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Intermediate mass black holes play hide-and-seek

Tuesday 27 May 2025 10:00 (12 minutes)

Binaries of intermediate mass black holes (IMBHs) with masses $M_{\rm bh} = 10^2 - 10^4 M_\odot$ are predicted to emit gravitational waves (GWs) potentially detectable with the Einstein Telescope. Though IMBHs of these masses are widely expected theoretically (and likely hosted in the centre of globular clusters and dwarf galaxies), these objects are very elusive and hard to detect with methods based on electromagnetic radiation. I will present results of state-of-the-art dynamical modelling that allowed us to put 3sigma upper limits on the mass of putative central IMBHs in the globular cluster 47 Tuc ($M_{\rm bh} < 578 M_\odot$) and the dwarf spheroidal galaxy Leo I ($M_{\rm bh} < 6.8 \times 10^5 M_\odot$). Nuclear star clusters (NSCs), high-density central stellar systems observed in galaxies of different morphological types, are favourable sites for IMBH binary formation and coalescence. I will explore this scenario by presenting a dynamical analysis of the $z = 1.4$ gravitationally-lensed star-forming Sparkler galaxy, known for hosting a remarkable population of $10^6 - 10^7 M_\odot$ stellar clumps. I will show that, before $z = 0$, up to seven of these clumps might spiral into the galactic centre and form an NSC: if these clumps contain IMBHs, the latter might form binaries and reveal themselves emitting GWs on their way to coalescence.

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