ASTR700 Lecture 3: Blackbodies & Accelerated Charges (ERA 2.4, 2.5, 2.7;[2.3,2.6,2.8 optional])

These should serve as conceptual reminders for you but do not cover all topics you're responsible for knowing.

1. Write down next to these equations what they mean and what they're used for.

$$u_\nu = \frac{1}{c}\int I_\nu d\Omega \tag{1}$$

$$B_\nu(T) = \frac{2h\nu^3}{c^2}\left[\frac{1}{e^{h\nu/kT}-1}\right] \quad ; \quad \text{for } h\nu \ll kT, \quad B(T) \simeq \frac{2kT\nu^2}{c^2} \tag{2}$$

$$B(T) = \frac{\sigma T^4}{\pi} \quad (\sigma = 5.669\ \mathrm{W\,m^{-2}\,K^{-4}\,sr^{-1}}) \tag{3}$$

$$\nu_{\rm peak} \simeq 59\,\mathrm{GHz}\left(\frac{T}{\mathrm{K}}\right) \tag{4}$$

$$P_\nu = kT \tag{5}$$

$$P = \frac{q^2\dot{\mathrm{v}}^2}{6\pi\epsilon_0 c^3} \tag{6}$$

$$|\vec{S}| = \frac{q^2\dot{\mathrm{v}}^2\sin^2\theta}{16\pi^2\epsilon_0 r^2 c^3} \tag{7}$$

For reference: ν is nu; v is velocity.

2. Some big-picture take-aways from today:
   - Blackbody radiation is isotropic; $\int B(\nu)d\Omega = 4\pi B(\nu)$.
   - The fact that noise temperature translates so easily to power for radio astronomy ($P_\nu = kT$) really only works in the radio regime, under classical mechanics assumptions about the energy behavior of waves.
   - Antenna temperature, T_A, can be thought of as the thermal noise of a resistor whose equivalent power output would match that of the observed source.
   - Synchrotron and bremsstrahlung emission originate from accelerated point charge emission! Telescope antenna patterns are also based on the Larmor formula.