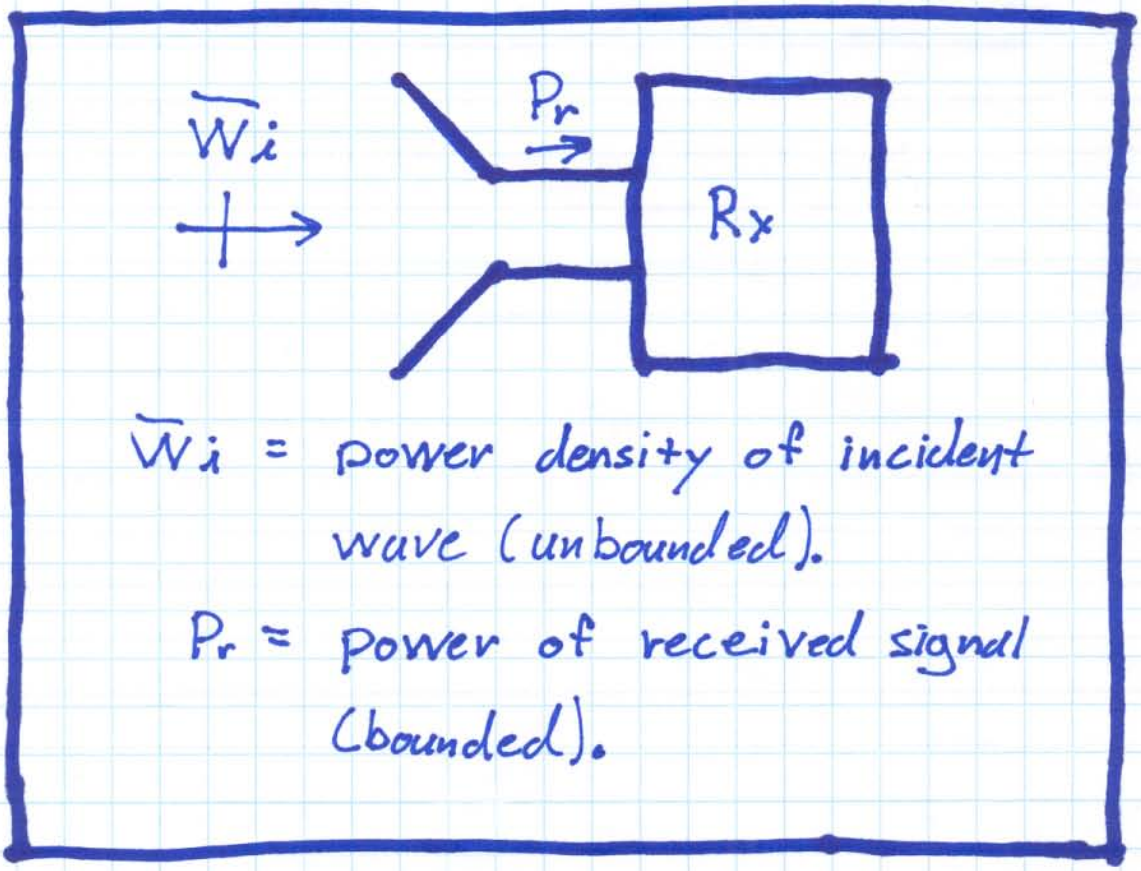
Effective Aperture

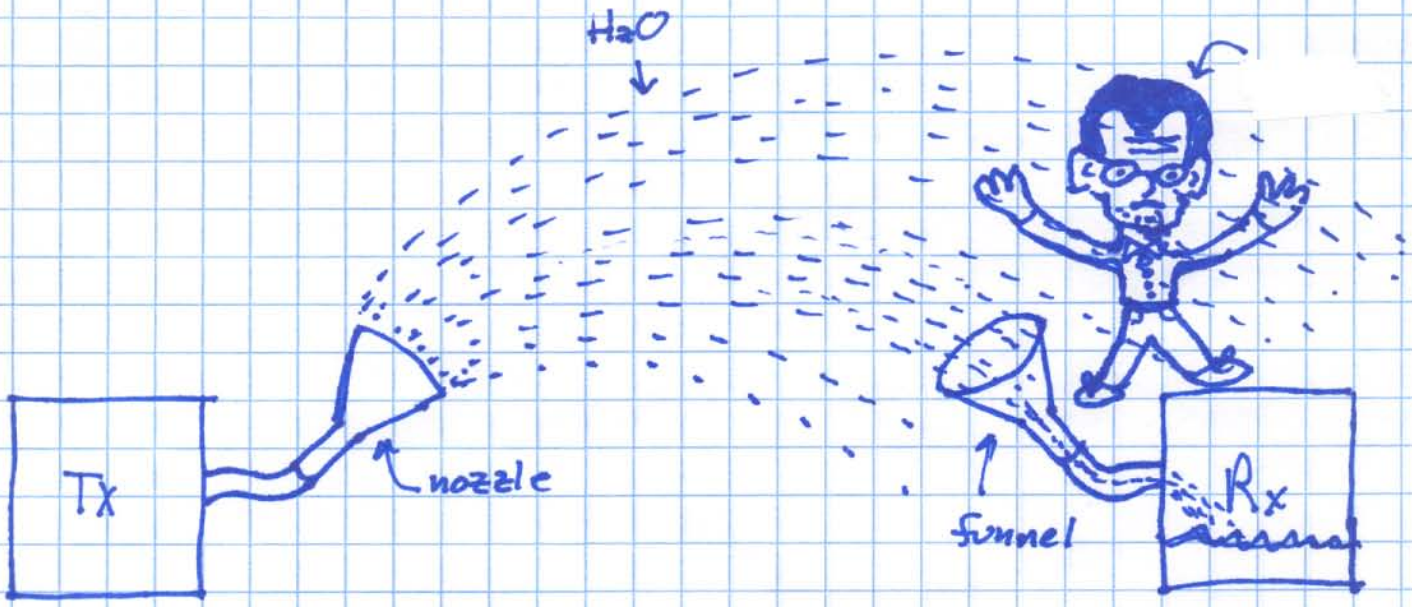
An antenna can also be used to receive e.m. waves! I.E., it couples an incident, unbounded wave into a bounded wave in a receiver:



$\bar{W}_i$ = power density of incident wave (unbounded).

P_r = power of received signal (bounded).

If the antenna at the Tx acts as a nozzle, then an antenna on the Rx acts as a funnel.



- Just like a funnel that collects water, an antenna on receive collects power.
- Also like a funnel, the "larger" the antenna, the more power is collected.

So, if incident power density is $\bar{W}_i$, and received power is P_r, we can define:

$$\frac{P_r}{|\bar{W}_i|} \triangleq A_e$$

Note the units:

$|\bar{W}|$ – $\frac{\text{Watts}}{m^2}$ $\quad P_r$ – Watts

$\therefore \quad \frac{P_r}{|\bar{W}|} \sim \text{Watts}\left(\frac{m^2}{\text{Watts}}\right) = m^2$

i.e., A_e has units of area.

$A_e \triangleq$ Effective Aperture (m^2)

$\therefore \quad P_r = |\bar{W}| A_e$ Makes sense! Recived power is power density in watts/square meter time antenna area.

- Note A_e may or may not have a correlation with the physical area of the antenna.
- Note also A_e is dependent on the direction of the incident wave.
  $\therefore$ $A_e(\theta, \phi)$ defines the receive pattern.