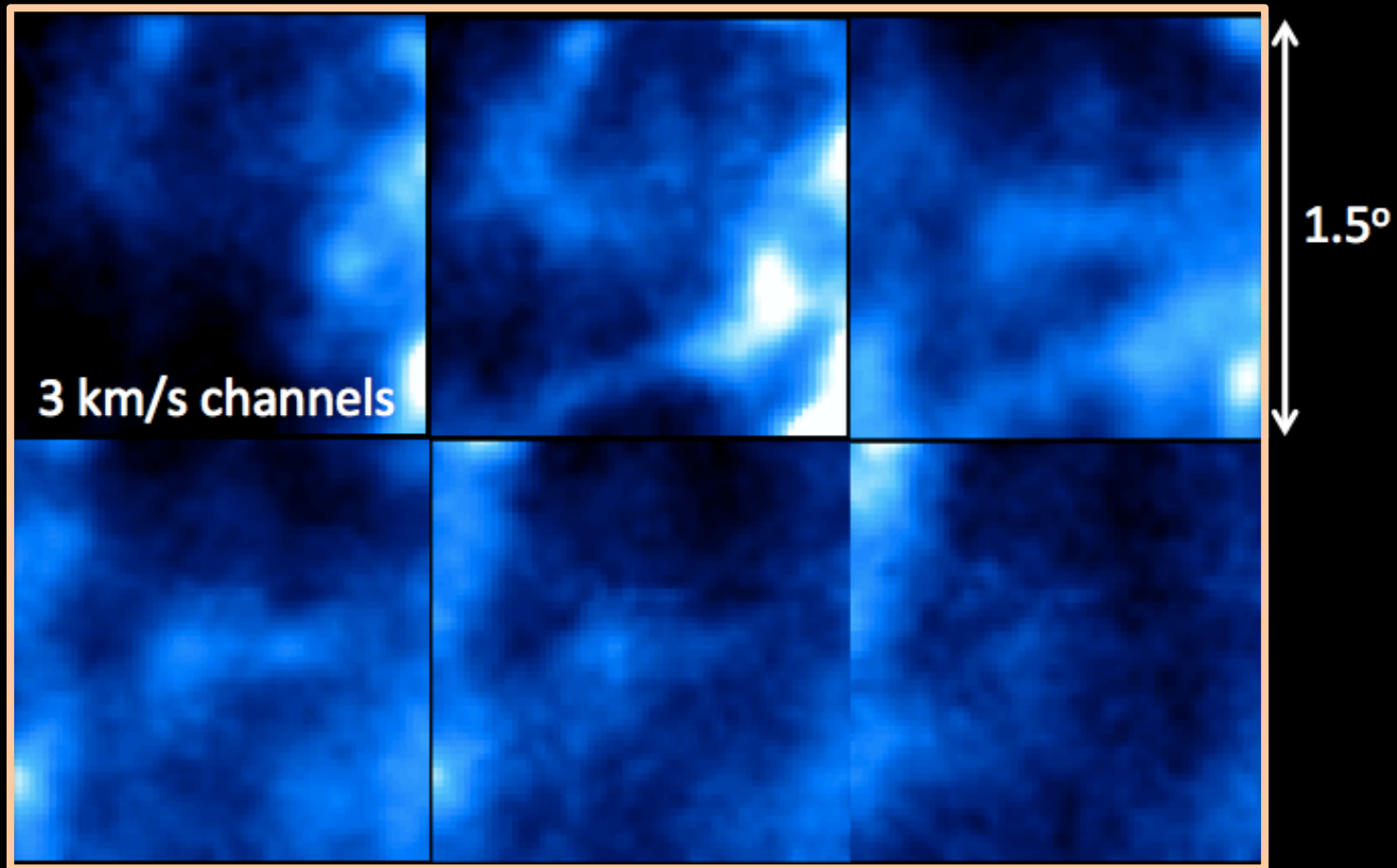
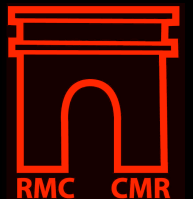


An HI Counterpart to Willman 1?



Kristine Spekkens

Royal Military College of Canada



An HI Counterpart to Willman 1?

- Radio maps of dSphs and the hunt for particle dark matter
- An HI detection near Willman 1 with the GBT?
- Implications of an HI counterpart

In collaboration with:

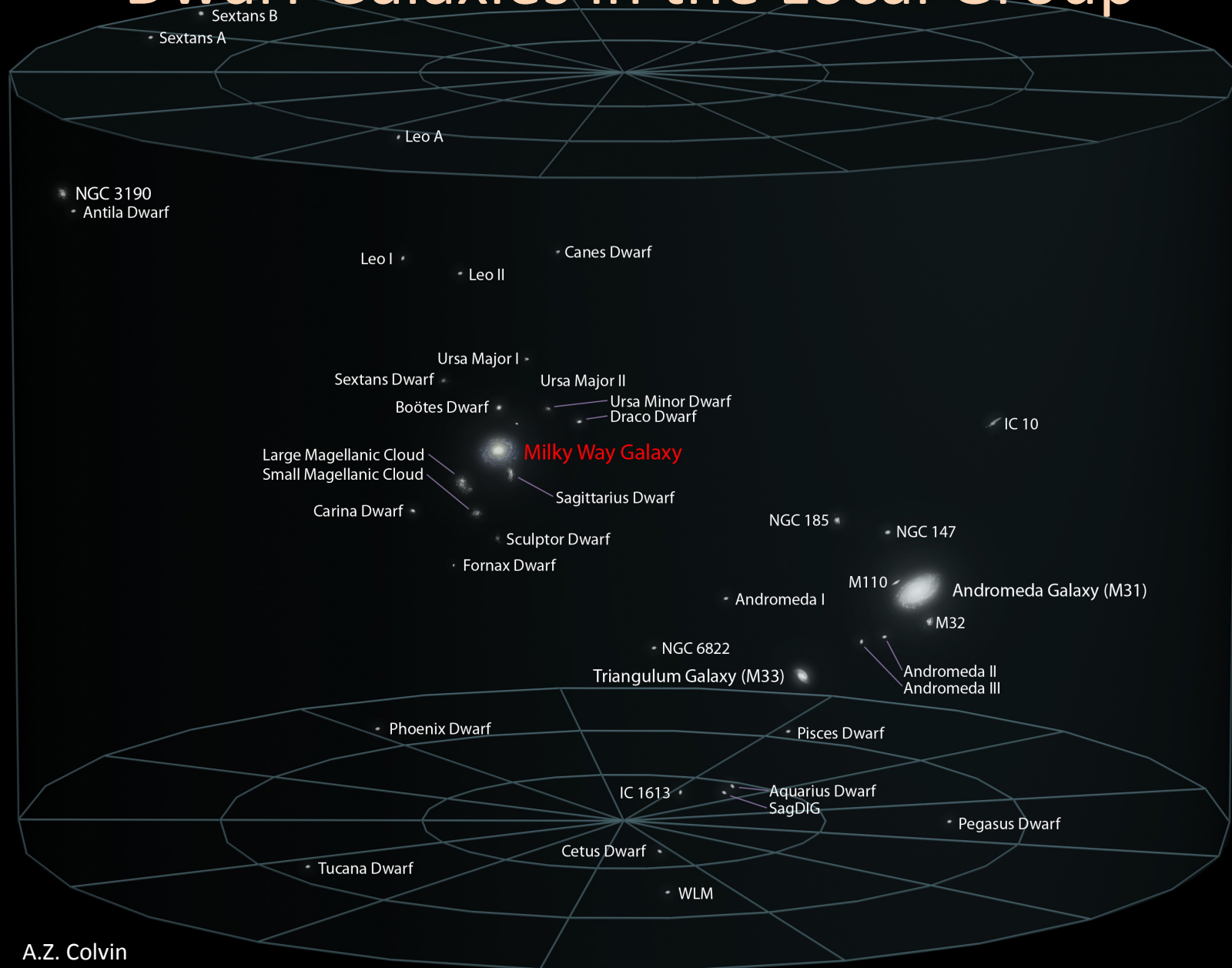
Brian Mason (NRAO), James Aguirre (UPenn), Aravind Natarajan (Pitt), Beth Willman (Haverford)

Kristine Spekkens

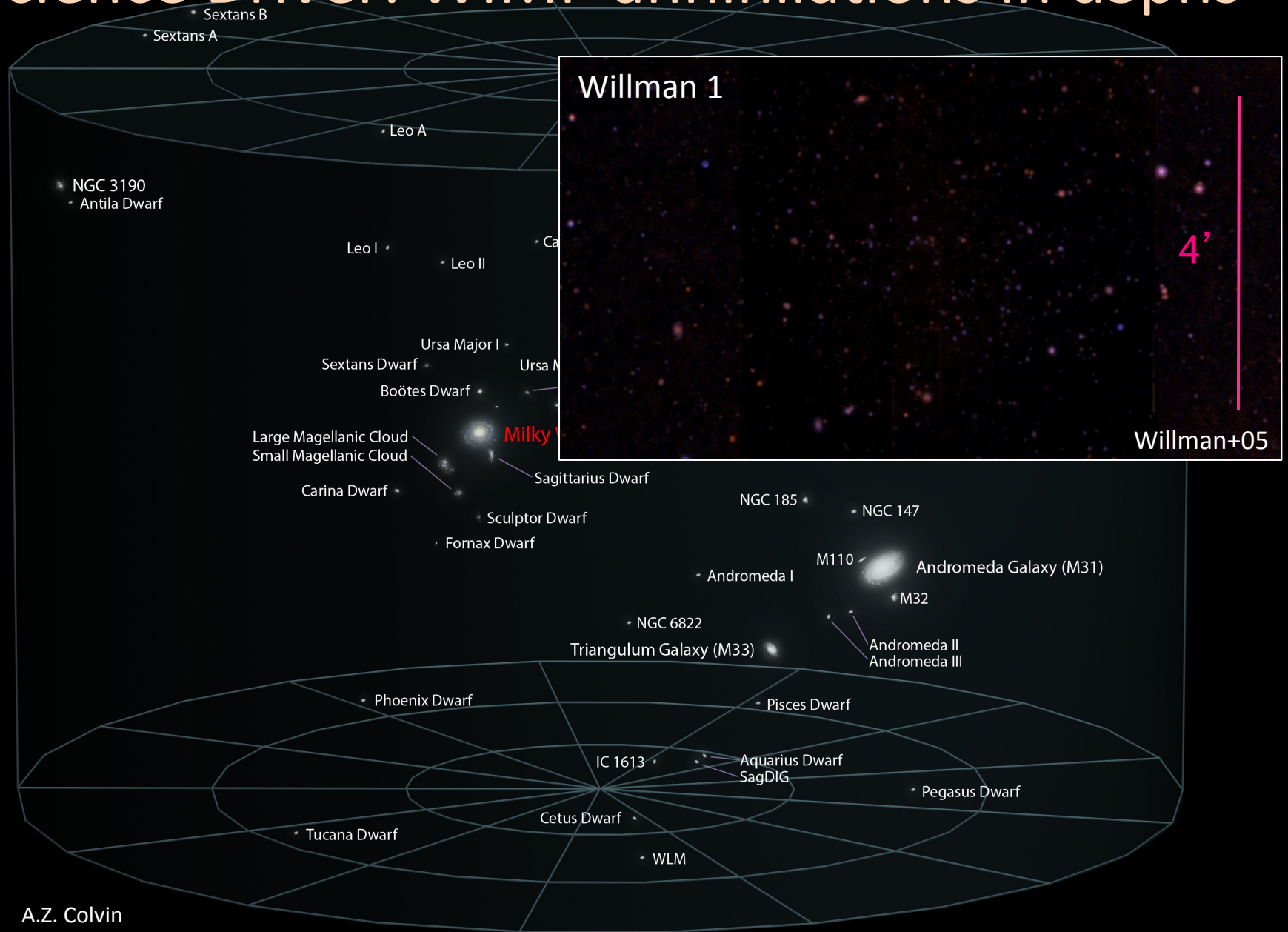
Royal Military College of Canada



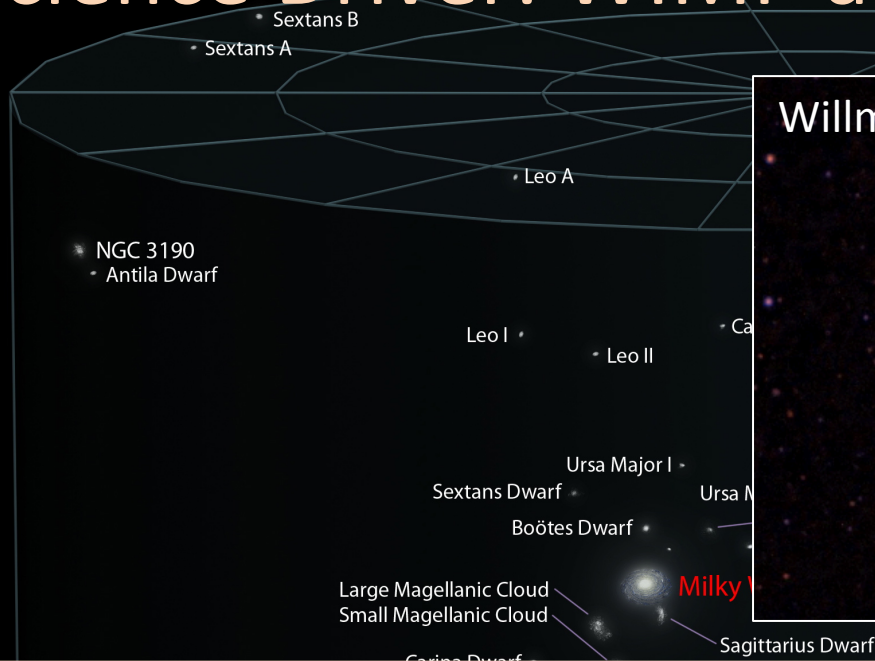
Dwarf Galaxies in the Local Group



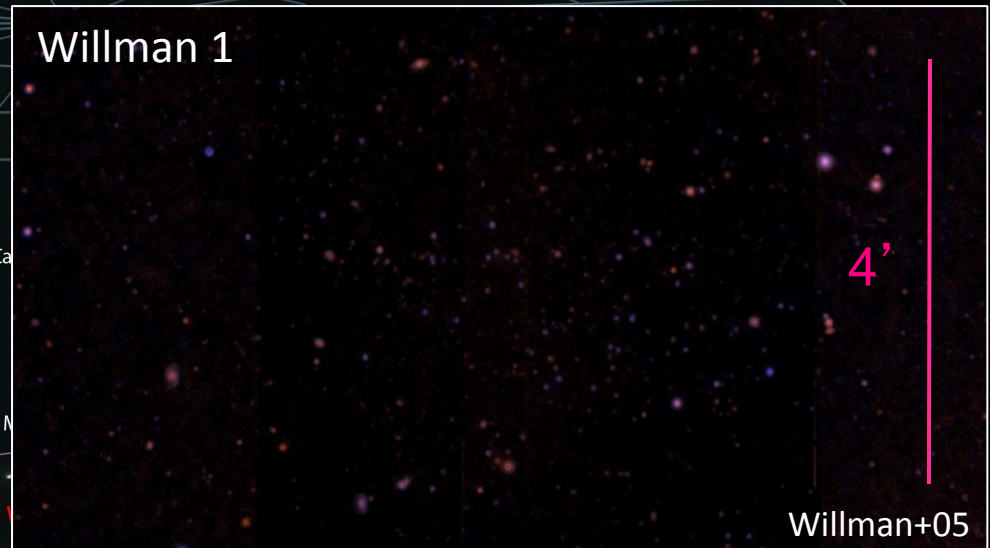
Science Driver: WIMP annihilations in dSphs



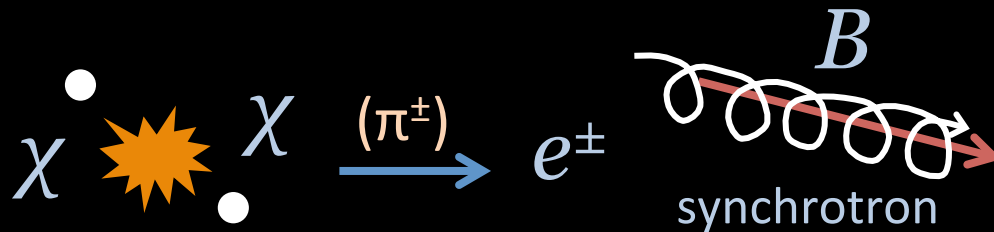
Science Driver: WIMP annihilations in dSphs



Willman 1



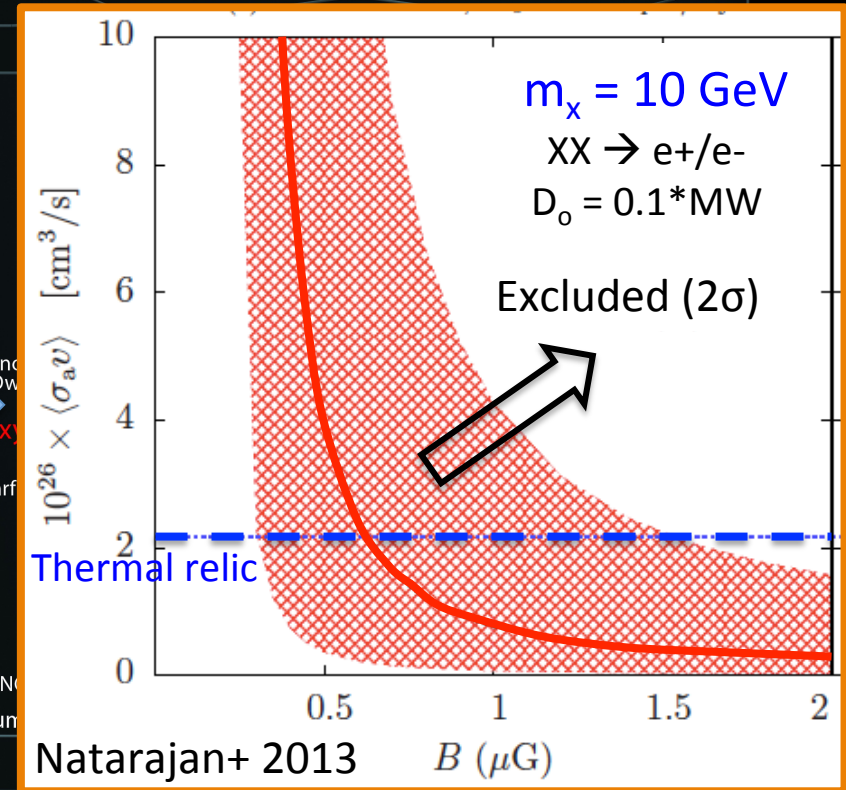
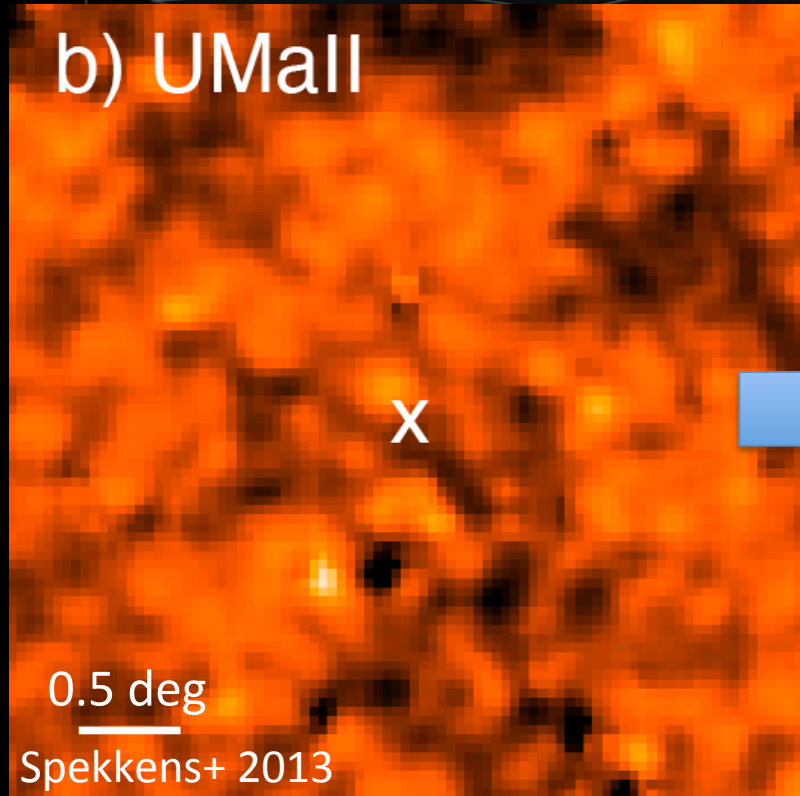
WIMP
models
predict:



Constrain particle dark matter properties with
degree-scale radio continuum maps of nearby dSphs

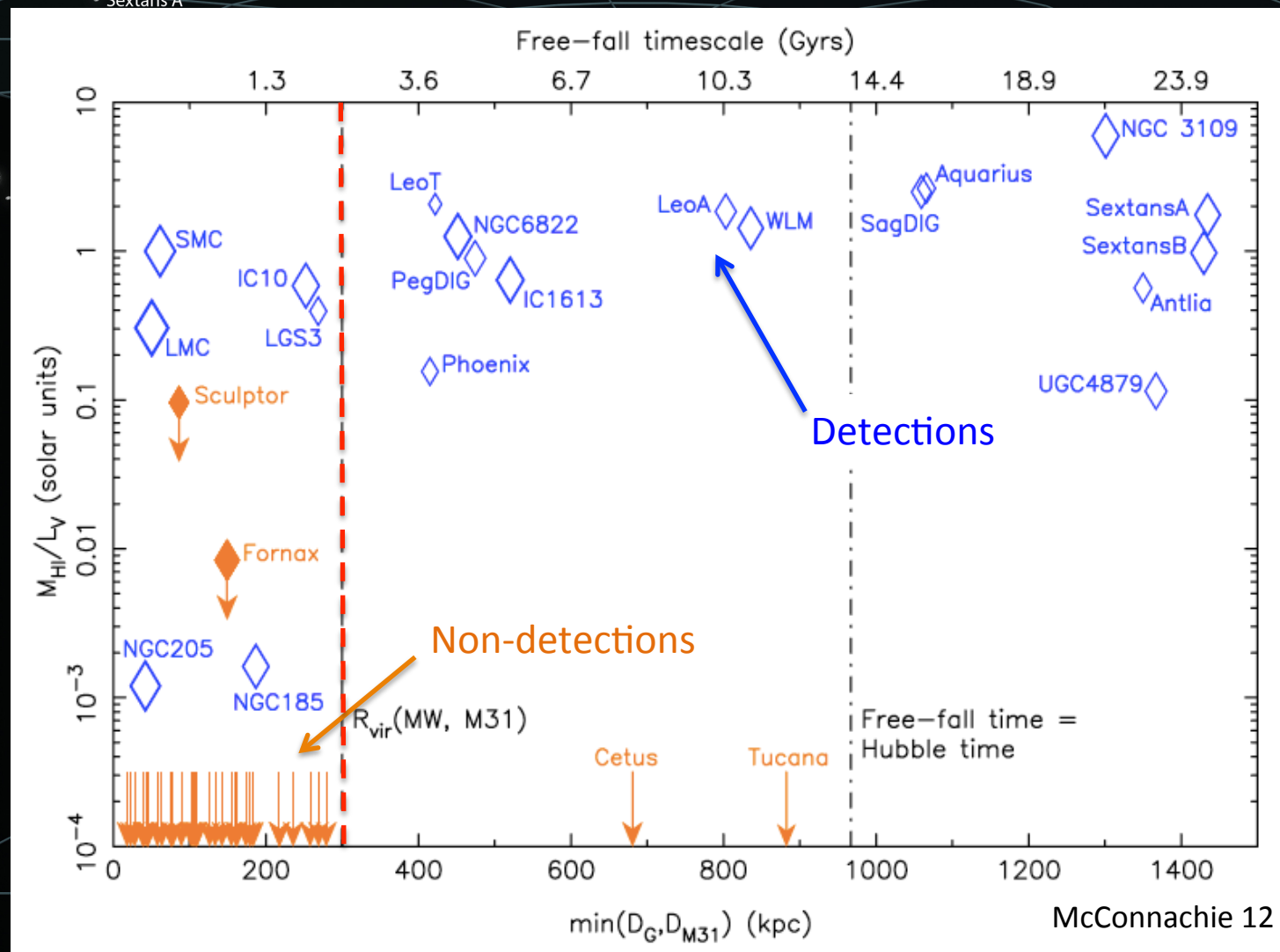
Science Driver: WIMP annihilations in dSphs

GBT data:



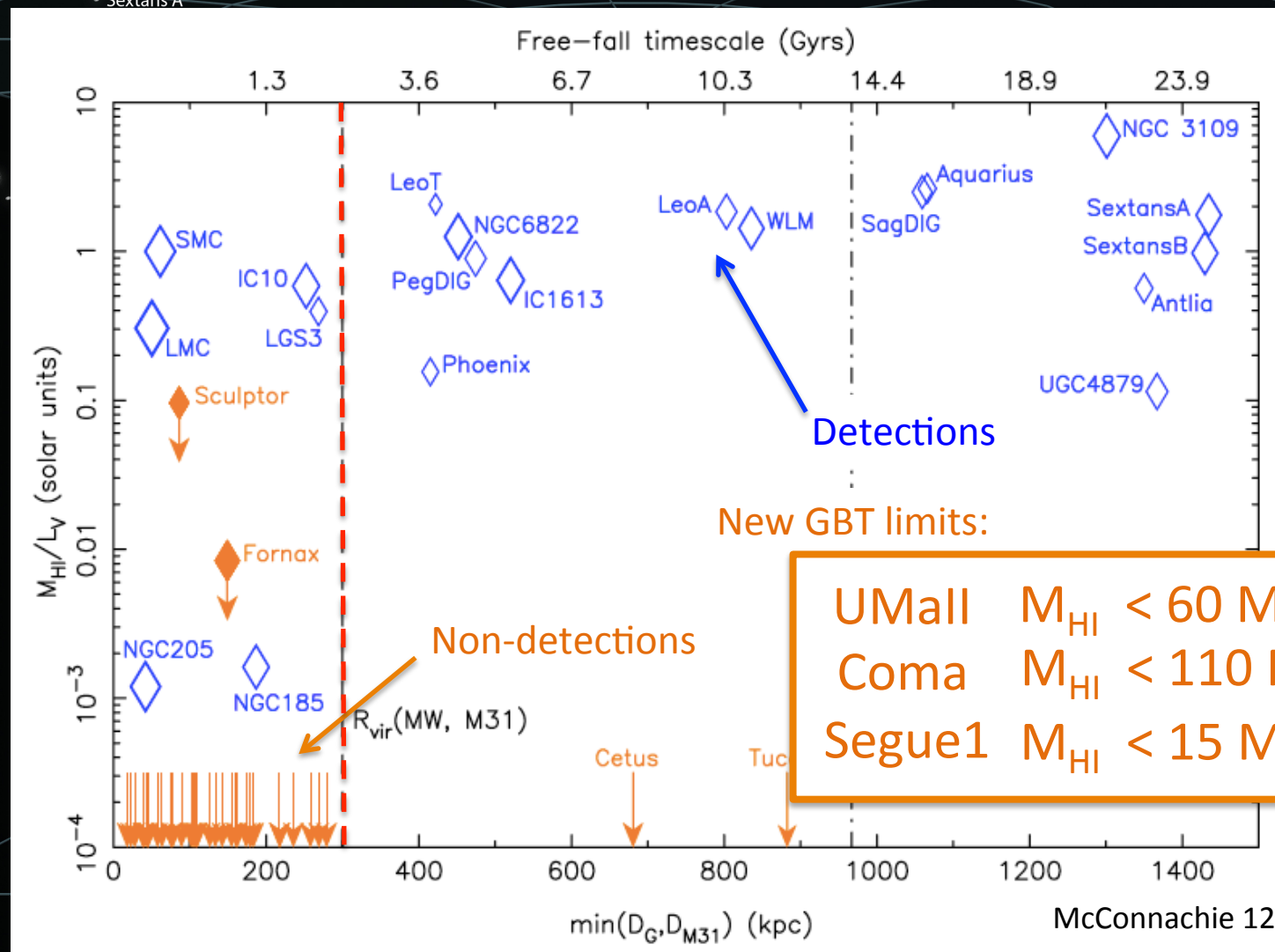
Constrain particle dark matter properties with
degree-scale radio continuum maps of nearby dSphs

Hunting for the ISM in dSphs: HI



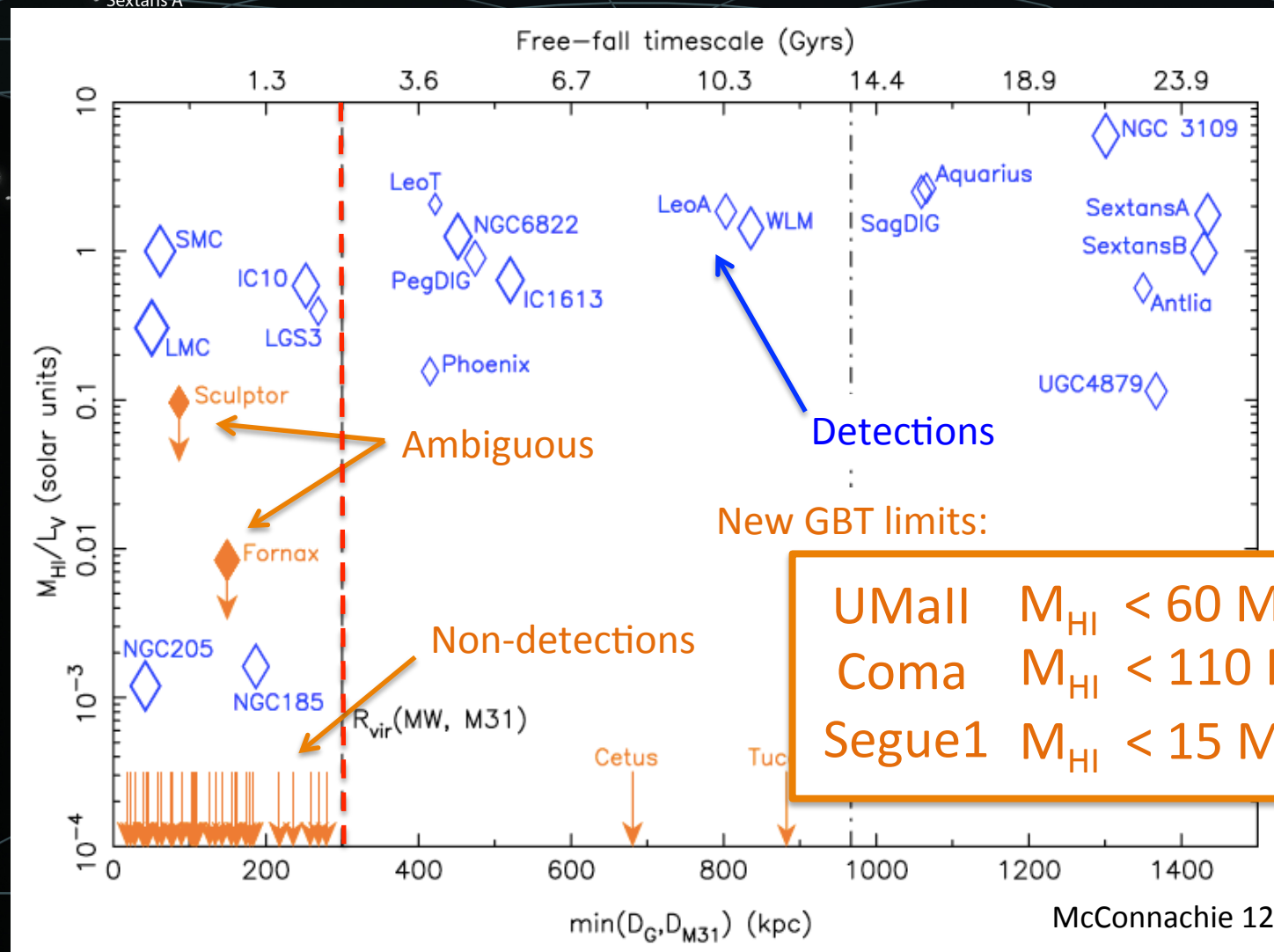
What HI constraints do our ancillary spectra provide?

Hunting for the ISM in dSphs: HI



Ultra-faint dSph HI limits rival those of classical dSphs

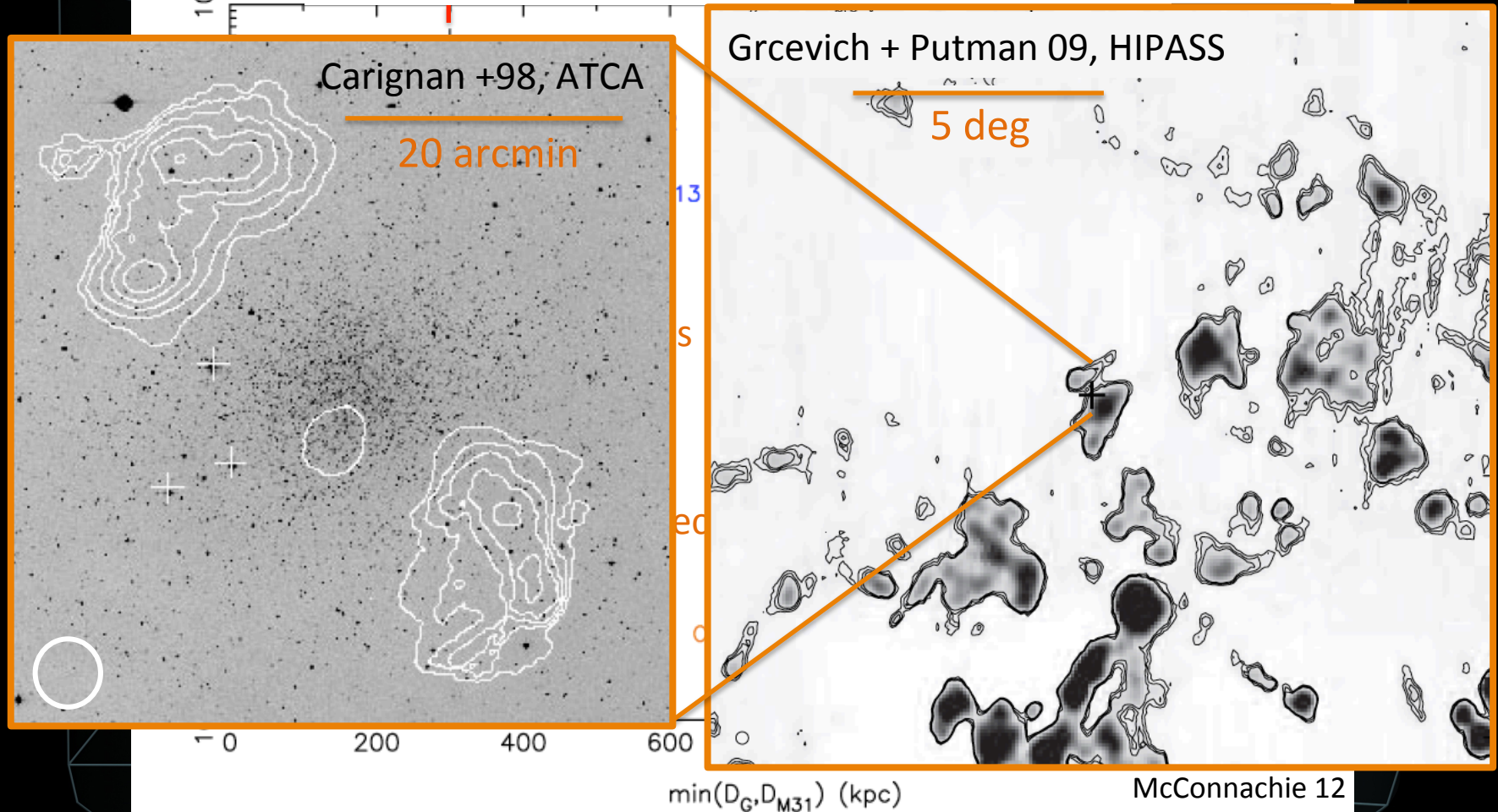
Hunting for the ISM in dSphs: HI



Ultra-faint dSph HI limits rival those of classical dSphs

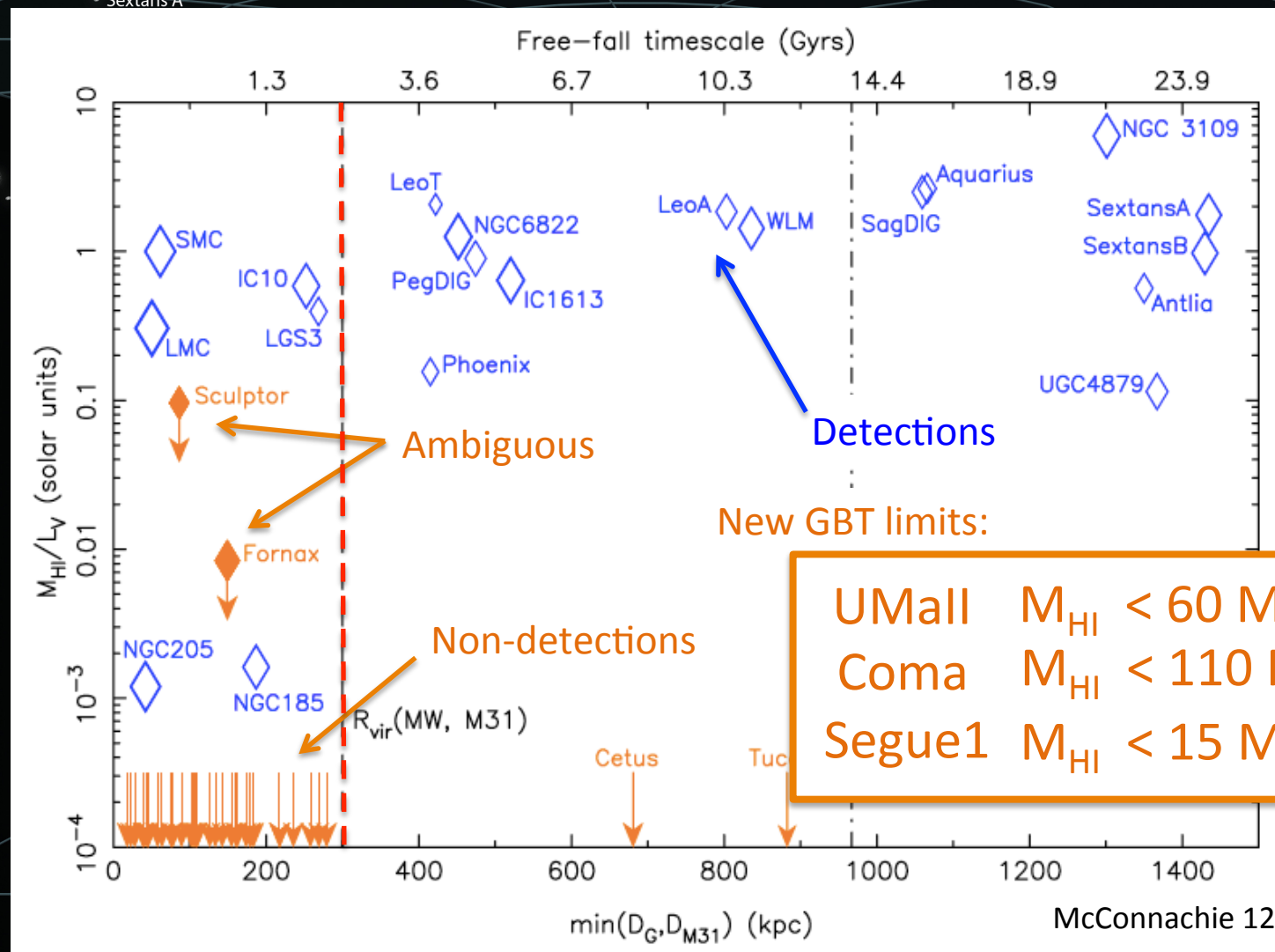
Hunting for the ISM in dSphs: HI

Ambiguous detection: Sculptor



Ultra-faint dSph HI limits rival those of classical dSphs

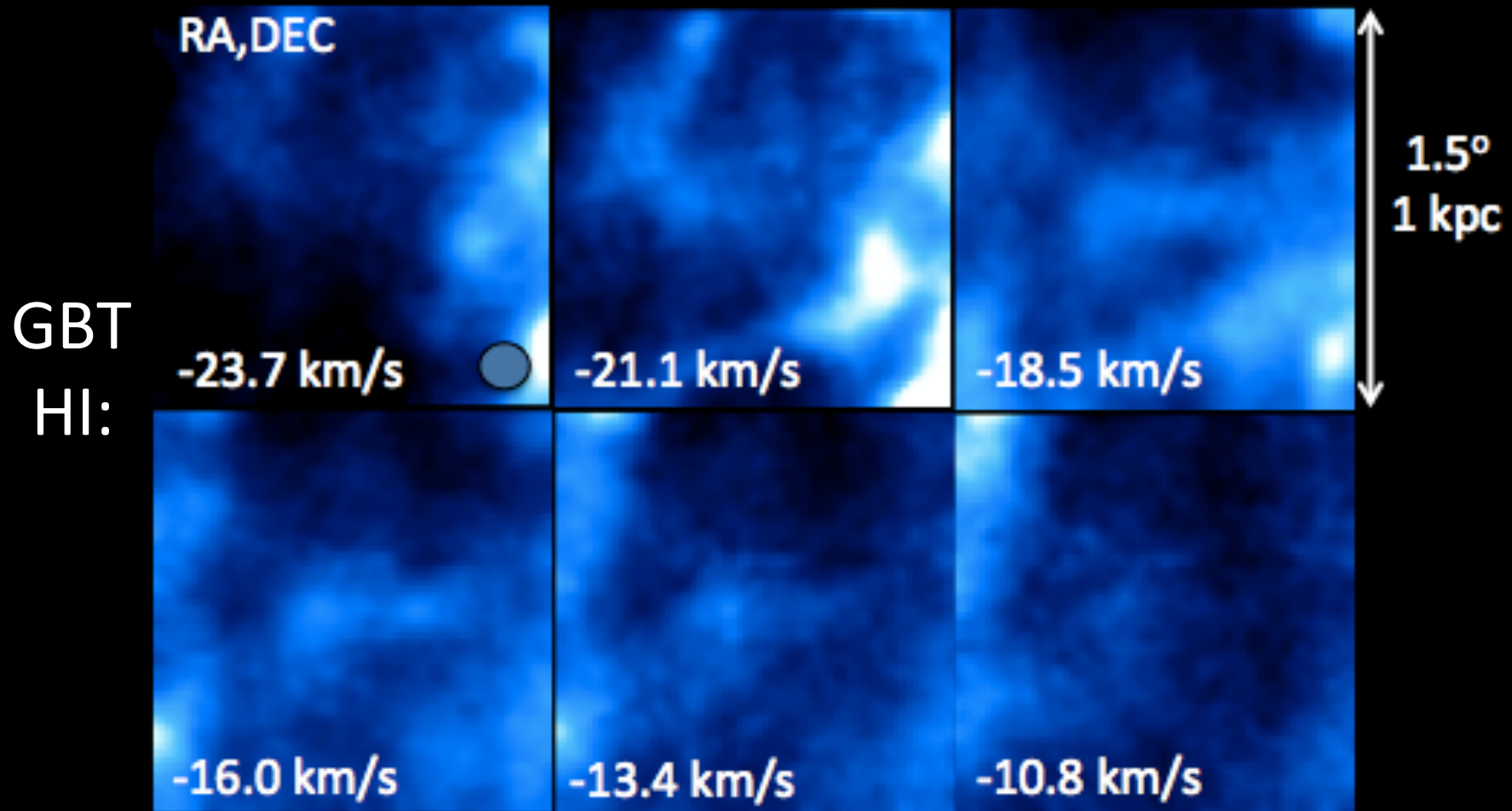
Hunting for the ISM in dSphs: HI



Ultra-faint dSph HI limits rival those of classical dSphs

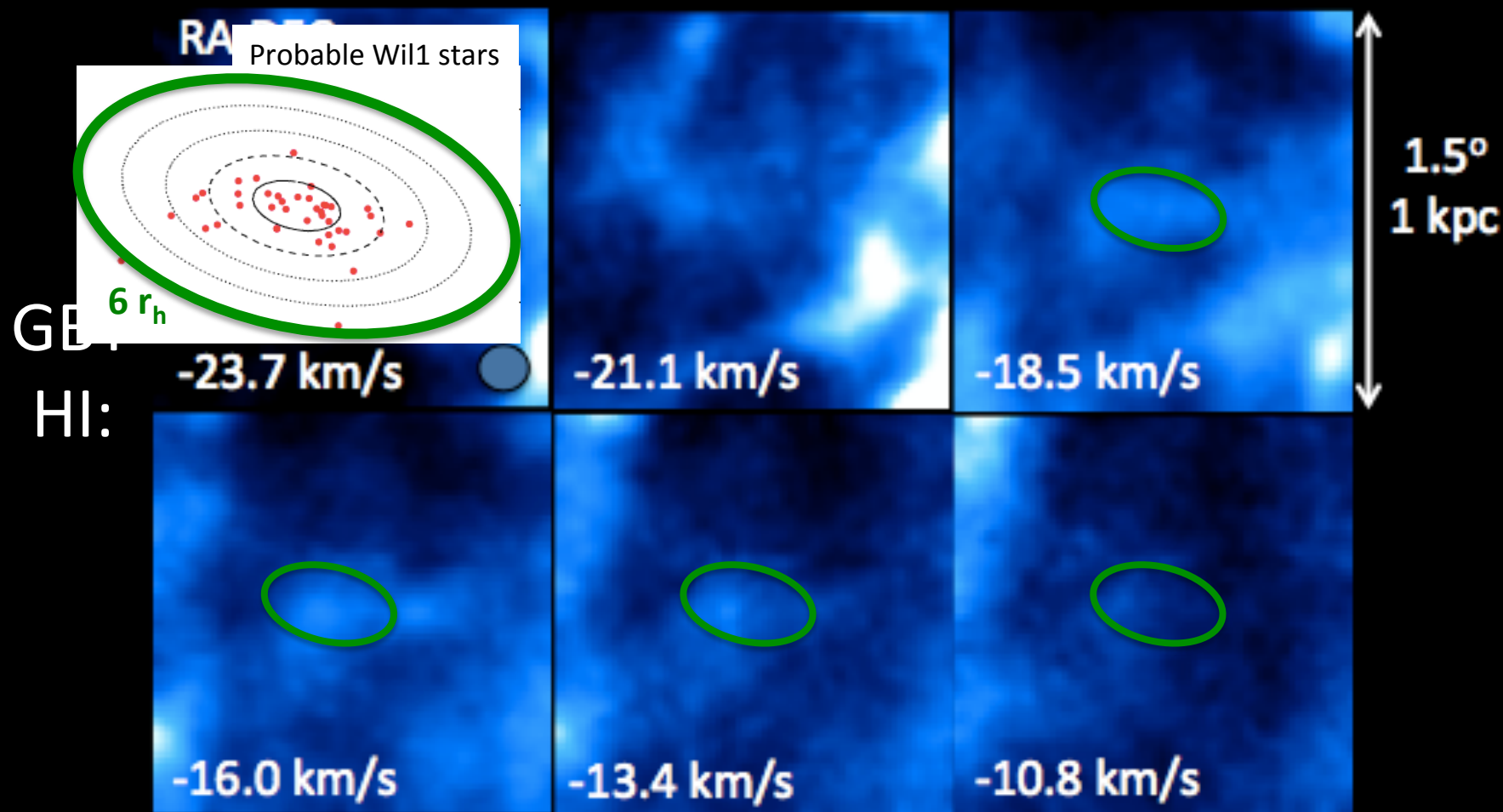
An HI Counterpart to Willman 1?

Will1 stars: $D=38$ kpc, $V = -14.1$ km/s, $\sigma = 4.0$ km/s (Willman+ 11)



An HI Counterpart to Willman 1?

Will1 stars: $D=38$ kpc, $V = -14.1$ km/s, $\sigma = 4.0$ km/s (Willman+ 11)

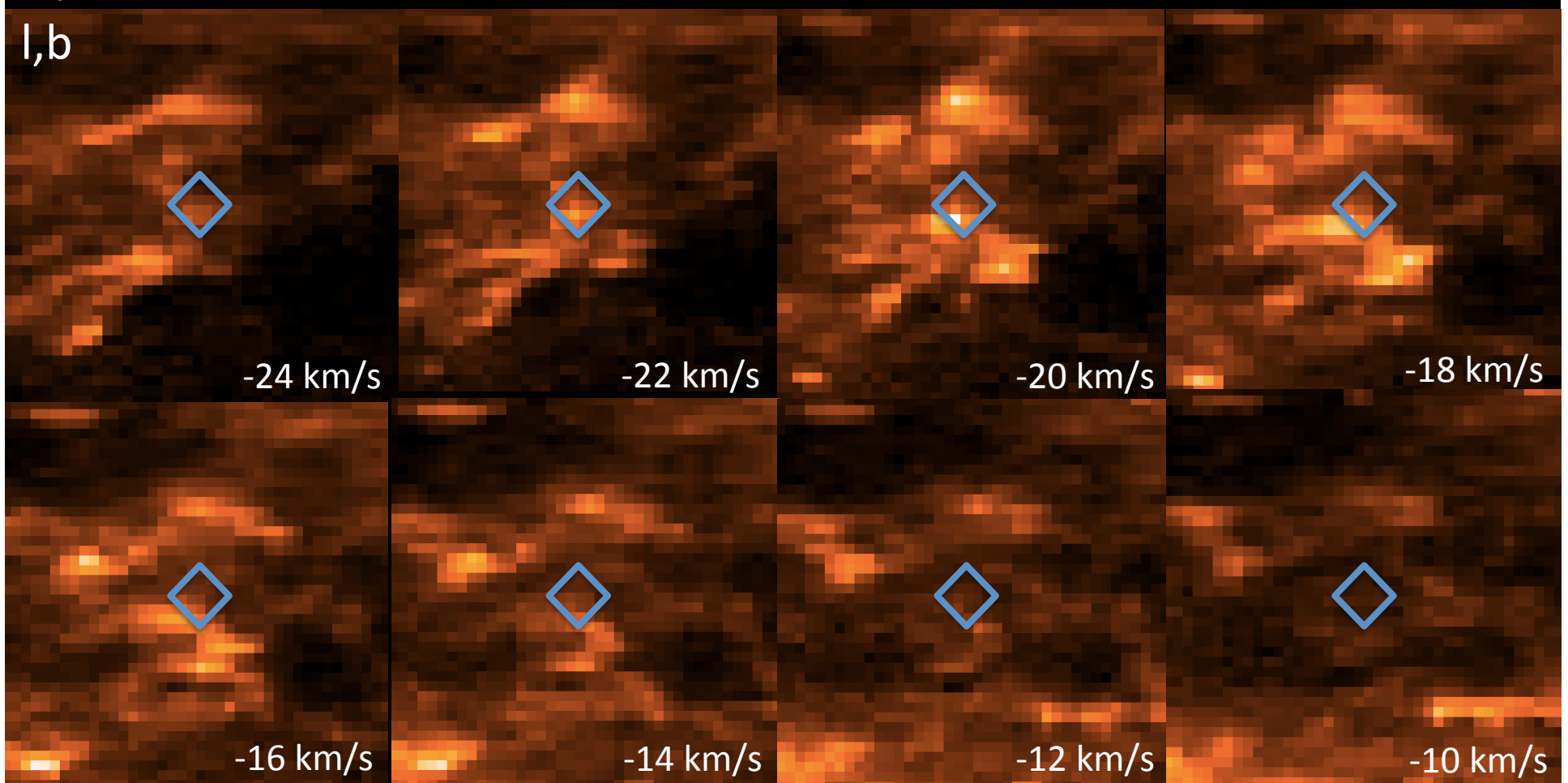


HI matches stars in 5D: RA, dec, PA, V_{sys} , σ ...

Widefield HI view near Willman1: LAB

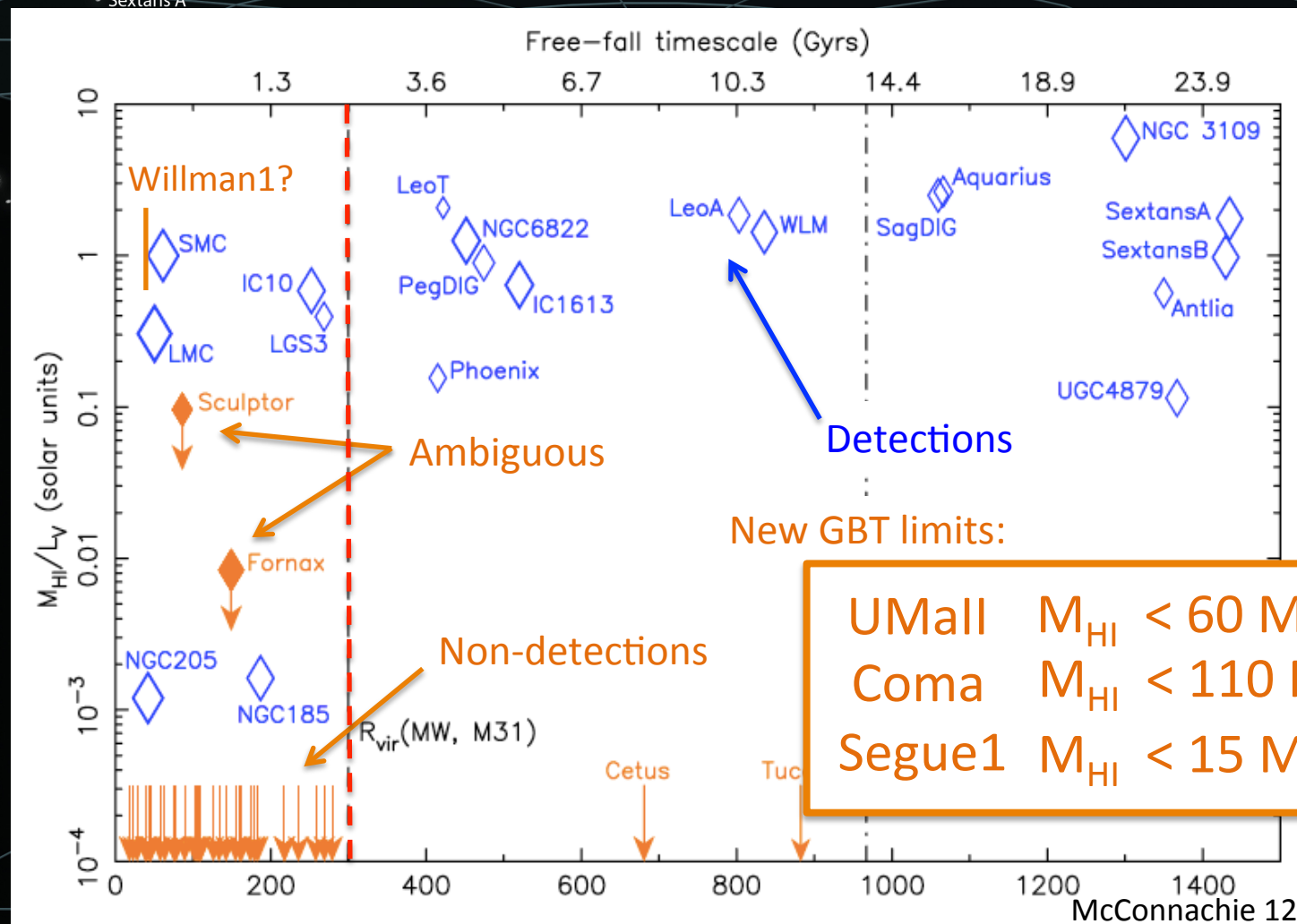
◇ = GBT map

$10^\circ = 7 \text{ kpc}$



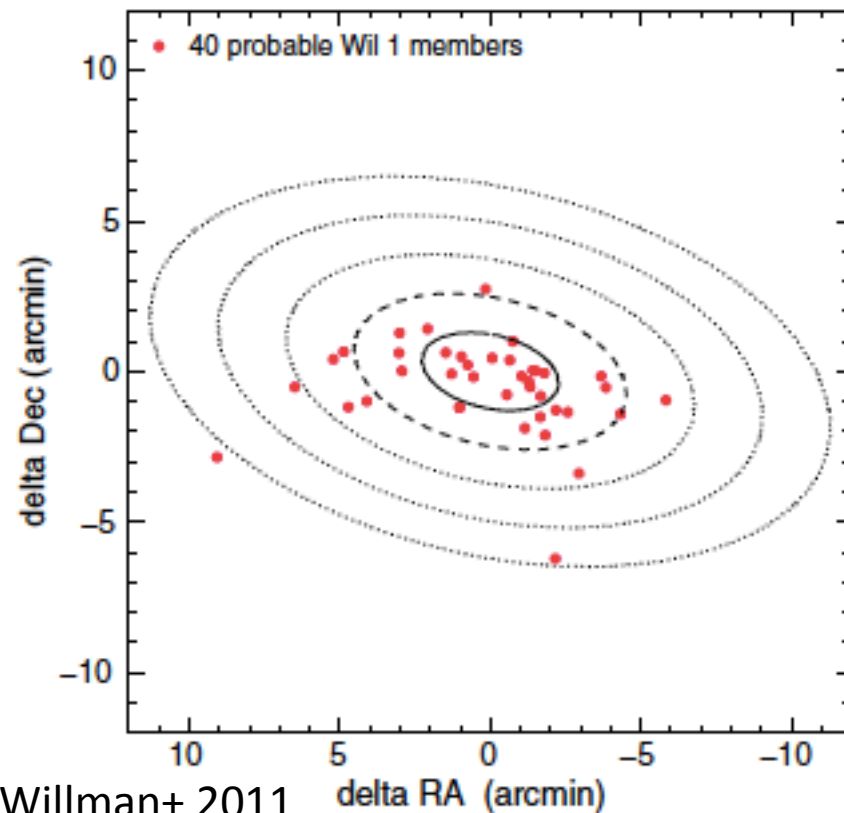
... but is clearly part of a larger Galactic structure

Hunting for the ISM in dSphs: HI

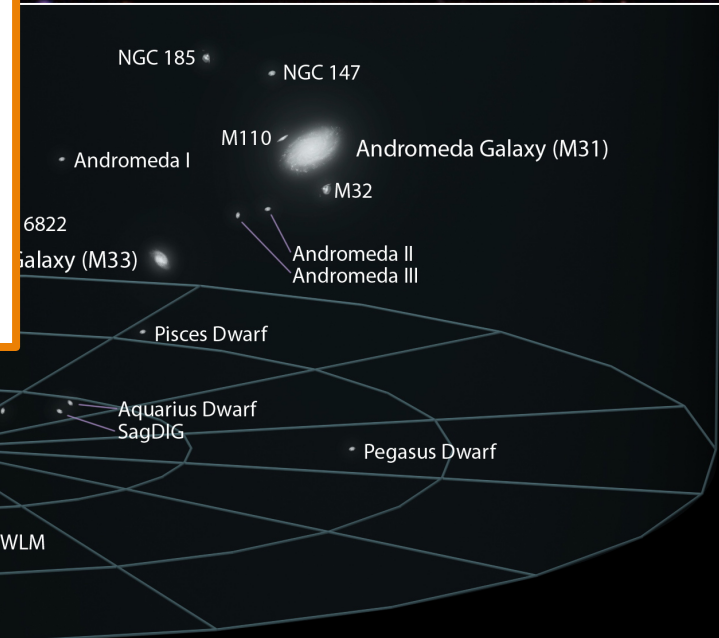


Ultra-faint dSph HI limits rival those of classical dSphs

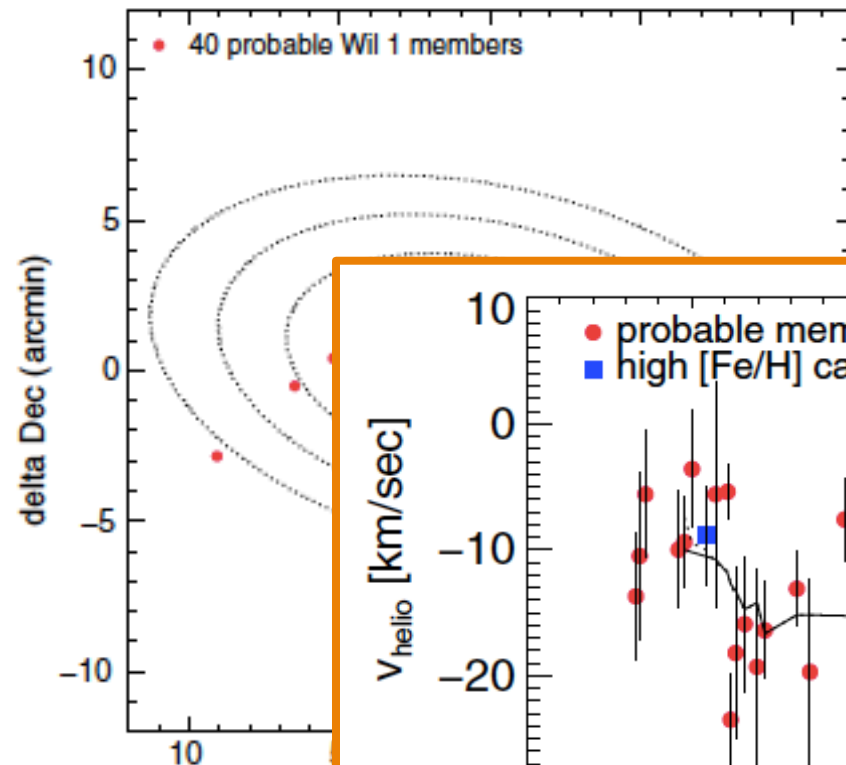
Willman 1: a dSph Unlike Others



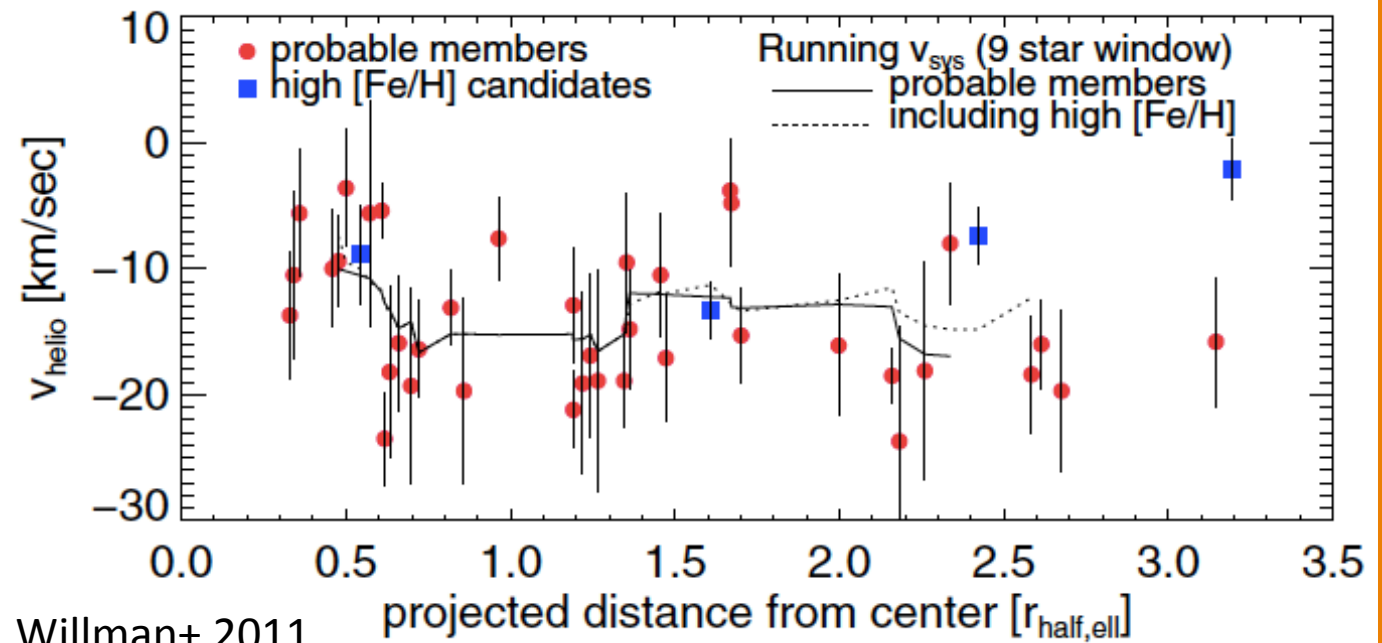
an 1



Willman 1: a dSph Unlike Others



Willman+ 2011

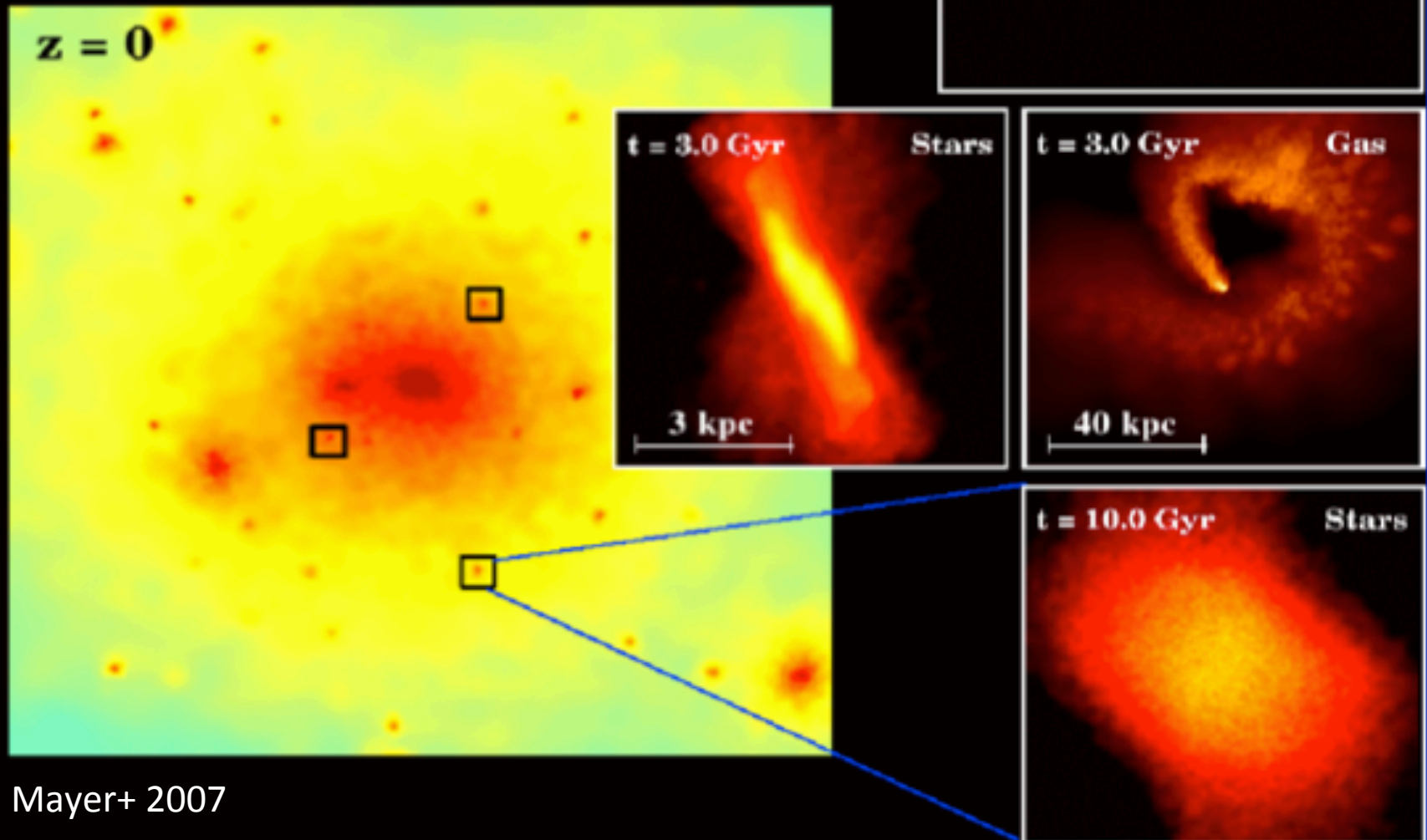


Willman+ 2011

Willman1 stars suggest the system is being disrupted

If HI is Associated with Willman 1...

Turning dlrrs into dSphs:

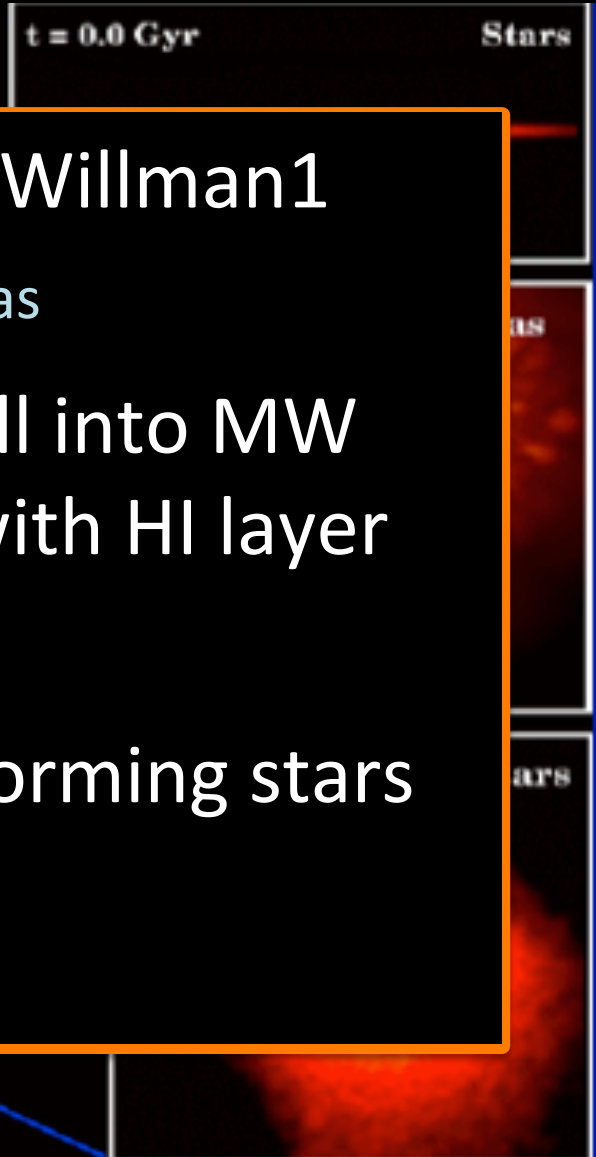


Mayer+ 2007

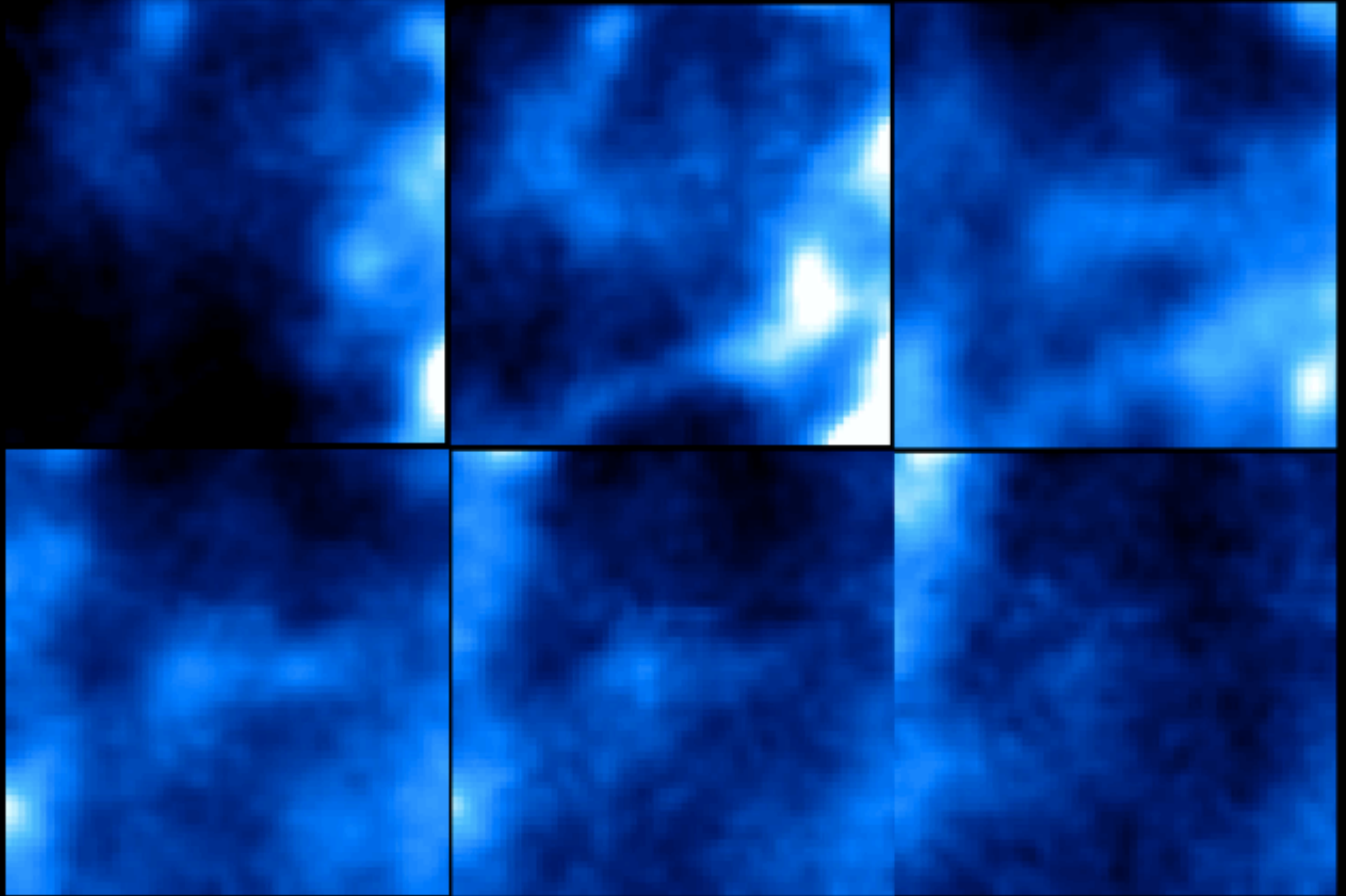
If HI is Associated with Willman 1...

Turning dIrrs into dSphs:

- Associated HI originated in Willman1
 - ↪ Sag dwarf hasn't swept up MW gas
- Willman 1 is on its first infall into MW potential, and interacting with HI layer
 - ↪ Otherwise HI wouldn't survive
- Willman 1 wasn't actively forming stars before infall
 - ↪ Old stellar population



An HI Counterpart to Willman 1?



An HI Counterpart to Willman 1?

✓ 5D match between
stars and HI

X One of many HI
clouds in the region

If HI is associated with Will1, are we
witnessing dlrr - dSph transformation and
cold gas accretion onto the Milky Way?

Further insight: high-resolution HI,
dust-to-gas ratios, proper motions...

... stay tuned!