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Inert compact binary formation in open clusters

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Gaia mission offers opportunities to search for compact binaries not involved in binary interactions (hereafter inert compact binaries), and results in the discoveries of binaries containing one black hole (BH) or one neutron star (NS), called “Gaia BHs” and “Gaia NSs”, respectively. Tanikawa et al. (2024, MNRAS, 527, 4031) have first pointed out that Gaia BHs can be formed much more efficiently in open clusters than on isolated fields. Very recently, the presence of Gaia NS1 have been reported. We assess if Gaia BHs and NSs can be formed in open clusters through dynamical interactions. In order to obtain a large number of inert compact binaries similar to Gaia BHs and NSs, we have performed gravitational N-body simulations for a large number of open clusters whose total mass is 120 million solar masses. These clusters have various masses, metallicities, densities, and binary fractions. We have found that open clusters form Gaia BHs (1-10 per million solar masses) much more efficiently than Gaia NSs (at most 0.1 per million solar masses) for any cluster parameters. This is quite inconsistent with observational results, because the reported numbers of Gaia BHs and NSs are 2 and about 20, respectively. This is also true even if NS natal kicks are unrealistically small. We have concluded that Gaia BHs can be formed in open clusters, while Gaia NSs cannot.

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