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The Galileo for Science (G4S) project: fundamental physics and space geodesy by the orbit analysis of the Galileo satellites DORESA and MILENA

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The orbits of the two Galileo spacecraft Doresa and Milena (GSAT 201 and GSAT 202) represent a very good opportunity in order to test the predictions of Einsten's General Relativity (GR) — in its weak-field and slow-motion limit — with respect to the predictions of alternative theories of gravitation. In fact, the relatively high eccentricity (about 0.16) of the orbit of these satellites is favorable not only in view of a new accurate test of the gravitational redshift, but also for the measurement of the tiny effects related with the Earth's gravitoeletric and gravitomagnetic fields. In this regard, the dynamic model used to determine the orbit of each spacecraft and, consequently, their precise orbit determination (POD), requires a significant improvement.
The results of the POD depend on the tracking technique and on the models implemented in the software used for the data reduction. Moreover, also the length of the arc considered for the orbit estimate plays a significant role. Concerning the dynamical model, the main challenge consists in improving the description of the non-conservative forces (NCF), starting from the direct solar radiation pressure, which provides the larger perturbation on the spacecraft orbit.
Numerical algorithms, such as linear combinations among orbital parameters, will be used to reduce the uncertainties due to the conservative forces, as the uncertainties in some coefficients of the Earth gravity field and on tides, so enhancing the effects of the predictions of GR. These linear combinations of the orbital parameters, if used in a reverse way, can behave as a pantograph that amplify the sensitiveness to the NCF, thus helping, indirectly, to select the best model to be applied for the modeling of the non gravitational perturbations.
The preliminary activities of the G4S project will be described in terms of the improvements of the dynamical model, the POD procedures and the analysis of the main relativistic effects.