Interstellar Medium 16-09-2019

Andromeda spectrum
- strong continuum (stellar light)
- some absorption spectral lines

Orion nebula
- no continuum
- Dominated by spectral lines.

ISM discovered ~100 years ago as when stationary CaII lines were seen at a spectroscopic binary star system

~ 1970 cm transitions CO [CO, etc].
We cannot observe cold H_2 as lines are in UV, mid IR etc which cannot be done from the ground

IRF has about the same brightness in IR and optical IR is thus as important as optical
By writing νI_ν on vertical axis we get integ total power when integrating over plot

$$\rightarrow \int \nu I_\nu \, d\log(\nu) = \int I_\nu \, d\nu$$

Milky way constituents
d_{avg} (2 stars) ≈ 2pc
heliosphere ≈ 200 AU
→ stars occupy ~ $3 \cdot 10^{-10}$ fraction of volume

→ remaing $(1 - 3 \cdot 10^{-10})$ filled by ISM
hydrogen + helium + traces of metals
ionized, neutral, molecular
etc

Dark clouds : absorption by dust in dense clouds
Dark bands straddle the milky ways. Extinction due to dust, not molecules. Dust ~20 k

SNRs : about 100 of them. Filamentary and shell like structures. Collisionally ionized by strong shock wave. Strong in radio due to synchroton emission, and bright in x-ray ~~bec~~ because hot (10^6 k gas).

Phases in ISM : hot ionized @ 10^6 k, HII, warm ionized and warm neutral medium @ 8000 k and cold stuff @ 100 k. → three phases?

~~Wa~~ Warm neutral medium covers bt of volume (40 %)
Warm ionized medium is birthplace of stars. Hot ionized is collisionally ionized (supernovea)

Cold neutral medium organized in clouds. Warm ionized medium & HII regions in Hα. Hot ionized medium : x-rays absorbed by ISM

Molecular hydrogen almost all in encircled region of sun. Outer galaxy completely dominated by atomic gas. There are galaxies that are mostly molecular.

Energy densities in ISM are nearly the same.
$U_{thermal}$, U_{magn}, U_{hydro} are coupled hydrodynamically
$U_{thermal}$ is weakly coupled to $U_{starlight}$. $U_{3K\,CMB}$ is not coupled to anything else.