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# Worldtube excision method for intermediate-mass-ratio inspirals: scalar-field model in 3+1 dimensions

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Binary black hole simulations become increasingly more computationally expensive with smaller mass ratios, partly because of the longer evolution time, and partly because the lengthscale disparity dictates smaller time steps. We explore a method for alleviating the scale disparity in simulations with mass ratios in the intermediate astrophysical range (10−4⪅q⪅10−2), where purely perturbative methods may not be adequate. A region ("worldtube") much larger than the small black hole is excised from the numerical domain, and replaced with an analytical model approximating a tidally deformed black hole. We apply this idea to a toy model of a scalar charge in a fixed circular geodesic orbit around a Schwarzschild black hole, solving for the massless Klein-Gordon field. This is a first implementation of the worldtube excision method in full 3+1 dimensions. We demonstrate the accuracy and efficiency of the method, and discuss the steps towards applying it for evolving orbits and, ultimately, in the binary black-hole scenario.

**Presenter:** WITTEK, Nikolas (Max Planck Institute for Gravitational Physics)

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