

Stuttgart 21st - 25th October



ILRS Technical Workshop 2019

Laser ranging:

*To improve economy, performance,
and adoption for new applications*





GENERAL INFORMATION

Registration and Workshop Office

From Sunday to Friday the registration desk and conference office are located in the conference area.

Opening Hours

| | |
|--------------------|---------------|
| Sunday, October 20 | 08:00 - 17:30 |
| Monday to Friday | 08:00 - 17:30 |

Contact

For all matters regarding the social program and organization, please contact:

Rebecca Bartkowski
Mobile: +49 52 08582 751
Email: Rebecca.Bartkowski@dlr.de

If you have any queries regarding the scientific program, please contact:

Dr. Daniel Hampf
Mobile: +49 711 6862 751
Email: ilrs.workshop@dlr.de

Internet Access

Complimentary internet access is available in the workshop area:

Network: Pullman Stuttgart Password: no password needed

Event Photos

Please noted that this event will be recorded photographically and partly published on organizer web-sites, in social networks or for organizer publications.

It is your right to refuse being photographed. Please inform the photographer accordingly.

Official Language

All presentations must be given in English, the official language of the workshop.



GREETINGS

Welcome to the ILRS Technical Workshop 2019!

It is our great pleasure to welcome you to the ILRS Technical Workshop 2019 in Stuttgart. Since we have started our laser ranging research activities in 2010, we have received great support from various members of the ILRS. In 2017, we had the opportunity to join the ILRS with our Uhlands-höhe engineering station, and we have been a proud member since. With our background as laser and optics research facility, we strive to contribute new technologies, techniques and ideas to the SLR community.

Organising this year's technical workshop is a great honour for us, and we would like to thank the ILRS governing board for entrusting us with this task. We are looking forward to five days of interesting presentations, discussions and excursions. In this booklet you will find helpful information for your stay at the workshop. If any questions remain, please do not hesitate to contact the registration desk or any member of our team. Enjoy your time in Stuttgart!

Daniel Hampf (on behalf of the local organising committee)



WELCOME FROM THE ILRS GOVERNING BOARD

The ILRS Governing Board welcomes the participants of the 2019 ILRS Technical Workshop to Stuttgart, Germany. Contrary to the broad program coverage of the biannual International Workshops on Laser Ranging, the off-year technical workshops give us the opportunity to focus on more specific topics that are of particular current interest or other important issues that need to be addressed in more detail for the quantity and quality of our data products and the development of our data access capability. This year's technical workshop will cover methodologies for improvement of system and network performance, synergies and new applications, novel concepts for improving future performance, and safety and security. Within this framework, we must improve the performance of our marginal stations and encourage the deployment of new stations to enhance our global coverage.

We must address the challenge of 1 mm quality data, tracking coverage for the more than 100 satellites that currently need our support, and expanding to new applications to increase our user base, while at the same time maintaining and improving our safety and security. Laser ranging systems are very expensive; the threshold for meaningful participation is high. We must continue to examine new technologies and better ways of applying the legacy technologies to provide the most effective, yet economical support to our current users and to attract new ones.

These workshops are intended to provide a venue for sharing ideas and concepts and how we should plan paths forward together in the framework of openness. However, just as important, we want everyone to have a good time.

For the ILRS Governing Board:

Toshi Otsubo

Chair, ILRS Governing Board

Mike Pearlman

Director, ILRS Central Bureau



LASER RANGING ACTIVITIES AT INSTITUTE OF TECHNICAL PHYSICS

The DLR Institute of Technical Physics is working in the field of ground station technologies for laser based monitoring of orbital objects, incl. space debris, with high accuracy using infrared laser sources. A first technology demonstrator was the Uhlandshöhe Research Observatory (UFO - (Uhlandshöhe Forschungsobservatorium), which was developed to demonstrate different laser transmitter systems incl. fiber based coupling at a high repetition rate.

An innovative compact station design directly derived from UFO ground station, the miniSLR system aims at developing a standardized SLR system that is capable of fully automated routine SLR measurements, e.g. to navigation satellites or geodetic or scientific missions.

Another site independent, transportable solution (STAR-C: Surveillance, Tracking and Ranging-Container) is currently being implemented for field operation at the DWD site in Stuttgart. It houses a massive frame equipped with a raising platform carrying an alt-azimuth mount, a laser transmitter and a receiver telescope. The platform is lifted above the container's roof level allowing for all sky tracking including low elevations. With its coudé-path optics, STAR-C is capable of transmitting high laser power, as needed for space debris and lunar laser ranging.

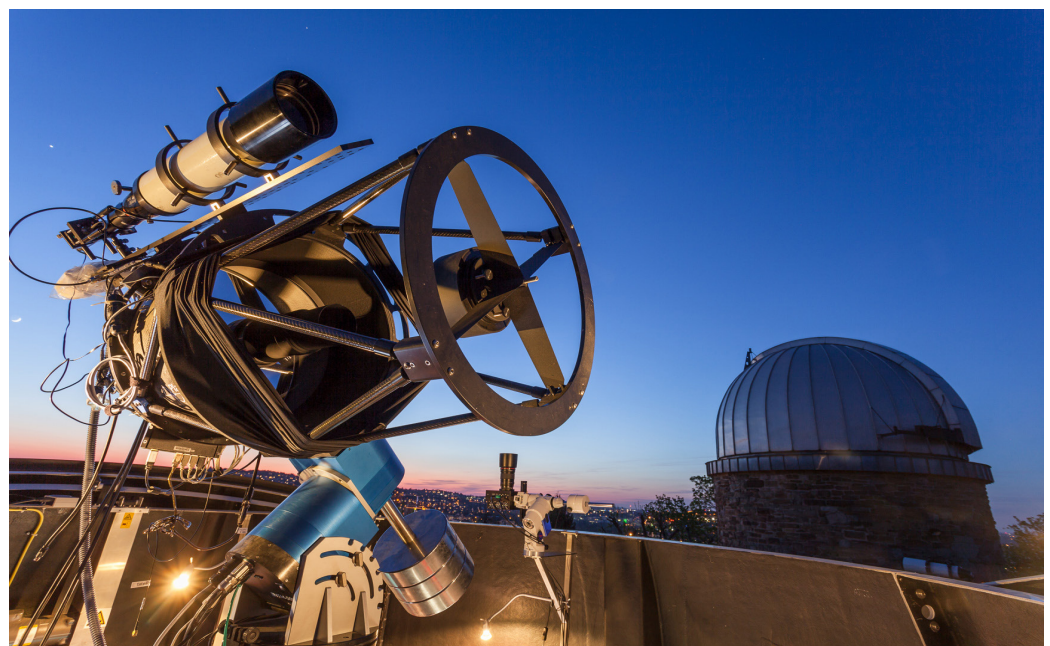
In-house development of a high-power pulsed laser source based on thin-disk laser technology is pursued. With pulse duration of a few nanoseconds, high repetition rates on the order of several kHz, a coupling with STAR-C transmitter will allow for laser ranging of orbital objects in decimeter dimensions in LEO.

MS-LART (multi-spectral large aperture receiver telescope), devoted as a high end platform for satellite and space debris laser ranging, will be the next step following the successful development at DLR's UFO satellite laser ranging station and will serve as the scientific basis for the next decade. The telescope is based on a Ritchey-Chrétien design with a primary mirror diameter of 1.75 m, has two Nasmyth ports, and a Coudé path option. The implementation of the project started in late May 2019 and 'first light' is expected in Dec. 2020.

With the increasing amount of space debris laser-based concepts on orbit modification have come up in the recent years. In particular, the commercial availability of cw lasers with an average power beyond the 10 kW level makes the technology of remotely based momentum transfer to space debris by photon pressure accessible. Concepts for orbit modification are being developed at the Institute of Technical Physics, including laser ablative interaction by using pulsed laser technologies.



STAR-C, our transportable space debris laser ranging station
© DLR



UFO, Stuttgart's first SLR station
© DLR



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INTERNATIONAL PROGRAM COMMITTEE

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Helmholtz Centre
Potsdam/GFZ,
Germany

Roelf Botha,
SARAO,
South Africa

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USA

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Czechia

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DLR,
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Latvia

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of PAS &
Polish Space Agency
Poland

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Geodesy Facility,
UK

Igor Zayer,
European Space
Operations Center,
EU

Zhongping Zhang,
Shanghai Data Center,
China

LOCAL ORGANIZING COMMITTEE, DLR

Nils Bartels

Denise Beisecker

Daniel Hampf

Wolfgang Riede

Ewan Schafer

Stefan Scharring

Samatha Siegert

Gerd Wagner

Paul Wagner

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DLR CONFERENCE OFFICE

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REGISTRATION, ABSTRACT MANAGEMENT AND CONFERENCE WEBSITE

BESL Eventagentur GmbH & Co. KG Website:
www.dlr.de/ilrs2019

Support:
helpdesk@besl-eventagentur.de
+49 30 325 999 7180

We build your
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To name just a few others...





INFORMATION FOR PRESENTERS

TALKS

When preparing for your talk, please consider these notes:

- Produce your presentation as pdf or PowerPoint file
- Note the length of your talk in the session program. For most talks, the allotted duration is 15 minutes, plus 5 minutes of discussion.
Please do not use the discussion time to continue your talk.
- We have one presenter laptop for everyone's use.
You cannot use your own laptop for the presentation.
- To copy the file onto the presenter laptop, you have two options:
 - Send your file to ilrs.workshop@dlr.de until October 18. Name your file like this: sessionX_surname.ppt (or pdf). If we receive your file in time, it will be ready for you on the presenter laptop during the workshop.
 - Bring your presentation on memory stick to the conference. Please contact the AV technician well before your session in order to copy your presentation onto the presenter laptop.
- Introduce yourself to the session chairs before the session.

POSTERS

When preparing your poster, please note:

- Print your poster on A0. Either portrait or landscape orientation are possible.
- Bring your poster printed.
- Stands and tape will be provided.
- There will be a dedicated 90 minute poster session on Wednesday afternoon. Please be near your poster during that time to interact with poster viewers.
- The three best poster presentations will win a little DLR souvenir.
- Please send a file of your poster (e.g. pdf) to Carey Noll before or shortly after the workshop:
carey.e.noll@nasa.gov

PROCEEDINGS

The ILRS governing board has decided not to request written papers of individual contributions. The conference website will contain only the abstracts and pdfs of the presentations and posters.

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SUPPORTERS AND EXHIBITORS



ASTELCO designs, develops, builds and services advanced mechanical and optical systems and dedicated software. ASTELCO builds completely retractable enclosures and fast-rotating domes from 2m to 12m Ø. ASTELCO is committed to quality, reliability and close connection to science. ASTELCO is specialized on Satellite Tracking & Identification Telescopes, including Active Optics with Laser Guide Star Systems.



Baader Planetarium is a small medium enterprise with more than 50 years of experience in producing and installing observatories for ground based surveillance and observation with more than 600 observatory dome installations around the world ranging from 2m up to 8.5m in diameter, serving a multitude of applications for scientific use.



DiGOS provides modern turnkey Laser Ranging Stations with high flexibility for current and emerging applications. The capabilities include tailored solutions as well as upgrading of existing SLR systems



Swabian Instruments develops outstanding data acquisition and signal generation systems for groundbreaking research and industry.

In the exhibition area you will find presentations by ASA, Baader Planetarium, GuideTech, Innolas, Quantum Design, Single Quantum and Swabian Instruments.



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VENUE

Pullman Stuttgart Fontana

Vollmoellerstrasse 5,
70563 Stuttgart,
Germany

Phone: (+49) 7117300

<https://www.accorhotels.com/de/hotel-5425-pullman-stuttgart-fontana/index.shtml>

SITE MAP



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ACCESS

By Car:

The Pullman Stuttgart Fontana is conveniently located by the office and administration center of Stuttgart-Vaihingen.

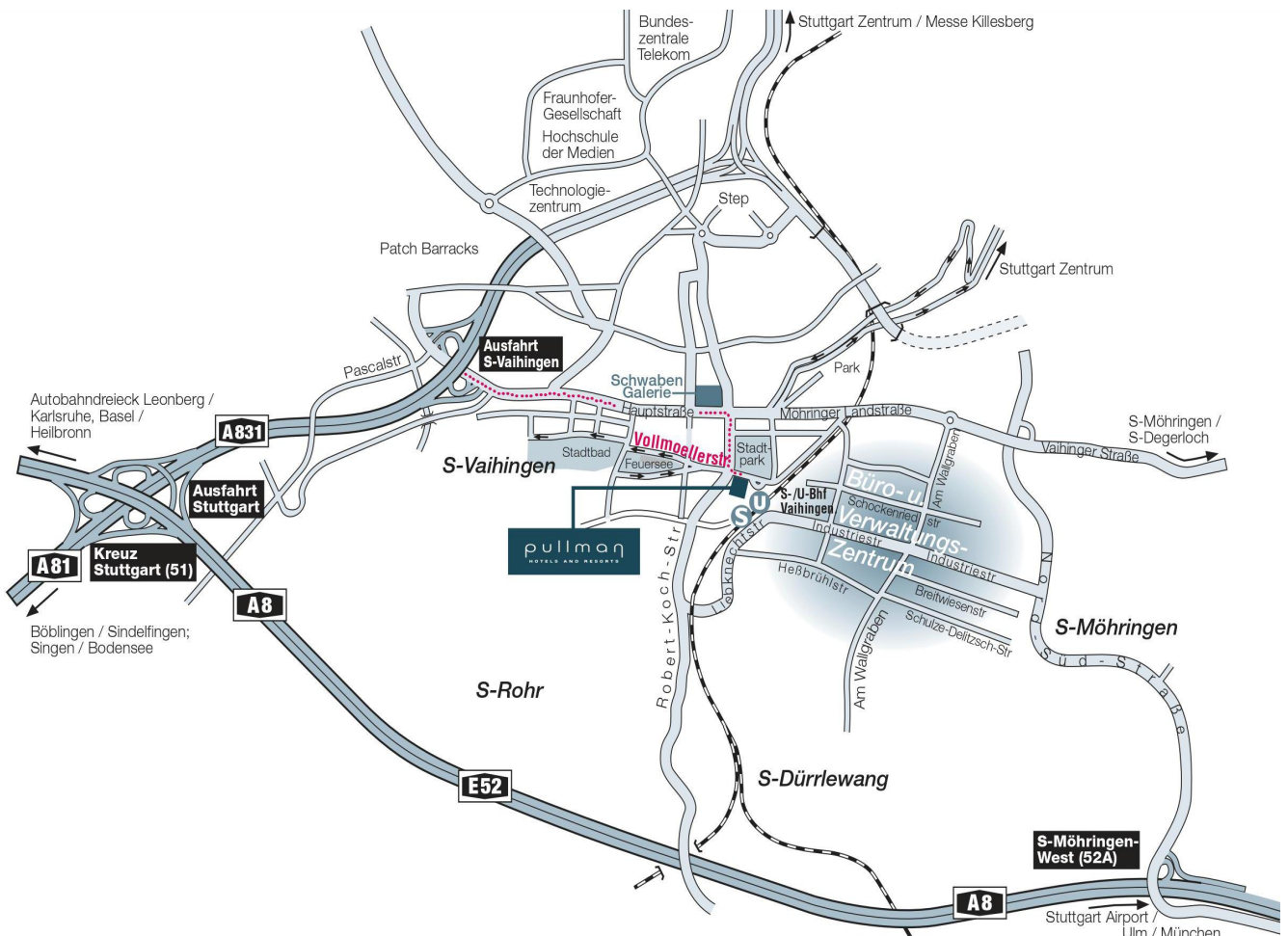
Exit highway A 8 / A 81 at the intersection Stuttgart, take the A 831 direction Stuttgart.

Next take exit Stuttgart-Vaihingen. Continue on the main street until you see the big crossroad by the Schwabengalerie, then turn right onto the Robert-Koch-Straße, at the next traffic light turn left into the Vollmoellerstraße.

By public transport:

From mainstation (13 min): with the subway (S-Bahn) S1 or S2 or S3 direction Herrenberg or Flughafen or Filderstadt.

From Stuttgart Airport (13min): with the subway (S-Bahn) S2 or S3 direction Schorndorf or Backnang. The hotel is direct next to the station Vaihingen.





SLR SCHOOL SUNDAY, 20TH OCTOBER 2019 (9:00 to 17:30)

Introductory and Refresher Course on Satellite and Lunar Laser Ranging October 20, 2019

Program

09:00—10:30 *Session 1: Introduction to the Satellite Laser Ranging Technique*

- Introduction: Mike Pearlman
- Satellite laser ranging (John Degnan/60 min)
 - Ground segment: laser, detector, event timers, tracking telescopes, meteorological stations, safety radars, ground calibration target
 - Space segment: retroreflector tutorial, array design considerations (total cross-section and link budgets, observation symmetry, minimizing pulse spread)
 - Overview of ground system and network evolution to achieve maximum range accuracy (1964 to present)
 - Overview of SLR contributions to Earth science and engineering applications
 - Ranging to the Moon and planets (intro to LLR and transponders)
 - Lunar laser ranging (Jean-Marie Torre and Doug Currie/20 min)
 - Ground segment: how is LLR different from SLR?
 - Space segment: lunar retroreflector, current and planned
 - History of LLR and its impact on SLR
 - LLR contribution to science
 - Challenges of LLR

10:30—11:00 *Break*

11:00—12:30 *Session 2: Data Analysis*

- Role and function of the Data Centers (Carey Noll/20 min)
- Analyzing of SLR observations – what do we do with the data? (Mathis Blossfeld/25 min)
- Data analysis demonstration - data download and normal point computation (Alex Kehn/25 min)
- Reference frames and geodetic products (Daniela Thaller/20 min))



Introductory and Refresher Course on Satellite and Lunar Laser Ranging October 20, 2019 Program

12:30—13:00 *Lunch*

13:00—15:00 *Session 3: Corrections and Error Sources*

- What corrections do we add to our basic range data? Where do they come from? (Jose Rodriguez/15 min)
- How do we calibrate and to get the most accurate data products; what are the issues? (Ivan Procházka/15 min)
- What are the error sources to our ranging data? (Ivan Procházka/15 min)
- Accurate timing; how do we get it? How good is it? What improvements are coming? (Ivan Procházka/15 min)
- The importance of ground surveys and how do we do them (Johann Eckl/15 min)
- Spacecraft center if mass modeling: modeling considerations and operational issues (Jose Rodriguez/15 min)

15:00—15:30 *Break*

15:30—17:00 *Session 4: Station Operations and Other Applications of Satellite Laser Ranging*

- Space debris, technique, and applications (Michael Steindorfer/20 min)
- A view of station operations; how do we work? (Matt Wilkinson and NESL/60 min)
 - o Operations from acquiring predictions, ranging, calibration, submitting data
 - o Meteorology data, clock synchronization, local QC, system maintenance, record keeping, etc.
 - o Good practices, etc.

17:00—17:30 *Wrap up*

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Laser Electronics

The advertisement features the neoLASE logo and tagline, a photograph of the company's building, and a list of product categories. Several laser devices are shown in the center.



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WELCOME RECEPTION MONDAY, 21TH OCTOBER 2019 17:45 - 19:00

A welcome aperitif and snacks will be offered on Monday 20 October 2019 at the Pullman Hotel Stuttgart after the workshop.

This event is covered by the registration fee.

TELESCOPES for SCIENCE, SAT-COM or SAT Identification – REMOTE and ROBOTIC OPERATION

ASTELCO Systems is your partner for professional Astronomical Telescopes, Observatories and related accessories.

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TECHNICAL TOURS THURSDAY, 24TH OCTOBER 2019 13:00 - 18:00

During the workshop, there will be a chance to visit Stuttgart's first SLR station at the historical observatory Uhlandshöhe and / or the new mobile space debris ranging station STAR-C. Bus transfers will be organised. Tours are included in the conference fee.

Meeting point:

13:00
Lobby / Main Entrance,
Conference Hotel Pullmann,
Vollmoellerstr. 5, 70563 Stuttgart

There will be two parallel tours (bus 1 and bus 2). Both tours will visit both stations.

| | Bus 1 | Bus 2 |
|-------|------------------------------|------------------------------|
| 13:00 | Departure from Hotel Pullman | Departure vom Hotel Pullman |
| 13:45 | Arrival at UFO | Arrival at STAR-C |
| 15:00 | Departure from UFO | Departure from STAR-C |
| 15:45 | Arrival at STAR-C | Arrival at UFO |
| 17:00 | Departure from STAR-C | Departure from UFO |
| 18:00 | Arrival at Hotel Pullman | Arrival at Hotel Pullman |

Note: If you only want to visit one of the stations (only UFO or only STAR-C), please use the bus that goes there first. Both stations are well connected by public transport (see next page), so you can make your way back to your place by bus, tram or metro. See additional notes on public transport on page 21.



UFO

The UFO (Uhlandshöhe-Forschungs-Observatorium) is our first SLR station, which has been operational since 2016. Its main purpose has been to provide a test-bed for new technologies and techniques for satellite laser ranging. Some noteworthy features are:

- Ranging wavelength: 1062 nm
- Repetition rate: up to 100 kHz
- Light transmission from laser to telescope by optical fibre

The UFO is situated at the historical observatory of Stuttgart. During the visit there will be chance of a short tour through the old part of the observatory.

Public transport: Tram U15 or bus 42 to station "Heidehofstraße". From there it is a 10 minute walk up the hill (steep!). Address: Zur Uhlandshöhe 41, Stuttgart



ILRS TECHNICAL WORKSHOP 2019

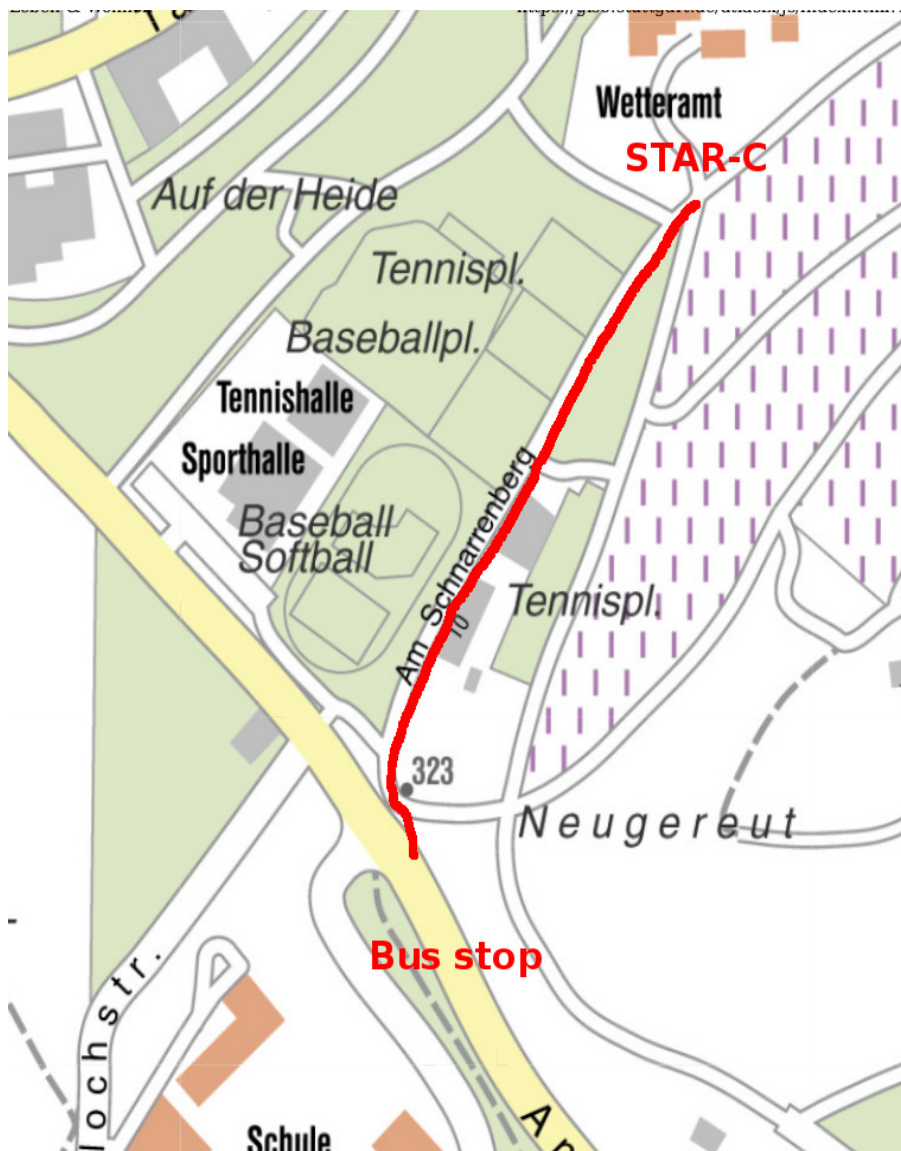
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STAR-C

The STAR-C is a space debris laser ranging station integrated into a standard container. It is currently under construction and first ranging experiments are planned for 2020. It features a Coudé path for high power laser transmission, a movable telescope platform and a strong infrared laser. STAR-C is currently located at the properties of the German Weather Forecasting Service (DWD). During the visit there will be a chance for a short tour of the DWD facilities.

Public transport: Bus 52 to station "Schnarrenberg". From there it is a 10 minute walk along some sports facilities and tennis courts (easy walk, no slope).

Address: Am Schnarrenberg 17, Stuttgart





SOCIAL DINNER THURSDAY, 24TH OCTOBER 2019 19:00 - 23:00

The conference dinner takes place in the Filderhalle in Leinfelden. Since the place can be reached very well by public transport, there will be no bus shuttle service.

Doors from 19:00
Dinner starts at 19:45

Public transport: Metro (S-Bahn) line S2 or S3, or tram U5, to station "Leinfelden". From there it is an easy walk along the station road towards the venue ("Filderhalle").

Address: Bahnhofstraße 61, Leinfelden-Echterdingen

Recommended connections from Vaihingen (conference hotel):

- 18:40, metro S2 (• Filderstadt)
- 19:00, metro S3 (• Airport)
- 19:10, metro S2 (• Filderstadt)
- 19:30, metro S3 (• Airport)

Travel time is 6 minutes.

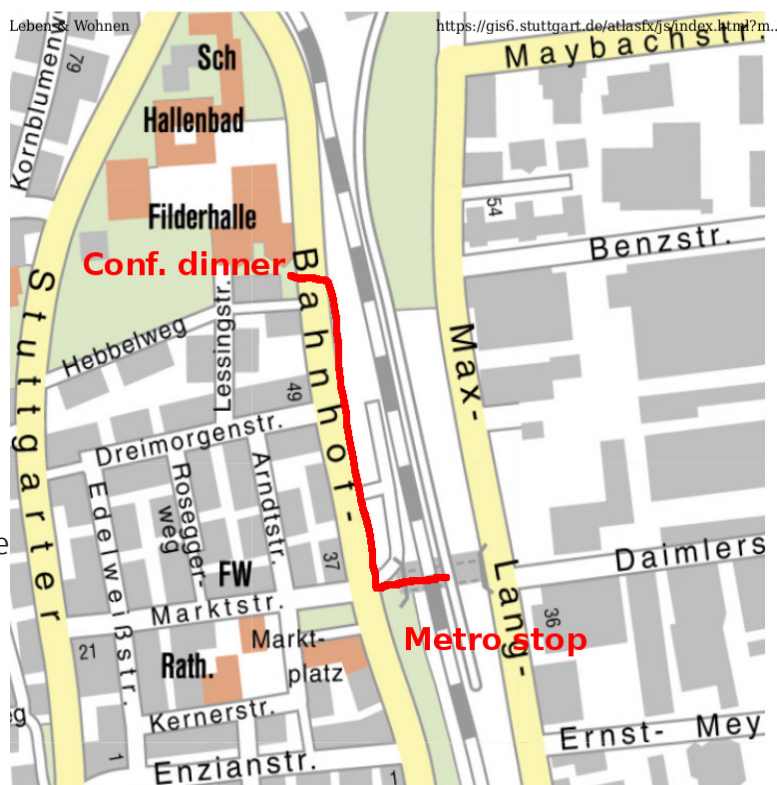
Please exit at station "Leinfelden".

Recommended connections from Leinfelden back to Vaihingen:

- Metros leave four times every hours at:
 - o XX : 13
 - o XX : 23
 - o XX : 43
 - o XX : 53
- Last train: 23:53

If require any help or assistance reaching the venue, please don't hesitate to contact the workshop organisers.

Please keep your dinner ticket ready for inspection at the entrance of the Filderhalle.



All photos:
© <https://www.stuttgart.de/item/show/555841>



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PUBLIC TRANSPORT IN STUTTGART

Public transport services are organised by VVS, which runs busses, trams (U-Bahn) and metros (S-Bahn). For connections and timetables, please check www.vvs.de or the VVS smartphone app. Use these station names to find your connection:

| Place | Station name | Services |
|----------------|----------------|------------------|
| Workshop Venue | Vaihingen | Metro, tram, bus |
| Social Dinner | Leinfelden | Metro, tram |
| UFO | Heidehofstraße | Tram, bus |
| STAR-C | Schnarrenberg | Bus |
| Airport | Flughafen | Metro |

Tickets: You can use single or daily tickets. From three trips, a daily ticket is the cheaper option. You can buy tickets in the app, from vending machines at tram and metro stations, or from the bus driver. Please observe the number of zones: 1 Zone is enough for Vaihingen and the SLR stations. For the dinner and airport, please buy 2 zones.

| | Single Ticket | Daily Ticket | Use for |
|---------|---------------|--------------|----------------------------|
| 1 Zone | 2,50 € | 5,20 € | UFO and STAR-C |
| 2 Zones | 2,90 € | 6,00 € | Social dinner (Leinfelden) |

Please buy your ticket before boarding a metro or tram!
For additional ticket options, e.g. three-day tickets, please consult www.vvs.de.



WORKSHOP PROGRAM

Monday

08:00 Registration

Session 1: Introduction

Chairs: Toshimichi Otsubo, Daniel Hampf

08:45 Welcome and house-keeping
Daniel Hampf

09:15 Welcome by DLR and the Institute of Technical Physics
Thomas Dekorsy

09:35 Overview of laser ranging activities at the Institute of Technical Physics
Wolfgang Riede

10:00 **Coffee Break**

10:30 Opening remarks from GB Chair: Highlighting the significance of the workshop
Toshimichi Otsubo

10:50 ILRS: Recent developments
Carey Noll

11:10 Next generation laser ranging systems
Matthew Wilkinson

11:30 Possible Pathways to Producing Rapid Millimeter Accuracy Normal Points
John Degnan

11:50 SLR in the next 7.5 years
Georg Kirchner

12:15 Discussion

12:30 **Lunch**

Session 2: Improving current station performance

Chairs: Manuel Catalan, José Rodríguez, Jens Steinborn

14:00 Session Presentation
Chairs



WORKSHOP PROGRAM

Monday

Session 2: Improving current station performance

Chairs: Manuel Catalan, José Rodriguez, Jens Steinborn

- 14:05 Quality of Orbit Predictions for Satellites Tracked by SLR Stations
Krzysztof Sośnica
- 14:25 Time Bias Service: Latest Status, Implementation and Prediction Quality Analysis
Sven Bauer
- 14:45 Copernicus Sentinel-3 Mission - Orbit Validation and SLR Station Quality Assessment
Marc Fernández Usón
- 15:05 An Independent Assessment of T2L2 Results from the NASA SLR Network
Van Husson
- 15:25 Statistical Evaluation of Simulated Normal Points Calculated with a Wiener Filter
Stefan Riepl
- 15:45 **Coffee Break**
- 16:15 INSAR Corner Cube at GRSM
Mourad Aimar
- 16:35 Effects of Reference Frequency Stability to SLR Measurements Errors
Vyacheslav Ivanov
- 16:55 Status of Laser Timing at Stafford, Virginia
Jake Griffiths
- 17:15 Lunar Laser Ranging Research and Experiment in Yunnan Observatories
Yuqiang Li
- 17:35 Poster presentations
Chairs
- 17:45 Transponder Standing Committee
Chair: Ulrich Schreiber

17:45 **Welcome reception**



WORKSHOP PROGRAM

Tuesday

Session 2: Improving current station performance

Chairs: Manuel Catalan, José Rodriguez, Jens Steinborn

- 08:30 Two Way Ranging on Lunar Reconnaissance Orbiter at Grasse MéO station
Herve Mariey
- 08:48 SRC PAS Borowiec Second Satellite Tracking System
Tomasz Suchodolski
- 09:06 Smart Transmit Telescope
Georg Kirchner
- 09:24 New SPAD Detector Package for SLR and Laser Time Transfer
Ivan Prochazka
- 09:42 The Preliminary Results of Ground Tests Over the Ring Array
Andrey Sokolov

10:00 **Coffee Break**

Session 3: Synergies and new applications

Chairs: Quirin Funke, Ulrich Schreiber, Daniele Dequal

- 10:30 Photometry with Gated SPAD: Theory and Approach
Zhipeng Liang
- 10:48 Time transfer accuracy
Daniele Rovera
- 11:06 Time transfer through GLONASS: motivation, goals and technical implementation
Sergey Martynov
- 11:24 Towards quantum communication from global navigation satellite system
Luca Calderaro
- 11:42 Laser Communication Experiments at Grasse -
France Station (ID7845) and Prospective Applications for Satellite Laser Ranging
Duy-Hà Phung



WORKSHOP PROGRAM

Tuesday

- 12:00 Fast Developing Space Debris Laser Tracking in China
Pengqi Gao
- 12:30 **Lunch**
- 14:00 Use of a Night-Tracking Camera during daytime
Emiliano Cordelli
- 14:20 Fine tracking for laser flux stabilization on an optical detector for space-to-ground laser link communication
Nicolas Maurice
- 14:40 LAGEOS and LARES satellites attitude determination with the LASSOS spin model
David Lucchesi
- 15:00 Benefits of SLR Tracking for Galileo Orbit and Attitude Determination
Florian Dilssner
- 15:20 Intra-technique Combination and Its Precision Evaluation based on SHAO SLR SINEX solutions
Xiaoya Wang
- 15:40 Discussion
Chairs
- 16:00 **Coffee Break**
- 16:30 Space Debris Panel
Chair: Tim Flohrer, Georg Kirchner
- 18:00 Mission Standing Committee
- 20:00 Network & Engineering Committee



WORKSHOP PROGRAM

Wednesday

Session 4: Novel concepts to improve the SLR network

Chairs: Michael Steindorfer, Zhang Zhongping, Andrey Sokolov

- 08:30 Daylight space debris laser ranging
Michael Steindorfer
- 08:50 Infrared Laser Ranging to Satellite and Debris in Shanghai station
Kai Tang
- 09:10 The potential of increased station performances for scientific SLR products
Mathis Bloßfeld
- 09:30 Improvements of the SOS-W automatic scheduler for special campaign support
Stefan Riepl
- 09:50 The miniSLR system: a standardized solution for routine SLR observations
Daniel Hampf
- 10:10 **Coffee Break**
- 10:40 GNSS Prediction from Navigation Message
Xue Dong
- 11:00 SGSLR Receiver Validation and Pulse Width Amplitude Correction
Evan Hoffman
- 11:20 Lunar surface control network with retro-reflectors and radio transponders
in Chang'E lunar missions
Jingsong Ping
- 11:40 Coherent Time and Frequency Distribution System for a Fundamental Station
Jan Kodet
- 12:00 Optical Laser time transfer and high repetition monostatic SLR
Johann Eckl
- 12:20 Discussion
Chairs



WORKSHOP PROGRAM

Wednesday

| | |
|-------|--|
| 12:30 | Lunch |
| 14:00 | Poster Session |
| 15:30 | Coffee Break |
| 16:00 | New applications panel Chairs: Evan Hoffmann, Sven Bauer |
| 17:30 | Governing Board Chairs: Toshimichi Otsubo, Michael Pearlman |



WORKSHOP PROGRAM

Thursday

Session 4: Novel concepts to improve the SLR network

Chairs: Michael Steindorfer, Zhang Zhongping, Andrey Sokolov

- 08:30 High repetition rate SLR at GRSM
Clément Courde
- 08:50 100 kHz satellite laser ranging demonstration at Matera Laser Ranging Observatory
Daniele Dequal
- 09:10 Progress of Transportable Cabin-Based SLR system
Zhang Zhongping
- 09:30 Status Report of Tanegashima SLR station (GMSL) and Developing status of JAXA's next SLR station
Takehiro Matsumoto
- 09:50 **Coffee Break**
Highlight Talk
Chair: Michael Pearlman
- 10:20 On the Birth and Future of Lunar Laser Ranging
Douglas Currie
- 11:20 SLR station excursion: Final announcements
Daniel Hampf

11:30 **Lunch**

- SLR station technical tours
- 13:00 Tours incl. bus transfer

Conference Dinner

- 19:00 Doors open
- 19:45 Dinner



WORKSHOP PROGRAM

Friday

Session 5: Safety & Security

Chairs: Jan McGarry, Jean-Marie Torre, Johann Eckl

- 09:00 Introduction
Chairs
- 09:10 European Laser Safety: Laser Emitters and Flight Safety
Jean-Marie Torre
- 09:30 Free space laser safety system for Aircraft Camera Detection in the Infrared
Andreas Leidig
- 09:50 Optically Detecting Aircraft for In-Sky Safety in Daylight Conditions
Matthew Wilkinson
- 10:10 **Coffee Break**
- 10:40 ADS ADS-B aircraft safety system assembled at less than EUR/USD 100
Toshimichi Otsubo
- 11:00 Web-based approach for system monitoring and remote SLR control
Theodor Bachem
- 11:20 SGSLR safety & security across global locations
Jan McGarry
- 11:40 Discussion
Chairs
- 12:00 Poster Award Ceremony
Denise Beisecker
- 12:15 **Lunch**



WORKSHOP PROGRAM

Friday

Session 6: Summary & Outlook

Chairs: Carey Noll, Michael Pearlman

- 13:30 Session summaries
 Standing committee summaries
 General Assembly
 Presentation of next workshop hosts
 Questions & Answers
- 16:00 End of Workshop

ILRS TECHNICAL WORKSHOP 2019

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POSTERS

| Session | Presenter | Title |
|-----------|-----------------------|---|
| Session 2 | Stefanie Häusler | An SLR Receiver to Discriminate Single- from Multiphoton Events |
| Session 2 | Mykhaylo Medvedskyy | Upgrade Hardware & Software Golosiiv Station 1824 |
| Session 2 | Thibaud Mourlon | Raspberry Pi-based Laser Beam Profiler |
| Session 2 | Krzysztof Sośnica | Processing of Satellite Laser Ranging Data to GNSS Satellites at IGIW WUELS |
| Session 2 | Manuel Sánchez Piedra | San Fernando Laser Station Updates and New Improvements |
| Session 2 | Jie Zhang | The Performance of 1m Aperture SLR Telescope in Wuhan JiuFeng SLR Station |
| Session 2 | Jorge del Pino | Continuous Sky Clarity Monitoring at Riga and Metsähovi: January 2018 - June 2019 |
| Session 2 | Ignatenko I.Yu. | Accuracy of Single Measurements in a Laser Location |
| Session 2 | Andrey Sokolov | An Array of Compact Cheap CCRs for High-elliptical Navigation Spacecraft |
| Session 2 | Erik Günther | All Sky Camera Concept |
| Session 2 | Rongwang Li | Mount model of 1.2m telescope at Kunming station |
| Session 3 | Ingrid Fausk | Where – a new software for geodetic analysis |
| Session 3 | Krzysztof Sośnica | Realization of the terrestrial reference frame based on integrated SLR measurements to LEO, geodetic, and Galileo satellites |
| Session 3 | Pengqi Gao | Space Debris Laser Ranging and Characteristic Analysis |
| Session 3 | Pengqi Gao | Weak Echo Signal Extraction in Space Debris Laser Ranging |
| Session 3 | Nils Bartels | Design and qualification of a recessed satellite cornercube retroreflector for ground-based attitude verification via satellite laser ranging |



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POSTERS

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|-----------|--------------------------|---|
| Session 3 | Ivan Prochazka | New photon counting detector packages optimized for space debris tracking and near infrared operation |
| Session 3 | Kai Tang | Progress of laser time transfer on Chinese Space Station |
| Session 4 | Dennis Chase | Using Problem Reports and LORs in the Sustainment of NASA SLR Networks |
| Session 4 | Alexander DeRieux | A Python-based Analysis Toolkit for SLR Ground Stations |
| Session 4 | Rivers Lamb | Application of Adult Stage Development Theory to the Management of the NASA SLR Operations Team |
| Session 4 | José Antonio López Pérez | YLARA station development status 2019 |
| Session 4 | Efim Tcyba | Determination of Precise EOP using Satellite and Lunar Laser Ranging |
| Session 4 | Peiyuan Wang | Contributions to sub-MHz SLR in Graz |
| Session 4 | Gerd Wagner | MS-LART: DLR's latest telescope platform for satellite and space debris laser ranging |
| Session 4 | Mateusz Drożdżewski | Troposphere delay modeling in SLRsolutions |



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