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Advances in Geodynamical Research

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The SLR station 1884 Riga reported several interesting results during the year 2018 and early 2019. In this presentation we summarise the most noteworthy results:

- Participation on the GREAT experiment, confirming Einstein's Relativity Theory;
- The Galileo navigation satellites 201 and 202 are in a non-circular orbit caused by a launch failure.

As a consequence of the variable gravity field, the time and frequency signals are modulated following Einstein's General Relativity theory. The value of this modulation can be measured if the Galileo orbit is independently determined from the radio navigation data.

All the Galileo satellites having a set of laser retroreflectors on board and the International Laser Ranging Service were asked to participate into the GREAT experiment with dedicated SLR Tracking sessions from the 1st to the 7th of each month during one year in order to supply the independent orbital data. Riga was able to observe Galileo 201 during April 2017. The experimental data confirmed the Relativity Theory with improved reliability [1, 2].

Observing Rotating Space Debris

There is a subgroup of space debris, consisting of intact satellites which suddenly stopped working and cannot be deorbited using the on-board resources. In general, these satellites are rotating in a complicated way. Many of them have laser retro reflectors on board. By laser tracking, supplemented in some cases by photometry, all the rotational parameters can be determined supporting the future operation of "capture and deorbit" satellites which are under research design at this moment.

Riga contributed to the observational campaign for the Topex-Poseidon satellite [3] and was one of the top observing sites during 2018 (Tab.1).

First Worldwide observation of the cubesat SNET-4

The SNET cubesat constellation is a group of 4 cubesats (24 × 24 × 24 cm) from Berlin Technical University and was launched on February 1, 2018, with the purpose of investigating and demonstration the inter-satellite communication technology within a distributed autonomously operating nanosatellite network. Because of this the exact interorbital distance between the SNET satellites is needed, and due to the weight, size and power limitation, the use autonomous orbital determination equipment as GNSS receivers on board is impossible.

The option used was to install very small (1 cm diameter) laser retroreflectors on the SNET satellites. The challenge of the small reflector size and the initial orbital parameters contributed to Riga being on April 12, 2018 the first SLR station in the world to get laser returns from any of the SNET satellites. Riga closed the year 2018 with a total of 46 observations for the 4 SNET satellites in orbit.

Participation on International and National Projects

During 2018 Riga participated on the development of a new state-of-the-art SLR system for ESA to be installed at "Pico del Teide" in Tenerife Spain. A full description of the project is provided in reference [4].

In a project financed by University of Latvia Foundation under the Mikrotīkls company donation in support of university research, a team from the Institute of Electronics and Computer Science and the Institute of Astronomy, University of Latvia have built the TS/ATIC to improve the precision and resolution of the time interval measurements at the SLR Station 1884 Riga. A full description of the project is provided in reference [5].

Table 1. *Rotating Space Debris SLR world observations for 2018*

Station	Total	Topex	Oicets	Adeos	% World
Borowiec	138	75	34	29	26.85%
Riga	120	77	29	14	23.35%
Graz	95	68		27	18.48%
Changchun	77	72	5		14.98%
Matera	47	47			9.14%
Herstmonceux	30	30			5.84%
Zimmerwald	6	6			1.17%
Potsdam	1	1			0.19%

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