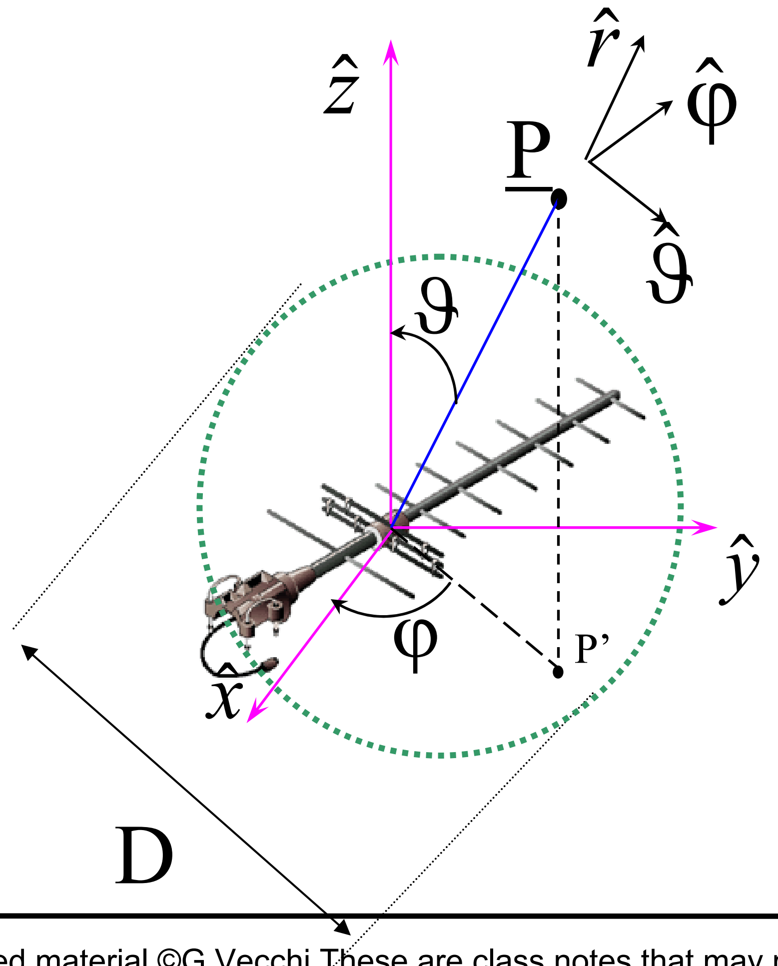
Radiation from antennas (transmit mode, TX)



- **Spherical system**
- **Antenna characteristic size D**

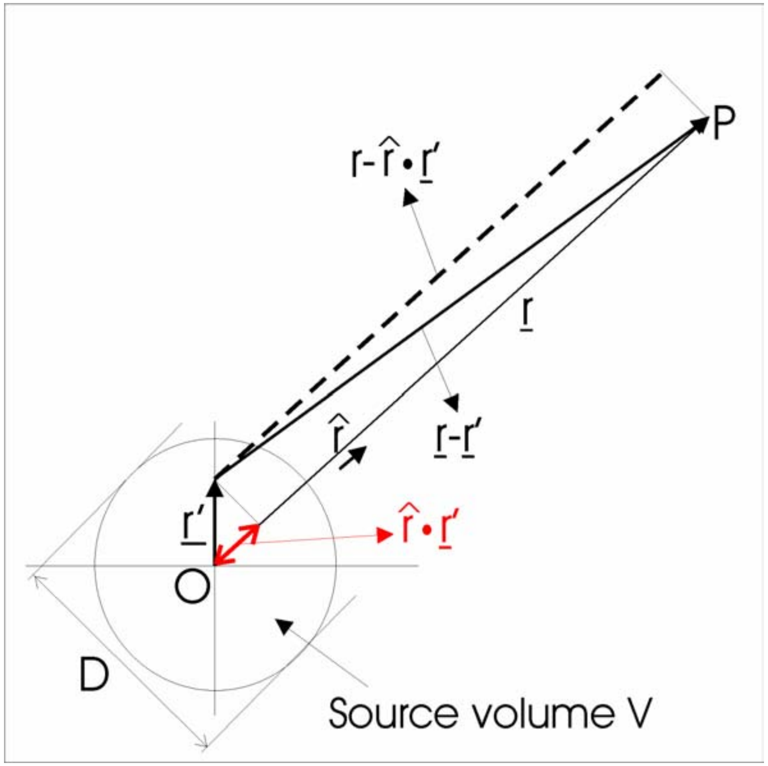
Far field conditions:

⇨ under the conditions:

1) $r >> \lambda$

2) $r >> D$ = size of the source region

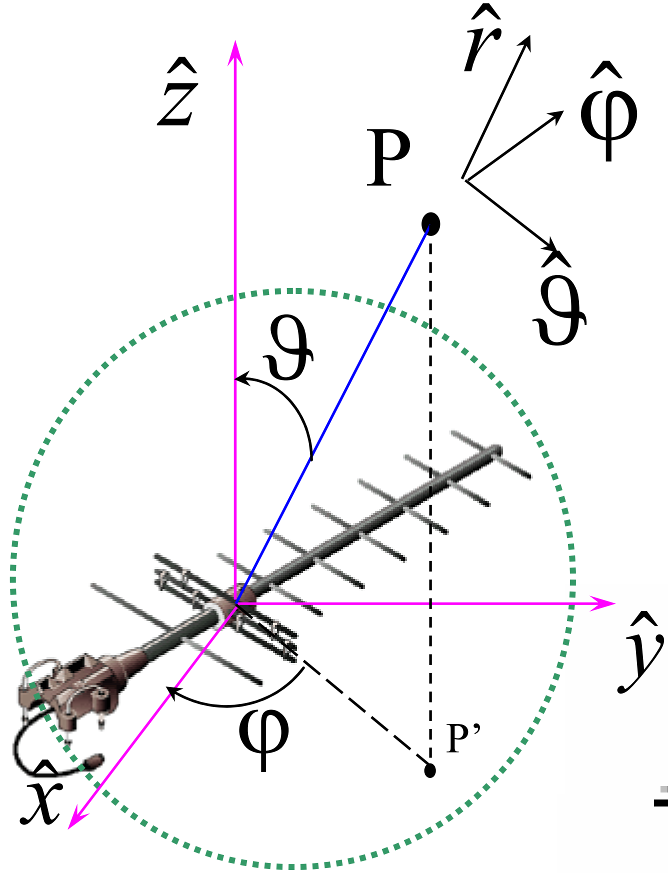
3) $r > 2D^2 / \lambda$ (Fraunhofer region)



⇨ approximation:

$$|\underline{r} - \underline{r}'| \cong r - \hat{r} \cdot \underline{r}'$$

$$\frac{1}{|\underline{r} - \underline{r}'|} \cong \frac{1}{r}$$



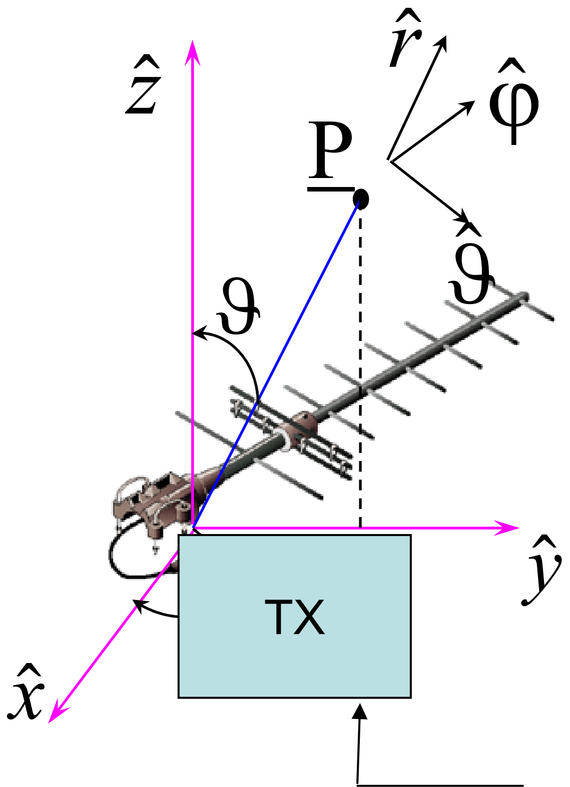
- **Far field radiation:**

$$\underline{E}(\underline{P}) = \frac{e^{-jk_0 r}}{4\pi r}\,\underline{e}(\theta,\varphi)$$

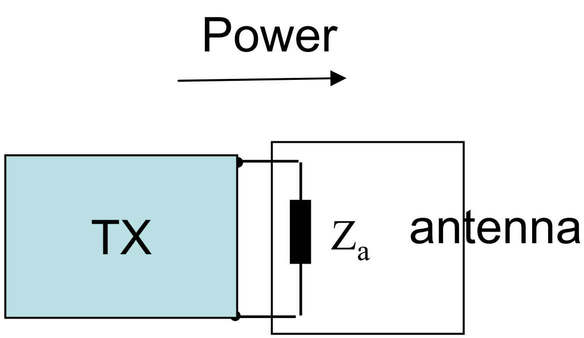
Antenna specific

"universal"

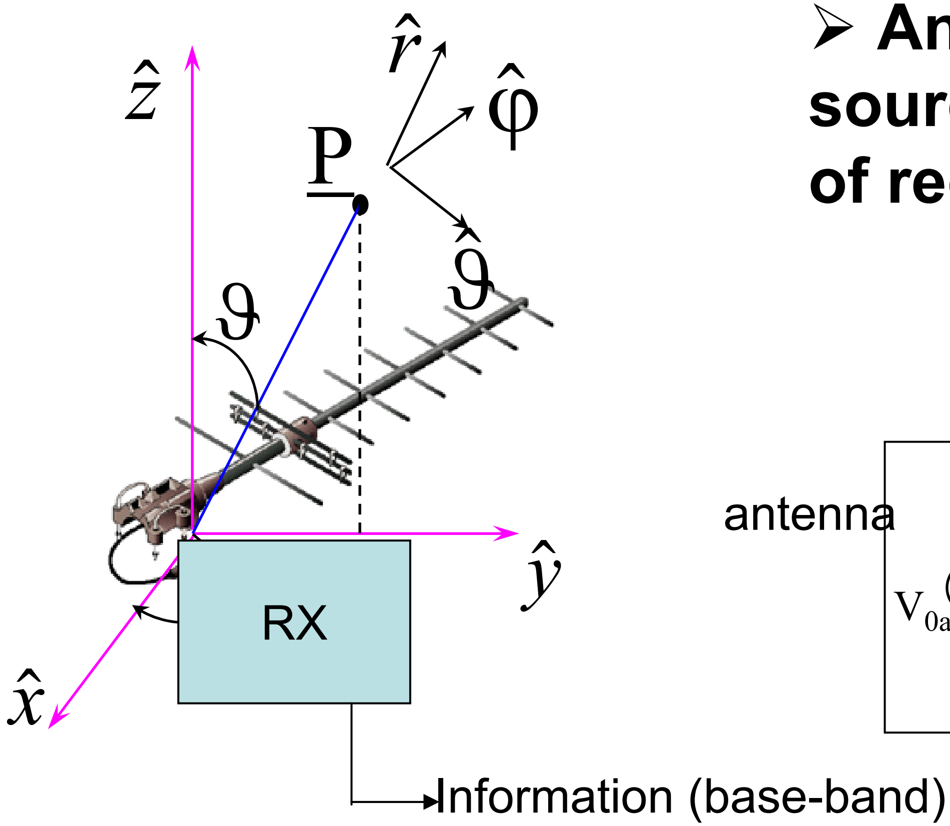
Radiation from antennas (transmit mode, TX)



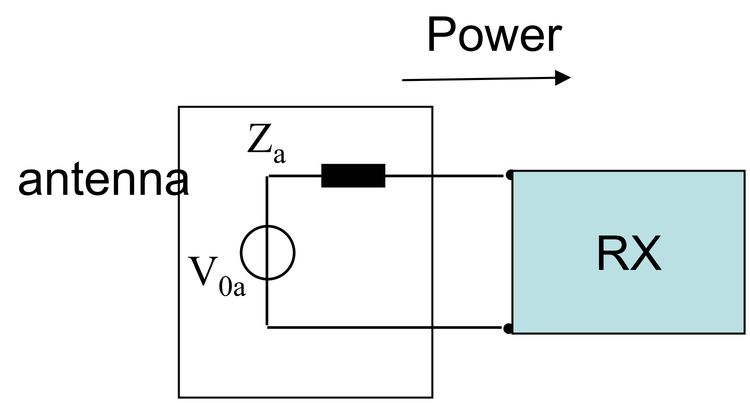
- **Antenna seen as an impedance from feeding circuit (TX)**



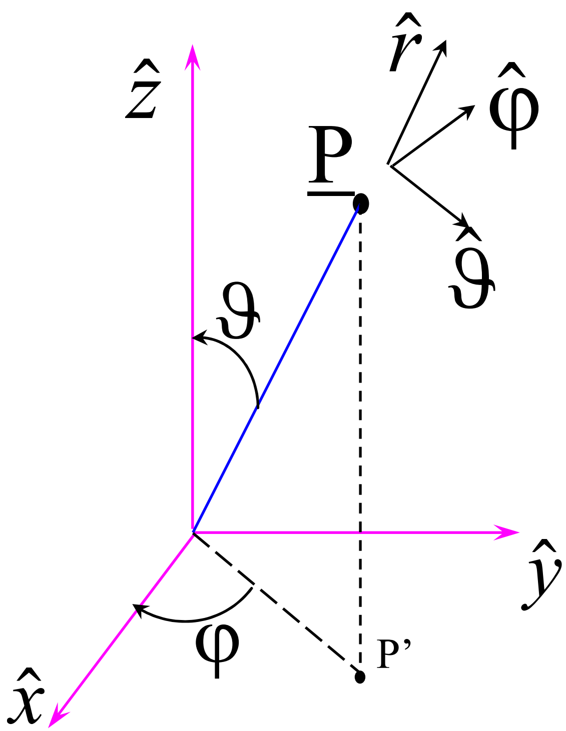
Antennas in Receive (RX) mode -1



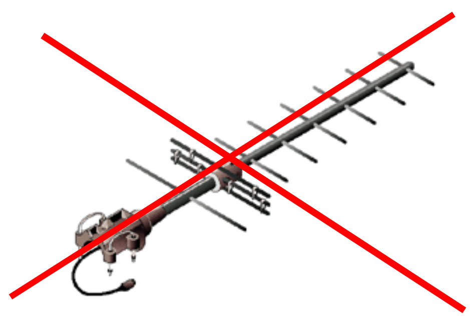
- **Antenna seen as a source from input stage of receiver (RX)**



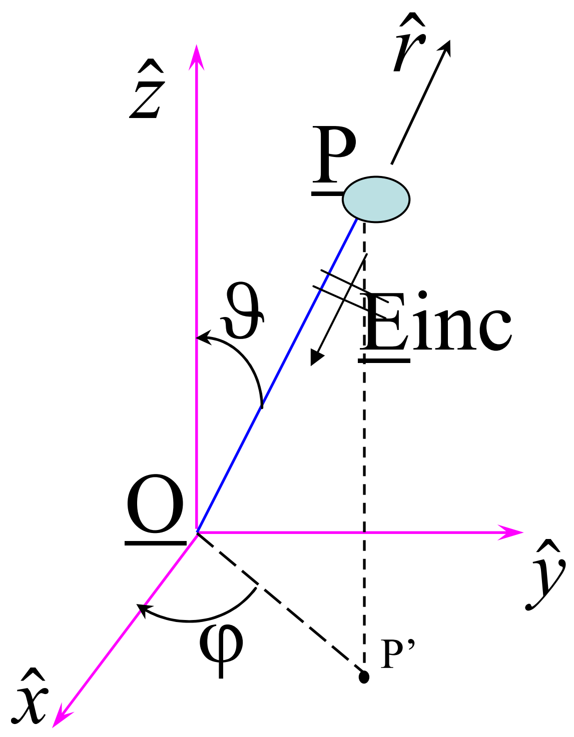
Antennas in Receive (RX) mode -2



- **Incident field: the field that would exist at the antenna location if the RX antenna were not present**

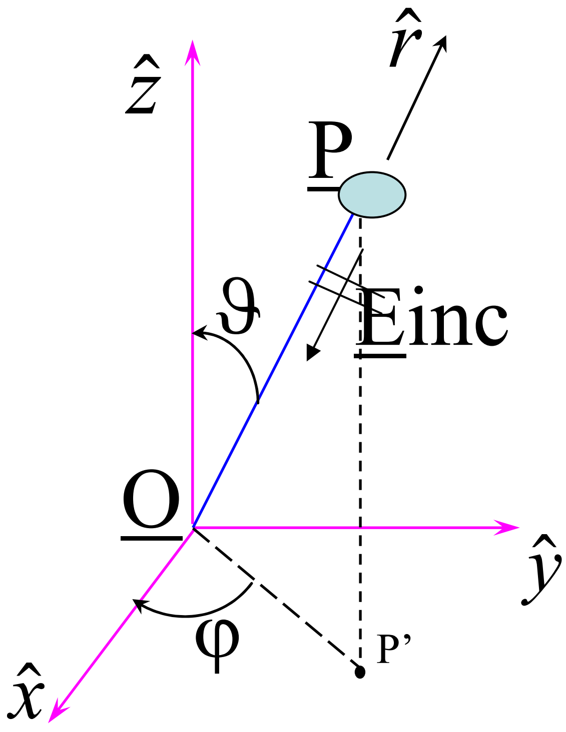


Antennas in Receive (RX) mode -3



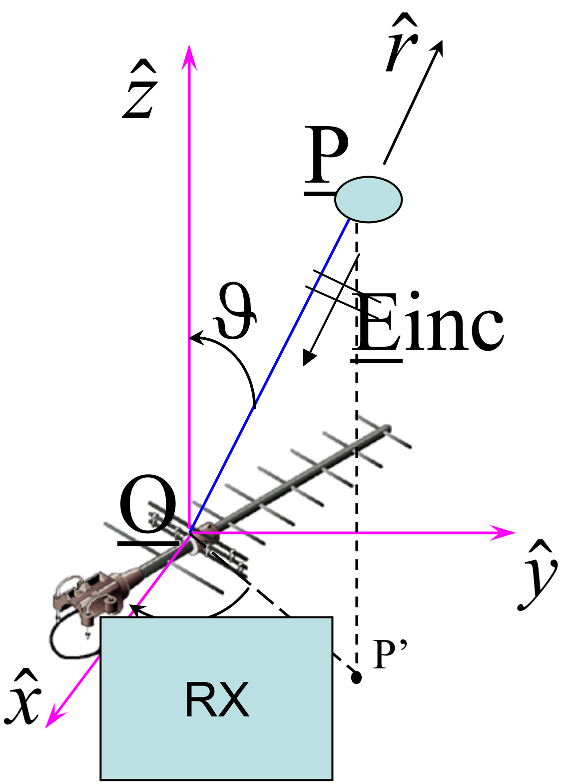
- **Incident field:** produced by "some" source (e.g. a TX antenna) located at P
- **Source location: P-O**
- **Direction of incidence= direction of arrival of wave= O-P/|O-P|**

Antennas in Receive (RX) mode -4



- **distance r= |P-O| between source (TX antenna) and receiving antenna must be such that O in the far-field of source, with size Dt.**
- **distance r= |P-O| must *also* be such that P in the far-field of receiving antenna (i.e. with respect to its size Dr)**

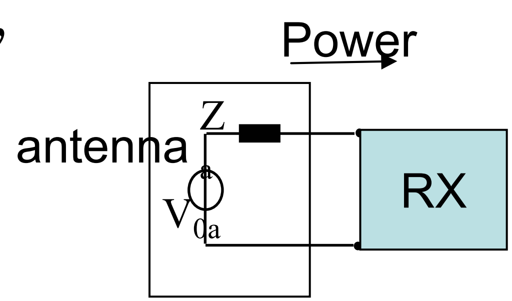
Antennas in Receive (RX) mode -5



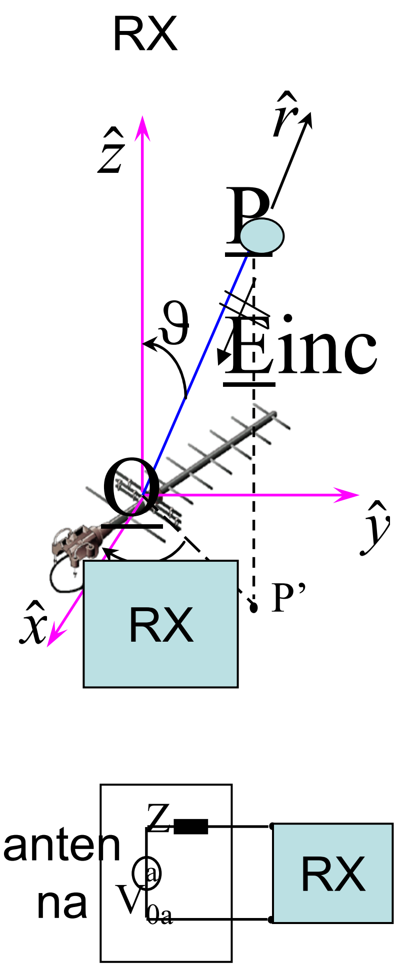
- **Voltage source**

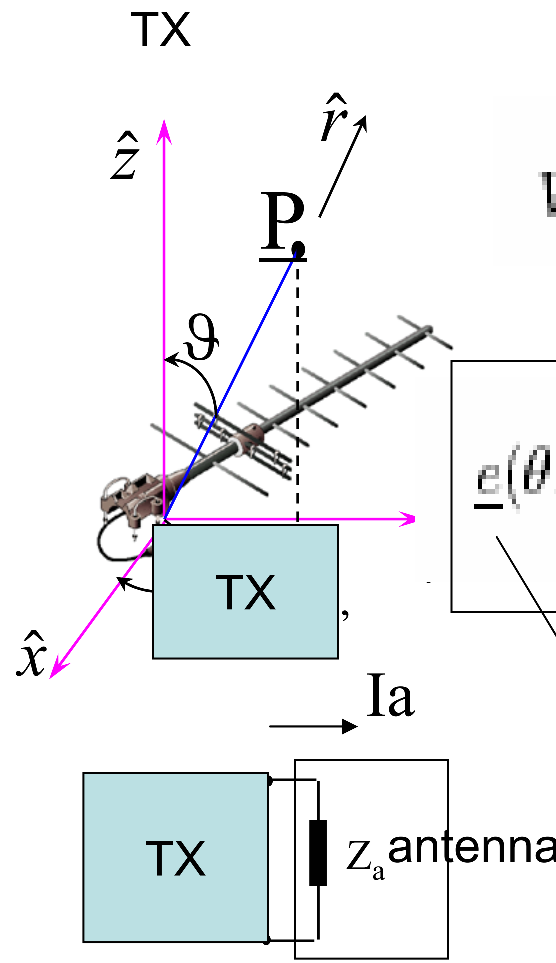
$$V_{0a}(\theta,\varphi) = \underline{E}_{inc} \cdot \underline{h}_e(\theta,\varphi)$$

Effective (equivalent) height



Reciprocity





$$V_{0a}(\theta,\varphi) = \underline{E}_{inc}\cdot \underline{h}_e(\theta,\varphi)$$

$$\underline{e}(\theta,\varphi) = \frac{-jZ_0}{2\lambda}4\pi I_a \underline{h}_e(\theta,\varphi)$$

$$\underline{E}(\underline{P}) = \frac{e^{-jk_0 r}}{4\pi r}\underline{e}(\theta,\varphi)$$