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Cyclostationary signals in LISA: a practical application to Milky Way satellites

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One of the primary sources of gravitational waves (GWs) anticipated to be detected by the Laser Interferometer Space Antenna (LISA) are galactic double white dwarf binaries (DWDs). However, most of these binaries will be unresolved, and their GWs will overlap incoherently, creating a stochastic noise known as the galactic foreground. Similarly, the population of unresolved systems in the Milky Way's (MW) satellites is expected to contribute to a stochastic gravitational wave background (SGWB). Due to their anisotropy and the annual motion of LISA constellation, both the galactic foreground and the satellite SGWB fall into the category of cyclostationary processes. Leveraging this property, we develop a purely frequency-based method to study LISA's capability to detect the SGWB from the principal MW satellites. To achieve this, we first analyze mock data generated by an astrophysical motivated SGWB spectrum, and then examine realistic data from a DWD population generated via binary population synthesis.

Our findings highlight the significance of the interaction between the astrophysical spectrum and LISA's sensitivity for detecting the satellite SGWB. Furthermore, we explore the potential to observe a hypothetical satellite located behind the galactic disk. Our results suggest that an LMC-like satellite could indeed be observable by LISA.

Primary author: POZZOLI, Federico (Istituto Nazionale di Fisica Nucleare)

Co-authors: SESANA, Alberto (Istituto Nazionale di Fisica Nucleare); HAARDT, Francesco (MIB); Dr BUSCICCHIO, Riccardo (Universitá di Milano-Bicocca)

Presenter: POZZOLI, Federico (Istituto Nazionale di Fisica Nucleare)

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