Plasma II - Exercises

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Multiple-choice question

In the course (p14) you have seen that the Bremsstrahlung emission of a thermal plasma decreases with increasing frequency. What limits the increase of Bremsstrahlung at low frequencies?

( ) At sufficiently low frequency Bremsstrahlung is replaced by line radiation.

( ) There is no limit and Bremsstrahlung emission approaches a constant value as the frequency decreases towards zero. As the energy carried by each emitted photon, $h\nu$, depends on the frequency the photon flux diverges (*infrared divergence*).

( ) At low frequency inverse Bremsstrahlung, i.e. photon absorption on free charges, becomes increasingly important and limits the net emission.

Measuring emission of an optically thin plasma

You observe a plasma with an emissivity ϵ (in [W/m^3]) with ideal broad-band detectors with an area A_{det}, each. Apertures in front of the detectors define lines-of-sight (LoS). Each aperture has an area A_{ap} and is located at a distance d from the detector. The objective of this exercise is to derive an expression for the signal amplitude in the limit that the distance between the camera and the plasma h is much larger than d and that ϵ does not vary significantly across the view cone (*narrow collimation*).

a) Derive an expression for the power detected with an infinitesimal small detector element dA_{det} as a function of the observed plasma volume dV_{plasma}.

b) Determine now the size of the plasma volume seen by a detector element.

c) Integrate over the entire detector to obtain the expression for the detector signal.