

Project: **LRS for Cooperative Targets**

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## 1 INTRODUCTION

In march 2018, the European Space Agency (ESA) and DiGOS Potsdam GmbH signed a contract for a Laser Ranging Station for Cooperative Targets.

The objective of this activity was to develop, deploy and validate an *operational prototype* Laser Ranging Station (LRS) as a turn-key facility requiring minimum human intervention other than an observer facilitating the scheduled campaigns and ascertaining adherence to laser safety regulations.

As the overall performance benchmark, the LRS shall be capable to range Galileo satellites to millimetre (normal-point) accuracy to about 27'000km orbital altitude. The LRS shall meet additional, state-of-the-art technical requirements defined by ESA whose performance was to be validated by laser ranging operation in day and night conditions at the final deployment site at Teide observatory on Tenerife.

The development of the operational prototype LRS started from the known cooperative targets (retro-reflectors on board of satellited) technology and provides the flexibility and basis for additional steps to achieve the future ESA objectives by upgrading the station for:

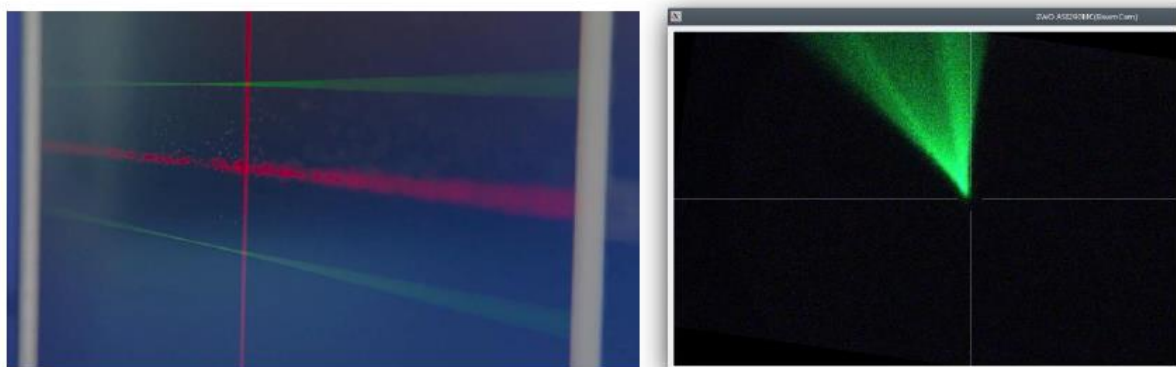
- Ranging of non-cooperative targets (i.e. space debris) during day and night
- Fully automated operation
- Support technology developments by enabling testing of critical optical sensor technology including satellite laser communication and quantum key distribution
- Support to future Space Traffic Management tasks (Space Traffic safety, contributing to Space Object Tracking cataloguing)
- Demonstration of networking / handover to/from passive optical sensors for unknown non-cooperative targets
- Advance development of new technical and operational standards

DiGOS Potsdam GmbH offered the turn-key delivery of an operational prototype laser ranging station (LRS) for ESA. Based on this proposal the parties signed the contract for a Laser Ranging Station for Cooperative Targets.

The project started on in march 2018 and was finished at the beginning of 2022 by acceptance of the LRS and the corresponding technical documentation by ESA.

## 2 EXECUTIVE SUMMARY

Beginning of 2022, the ESA Laser Ranging Station was successfully developed, deployed and verified on Tenerife under the lead of DiGOS, a project team of highly experienced European SMEs in the field of astronomy as well as internationally recognized institutes. The capabilities, expertise and dedication of the project team were the key to this success. Laser ranging stations are highly complex systems whose development not only require a highly specialized team in various engineering domains, but also well-founded expertise on system level. Overall system design, engineering and integration require an in-depth knowhow of SLR technology. Especially, under restrictions of the CoVID pandemic the achieved performance is outstanding.



LAGEOS:  $2.6 \pm 8\text{mm}$   
LAGEOS-2:  $1.5 \pm 9\text{mm}$

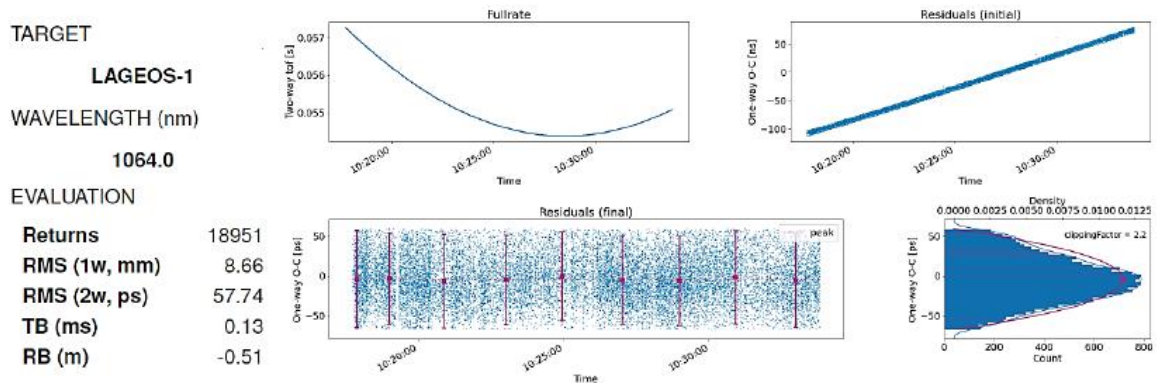


Figure 1: Normal Point Precision for satellites LAGEOS & LAGEOS-2 (geodetic reference)

Today, Izana 1 (IZN-1) is a high-performance laser ranging station which contributes to ESA's Space Safety activities and is also upgraded to support laser communication according to O3K CCSDS. During the development of the first laser ranging station for ESA, the field of laser stations for different applications like laser ranging or laser communication received a high European visibility. This project also contributed to further opportunities for similar and derived technologies.



### 3 PICTURES

