Extreme Mass Ratio Inspiral (EMRI) Search Techniques for the LISA Mission

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Extreme Mass Ratio Inspirals (EMRIs) describe the long-lasting inspiral and plunge of stellar remnants into massive black holes in the centers of galaxies. The small compact object spends 10^3 to 10^5 orbits in close vicinity of the massive black hole, and the orbit displays extreme forms of periastron and orbital plan precession. The large number of orbital cycles allows ultra precise measurements of the parameters of the binary system as the gravitational wave signal encodes information about the spacetime of the central massive object. EMRI waveforms are complex and the signals need to be coherently tracked for hundreds to thousands of cycles to produce a detection, making EMRI signals one of the most challenging data analysis problems in all of gravitational wave astronomy. To address these challenges we consider the collection of harmonics for the system, filtering short segments of data against a comb of harmonics. The number of important harmonics depends on the source properties such as the eccentricity and black hole spin and these properties can be exploited to identify EMRI signals in simulated data for the Laser Interferometer Space Antenna (LISA) mission in the LISA Data Challenges [1].

References

[1] LISA Data Challenges: https://lisa-ldc.lal.in2p3.fr/