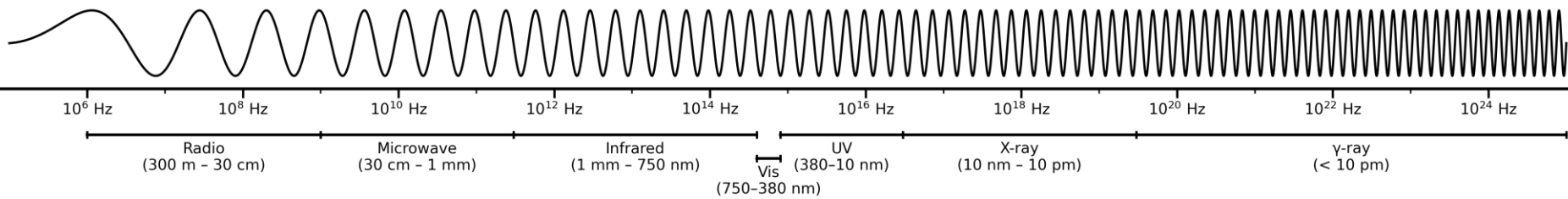


mw-atlas

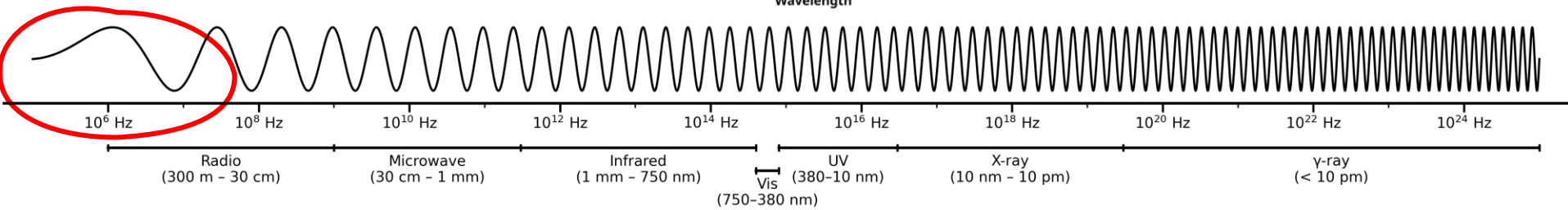
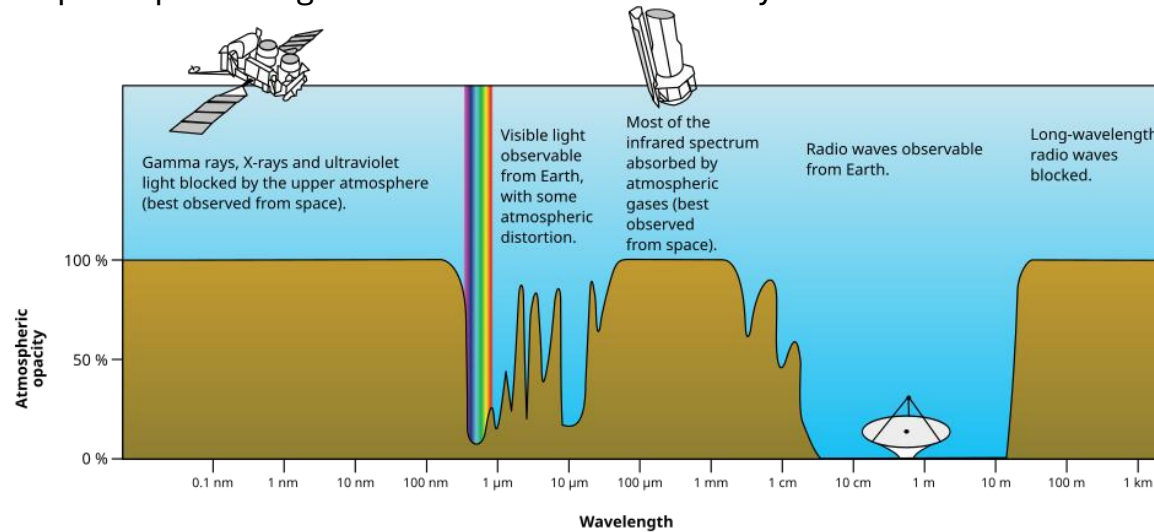
Reconstructing the Milky Way across all wavelengths

Laurin Söding @ Schneefernerhaus 2026

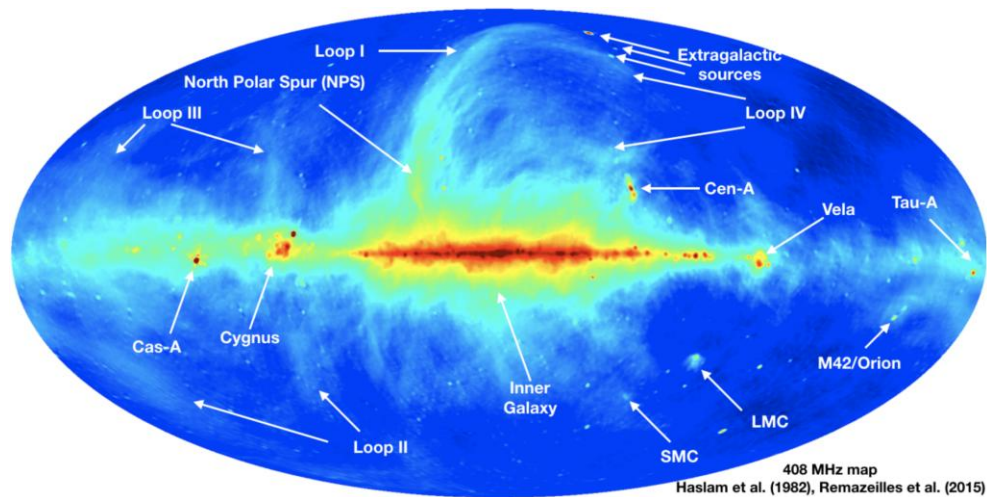


The practical floor: opacity at low wavelengths

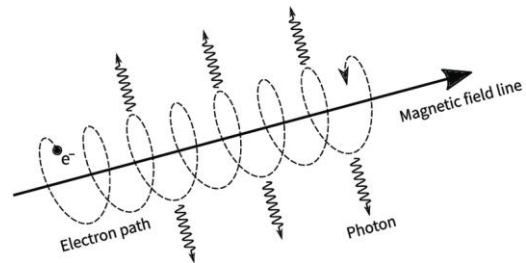
- Below about 0.1Mhz (3000m):
The ISM is opaque in most directions due to free-free emission becoming opaque: $\tau_{ff} \propto \nu^{-2}$
- Below about 10Mhz (30m):
Earth's ionosphere prevents ground-based radio astronomy



Synchrotron emission

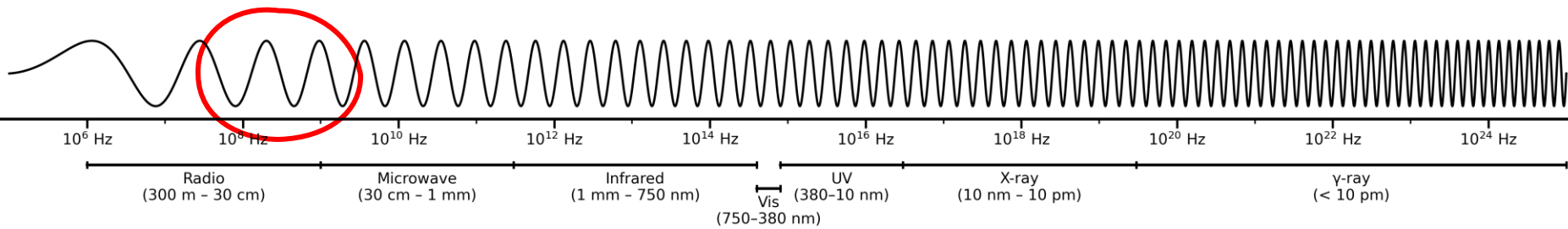


Synchrotron emission mechanism



Synchrotron emission sensitive to magnitude of B_{\perp} and n_e

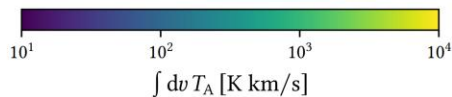
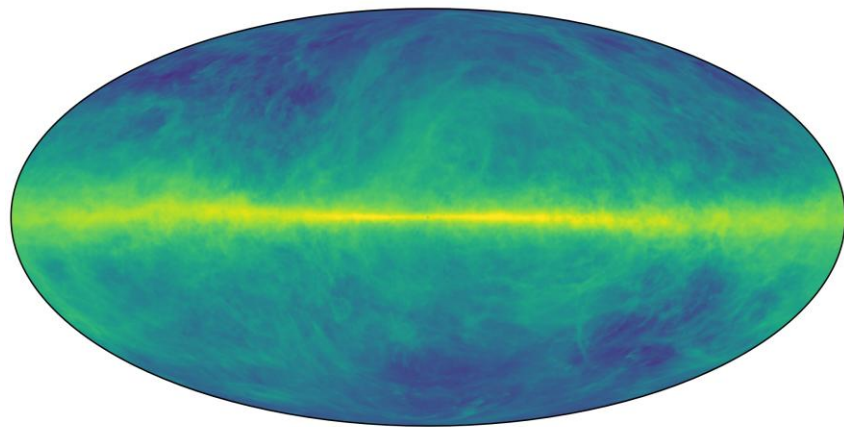
→ Richa



Radio recombination lines

→ Fabian,
Lewis

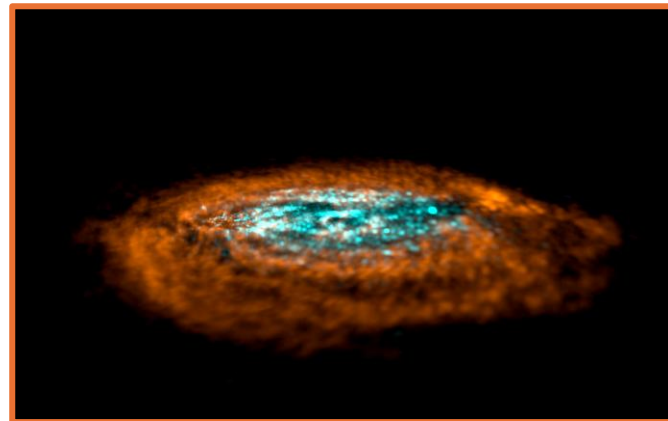
HI4PI: 21cm full-sky



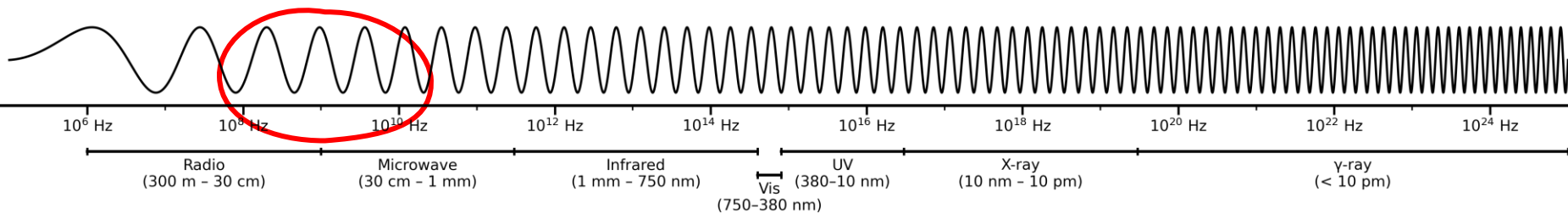
There are many more:

- OH (18cm)
- H₂CO
- CH₃
- ...

But no all-sky coverage for any of these



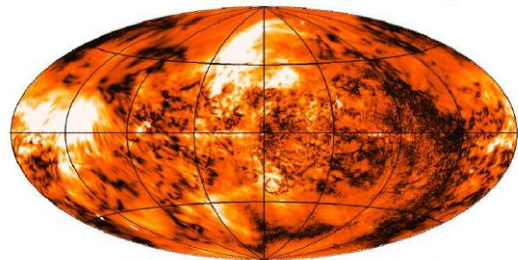
Söding et al. 2024



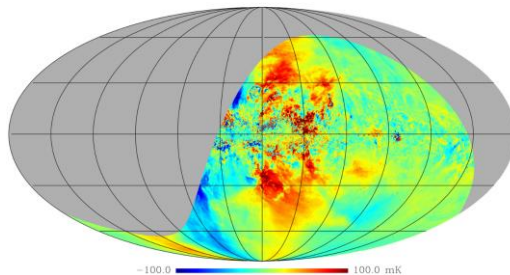
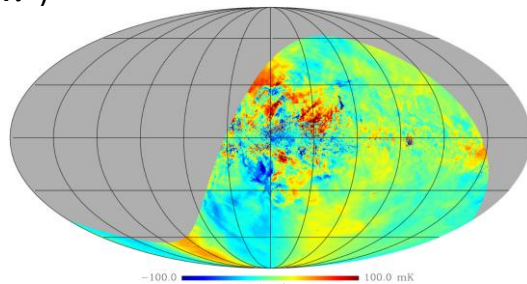
Synchrotron polarisation

- Polarisation of synchrotron emission traces magnetic field orientation
Complication: Faraday rotation (polarisation angle β changes proportional to $B_{\parallel} n_e$ and λ^2)

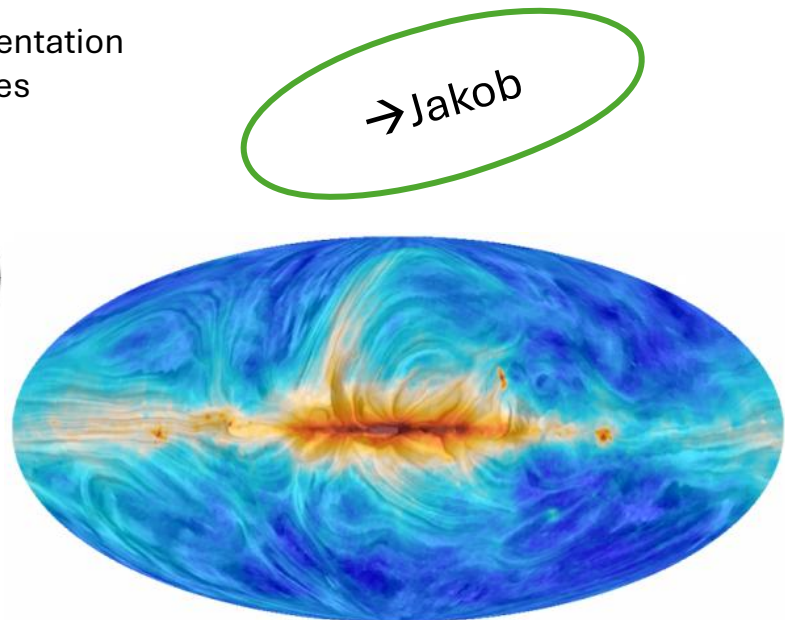
PI at 1.4 GHz (26m DRAO+30m Villa Elisa)



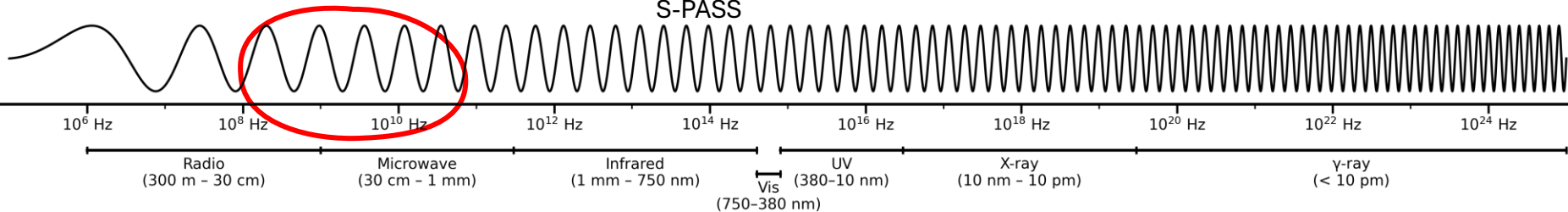
DRAO



S-PASS

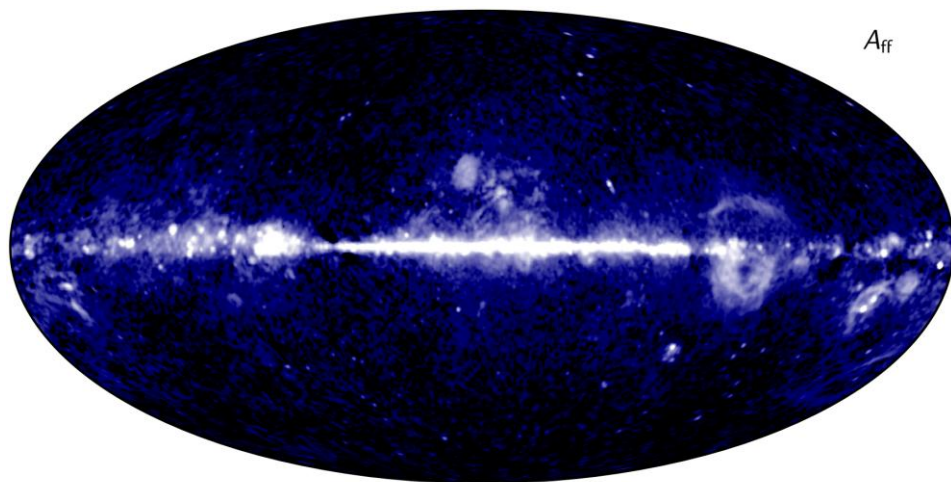


Planck



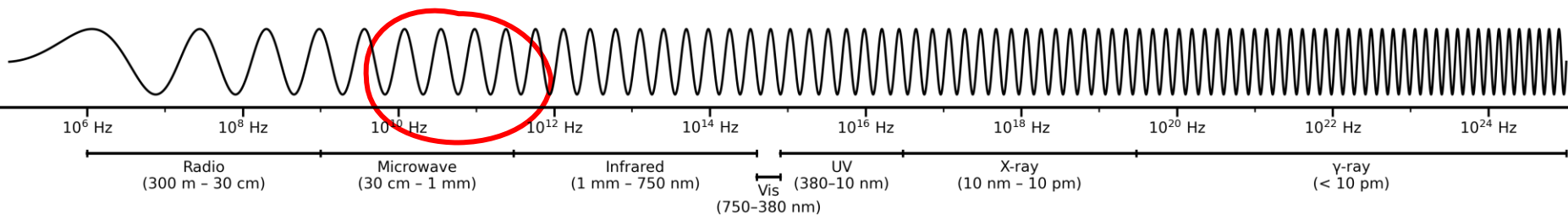
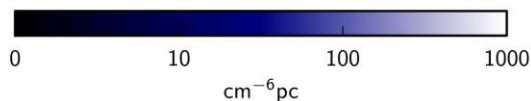
Free-free emission

Component-separated map from Planck



- Thermal bremsstrahlung
- Traces integrated n_e^2 (emission measure)

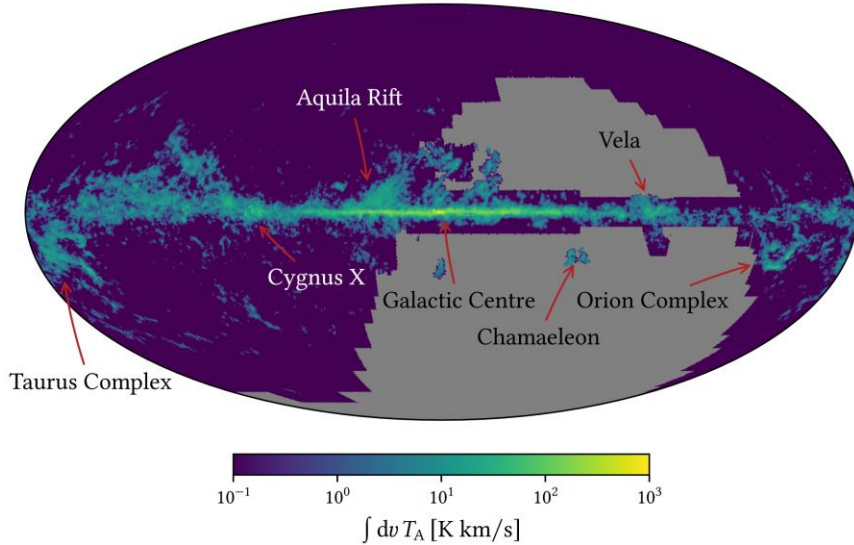
→ Ananya P.



Molecular emission lines

→ Fabian

CO molecular emission

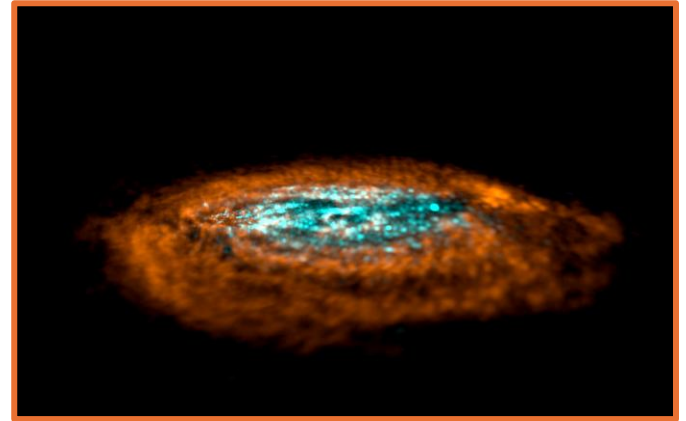


Dame et al. 2001 and 2022

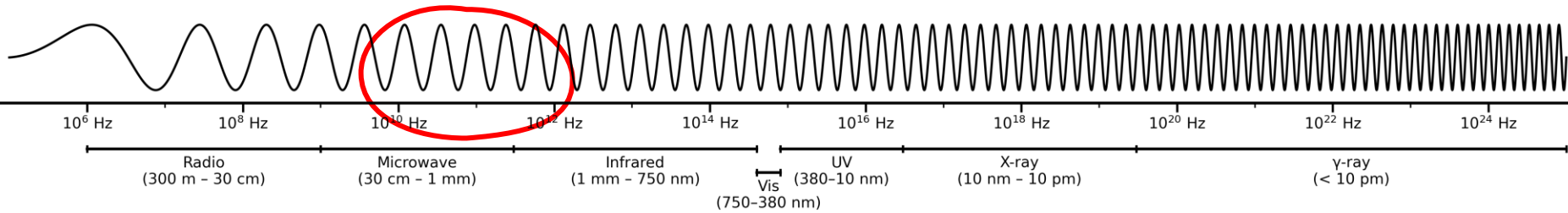
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- CH₃
- ...

But no all-sky coverage for any of these



Söding et al. 2024



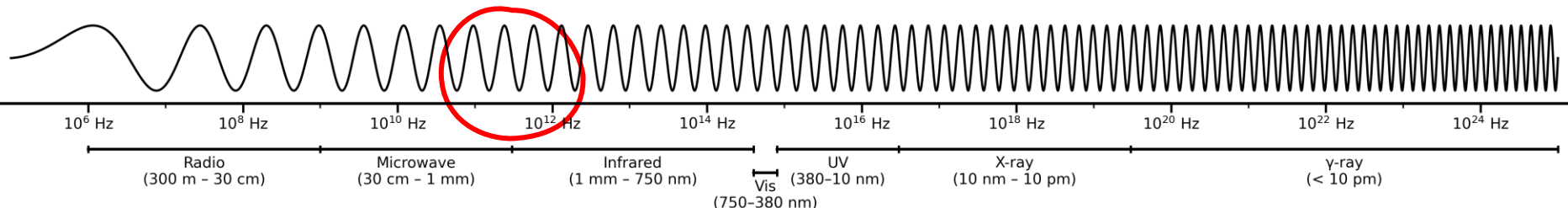
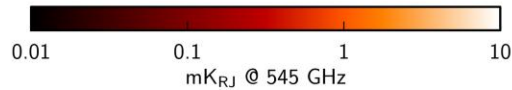
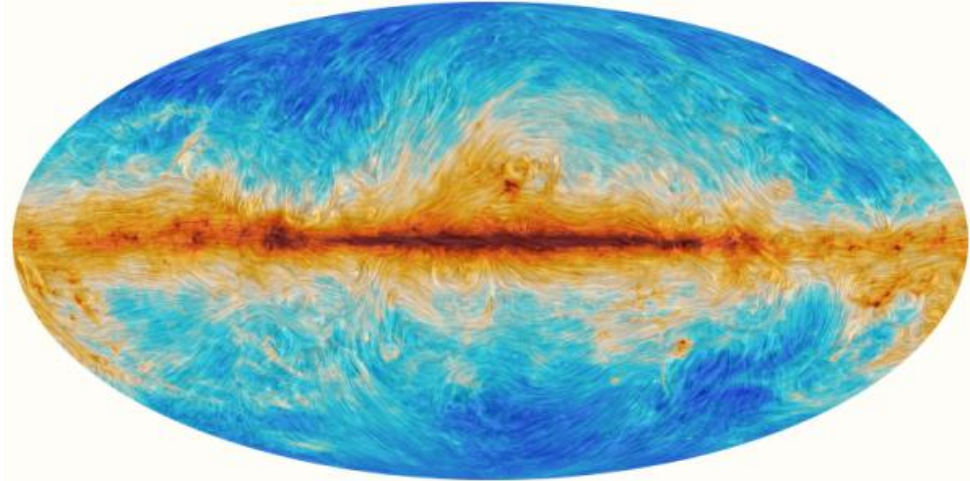
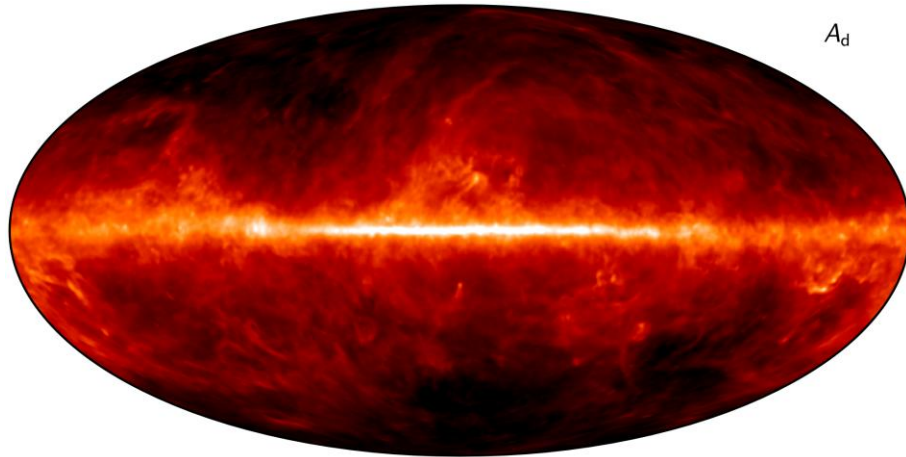
Thermal dust emission

→ (Fabian), ...

Planck: Intensity traces total dust column

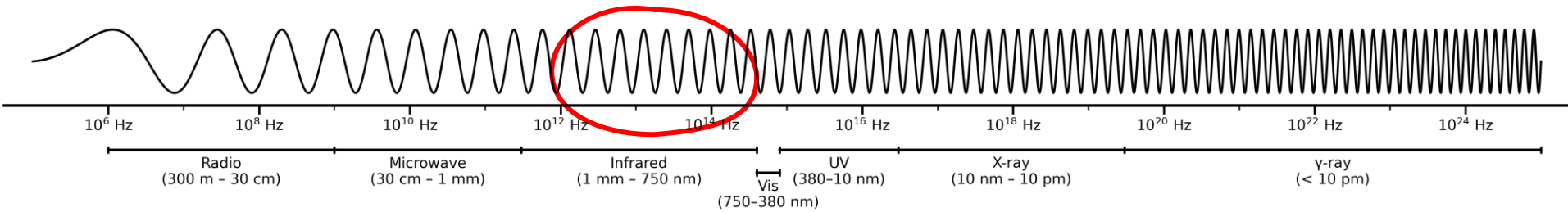
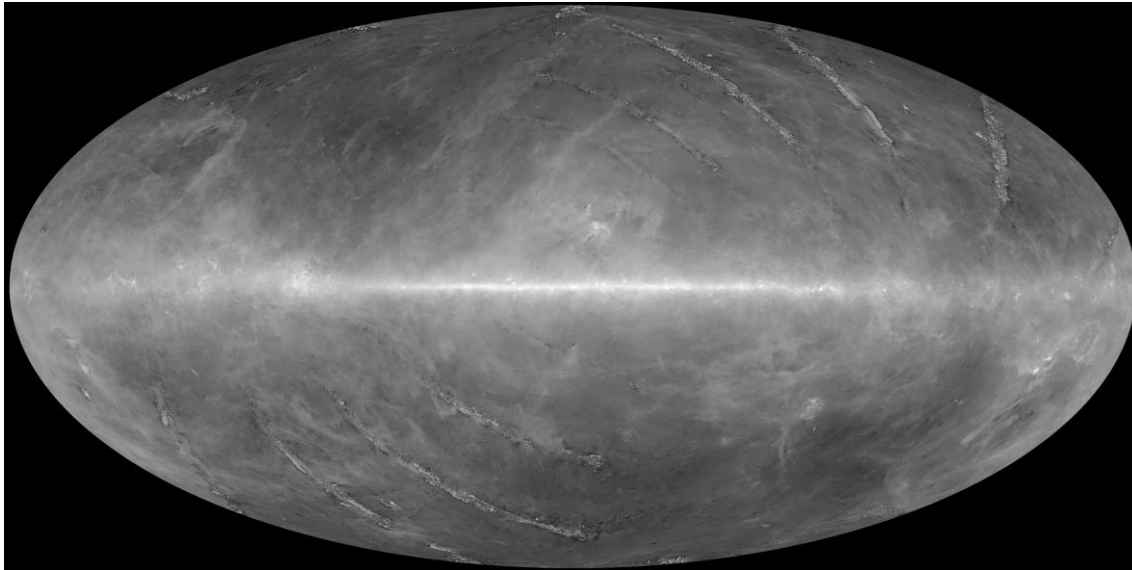
A_d

Planck: Polarisation traces B-field



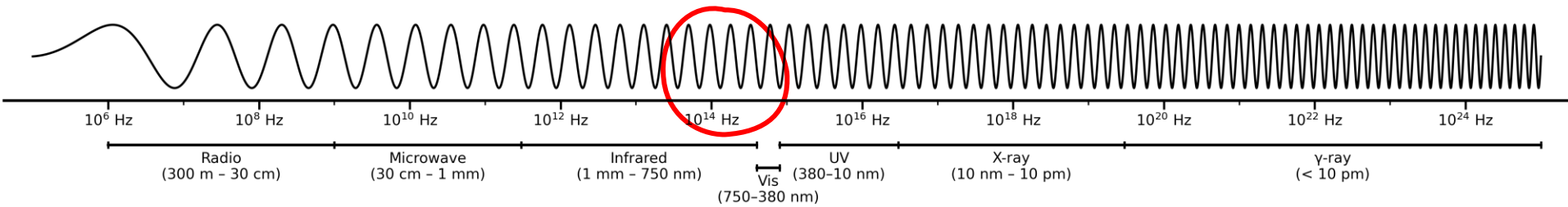
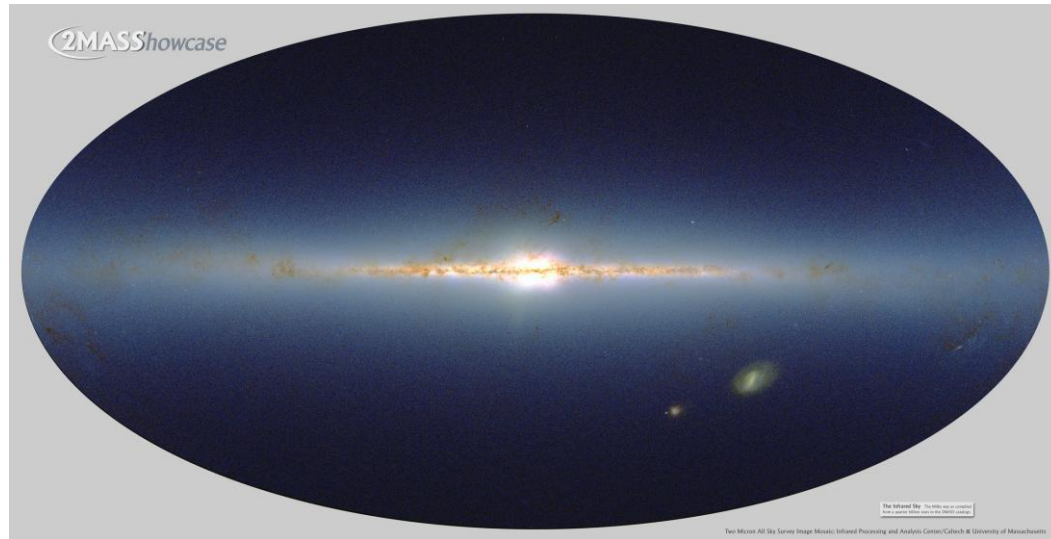
Polycyclic aromatic hydrocarbons

WISE 12 μ m: Emissions bands excited by UV photons from stars



Near-infrared starlight

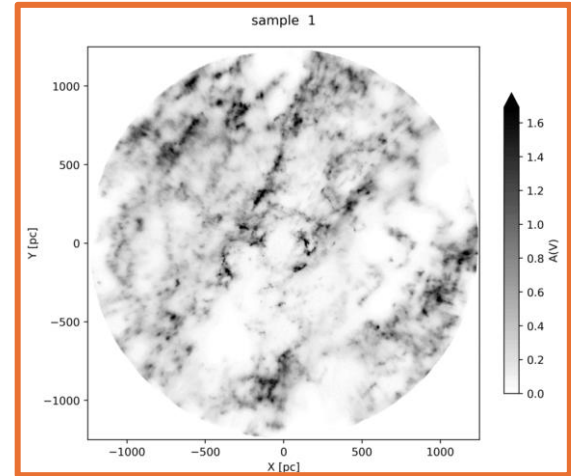
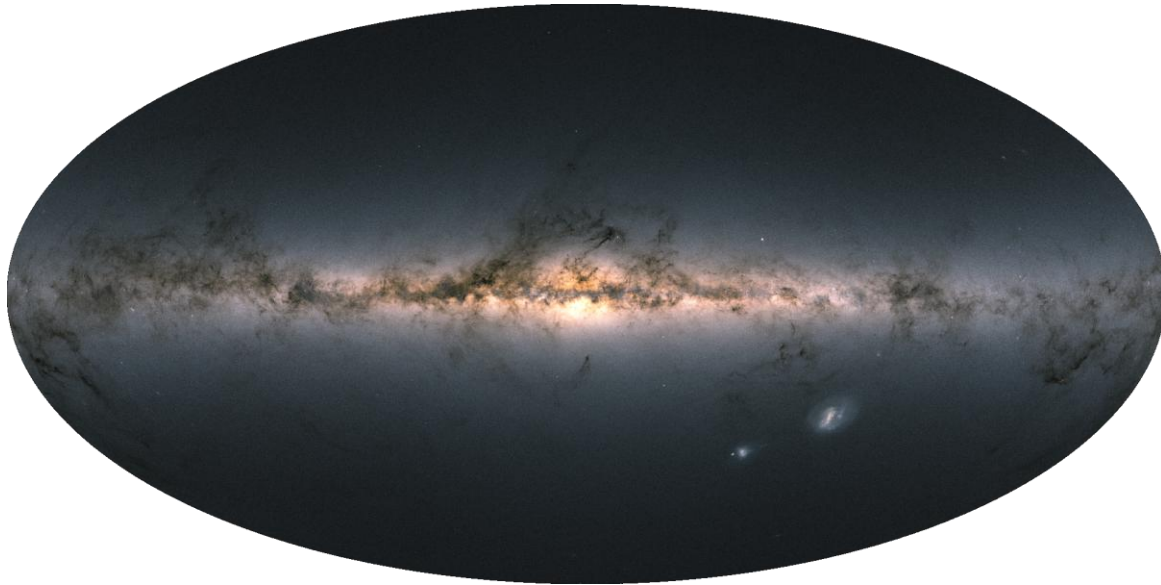
2MASS: Mainly cool giants and red dwarfs, can look through much of the dust



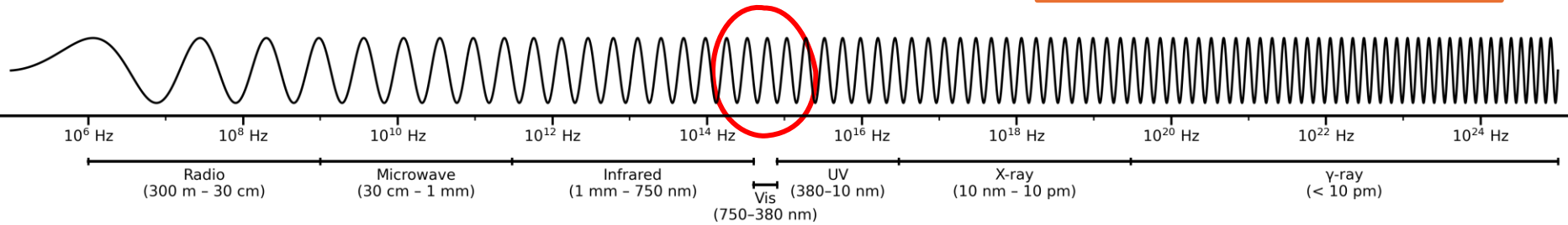
Gaia

Gaia: 6D (positions and velocities) for about 10^7 stars
Stellar parameters from spectra & colours

→ Robert, Fabian,
Matthias (& Tanvi
& Johanna)

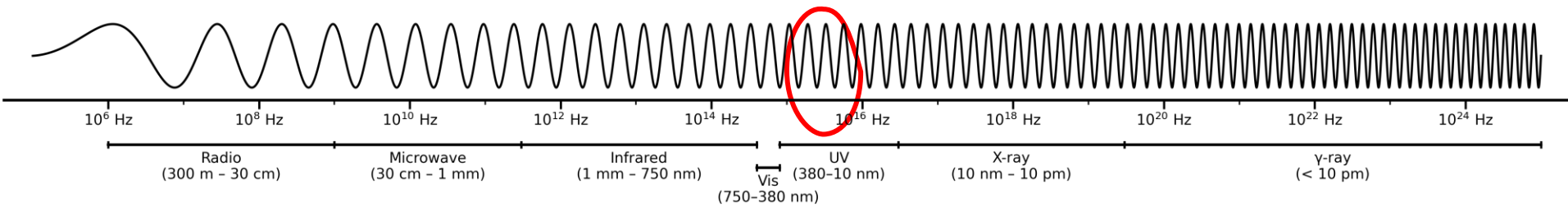
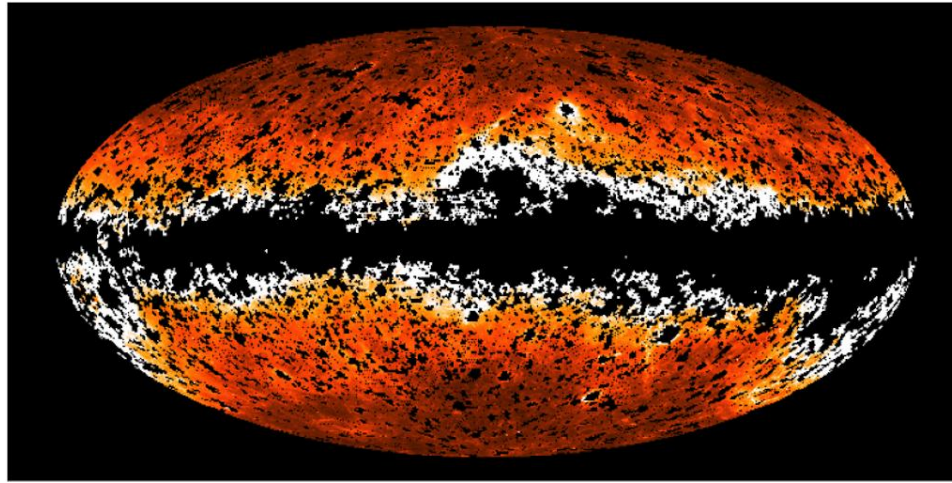


Edenhofer et al. 2024



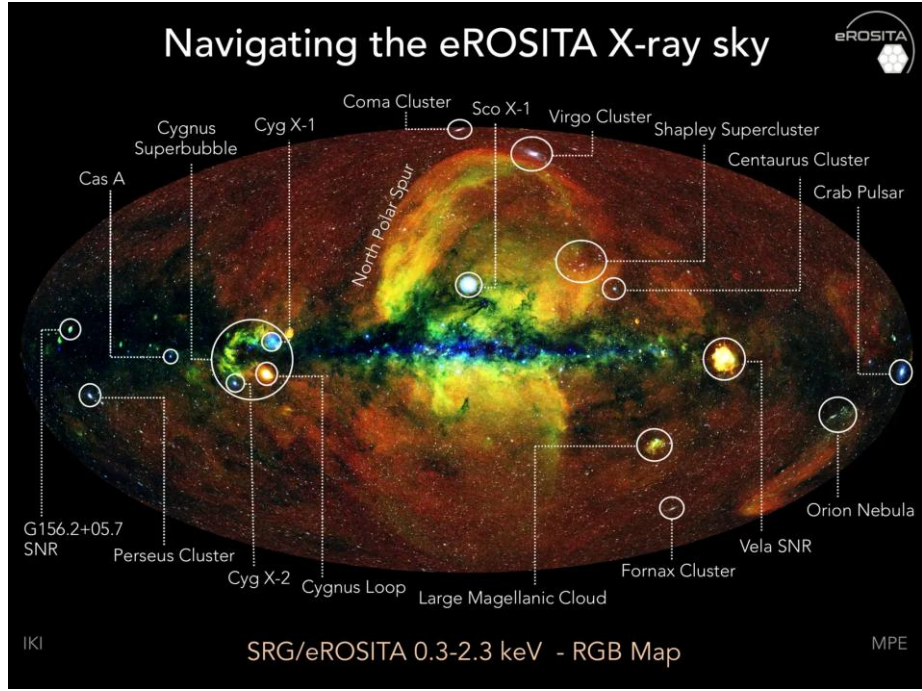
Ultraviolet

GALEX: UV is strongly affected by dust extinction
Traces hot gas at high latitudes

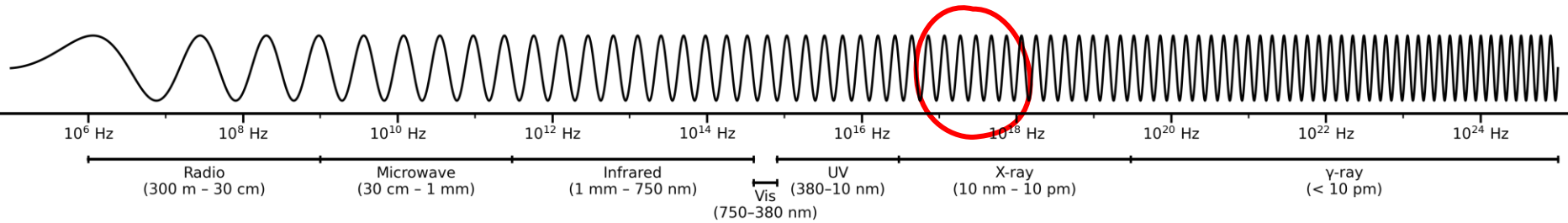


X-rays

→ Ananya P.



- Traces the hot ionised medium (heated by supernova shocks).
- Visible local bubble and distant SNRs
- Absorption gives rough distance information
- Russia jails the Galactic centre half of the dataset



γ -rays

Fermi-LAT:

- Gamma rays from cosmic ray protons hitting ISM gas
- Inverse Compton scattering of cosmic ray electrons

→ Hanieh & Mareike

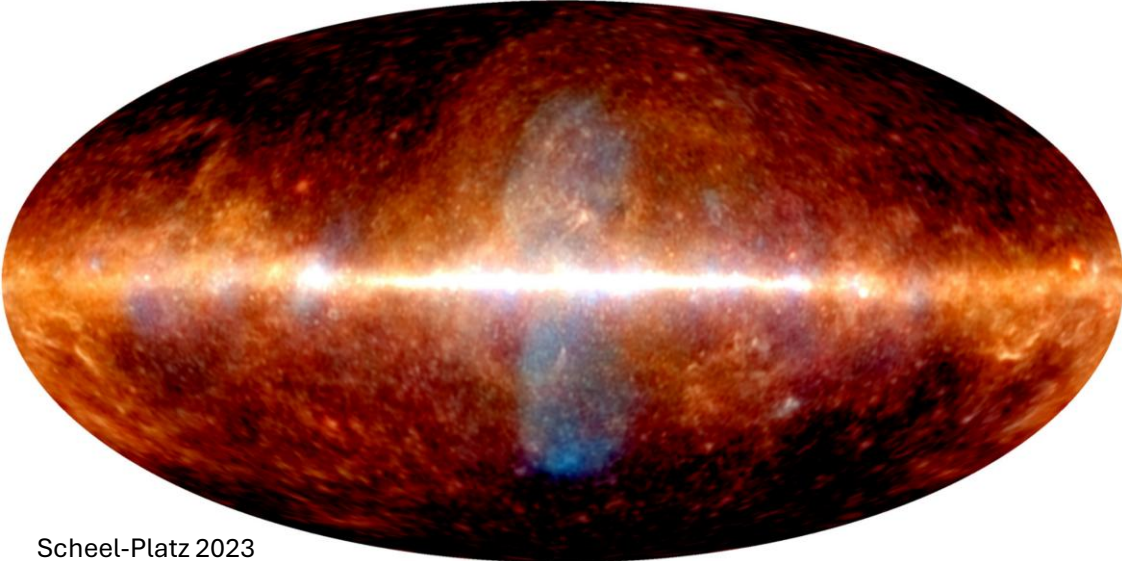
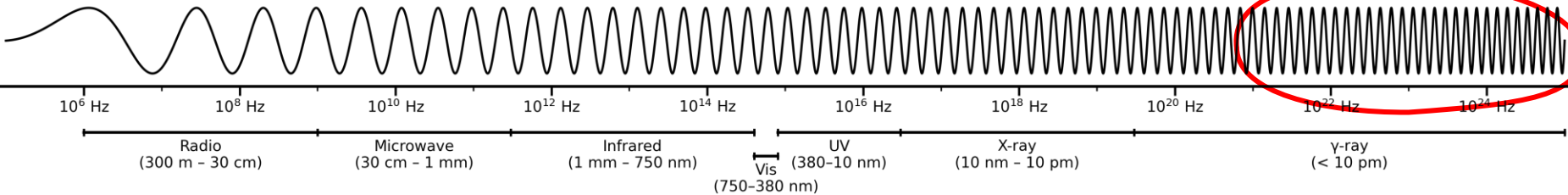


Figure not yet public

Zandinejad et al. in preparation

Scheel-Platz 2023



Putting things together – one step at a time



- “The best Milky Way map, by Gaia”: Artist’s impression
- Let’s make a better one!
- Approaching the big “everything, everywhere, all at once”-problem step-by-step!

→ Everyone!

