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Probing Fundamental physics with extreme mass ratio inspirals

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Extreme mass ratio inspirals (EMRIs) composed of a stellar-mass object inspiraling into a supermassive black hole (SMBH), emitting GWs in the milli-Hertz band, are the most promising GW sources for space-based observatories. The rich information about the spacetime geometry surrounding the SMBH is encoded in the GWs, making EMRIs an excellent source for studying black hole physics like the charges carried by black holes and the DM halos around black holes. Firstly, we use EMRIs to probe the charges carried by black holes and the fundamental fields associated with the charges. Then Using the static and spherically symmetric metric for a black hole immersed in dark matter (DM) halos with Hernquist, Burkert, and Navarro-Frenk-White density distributions, we study the possibility of the detection of DM halos and the distinction between different DM halos with the extreme mass ratio inspiral systems (EMRIs).

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