## Galactic winds and dynamos

Rainer Beck



- Outflows are common (R.J.Dettmar)
- Outflows are related to star formation in the disk (R.J.Dettmar, D.Bomans)
- Bulk velocity of cosmic rays in the halo of NGC253 is similar to the escape velocity of ~300 km/s (V.Heesen)
- Radio scaleheights do not depend on star-formation rate: bulk velocity of cosmic rays related to the star-formation rate (M.Krause)
- Outflows are needed for efficient large-scale dynamo (helicity flow)
- The required outflow velocities are only a few km/s faster outflows suppress the large-scale dynamo (D.Moss, S.Sur)

## Dynamos with winds



## Tasks (theory)

- Which gas component carries the helicity flow? (hot gas)
- What is the outflow velocity required for efficient helicity transport? (a few km/s, effectively)
- How does the self-regulation work?
- Dependence of outflow velocity on star-formation rate?
- Effects of inflow?
- Understand magnetic reconnection

 Global MHD models with dynamo action and outflow: (D.Breitschwerdt, Y.Dubois, M.Hanasz)
Small scales
Range of star-formation rates/total field strengths
Barred galaxies

## Tasks (observations)

- Vertical distributions of edge-on galaxies in radio continuum, IR, Hα and X-rays
- Dependence on SF rate, field structure, ...
- Outflow (fountains or winds) velocities in Hα (and X-rays?)
- Variation of rotation velocity and velocity dispersion with height (HI,Hα)

Needed: spectral resolution (instrumentation is lacking!)

- Asymmetry of polarized emission in mildly inclined galaxies at several wavelengths: tomography
- Pattern of halo fields (PI and RM) of edge-on galaxies: coherent quadrupolar (dynamo), filaments, loops?
- Compare velocity fields with magnetic pattern

Higher resolution and sensitivity in radio polarization:

LOFAR surveys of edge-on and dwarf galaxies (Key Project)

 EVLA surveys of edge-on galaxies (in prep) and dwarfs (LittleTHINGS)