Lights in a sea of darkness: constraining the nature and properties of dark matter using the stellar kinematics in the centres of ultra-faint dwarf galaxies

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Propositions accompanying the dissertation

Lights in a Sea of Darkness

Constraining the Nature and Properties of Dark Matter using the Stellar Kinematics in the Centres of Ultra-Faint Dwarf Galaxies

1. The ultra-faint dwarf galaxy Eridanus 2 likely hosts a star cluster, and the latter's existence disfavours dark matter consisting entirely of massive astrophysical compact halo objects with masses $\sim$10–100 $M_{\odot}$ (Chapter 2).
2. The dark-matter haloes of ultra-faint dwarf galaxies do not have cores with radii $\sim$1 kpc, unlike more massive dwarf galaxies (Chapters 3 & 4).
3. The majority of ultra-faint dwarf galaxies around the Milky Way are not significantly tidally stripped within their half-light radii (Chapter 4).
4. Fuzzy dark matter cannot consistently explain the dark-matter density profiles of ultra-faint and classical dwarf galaxies, without invoking additional physics (Chapters 3 & 5).
5. It is beneficial to science to explore alternatives to cold dark matter and to dark matter in general.
6. To resolve the debate around the cusp–core problem, galactic star formation models need to become more predictive in their effects.
7. The hardest part of scientific research is precisely formulating the right question, rather than answering that question.
8. Theoretical quantile–quantile plots are more useful than histograms for visually detecting outliers.
9. Good and accessible figure design is as important as good academic writing, and should be explicitly addressed in science curricula.
10. One should never discount the capabilities of less experienced team members and must encourage them to voice their questions and criticism.

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