Detecting magnetism in compact galactic binaries with LISA

E. Savalle, A. Bourgoin, C. Le Poncin-Lafitte, S. Mathis, M.-C. Angonin, and C. Aykroyd

LISA (Laser Interferometer Space Antenna) is set to observe gravitational waves emitted by galactic binaries consisting of white dwarfs or neutron stars. Some of these objects are highly magnetized, making them among the most magnetic astrophysical objects in the universe. This magnetism can disrupt the binary's orbit over time, potentially affecting the emission of gravitational waves. While the current data processing pipeline for the LISA Data Challenge (LDC) for galactic binaries does not consider magnetism or eccentricity, recent research has shown that magnetism can cause a shift in gravitational wave frequencies and can potentially be detected by LISA if the binary's orbit is eccentric. This study examines the effects of a future data analysis on magnetic galactic binary systems with quasi-circular orbits using the current LDC tools. It reveals that a single eccentric galactic binary can be interpreted as multiple binary systems, potentially leading to biased population studies. Additionally, the study confirms that for quasi-circular orbits, the system's magnetic energy can be inferred once its second harmonic is detectable by traditional quasi-monochromatic source searching algorithms. As a result, LISA's observations could provide new insights into the nature and origin of magnetic fields in white dwarfs or neutron stars.