The Galileo for Science 2.0 Project

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The Galileo for Science Project (G4S_2.0) is an Italian project funded by the Italian Space Agency (ASI) with the aim of conducting Fundamental Physics measurements by exploiting the Galileo-FOC (Full Operational Capability) Constellation. The collaboration includes the Center for Space Geodesy (ASI-CGS) in Matera, the Istituto di Astrofisica e Planetologia Spaziali (INAF-IAPS) in Roma, and the Politecnico di Torino (POLITO).

The project aims to achieve multiple scientific objectives, as i) a new measurement of the gravitational redshift (to introduce a further limit on the Local Position Invariance), ii) to place constraints on the possible presence of dark matter in our galaxy in the form of Domain Walls, iii) the measurement of the relativistic precessions of the orbit of the satellites (with the possibility to constrain the inverse square law of distance in gravitation at the altitude of the Galileos) and, finally, iv) a test of a pure relativistic positioning system. A further target of G4S_2.0 is the development of an advanced accelerometer for the direct measurement of inertial accelerations acting on a next generation of Galileo Satellites.

To obtain reliable and robust measurements in fundamental physics, two key activities play a fundamental role: i) performing high-quality Precise Orbit Determination (POD) for the Galileo satellites and ii) estimating their clock-bias with extreme precision.
For these reasons, the ILRS Central Bureau was asked to conduct a dedicated SLR campaign for some Galileo-FOC satellites. The campaign started on January 20, 2024 and will last two years for the two Galileo satellites in elliptical orbit.

An increased number of SLR data is important to reduce systematic errors in the measurements. Orbit modeling errors are strongly correlated to the clock solutions and SLR data are essential to characterize orbital radial errors. Since these systematic errors are mainly due to the mismodeling of the direct solar radiation pressure, it will be useful to have a campaign long enough to account for the variation of the so-called beta angle (the Sun height over the orbital plane), whose period of variation is equal to the Draconic year, very close to 365 days. Indeed, one of the goals of G4S_2.0 is to improve the modelling of the non-gravitational perturbations on Galileo satellites.

Current results from the SLR campaign will be presented and their relation to future G4S_2.0 measurements will be discussed.