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# A natural explanation of the VPOS from multistate Scalar Field Dark Matter

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Observations with the Gaia satellite have confirmed that the satellite galaxies of the Milky Way are not distributed as homogeneously as expected. The same occurs in galaxies such as Andromeda and Centaurus A, where satellite galaxies around their host galaxies have been observed to have orbits aligned perpendicular to the galactic plane of the host galaxy. This problem is known for the Milky Way as Vast Polar Structure (VPOS). The Scalar Field Dark Matter Field (SFDM), also known as Ultralight-, Fuzzy-, BEC-, Axion-dark matter, proposes that dark matter is a scalar field, which in the non-relativistic limit follows the Schr\"odinger equation coupled to the Poisson equation. Although the scalar field here is classical, the Schr\"odinger equation contains a ground state and excited states as part of its nature.
In this talk, we show that such quantum character of the SFDM can naturally explain the VPOS observed in galaxies. By taking into account the ground and the first excited states only, we can fit the rotation curves of the galaxies in a very simple way, and with the best-fit parameters obtained, we can explain the VPOS. We do this with particular galaxies, such as the Milky Way, Andromeda, Centaurus A, and six other galaxies whose satellites have been observed. From this result, it follows that the multistate SFDM is not distributed homogeneously around the galaxy and therefore explains the VPOS distribution of satellite galaxies. According to this result, this could be a generalized characteristic of galaxies in the Universe. Finally, we also show how the scale of each galaxy depends on a parameter that is determined by the final temperature of the scalar field of the galaxy halo under study. This explains why different galaxies with SFDM give different values of the mass of the scalar field.

**Primary authors:** Dr MATOS, Tonatiuh (Centro de Investigación y de Estudios Avanzados del IPN); Dr BERNAL, Tula (Universidad Autonoma Chapingo)

**Presenter:** Dr MATOS, Tonatiuh (Centro de Investigación y de Estudios Avanzados del IPN)

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