

The LARES and LARES 2 satellites for tests of gravitational physics and frame-dragging

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The two missions of the Italian Space Agency (ASI), LARES and LARES 2 have the main objectives to test the general theory of relativity (GR) and to measure with high accuracy the phenomenon of frame dragging. Frame-dragging is an intriguing phenomenon of GR which implies that a current of mass-energy, such as the rotation of a body, generates spacetime curvature. LARES has already tested frame-dragging with an accuracy of a few parts in one hundred and verified other aspects of GR and of alternative gravitational theories, such as the weak equivalence principle. LARES 2 will test and verify frame-dragging and GR with greatly improved accuracy. The accuracy of such a measurement is dependent on the accurate knowledge of the Earth gravitational field, on the data of the other laser-ranged satellites LAGEOS and LAGEOS 2, on the particular design of the satellites and on the orbital injection accuracy. Concerning this last aspect, both launches of LARES in 2012, with the VEGA launcher, and LARES 2 in 2022, with the empowered version VEGA C, were extremely accurate. Both launchers were developed by ESA-ASI-Avio. In particular LARES 2 was released into the orbit with an injection accuracy which was better than what we expected by about an order of magnitude. Therefore, we estimate to get a measurement of frame-dragging with a relative accuracy which, in a number of years, will reach a few parts in one thousand or even 10^{-3} . To reach such a level of accuracy every perturbation needs to be known, measured or estimated with extremely high accuracy. The presentation will discuss the principles of these space experiments and some design details of the missions.

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