

Interstellar Radiation Fields

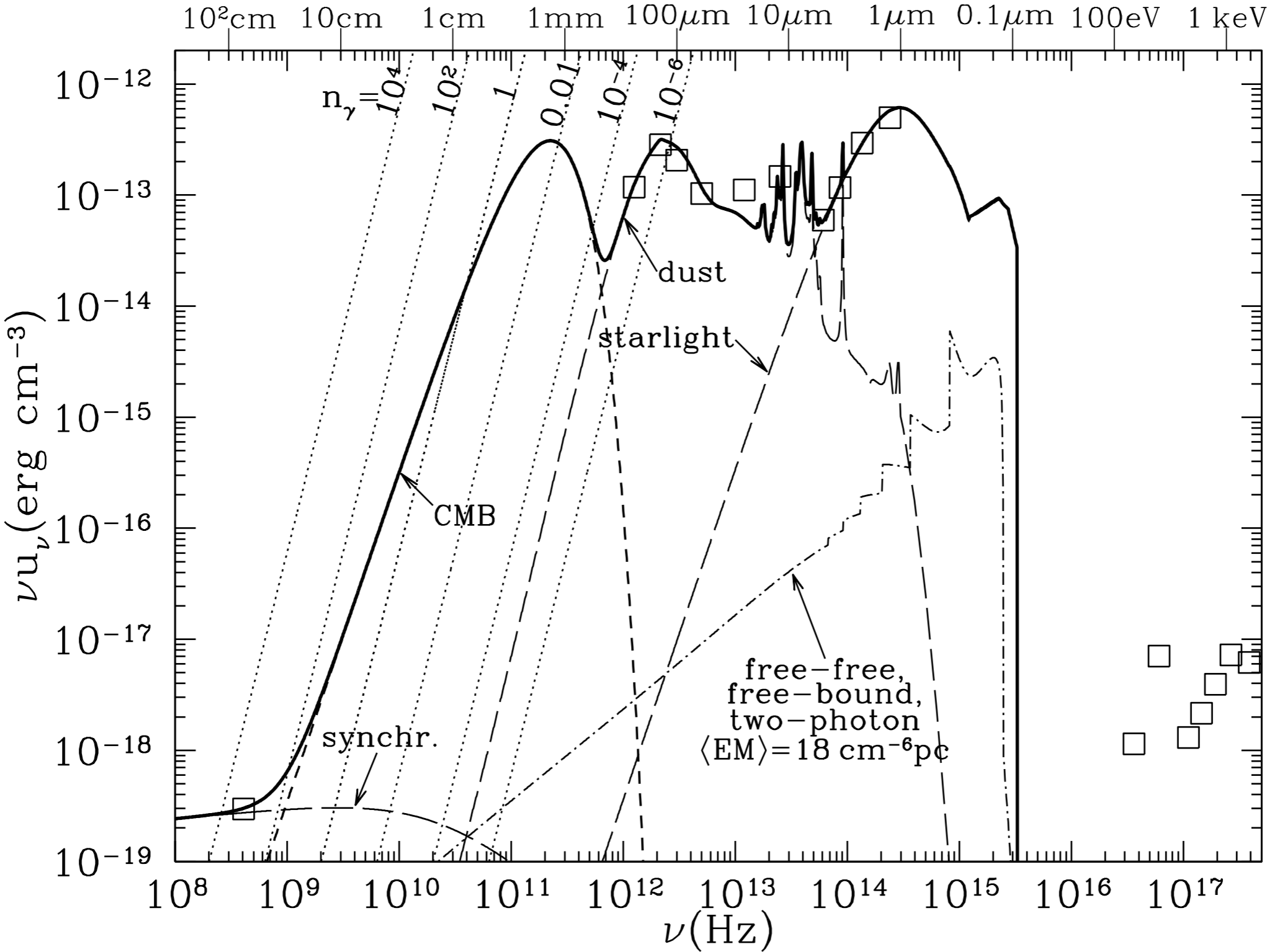
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Main Interstellar Radiation Field Components

- Galactic synchrotron radiation from relativistic electrons
- The CMB
- Starlight (UV photons from stellar photospheres)
- Mid- and far-IR emission from dust grains heated by starlight
- Emission from plasma at $T > 10,000$ K: *free-free, free-bound, bound-bound, X rays*

Components of the interstellar continuum radiation

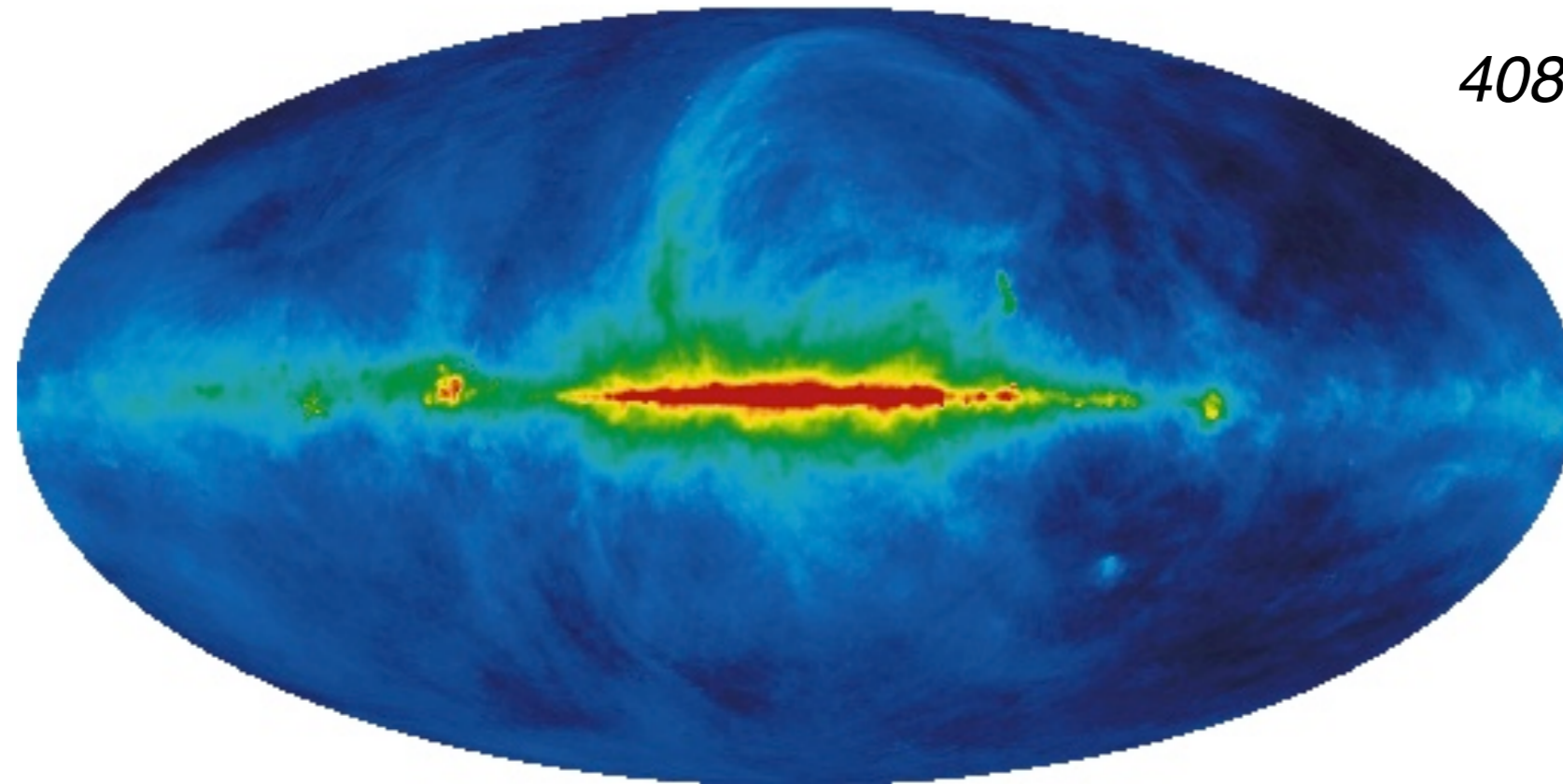


Picture credit: B. Draine's book (fig. 12.1)

Synchrotron Radiation

relativistic electrons moving in magnetic field

*synchrotron radiations dominates sky
brightness at $\nu < 1$ GHz (i.e. $\lambda > 30$ cm)*

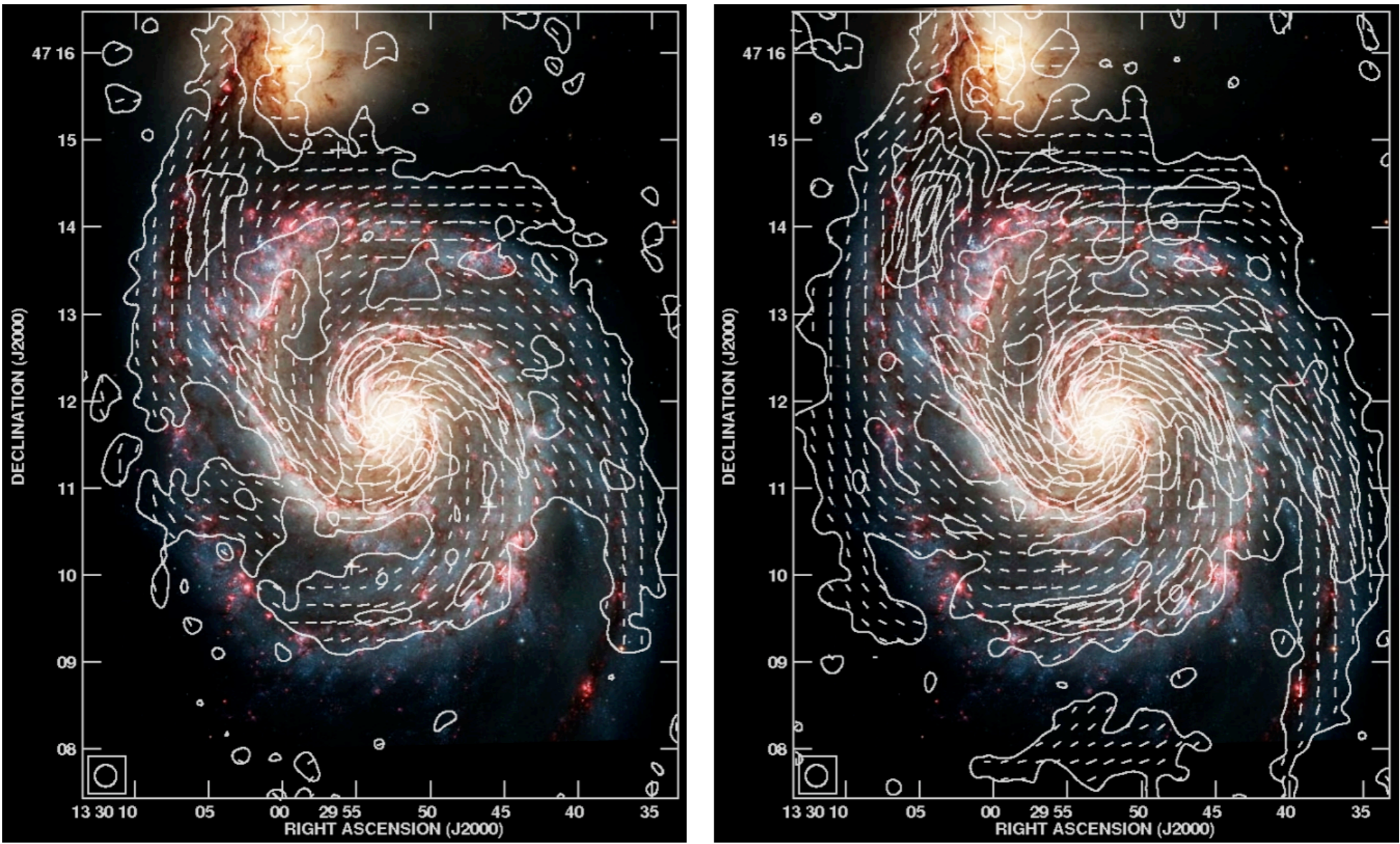


408 MHz map

Haslam et al. (1982)

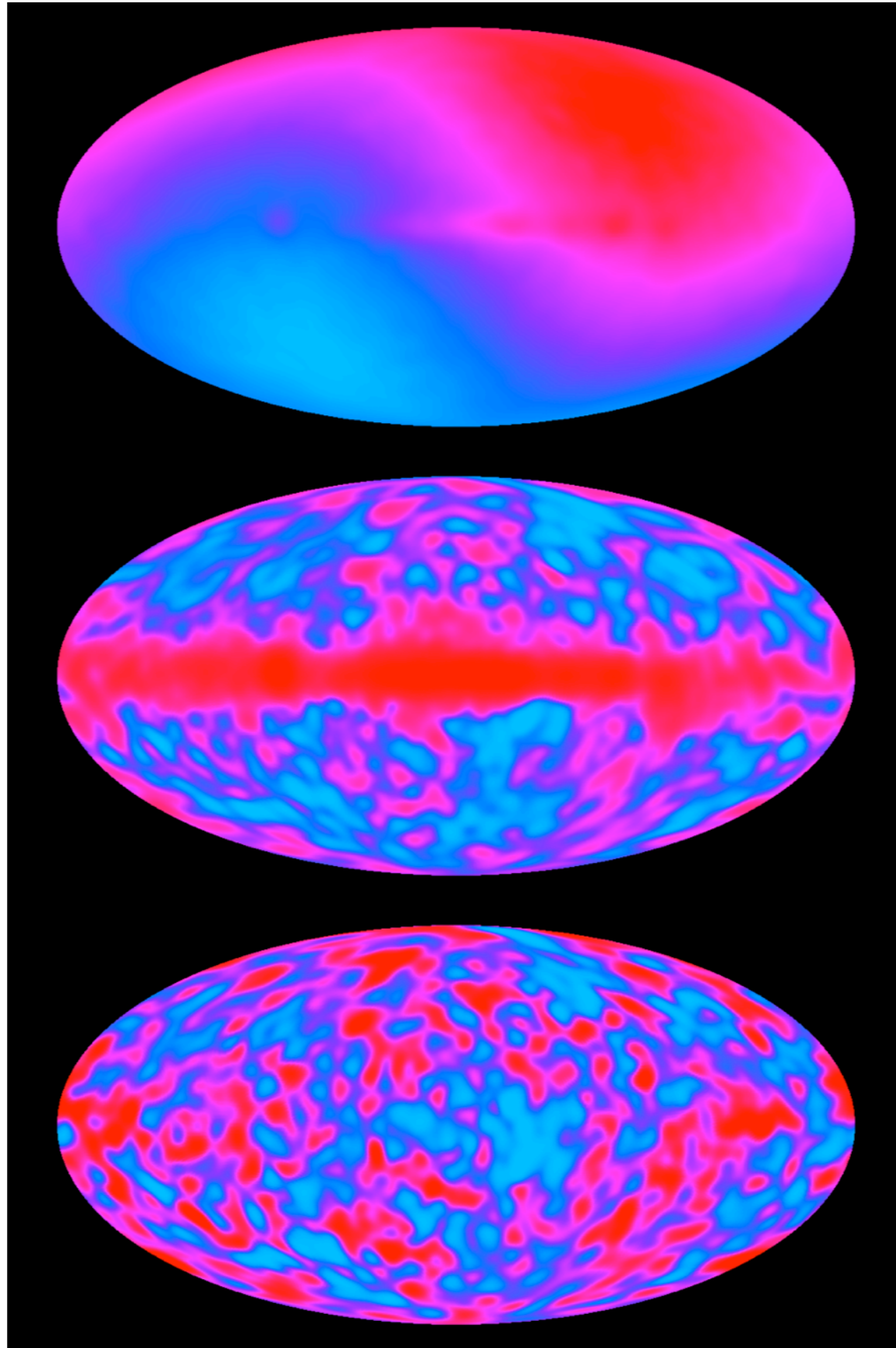
$$(u_\nu)_{\text{synchr}} \propto \nu^\beta$$

Magnetic Fields in M51



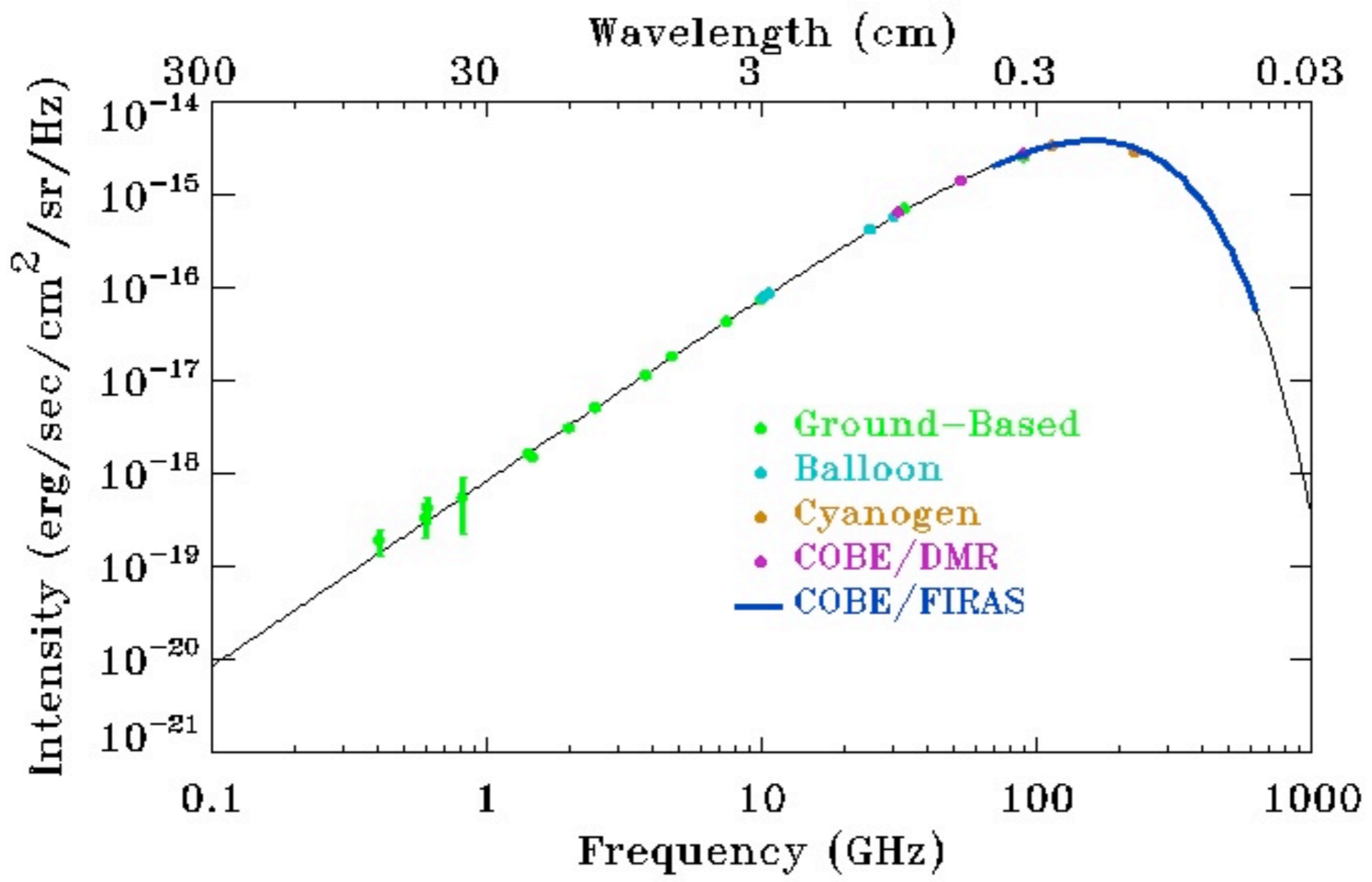
Fletcher et al. (2011)

The CMB



Picture credit: http://lambda.gsfc.nasa.gov/product/cobe/dmr_image.cfm

The CMB spectrum



Picture credit: http://asd.gsfc.nasa.gov/archive/arcade/cmb_spectrum.html

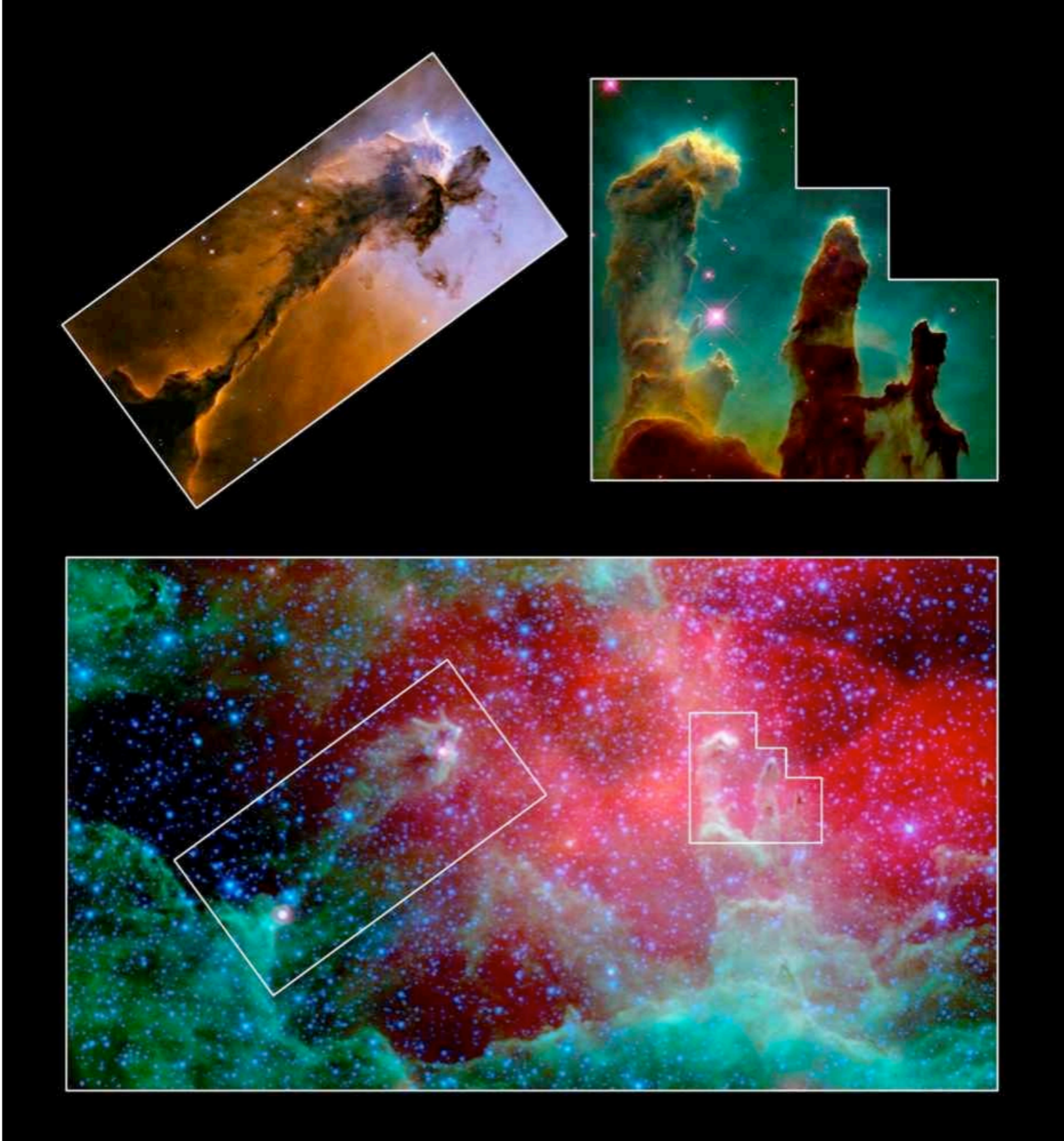
Starlight

30 Doradus (LMC)



Picture credit: NASA/ESA; Paresci, O'Connell; <http://hubblesite.org/gallery/>

Mid-/Far-IR Light - Dust Emission

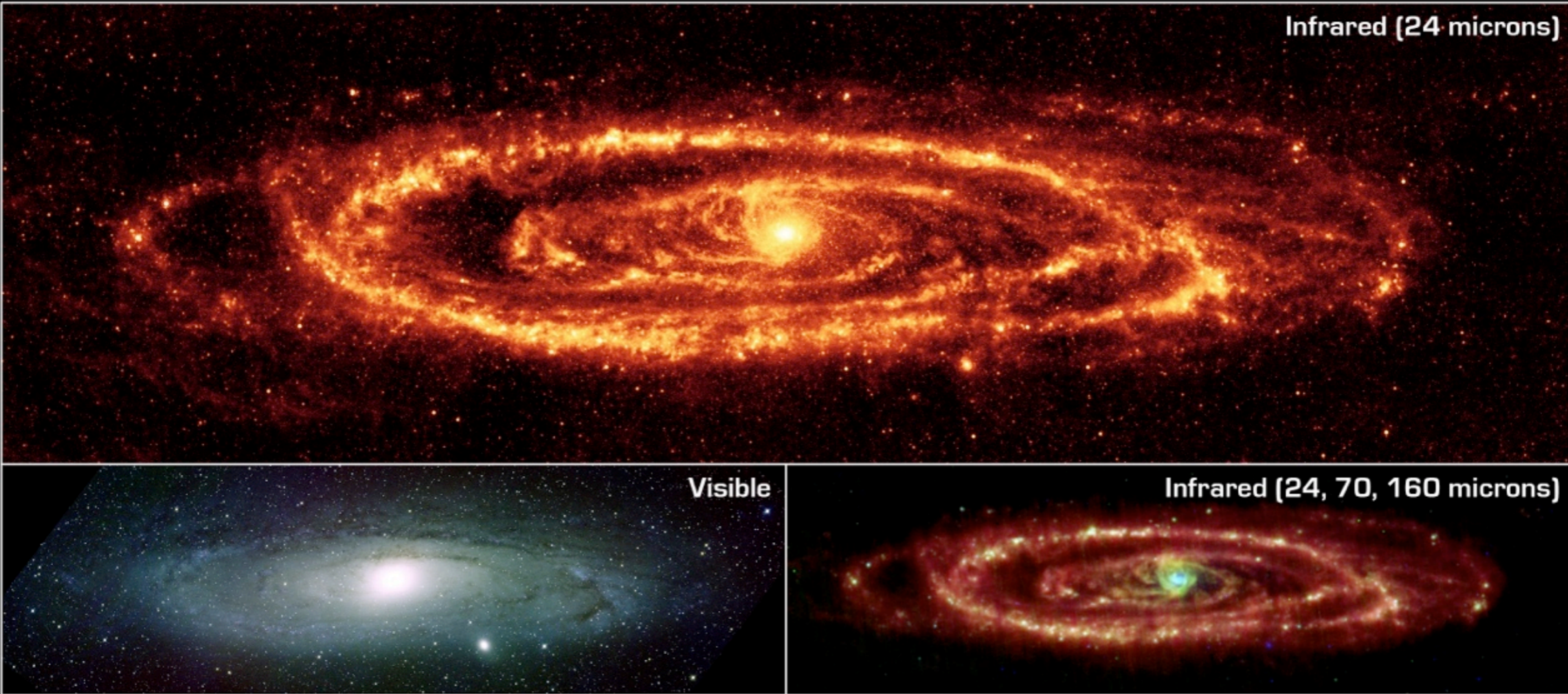


HST

Spitzer

Picture credit: NASA/JPL; N. Flagey; <http://photojournal.jpl.nasa.gov/figures>

Dust Emission in Andromeda



Dust in Andromeda Galaxy (M31)

NASA / JPL-Caltech / K. Gordon (University of Arizona)

Spitzer Space Telescope • MIPS

Visible: NOAO

ssc2005-20a

Dust Emission in M82



Picture credit: NASA/JPL; C. Engelbracht et al.

Comparison of galaxy spectral energy distribution

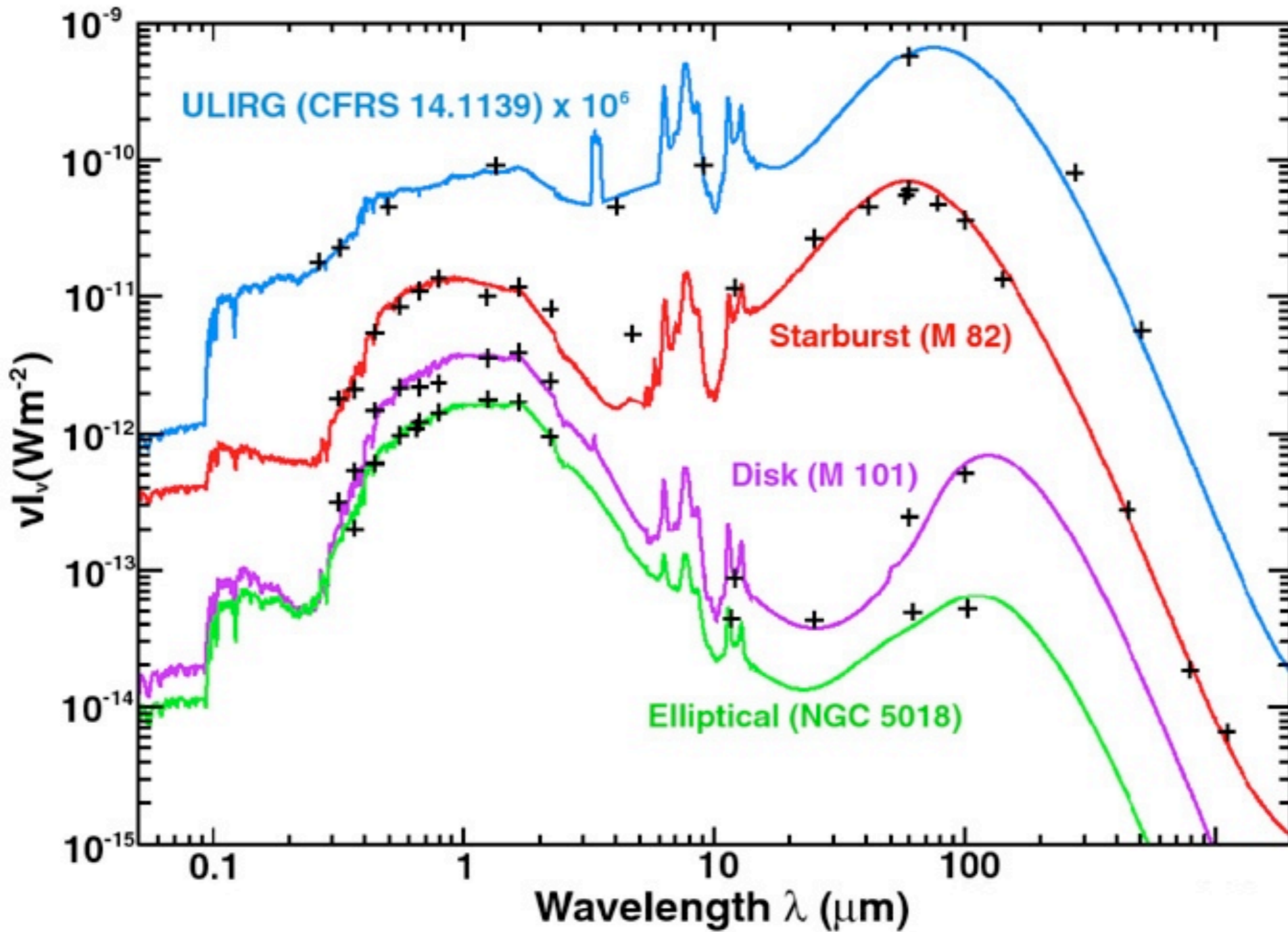
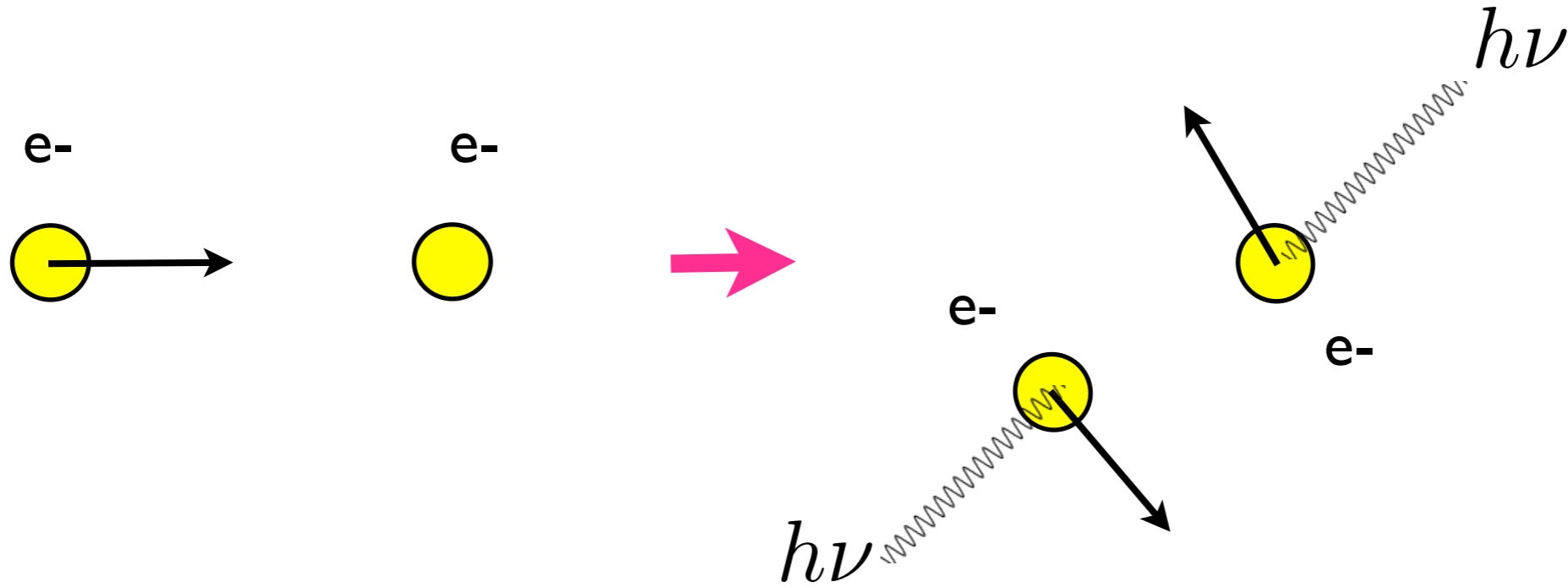


Fig 7.7 (P. Chaniai, G. Lagache) 'Galaxies in the Universe' Sparke/Gallagher CUP 2007

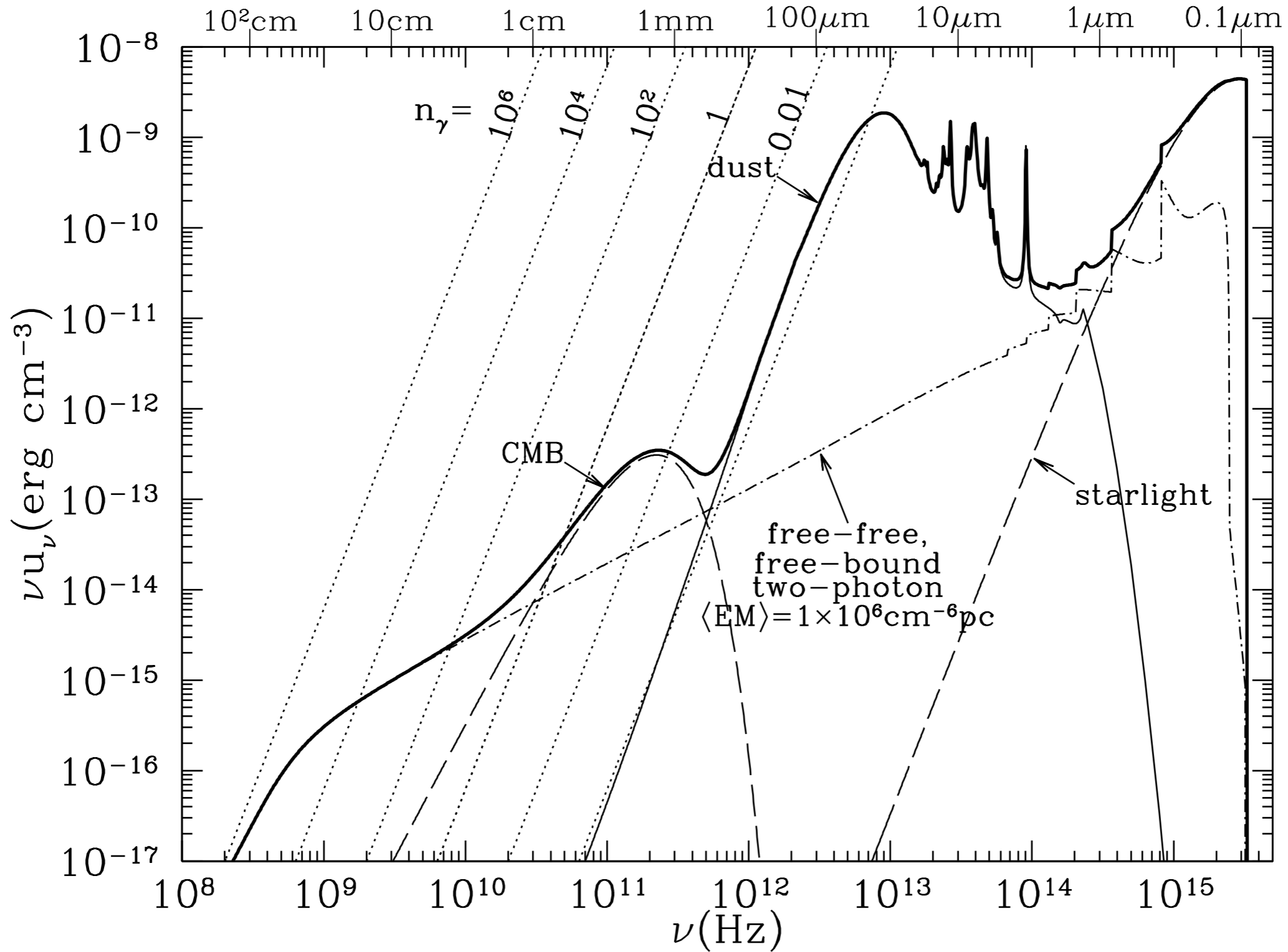
Bremsstrahlung (free-free emission) in Plasma



Free-free emissivity:

$$j_{\text{FF},\nu} = \frac{8}{3} \left(\frac{2\pi}{3} \right)^{1/2} g_{\text{FF},i} \frac{e^6}{m_e^2 c^3} \left(\frac{m_e}{kT} \right)^{1/2} e^{-h\nu/kT} n_e Z_i^2 n_i$$

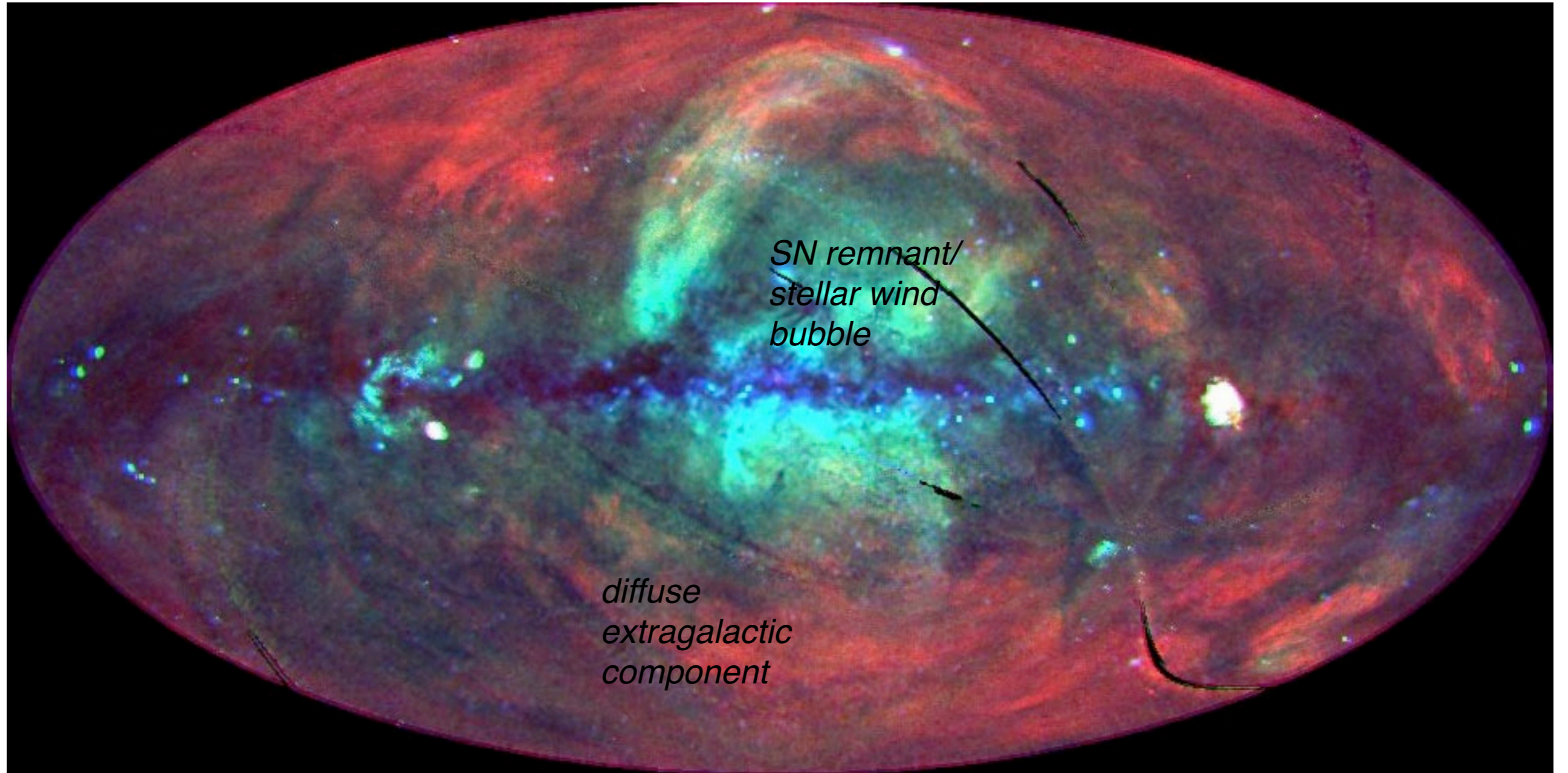
Radiation in a PDR near a hot star



Picture credit: B. Draine's book (fig. 12.3)

Diffuse X-ray background

ROSAT all-sky X-ray map



red: 0.25 keV; green: 0.75 keV; blue: 1.5 keV (all soft X-rays)

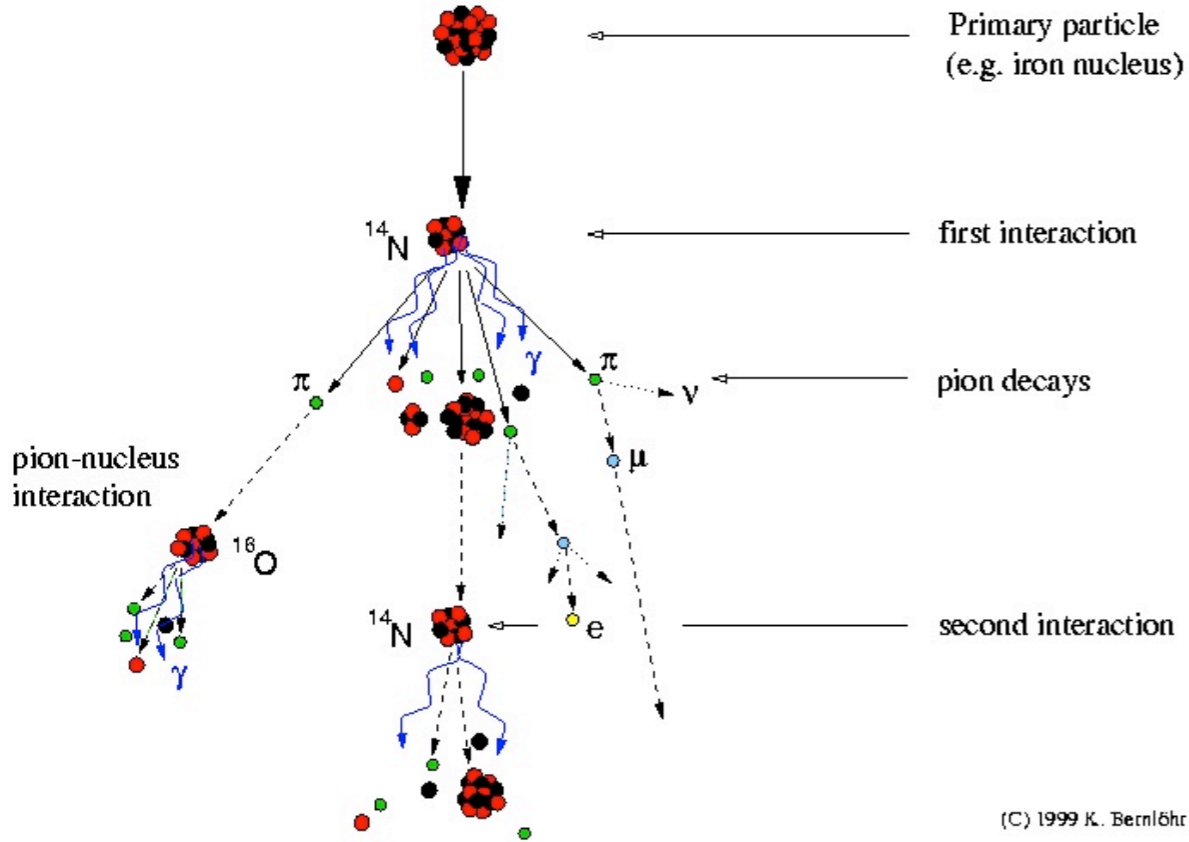
Picture credit: NASA GSFC

Gamma & Cosmic Rays

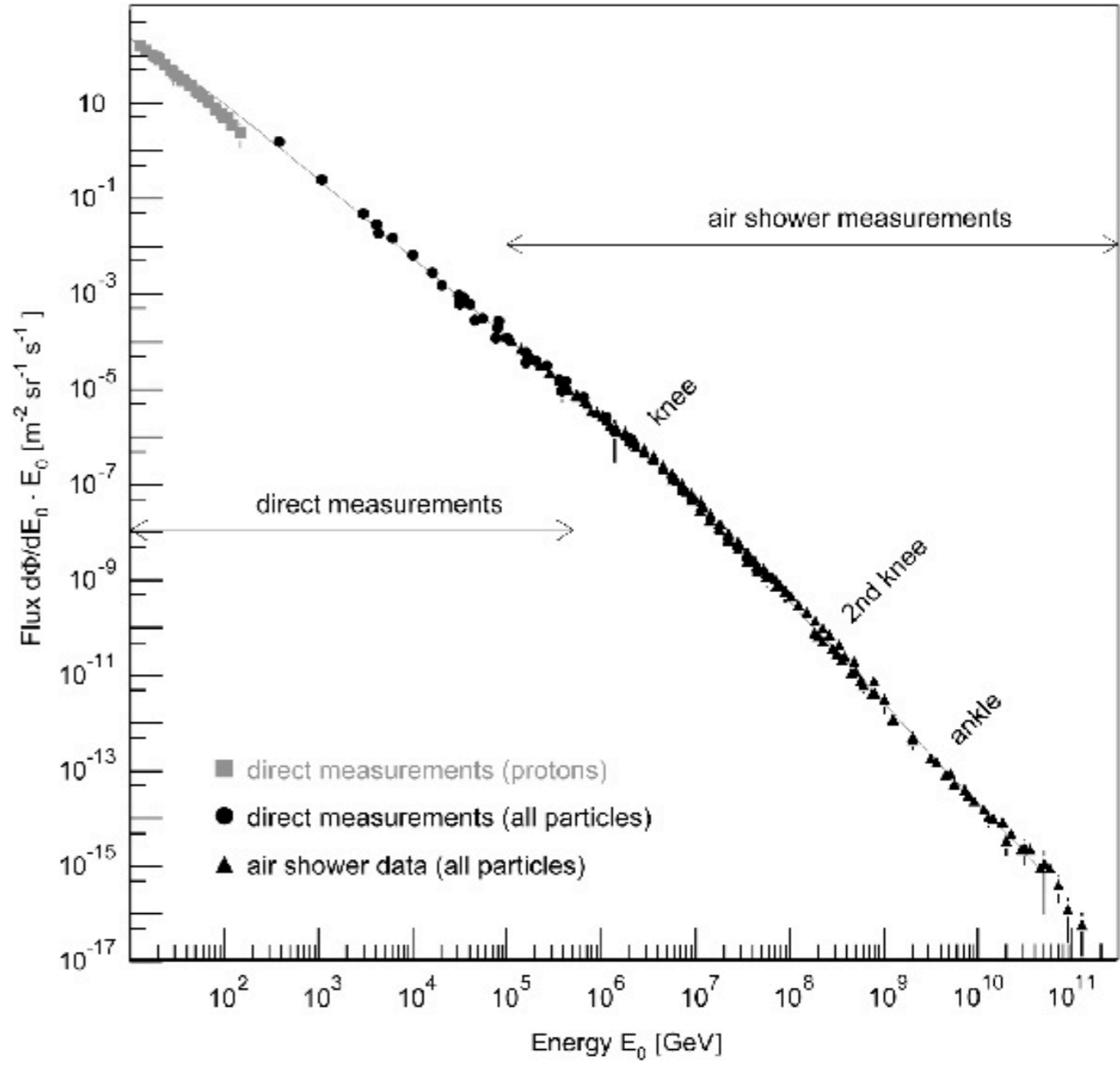
Gamma rays are emitted by accelerated cosmic rays and high-energy collisions of electrons with ions

Range: ~ 50MeV - 3 GeV

Development of cosmic-ray air showers



Cosmic-ray spectrum (> 10 GeV)



Credit: Bluemer et al. (2009)