Report from NESC meeting on Thursday 23rd January 2025

NESC held a meeting on 23rd January on Microsoft Teams with **56** participants online.

## *Study of systematic effects in dark matter surveys using the Galileo constellation*

**Bruno Bertrand** presented analysis from the GASTON project, which aims to detect dark matter from disturbances in clocks onboard the Galileo satellites. **Clément Courde** reminded the NESC of the 3 month campaign of intensive tracking in 2021 that required that at all times at least one SLR station was tracking a Galileo satellite. Dark matter could impact fundamental constants, which could shift atomic energy levels and consequently cause small frequency changes in atomic clocks. If it exists on the scale of large 'clumps' in the solar system then, when they are encountered by the Earth, Galileo clock-pairs could contain a signal. From analysing a year of ESOC data, a number of such signals were detected at the satellite orbital period. These are not necessarily dark matter detections, however, as some systematic effects still need to be taken in to account. The signals could be caused by orbital mismodeling, but the orbital period signal is not seen in SLR residuals. Alternatively, the Earth's magnetic field could be having an effect on the satellite clock frequency, but this is not correlated. The team are also studying using the GNSS constellations to probe gravitational waves.

## *Airborne object detection with a thermal infrared camera to ensure a safe operation of laser-optical ground stations*

**Nils Bartels** demonstrated the aircraft identification capability of an infrared camera used in the miniSLR SLR system in Stuttgart. The camera is a Tau2, Teledyne FLIR LLC with 640x512 pixels and a FOV of about 10.4x8.3º. Images are categorised in to groups and marked as 'safe' or 'unsafe'. Using Python software, the images are processed by removing a median smoothed background image. They are then assessed by a threshold and outstanding objects are detected and the laser can be switched off. The analysis takes about 7ms on a standard PC. This work was recently published here and includes the Python source code. The images collected using this camera are are also available to download.

## ACES onboard the ISS, ELT requirements

The ACES mission is being prepared for launch on 21st April 2025 and will include the ELT detector package for laser signals. **Jan Kodet** reminded the NESC of the requirements for SLR stations to take part in the upcoming ACES tracking campaign. A website has been built [https://www.asg.ed.tum.de/fesg/european-laser-time-transfer-elt/] along with a contact email address [elt@sgd.lrg.tum.de] to keep stations up-to-date and to answer any questions. The website has the latest version of a laser safety spreadsheet for stations to fill out. Stations are required to implement a laser safety chain which can switch between SLR and ELT modes of operation and they must detail this as a hazard control procedure. A Go/No-go flag will be published by EDC, which will be valid for 5 minutes. ELT will be gated at 100Hz by the onboard timescale and stations must fire their lasers to coincide with this detection window. The CPF predictions will contain a UTC offset and drift in a header record. It is also possible to observe asynchronously with higher repetition rates of around 100kHz. There is no real-time feedback from the ELT detector. After tracking, stations will upload their full rate data and get an instant reply to say whether the detections were successful. A calibration team will visit stations to determine the outgoing timing corrections and a questionnaire is available on the website. There will be a 6 month commissioning period after the launch of ACES.

## The Correlation Between Geodetic Satellite Passes and positioning quantity for ITRF2020

**Alexandre Belli** showed that the determination of 3D residuals for stations improves with the number of LAGEOS 1 & 2 and Etalon 1 & 2 passes tracked in the weekly solution. Once a station reaches 50 passes in a week the residuals not longer improve. Future work will look at the impact of productivity on EOP, gravity coefficients, length of day, origin and scale. Current ILRS tracking requirements are 3500 passes per year and 600 passes of LAGEOS and LARES. Network performance can be further assessed using the website built by Magda Kuzmicz-Cieslak [https://geodesy.jcet.umbc.edu/ILRS_AWG_MONITORING] which gathers the results from the ASC and includes a plot of tracked passes vs available passes for selected stations.

## Update following the IWLR in Kunming

**Xiaoyu Pi** updated the NESC with the new webpages [https://23rdworkshop.casconf.cn/page/1858791503279820800] containing the presentations from the IWLR in Kunming, China held in October 2024. The Workshop was filmed and the videos are currently in processing. There will be a special topic for the IWLR in Astronomical Techniques and Instruments [http://www.ati.ac.cn] and the deadline for submission is 25th June 2025.

## GENESIS + NGLR News

**Clément Courde** highlighted the recent launch of the Next Generation Lunar Retroreflector (NGLR), which is due to arrive at the Moon on the 2nd March. This is a single large retroreflector. Clément gave an update on the GENESIS mission and the discussions over the retroreflector target array. A recommendation has been sent to ESA for an increased optical cross-section of 7 million $m^2$.

The presentation slides from the meeting will be available here https://ilrs.gsfc.nasa.gov/network/newg/newg_activities.html

The date for the next NESC meeting was set as **Thursday 13th March at 1400 UTC**

**If you missed the meeting** and would like to catch up, please send me an email (matwi@nerc.ac.uk) and I can provide the recording.