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Constraining Fuzzy Dark Matter With Galactic-Center Resonant Dynamics

Monday 7 April 2025 17:45 (15 minutes)

In this talk I will discuss the influence of axion dark-matter cores on the orbits of stars at the Galactic center. This dark matter candidate condenses into dense, solitonic cores, and, if a supermassive black hole is present at the center of such a core, its central part forms a 'gravitational atom'. Here, I will present a calculation of the atom's contribution to the gravitational potential felt by a Galactic-center star. I will then describe the angular-momentum dynamics this potential induces, and show that they are similar to vector resonant relaxation. Its influence is found to be sufficiently strong that such a dynamical component should be accounted for in Galactic-centre modelling. For the Milky Way, the atom is expected to be somewhat spherically asymmetric, and we use this to derive a stability condition for the disc of young, massive stars at the Galactic centre – if the atom's mass is too large, then the disc would be destroyed. Thus, the existence of this disc constrains the mass of the axion particles. I will show that plausible parameter values imply that m_a is excluded in the range 3×10^{-20} eV
$lesssim m_a$
$lesssim 6.5 \times 10^{-20}$ eV – a region which is mostly unconstrained.

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