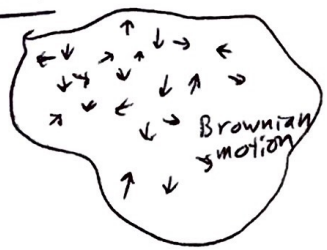
Blackbody

Requires:

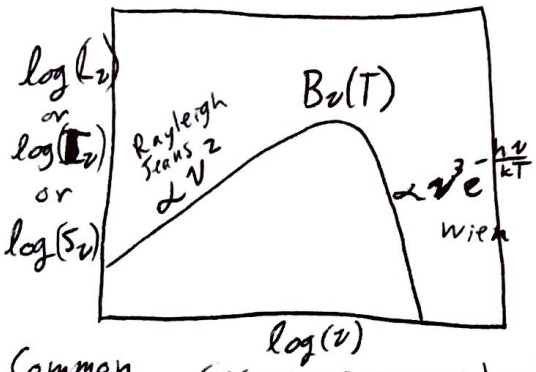
- Object of high opacity (perfect)
- Plus standard "thermal" conditions

Visual:



Basic Emission from thermal motions.

Spectrum:



Common Sources: Cosmic microwave background, Stars, planets, etc.

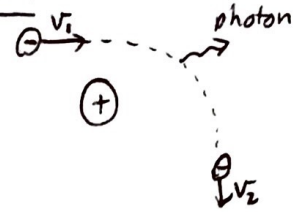
Free-free / Thermal Bremsstrahlung

German for "Braking radiation"

Requires:

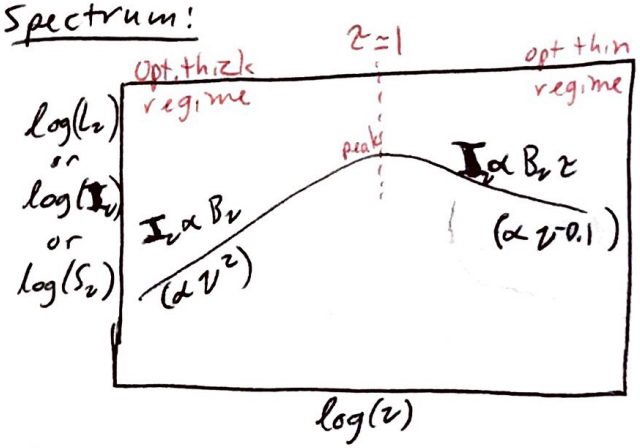
- Ionized medium
- Plus standard "thermal" conditions.

Visual:



Free e^- is accelerated due to coulomb force from proton

Spectrum:



Common Sources: HII regions, solar wind, etc.

THESE ARE BOTH "THERMAL" MECHANISMS, WHICH REQUIRES:

- All e^- have same characteristic temperature (LTE).
- Brightness depends on temperature: $I_\nu(T, \ldots)$
- Thermal velocity distribution $\left(\langle v^2 \rangle = \frac{3kT}{m}\right)$

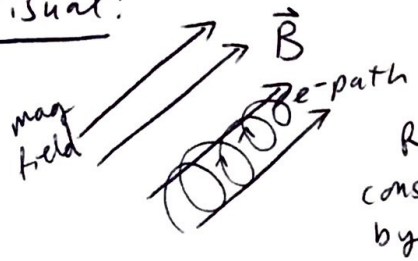
↳ see ERA B.8

Synchrotron/Magneto Relativistic bremsstrahlung

Requires:

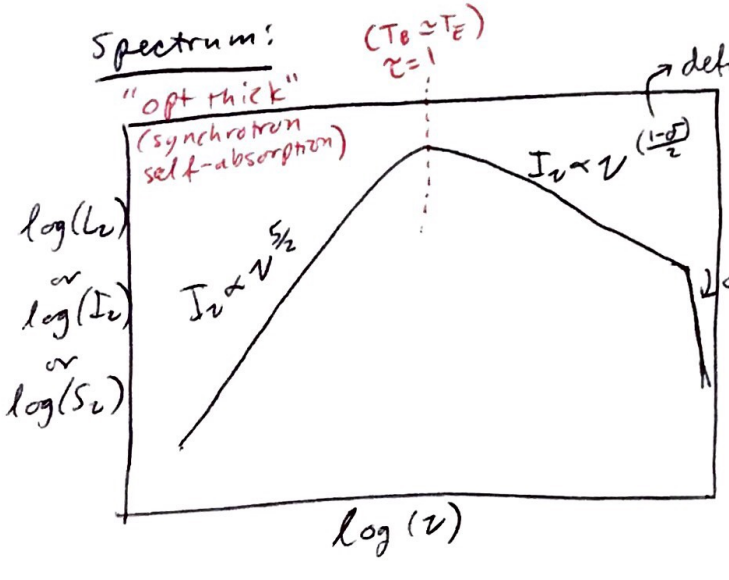
- Relativistic protons or e^-'s ("cosmic rays")
- Diffuse magnetic field

Visual:



Relativistic e^- constantly accelerated by magnetic field $\vec{B}$

Spectrum:



defined by energy distribution of e^-'s ($n(E)dE \propto E^{-\delta}dE$) usually $I_\nu \propto \nu^{-0.7}$

down-turn from e^- energy losses (high E lose energy faster) usually $I_\nu \propto \nu^{\left[\left(\frac{1-\delta}{2}\right)-\frac{1}{2}\right]}$ above this break.

Common sources: active galactic nucleus cores & jets, diffuse Galactic structure, supernova remnants, shocks in galaxies, etc.

Compton & Inverse Compton Scattering

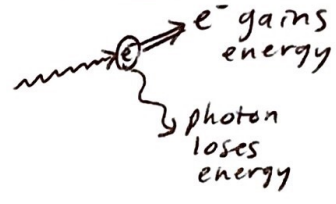
Compton Requires:

- low-energy e^-
- incident high-energy photon

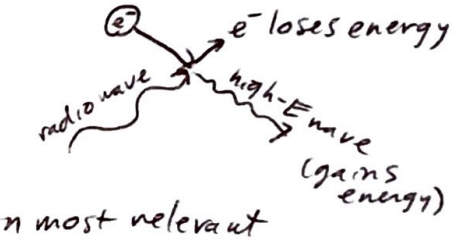
Inverse Compton Requires:

- high-energy (relativistic) e^-
- low-energy photon

Visual:



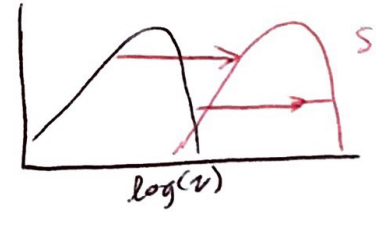
Visual:



Inverse Compton most relevant for us because requires:

- Relativistic e^-'s (synchrotron source)
- External radiation field or own radio waves (self-Compton)

Spectrum:



Shifts radio waves to higher energy.

Commonly seen: CMB as external rad. field, synchrotron sources (AGN or cluster halo) in foreground.