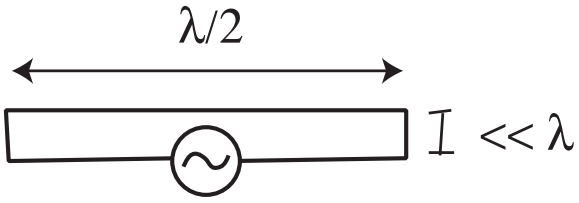
Physics 124 – Problem Set # 5

(due Friday, November 1)

1. Griffiths, problem 11.23.

2. Griffiths, problem 11.25.

3. (Marion and Heald, problem 9-12) The half-wave *folded-dipole* antenna is shown in the figure. Assuming that current waves propagate along the wire at speed c, show that the current in the 'folded' portion has the same amplitude and is in phase with that in the center-driven portion. Deduce that the angular distribution of radiation intensity is the same as that of the single center-driven $m = 1$ half-wave antenna but that the radiation resistance is four times greater (*i.e.*, about 300 Ω). This style of antenna is often used with FM radio receivers. How long is it when cut for a frequency f of 100 MHz?



4. Consider a set of two center-driven antennas of length d aligned parallel to the $\hat{z}$ axis, separated from one another by a distance D in the $\hat{y}$ direction, and driven 180° out of phase.

   (a) Compute the power $dP/d\Omega$ radiated by the set of two antennas.

   (b) Simplify this formula in the limit $d, D << \lambda$, $\lambda = 2\pi c/\omega$. The leading term should be of order $d^4 D^2$.

   (c) Compute the time-dependent quadrupole moment of the charge distribution on the antennas.

   (d) Use the formula for electric quadrupole radition to compute $dP/d\Omega$. The result should agree with that of part (b).

   (e) Find the radiation pattern for the case $d = D = \lambda/2$ and sketch its variation over the sphere at infinity.