

# 2023 VIRTUAL INTERNATIONAL WORKSHOP ON LASER RANGING

OCTOBER 16-20, 2023

NEW DEVELOPMENTS IN SATELLITE LASER RANGING

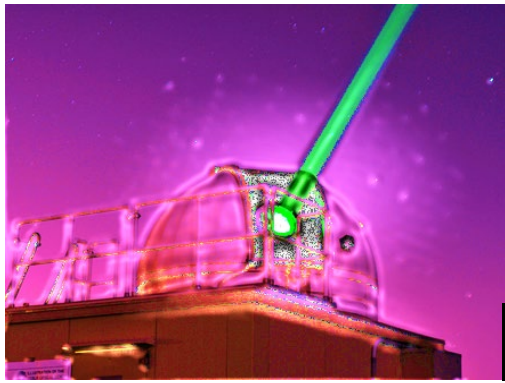


# 2023 Virtual International Workshop on Laser Ranging

**Workshop Closing**

**Friday, October 20th, 2023 – 14:30 - 14:45 UTC**

**ILRS CB, ILRS GB, Organizing Committee**



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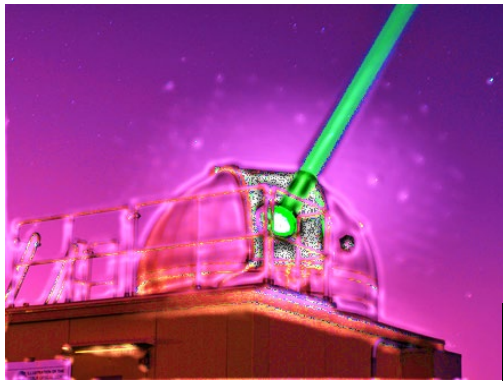
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## Session 01 - Scientific Analysis of SLR Observations: Past, Current and Future Challenges and Possibilities

**Co-Chairs:** Mathis Blossfeld, David Sarrocco, Frank Lemoine

- 8 talks covering the **simulations of new satellites**, the determination of **target signatures of LARES-2**, the analysis of **geophysical background models** as well as the **precise orbit determination** of selected SLR-tracked satellites
- Important points and highlights from the session
  - simulations reveal that the geocenter as well as the low-degree spherical harmonics would mostly benefit from a **satellite in a circular orbit (10,000 km altitude) with an inclination of 30-40 degree**
  - **refined target signature (CoM) models for LARES-2 only add small corrections to the mission-provided default value** of 174mm; retro-reflector characteristics are important and considered in this determination
  - for a satellite precise orbit determination based on the **most recent ITRS realizations, it is important to use the range biases of the ILRS Data Handling File** as fixed or at least as a priori values
  - a multi-year project involving various ILRS stations will **investigate General Relativistic effects using SLR and GNSS** observations to the Galileo satellites (Galileo 4 Science 2.0)
- The ILRS ASC will meet virtually next week (**Oct., 26<sup>th</sup> between 1 and 4 PM**). If you are interested in participating in that meeting, please write an email to [mathis.blossfeld@tum.de](mailto:mathis.blossfeld@tum.de)



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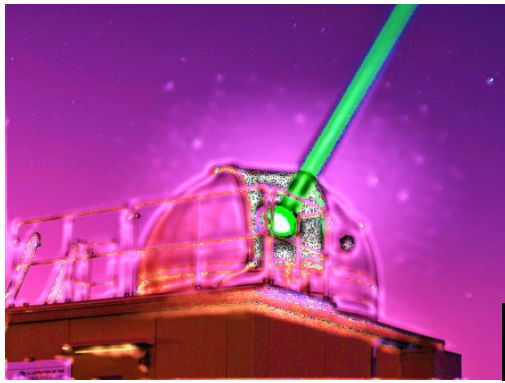
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## Session 02 - New Technology and Operations

**Co-Chairs:** Matthew Wilkinson, Jeffrey Dorman

- The **New Technology and Operations** session included new hardware for laser ranging, such as the high-speed event timer from Eventech and the hybrid photodetector.
- It also included the demonstration of new ideas, such as detecting aircraft from audio signals.
- Using computer learning techniques to identify aircraft tracks in visual sky images could be the beginning of how we incorporate these powerful tools for the benefit of SLR operations.
- Low-cost technology that can be deployed at SLR stations, such as the cloud mapping device used at Grasse and the audio aircraft detection is something that all stations could look in to.
- Low-cost designs, such as the mini-SLR system makes deploying new stations more affordable.
- New stations at Yebes and Tsukuba show us what the state-of -the-art looks like and these stations have huge potential to contribute to the global network.
- It is also important that long-existing stations keep to best practice as was demonstrated by the NASA ground tests and highlighted by the list of station requirements for the ILRS.



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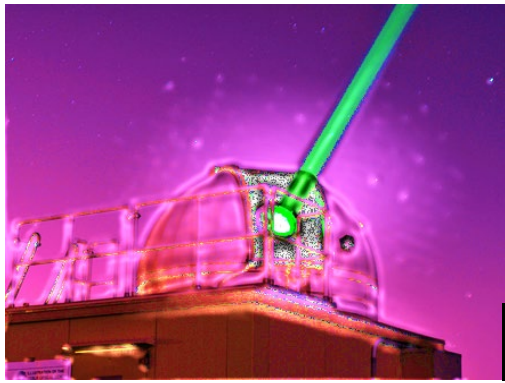
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## Session 03 - Lunar Laser Ranging and Transponders

**Co-Chairs: Nicholas Colmenares, Clément Courde, Stephen Merkowitz**

- Important points from the session
  - CAS lunar orbiter launch in 2024 to explore high-accuracy time transfer tech in cislunar space
  - Changchun Observatory + CAS designing LLR system w/ separate transmit & receive telescopes
  - German SW package LUNAR was developed, and relativistic quantity constraints were presented
  - Using the ACES space clock on the ISS and closed-loop delay compensation, accurate ground-based optical clock comparisons over long free space distances are possible
  - SLR stations could support LLR measurements to NGLRs with appropriate hardware choices/tuning
  - Wideband comms (1 Mbps to 1 Gbps) between Earth & SS planets possible w/ modest laser powers and submeter planetary telescopes communicating w/ a nominal 2.2 m telescope in polar orbit
  - Updated APOLLO dust obscuration study w/ thermal modelling presented
- Any issues that need further investigation
  - LLROs need upgraded capabilities (shorter laser pulse width, etc.) for effective utilization of NGLRs



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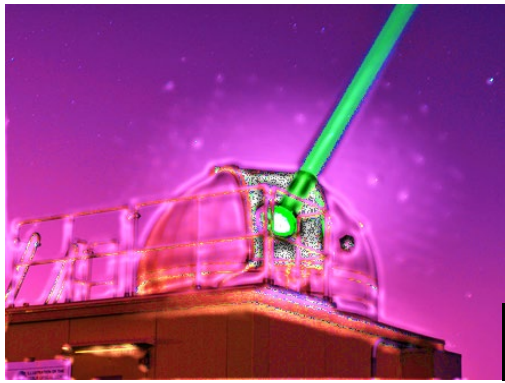


## **Session 04 - Missions and Applications**

**Co-Chairs: Robert Sherwood, José Carlos Rodríguez**

- The session focus was on future and recently launched or approved missions.
- This included discussion of the very exciting GENESIS mission designed to radically improve the linkage between space geodetic techniques to benefit the ITRF.
- As well as recent missions such as SWOT and the Beidou3 tracking extension.
- We also had presentations from several missions launching in the near future and seeking ILRS support.
- The number of applications to the MSC for support continues to grow, this is good news.
- We discussed plans for the ILRS to request regular feedback reports from missions, we consider this a very positive move providing evidence for the network that can be invaluable in securing support for our infrastructure.
- Finally, the MSC is currently looking to recruit new members. If you have an interest in helping to make new missions a success by offering your help and expertise, please contact us.





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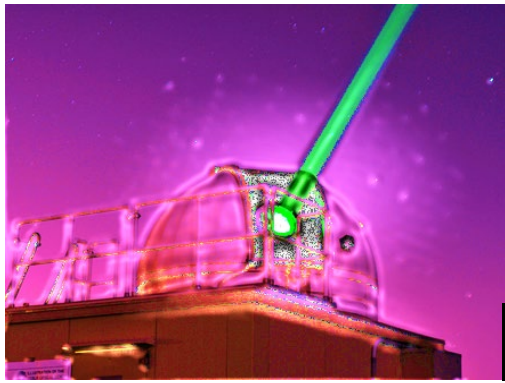
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## **Session 05 - Space Debris**

**Co-Chairs: Michael Steindorfer, Emiliano Cordelli**

- ESA: zero debris policy -> 2030, new space debris mitigation policy
- Graz: sub-1000€ debris detection system: image analysis, time and across track bias, scheduling
- ELSA-d mission updates, ILRS support, drag based fly-by
- Comenius Bratislava: Stare & chase, improving TLE predictions, debris blind tracking success
- Shanghai & Kunming debris tracking results and plans: daylight, distant targets, high power
- Zimmerwald: Debris upgrade -> high power laser, monostatic SLR system
- DLR: Kepler observatory - debris related activities, passive camera, laser-ranging, spectral analysis
  
- The debris community is very active and new stations will join soon: e.g. Izana-2
- Technology development works as a driver for whole community



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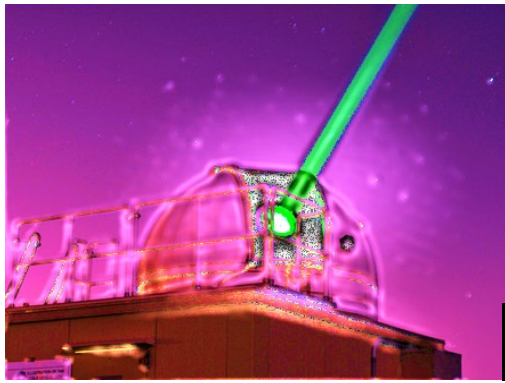


# 2023 Virtual International Workshop on Laser Ranging

**Workshop Closing**

**Friday, October 20th, 2023 – 14:15 - 14:30 UTC**

**ILRS CB, ILRS GB, Organizing Committee**



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**NEW DEVELOPMENTS IN SATELLITE LASER RANGING**



Mike Pearlman, ILRS Central Bureau Director

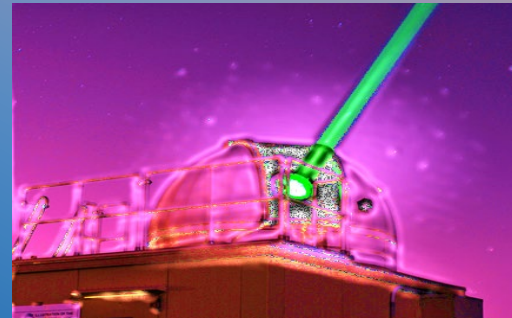
Closing Remarks







*50 Years of ILRS Workshops!*

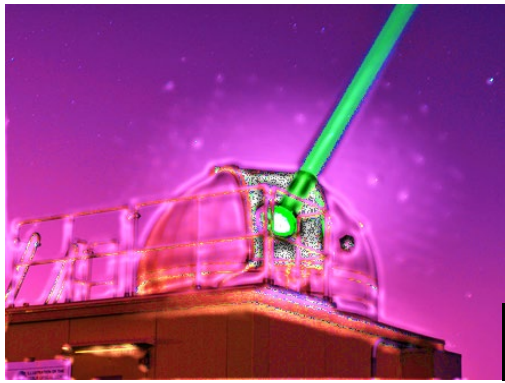


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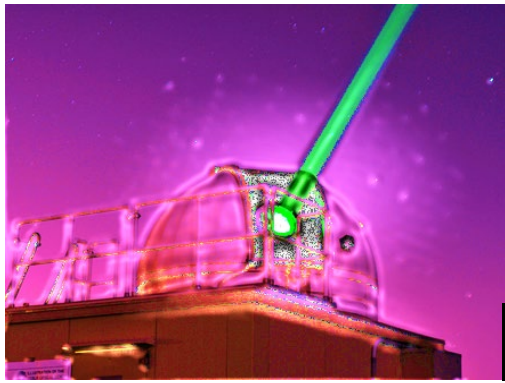


## Some Reminders for the Stations

Mike Pearlman and Van Husson

1. Keep your Station Logs up to date.
2. Keep your History Logs up to date.
3. Data is supposed to be forwarded within 24 hours.
4. Complete the transition to CRD V2.
5. Calibrate your system at least every two hours.
6. Take regular ground tests to better understand your system performance.
7. Monitor your RMS and system delay stability to detect changes in your system.
8. Take regular ground surveys/measurements of your calibration distances. (some systems have the target is at the end of the telescope or inside the building). Some systems like Zimmerwald have a target that is 660 m, which seems a little too far if we are trying to minimize systematic errors.

Thank you!



# 2023 VIRTUAL INTERNATIONAL WORKSHOP ON LASER RANGING

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## Next Workshop: 2024 International Workshop on Laser Ranging Kunming, China (Date TBD)

Presentation from Kunming colleagues



# Kunming Awaits ...

Introduction to preparations for the next ILRS workshop in Kunming, China in 2024

Xiaoyu Pi

**ILRS 2023 Virtual International Workshop on Laser Ranging (VIWLR)**



# Keywords of Kunming

- the “Spring City”
- 70% flowers in China
- Biggest flower market in Asia



Flower



Tourism

- 12 million tourists during last holiday week (9.29-10.06)
- Famous travel destination in China

- Ethnic minorities
- Unique culture
- Different structure styles
- Different food style



Culture



International

昆明



- 8M+ population
- Gateway to the SE Asia
- Important node in China's Belt and Road Initiative



# Yunnan observatories



- **Kunming observatory station (Main SLR Site)**
- Lijiang observatory station
- Fuxian solar observatory station
- 20+ astronomical observation equipment in operation
- 300+ personnel
- 1000+ research papers in SCI/EI journals in 2011-2021



# The Schedule

Preparations for the event in **Sep. or Oct. 2024**

Tasks	Time point
Decide the specific dates	2023.12.
Set up IPC and LOC	2024.01
Venue reservation	2024.02
Set up the website Decide theme and agenda	2024.02~04
Collecting the reports	2024.04~08
Invitation and reservation	2024.06~09
Host the Conference	2024.09~10

# The Local Organization Committee

## Chairmen:

- Prof. LI, Yuqiang
- Prof. ZHANG, Zhongping

## Secretary:

- SU, Xiaoli
- ZHANG, Haitao
- Pi, Xiaoyu

## Members:

- Prof. LI, Zhulian
- Prof. LI, Rongwang
- Dr. ZHAI, Dongsheng
- Dr. ZHOU, Yu
- Dr. TANG, Rufeng
- ...

Totally 15~20 personnel would be called into the LOC to guarantee the operation of the event



# The Meeting Place

## Empark Grand Hotel Kunming

No.1 Yingbin Road, Guandu, 650214 Kunming, China

Empark Grand Hotel Kunming offers comfort accommodations with modern facilities and convenient guest services.

- Wi-Fi
- Meeting rooms
- Hot tub
- Business center
- Air-conditioned
- Has TV
- Car parking
- Swimming pool
- Pet-friendly
- Restaurant
- Smoke-free rooms
- Airport shuttle
- Spa
- Fitness center
- Bar/lounge
- Sauna

- Opened: 2006
- Renovated: 2016
- Number of Rooms: 746



# Welcome to Kunming



- 4<sup>th</sup> biggest airport in China
- 173 navigable cities (122 domestic, 47 international, and 4 regional)
- 120 international routes



- Easy payment with Alipay/WeChat
- International cards supported



- Diversity of food tastes
- Unique local cuisine (flowers, wild mushrooms, ...)



- Flower
- Jade product
- souvenirs with ethnic characteristics



Add bank card No. (497 banks supported)

Tap to enter bank card No. 

Submit



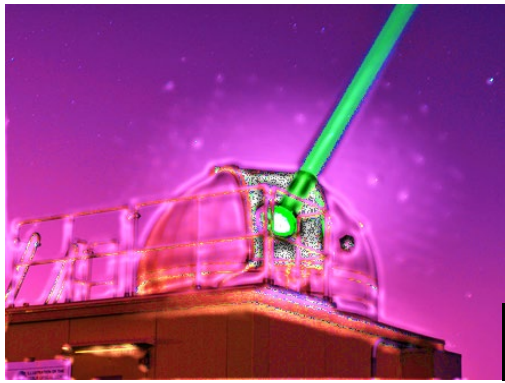


An aerial night view of Taipei, Taiwan. The city's lights are visible, with the prominent Taipei 101 skyscraper in the center. In the foreground, there is a large, dark green park area with a winding path and a lake. The sky is dark blue with some clouds.

We're looking forward to your visit!

Thank you!





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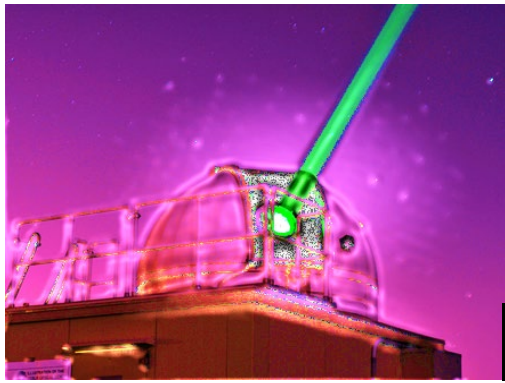
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Stephen Merkowitz, ILRS  
Governing Board Chair

Closing Remarks





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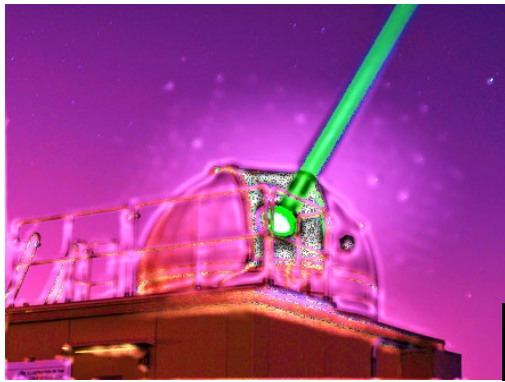
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**Next:**

**2024 International Workshop on Laser Ranging –  
Kunming, China (Date TBD)**

**Stay tuned for more information...**

**See you in Kunming!**



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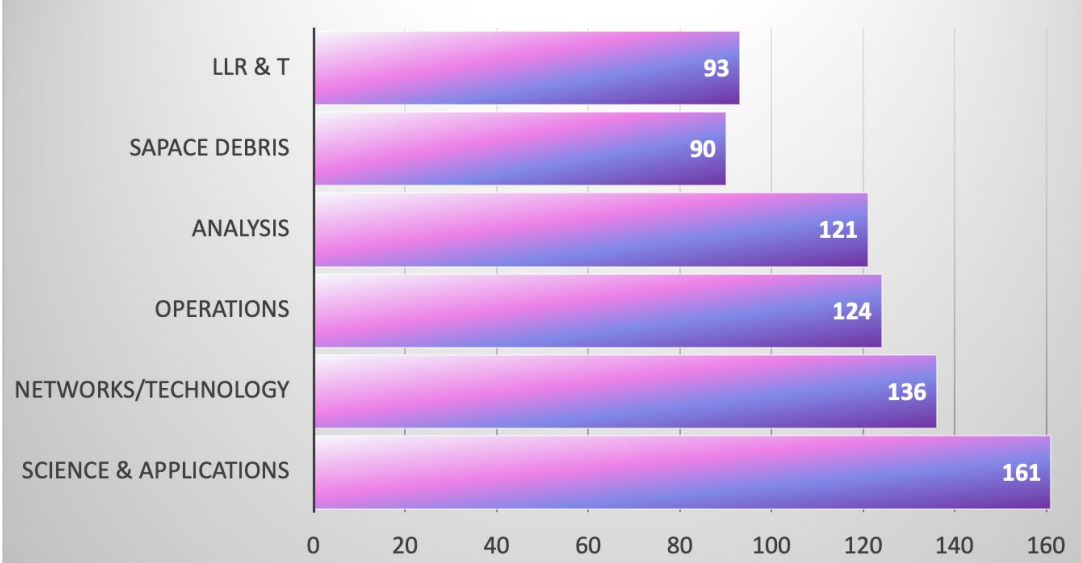
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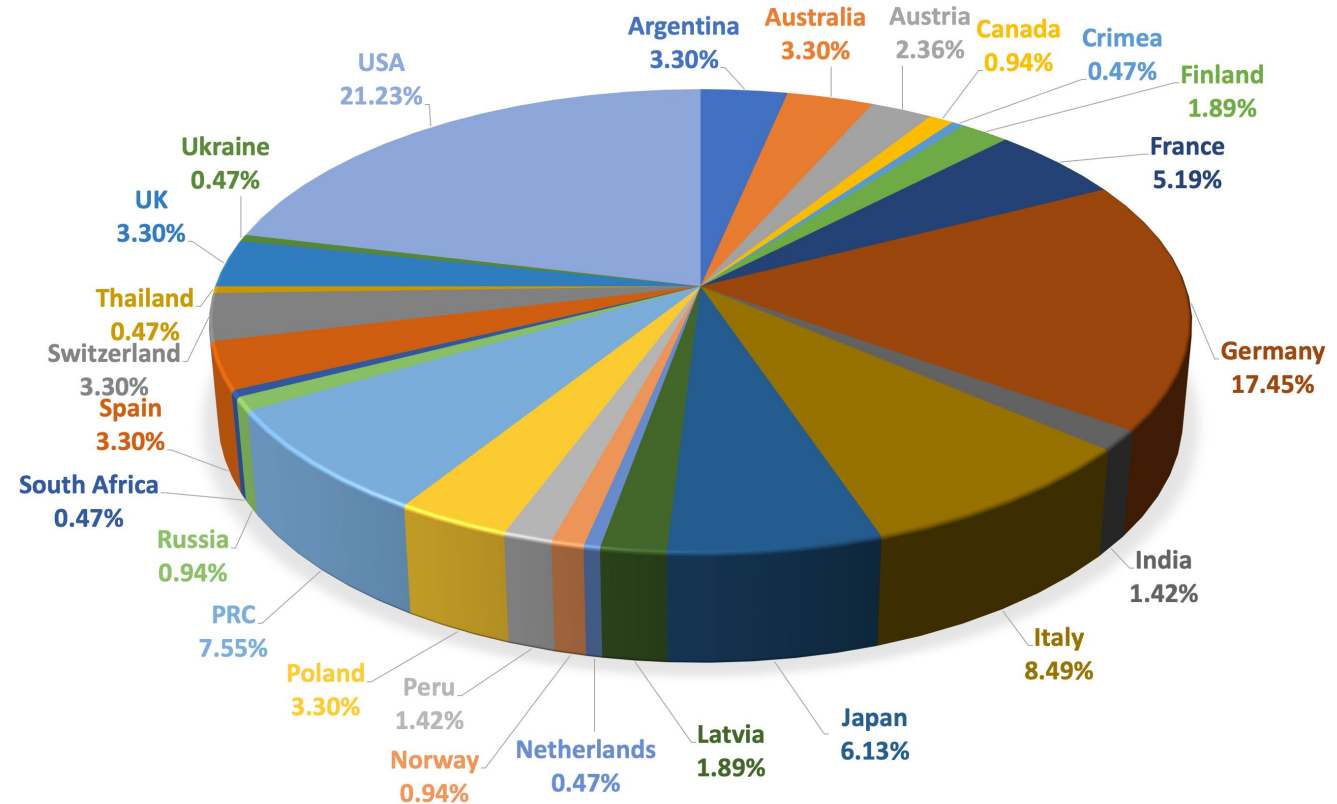


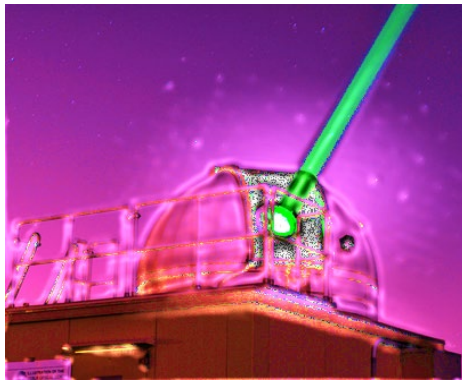
**Registrants:**  
**25 Countries**  
**213+ Participants**  
**More than 100 participants per Session...**

Registrants' Satellite Laser Ranging Areas of Interest



ILRS 2023 INTERNATIONAL WORKSHOP ON LASER RANGING REPRESENTATION





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On behalf of the ILRS CB, ILRS GB, and the Organizing Committee

Thank you for your participation!



**Muchas Gracias!**

