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Post-Newtonian properties of an EMRI in non-vacuum region using Logarithmic Potential

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There are many astrophysical scenarios where extreme mass ratio inspiral (EMRI) binaries can be surrounded by matter (esp. dark matter) distribution. The mass distribution can affect the dynamical properties (e.g. orbital frequency, orbital velocity, etc.) and the rate of energy radiation from the EMRI. We assume a power law dependency of mass distribution density on the radial distance from the center of mass (instead of a point mass source as used in Schwarzschild spacetime). Using the Newtonian order Poisson equation one obtains a general power law potential (instead of Kepler-Newton (KN) potential which is valid for vacuum regions). In this presentation, I would discuss the expressions for dynamical quantities and the average energy radiation rate from the circular orbit EMRI corrected up to the first post-Newtonian (1PN) order. These quantities can be significantly different in the presence of potential due to matter distribution as compared to that in the Kepler-Newton potential. The effect of mass distribution could be studied further in more realistic 3D orbits (by including eccentricities, precession, etc). Such signatures can be added to the existing templates for the gravitational waveforms which could be vital for the study using upcoming space-based detectors.

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