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ENGINEERING PHYSICS

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- **Particles field interactions – a classical experiment**

Free particle solution

- *When a particle is moving in a zero potential region the general solution of this equation is of the form*

$$\psi(x) = Ae^{ikx} + Be^{-ikx}$$

And the energy of the wave is $E = \frac{\hbar^2 k^2}{2m}$

- *No quantum effects are obvious since all k values are allowed and hence all energy states are allowed*
- *However, particles do move in regions of space where the potential is non-zero.*
- *The classical effects can be inferred from a simple classical experiment*

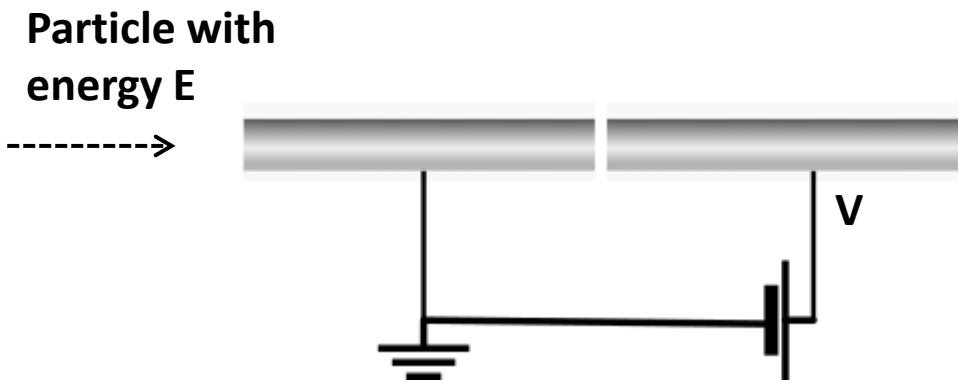
Particle interacting with fields

A system of a split tube of a highly conducting metal with a very narrow separation

The first part is at zero potential and the other held at a constant potential V

A charged particle with energy E moving along the axis of the tube

The particle continues to move in the first tube without any change in energy

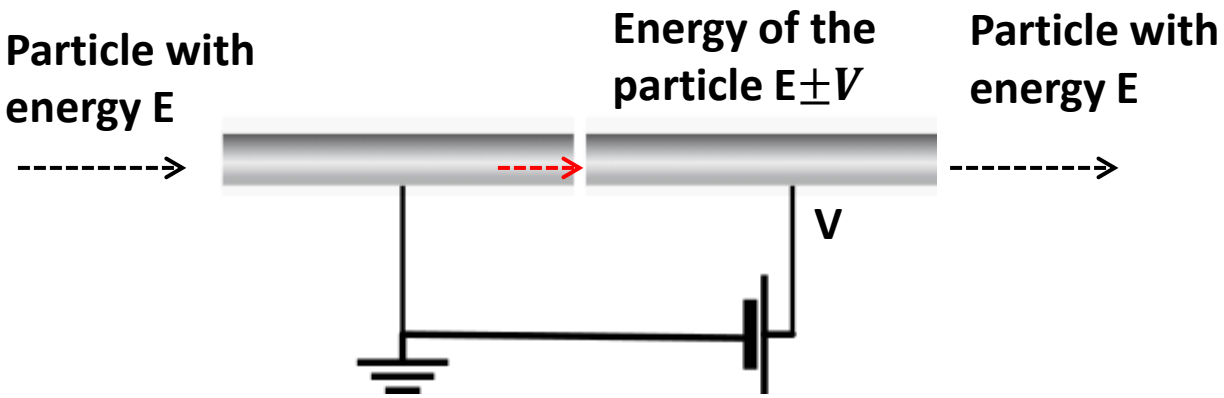


Particle interacting with fields

At the entrance of the second tube the particle feels an acceleration /deceleration

Once within the second tube the particle continues to move with energy $E \pm V$

The particle exiting the second tube feels a deceleration / acceleration and exits the tube with the initial energy



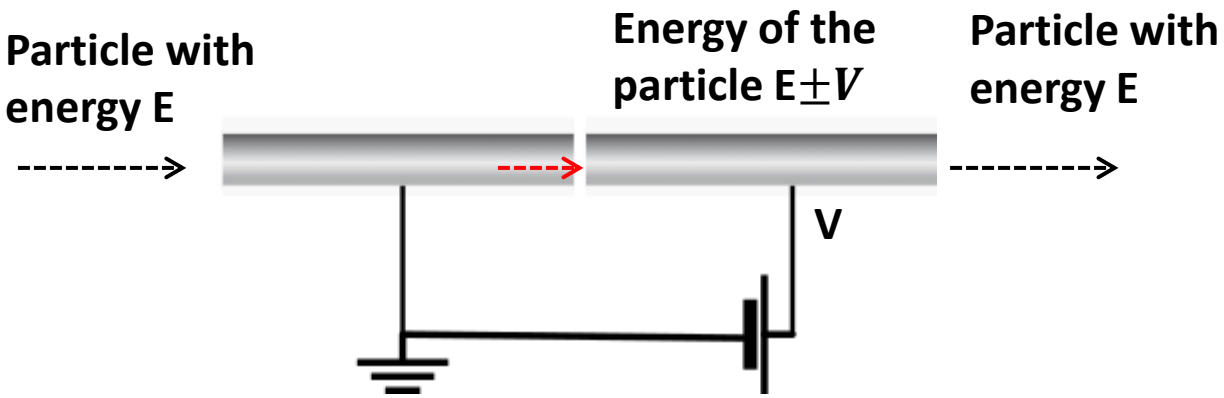
Particle interacting with fields

Classically if E < V the particle is repelled if the charge on the particle is of the same sign of the potential

Particle can interact with fields –

exchange energy with the field within the framework of the uncertainty principle

The plot of the potential as a function of distance with x=0 at the point of the separation of the tube is a step function



Quiz .....

- *A particle can move in a region of space described by a potential exchanging energy with the field*
- *The energy gained by the particle violates the energy conservation principles*
- *A particle can lose energy to a field*
- *It is impossible to create regions of space where the potential is a constant*

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THANK YOU

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