

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 GHz, or λ – λ m), the energies ($E = hf$) of the photons are a few electron microvolts (5 GHz = 21 microvolts, 6 cm; 100 GHz = 400 microvolts, 3 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 $\langle I^2 \rangle$. It will radiate a mean power $\langle I^2 \rangle R_r$, 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 be measured with the same characteristics as the thermal noise from a resistor R_r held at a temperature T