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Stream Splitting as a New Signature of Dark Matter Subhaloes and Intermediate-Mass Black Holes in the Milky Way

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The population of dark matter subhaloes in the Milky Way provides constraints on the dark matter particle mass. Previous studies suggest that stellar streams serve as probes of dark substructure through the dynamical signatures, such as gaps, imprinted by perturbations. With the advent of the Gaia satellite, several streams running nearly parallel to each other have been discovered. In this study, we report that a single stellar stream can split into two parallel streams following an encounter with a dark matter subhalo or an intermediate-mass black hole. This stream splitting occurs when the perturber approaches along the stream's tidal axis. Our scenario is supported by analytical modelling and N-body simulations. Moreover, the morphology and kinematics of the resulting parallel streams have possibility to offer an estimation of the mass of the perturber. Our results highlight that not only gaps but also splits should be considered to estimate the true abundance of subhaloes.

References

Kaneda, Mori, Otaki (2024), PASJ, 5, pp. 1026–1040; Kazuno, Mori, Kaneda & Otaki, PASJ, 76, L39 (2024)

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