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The 2.5PN linear momentum flux and associated recoil from inspiralling compact binaries in quasi-circular orbits: Nonspinning case

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Anisotropic emission of gravitational-waves (GWs) from inspiralling compact binaries leads to the loss of linear momentum and gravitational recoil of the system. The loss rate of linear momentum for a non-spinning binary system of black holes in quasi-circular orbit is obtained at the 2.5 post-Newtonian (PN) order and used to provide an analytical expression for the 2.5PN accurate recoil velocity of the binary in the inspiral phase. The maximum recoil velocity of the binary system at the innermost stable circular orbit (ISCO)) estimated by the 2.5PN formula is of the order of 4 km/s which is smaller than the 2PN estimate of 22 km/s. This indicates the importance of higher order post-Newtonian (PN) corrections. Going beyond inspiral, we provide an estimate of the more important contribution to the recoil velocity from the plunge phase. The maximum recoil velocity at the end of the plunge, involving contributions both from inspiral and plunge phase, for a binary with symmetric mass ratio $\nu = 0.2$ is of the order of 182 km/s.