Fermi Planck Synergies

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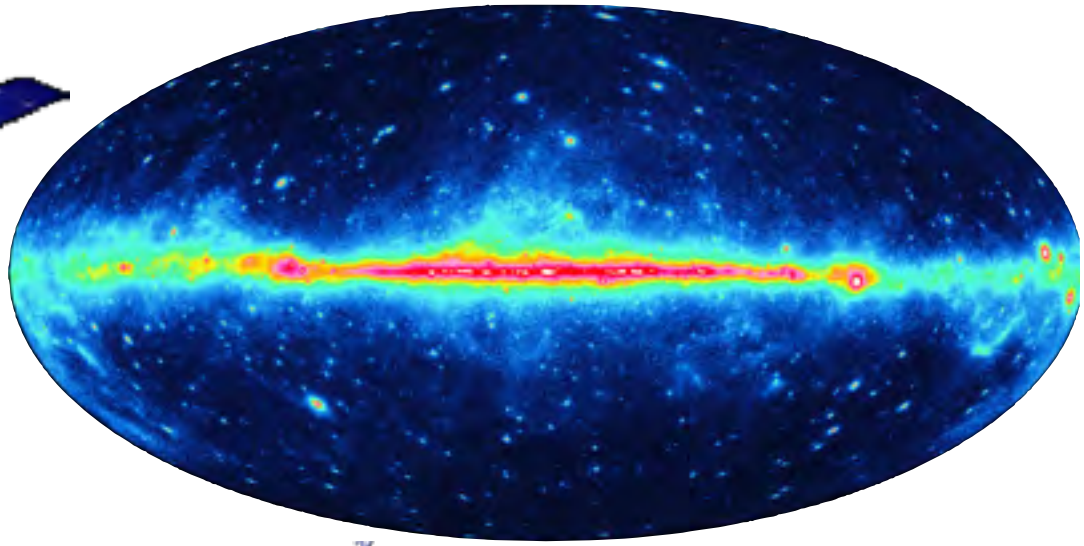
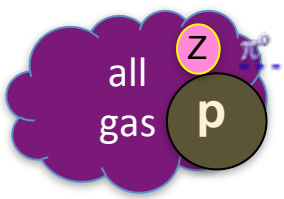
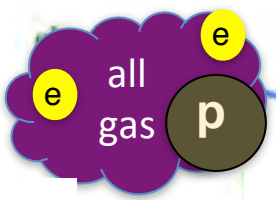
with help from
A. Strong, E. Orlando, P. Giommi

the γ-ray sky





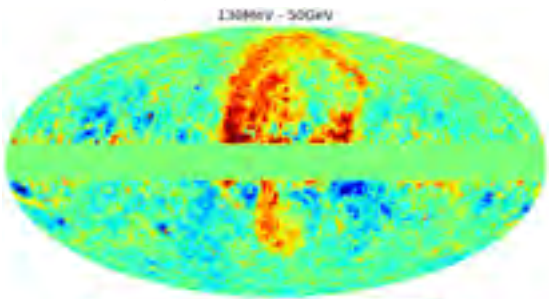


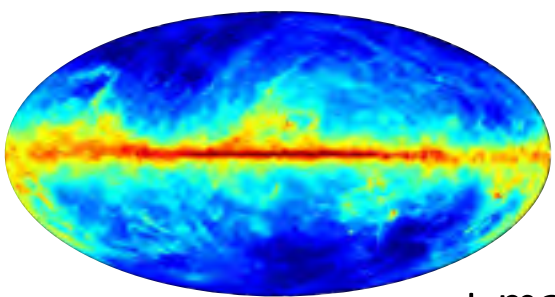
γ ray

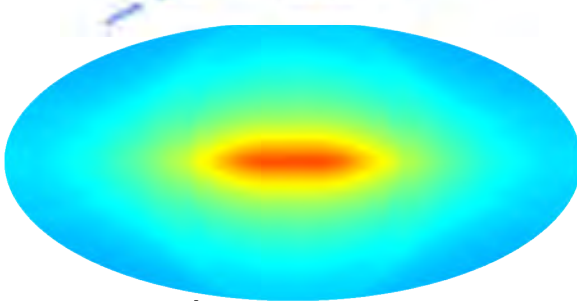
γ ray

γ ray

e

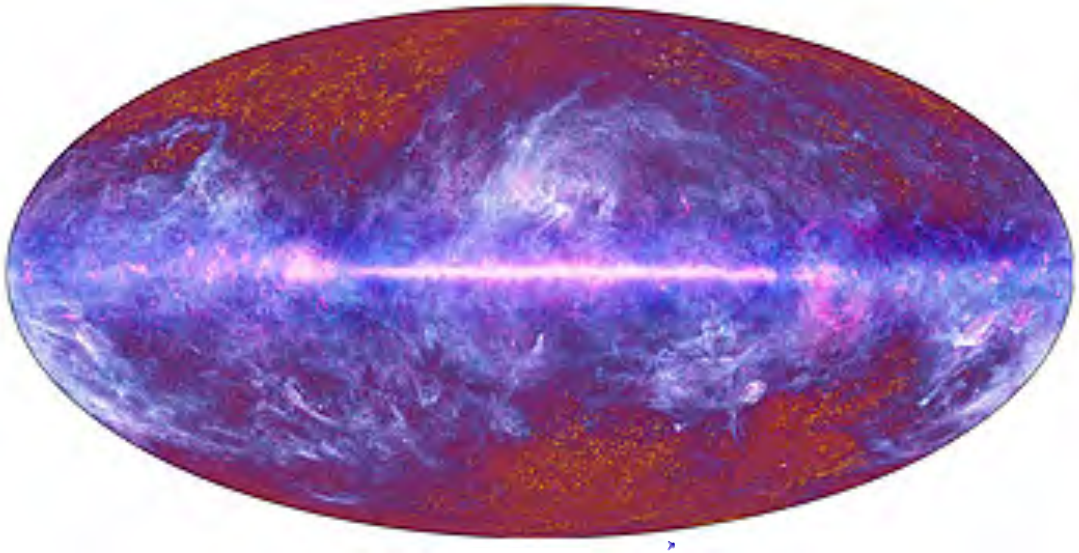




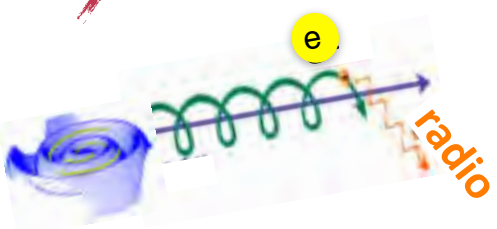


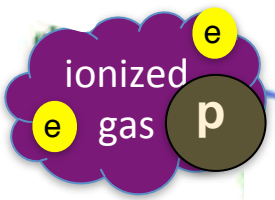
+ many sources !

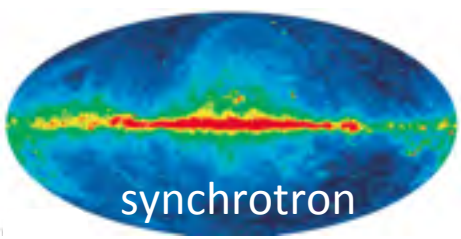
the microwave sky

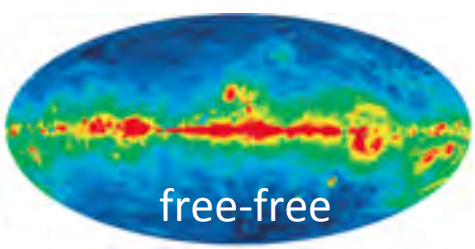


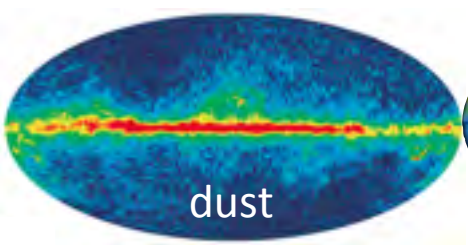
PLANCK 1 year
30 GHz to 857 GHz

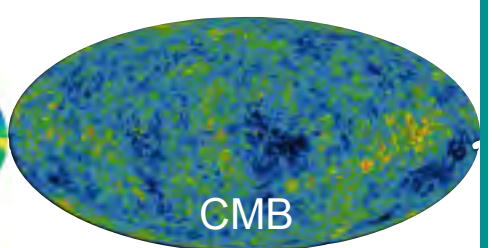








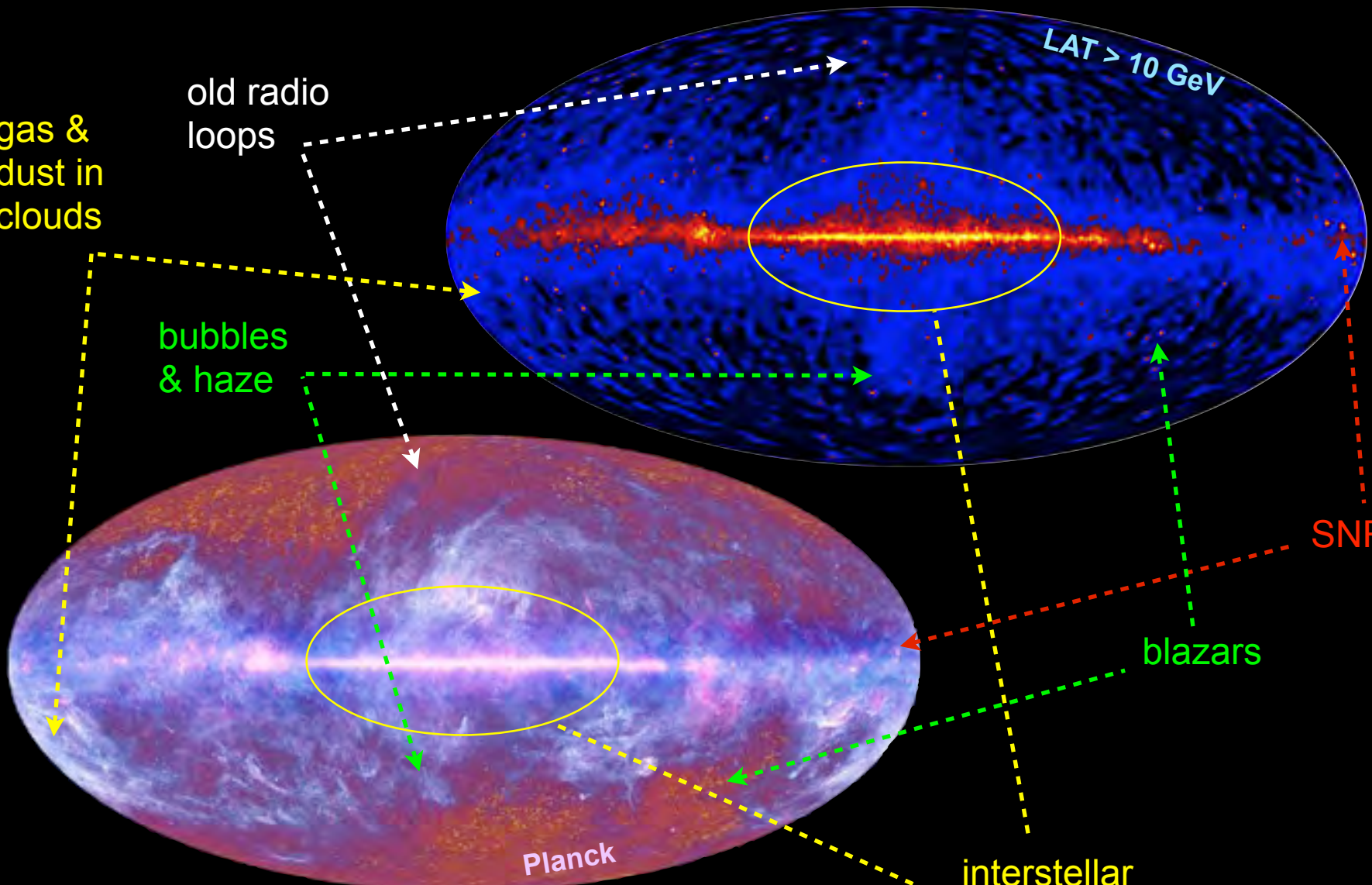




WMAP

+ sources + spinning dust

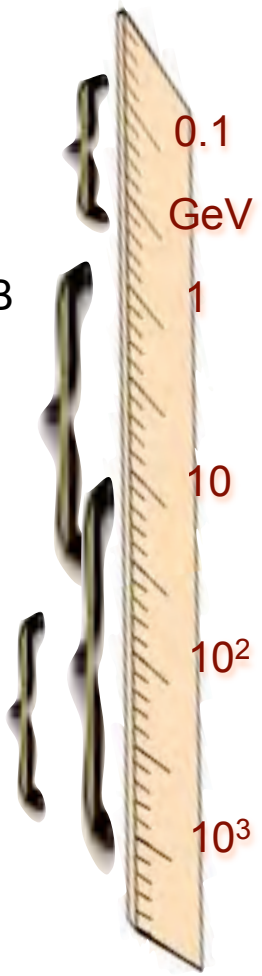
multiple synergies



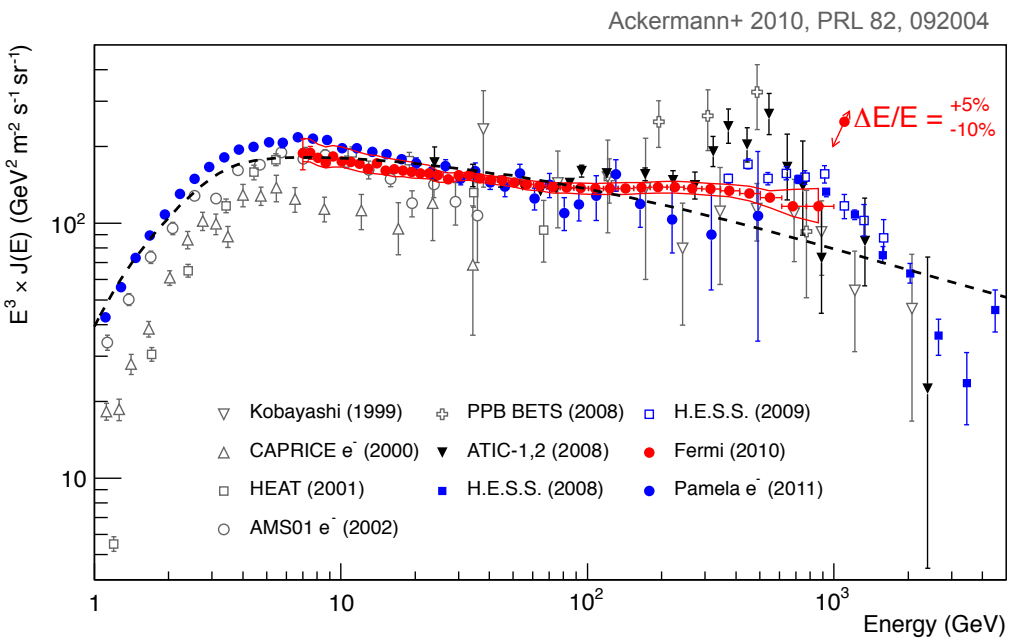

cosmic-ray
electron
synergies

sampling the CR electron spectrum

- remote measurements
- bremst. emission in gas (Fermi)
- synchrotron emission in B (radio + Planck) ⇒
  - e^- spectrum & flux
  - B field
- direct measurement (Fermi + others)
- IC emission in ISRF (Fermi + Planck constraints on ISRF)



in-situ measurements (solar modulation)



$e^{\pm}$ spectrum & total B field

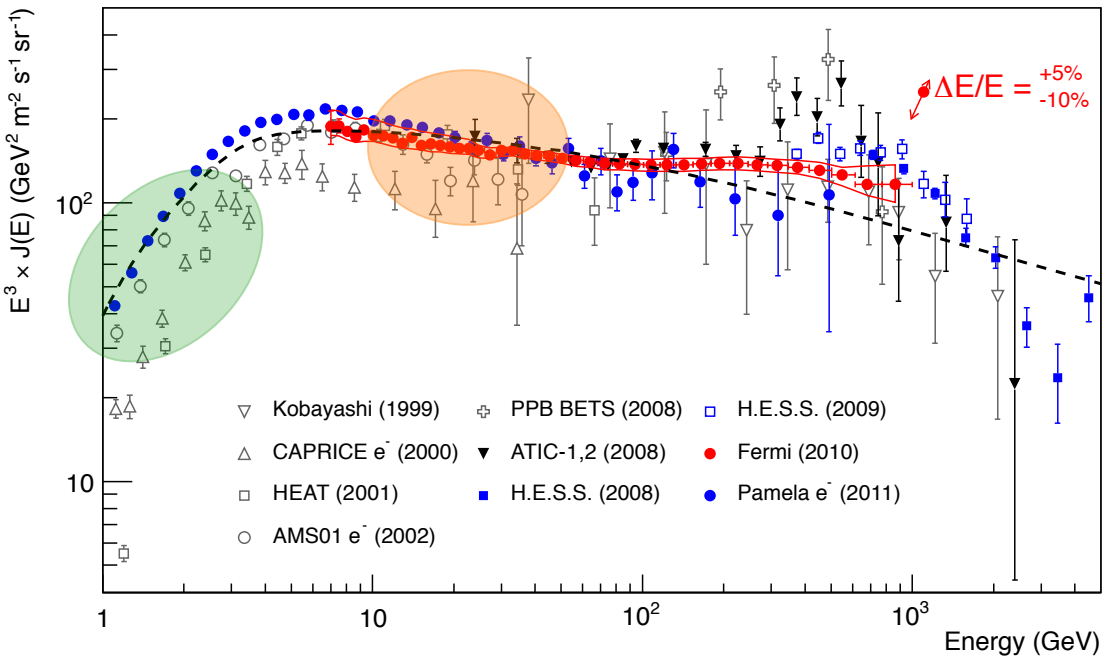
- low-energy electron break
  $E_e^{-1.6}$ | $E_e^{-2.5}$ | $E_e^{-2.2}$

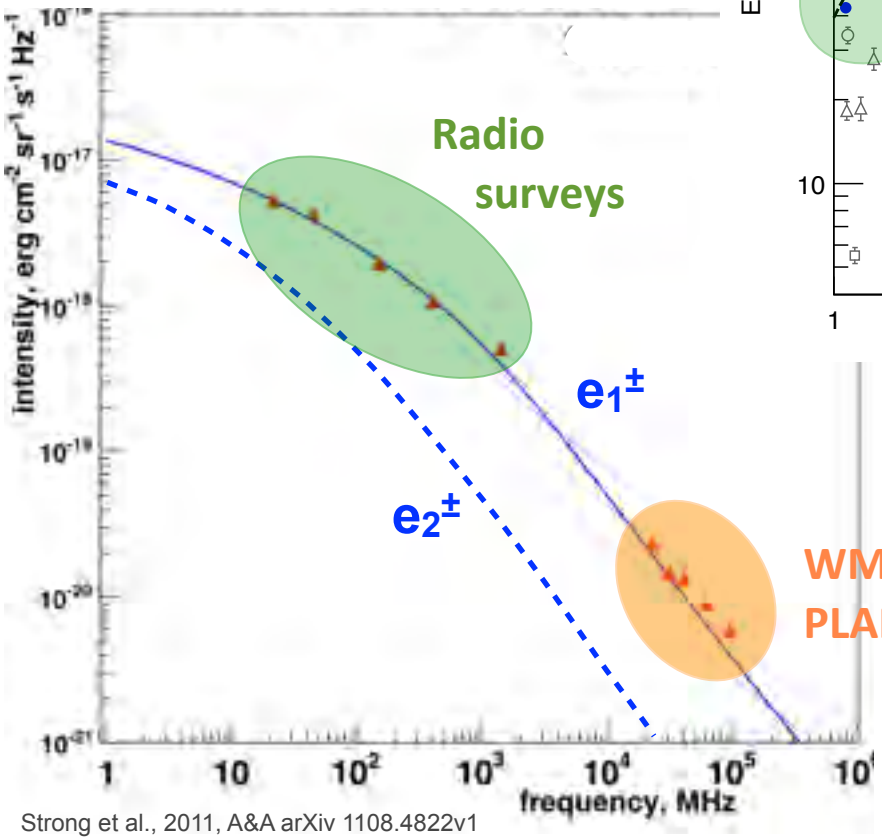
  4 GeV 50 GeV

  - $E_e^{-2.2}$ steeper than in SNRs
  - significant $e_2^{\pm}$ contribution at low energy

- $B_{rand} \sim 7.5\ \mu G\ e^{-R/30\ kpc}\ e^{-z/4\ kpc} > B_{reg} \sim 2\ \mu G$

Ackermann+ 2010, PRL 82, 092004





Strong et al., 2011, A&A arXiv 1108.4822v1

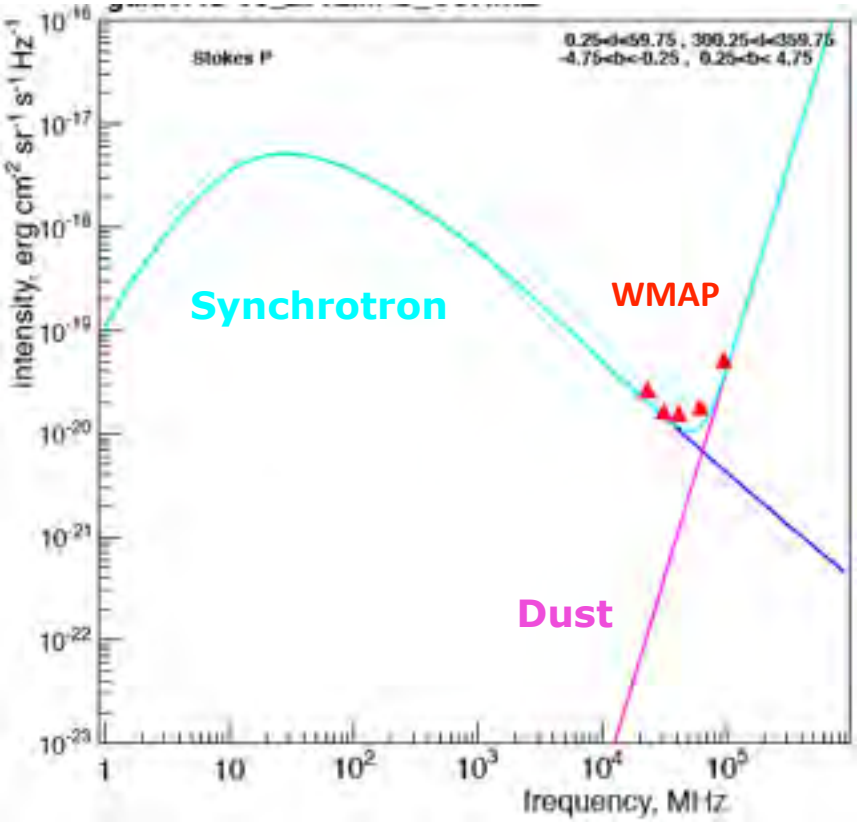
remote synchrotron ⇒ interstellar spectrum before modulation

remote vs. local electrons ⇒ determination of B field

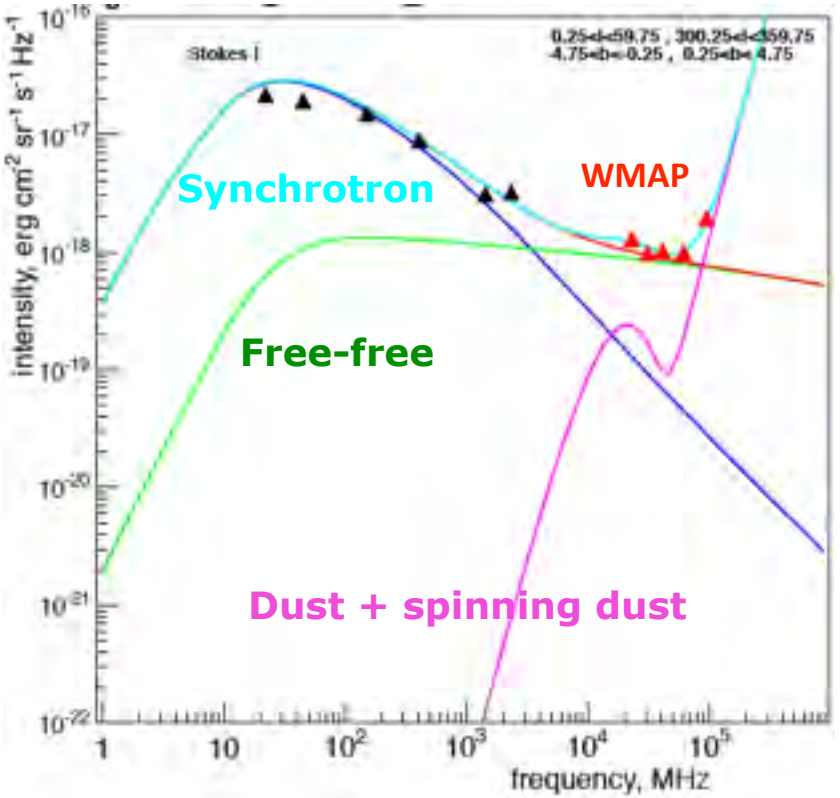
a step toward 3D mapping of e± and B

- synchrotron emission in the inner Galaxy, total and polarized ⇒ B_{random} & $B_{regular}$

- polarized emission



total emisison

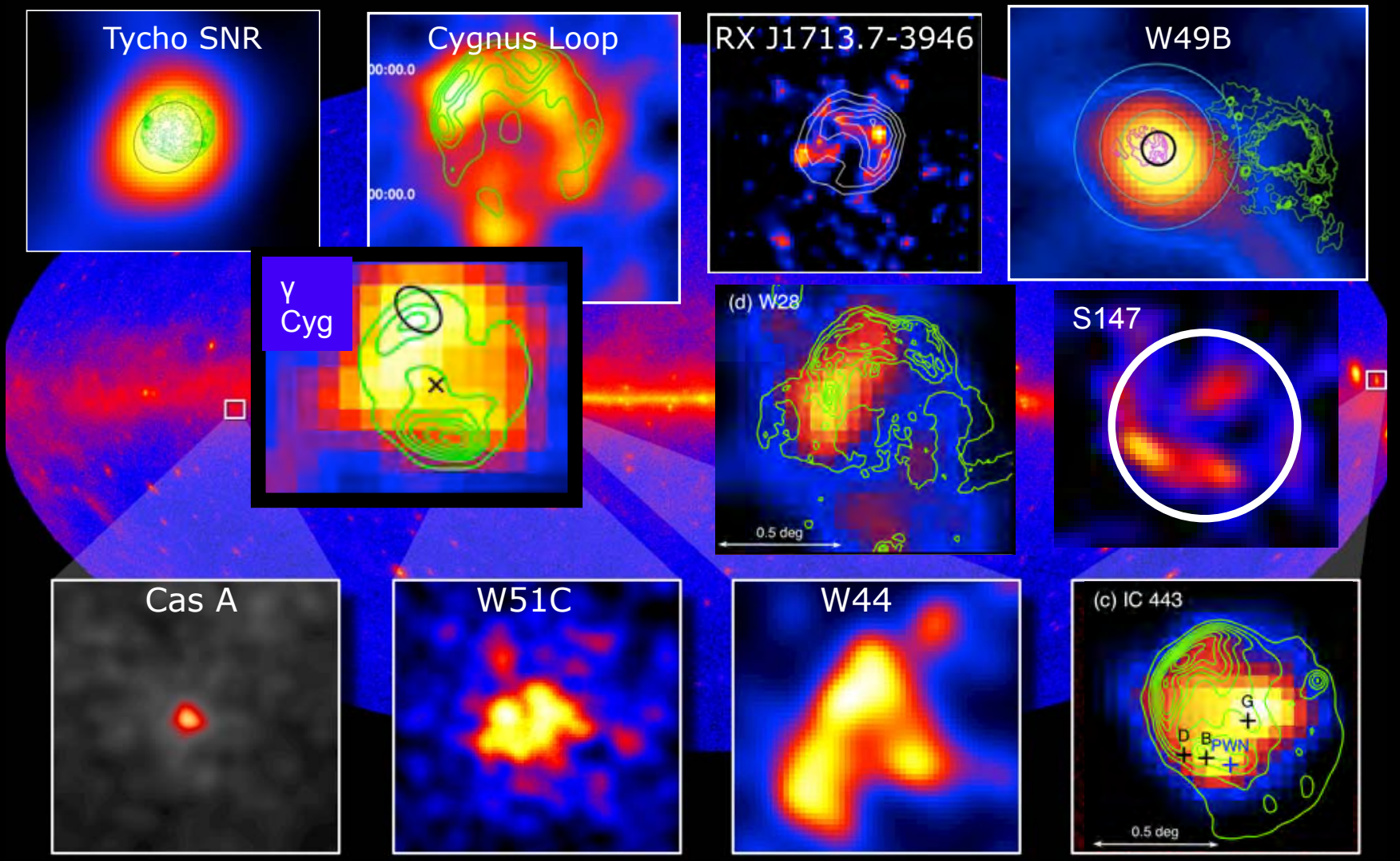


Orlando & Strong, ApJ submitted: see poster

gallery of GeV supernova remnants

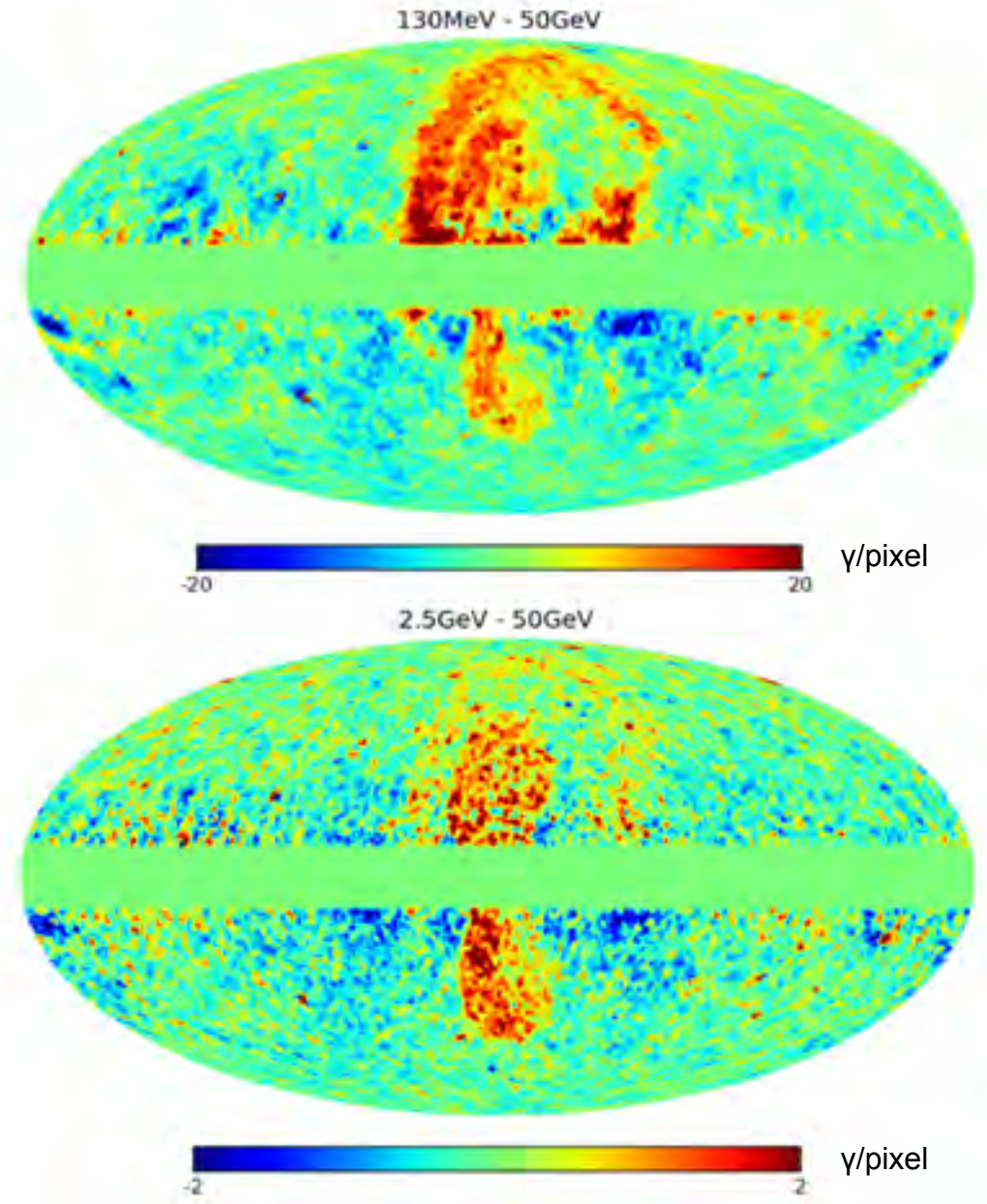
- Planck/Fermi/HESS+MAGIC+VERITAS:
  - spatial correlations of multi-GeV electrons and γ rays inside remnants ?
  - electron ageing inside remnants

Puppis A: see poster by J. Hewitt



Loop I & Fermi bubbles

- Fermi LAT 3 years residuals above gas, IC, isotropic, & point-sources

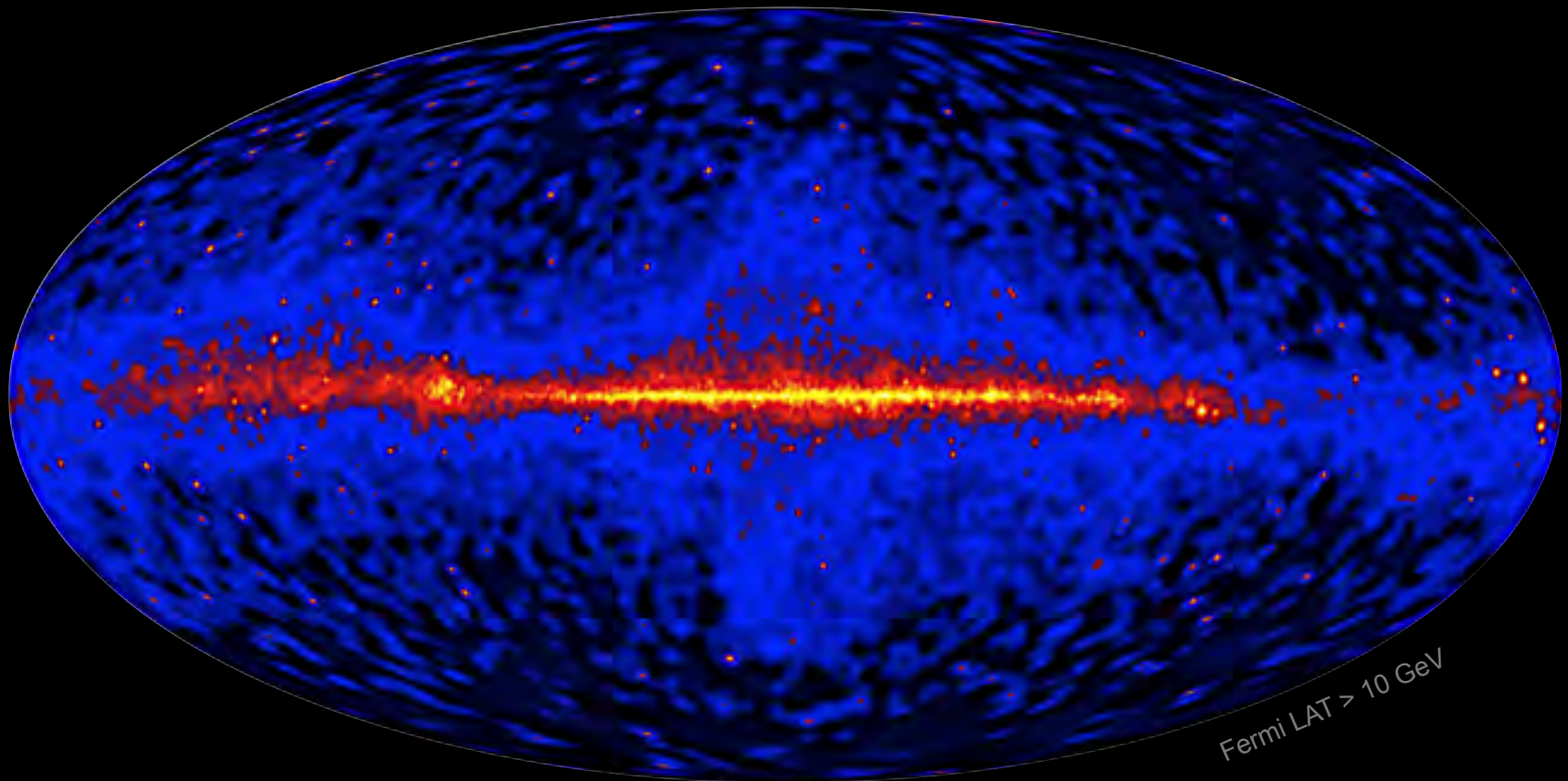


Casandjian et al. 2009
eConf Proceedings C091122

Su et al. 2010, ApJ 724, 1044

whence ?

- 4 years Fermi > 10 GeV and Planck haze
- cosmic rays in Galactic winds? from a nearby bubble? jets from the central black hole?



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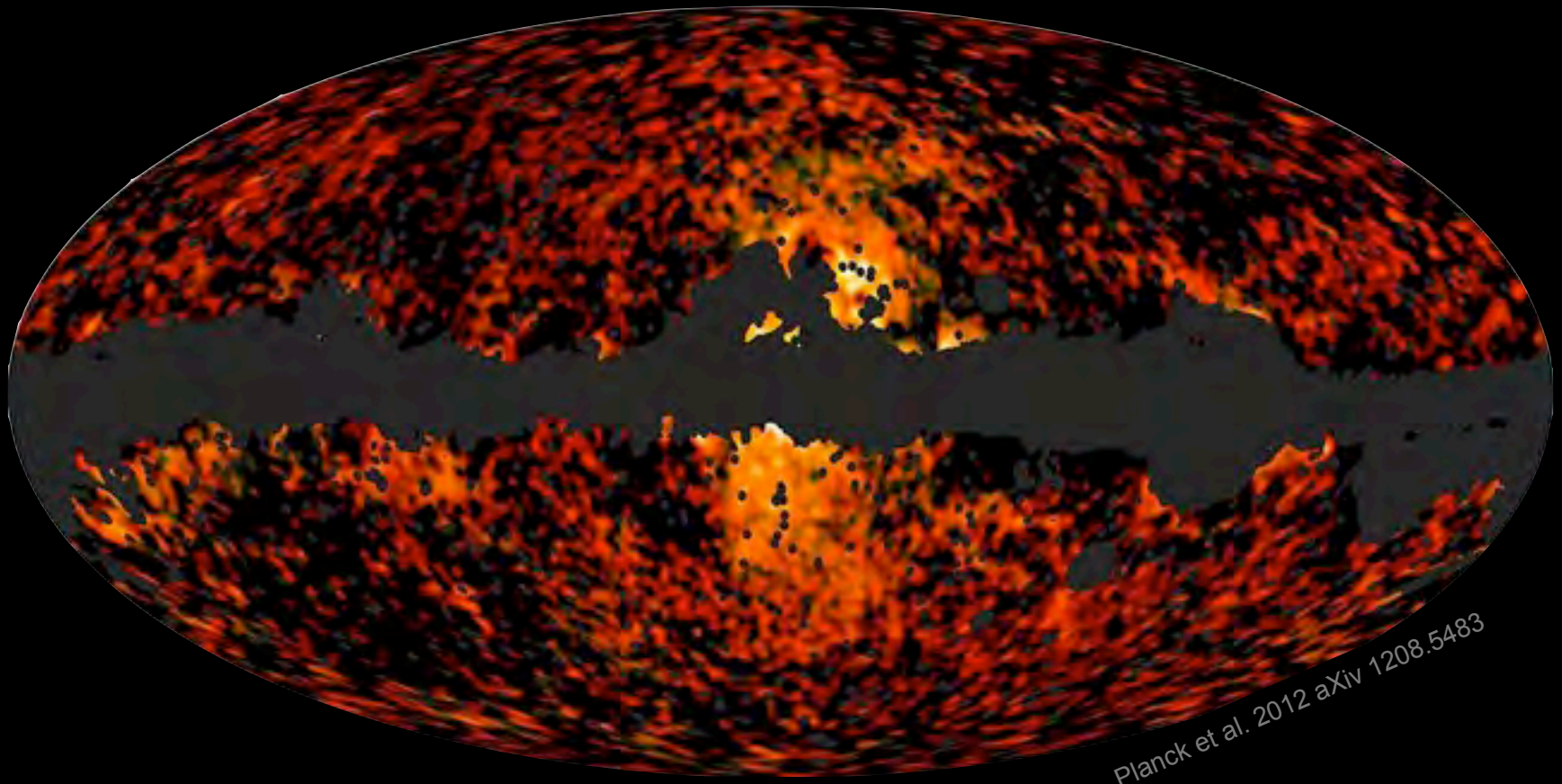

Planck et al. 2012 aXiv 1208.5483

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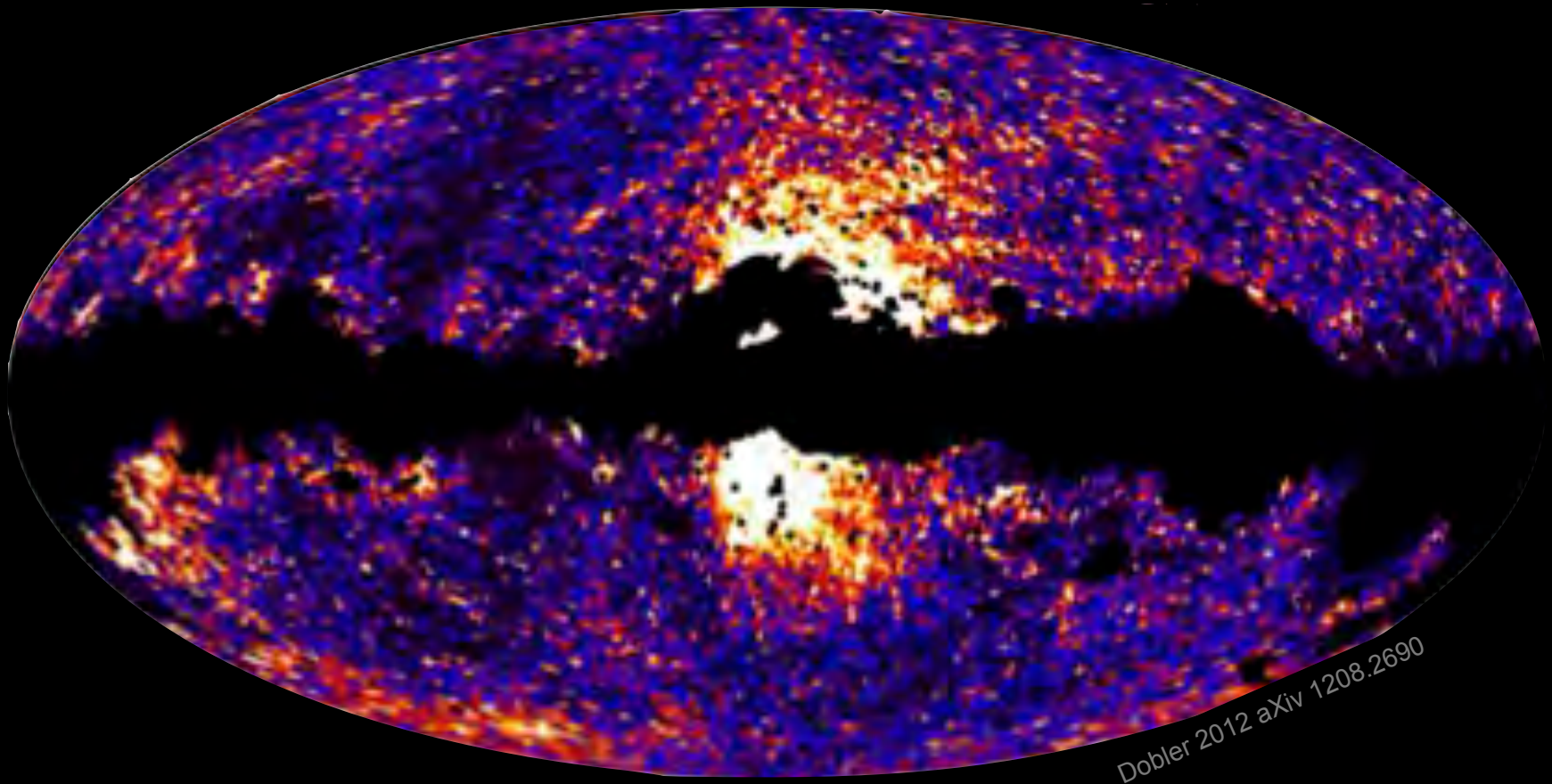
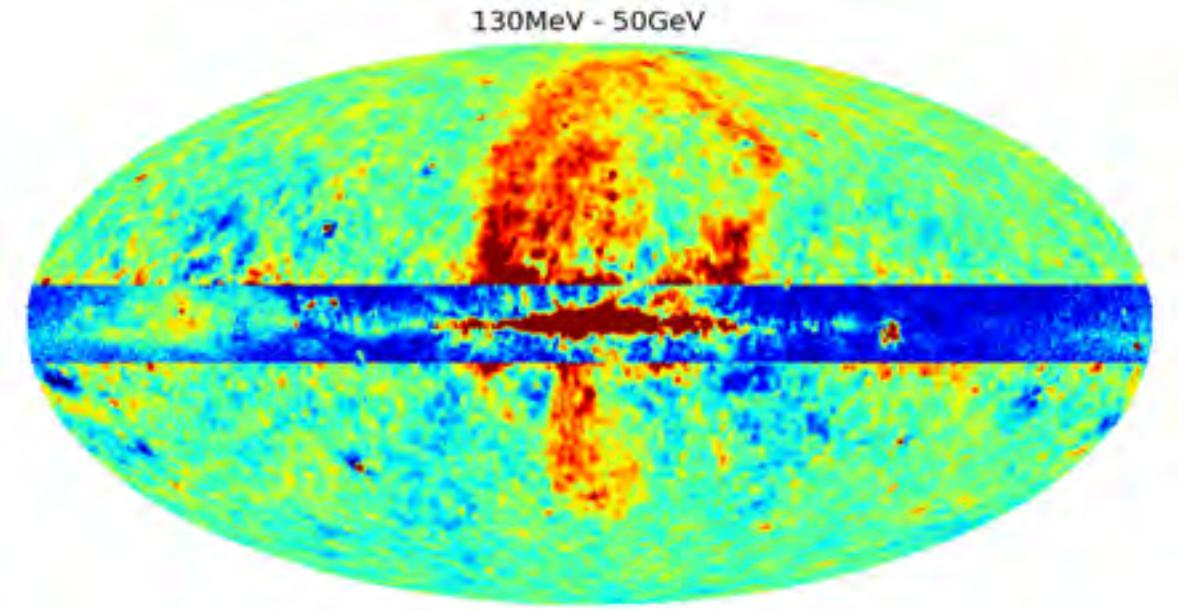


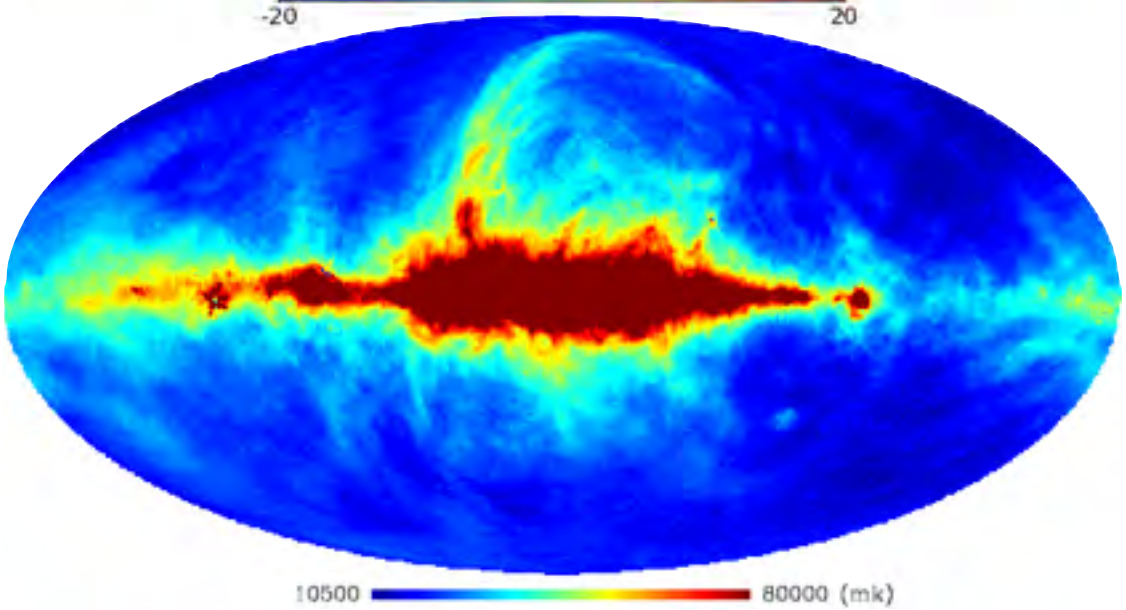
Dobler 2012 aXiv 1208.2690

mapping B and electrons

- against
  23 GHz polarized
  WMAP

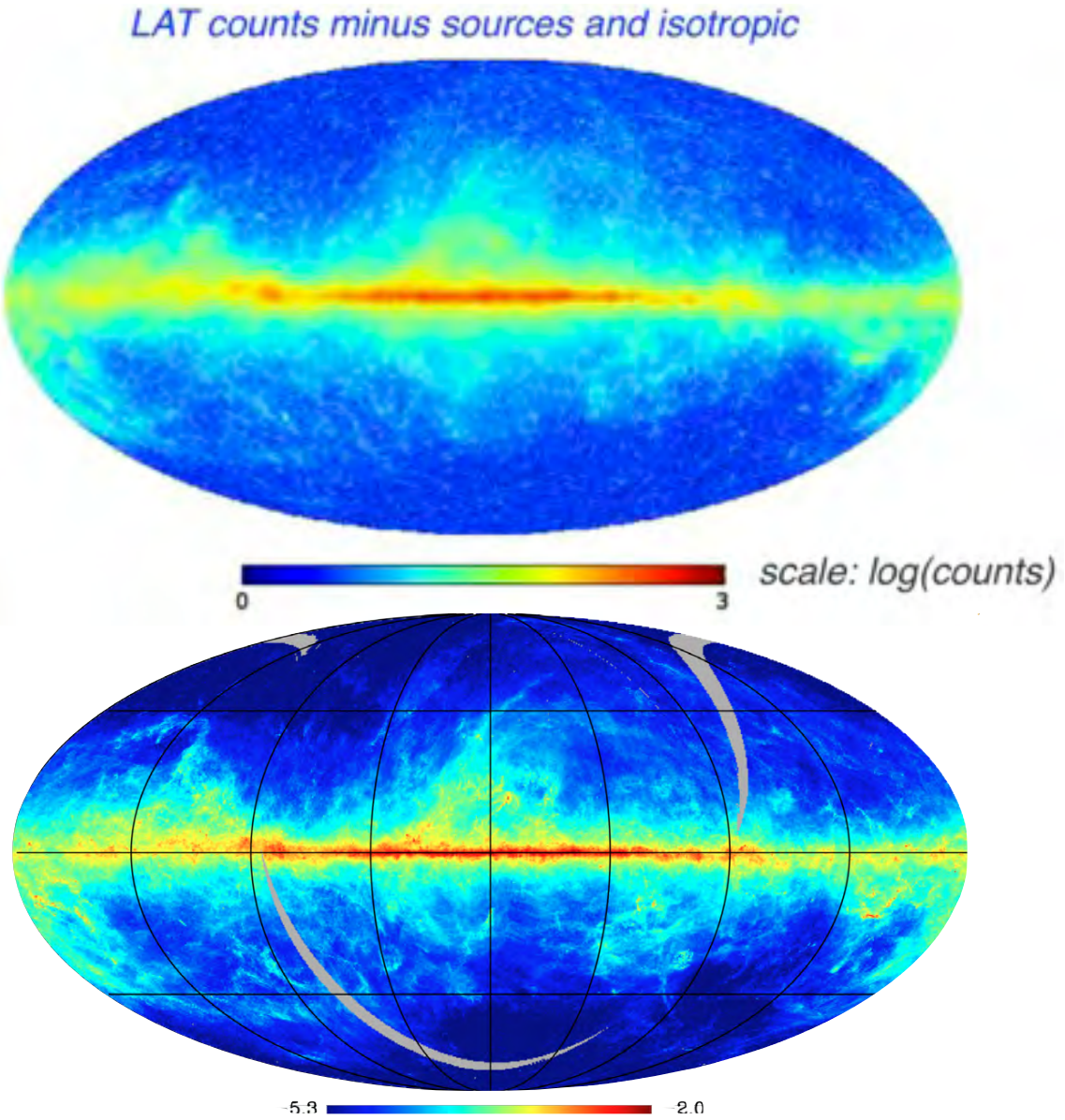


- against
  408 MHz
  Haslam et al.




interstellar
gas and dust

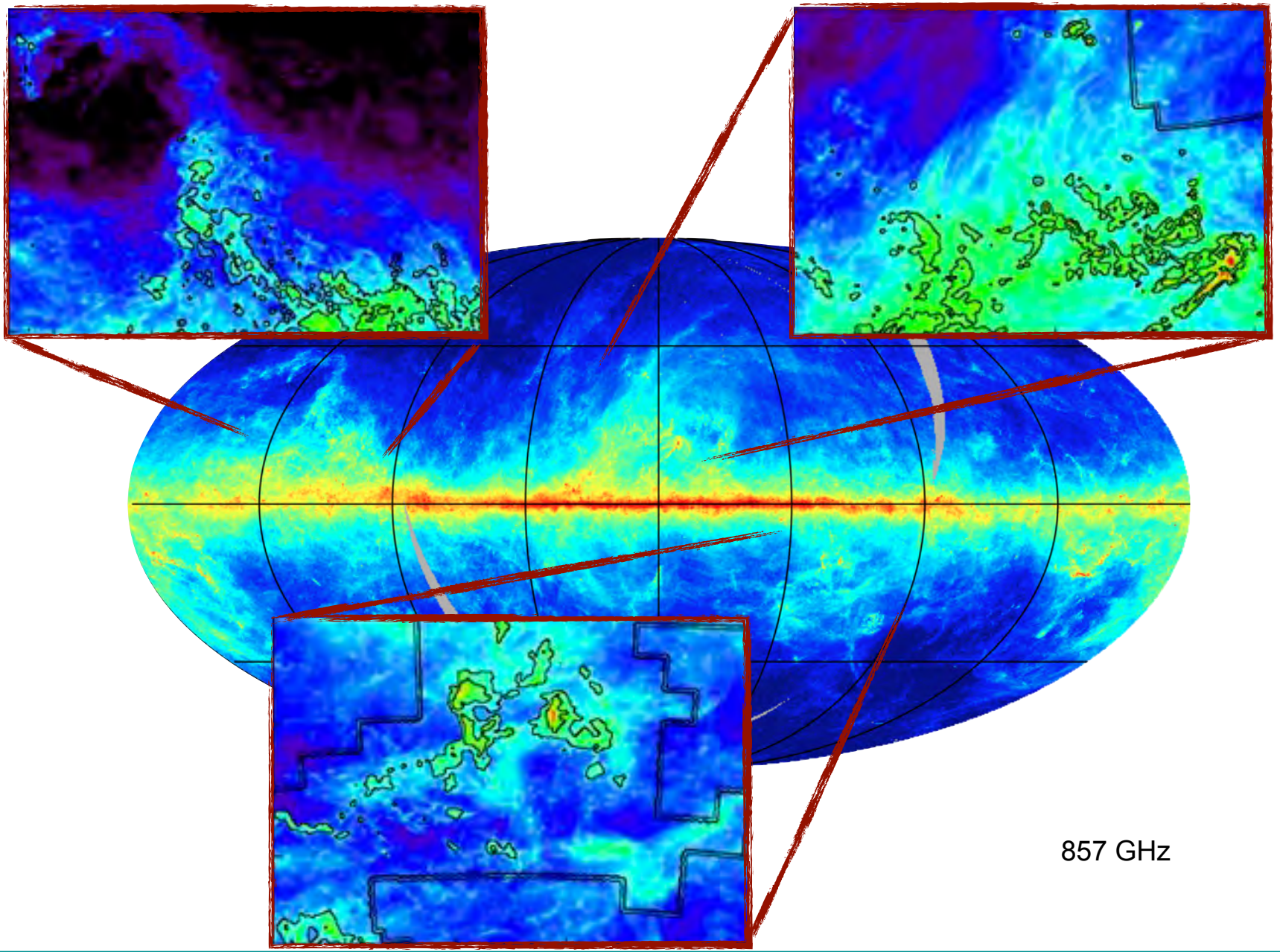
the total ISM



Fermi LAT diffuse model

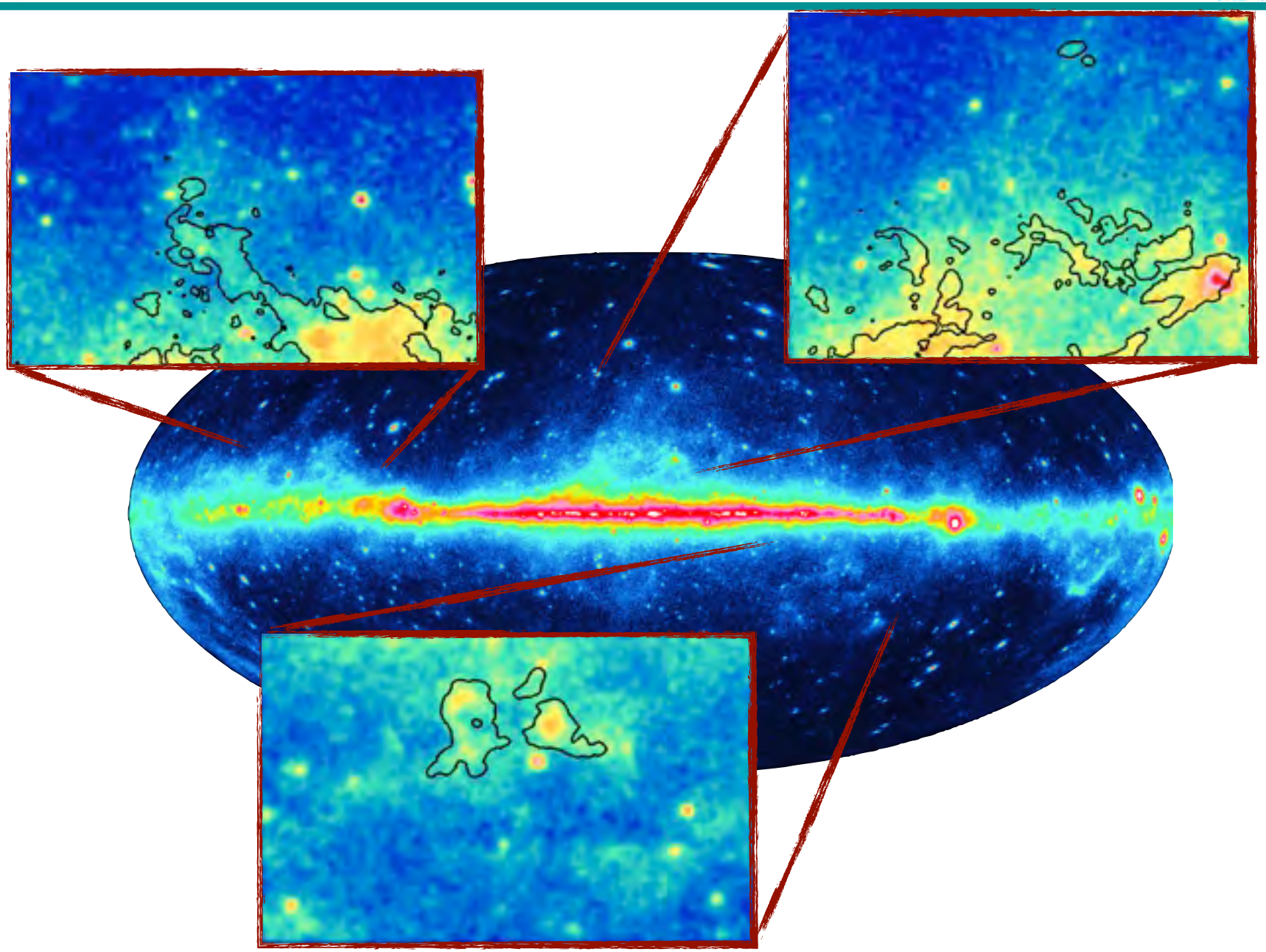
Planck et al. 2011, A&A 536, A19

dust optical depth (IRAS+Dirbe+Planck)

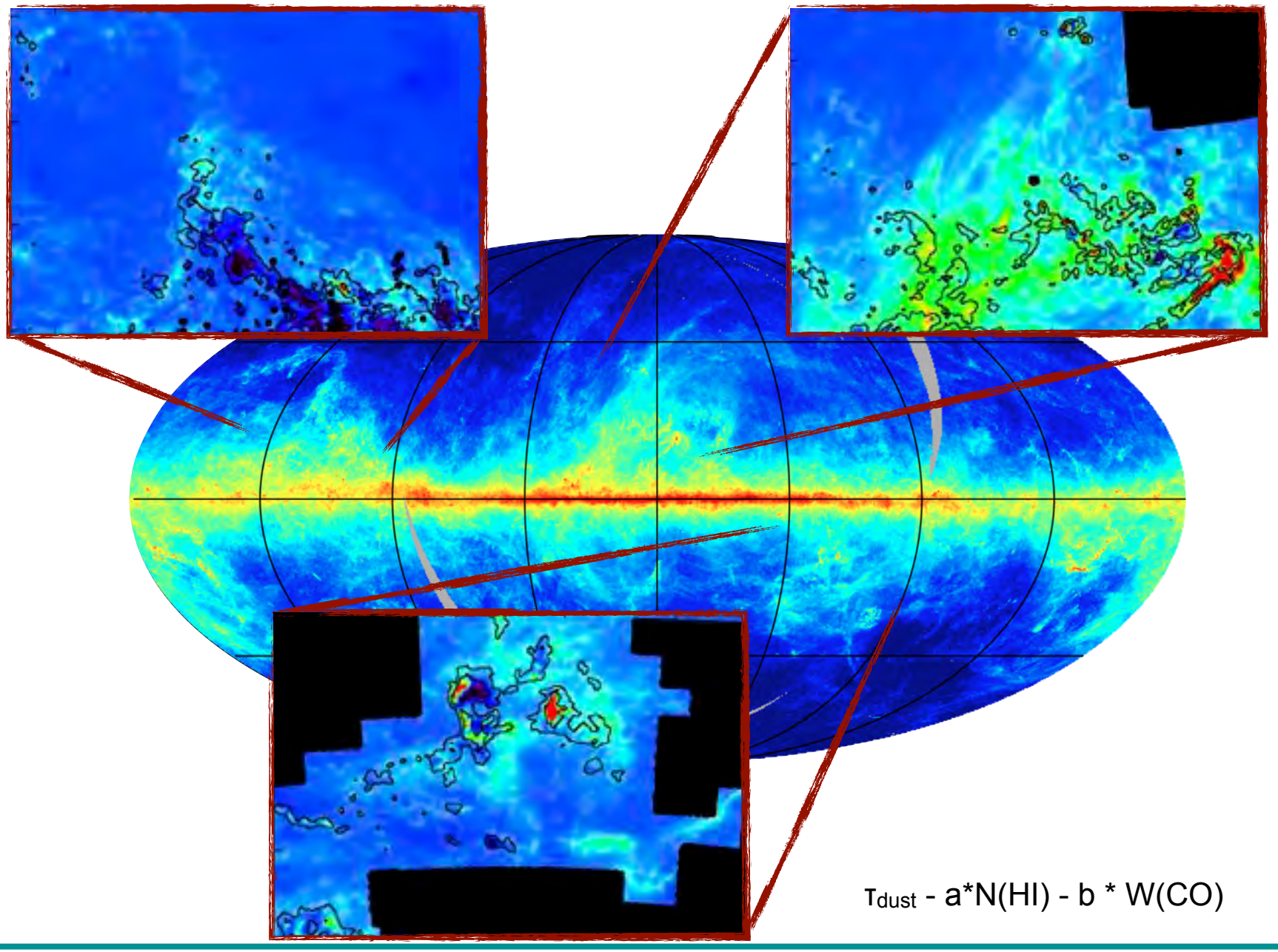


Planck et al. 2011, A&A 536, A19

γ rays > 600 MeV

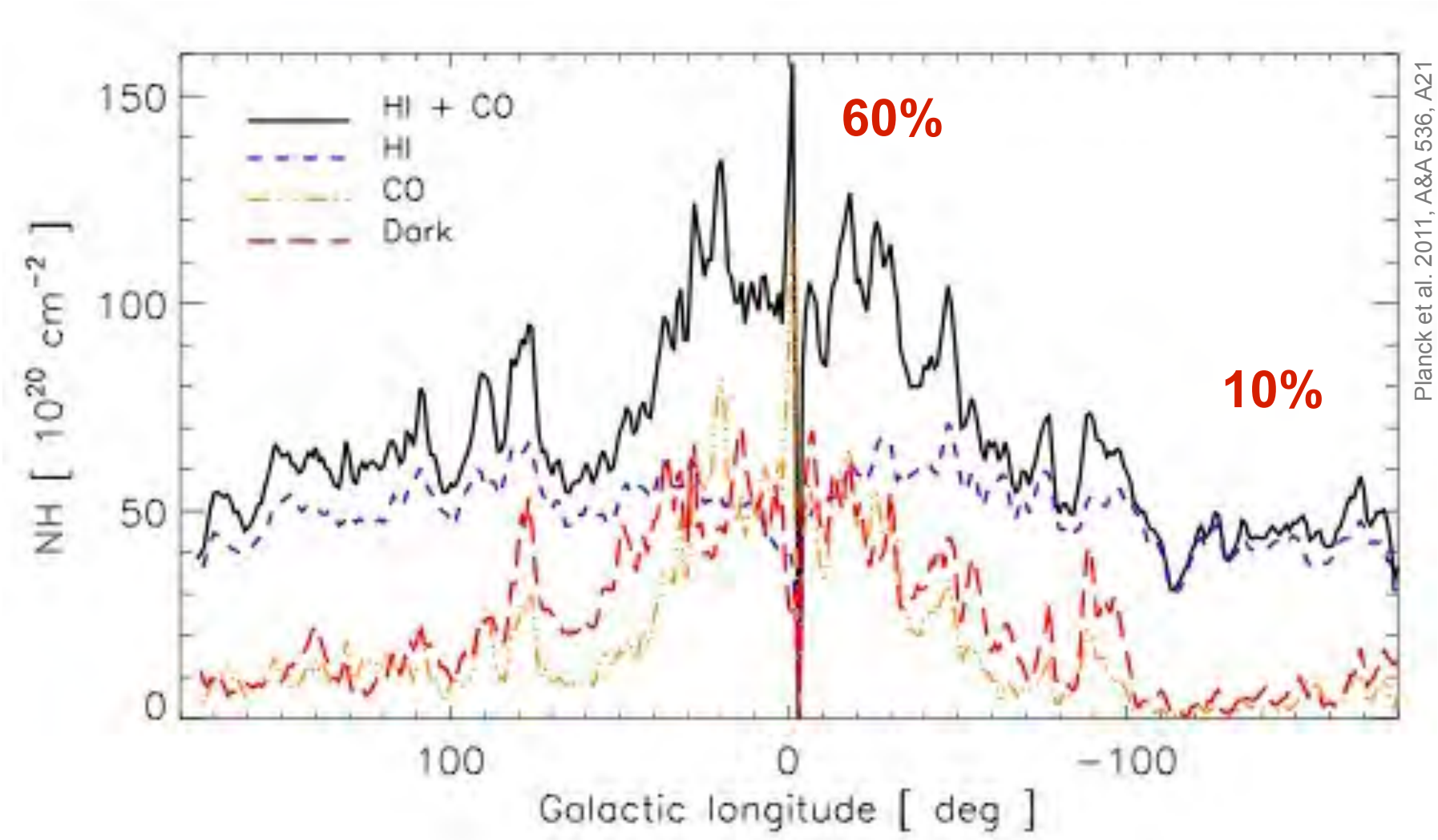


dark neutral gas map from dust



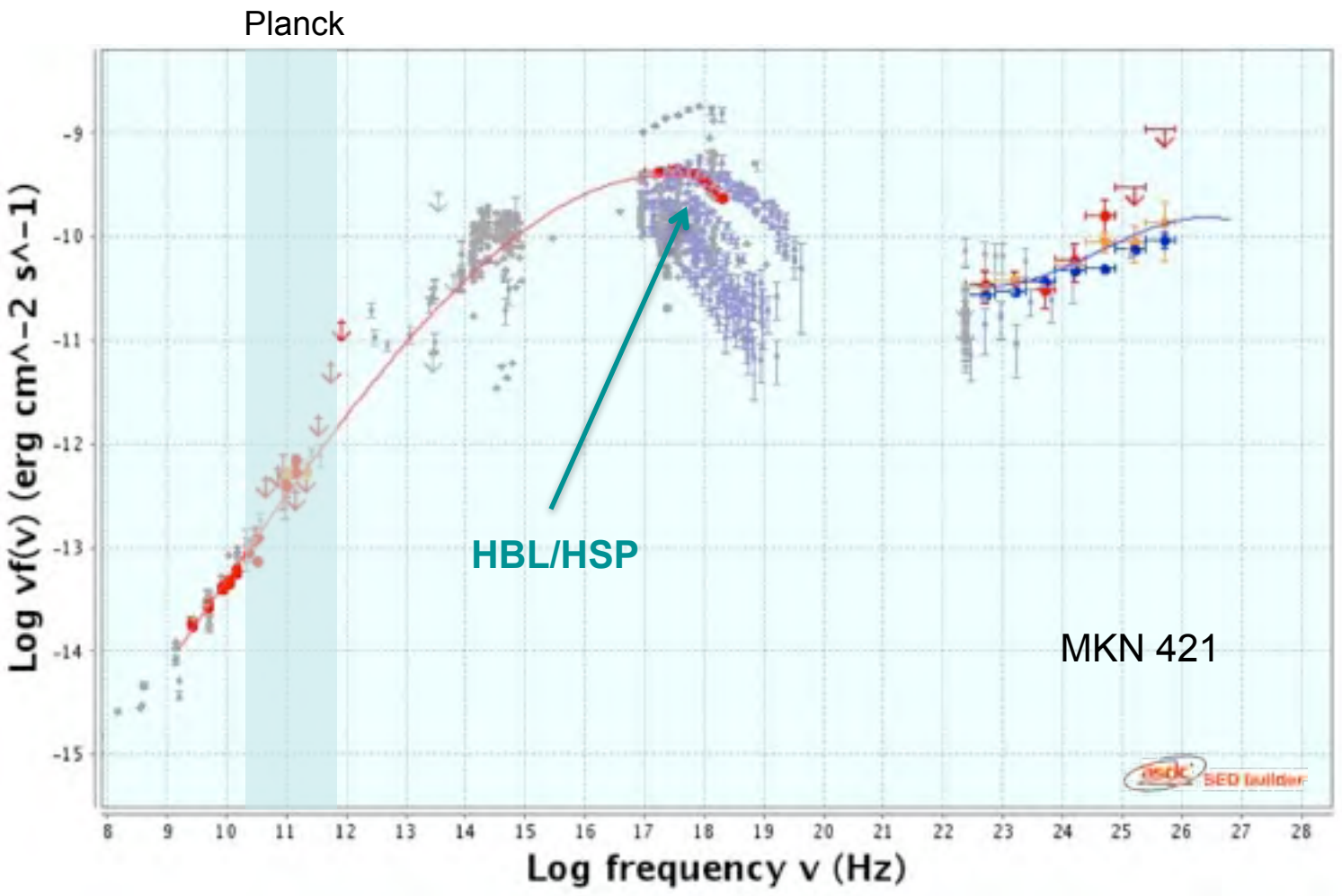
total dark gas

- dark neutral mass ≥ CO-traced mass except in molecular ring




Blazars

constraining blazars SEDs



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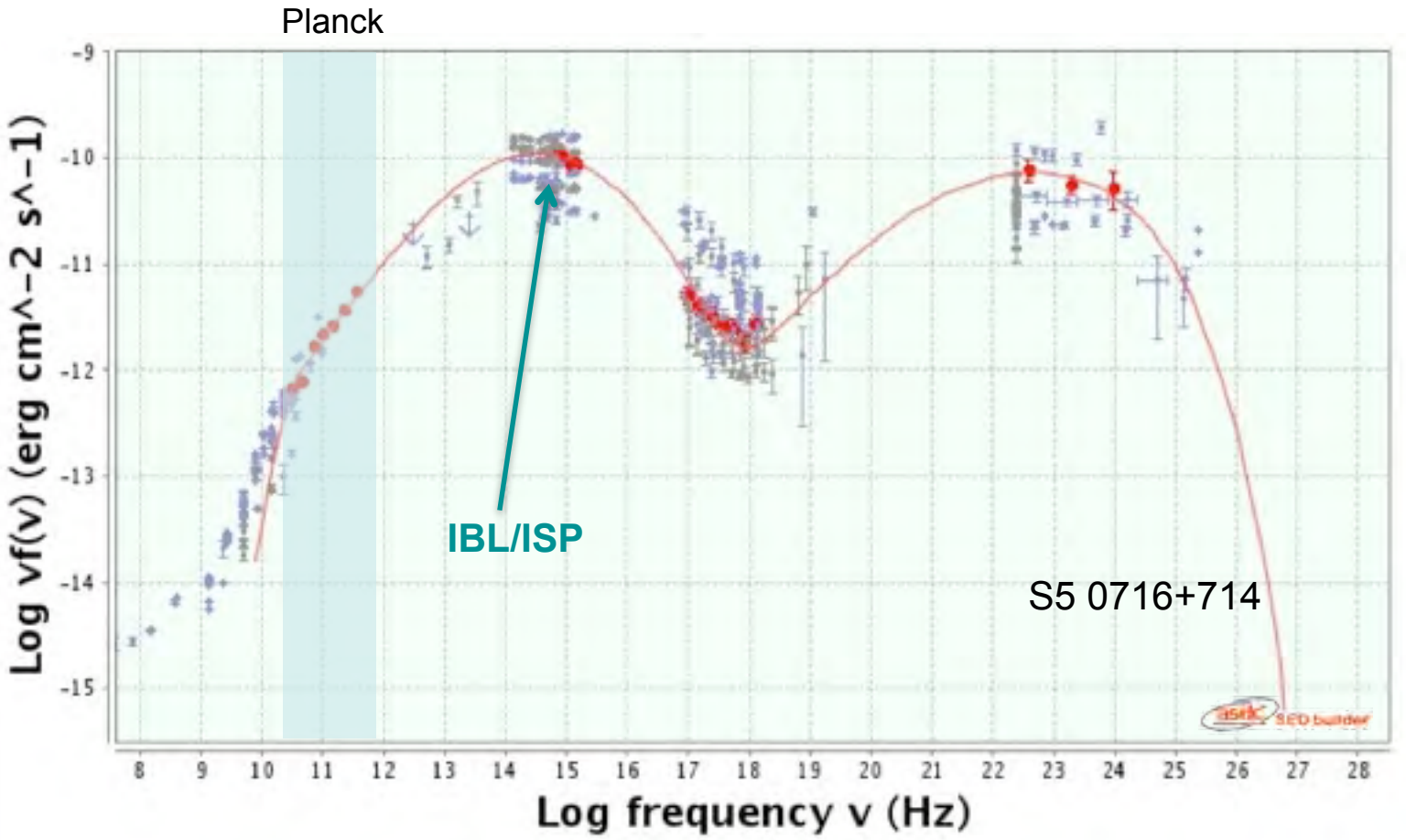
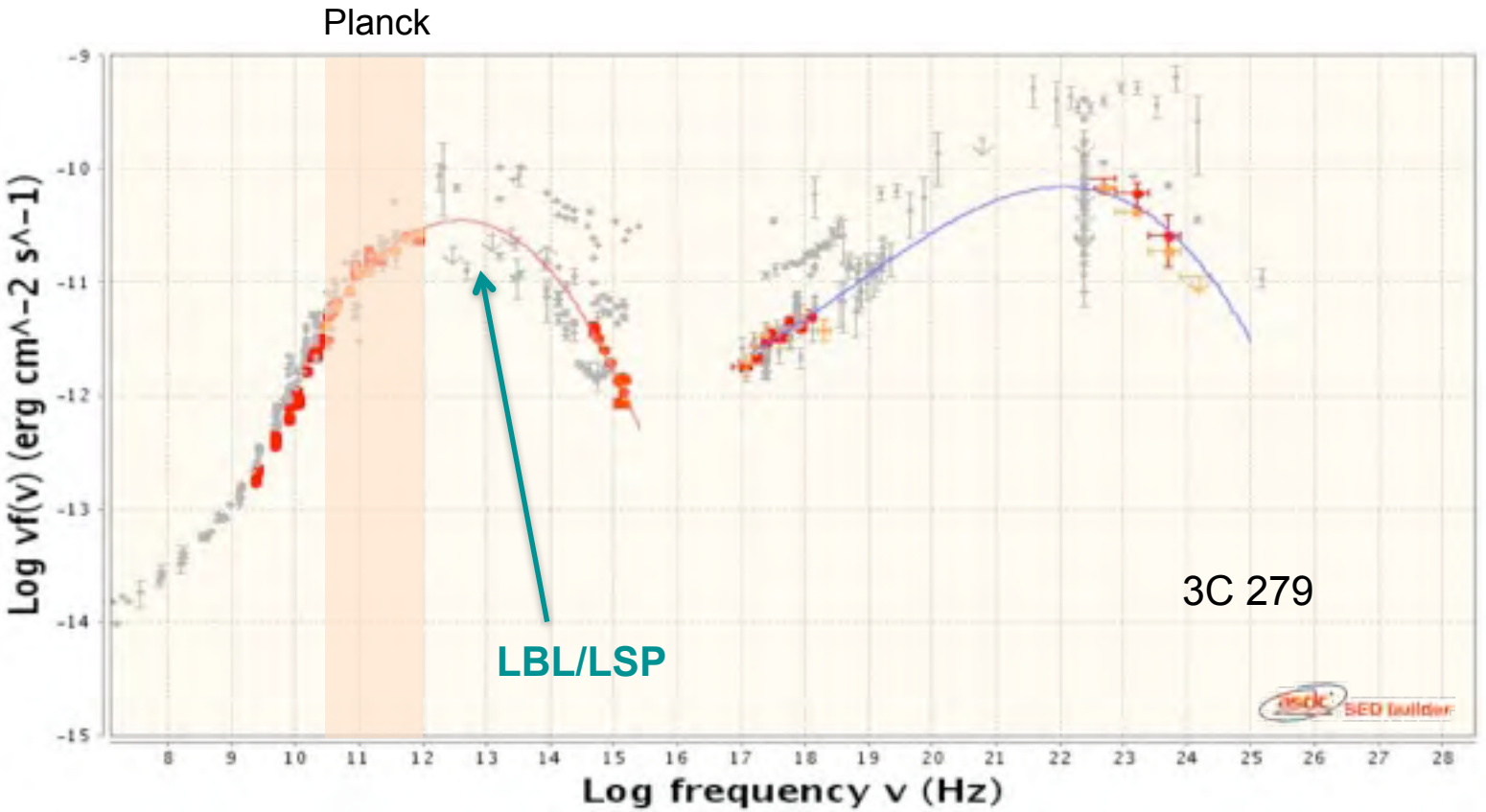
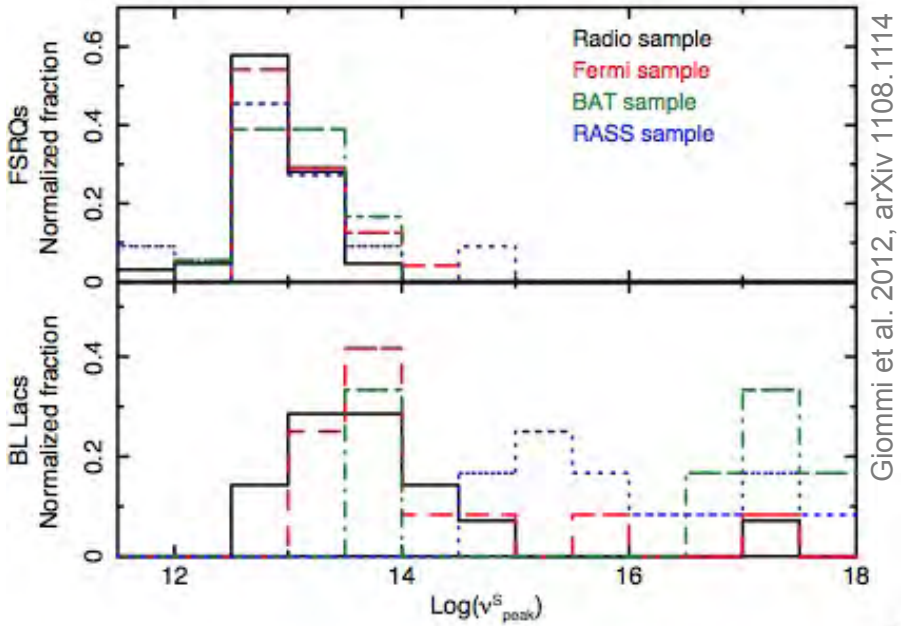


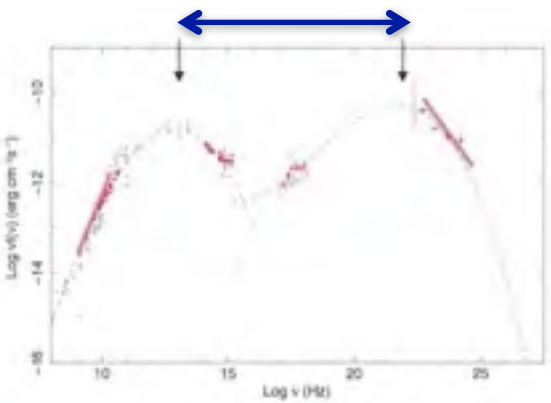
constraining blazars SEDs

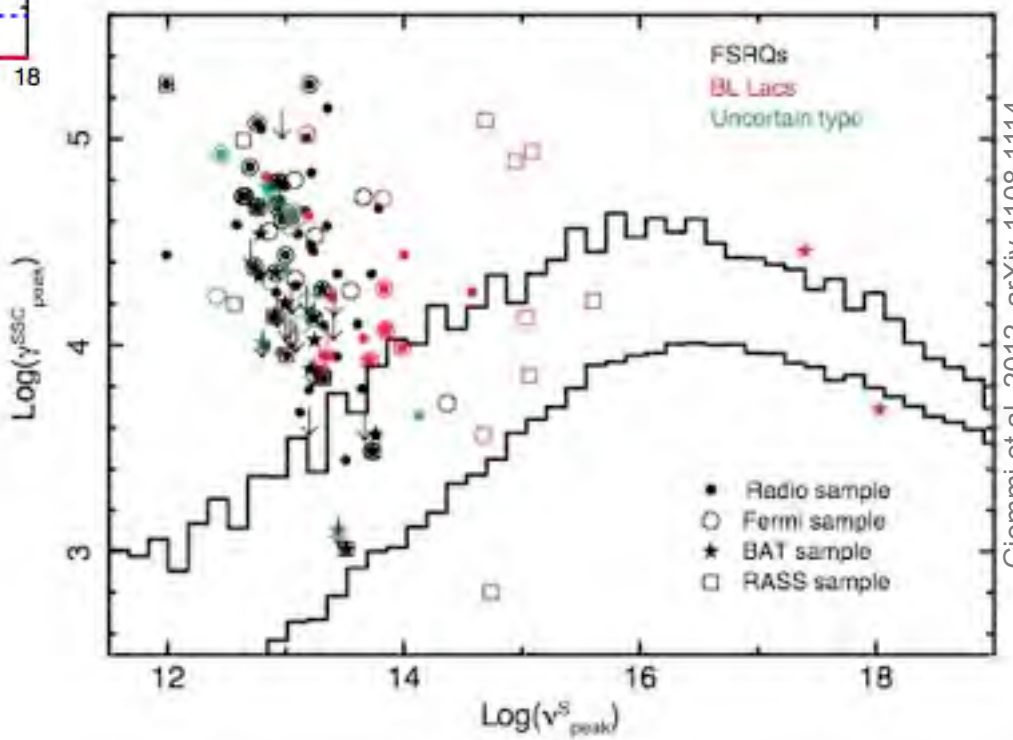


testing the homogeneous SSC



Giommi et al. 2012, arXiv 1108.1114





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