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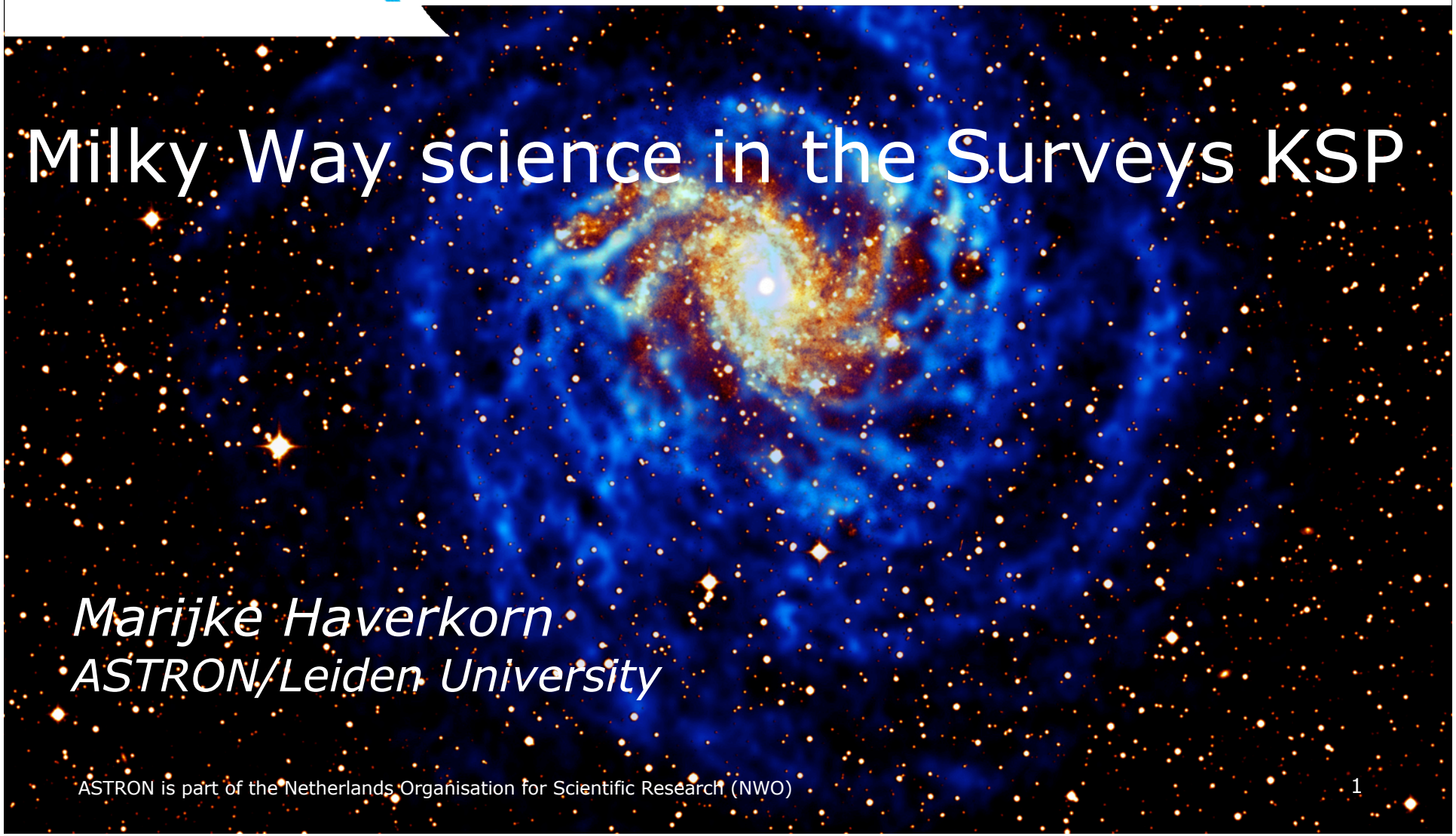
Netherlands Institute for Radio Astronomy



Milky Way science in the Surveys KSP

Marijke Haverkorn
ASTRON/Leiden University

Galactic observations as part of the Surveys KSP

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Galactic plane survey at all survey KSP Tier 1 frequencies

Galactic latitudes below about 10 degrees

Night time observations preferred because the sun is an emitter on small baselines, creating spurious large-scale diffuse emission

Intrastation baselines needed to recover largest scales

Galactic science case

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- supernova remnants
  - missing supernova remnant problem
  - spectral curvature
  - spatial variation of spectral indices
- tomography of synchrotron emissivity
- radio recombination lines (RRLs)
- star formation

supernova remnants: missing SNR problem

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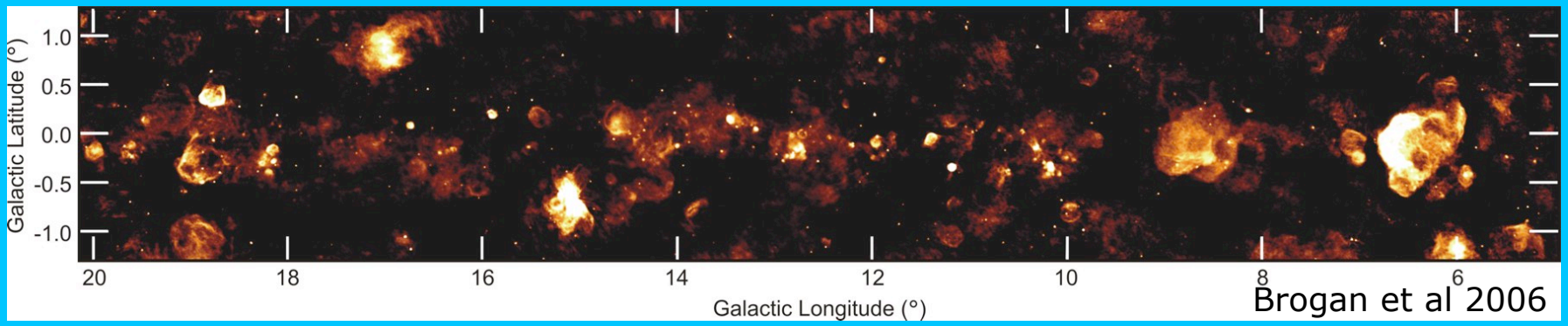

Brogan et al 2006

VLA survey at 327 MHz, 42" resolution, small part of inner Galactic plane

- About 1000 Galactic SNRs predicted vs about 265 known.

  Selection effects against young, small objects and old, large, faint shells.
- characterizing the full SNR population crucial for
  - understanding production and energy density of Galactic cosmic rays
  - turbulence
  - triggered star formation
- detection of old SNRs is important for SNR-pulsar associations and possible identification of gamma-ray sources.

  → low-freq, high-res data needed

supernova remnants: spectral index variations in space

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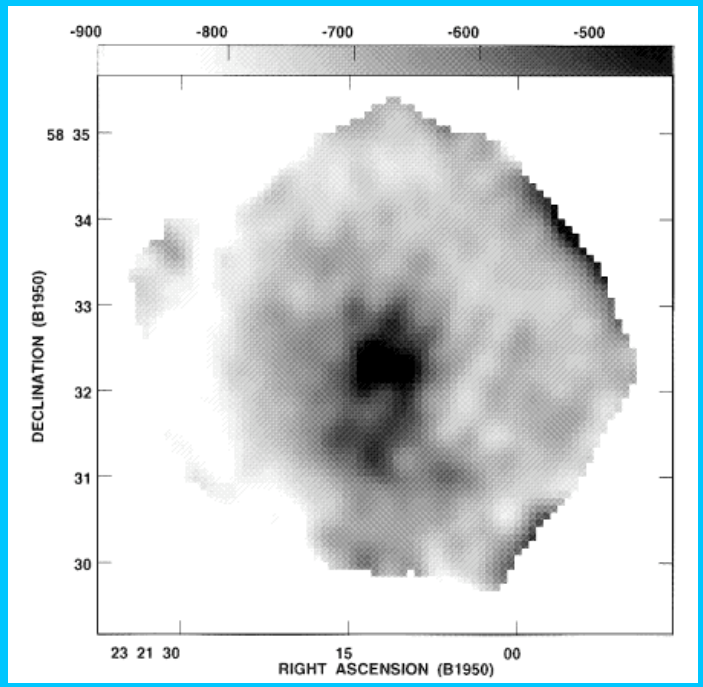
- models of particle acceleration (shocks or second order Fermi acceleration) predict structure in the particle distributions. This would be visible as spatial variations in spectral index in dynamical structures.

- spectral index variations are unique indicators of cold, unshocked ejecta *within* young SNRs

→ Again, low-freq, high-res data needed



Kassim et al 1995

supernova remnants: spectral index variations in frequency

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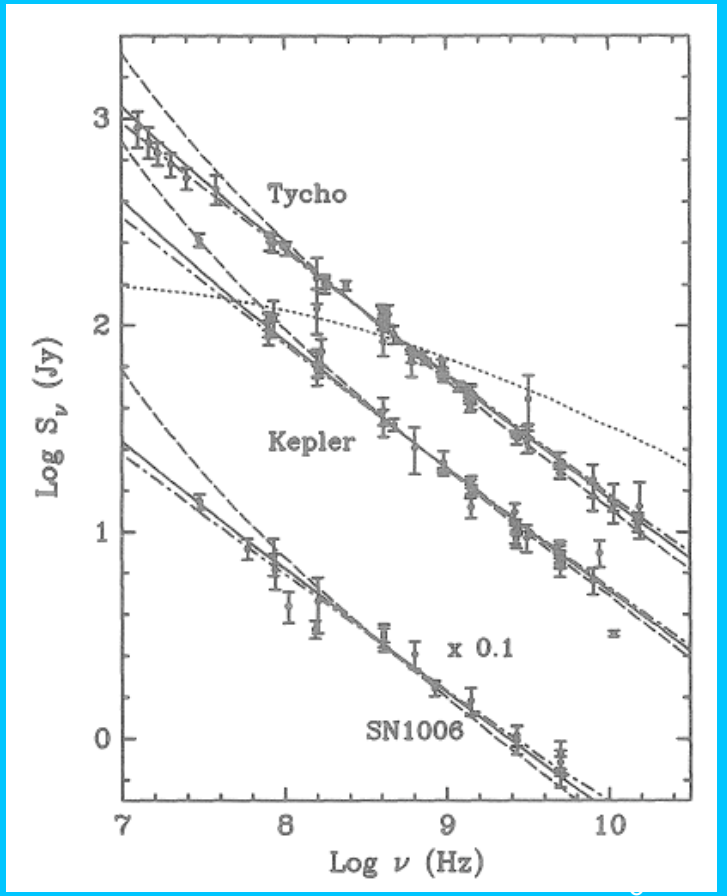
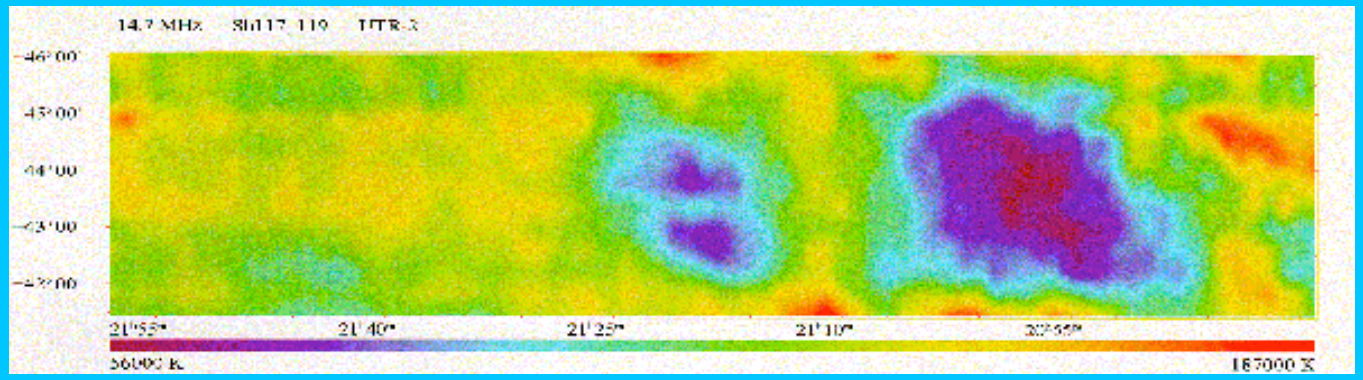
Spectral curvature at low frequencies is a sign of second order Fermi acceleration. The frequency of curvature is a measure of the magnetic field strength

→ Again, low-freq, high-res data needed



Reynolds & Ellison 1992

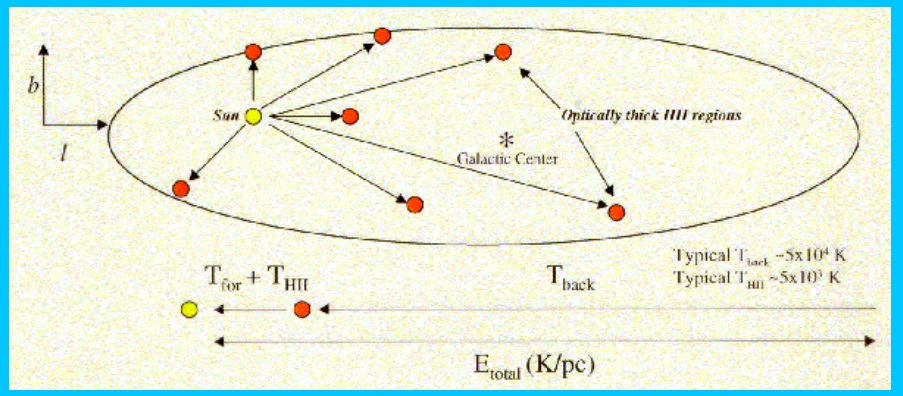
tomography of synchrotron emissivity



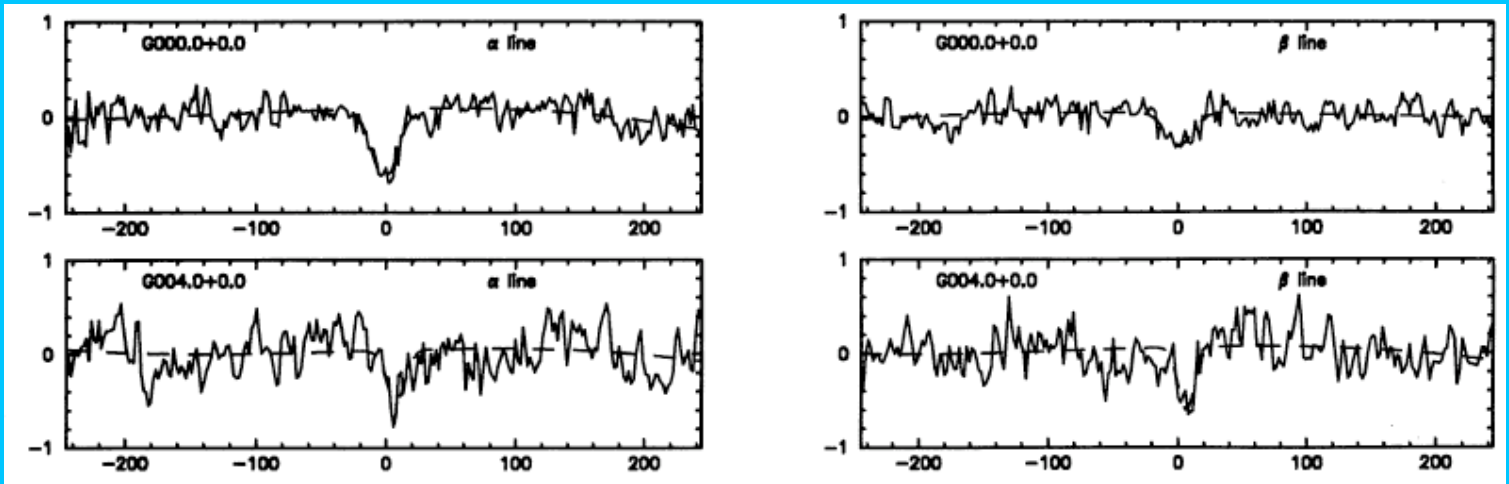
UTR-2 telescope, 15 MHz, Sharpless 117 and 119, 2° resolution

- at low frequencies (< ~ 75 MHz), HII regions are visible in absorption
- gives 3D image of synchrotron emissivity

→ Again, low-freq, high-res data needed



radio recombination lines (RRLs)

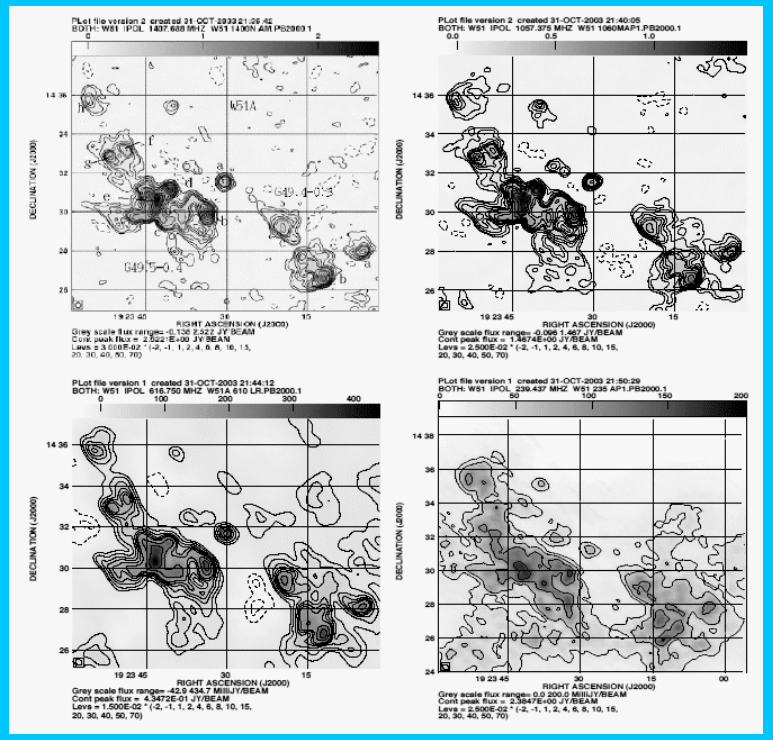


Erickson et al 1995

- RRLs (H, He, C) are uniquely sensitive to physical conditions such as temperature, kinematics, ionization, and abundances of heavy elements in the interstellar medium
- Strong lines are present in HII regions, but also weak, narrow lines in the diffuse ISM
- Line widths vary from 5 km s^{-1} to 50 km s^{-1} (Erickson et al 1995)

star formation

- HII regions: combine low-frequency optically thick data with high-frequency optically thin data to get emission measure and filling factor estimates.



Srivastava & Rao 2009

- HII region kinematic distance ambiguity solved when observing in absorption
- Detect low-density extended halos around HII regions
- Planetary nebulae, chromospheres around young, active stars, etc

commissioning

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- test imaging of extended structure
- test cleaning/deconvolution algorithms on extended structure
- test source finding algorithms

- test intrastation baselines
- test including intrastation baselines in survey data

- test radio recombination line measurements

- test day time vs night time calibratability

- 'simple' Galactic field with a well-known SNR (CTA1?)

- 'simple' Galactic field with large-scale diffuse emission and compact sources

- field including am HII region or molecular cloud - very high frequency resolution