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The case of an IMBH in the galactic centre: insights from N-body simulations

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We present the results of direct N-body simulations focusing on stellar discs interacting with a central supermassive black hole (SMBH) and an off-plane intermediate mass black hole (IMBH) embedded within a spherical star cluster. For models with a high-mass IMBH ($m_\bullet \simeq M_\mathrm{d}$) on a retrograde orbit with respect to the stellar disc, we find that the IMBH tends to anti-align with the radially overlapping disc stars' inclination angles, with a tendency to become orthogonal with respect to the outer region of the disc. The final state of the IMBH's inclination angle is governed by the relative magnitudes of the angular momentum vectors of the IMBH and the radially overlapping disc region. In contrast, when on prograde orbits, the IMBH and the disc always align with their total angular momentum vector. Lower mass IMBH models ($m_\bullet \ll M_\mathrm{d}$) on retrograde orbits exhibit roughly constant inclination angles over time. During the process of anti-alignment, a massive, retrograde IMBH disrupts the stellar disc. This disruption fragments the disc into 2–4 distinct sections, each characterised by overdensities of their angular momentum vectors. These sections are transient but become prominently observable between 5 to 6 Myrs. Their appearance coincides with the age of the young stars in the disc at the Galactic centre, offering a potential explanation for their observed distribution.

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