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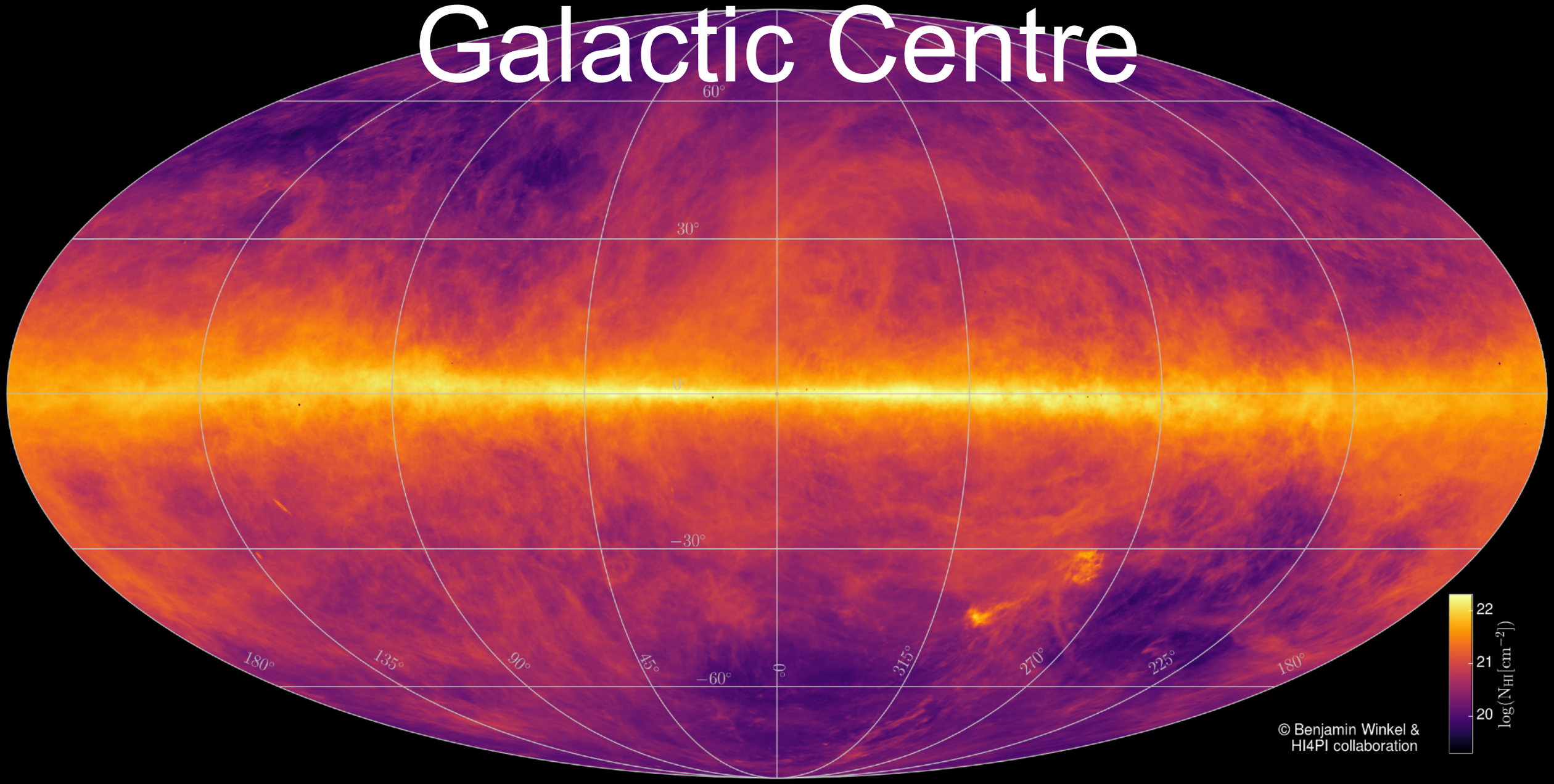
HI in the Direction of the Galactic Centre



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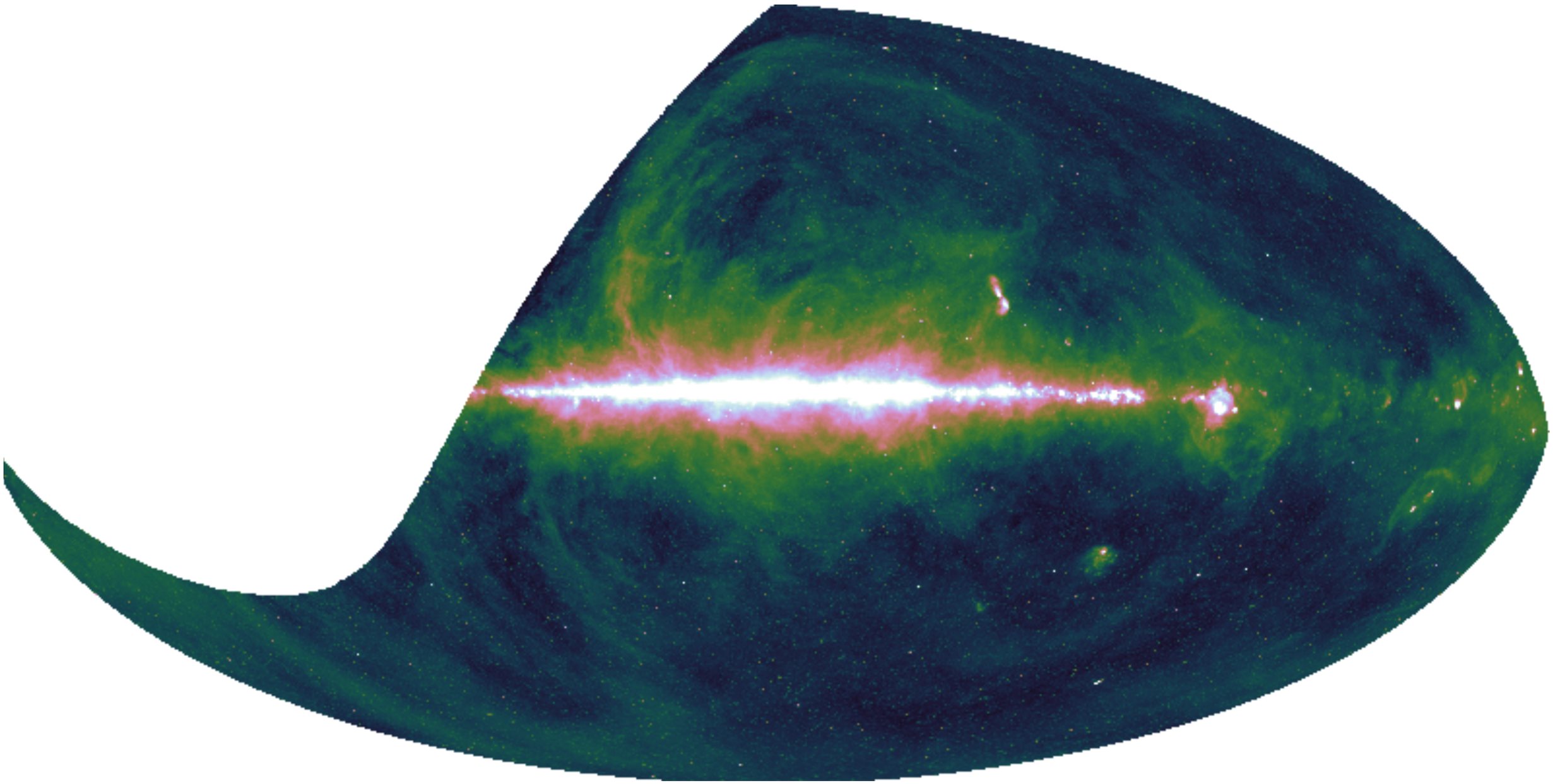
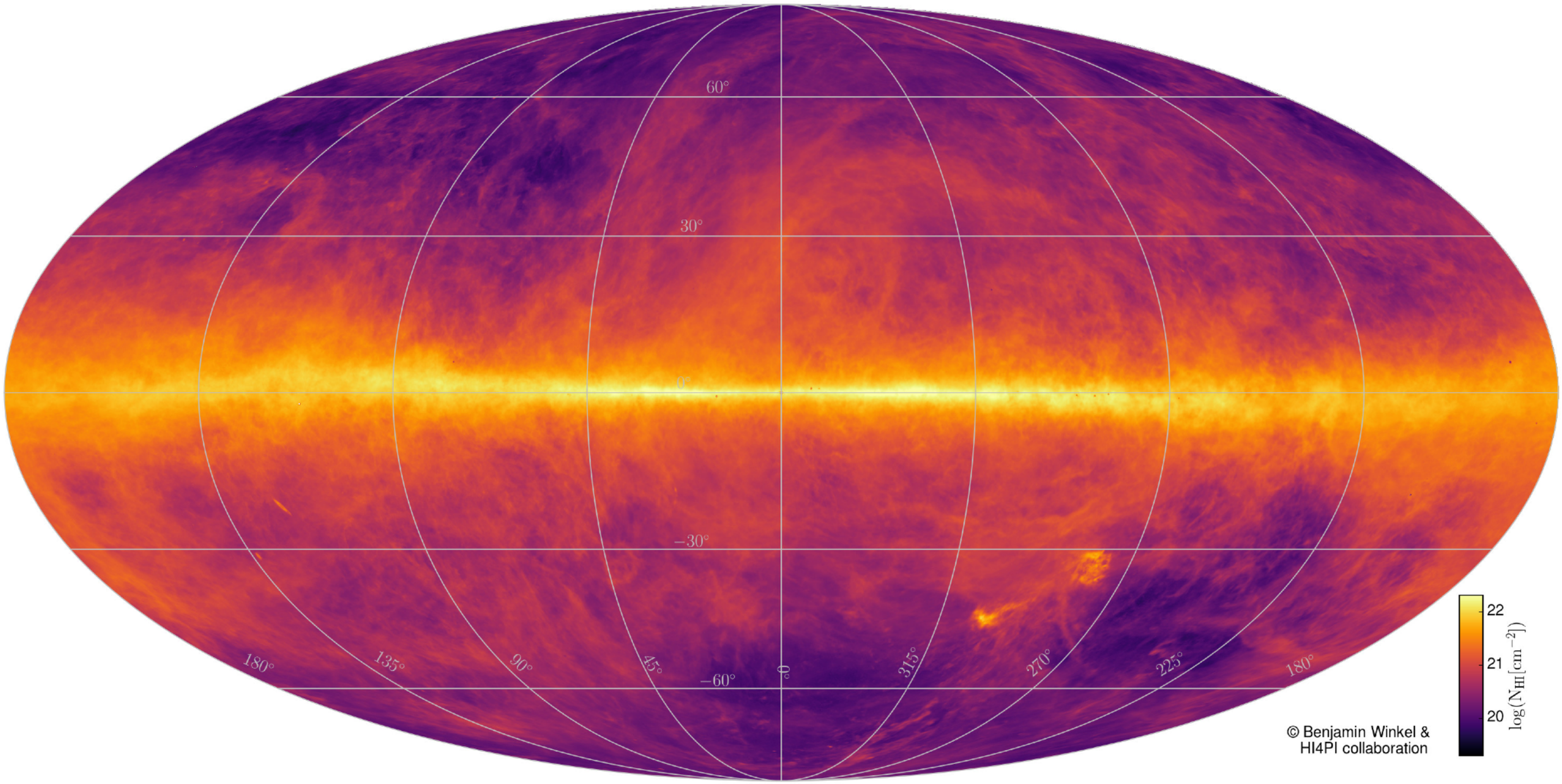
CHIPASS 1.4 GHz Radio Continuum
Calabretta et al 2012

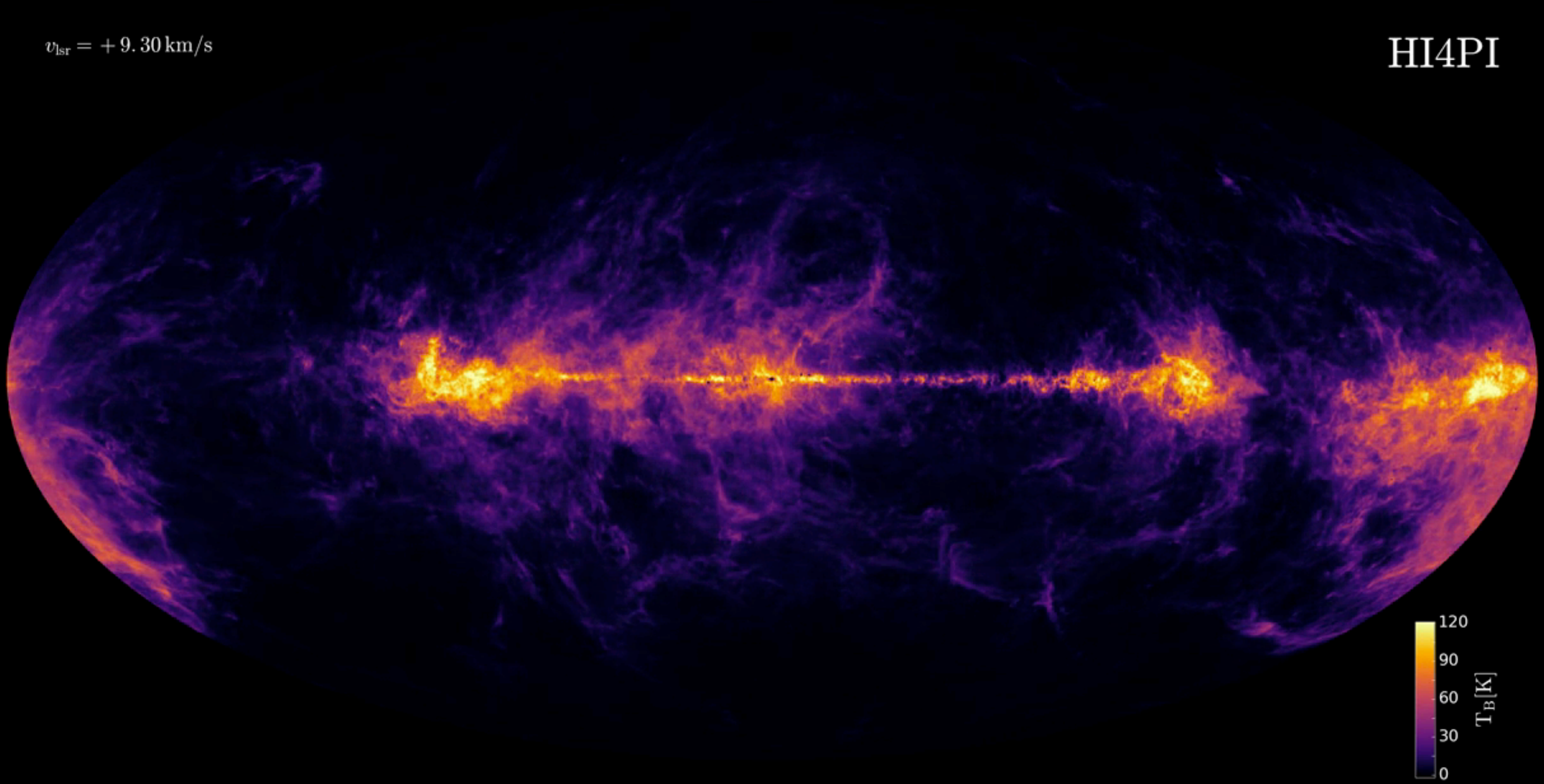


HI4PI total HI column
Ben Bekhti, … NMcG,… et al 2016



$v_{\rm lsr} = +9.30\,{\rm km/s}$

HI4PI



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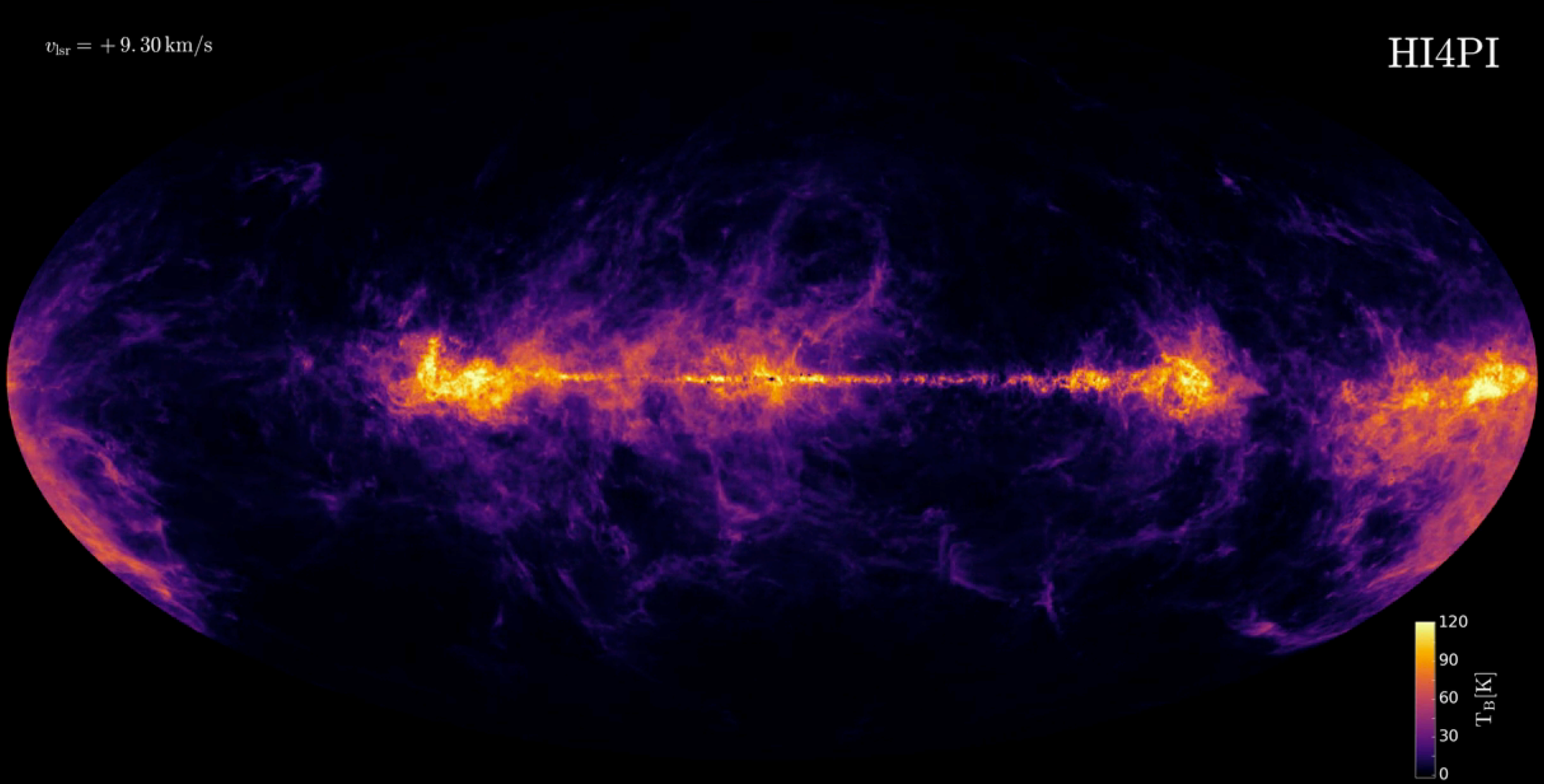
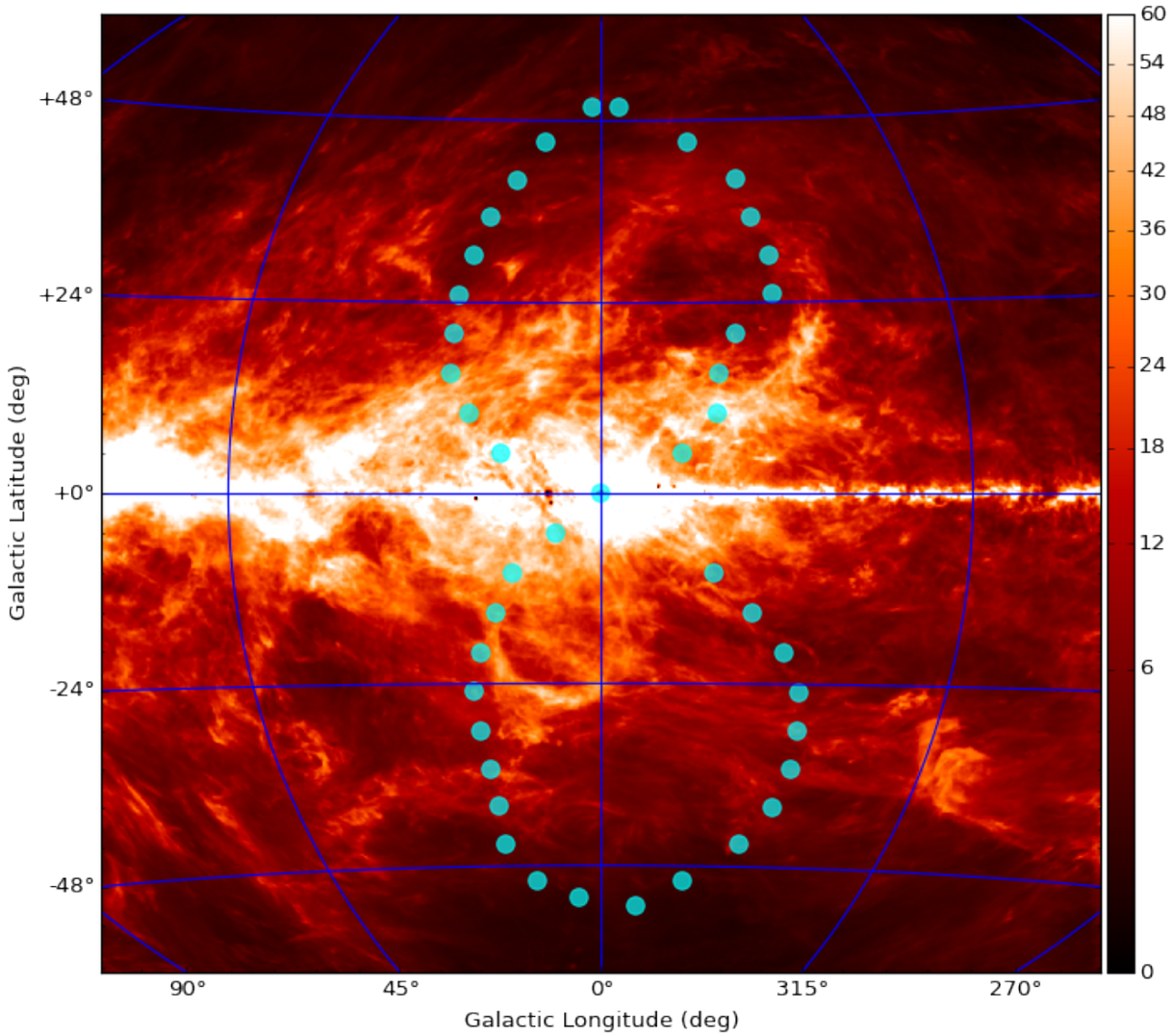
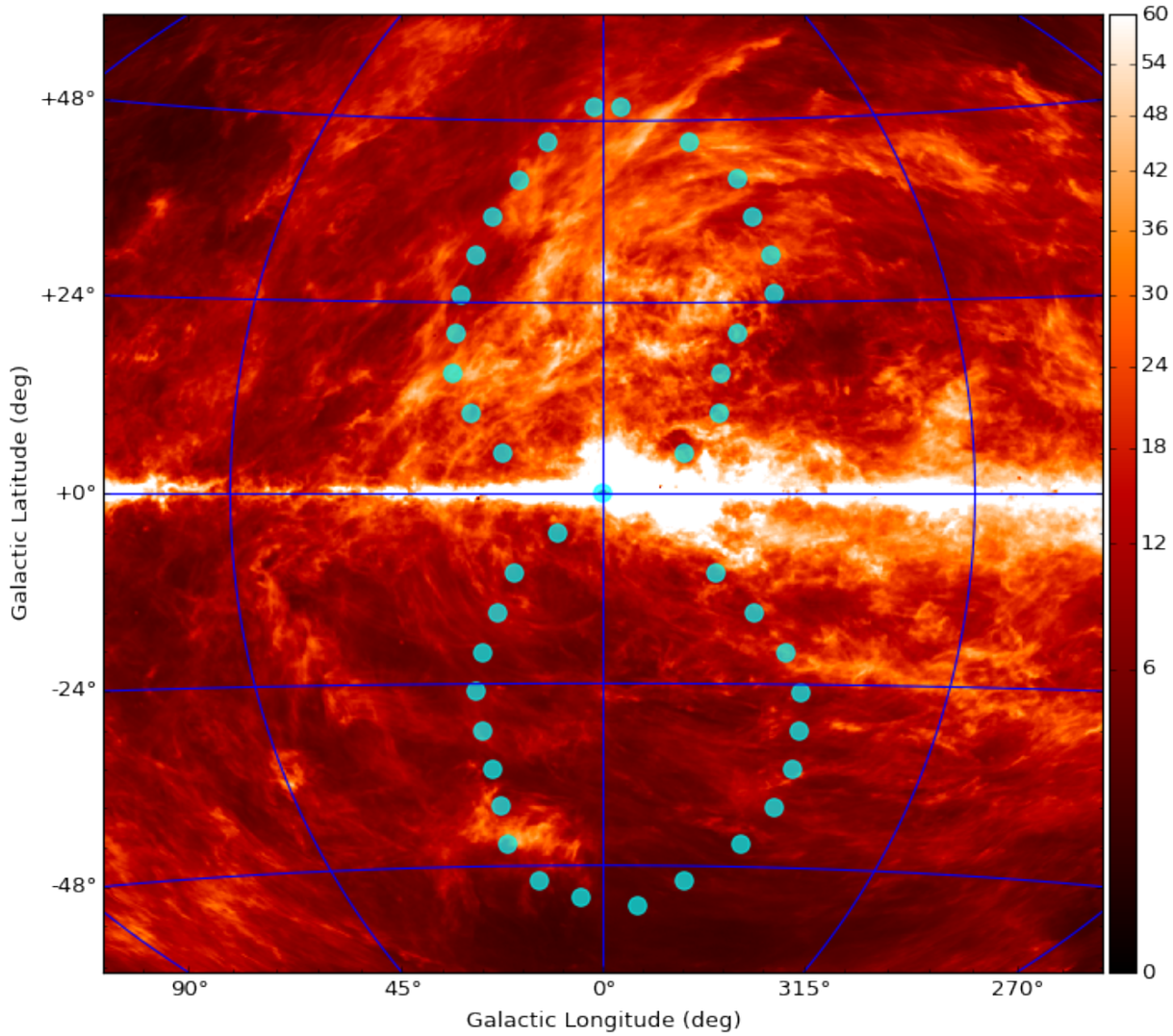


Some local confusion…

v=7 km/s



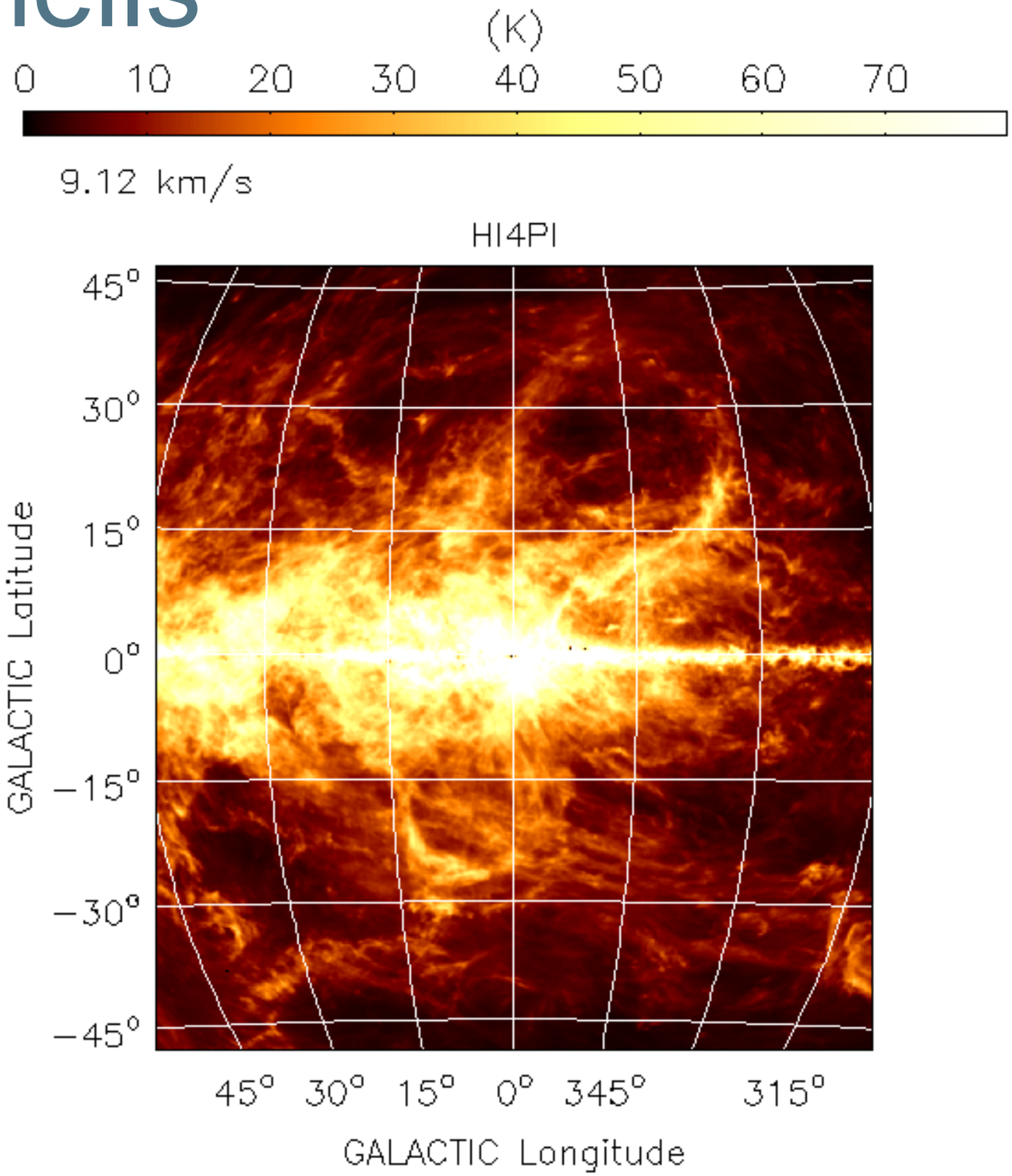
v=-2 km/s



HI4PI data (Ben Behkti,…NMcG et al 2016))

‘Local’ Gas HI Shells

- Upper Sco shell at l=-10, b=+21 (Cappa de Nicolau & Poppel 1980; de Geus 1992)
- Expansion velocity
- Stellar distance 145 pc (de Zeeuw et al 1999)
- Contains X-ray emission (McCammon 1983)
- Polarized radio continuum (Wolleben et al 2010)



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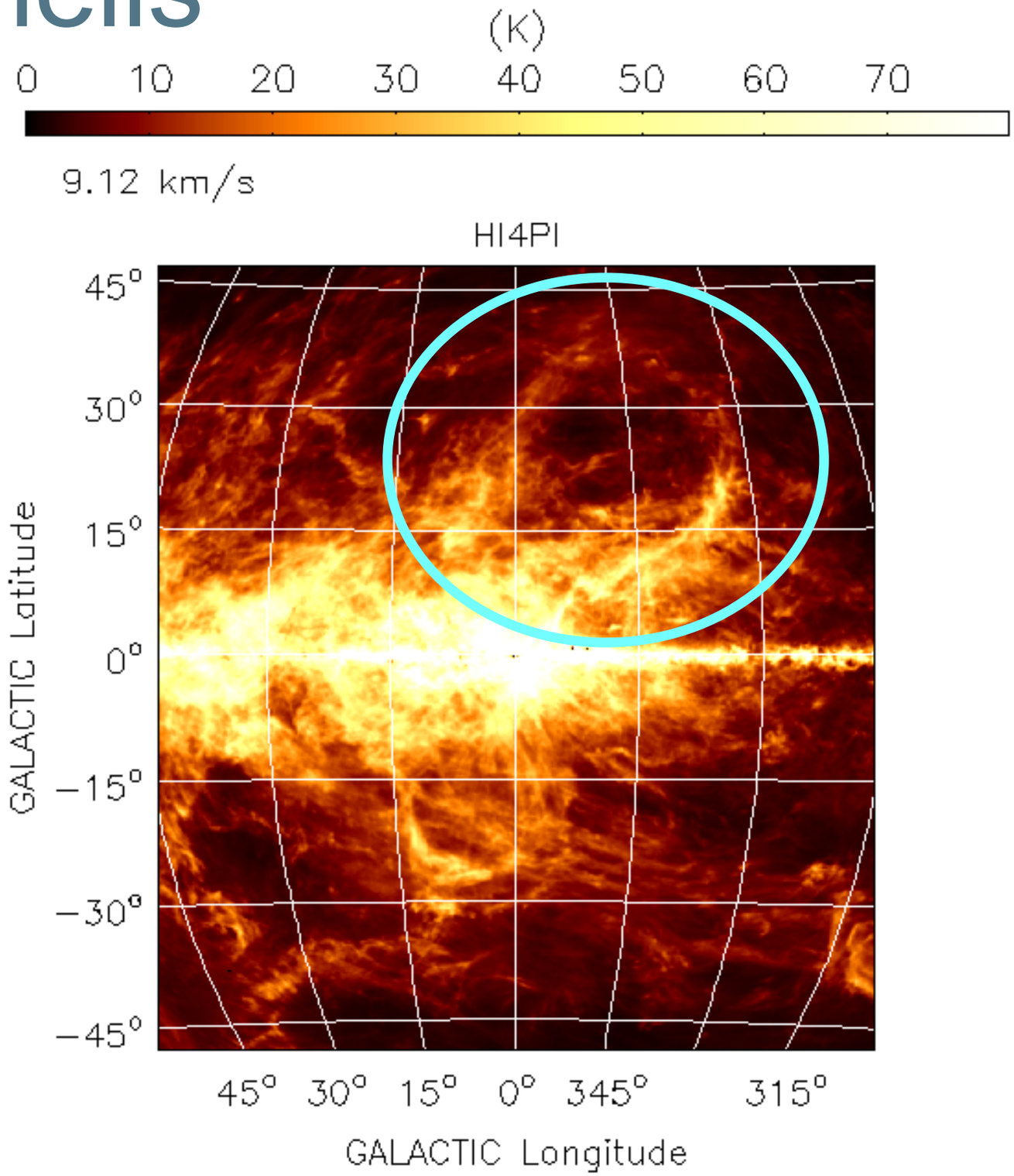
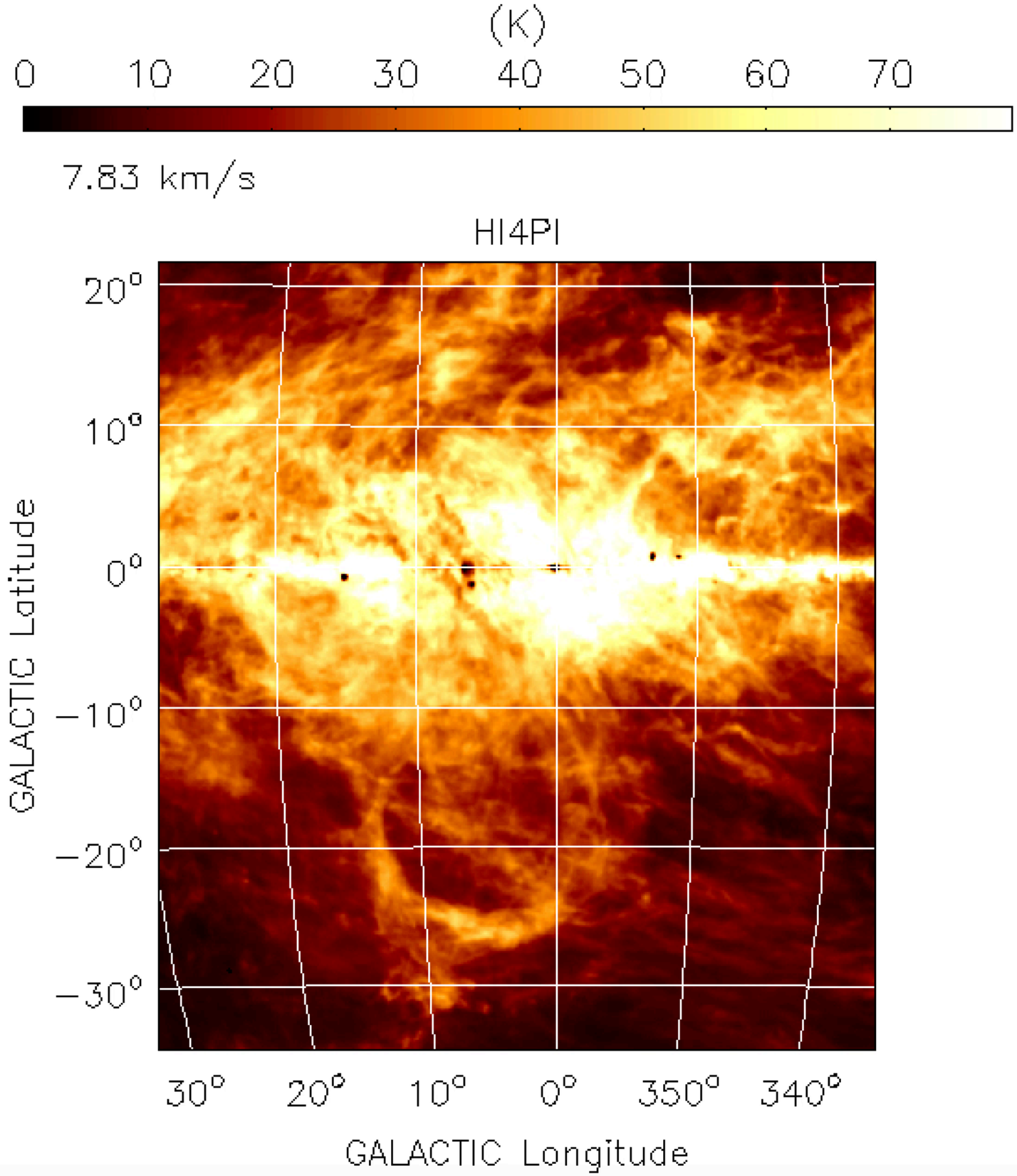


GSH 006-15+7

- Expanding HI shell (Moss, McG et al 2012)
- kinematic distance ~1.2 kpc plus circumstantial evidence:
  - HI self-absorption
  - star formation
  - size



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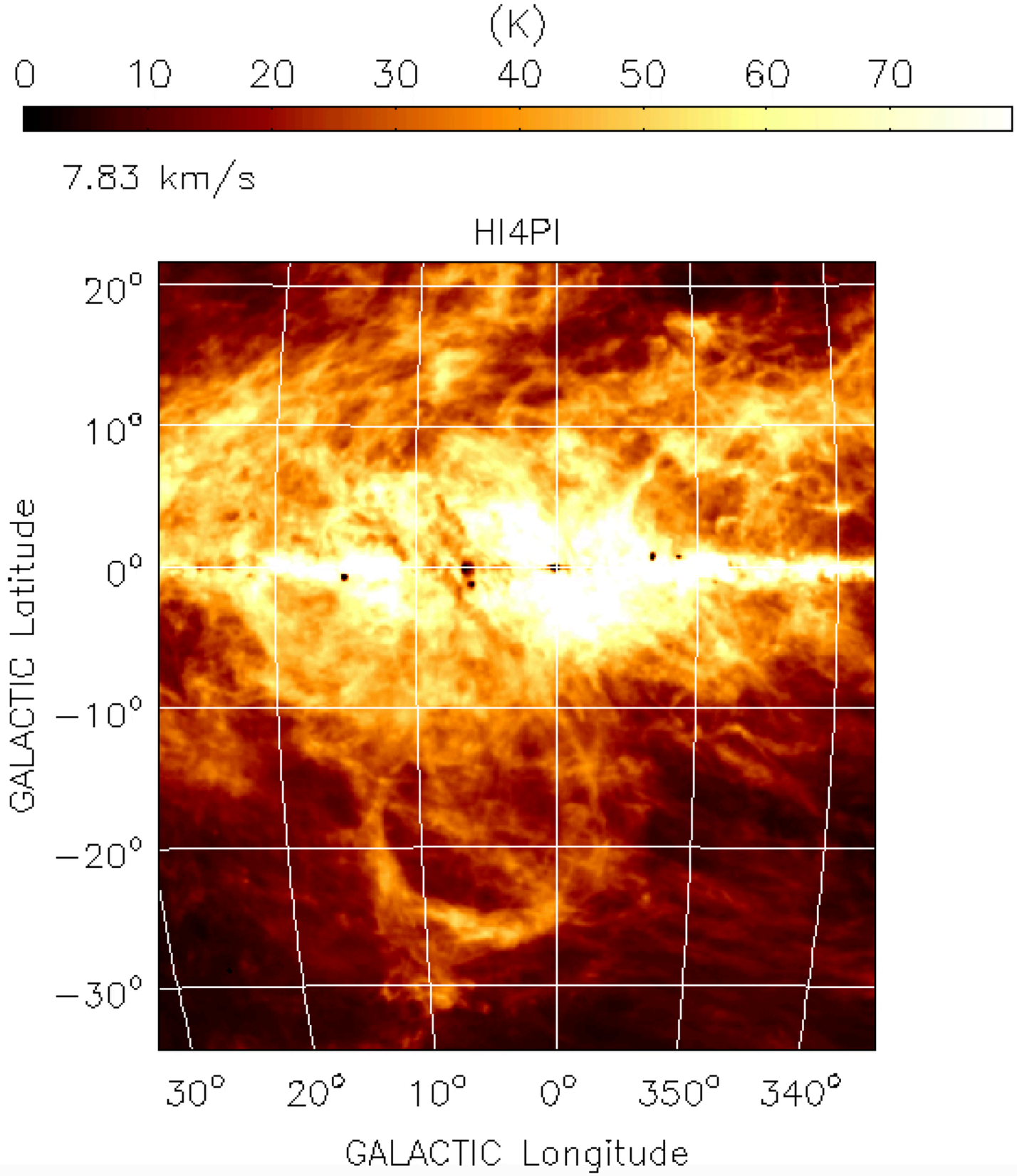

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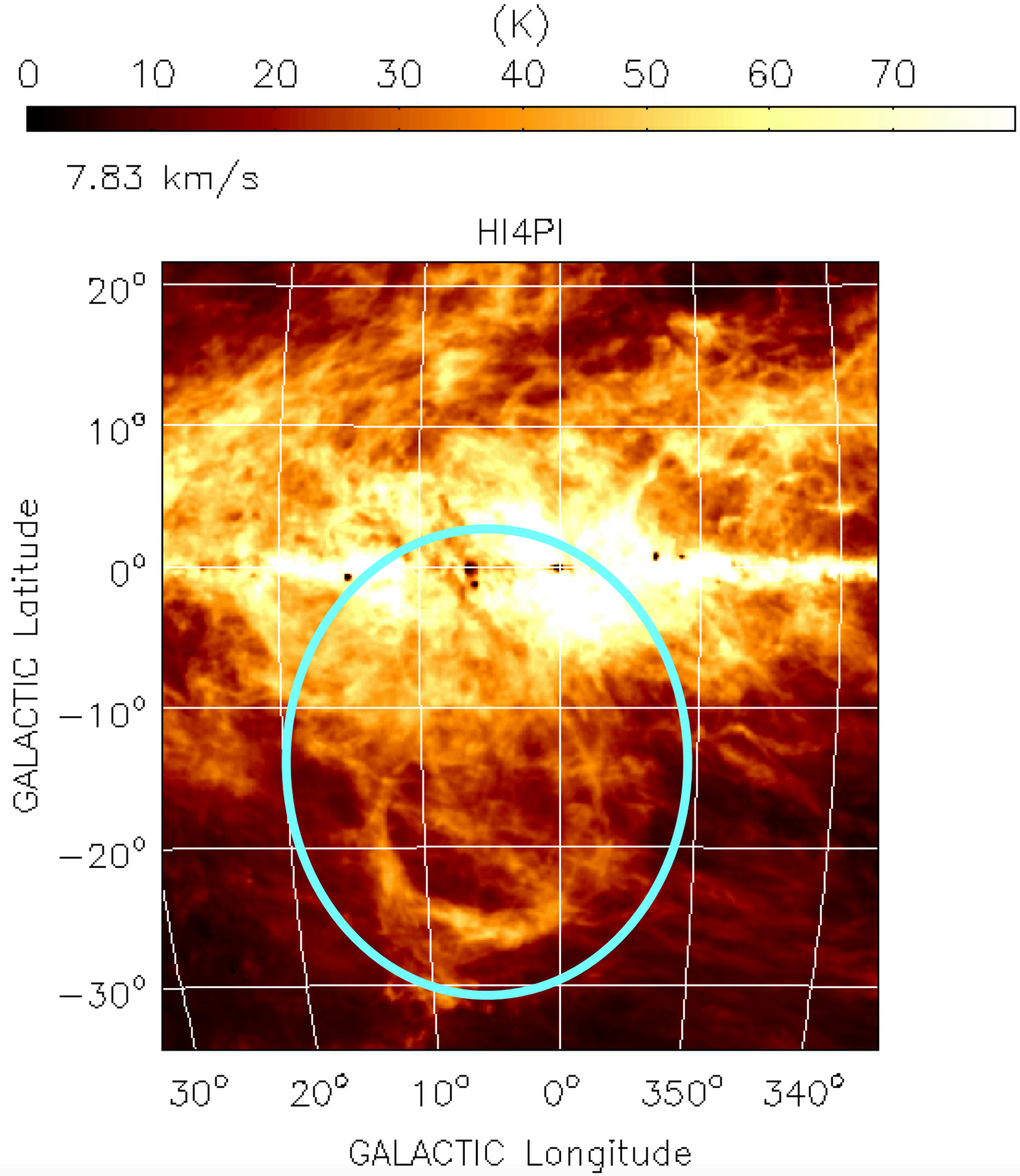
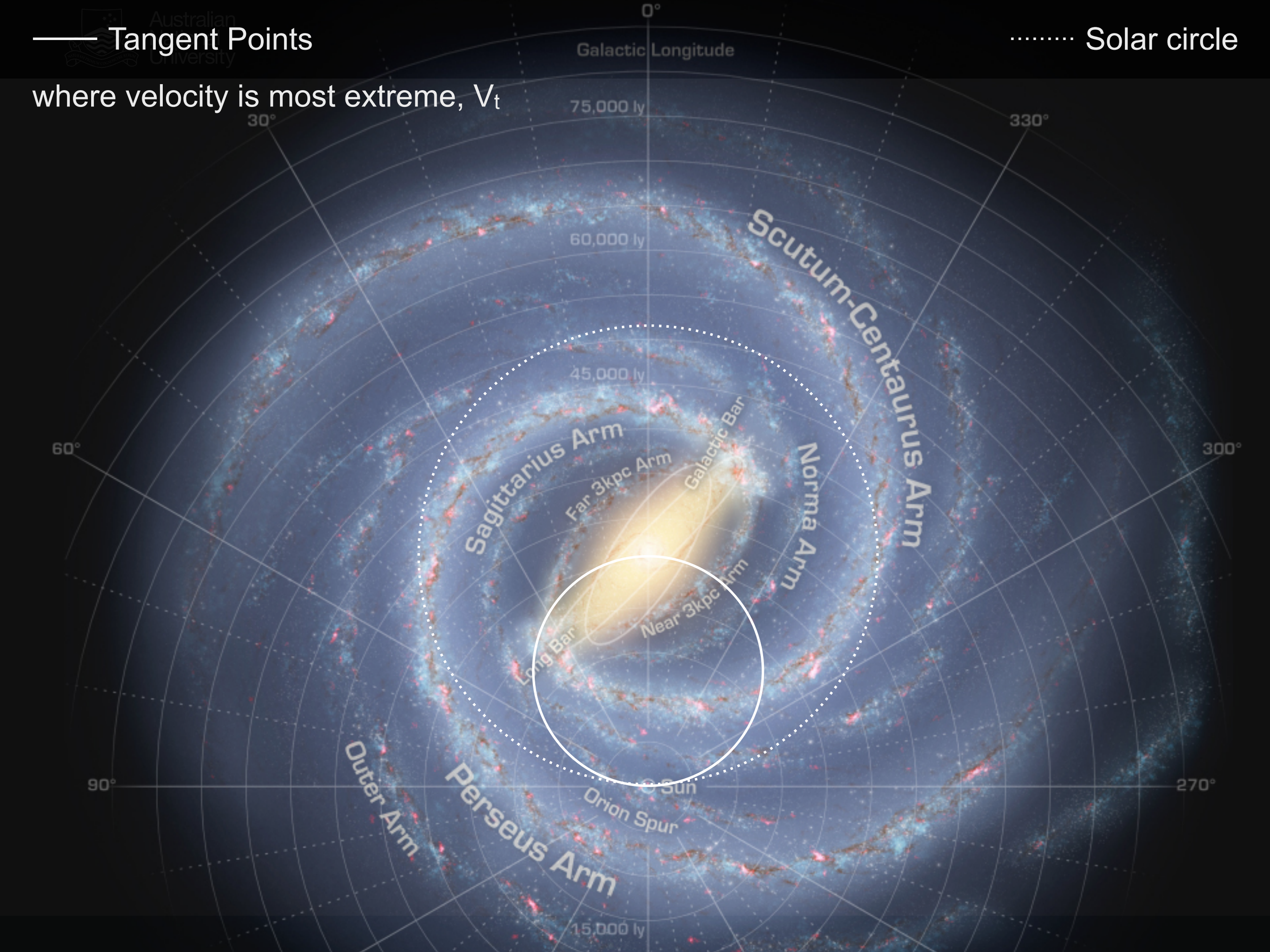


—— Tangent Points

····· Solar circle

where velocity is most extreme, V_t



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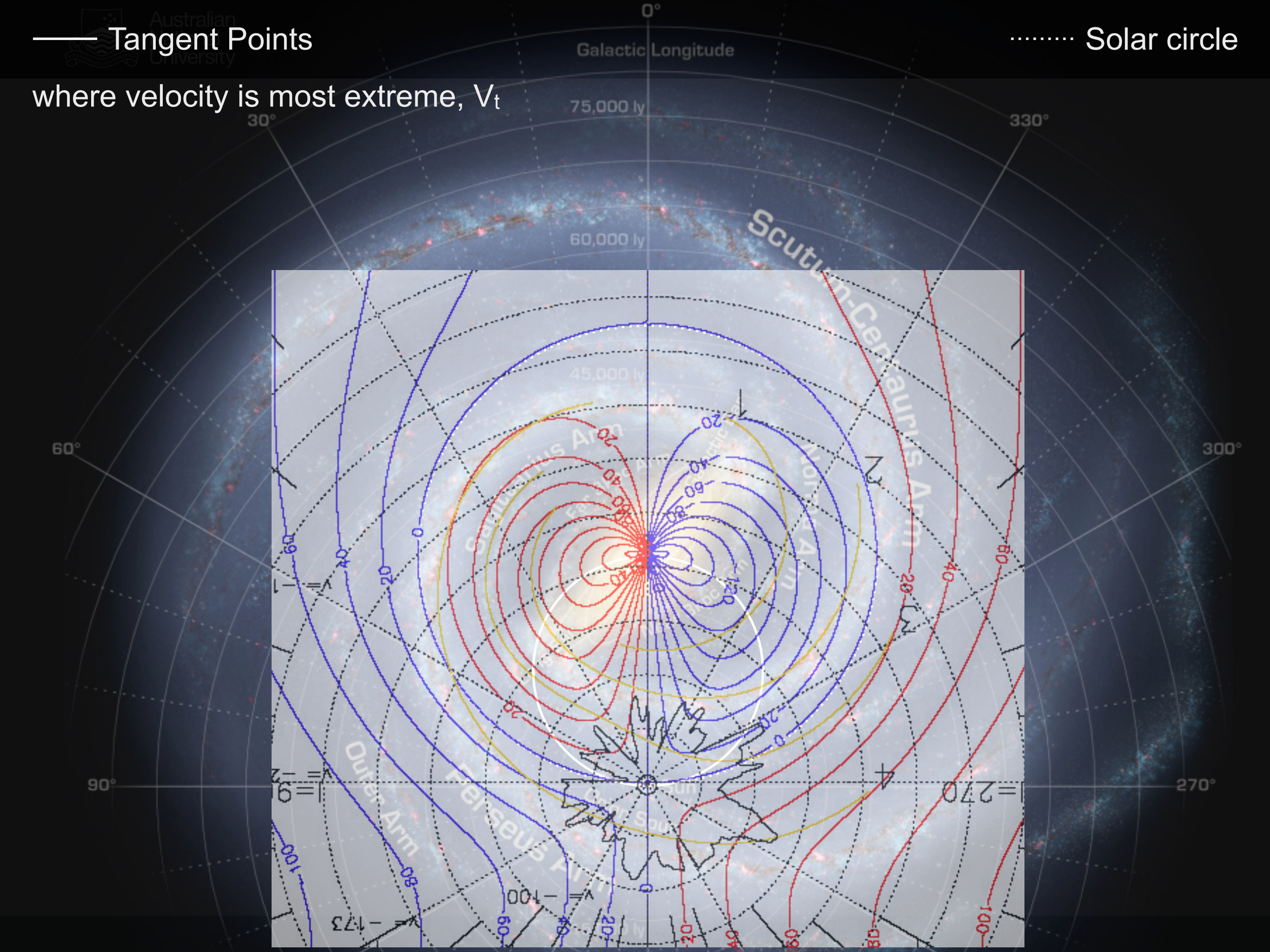
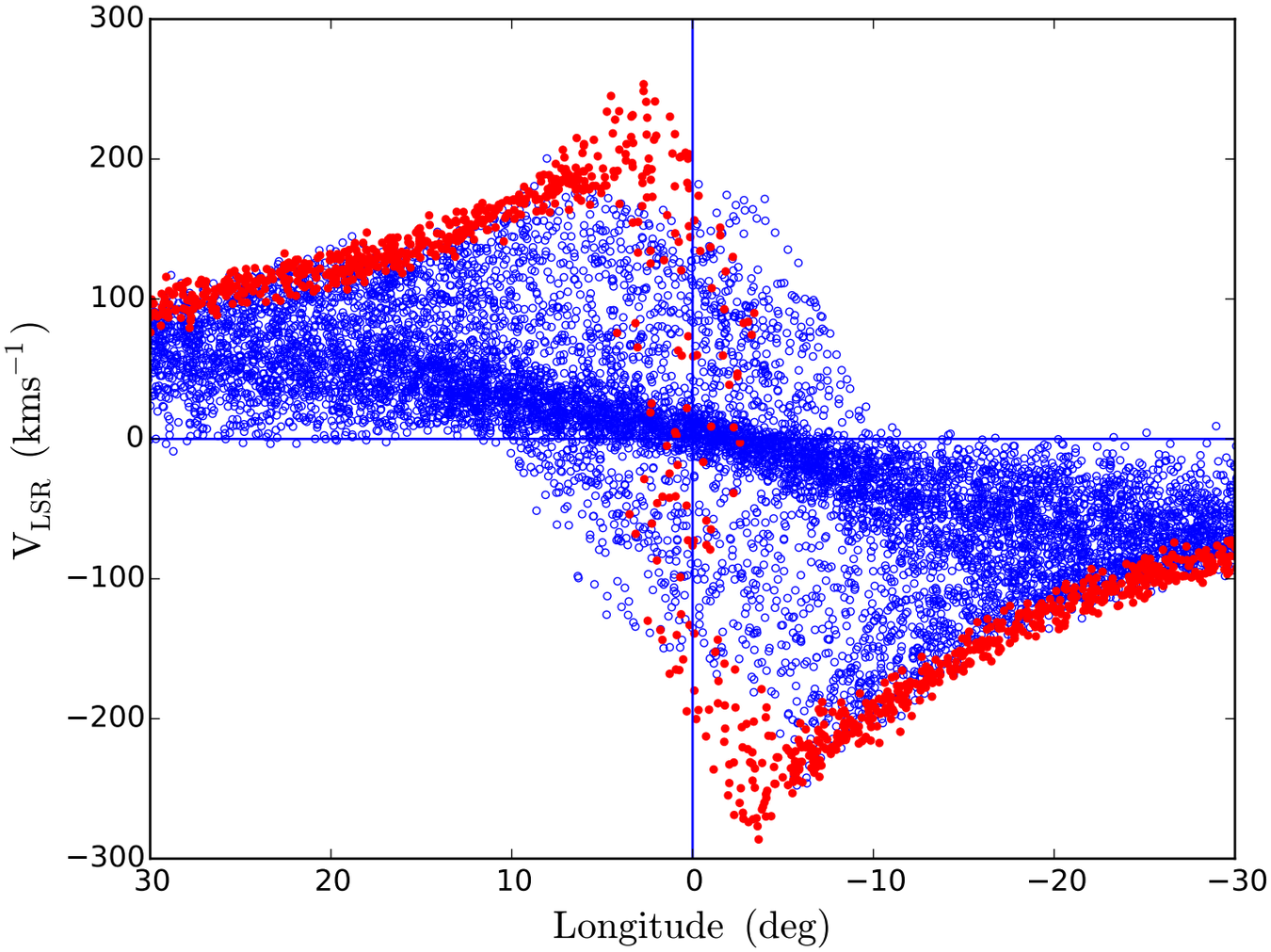
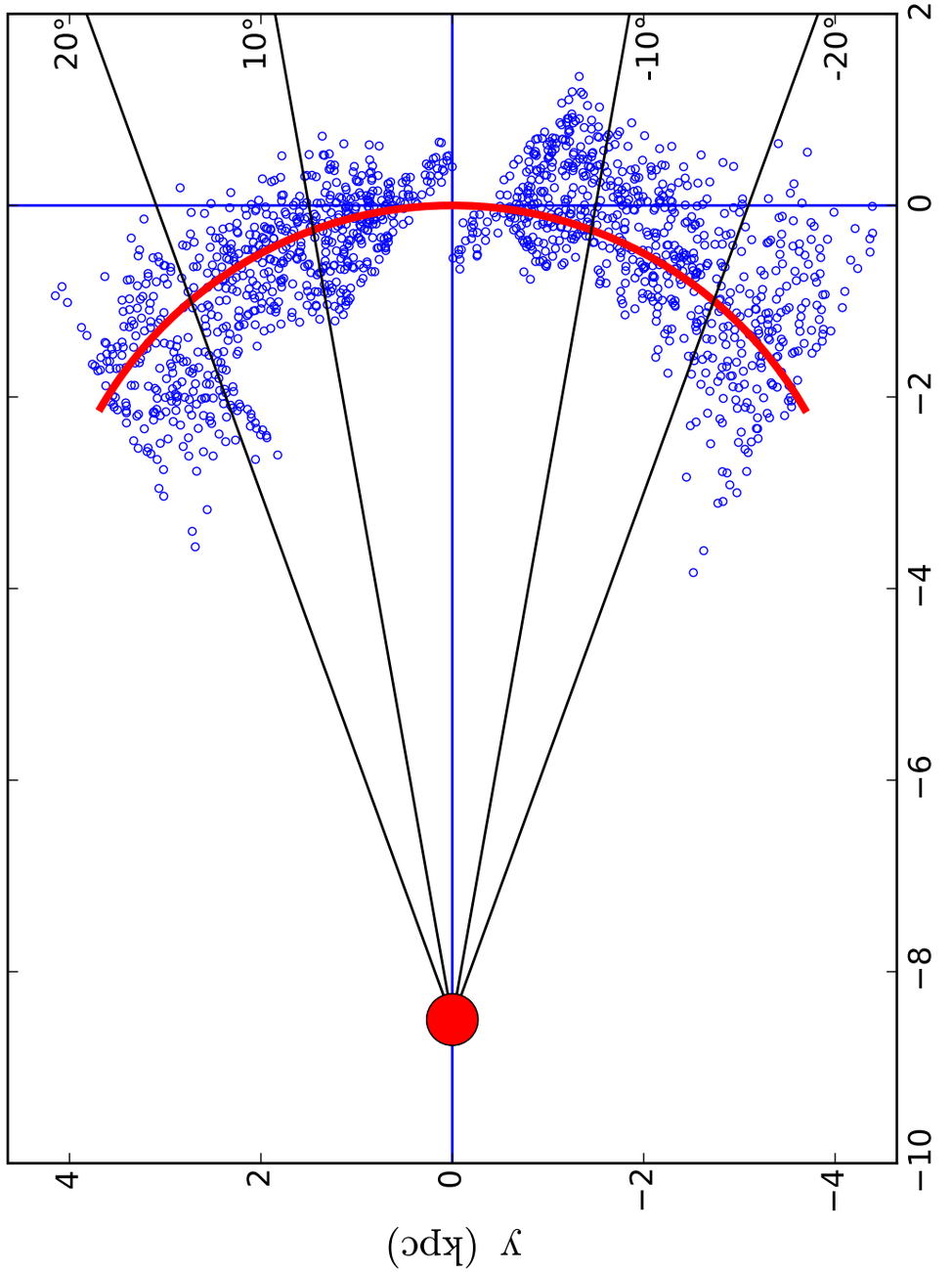


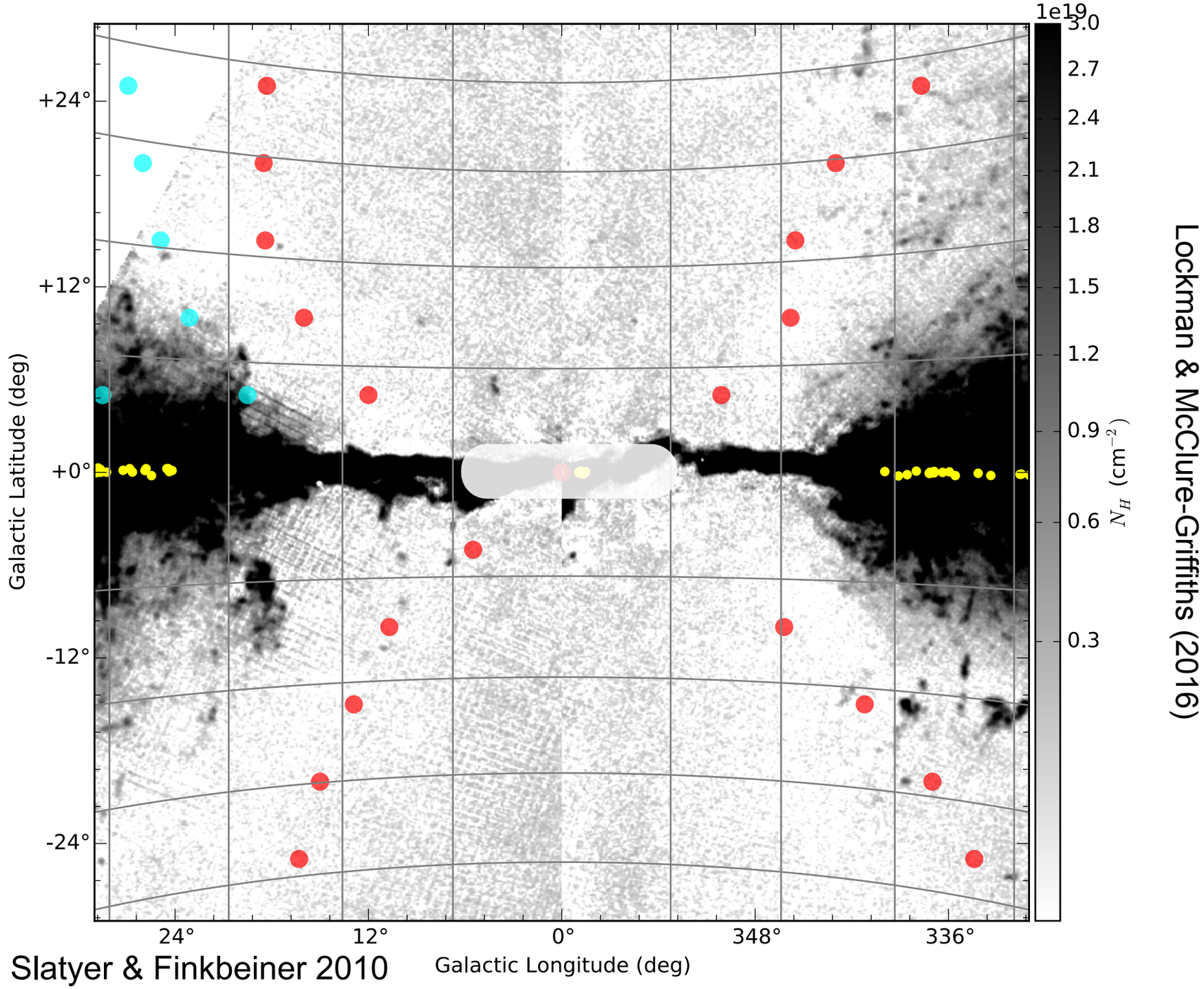
Extracting G.C. Gas





Lockman & McClure-Griffiths (2016)

Atomic Hydrogen in the GC



Circles from Su, Slatyer & Finkbeiner 2010

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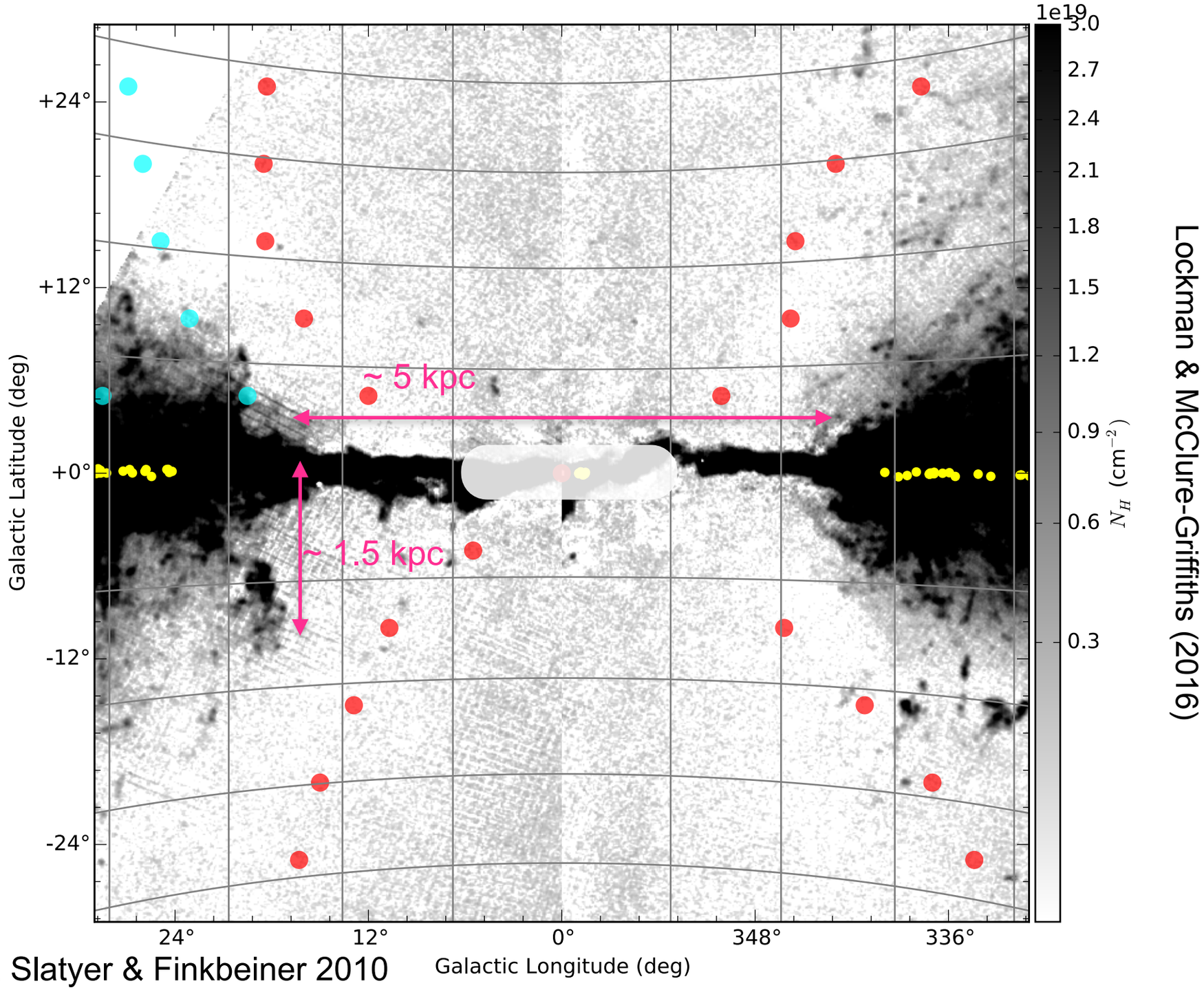
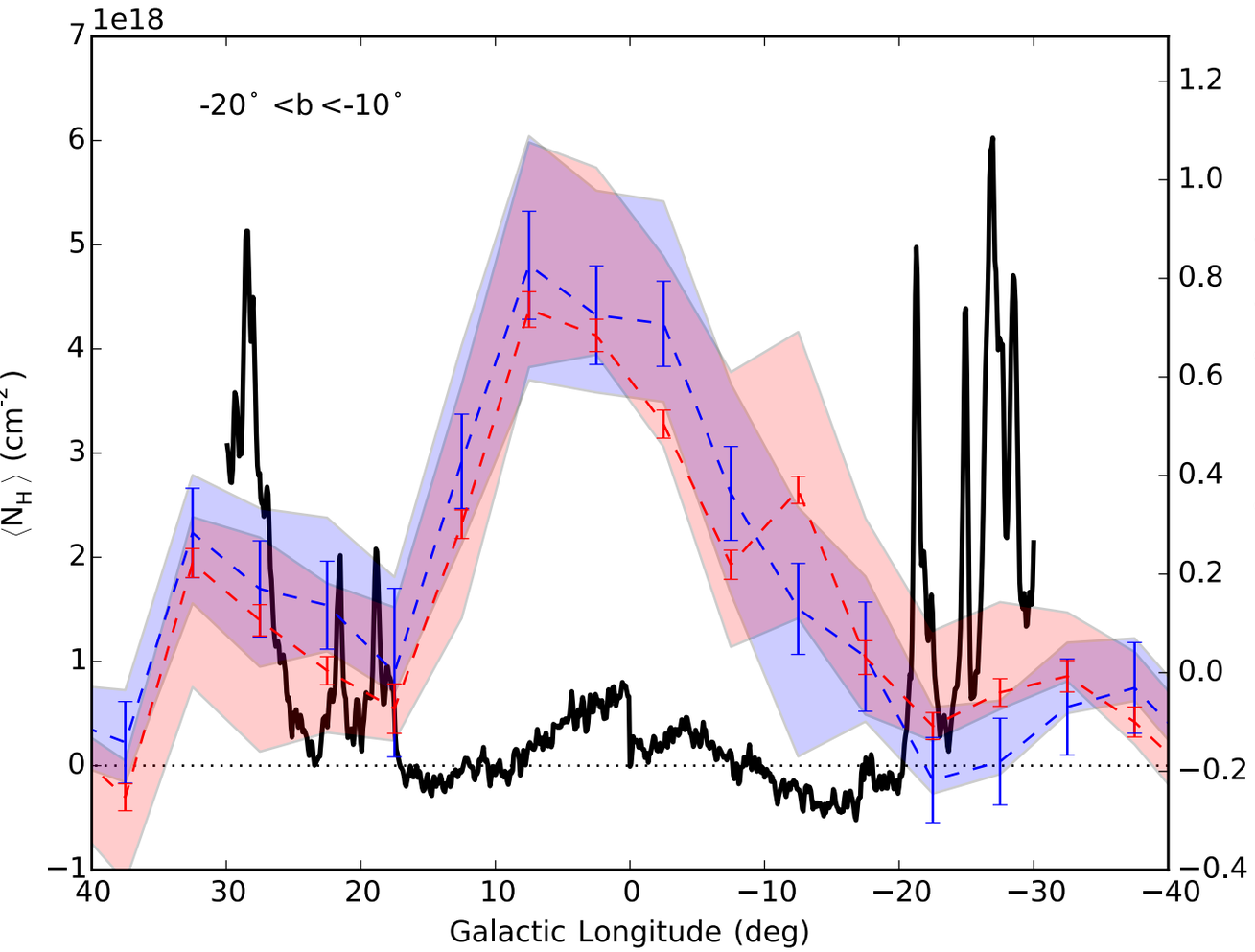
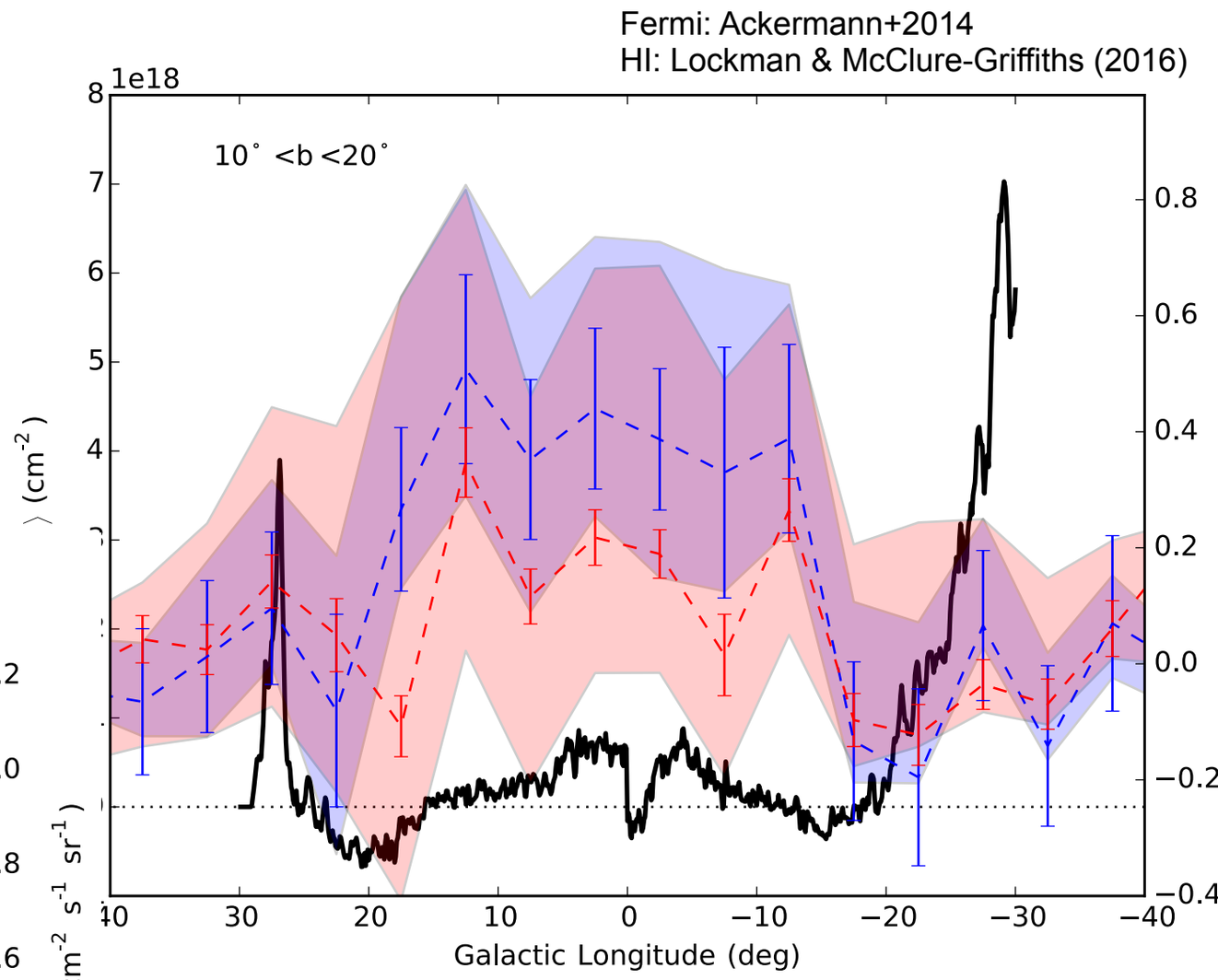


Circles from Su, Slatyer & Finkbeiner 2010

HI and γ-rays





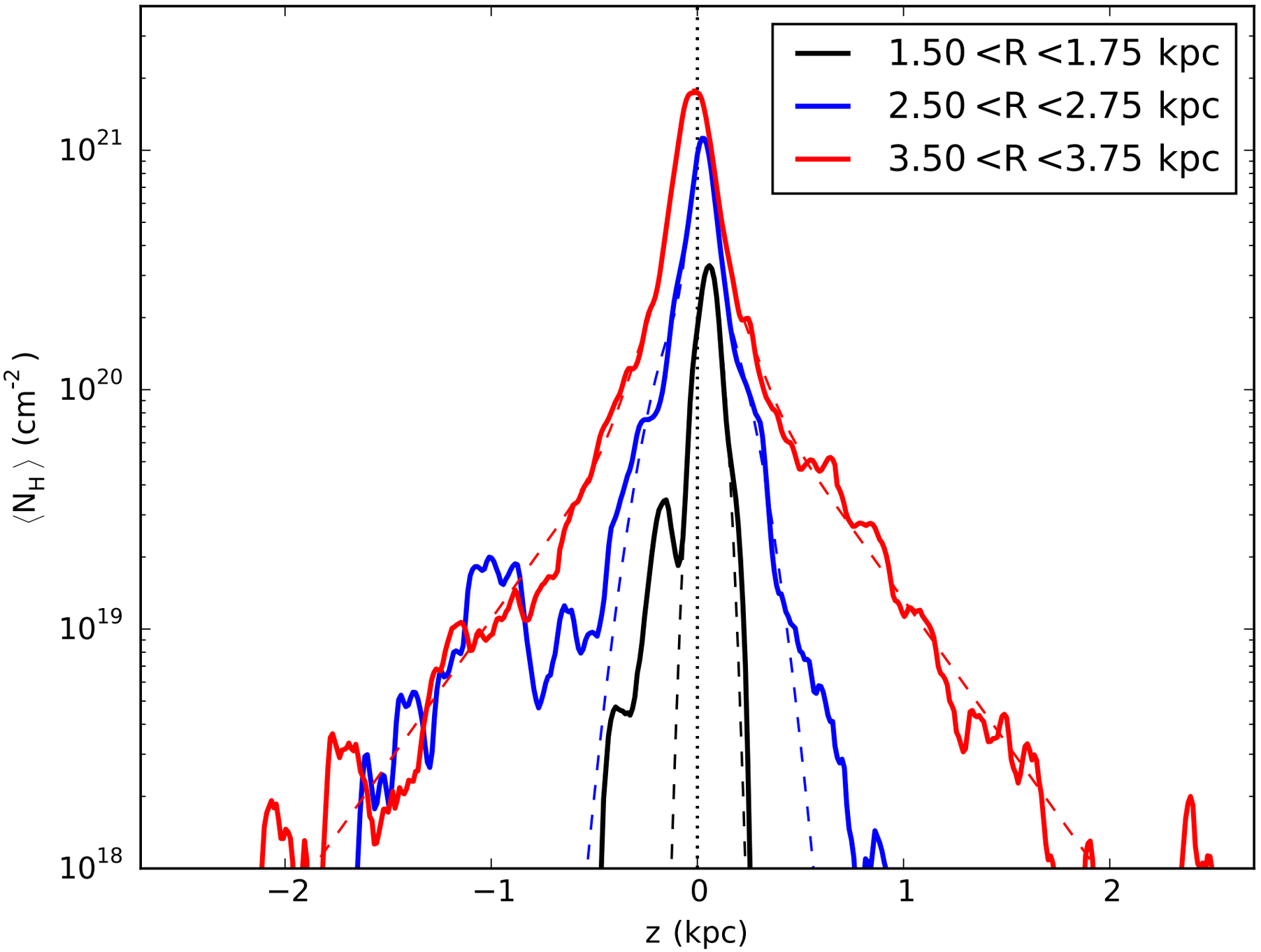
The missing halo

Surface Density:

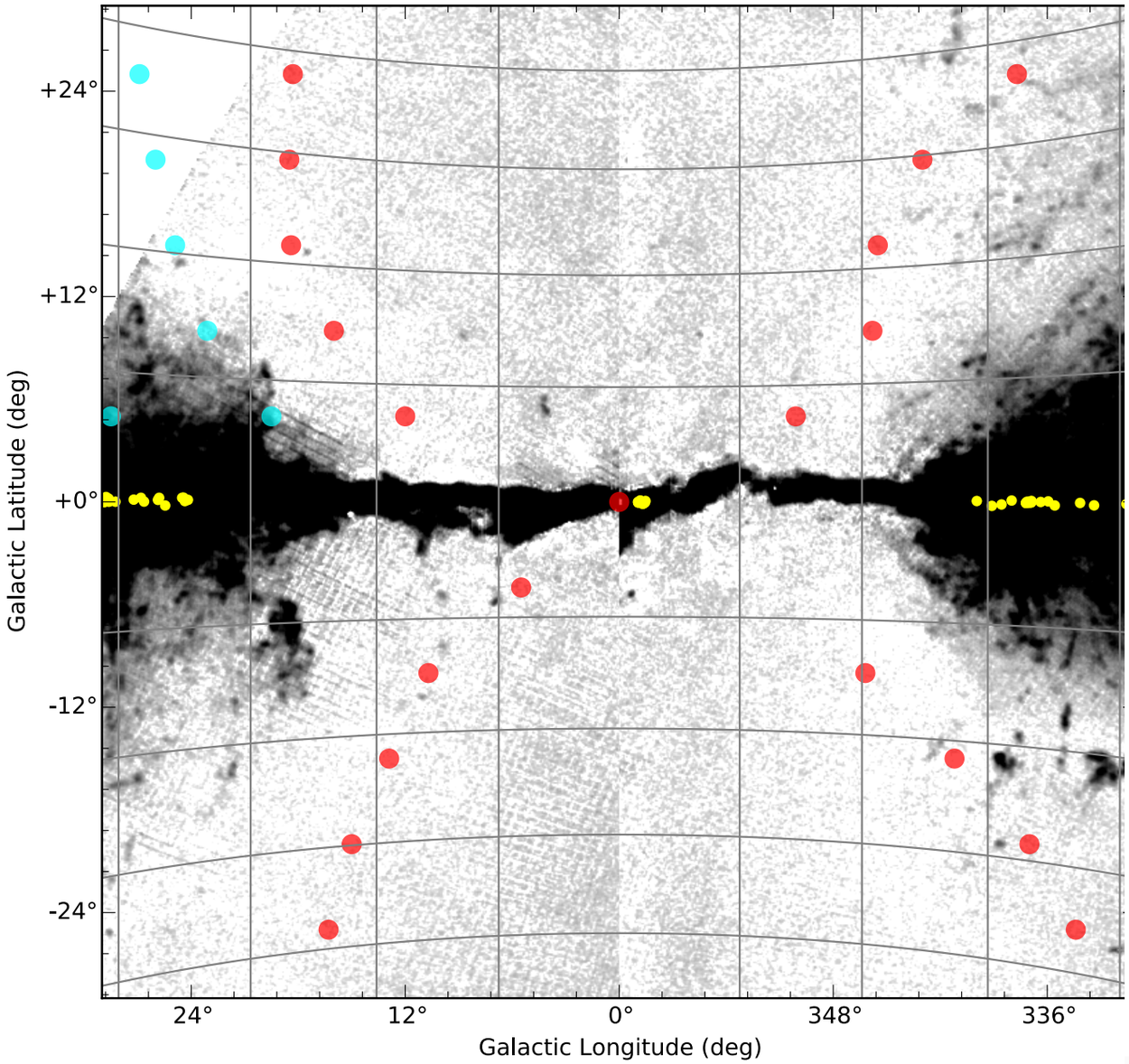
1.5<R<1.75:
0.4 M_{sun}/pc^2

2.5<R<2.75:
1.6 M_{sun}/pc^2

3.5<R<3.75:
3.4 M_{sun}/pc^2



Surprisingly large?



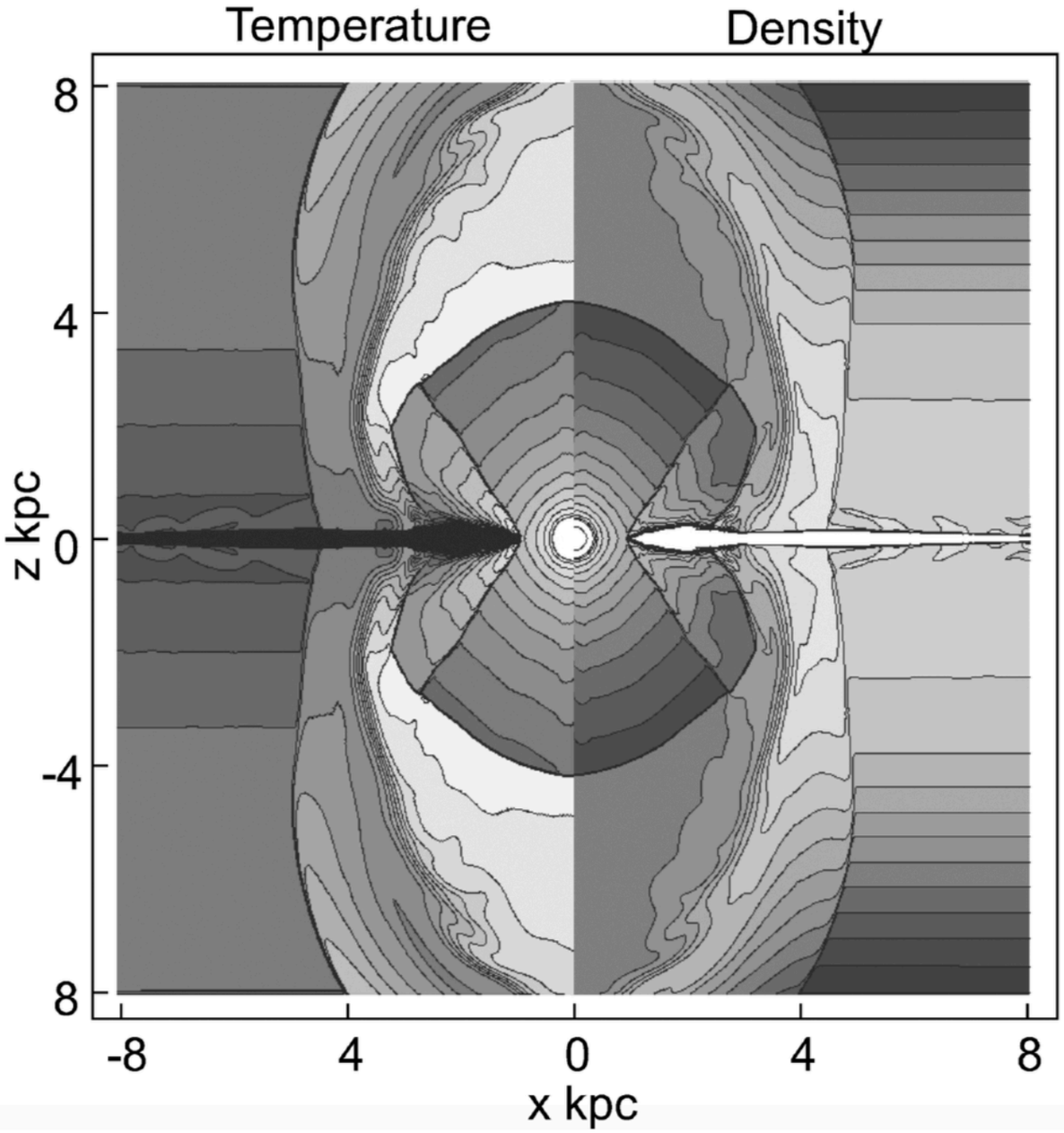


Fig 4: Sofue et al 2016

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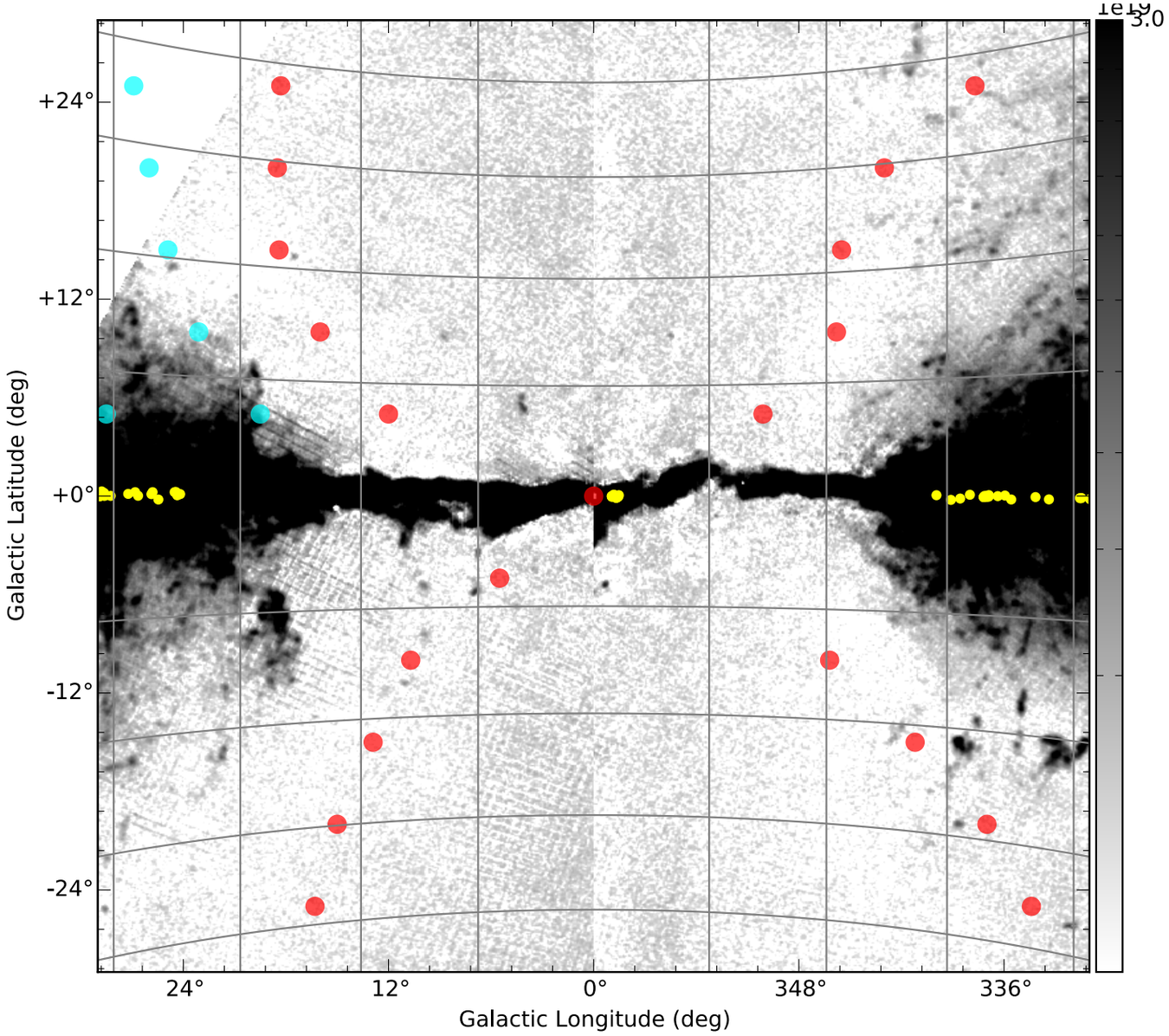


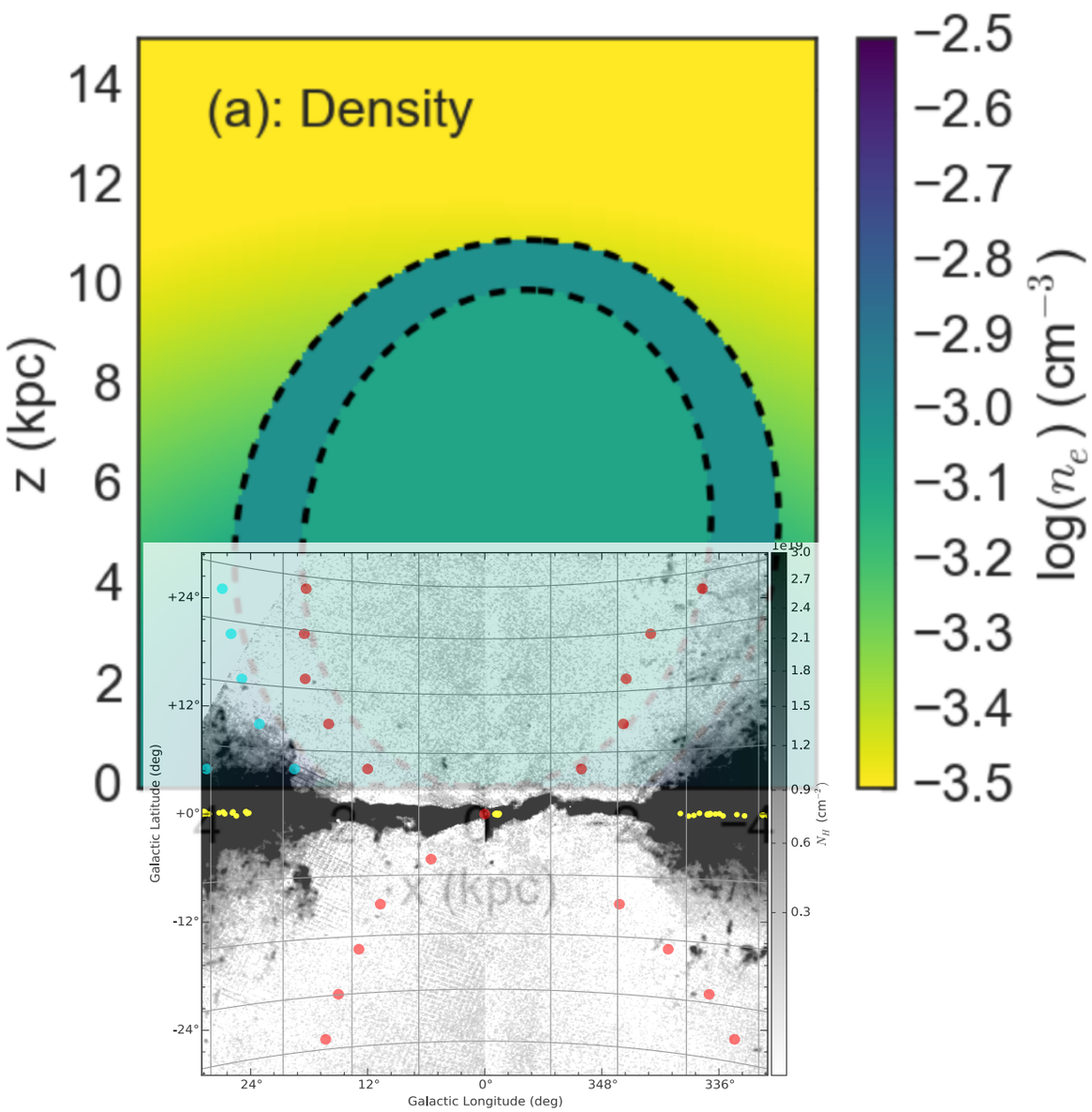
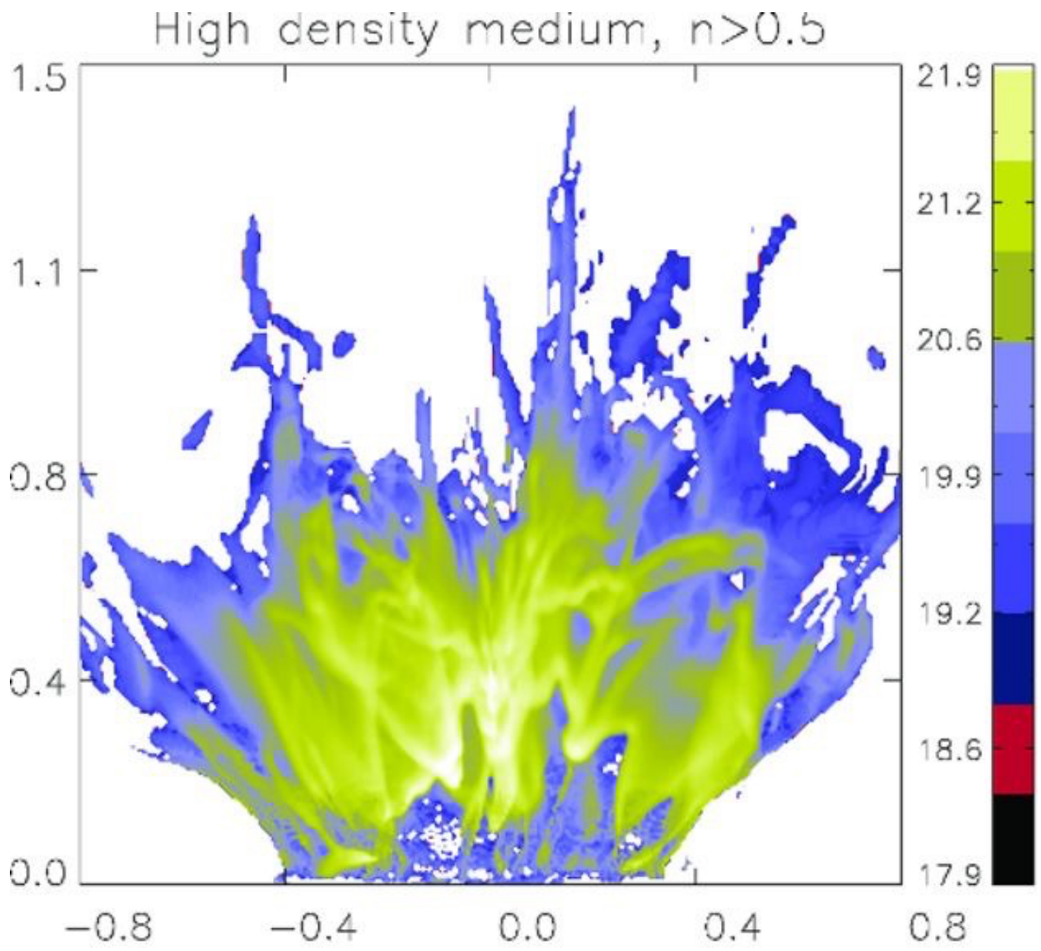
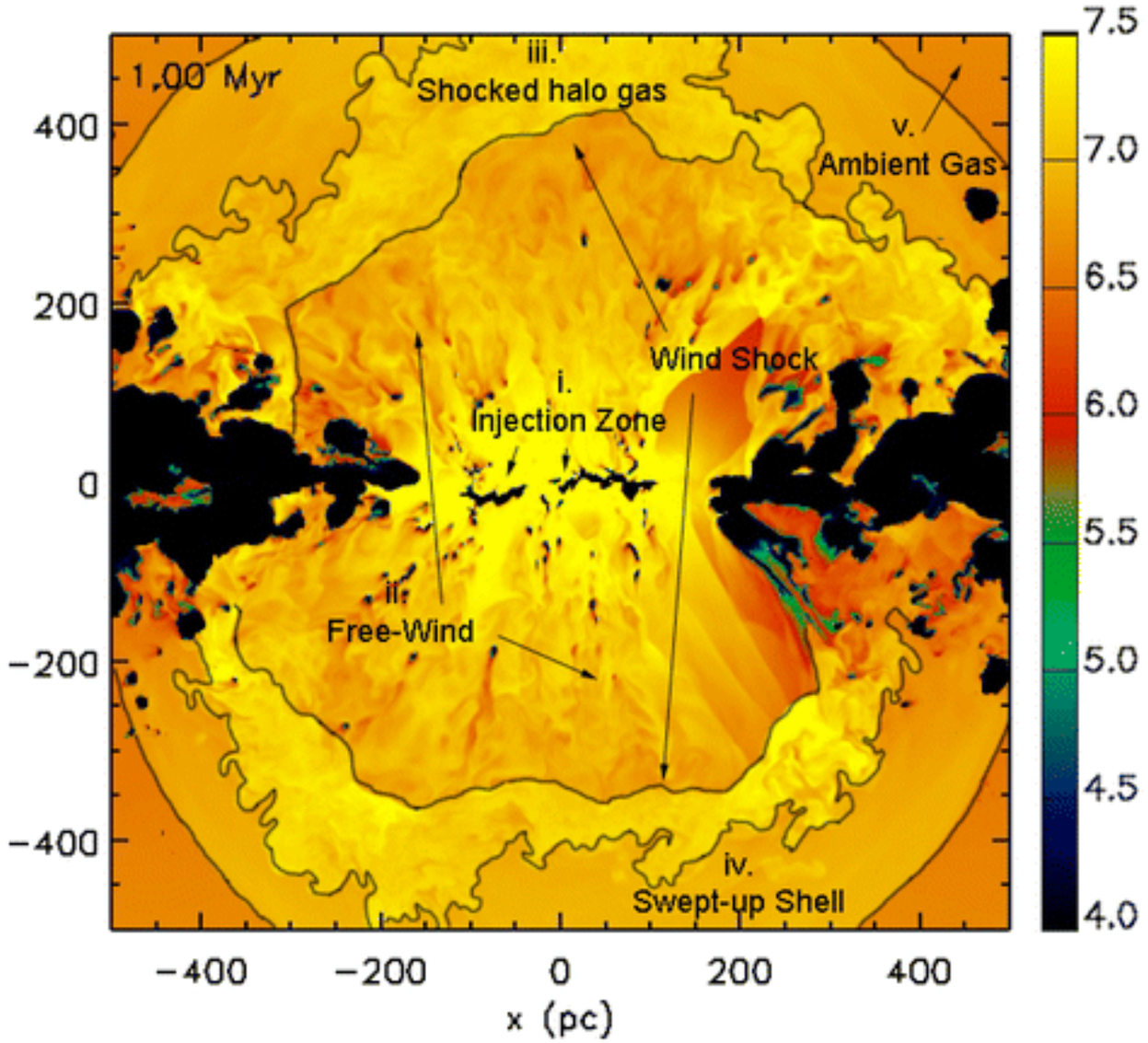


Fig 4: Sofue et al 2016

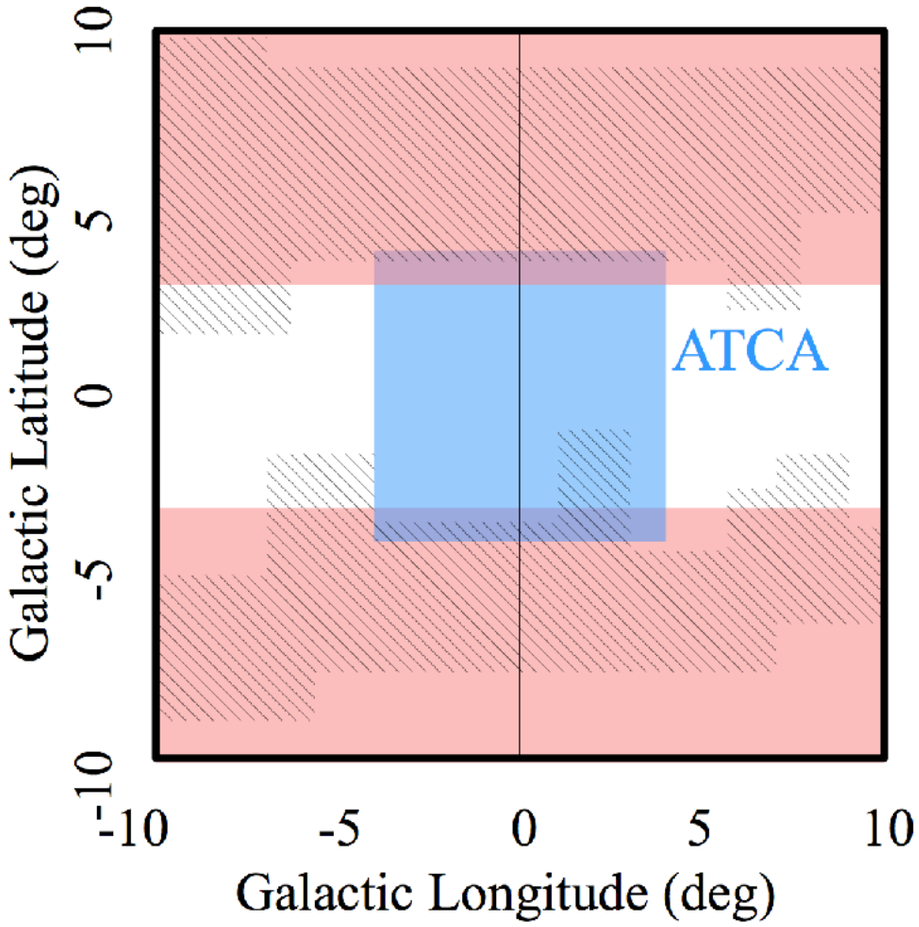
Cool entrained gas in nuclear outflows



M82 wind simulations: Melioli+2014



M82 wind simulations: Cooper+2008



And the MW?…

di Teodoro, McClure-Griffiths, Lockman et al (2017, submitted)

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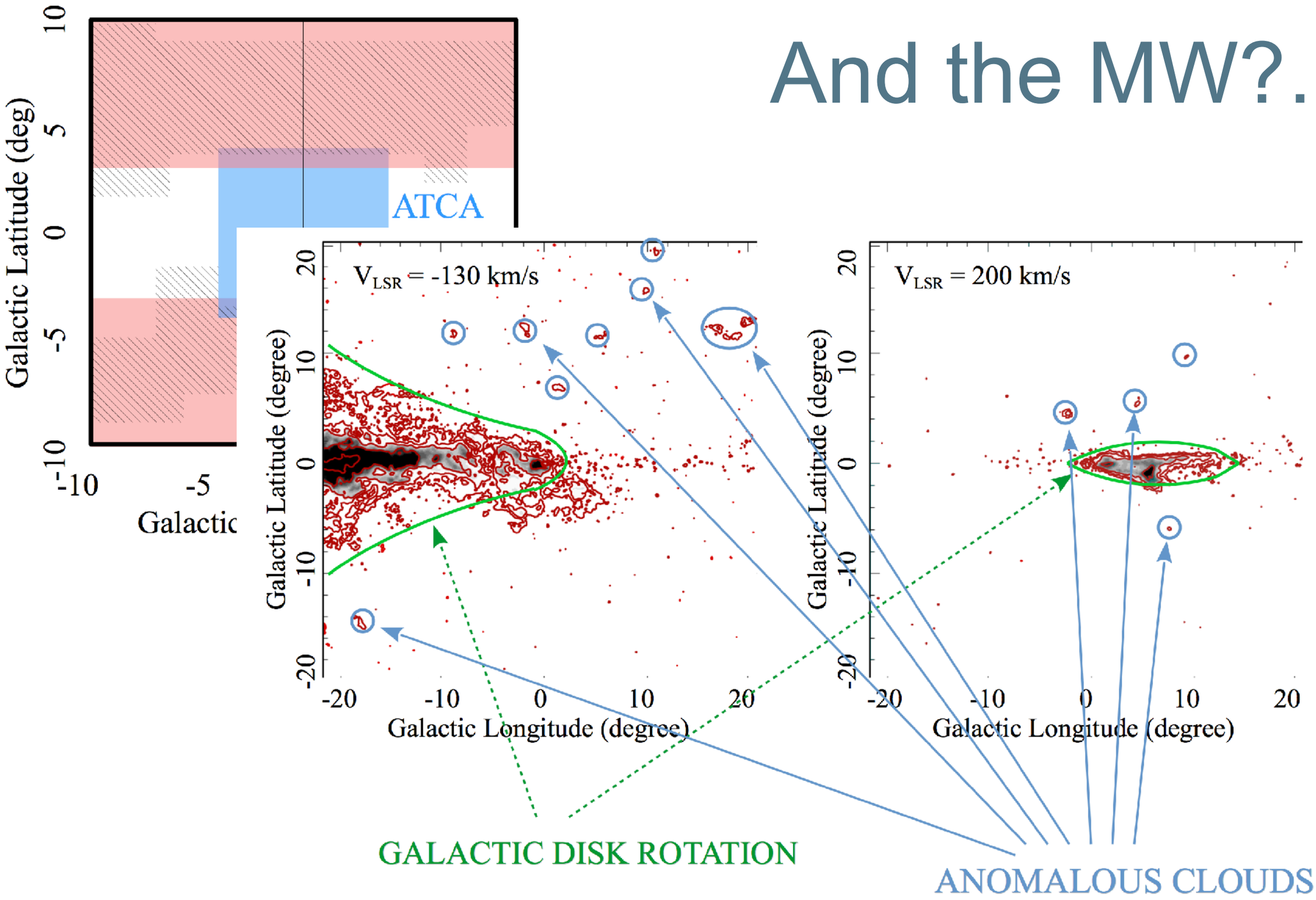
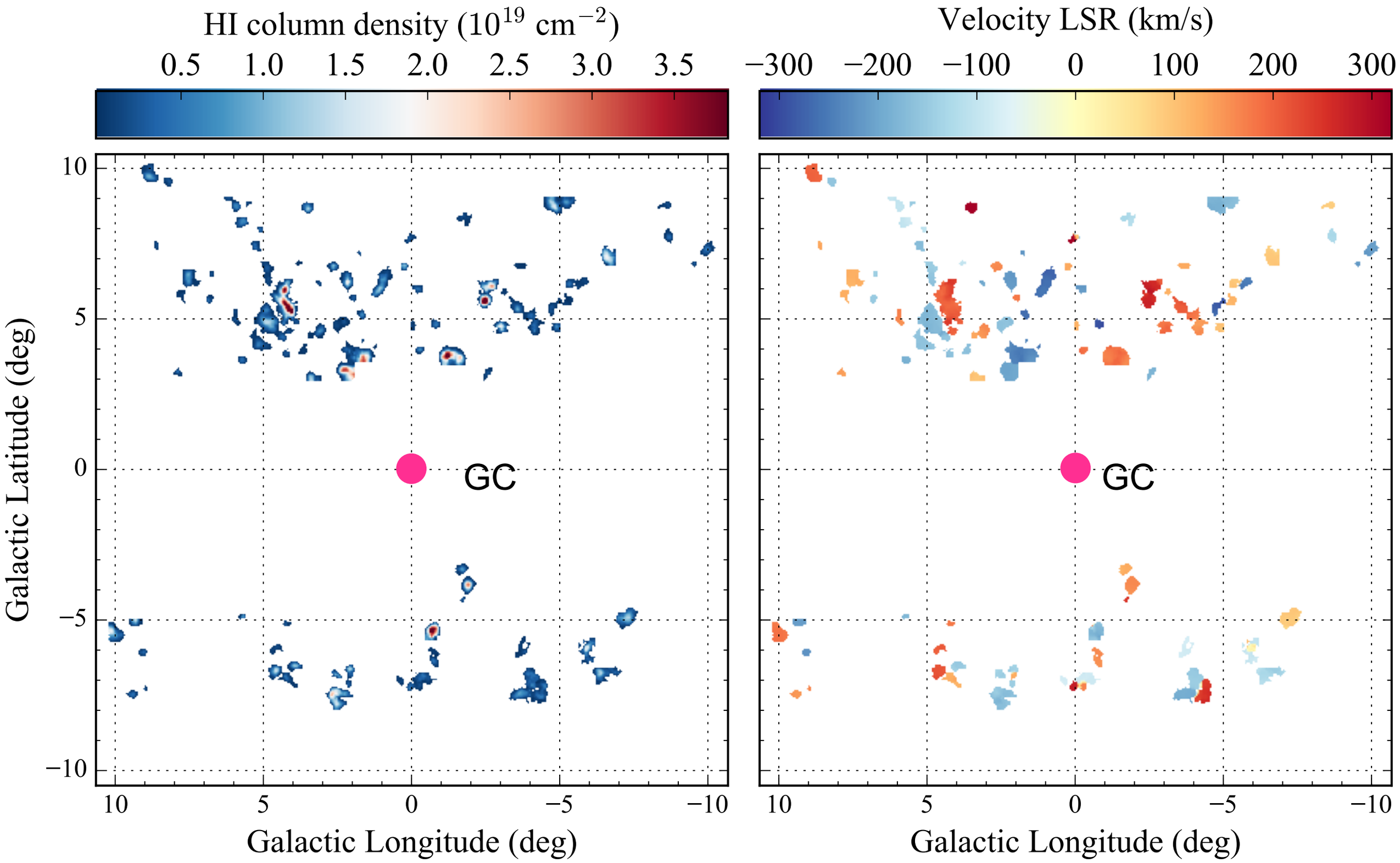
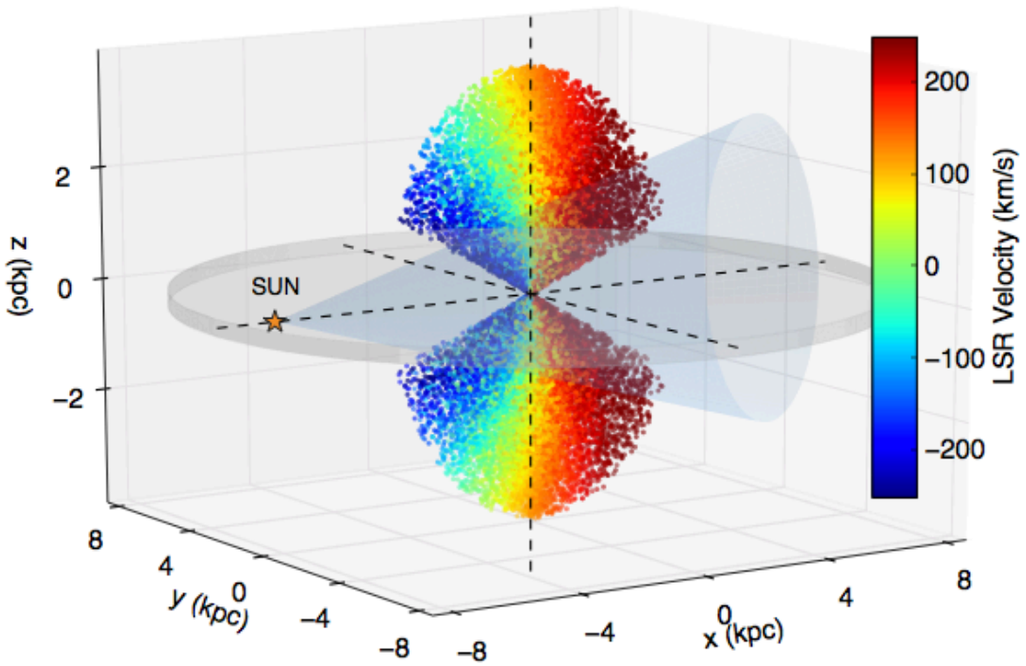


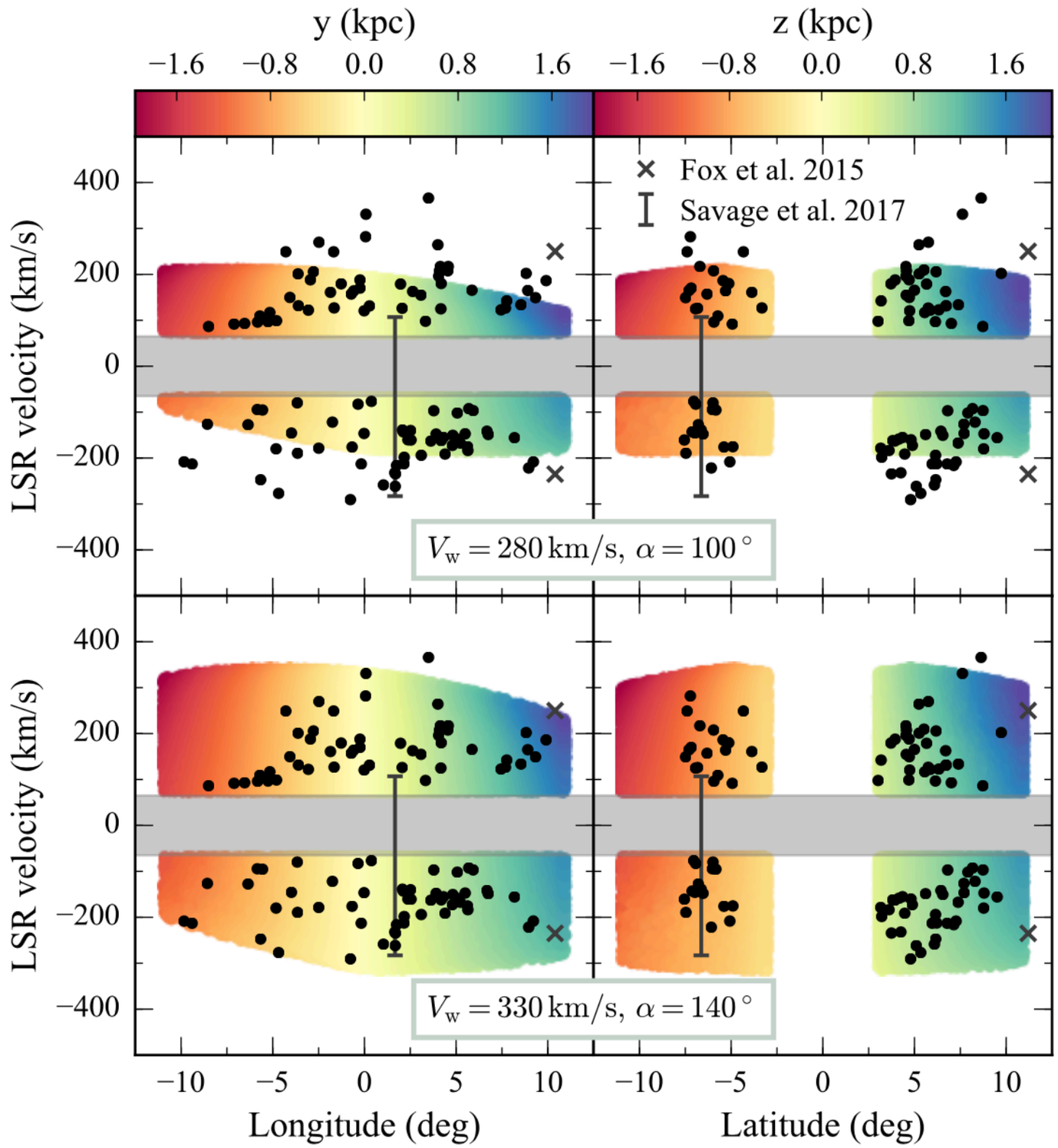
di Teodoro, McClure-Griffiths, Lockman et al (2017, submitted)



di Teodoro+2017



V_w = 300-400 km/s
α > 140 deg



wind luminosity: $L_w \simeq 3 \times 10^{40}$ erg/s
cold gas mass flux: 0.1 $M_\odot$ yr^{-1}

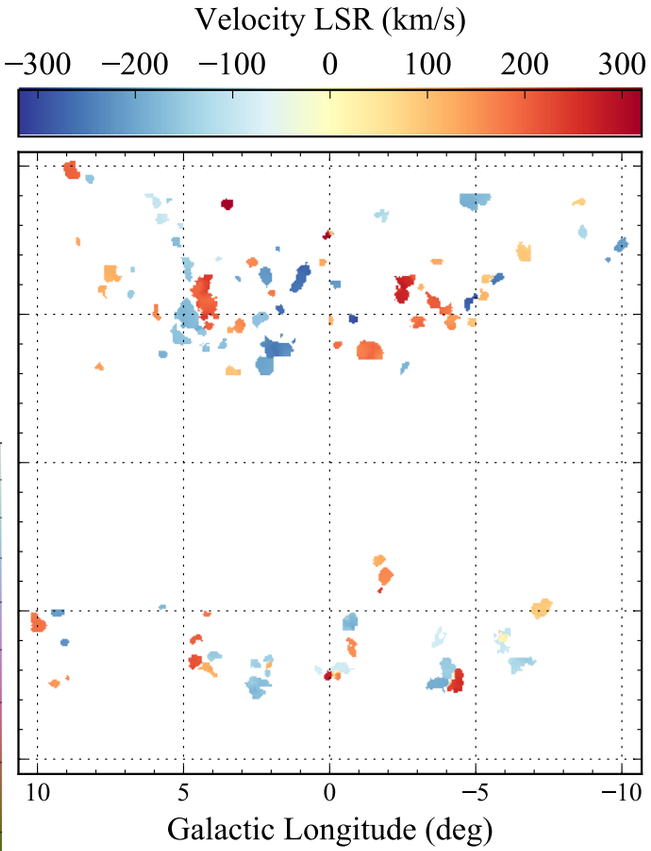
di Teodoro+2017

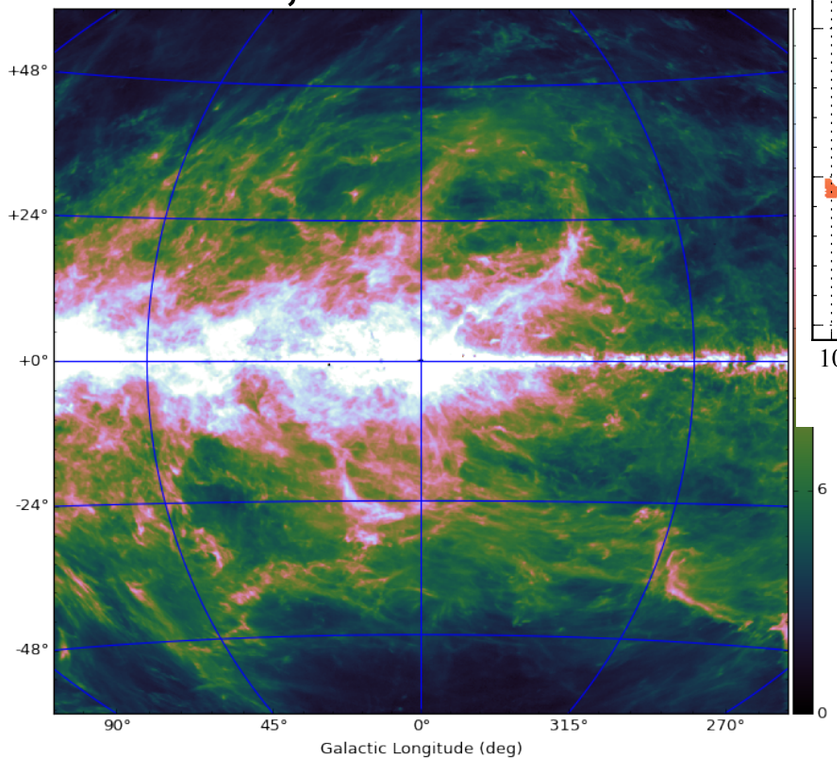
Key parameters

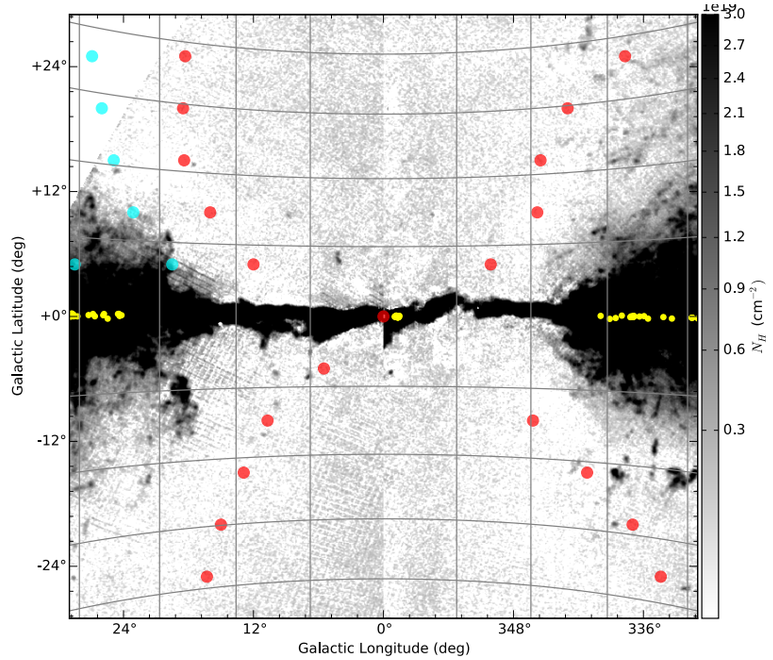
- 300 km/s < V_w < 400 km/s (McG+2013 ~200 km/s)
- α >140^o
- Total HI mass in clouds: 10^6 $M_\odot$
- Kinetic power of the clouds: 5 x 10^{39} erg/s
  - Could be supplied by GC SNe with SFR~0.1 $M_\odot$/yr (Barnes+2017)
- Cloud lifetimes: 2 - 8 Myr (median 3.6 Myr)
  - Challenge for theory. Destruction timescales are generally much lower
- Mass loading rate ~0.1 $M_\odot$/yr
- Velocity of the hot component: $V_h \sim V_w[3n_w/2n_c]^{-1/2}$ ~2000 km/s (Martin+2005)

Summary

Foreground objects:
GSH 006-15+07 (~1 kpc, Moss+ 2012)
Upper Sco (de Geus+1992,Wolleben+2010







HI at the Galactic Centre:
Inner R~2.5 kpc reduced missing thick disk
(Lockman & McClure-Griffiths 2016)

HI in the outflow:
(di Teodoro+2017)