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Observations of Magnetic Fields in Edge–on Galaxies

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Radio continuum observations of edge–on galaxies with the intention of detecting magnetic fields are presented. After the detection of a large radio halo in NGC 4631 in 1977 new questions about disk–halo interactions and the possible existence of large–scale magnetic fields arised. The first detection of linearly polarized emission in a galaxy halo succeeded also in NGC 4631 in 1988.
In the last years several edge–on galaxies have been observed with the Effelsberg and VLA radio telescopes in polarized intensity, and ordered large scale magnetic fields are present in most (if not all) of them. Their integral properties, like sizes, star formation activity and interaction, cover a large range. There exist isolated galaxies like NGC 4565 with just a faint radio nucleus and no detectable radio halo, which show large scale fields parallel to the galactic plane, isolated galaxies with thick radio disks (like NGC 891), where the field lines run also mainly parallel to the plane, but seem to tilt away from the plane at larger radii, as well as interacting galaxies, which do also show very different properties: In NGC 3628, a galaxy with a bright starburst nucleus, magnetic field lines mainly parallel to the disk are detected, whereas NGC 4631 and M 82, also starburst galaxies, show highly uniform magnetic fields perpendicular to the disk, accompanied by a huge radio halo (NGC 4631) or high velocity galactic winds (M 82). New measurements at high frequencies show that the existence of vertical magnetic fields and large radio halos are the exceptional rather than the normal case.
Large scale magnetic fields parallel to the plane of spiral galaxies can probably be explained by the "standard" dynamo models, including differential rotation and turbulent motions, whereas vertical magnetic fields suggest a contribution of galactic wind motions perpendicular to the plane.