

Problem 2 (25 points)

A particle with charge $Q > 0$ and mass m is released from the positive electrode of a parallel plate capacitor (see the cross-section shown below) and eventually passes through the small hole in the second electrode into a region of uniform magnetic field. The magnetic field is pointing out of the paper plane. The particle is non-relativistic, i.e. its kinetic energy and momentum are related by $U_{\text{kin}} = p^2/(2m)$.

- (a) On the drawing, sketch the electric field lines created by the capacitor. Neglect fringe effects.

- (b) On the picture, sketch the trajectory of the charged particle after it has entered the magnetic field.

- (c) On the graph, sketch how the kinetic energy U_{kin} of the particle changes, as it moves along its trajectory through the electric field and then the magnetic field. L is the path length along the trajectory of the particle, starting from the positive electrode. The distance between the capacitor plates is 1mm. Assume that the magnetic field is weak enough, such that the particle travels at least a distance $L > 1\text{mm}$ in the magnetic field.

- (d) On the picture, draw the trajectory for a particle with charge $4*Q$, but the same mass m , assuming it starts from the same point as the first particle.

