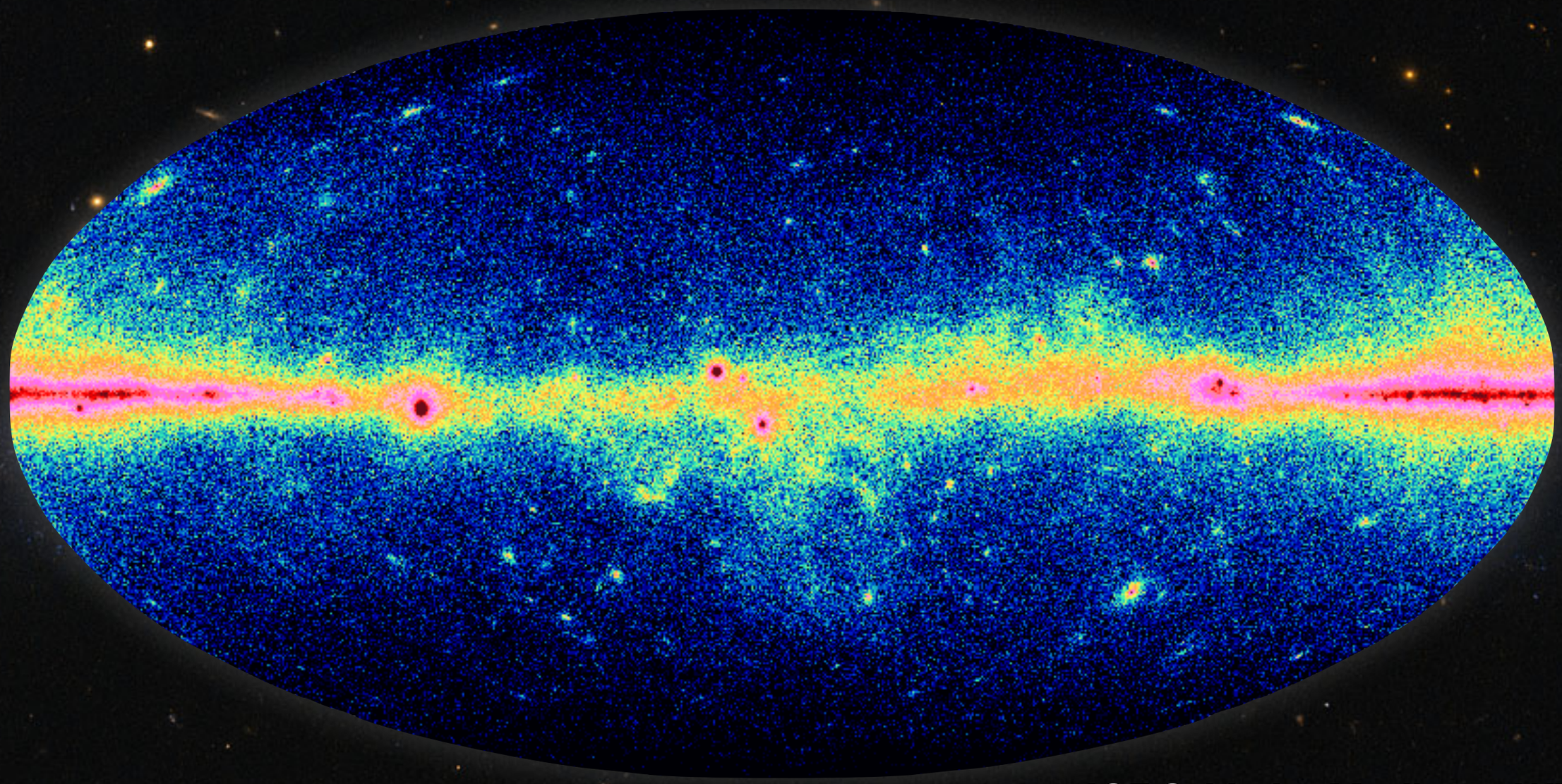
Cosmic rays in the Orion-Eridanus superbubble



ICRC 2019 - Madison, WI, USA

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on behalf of the Fermi-LAT collaboration

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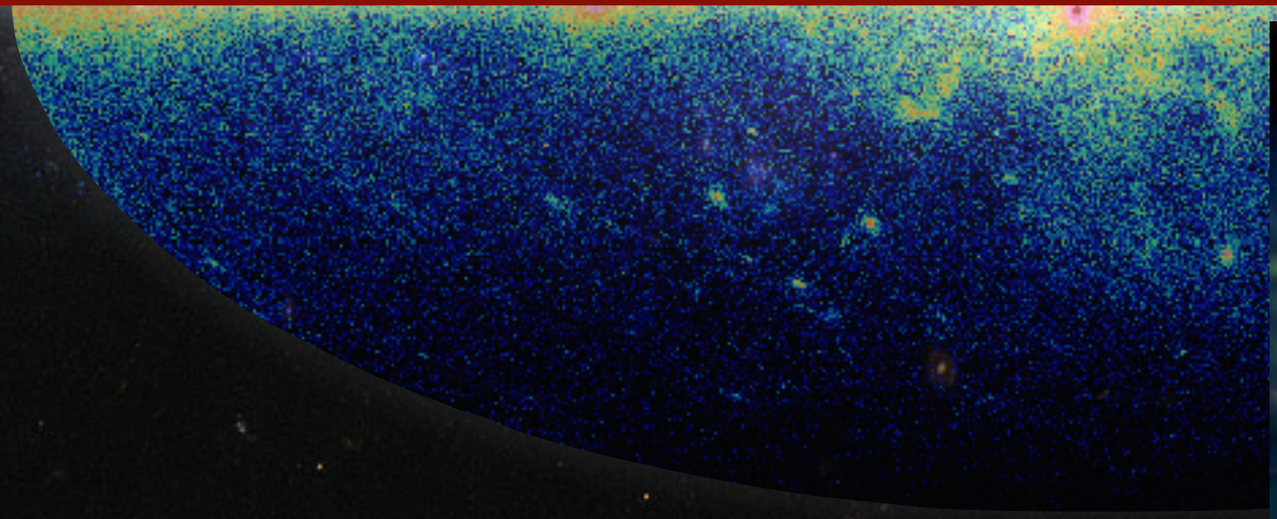
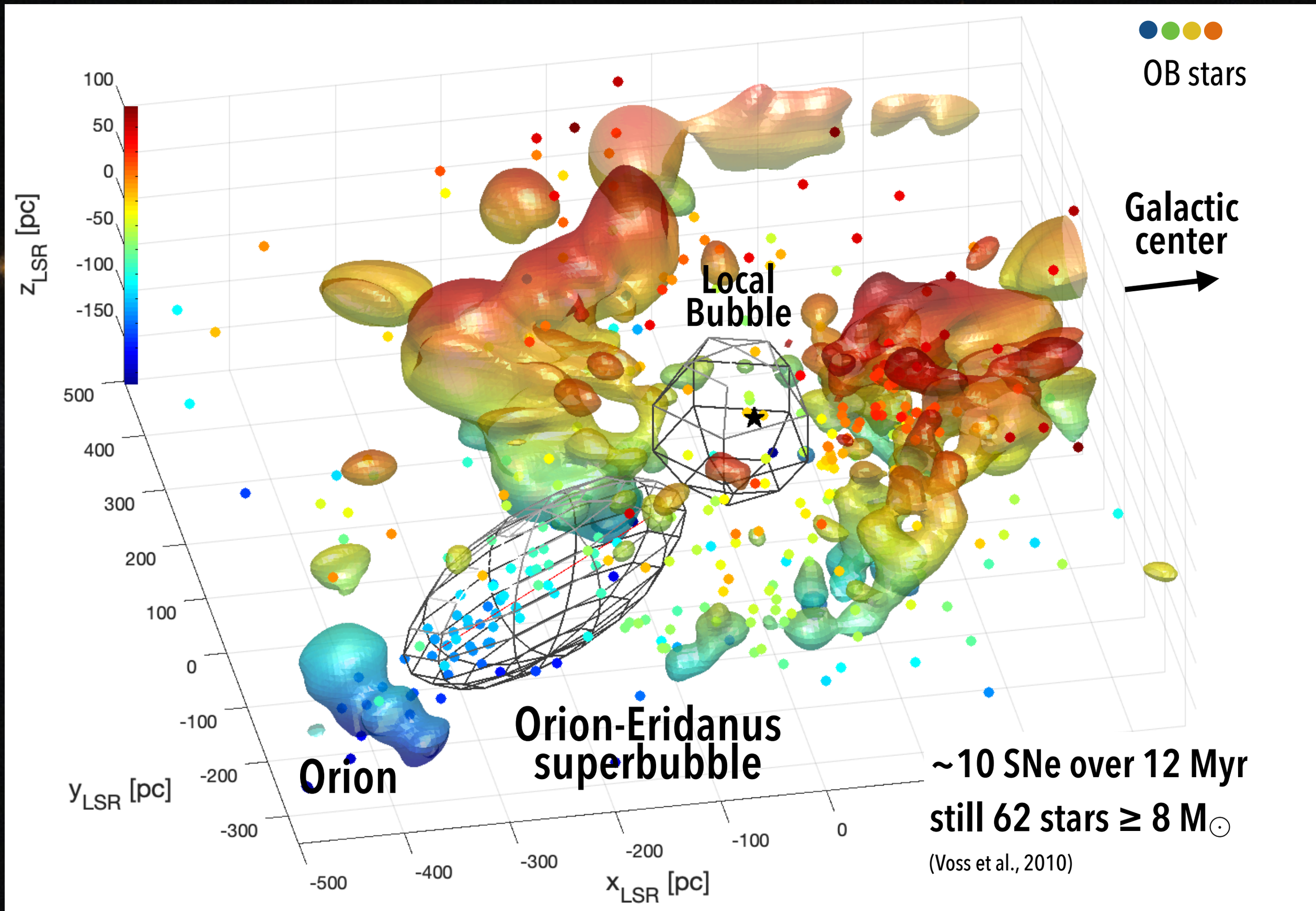
Cosmic ray origins ?

Superbubbles

- Origin of CR > 10 TeV ? (Bykov and Toptygin, 2001; Parizot et al., 2004)
- Mechanism : Diffusive Shock Acceleration (Fermi 1)
  + Diffusion in momentum due to MHD turbulence (Fermi 2)
- One example : Cygnus X superbubble, Fermi+HAWC up to TeV γ rays (Ackermann et al., 2011)



The Orion-Eridanus superbubble

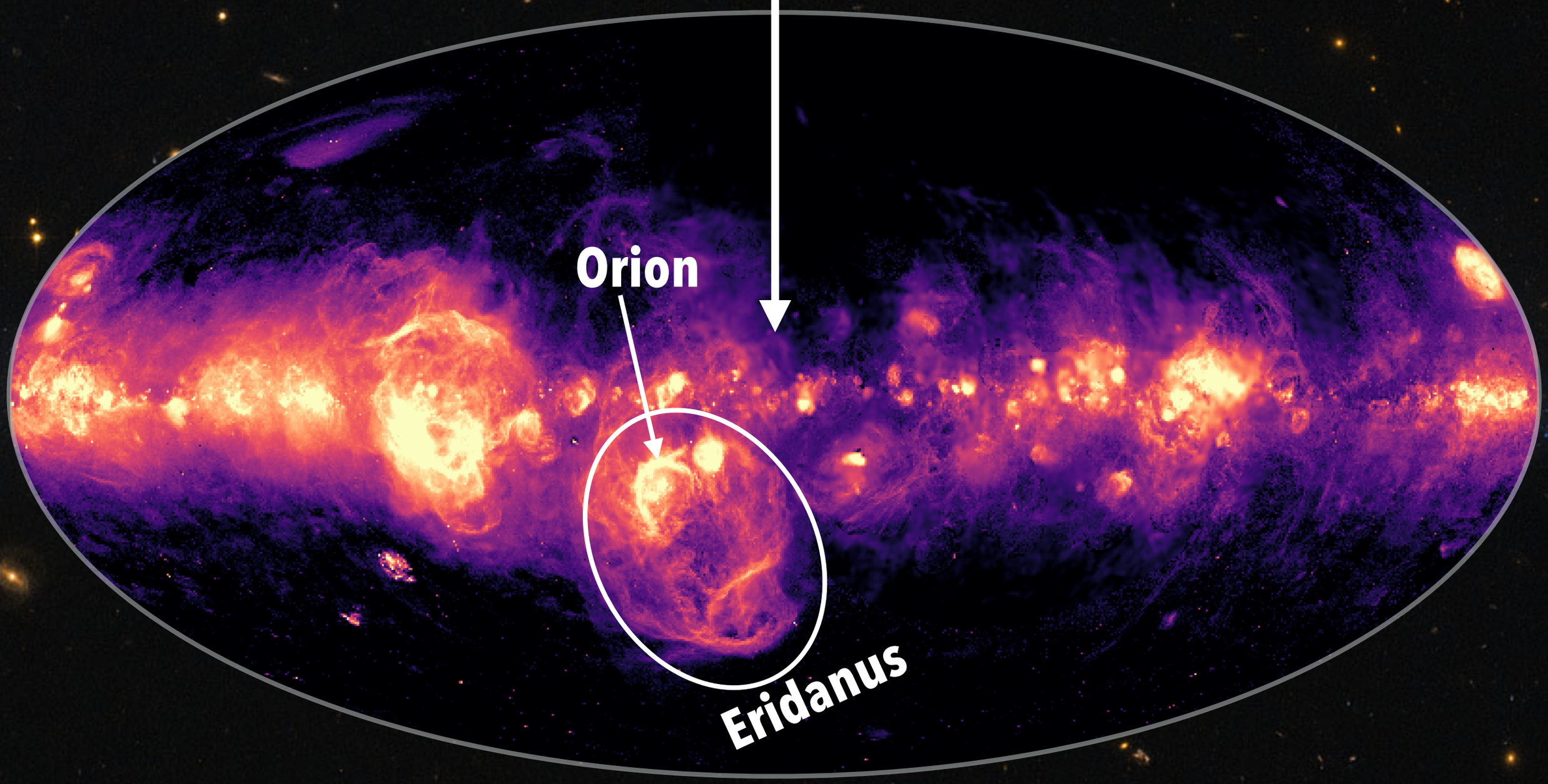


~10 SNe over 12 Myr

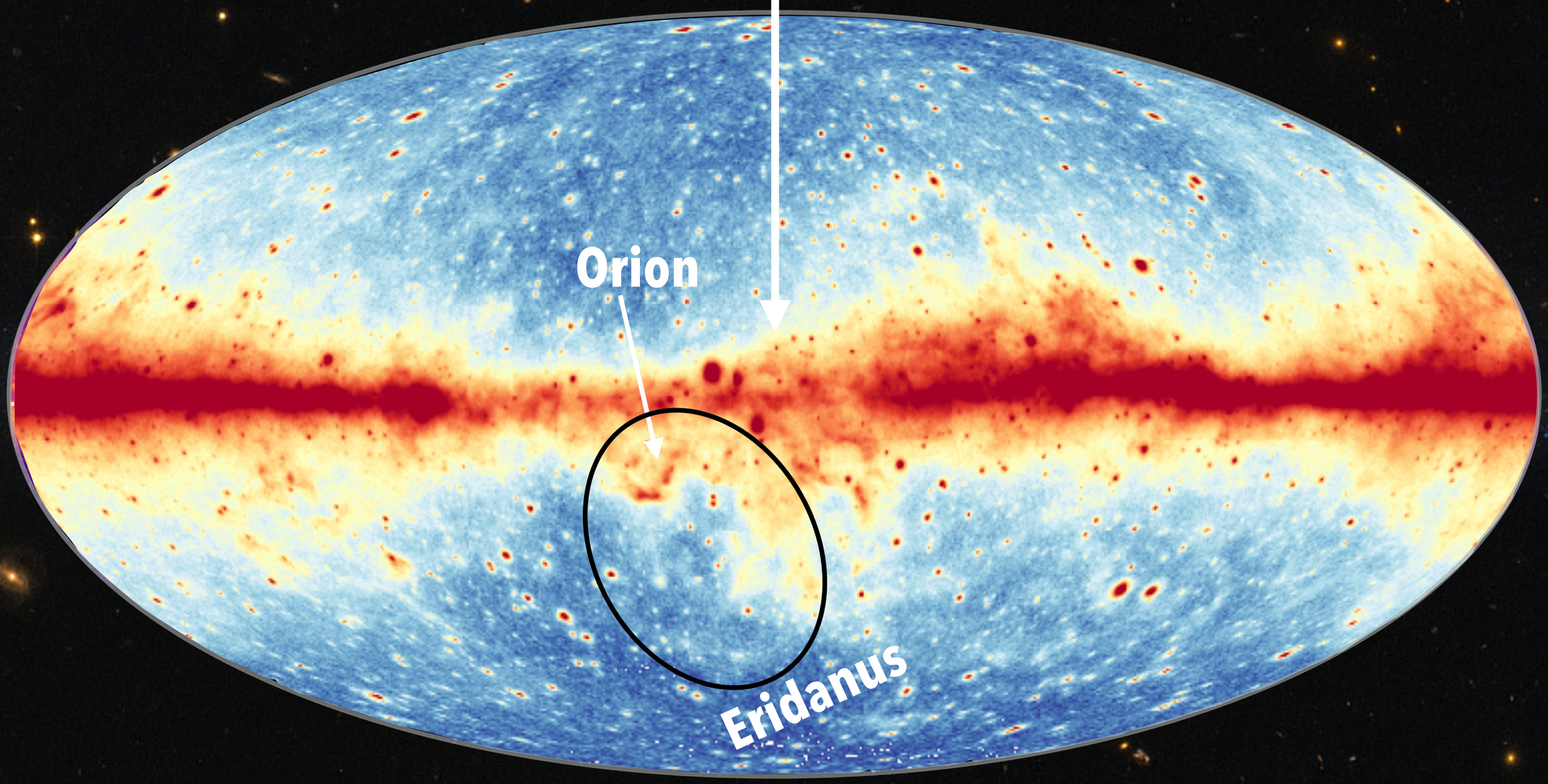
still 62 stars ≥ 8 $M_\odot$

(Voss et al., 2010)

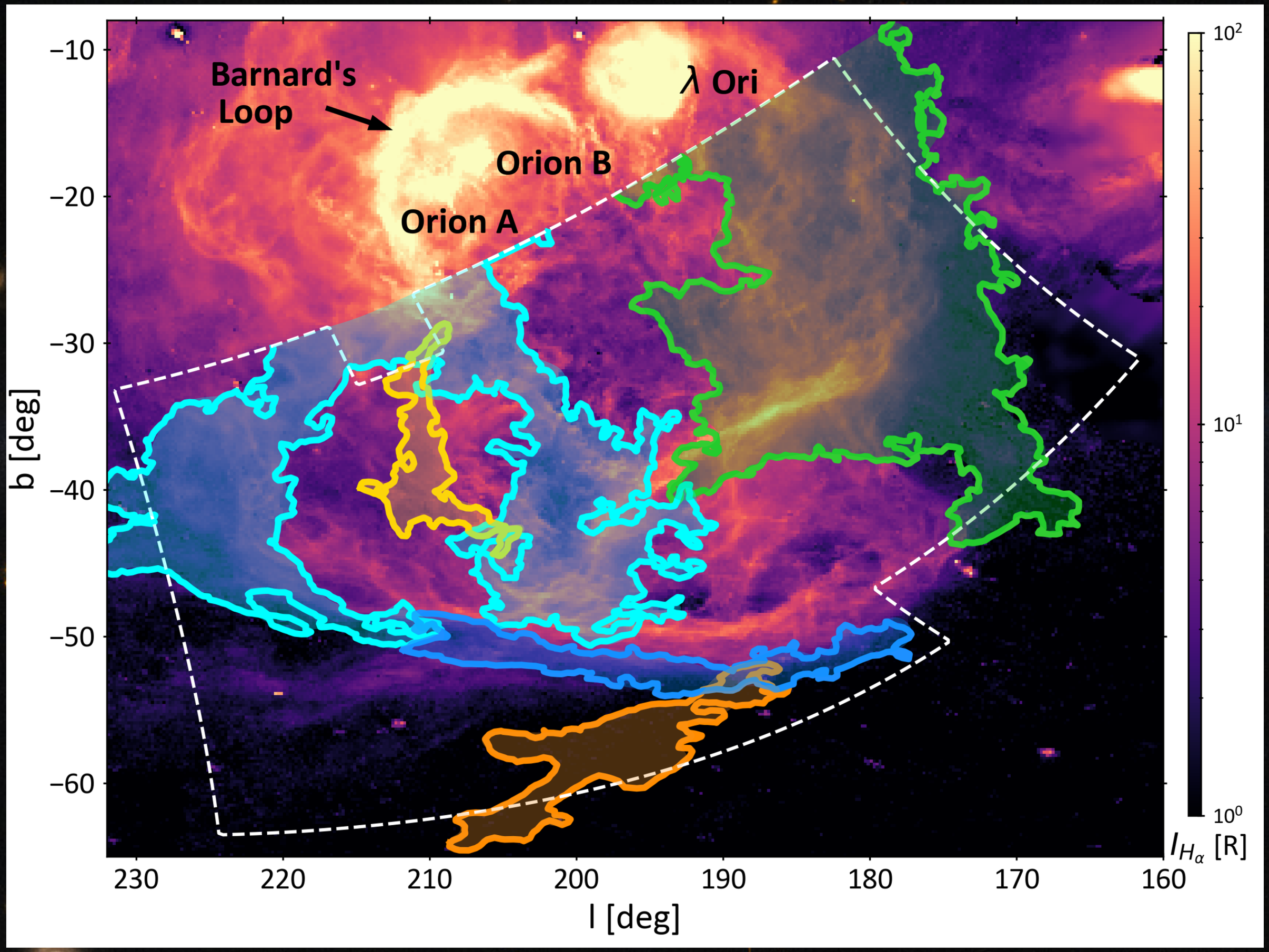
Hα recombining gas



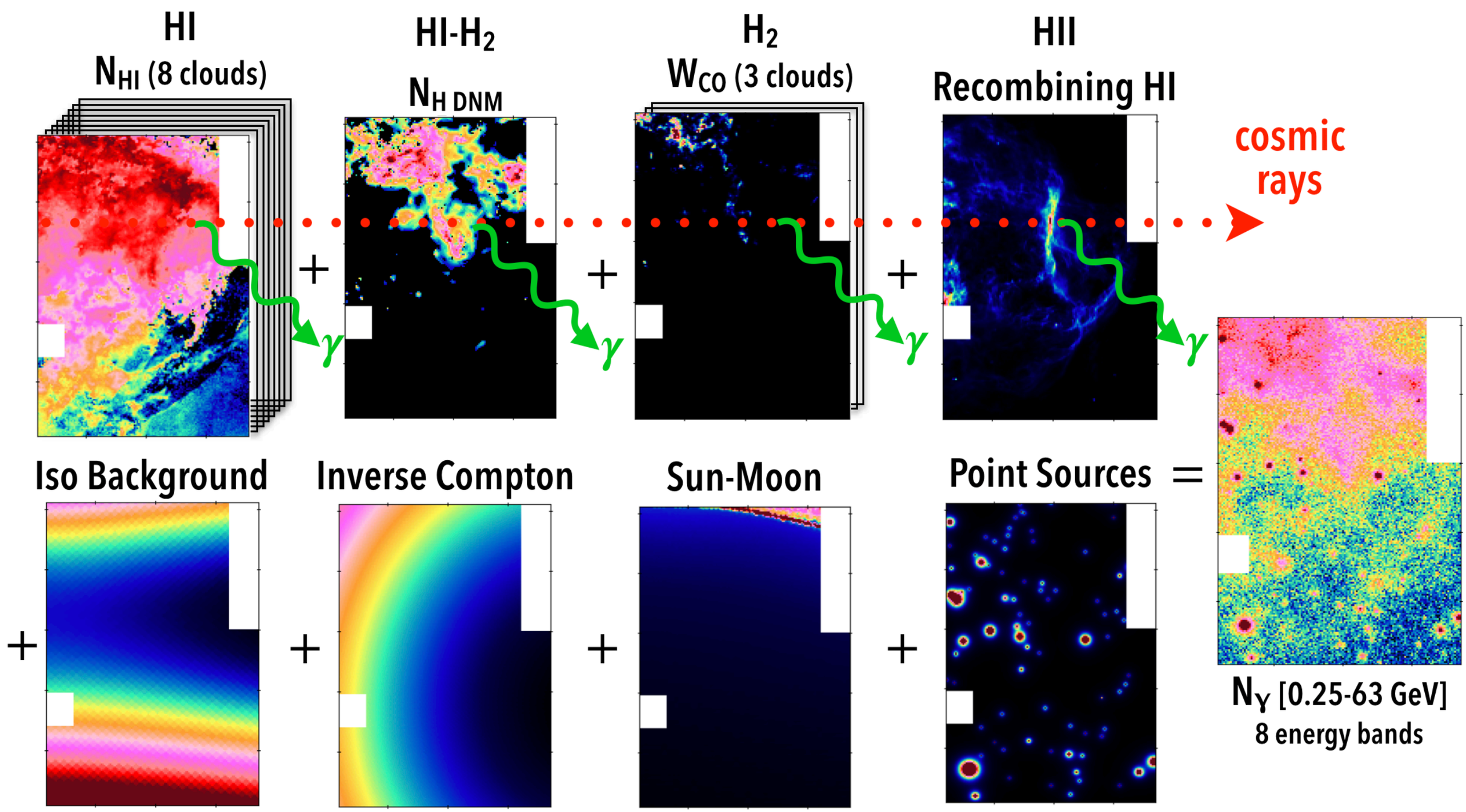
Fermi-LAT > 400 MeV



Cloud components in the superbubble



γ-ray model fitted to the LAT data



HI : HI4PI 2016, CO : CfA (Dame et al. 2001) + SEST, Hα : VTSS, SHASSA, WHAM (Finkbeiner 2003), Dust : Planck + IRAS optical depth at 353 GHz, γ : Fermi-LAT, 10 years, 0.25-63 GeV

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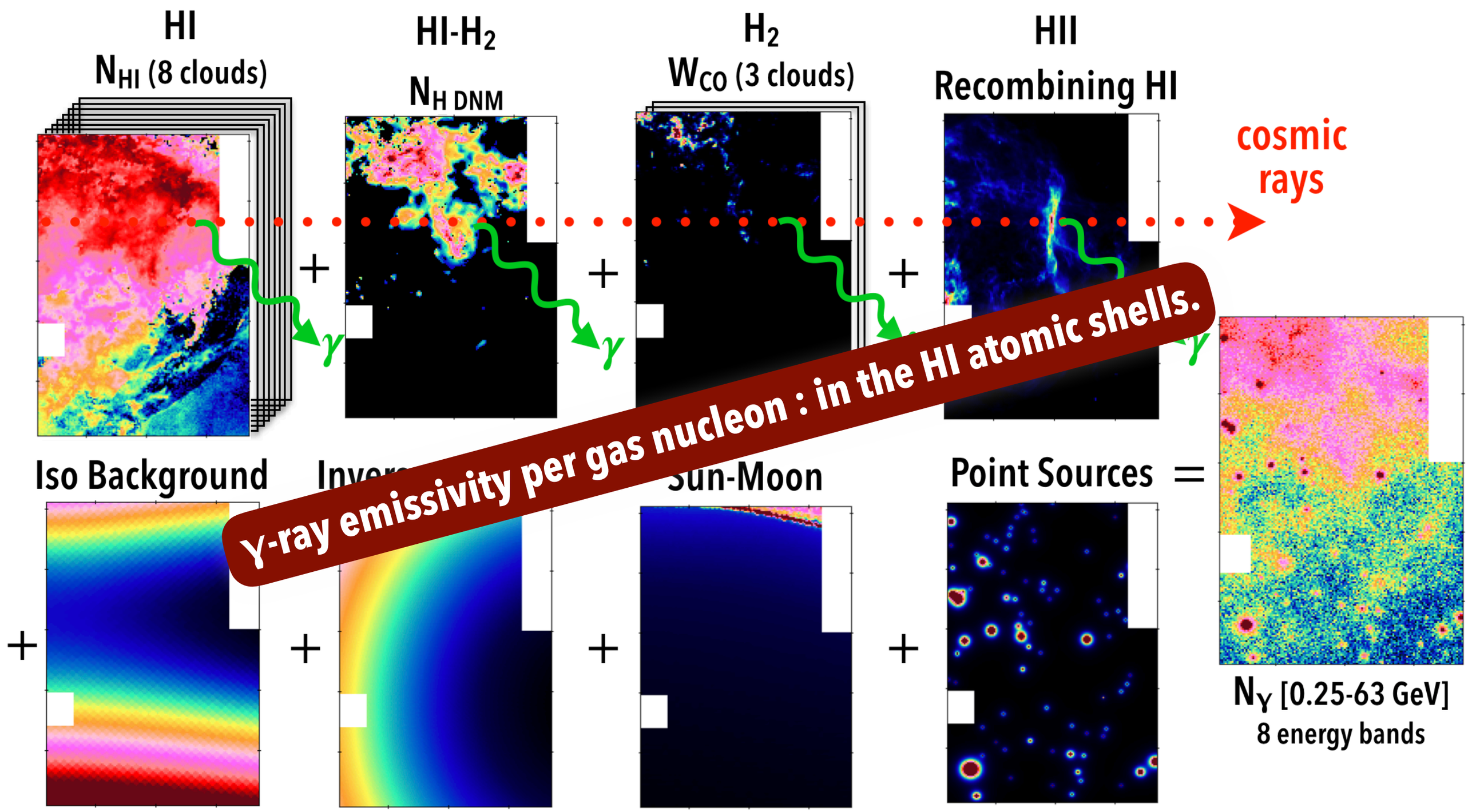

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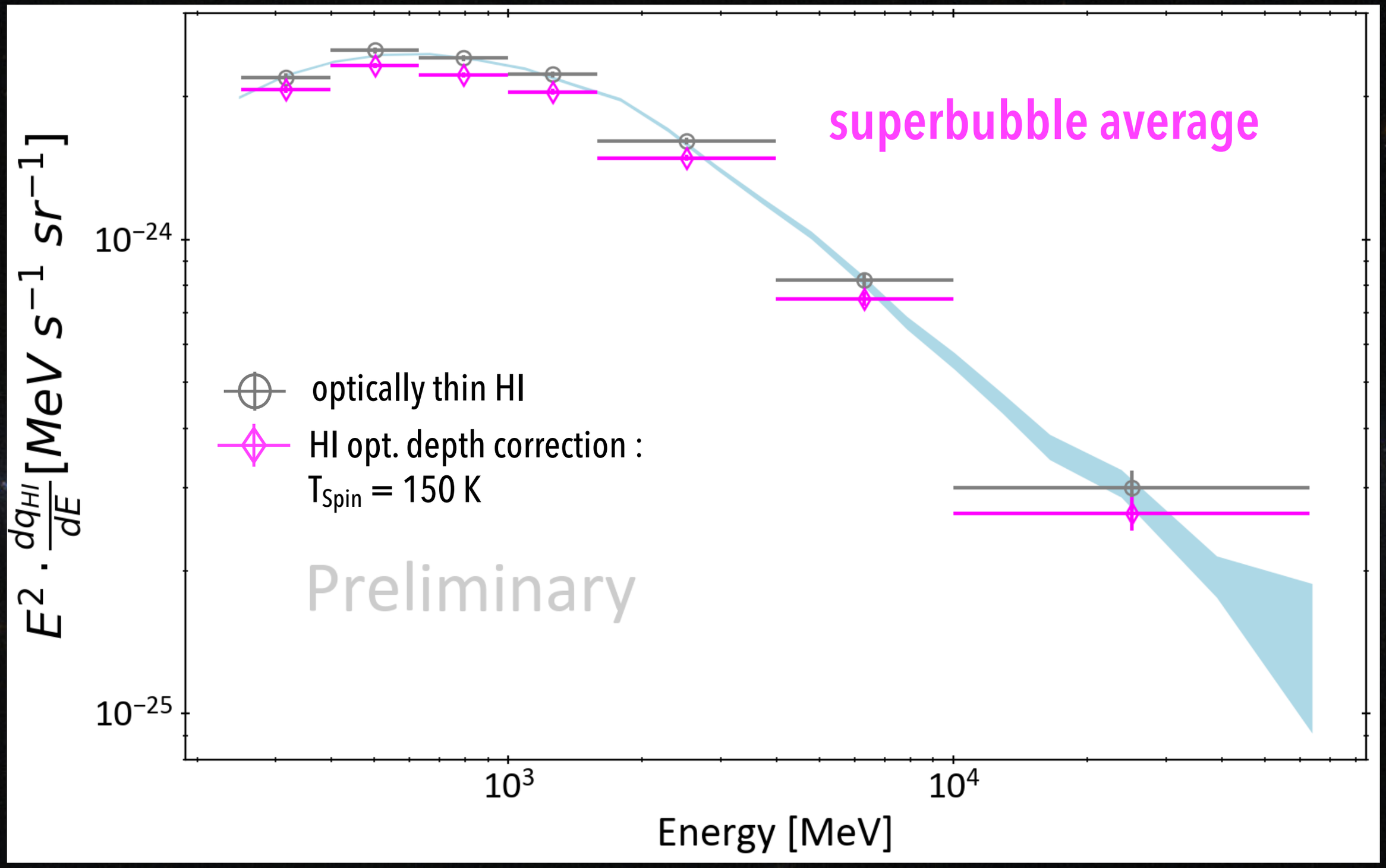
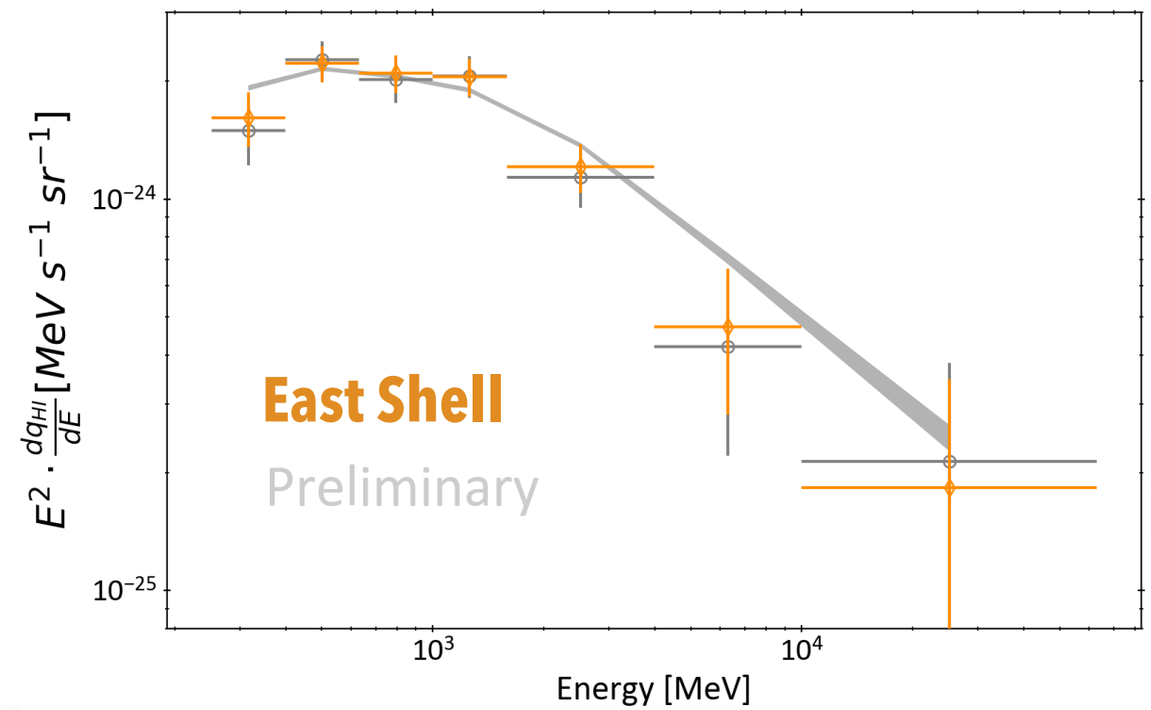
no hardening in the γ-ray emissivity spectrum

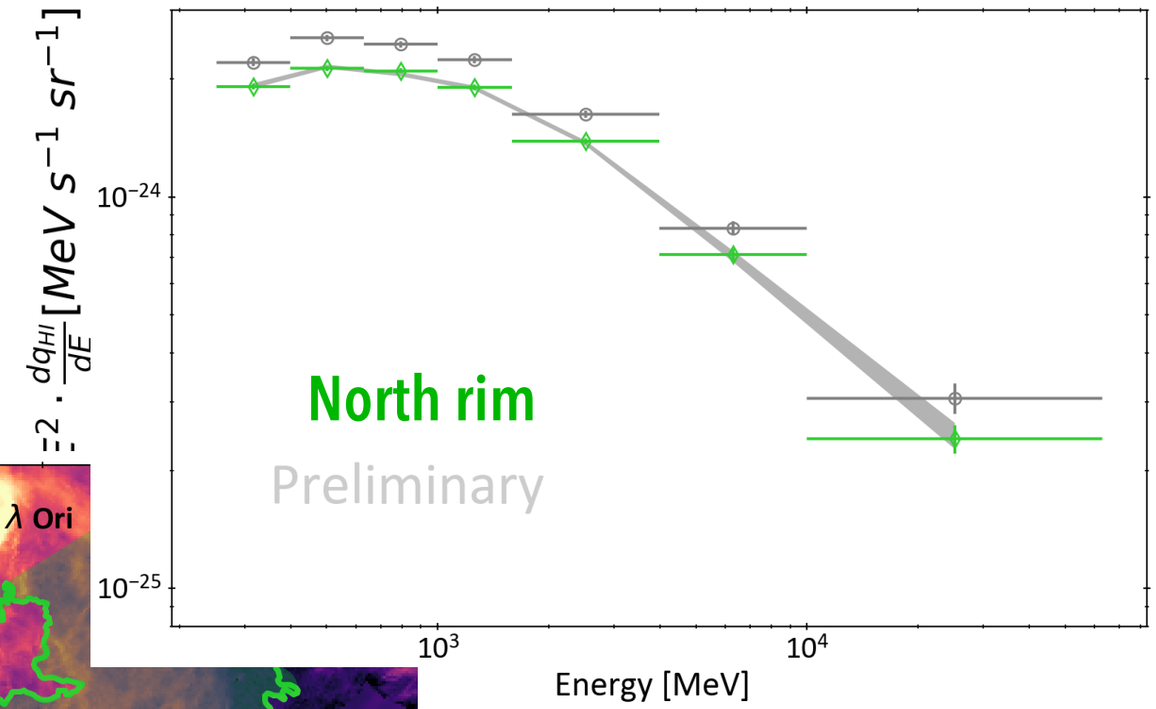


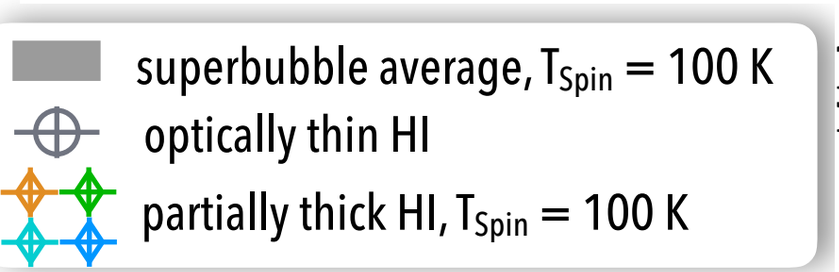
6% difference (12 σ)
inherent to N_{HI} uncertainty

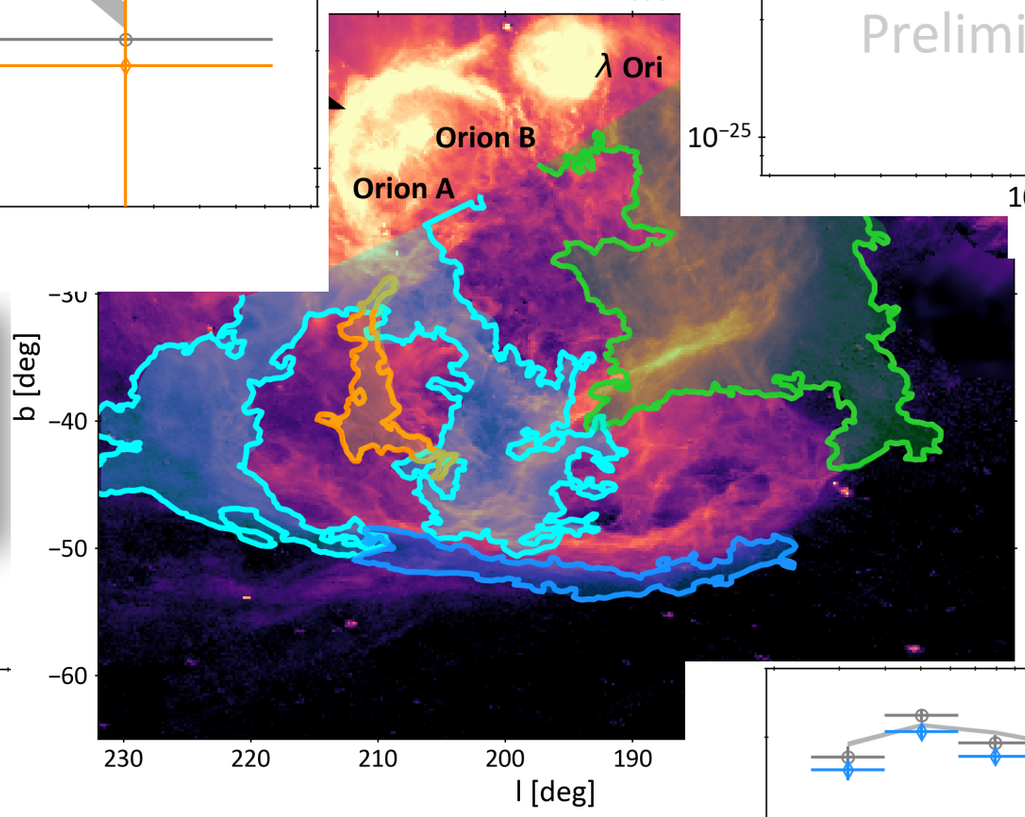
Local ISM average, T_{Spin} = 140 K
(Casandjian 2015)

uniform spectra in the superbubble

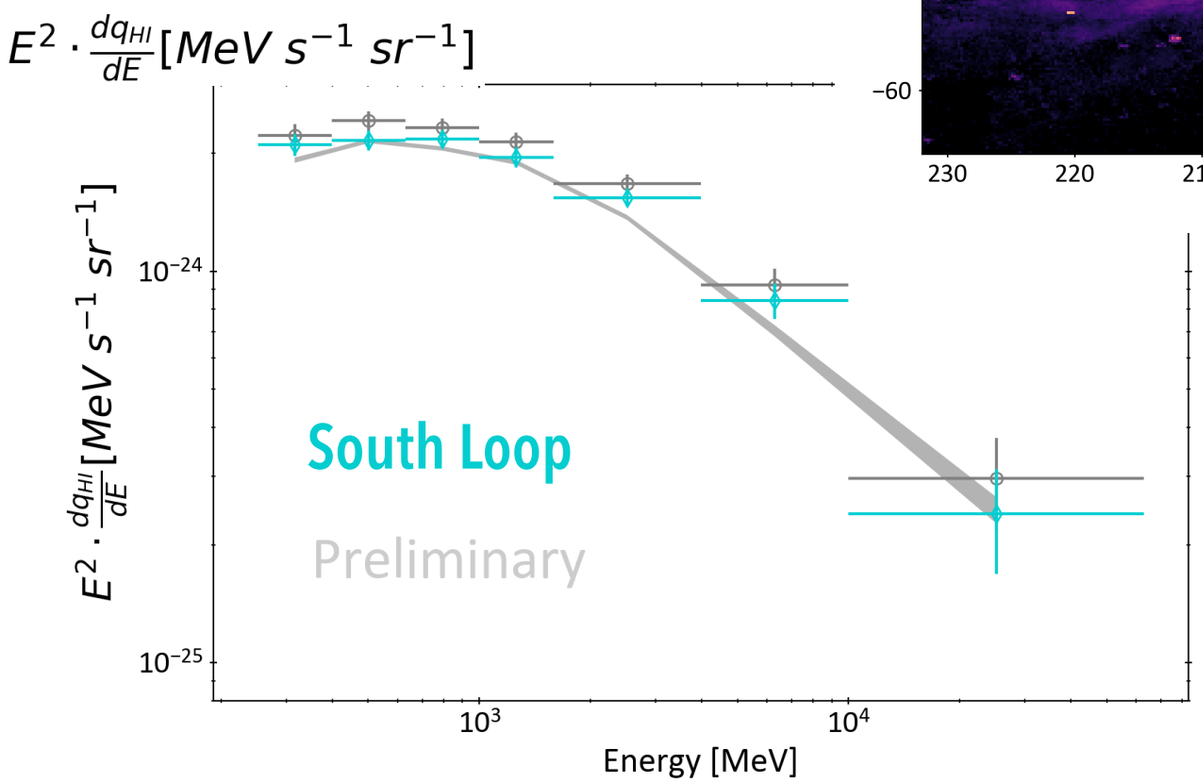


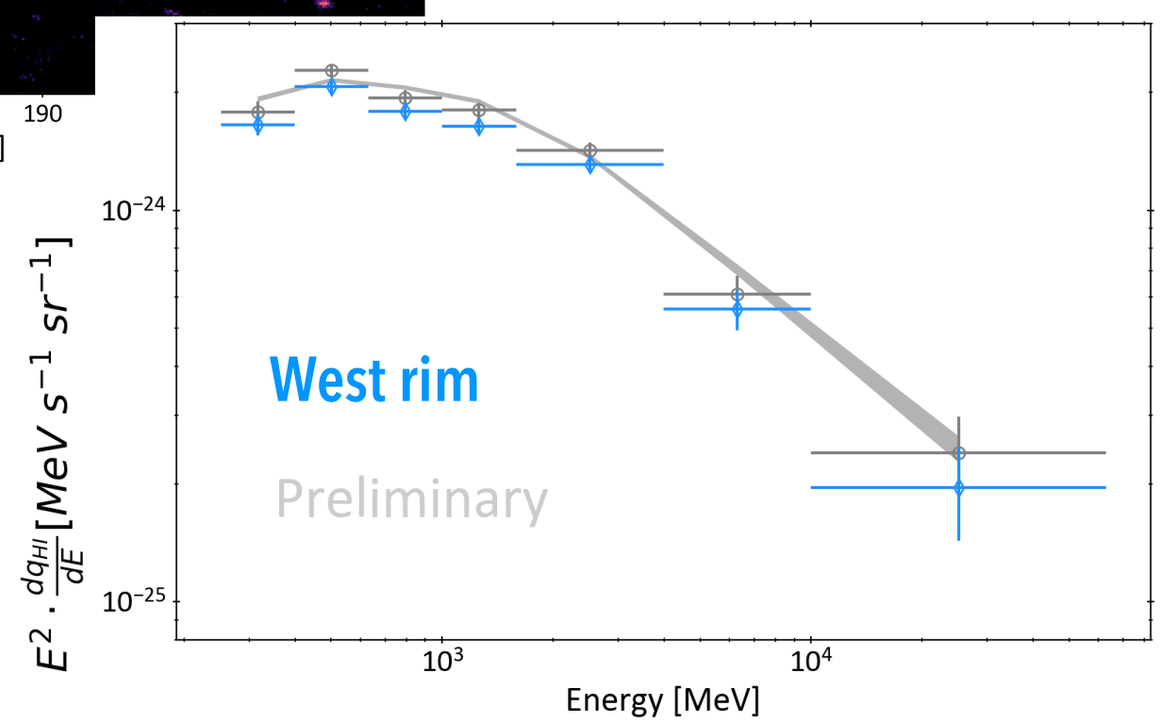




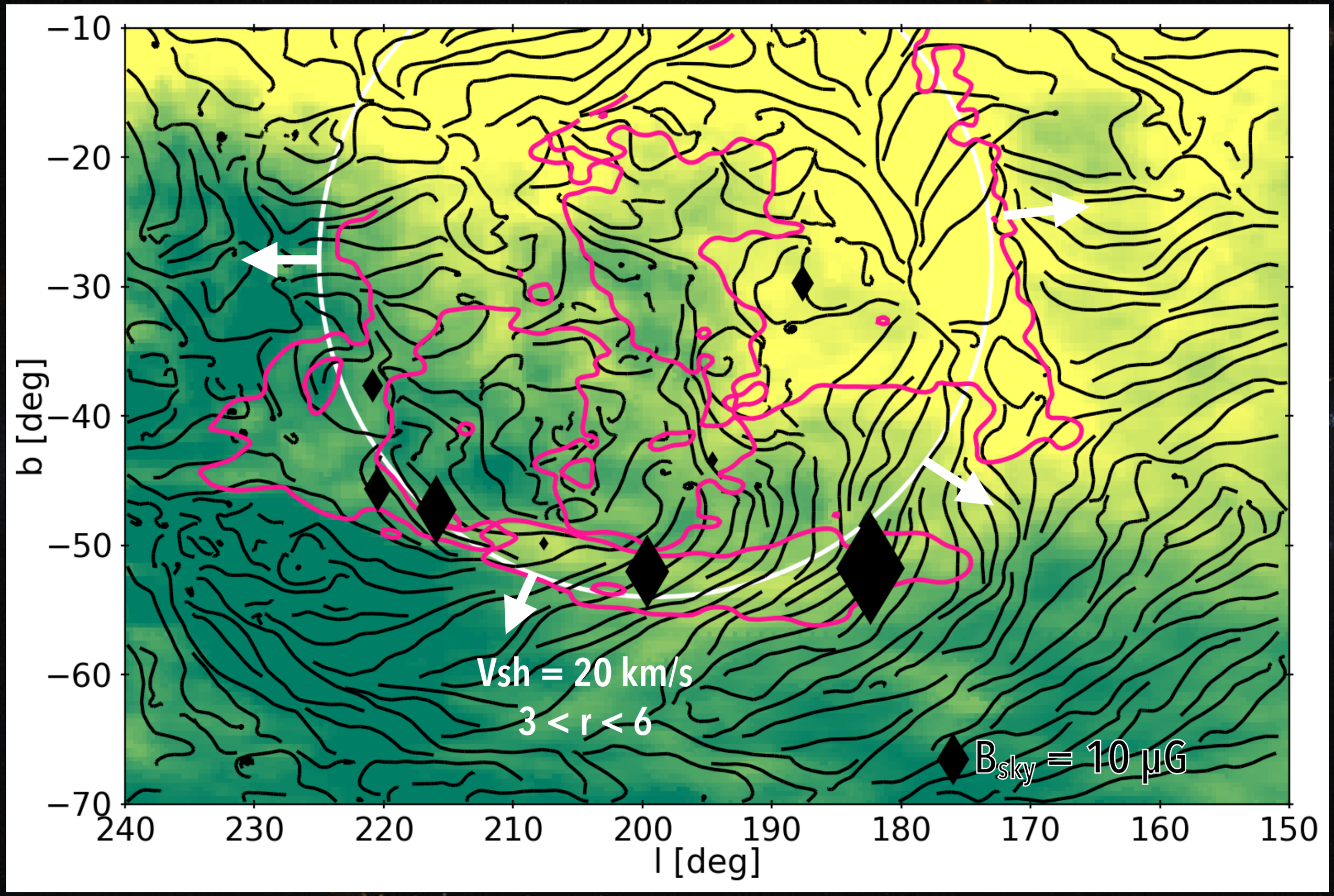


< 8% difference, consistent with systematic uncertainties in N_{HI}



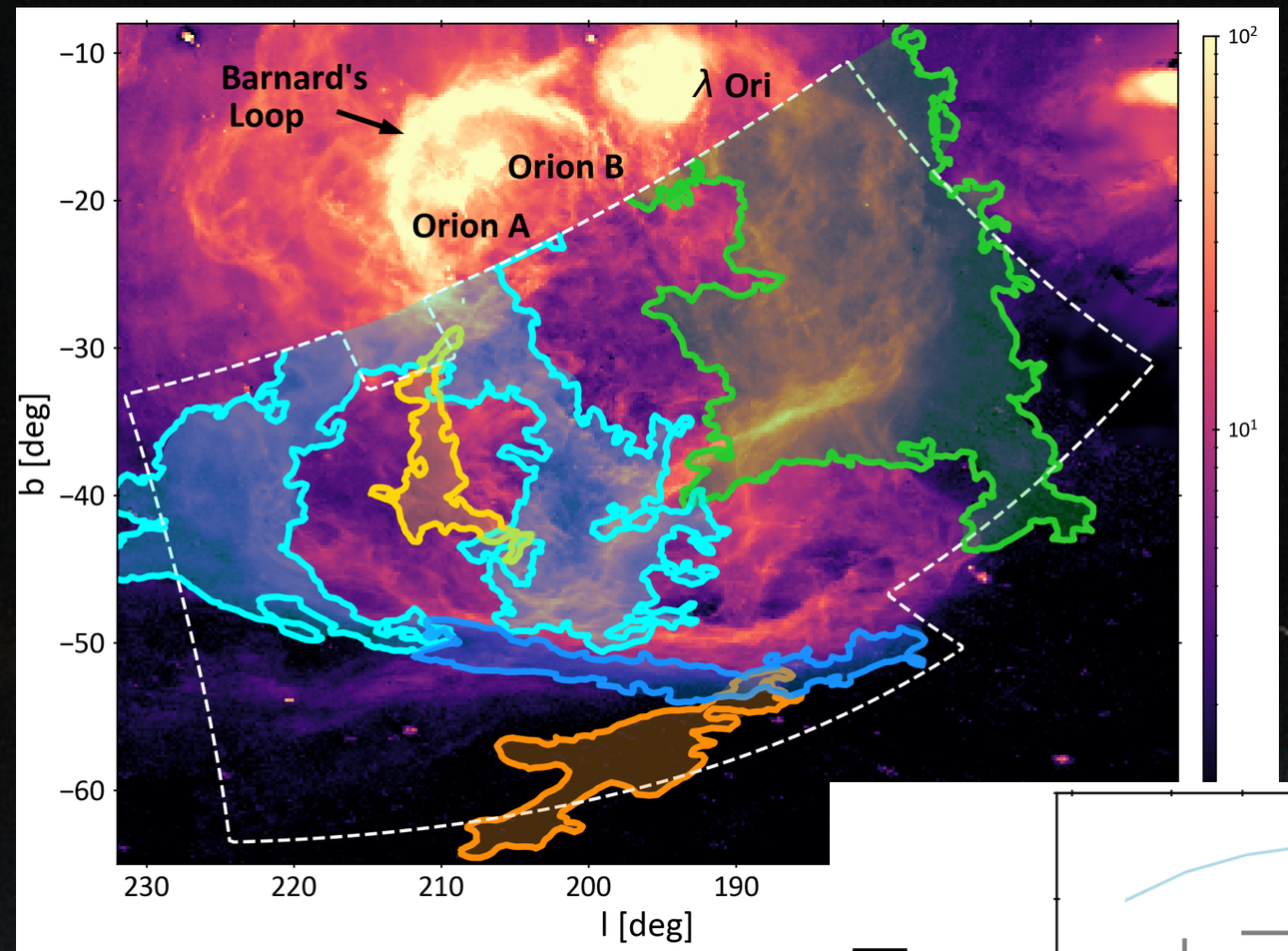


Wrapped, compressed magnetic field

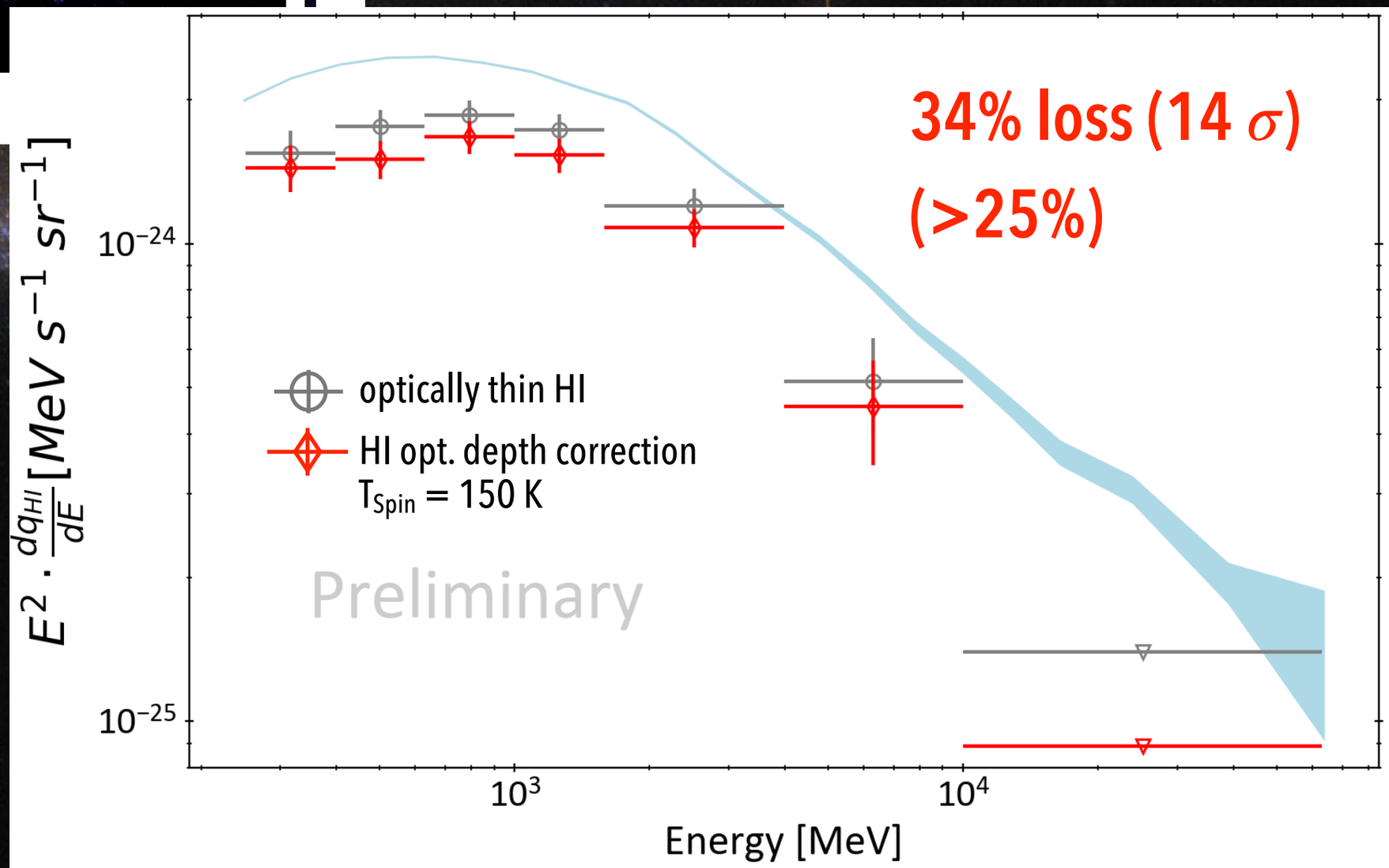


Planck dust polarised emission at 353 GHz + HI (LAB) + HI contours (0.5° smoothing)

Loss of cosmic rays in a diffuse cirrus outside the superbubble

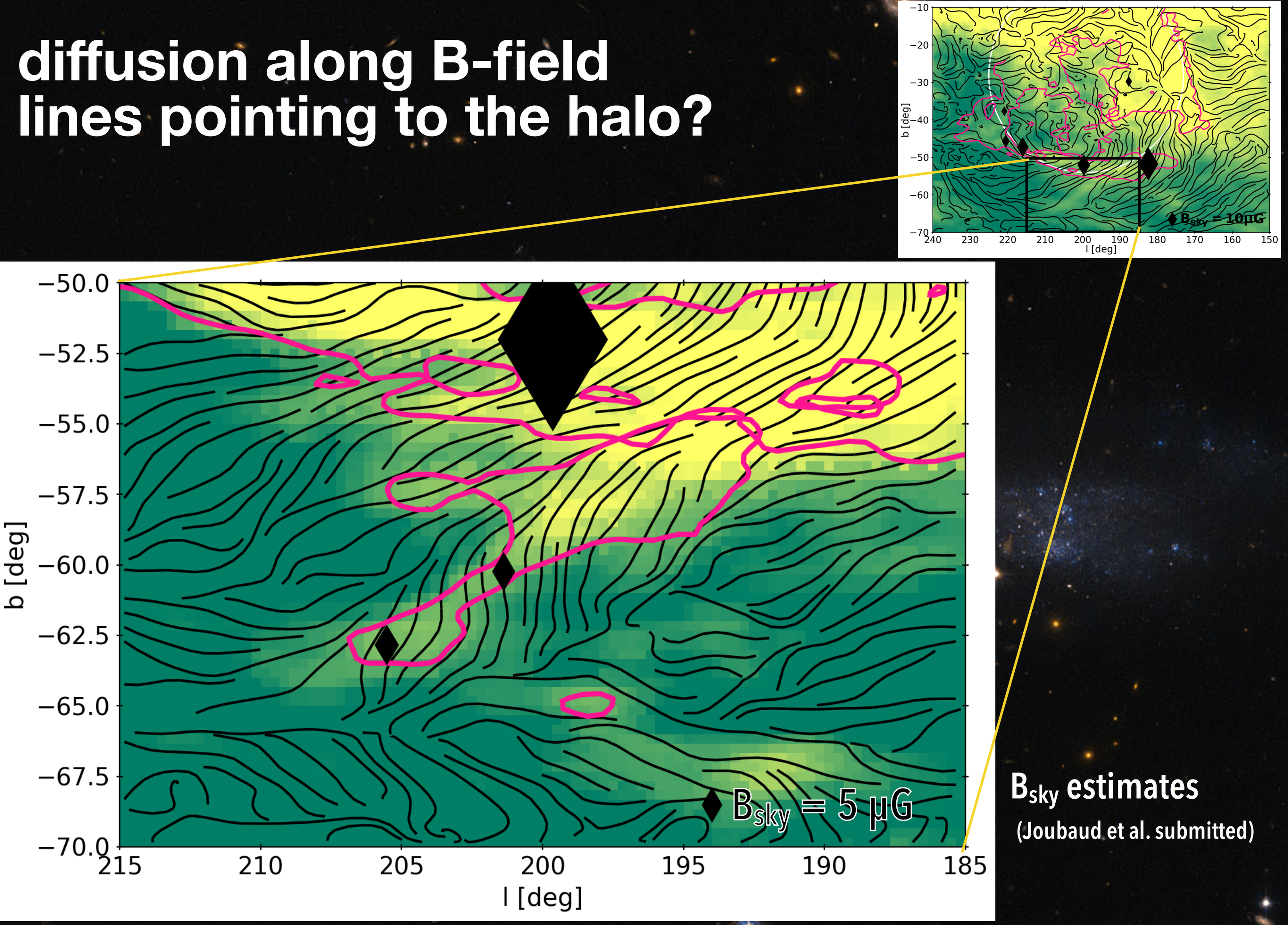


Eridu cirrus
D = 200-300 pc



Local ISM average, T_{Spin} = 140 K
(Casandjian 2015)

diffusion along B-field lines pointing to the halo?



B_{sky} estimates

(Joubaud et al. submitted)

Planck dust polarised emission at 353 GHz + HI (LAB) +HI contours (0.5° smoothing)

Conclusions

- Little impact of MHD turbulence on CR propagation at ~ 3-600 GeV,
- no spectral hardening indicating (re)acceleration,
- unexpected « grey » loss of 34% in a cirrus cloud outside the superbubble.

Thank you for your attention !