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Analyzing the Global Magnetic Field Configuration of Edge-On Galaxies with Radio Polarimetry Data

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In recent years, we learned that magnetic fields (B-fields) and cosmic rays (CRs) play a crucial role in shaping the evolution of galaxies and their halos, influencing processes from gas dynamics to accretion phenomena. A comprehensive exploration of these magnetic field effects is essential for advancing our understanding of the fundamental drivers behind galactic evolution. For this task, modern radio interferometers such as the Jansky Very Large Array (JVLA) or the Low Frequency Array (LOFAR) are essential as they allow us to trace CRs and B-fields through synchrotron emission in great detail.

When analyzing the magnetic field configuration of edge-on galaxies, many show distinctive "X-shaped"B-fields. Such a morphology already hints at the interesting interplay between thermal and non-thermal processes that govern the driving mechanisms of material from the galactic disk into the halo. To unravel the formation of this characteristic morphology, three dimensional analytical models are fitted to polarization-angle maps of multiple edge-on galaxies, utilizing data from the CHANG-ES Survey (Continuum Halos in Nearby Galaxies - an EVLA Survey). Additionally, a combination of JVLA and LOFAR data is employed to analyze cosmic ray transport within these galaxies, providing insights into the relative significance of CR-driven and thermal processes within the context of galactic winds.

Upcoming radio surveys, from the Square Kilometre Array (SKA) and its pathfinders, with high angular resolution and full polarization information, will significantly expand our sample, facilitating a detailed understanding of the magnetization process in galactic halos.

keywords

galaxies, magnetism, polarization, cosmic rays

In-person or online?

in-person

Career level

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