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Performing precision gravitational-wave science with LISA using extreme-mass-ratio inspiral observations

Thursday, 24 October 2024 10:00 (30 minutes)

The formation and evolution of massive black holes (MBHs) is an unresolved mystery in astrophysics.
A primary goal of the Laser Interferometer Space Antenna (LISA) mission is therefore to study massive black holes (MBHs) and their environments from their gravitational wave emission in binary systems.
One class of these systems are extreme-mass-ratio inspirals (EMRIs), in which a stellar-mass compact object (CO) completes tens of thousands of orbital cycles around a MBH over a timescale of years before merging.
The precession of the CO trajectory produces a waveform rich in harmonic structure, enabling LISA to measure source parameters to one part in a milion.
However, this waveform complexity and extreme measurement precision makes EMRI data analysis a computationally expensive procedure.
In this talk, we will show how these exquisite waveforms can be generated in milliseconds with the FastEMRIWaveforms (FEW) package.
We will then explore what future improvements in waveform generation with FEW are required to fully exploit the science potential of EMRI signals.
Lastly, we will demonstrate how the measurement precision of EMRIs makes them ideal candidates for investigating environmental effects and performing cosmology/lensing studies.

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