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Intermediate mass-ratio inspirals with dark matter minispikes

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The dark matter (DM) distributed around an intermediate massive black hole (IMBH) forms an overdensity region called DM minispike.
We consider the binary system which consists of an IMBH with DM minispike and a small black hole inspiralling around the IMBH in eccentric orbits.
The factors which affect the evolution of the orbit include the gravity of the system, the dynamical friction and accretion of the small black hole caused by the DM minispike, and the radiation reaction of gravitational waves (GWs).
Using the method of osculating orbit, we find that when the semi-latus rectum $p \ll 10^5 R_s$ (R_s is the Schwarzschild radius of the IMBH) the dominated factors are the dynamical friction and accretion from the DM minispike, and the radiation reaction.
When $p \gg 10^5 R_s$,
the gravity from the DM minispike dominates the orbital evolution.
The existence of DM minispike leads to the deviation from the Keplerian orbit,
such as extra orbital precession,
henceforth extra phase shift in the GW waveform.
By calculating the signal-to-noise ratio for GWs with and without DM minispikes and the mismatch between them,
we show that the effect of the DM minispike in GW waveforms can potentially be detected by future space-based GW detectors such as LISA, Taiji, and Tianqin.

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