A chartography of spacetime with gravitational waves: bridging astrophysics with geometry and topology.

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Abstract

The gravitational capture of a stellar-mass compact object (CO) by a supermassive black hole is a unique probe of gravity in the strong field regime. Because of the large mass ratio, we call these sources extreme-mass ratio inspirals (EMRIs). In a similar manner, COs can be captured by intermediate-mass black holes in globular clusters or dwarf galaxies. The mass ratio in this case is lower, and hence we refer to the system as an intermediate-mass ratio inspiral (IMRI). Also, sub-stellar objects such as a brown dwarf, with masses much lighter than our Sun, can inspiral into supermassive black holes such as Sgr A* at our Galactic centre. In this case, the mass ratio is extremely large and, hence, we call this system ab extremely-large mass ratio inspirals (XMRIs). All of these sources of gravitational waves will provide us with a collection of snapshots of spacetime around a super-massive black hole that will allow us to do a direct mapping of warped spacetime around the supermassive black hole, a live cartography of gravity in this extreme gravity regime. Also, they allow us to study the geometry of warped spacetime and, possibly, a way to look into its topology.

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