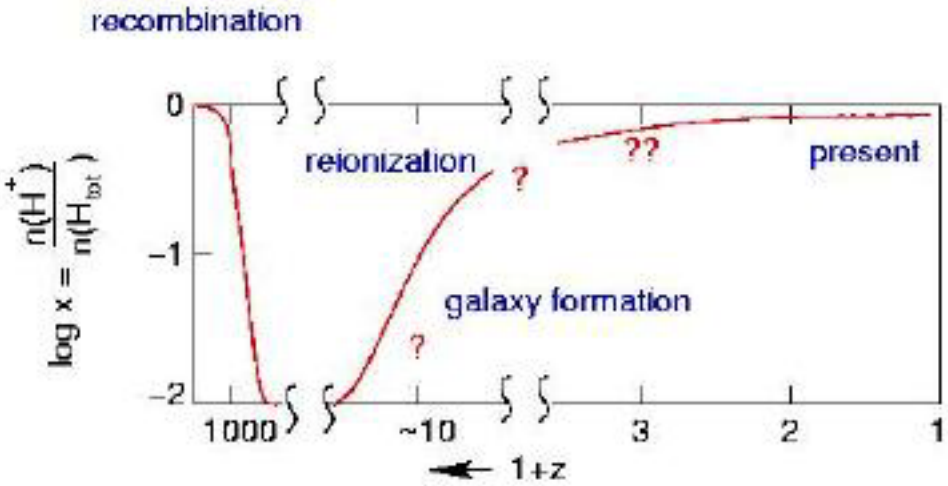
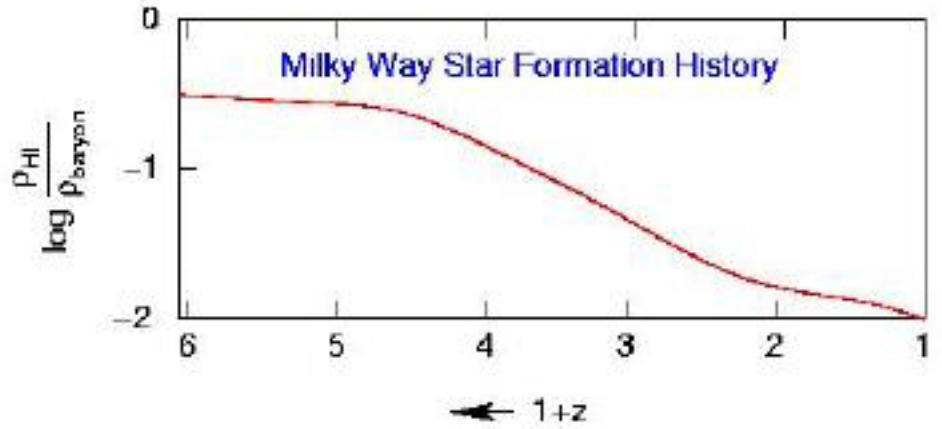
SKA Studies of HI

- The History of HI in the Universe
- Studies of Galaxies and Galaxy Interactions
- Studies of HI in the Milky Way and nearby galaxies
  - Structures
  - Spin Temperatures
- SKA Possibilities

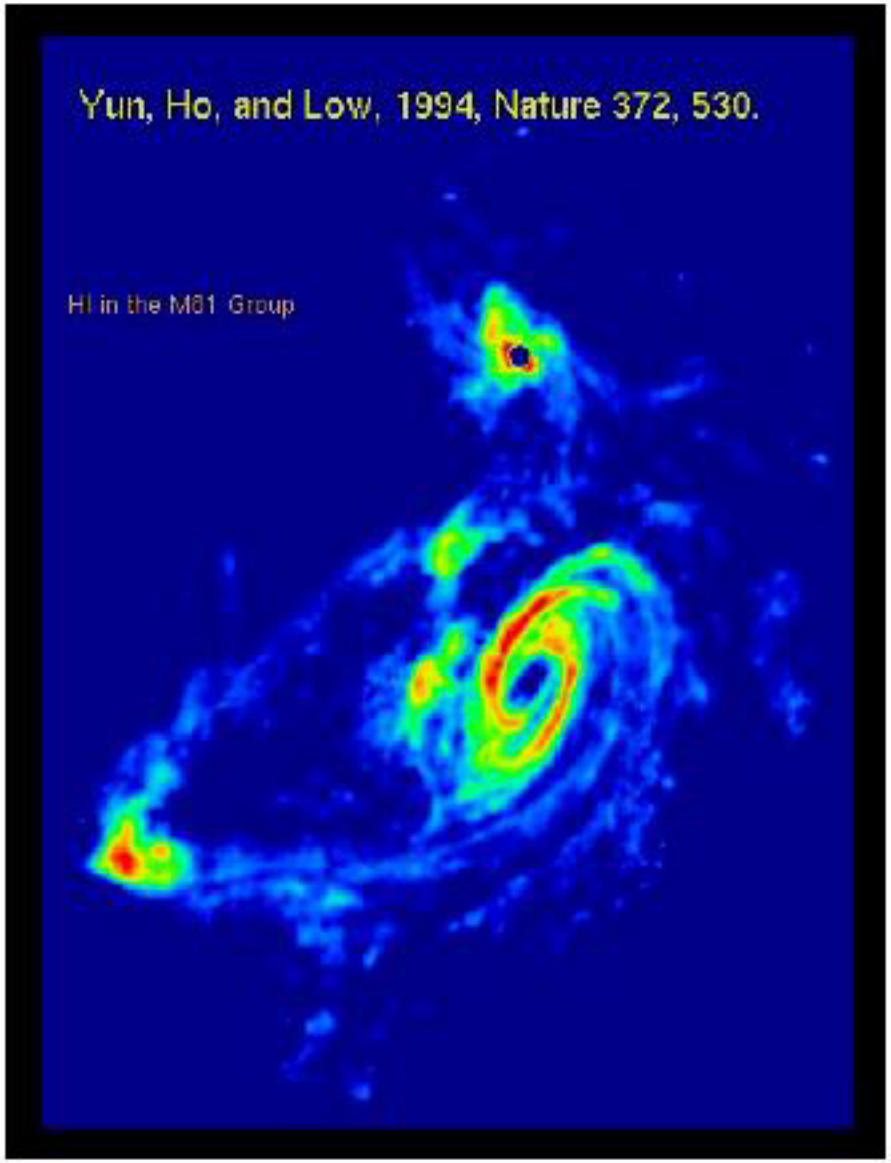
The H I History of the Universe





HI Mapping of :

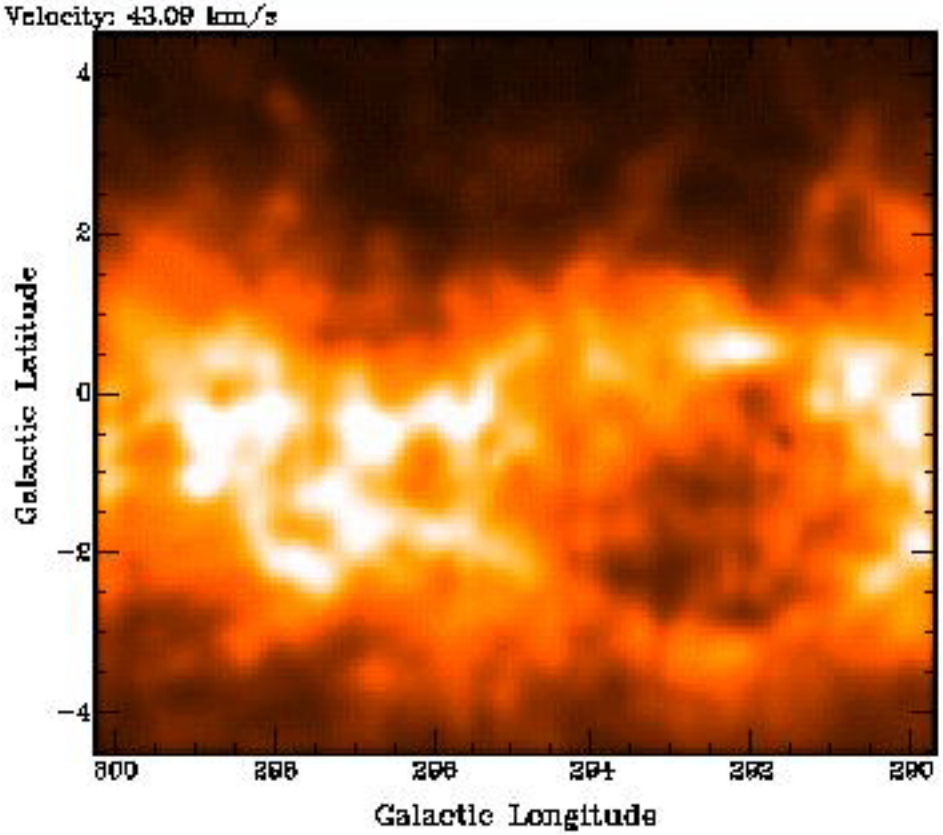
- Galaxy Interactions
- Galaxy Mergers
- Galaxy Formation



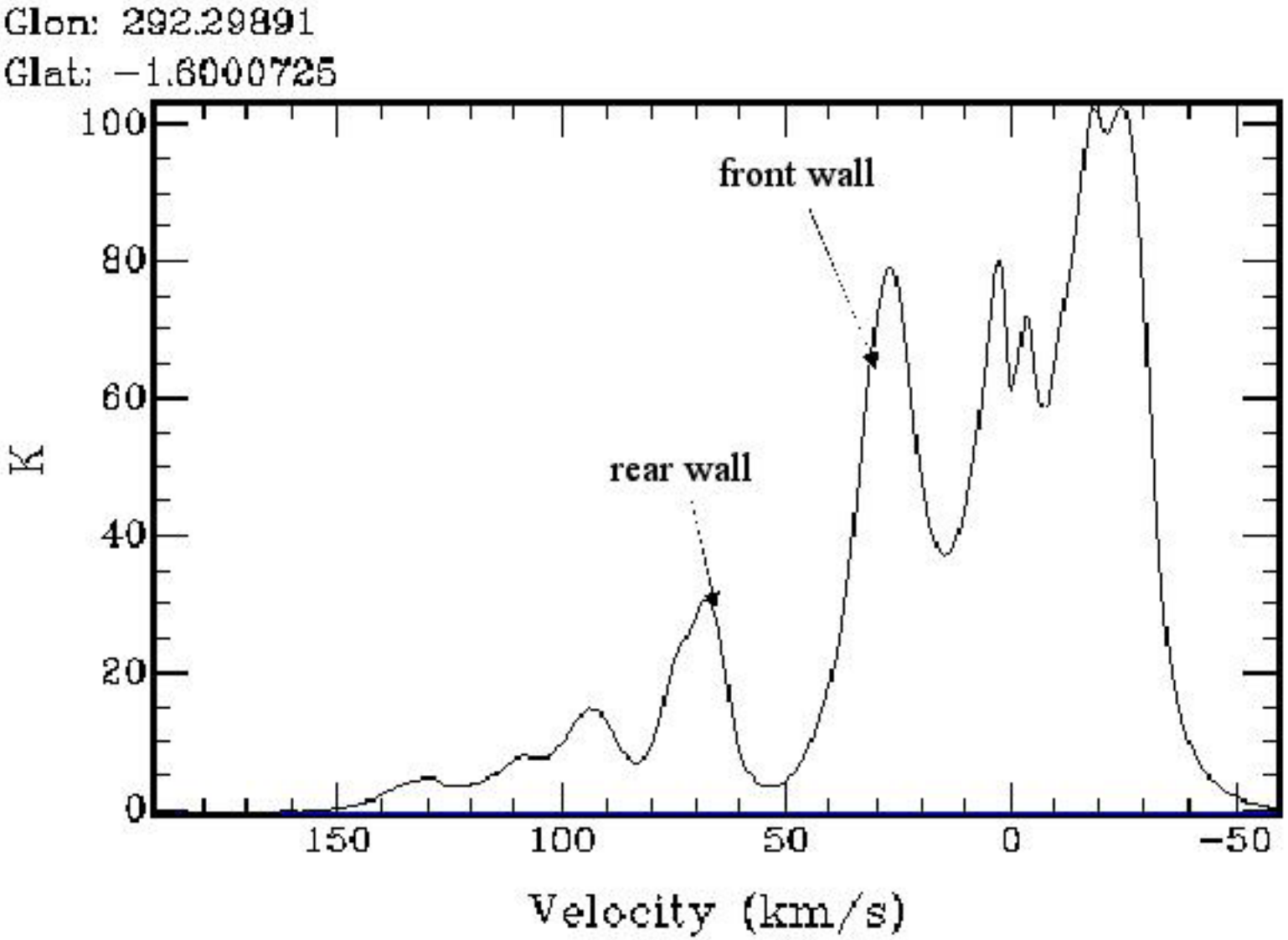
Mapping ISM Structure

- The 21-cm line is good for mapping big things because H I is so widespread.
- The 21-cm line generally traces the column density directly ($T_B = C_o N_H$).
- The HI shows the transition from discrete, deterministic structures to stochastic, turbulent dynamics.

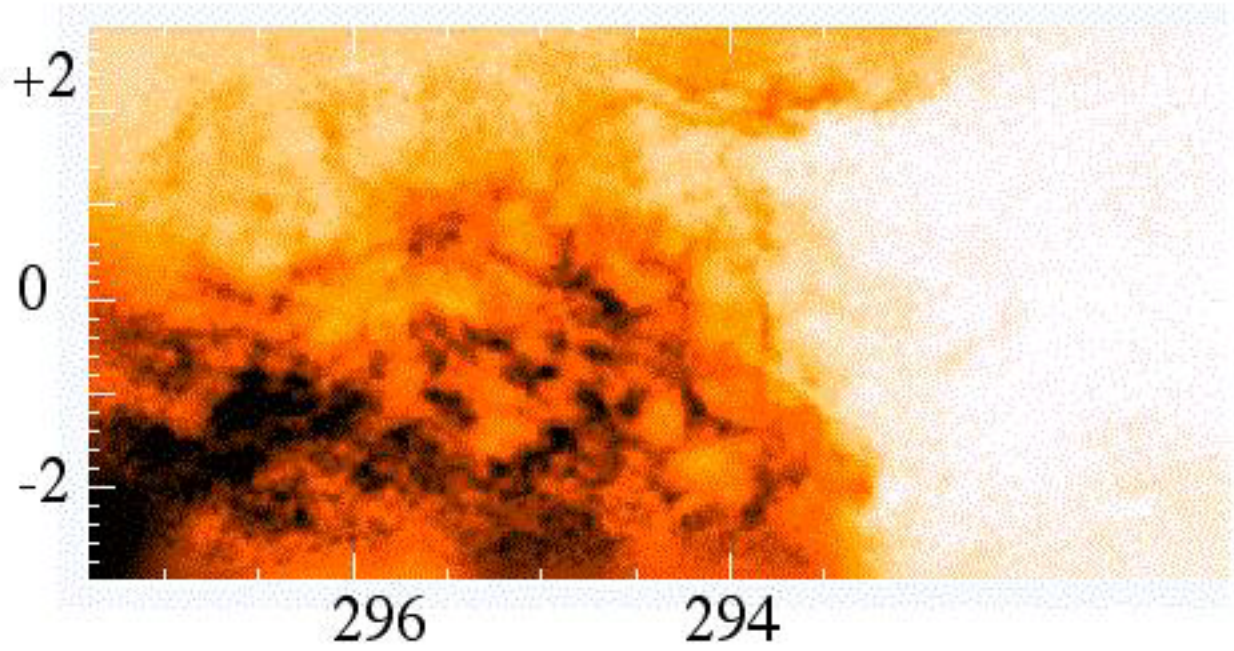
An HI shell in the outer galaxy



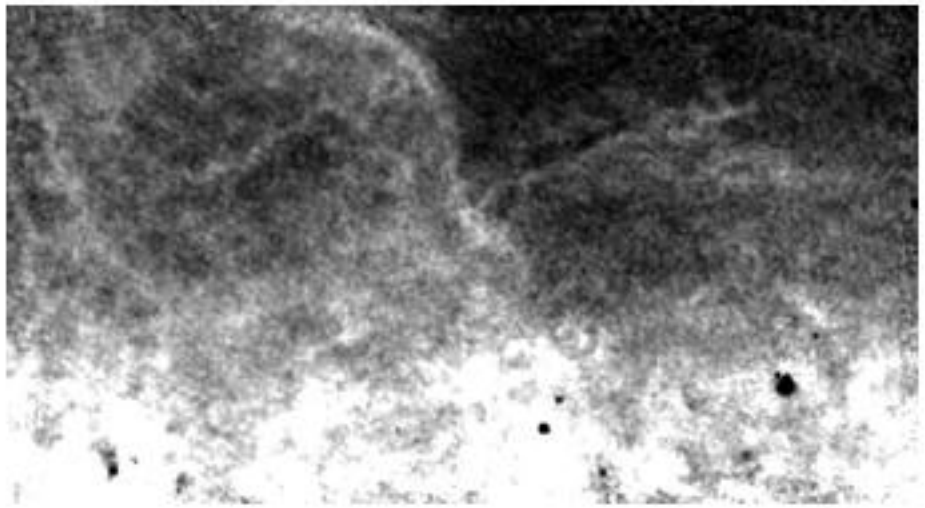
Supershell Identification

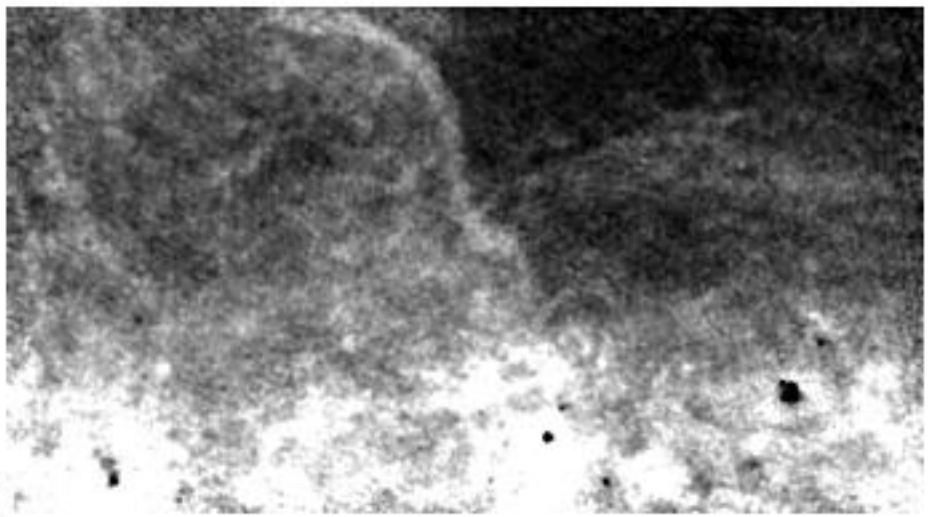


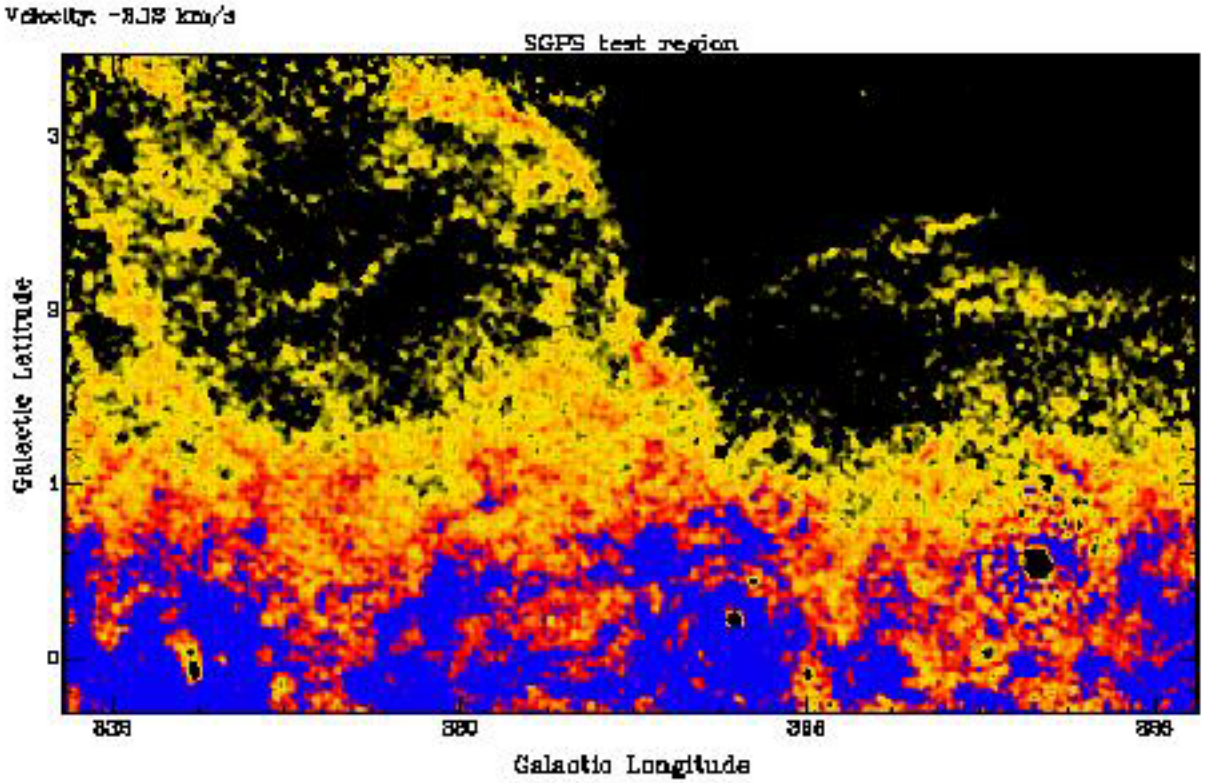
Parkes plus ATCA image of east side of G278 bubble



An HI shell in the fourth quadrant :






Velocity: -8.38 km/s
SGPS test region
Galactic Latitude
Galactic Longitude

Interstellar shells, bubbles, and chimneys

- Sizes range from a few pc to almost a kpc.
- Velocities range from stalled to ~50 km/s.
- Dynamical ages are up to 2×10^{7} years.
- Kinetic energy implied can be 10^{53} ergs.
- Mass flux to the halo maybe $>10^{4}$ per event.

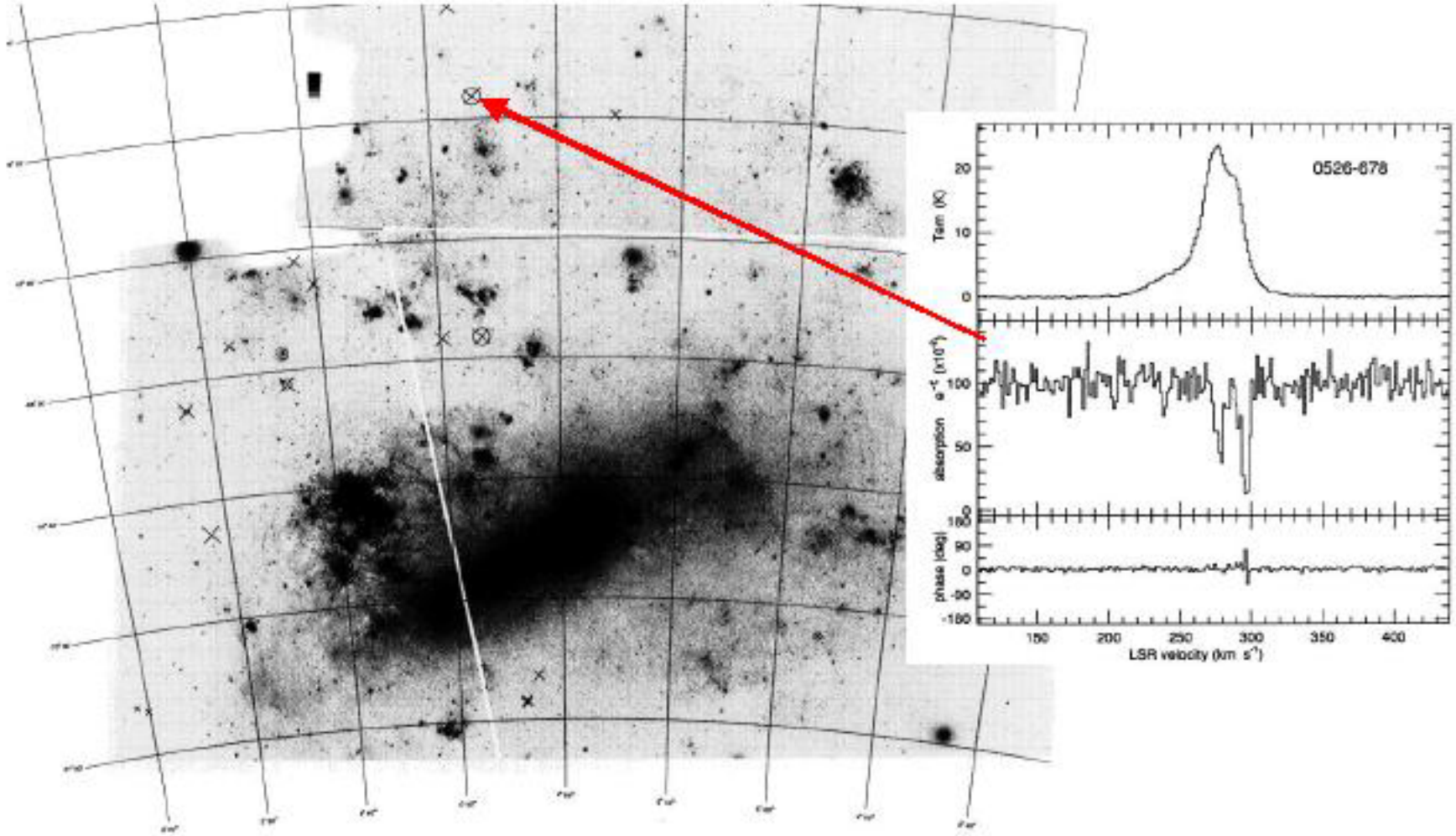
The SKA is good for **Low Surface Brightness** objects observed with resolution 1″ to 10″ at 21-cm

- In a 3 hour integration the SKA can map the HI line with
  - sensitivity ~1 K
  - angular resolution ~3″
  - velocity resolution ~1 km/s.

- The SKA can map ISM tracers like
  - the 21-cm line of HI,
  - the 18-cm lines of OH,
  - and the 9-cm lines of CH

  over large areas with ~arc second resolution.
- The VLA B-array has a filling factor of 2×10^{-4} while the SKA will have a filling factor of 10^{-2} over the same area.

HI Absorption - Emission Studies of T_{spin}



Absorption Studies at cm-waves are limited by the scarcity of strong background sources.

- We cannot map the spatial distribution of the HI optical depth as we map the emissivity .
- Interesting objects never have a background source behind them !

More Background Sources !

- The SKA will allow sensitive absorption spectra (σ_τ~0.05) to be measured toward background sources as faint as 200 μJy.
- This means there will be 500 times more background sources (extragalactic continuum sources) available than for the VLA.
- The density of these background sources is ~ one per 4 square arc minutes.

Conclusions :

The SKA will improve Galactic spectroscopy of cm-wave lines by nearly two orders of magnitude in **brightness sensitivity**.

The SKA will allow us to study the HI optical depth, τ, and excitation temperature, T_{spin}, wherever we like !