Lecture 7 – Radiometry

Antennas

When we were discussing photography we were talking about incident photons knocking around electrons. For passive microwave radiometry (typically $5 – 100 \text{ Ghz}$, or $x – x \text{ m}$), the energies ($E = hf$) of the photons are a few electron microvolts ($5 \text{ Ghz} = 21 \text{ microvolts, } 6 \text{ cm}; 100 \text{ Ghz} = 400 \text{ microvolts, } 3 \text{ mm}$). This doesn't do much to a molecule, so we take a conductor and have it induce a fluctuating current, and then the current can be amplified and detected.

We call the structure that collects the radiation and transitions it to a fluctuating voltage in the circuit it is connected to. Usually a parabolic dish.

First, consider a transmitting antenna through which we run an alternating current with mean square current $<I^2>$. It will radiate a mean power $<I^2>R_r$, where $R_r$ is called the “radiation resistance” of the antenna.

If we put the antenna in receiving mode and point it at some region emitting microwave energy, then a voltage will me measured with the same characteristics as the thermal noise from a resistor $R_r$ held at a temperature $T$. 