Can X-ray analysis tell us more about radio polarized ridges in perturbed spiral galaxies?

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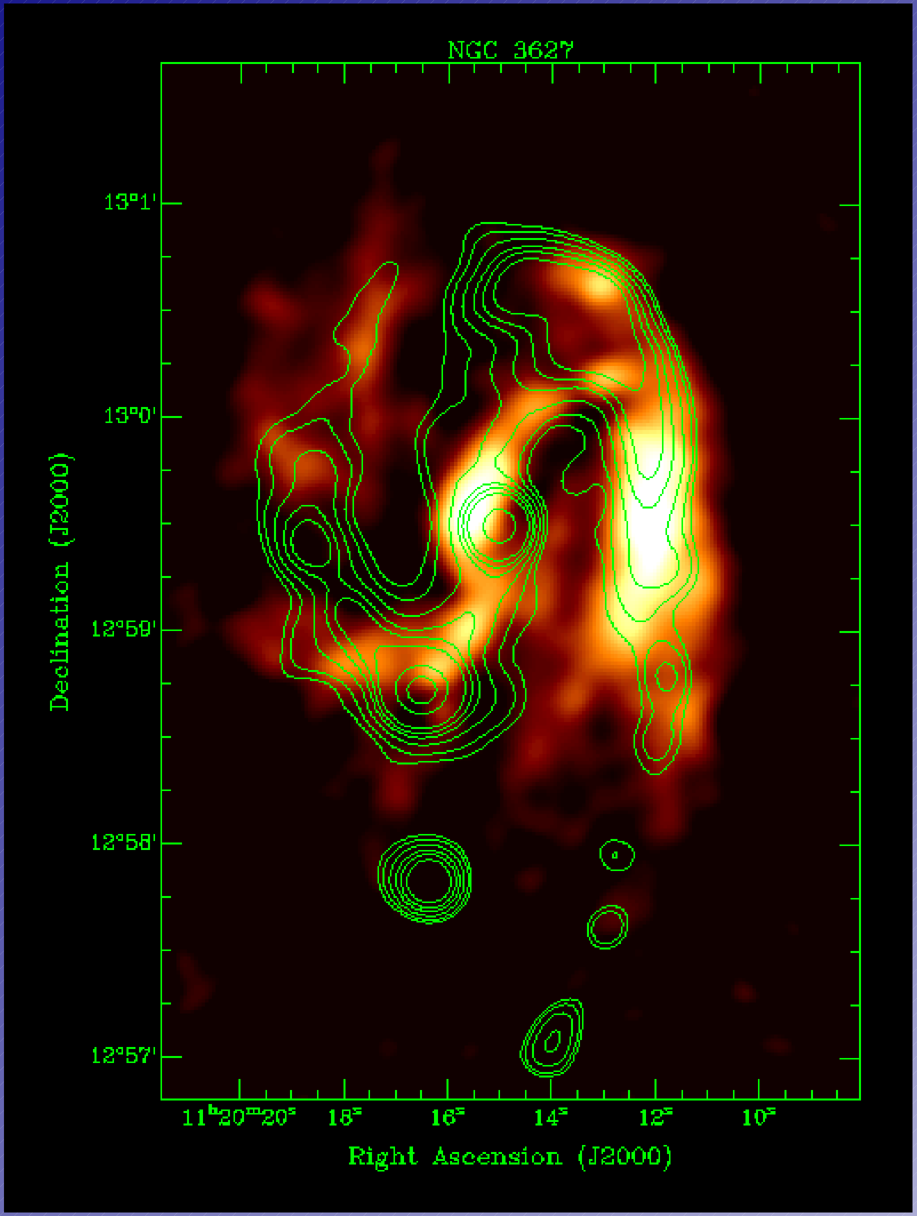
Plan

- Where can we find radio polarized ridges?
- What are they?
- How could X-ray observations possibly help?
- The results and how we may explain them?
- Conclusions and future study

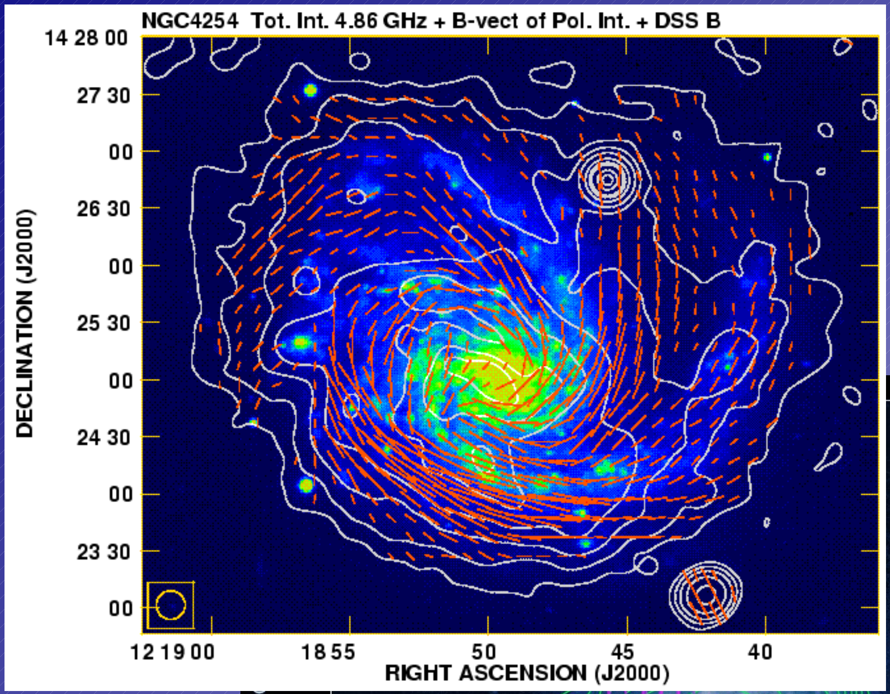
Radio polarized ridges

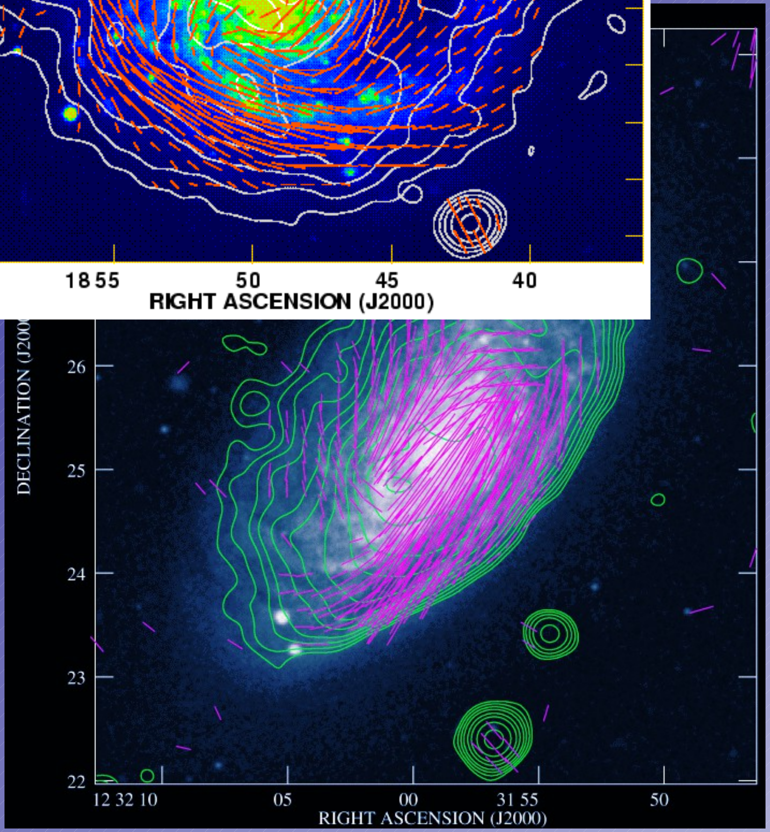


- Seen wherever a compression or shear of the magnetic field takes place
- Polarized radio emission is then increased due to higher ordering of the magnetic field
- Best candidates for having such features are perturbed galaxies (in groups and clusters)

- Soida et al. 2001

How can they form?





- Ram pressure

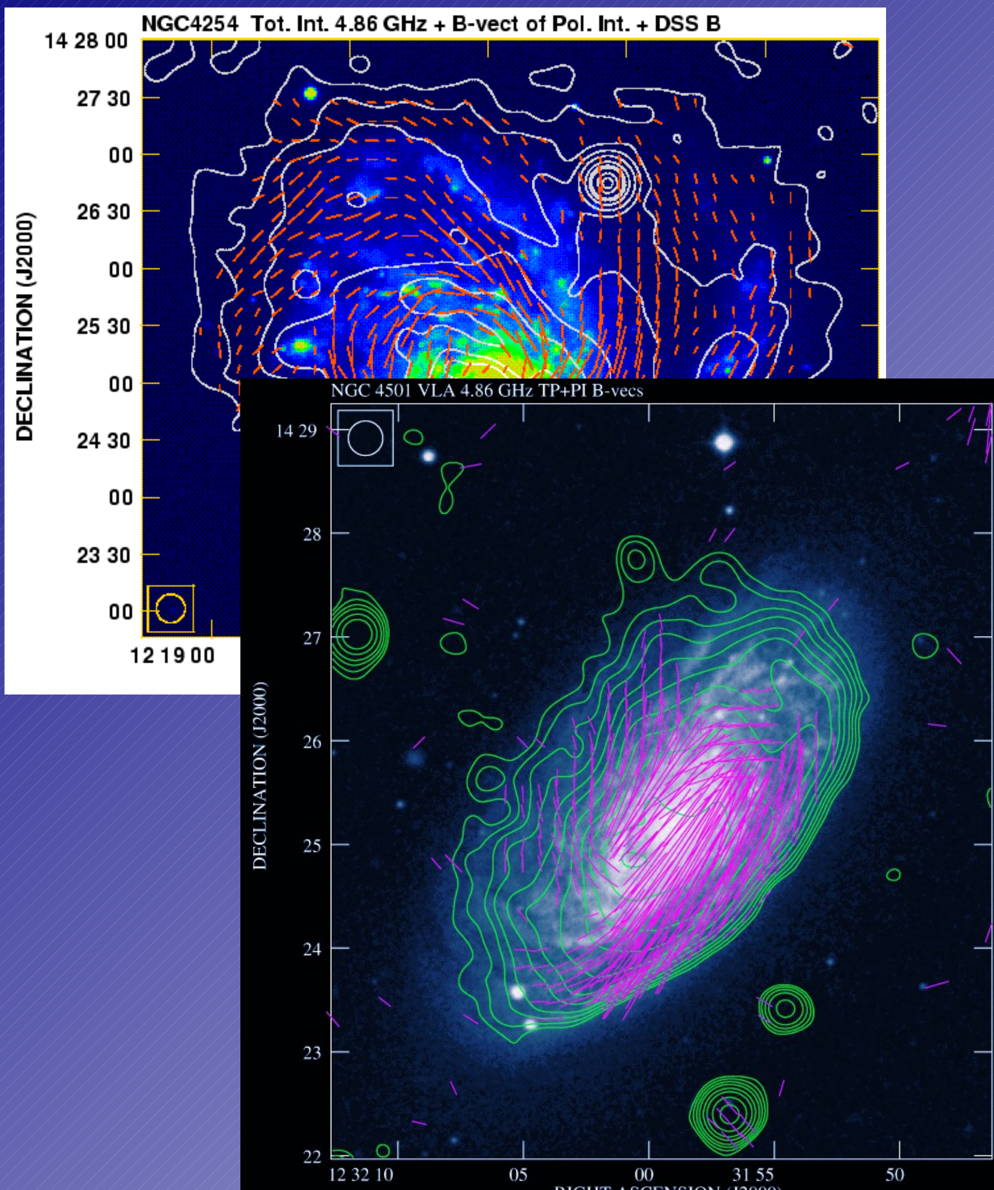
  High velocity against the intergroup/intracluster medium produces ordering and compression of the magnetic field on the leading side of the disk

- Tidal influence

  Can stretch a spiral arm what increases shearing forces and leads to amplification of the magnetic field

- Chyży et al. 2007, 2008

How can they form?



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- Vollmer et al. 2007

How can X-ray observations help?

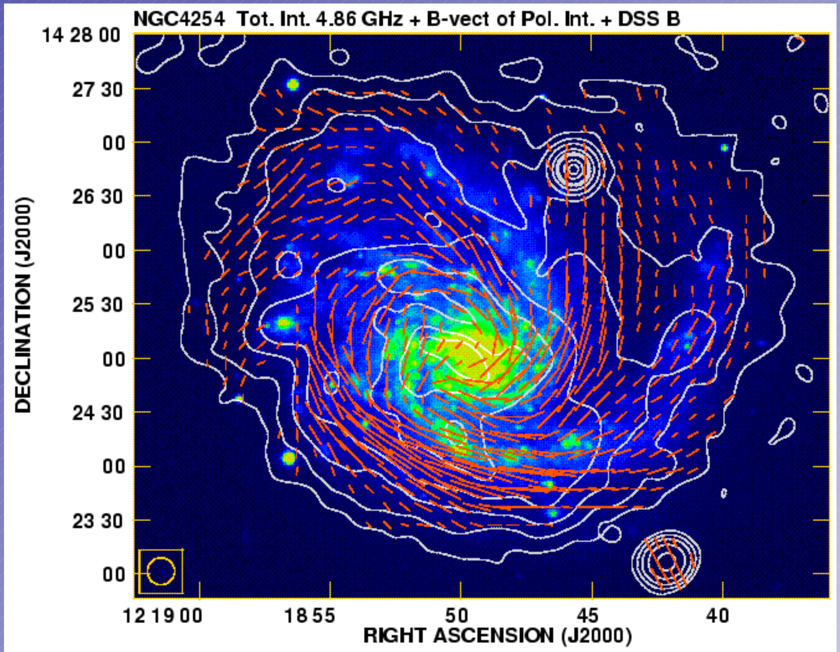
- X-ray traces hot gas emission
- A good way to compress and to heat is by shock
- A shock moving through a medium increases its temperature and the dependence is

  $T \propto v^2$

- Then, we can just estimate if the measured temperatures (via spectral analysis) argue for heating by a shock

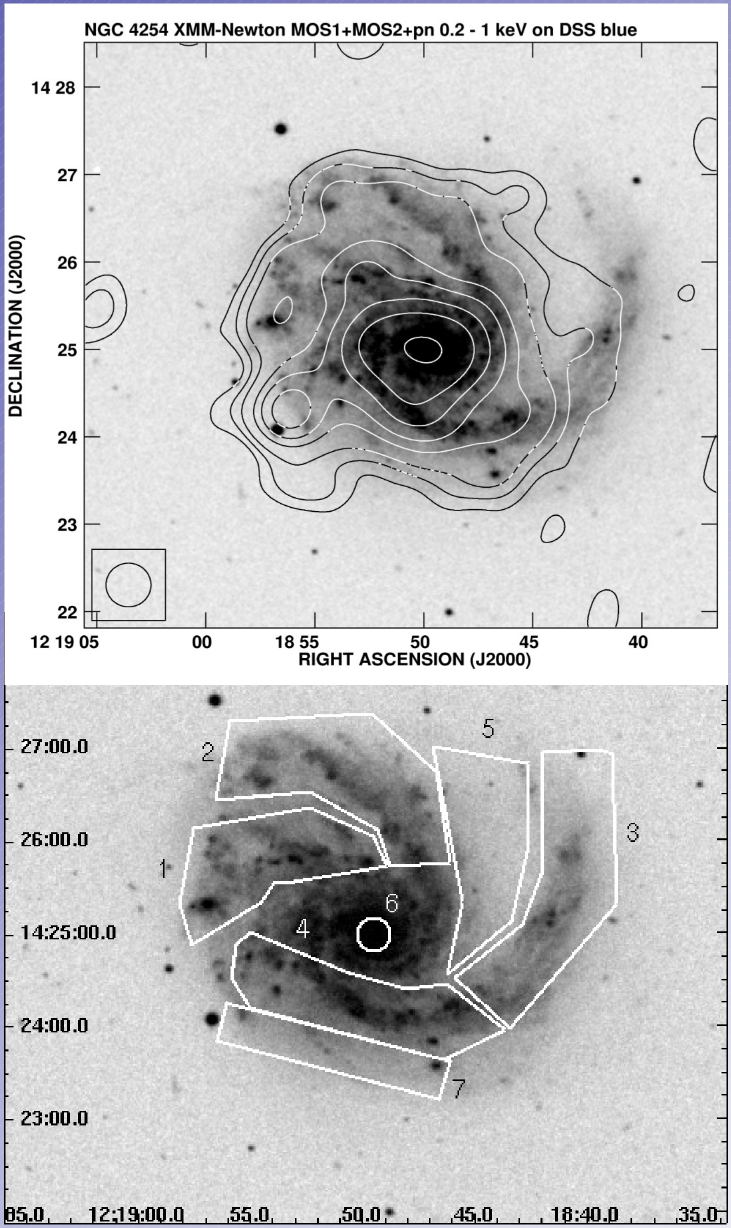
The results and explanation

- Galaxy is assumed to move at around 1000 km/s (model by Vollmer et al. 2005)
- We see an H I clump south of the galaxy falling inwards with a relative velocity of the order of 100 km/s



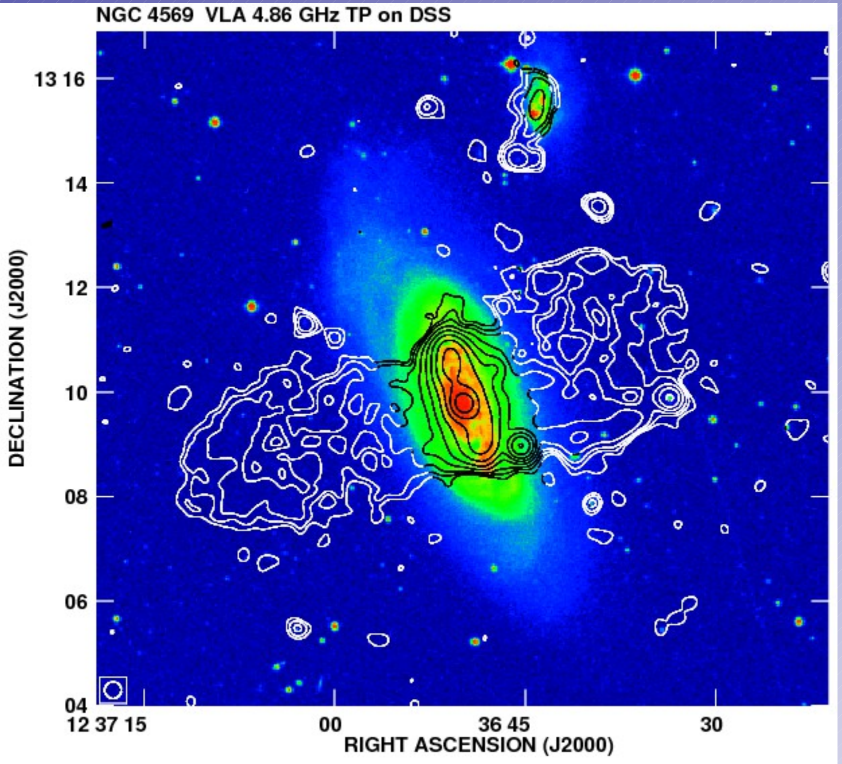
The results and explanation

- In region 4 we detect hot gas with kT = 0.65±0.1 keV, which corresponds to v of the order of 700 km/s
- In region 7 the temperature of hot gas drops to kT = 0.14±0.04 keV → v around 350 km/s
- Higher kT in region 4 are rather due to intense star formation.
- This favors tidal interactions



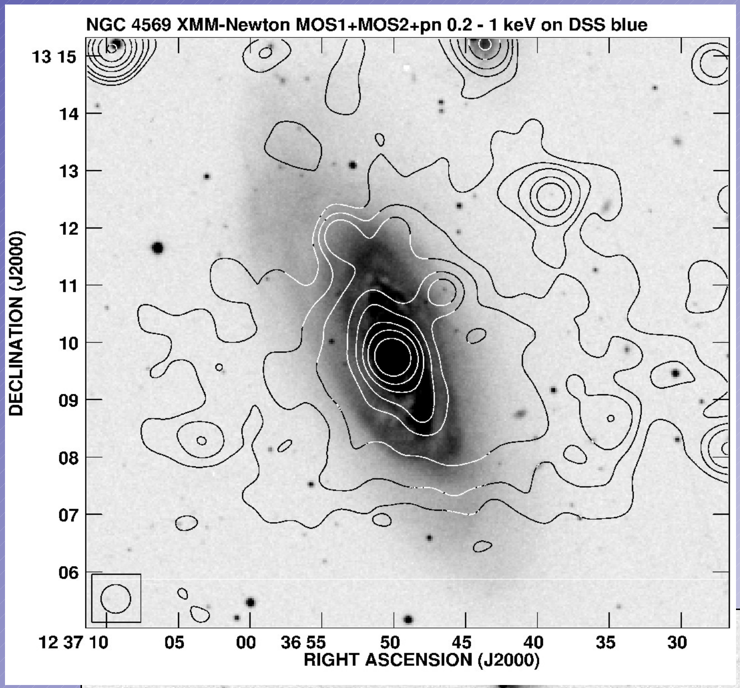
The results and explanation

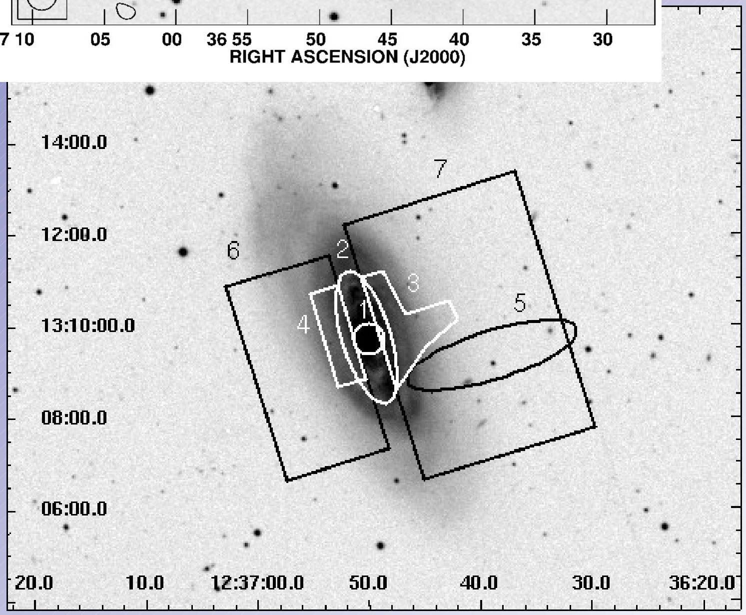
- Polarized „spur” in the southern edge of the western lobe
- Galaxy is moving to the NE!
- What about strong galactic wind?



The results and explanation

- In region 5 there is no star formation, but the hot gas of kT = 0.62±0.2 keV is hotter than in the lobe (0.43±0.1 keV).
- The velocity corresponding to 0.62keV is of the order of 700 km/s
- A good explanation seems to be an H I extension just outside the radio lobe – in such case a galactic wind would be hitting denser gas





Conclusions and future study

- Looking for signatures of shocks in radio polarized ridges seems to work
- It is possible to distinguish between shock/tidal origin of magnetic field compressions
- More polarized ridges need to be examined (good candidates available) to confirm our findings