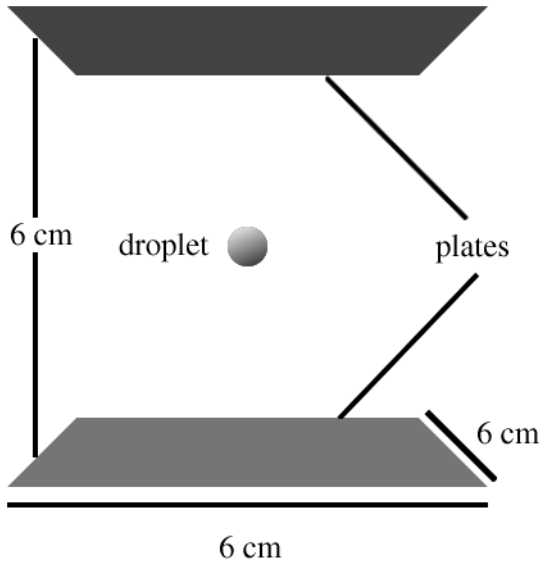
1. Radiation in electrostatic levitation

   Electrostatic levitation is used for property measurements in a pure liquid, with its containerless nature removing a major possible source of contamination.

   Below is a picture of a simplified levitator, with a charged droplet of the test liquid suspended exactly centered between two square plates.



   Data:

   - Plates' emisivity: 0.8
   - Droplet emissivity: 0.5
   - Droplet diameter: 0.5 cm (sphere surface area is $4\pi R^2 = \pi d^2$)

   (a) Considering the droplet surface as S_1, and the upper and lower plate surfaces facing the droplet collectively as S_2, calculate the viewfactor from the droplet to the upper and lower plates F_{12}. (Hint: think of the plates as sides of a cube.)

   (b) Calculate the viewfactor from the plates to the droplet.

   (c) Using a graph, calculate the viewfactor F_{22} (which is equal to the viewfactor from one plate to the other), *not* including the influence of the droplet (*i.e.* as if it weren't there).

   (d) If the droplet is at 800 K, and the plates at 1000 K, calculate the total power radiated in each direction (*i.e.* Q_{12} from droplet to plates, Q_{21} from plates to droplet).

   (e) If its actual thermal conductivity as measured in the levitator (*e.g.* by a laser flash technique) is 20% higher than that predicted by the Wiedmann-Franz law for electronic heat conduction, what other heat conduction mechanism could be active (name one)?