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The Galileo for Science Project (G4S_2.0): Domain Wall Dark Matter and Atomic Clocks

Friday, 12 July 2024 15:00 (25 minutes)

G4S_2.0 (Galileo for Science) is an ongoing project funded by the Italian Space Agency (ASI) and carried out by the Center for Space Geodesy (ASI-CGS) in Matera, the Istituto di Astrofisica e Planetologia Spaziali (IAPS/INAF) in Rome, and the Politecnico di Torino (POLITO). The project's goal is to address several intriguing challenges, including Fundamental Physics measurements using the European Galileo Global Navigation Satellite System (GNSS).

One aspect of the project focuses on updating the current constraints on ultralight scalar field dark matter (ULDM) in the form of topological galactic Domain Walls (DWs).

The ultralight scalar within the DW may interact with certain degrees of freedom of the Standard Model (SM) of particle physics. This interaction is typically described as an effective low-energy lagrangian density that takes into account the couplings between ultralight dark matter and the SM.

In a simplified scenario, the ultralight dark matter of the DW could interact only with a single degree of freedom of the SM, such as the electron Dirac field. In such a scenario, if a DW were to interact with the onboard atomic clock of a Galileo satellite, it could cause a temporary shift in the fundamental electron mass, resulting in a glitch in the nominal operating frequency of the target atomic clock. This glitch would theoretically propagate throughout the entire Galileo clock network, providing a detectable pattern.

We will give an overview of the assumptions regarding Dark matter and DW, as well as the activities conducted at IAPS-INAF in Rome, which are essential for constraining the presence of DW dark matter and its potential interaction with the SM sector. Specifically, we will discuss the updated results regarding the statistical properties of the global Galileo Rubidium (Rb) - Passive Hydrogen Maser (PHM) clock network and its ability to detect a possible Domain Wall signal.

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