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Multi-domain spectral method for self-force calculations

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We present a multi-domain elliptic solver in 2D based on spectral methods to solve typical self-force equations in an Effective Source m-mode scheme. The domain decomposition exploits two features to enhance accuracy. With a reference centred at the black hole, the horizon and wave zone regions are treated with a hyperboloidal approach, allowing asymptotic regions to be included in the numerical grid. However, The effective source is obtained in a reference frame centred at the particle position, allowing a relatively quick and effective scheme for calculating high-order puncture fields. The code is benchmarked for the scalar self-force of a particle on a circular orbit in the Schwarzschild spacetime.

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