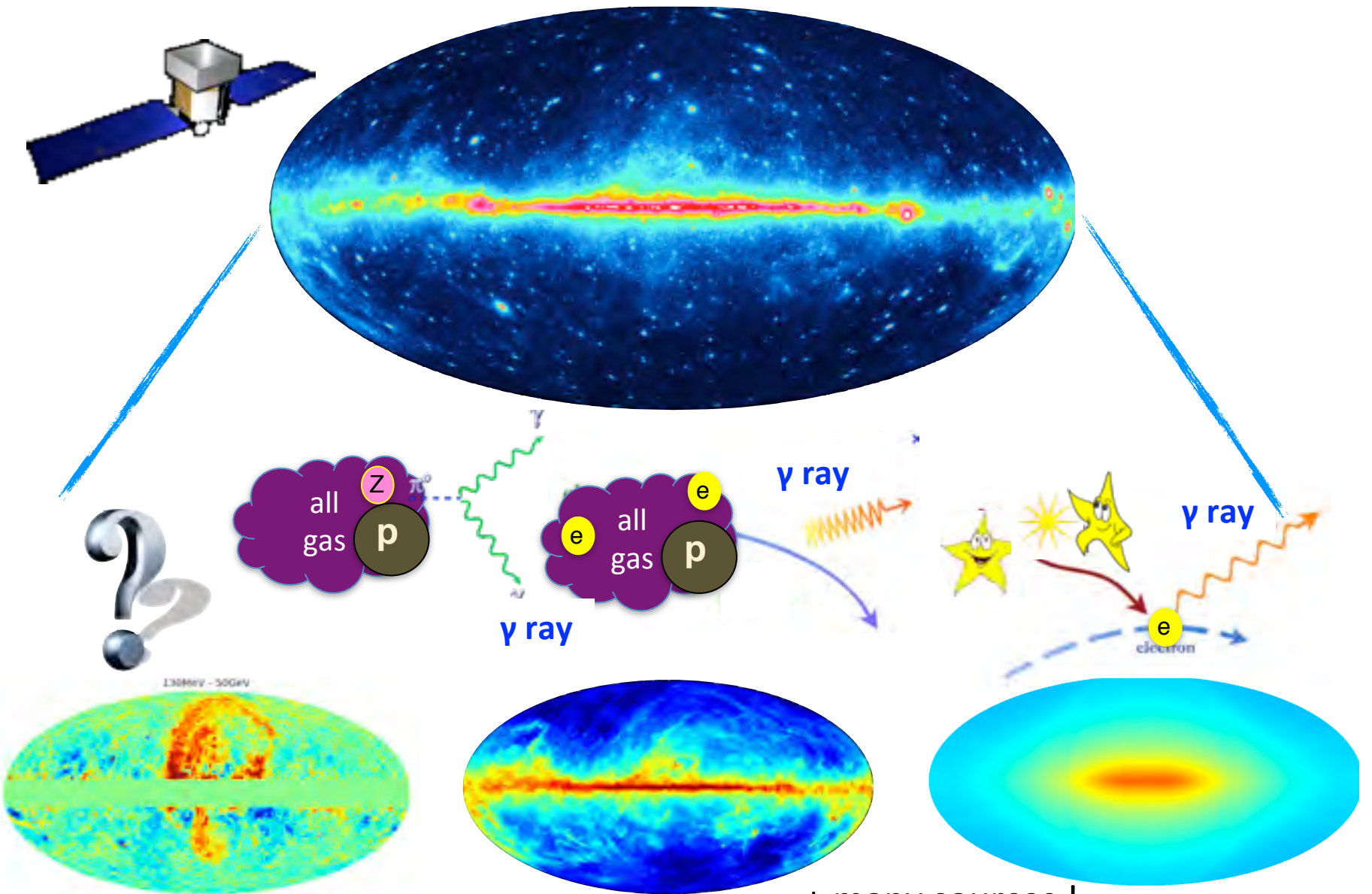


Fermi Planck Synergies

Isabelle Grenier
AIM, Paris Diderot & CEA Saclay
with help from
A. Strong, E. Orlando, P. Giommi

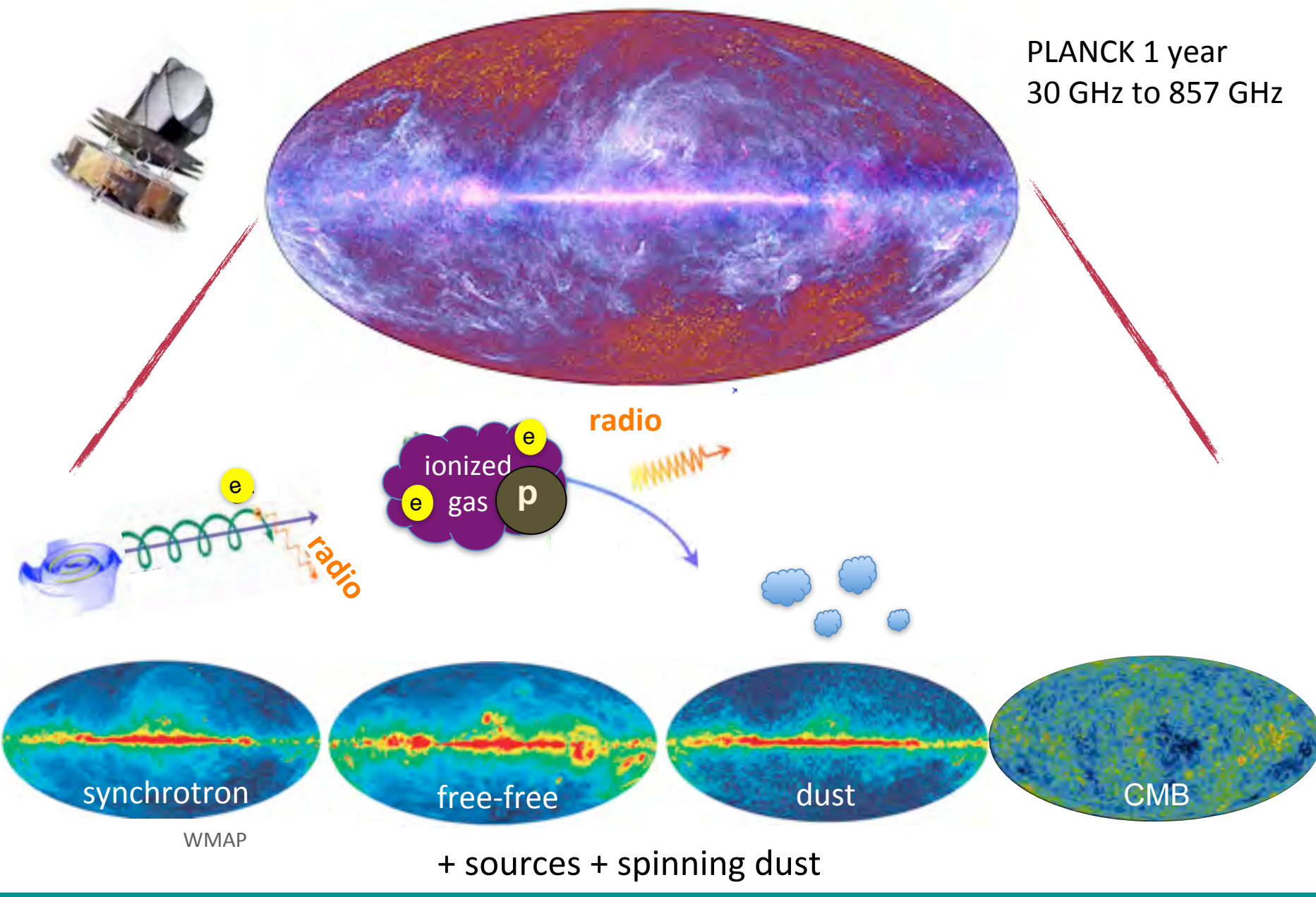


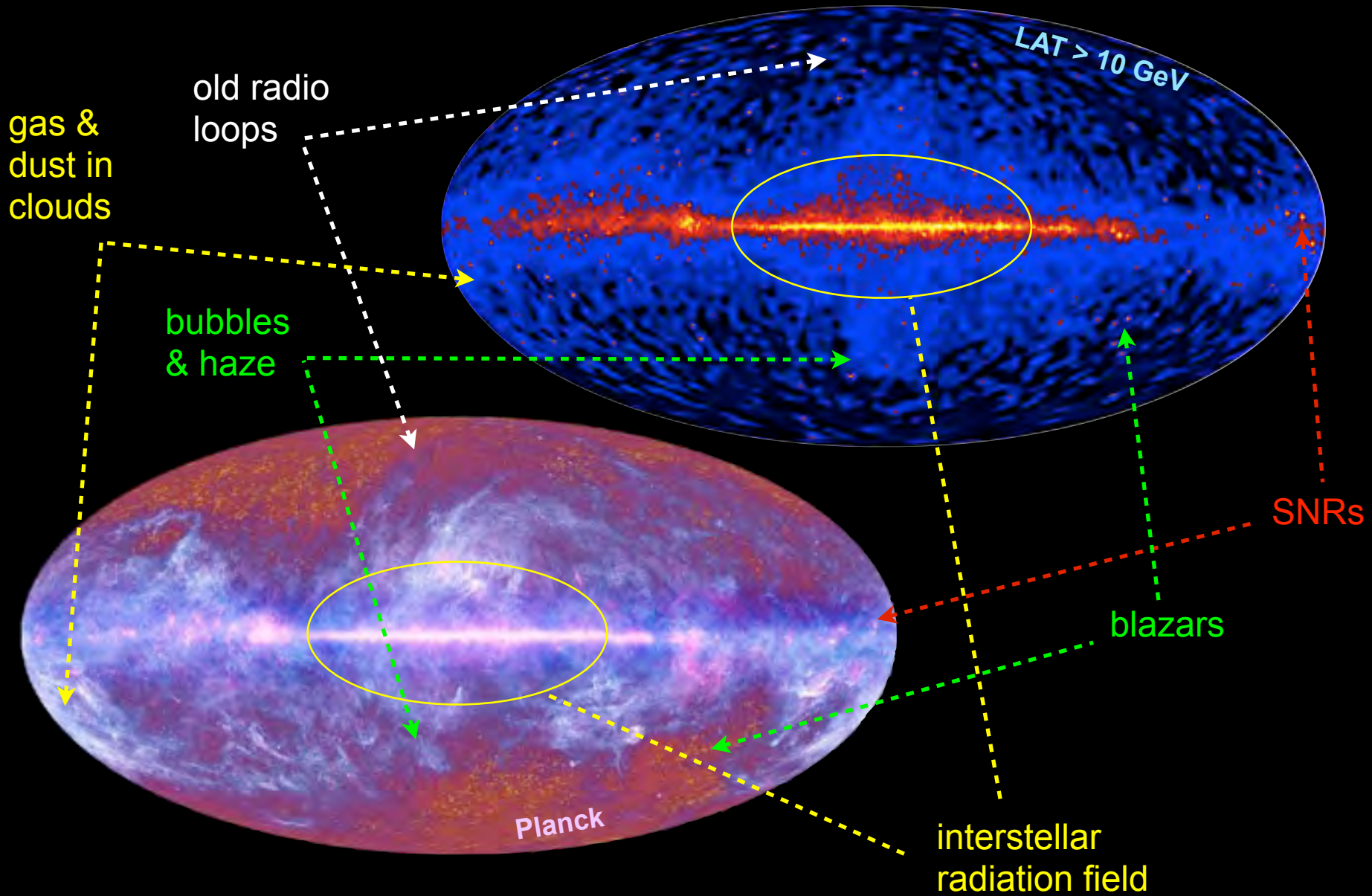
the γ -ray sky




+ many sources !

the microwave sky







cosmic-ray
electron
synergies

sampling the CR electron spectrum

remote measurements

bremst. emission in gas (Fermi)

synchrotron emission in B (radio + Planck) \Rightarrow

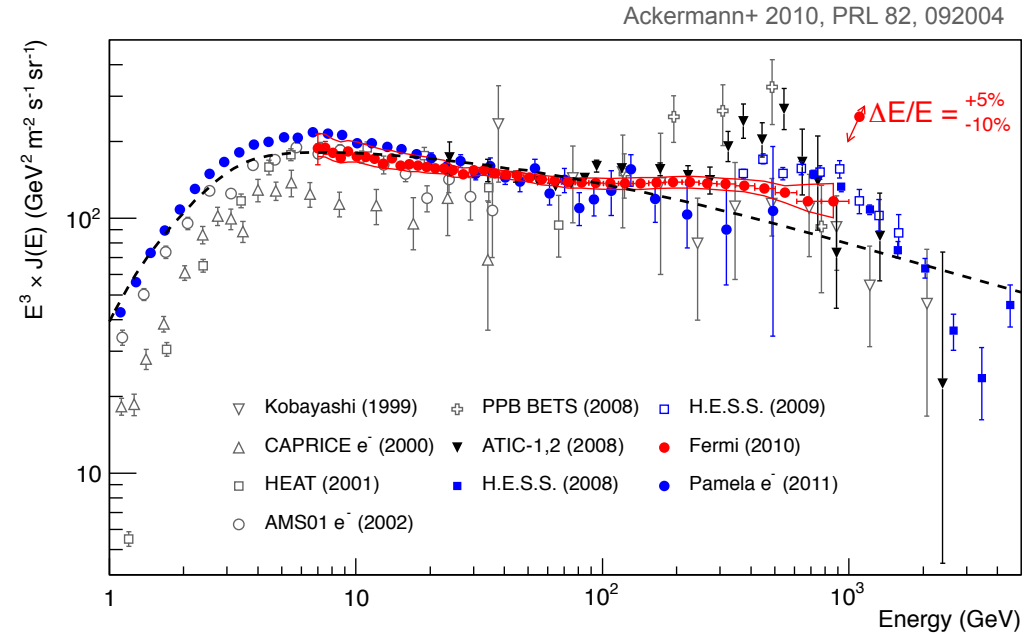
- e^- spectrum & flux
- B field

direct measurement (Fermi + others)

IC emission in ISRF (Fermi + Planck constraints on ISRF)



in-situ measurements (solar modulation)

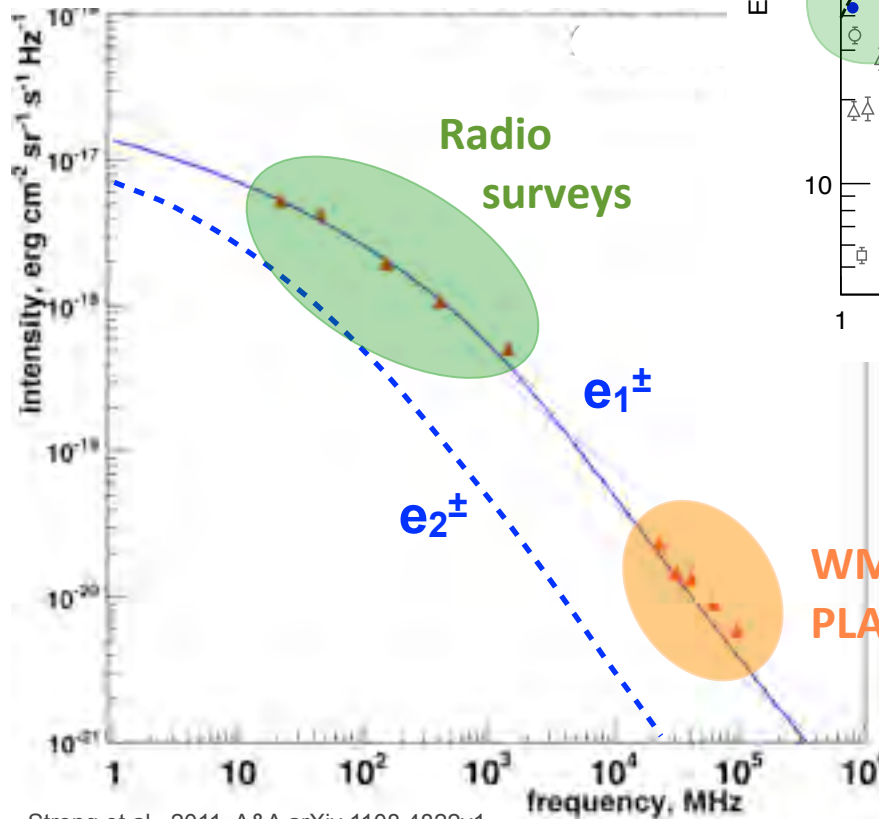


low-energy electron break

$$E_e^{-1.6} \quad | \quad E_e^{-2.5} \quad | \quad E_e^{-2.2}$$

4 GeV 50 GeV

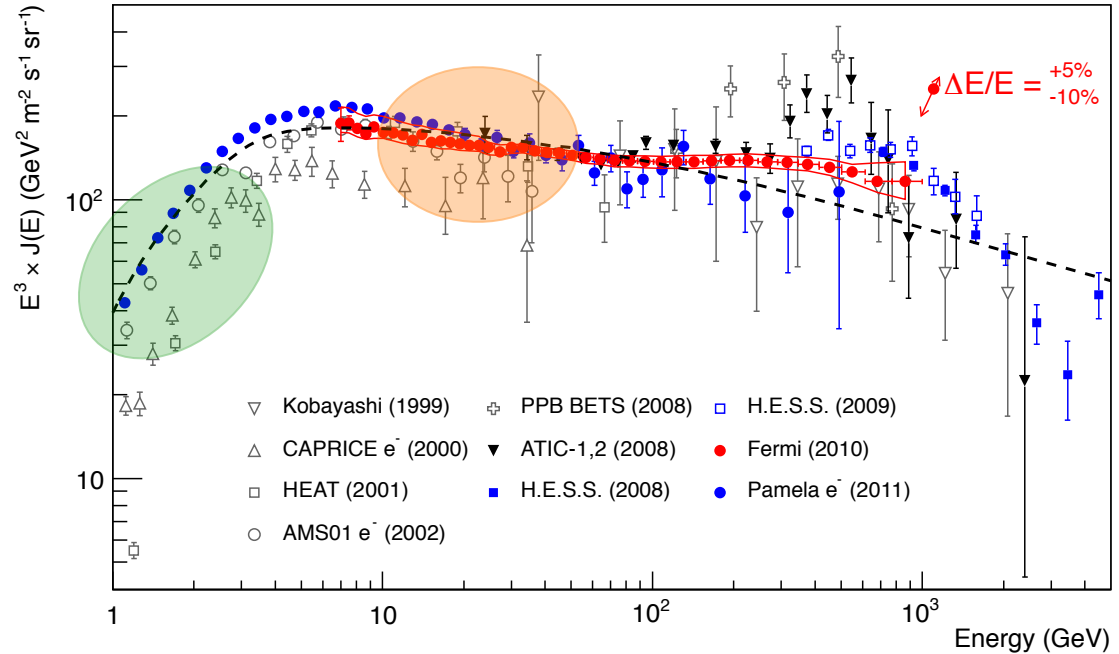
- $E_e^{-2.2}$ steeper than in SNRs
- significant e_2^\pm contribution at low energy



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

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

Ackermann+ 2010, PRL 82, 092004



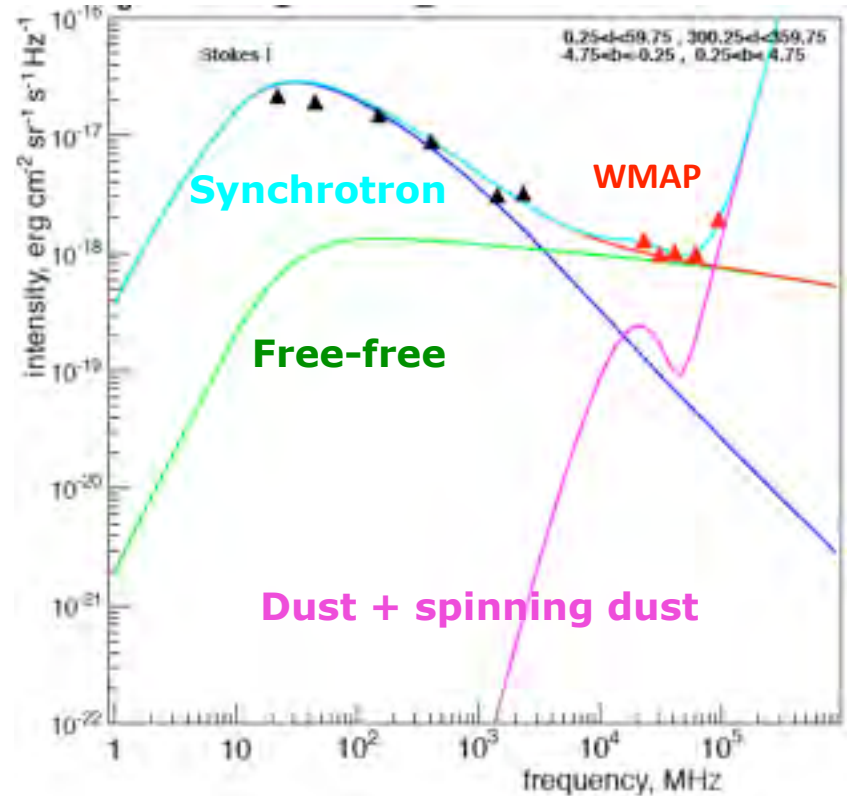
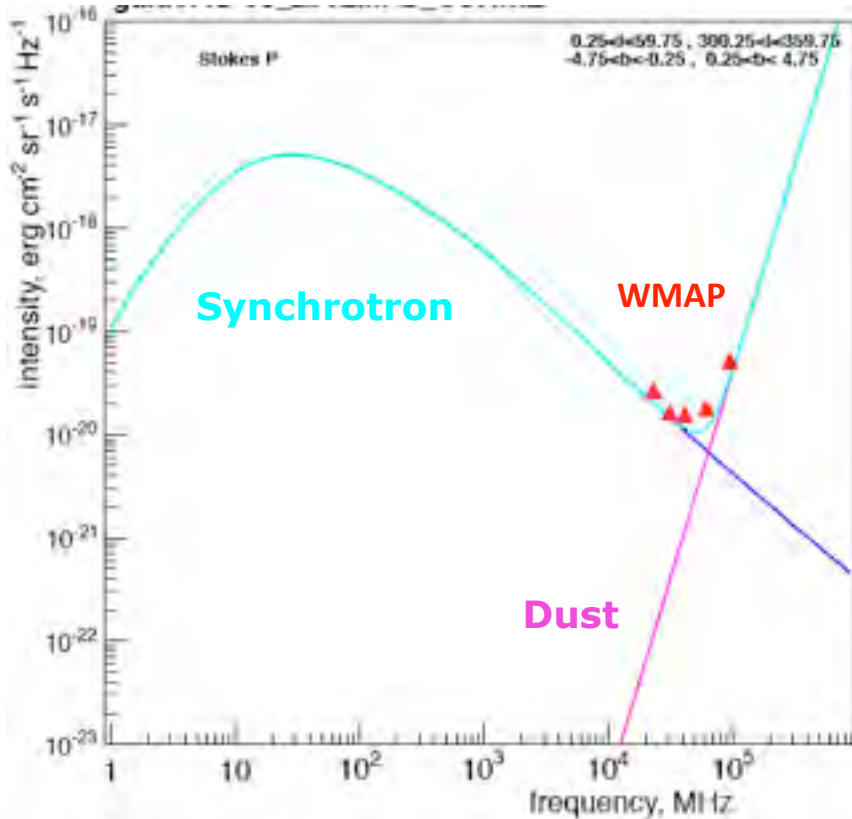
remote synchrotron \Rightarrow interstellar spectrum before modulation

remote vs. local electrons \Rightarrow determination of B field

synchrotron emission in the inner Galaxy, total and polarized $\Rightarrow B_{\text{random}}$ & B_{regular}

polarized emission

total emission

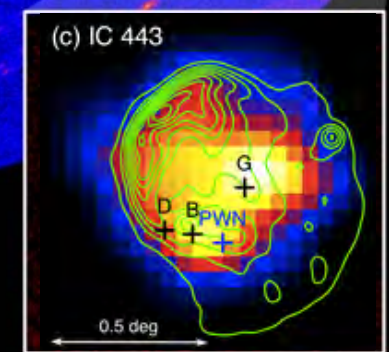
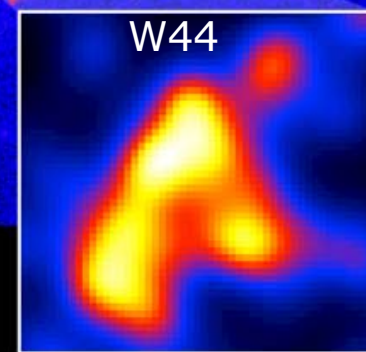
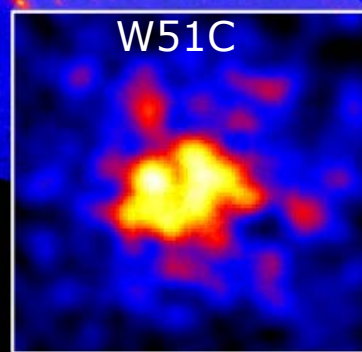
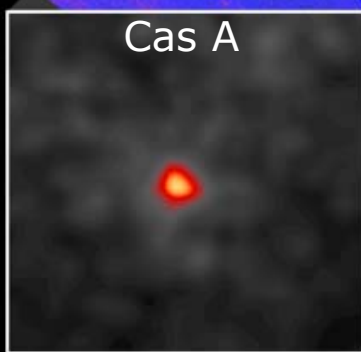
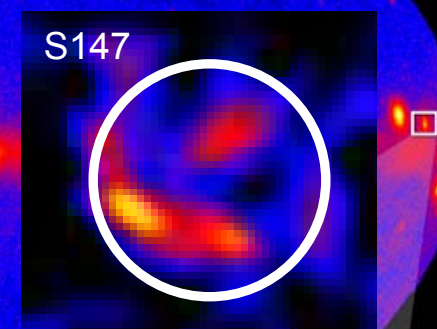
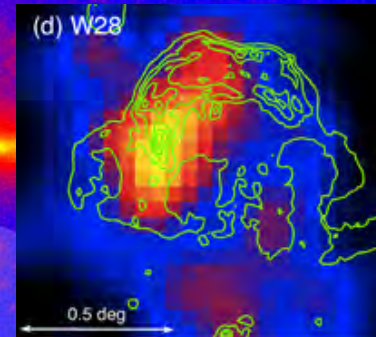
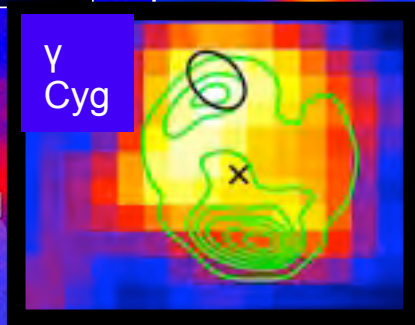
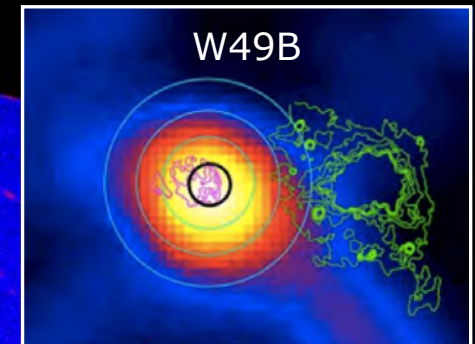
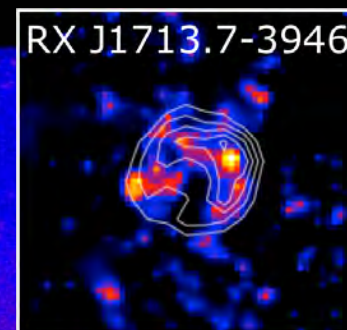
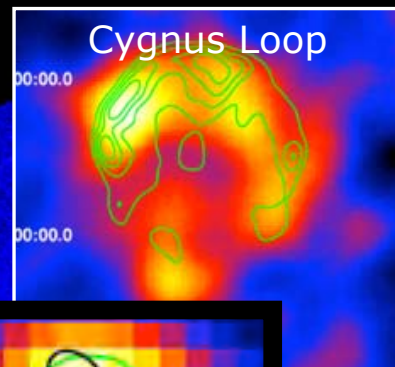


Orlando & Strong, *ApJ* submitted: see poster

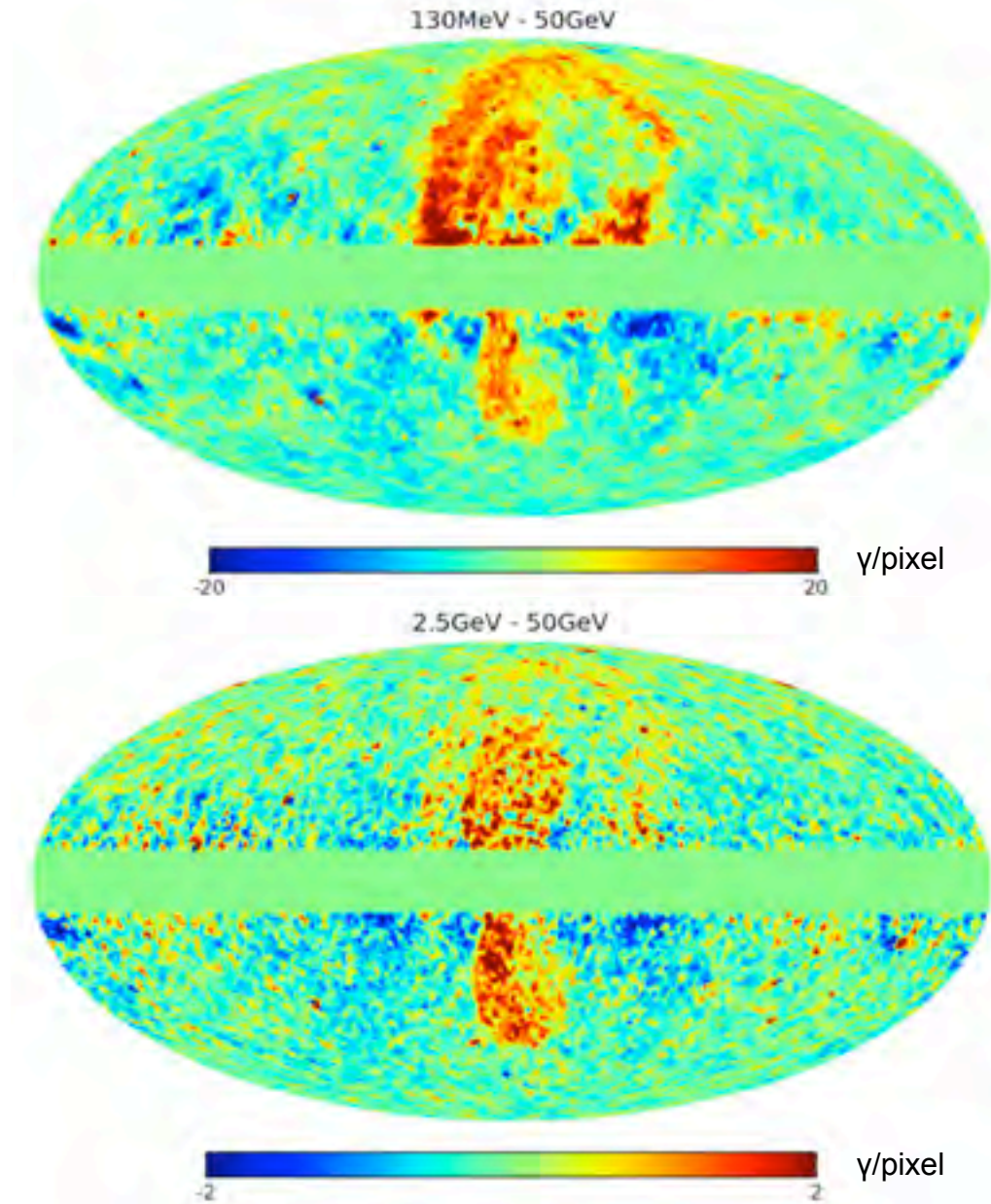
Planck/Fermi/HESS+MAGIC+VERITAS:

- spatial correlations of multi-GeV electrons and γ rays inside remnants ?
- electron ageing inside remnants

Puppis A: see poster by J. Hewitt



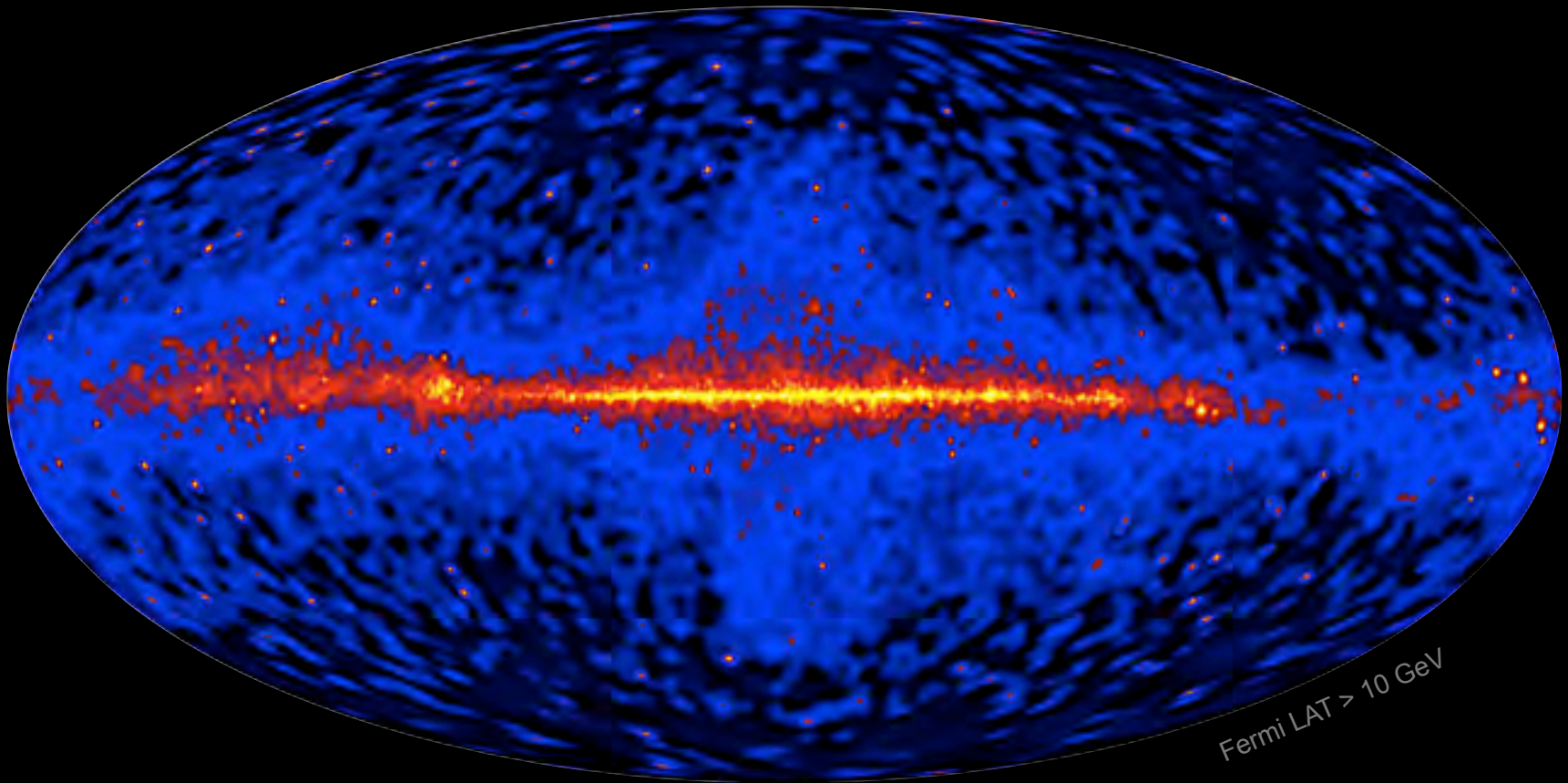
- Fermi LAT 3 years residuals above gas, IC, isotropic, & point-sources



Casandjian et al. 2009
eConf Proceedings C091122
Su et al. 2010, ApJ 724, 1044

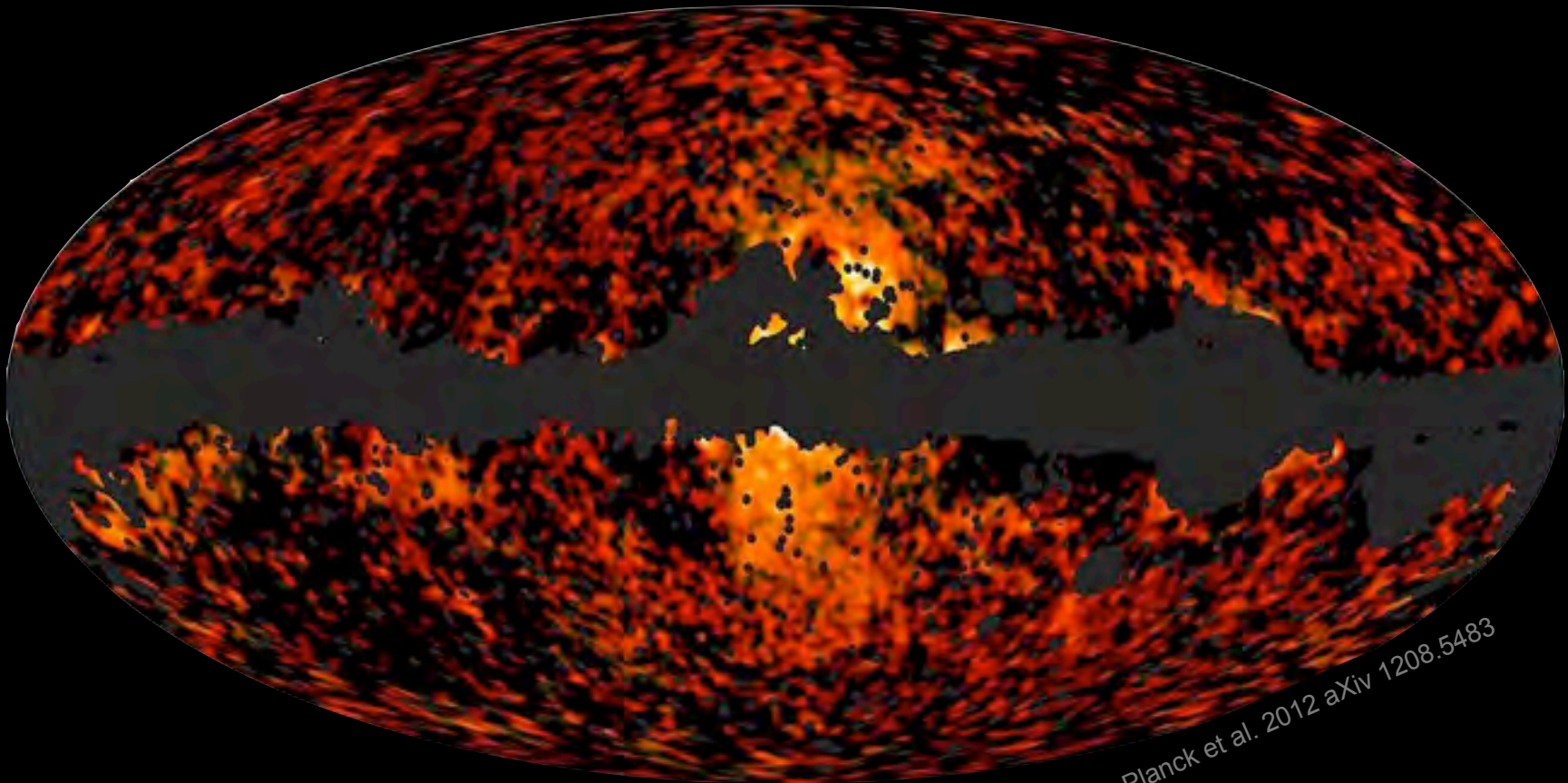
whence ?

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



whence ?

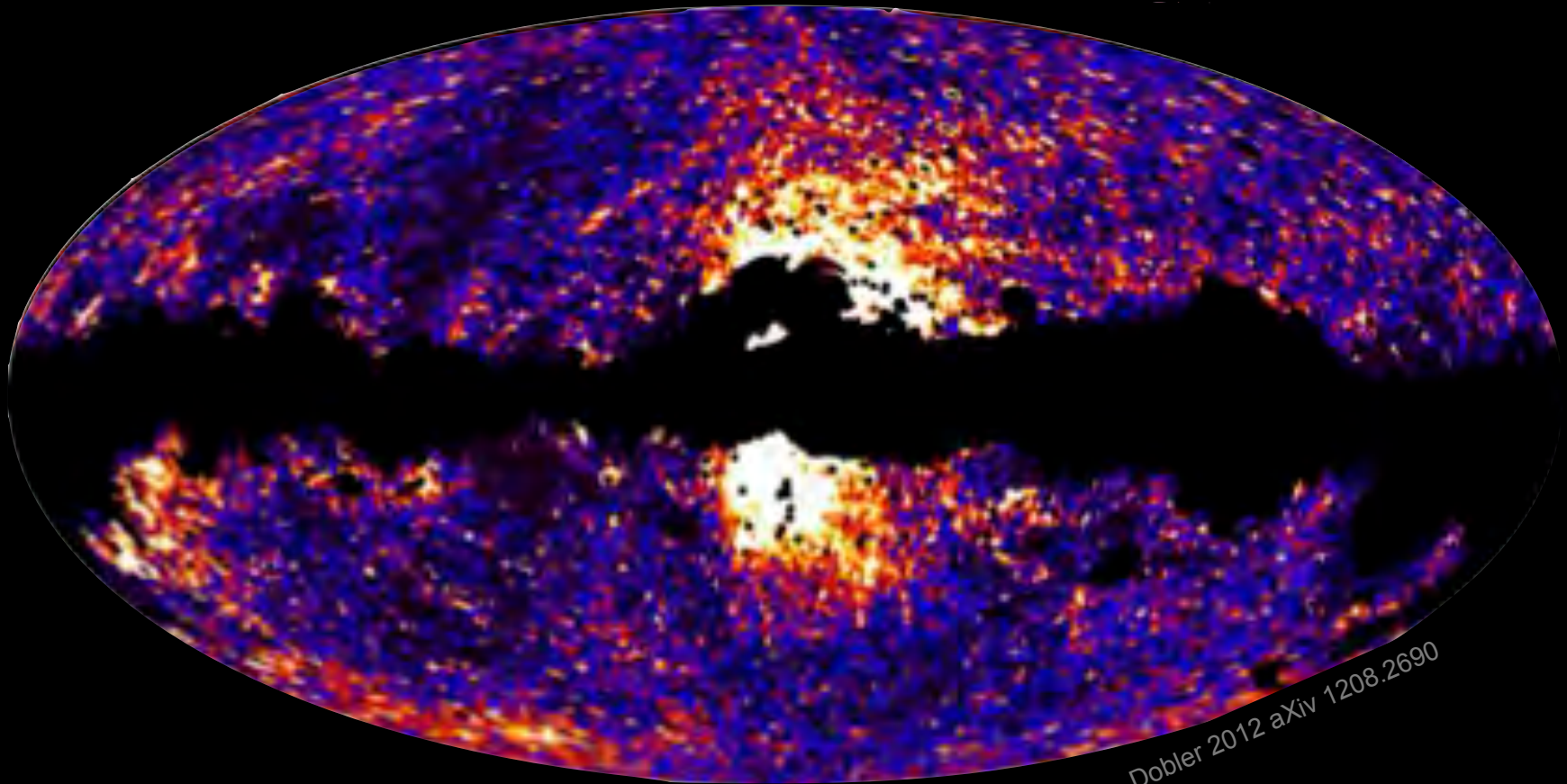
- 4 years Fermi > 10 GeV and Planck haze
- cosmic rays in Galactic winds? from a nearby bubble? jets from the central black hole?



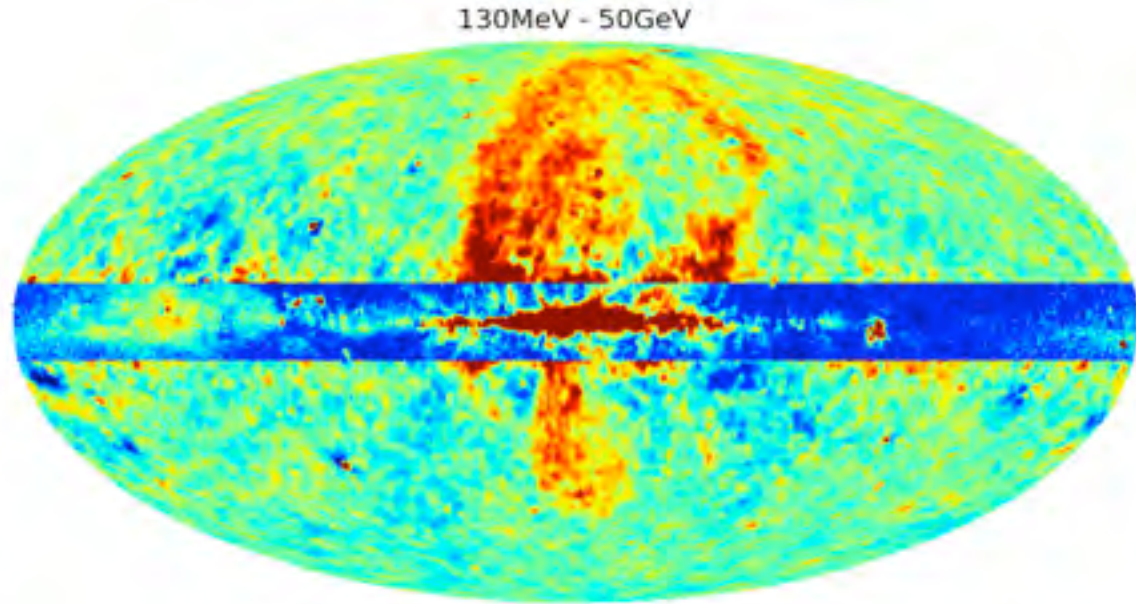
Planck et al. 2012 aXiv 1208.5483

whence ?

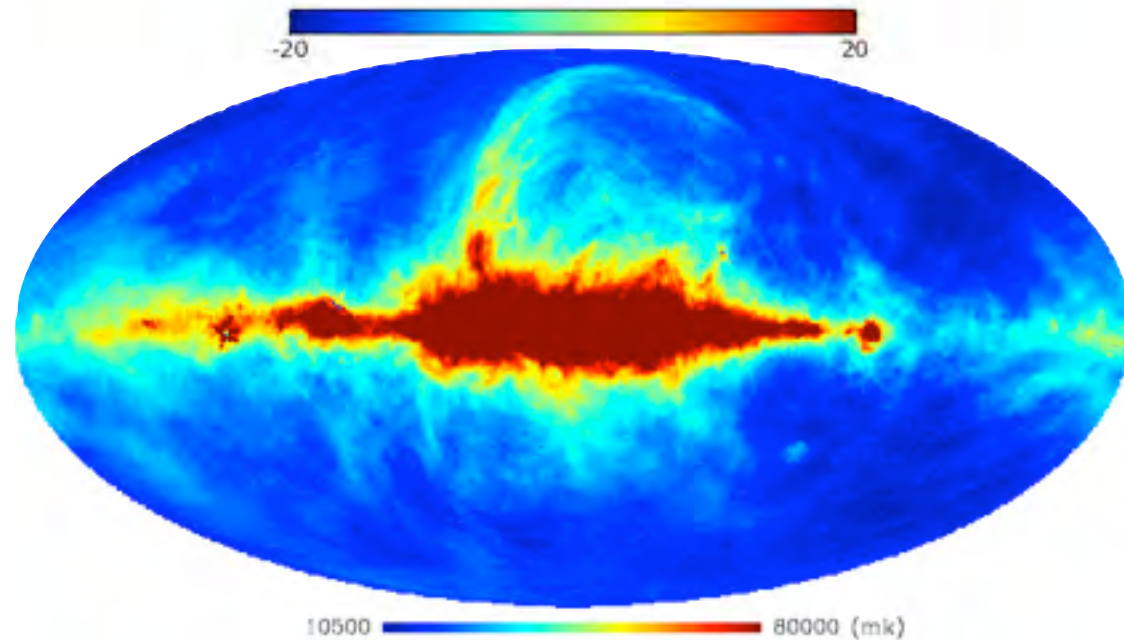
- 4 years Fermi > 10 GeV and Planck haze
- cosmic rays in Galactic winds? from a nearby bubble? jets from the central black hole?




against
23 GHz polarized
WMAP



against
408 MHz
Haslam et al.

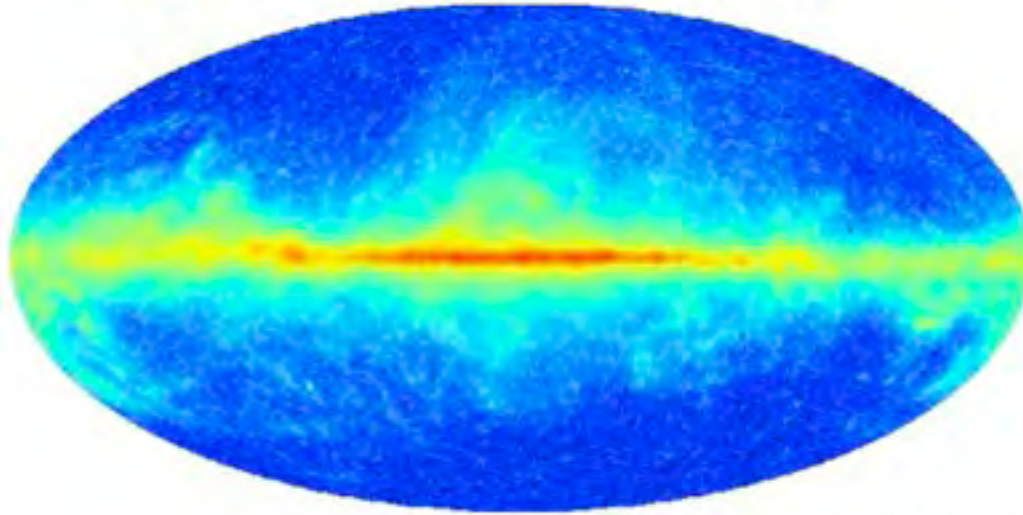




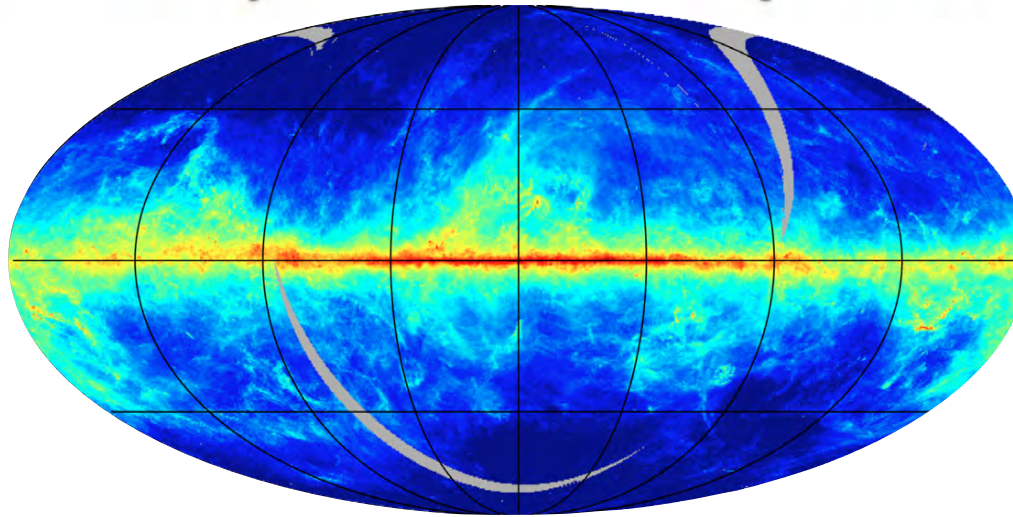
interstellar
gas and dust

the total ISM

LAT counts minus sources and isotropic

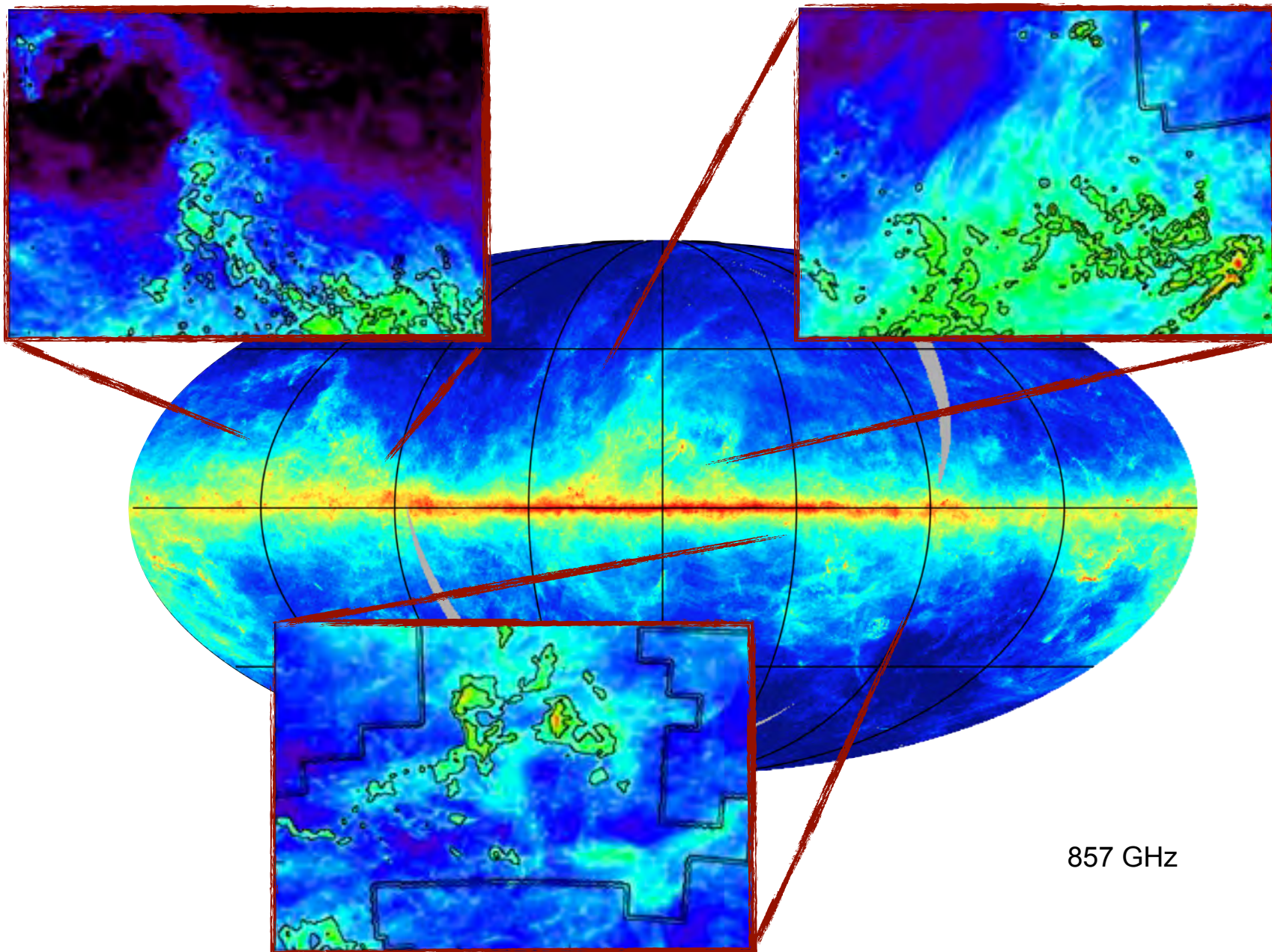


0 3 *scale: log(counts)*



-5.3 -2.0
Planck+IRAS dust optical depth

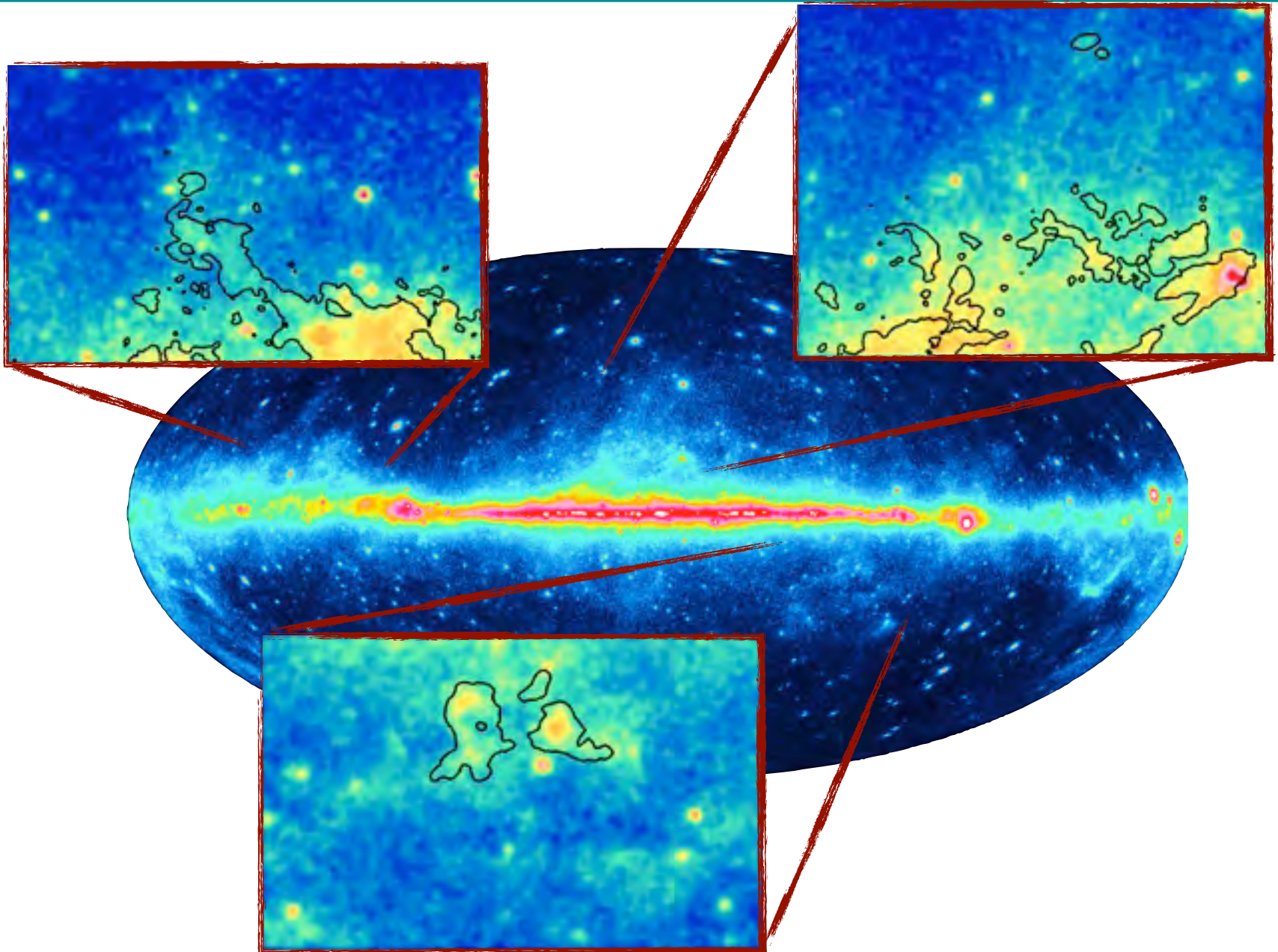
dust optical depth (IRAS+Dirbe+Planck)



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

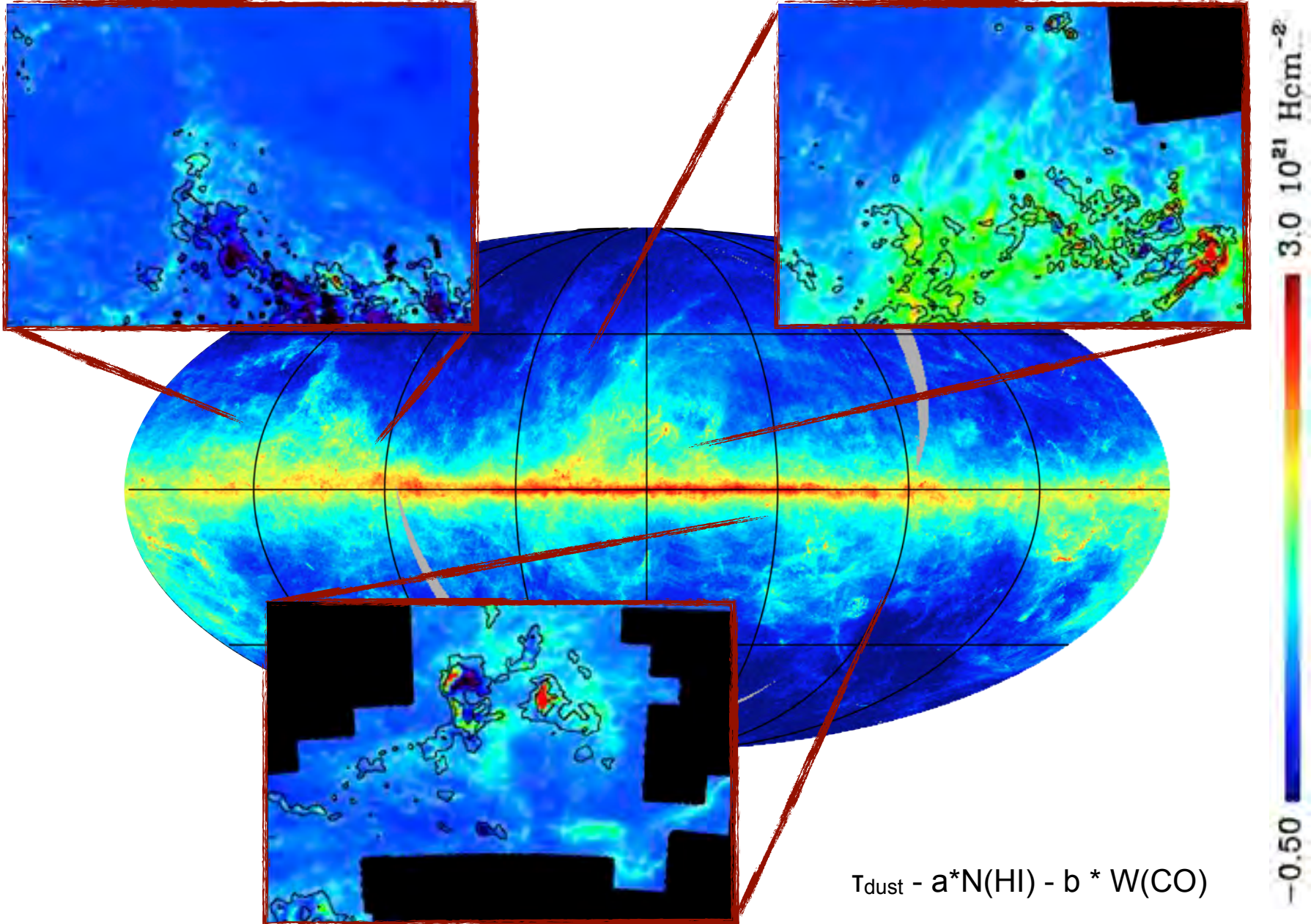
857 GHz

γ rays > 600 MeV



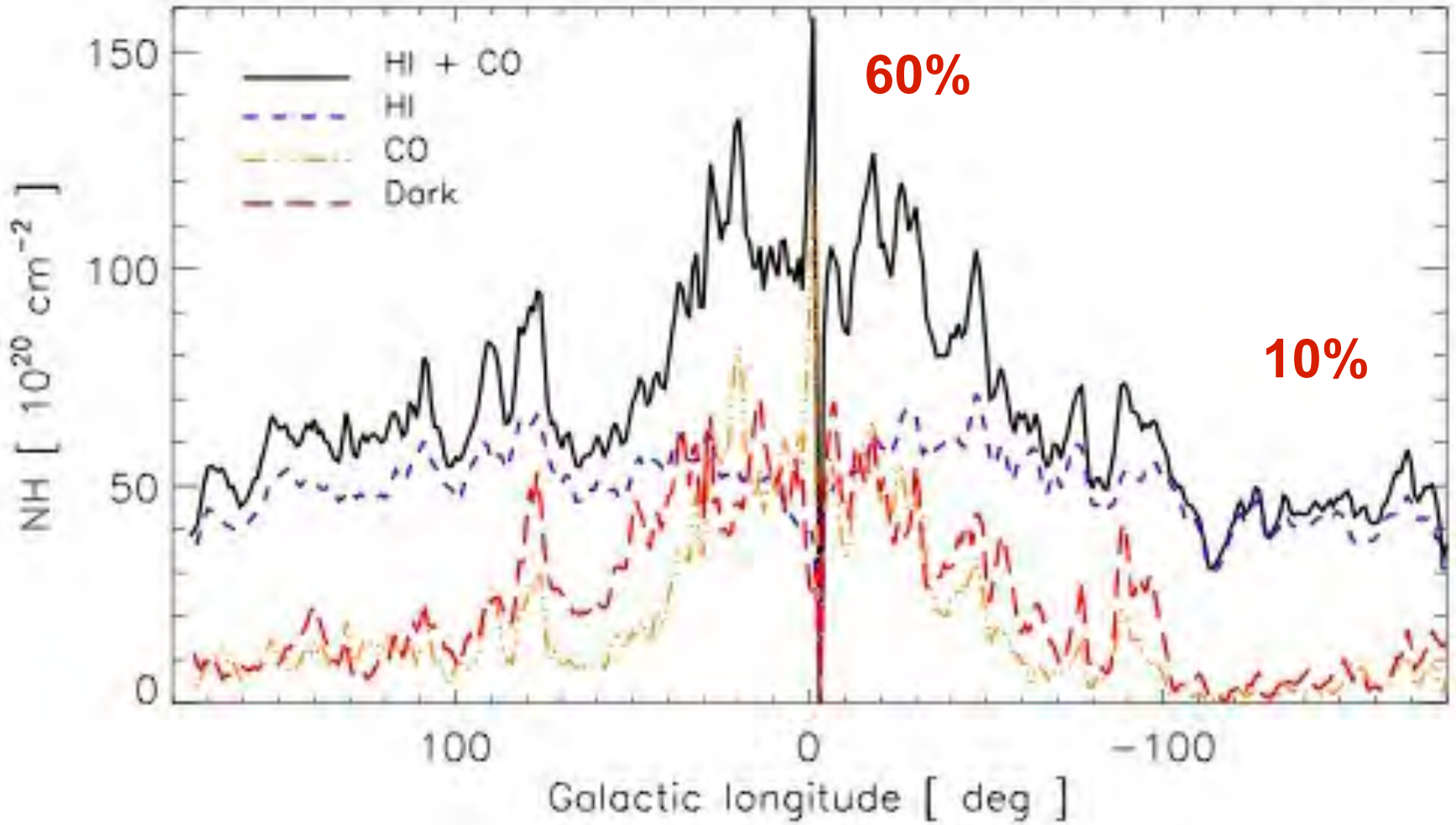
dark neutral gas map from dust

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



total dark gas

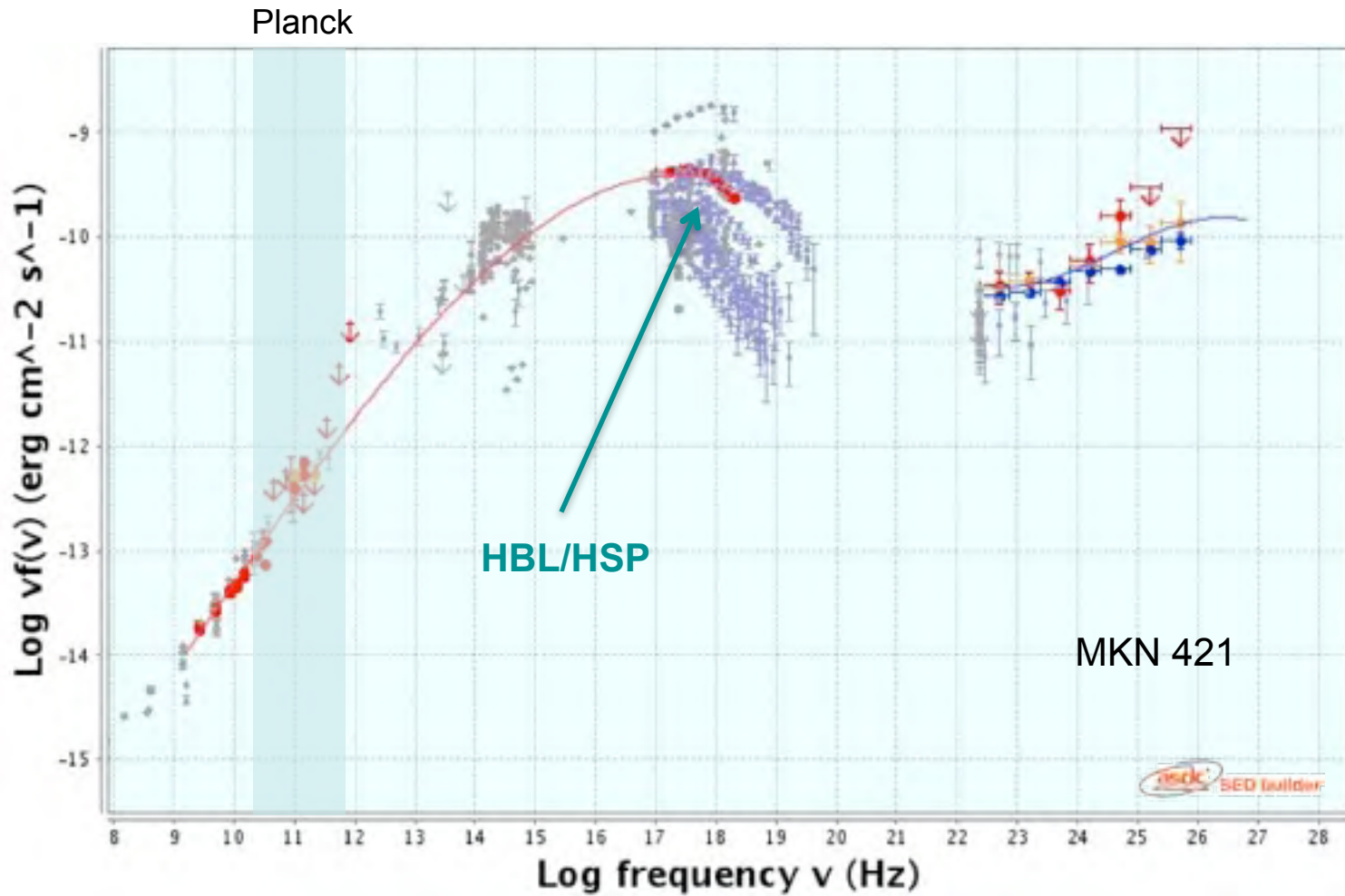
dark neutral mass \geq CO-traced mass except in molecular ring

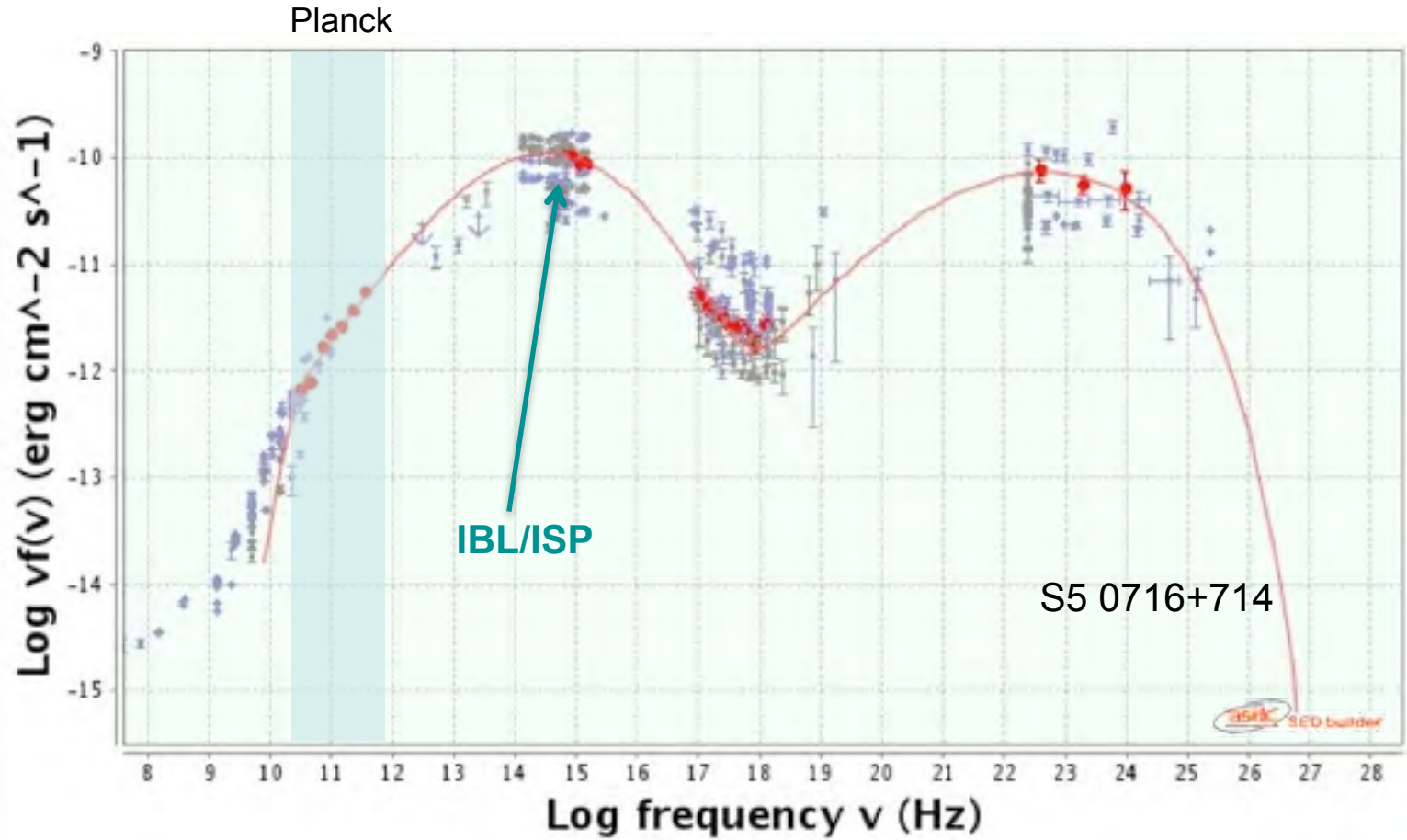


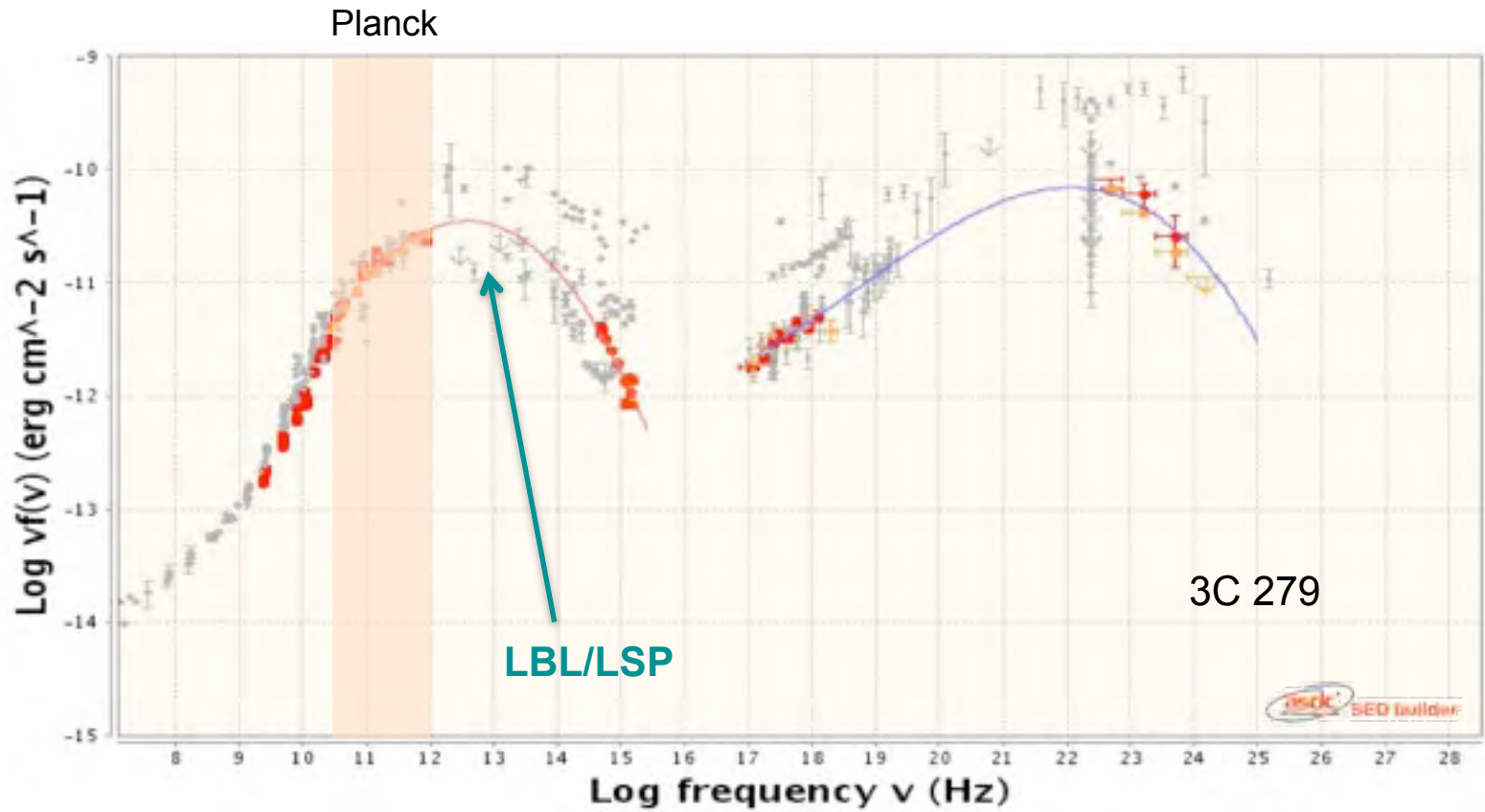
Planck et al. 2011, A&A 536, A21

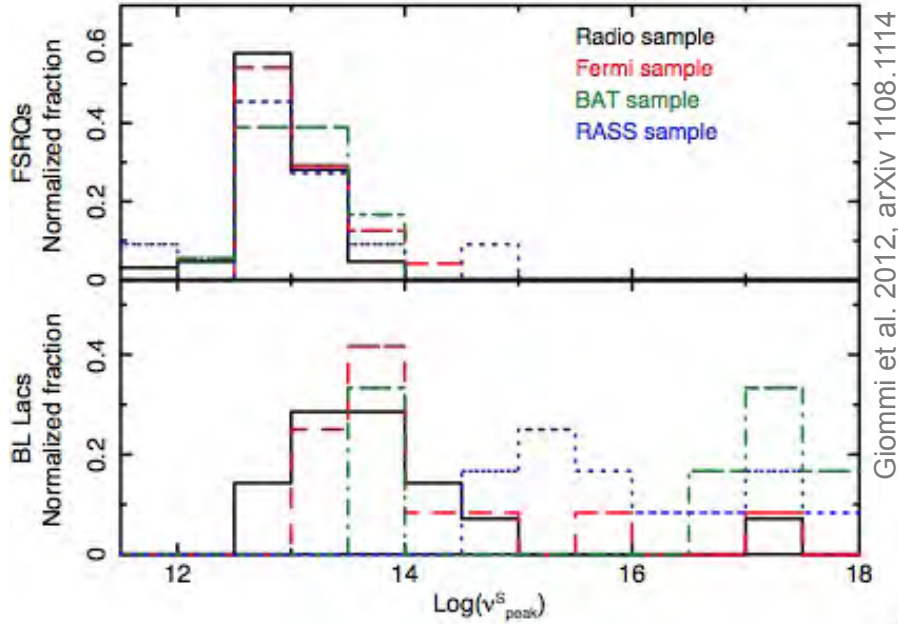


Blazars

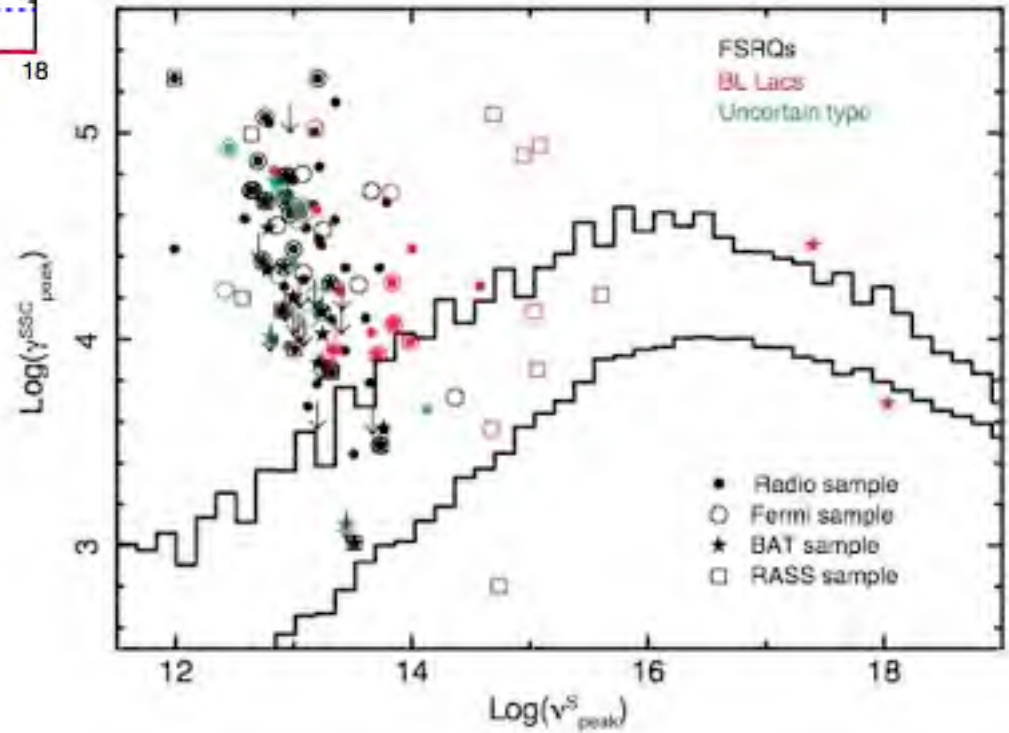
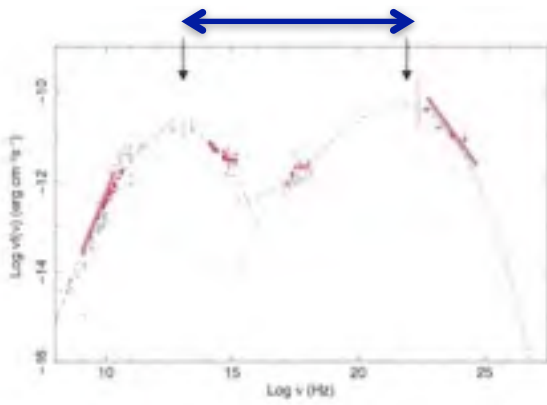








Giommi et al. 2012, arXiv 1108.1114



Giommi et al. 2012, arXiv 1108.1114