Lagrangian of particle in electromagnetic field

The Lagrangian of a particle in an electromagnetic field is given by:

\[ L = \frac{1}{2} m v^2 - eA \cdot v - \frac{1}{2} \mu_0 e^2 B^2 \]

where:
- \( m \) is the mass of the particle,
- \( v \) is the velocity of the particle,
- \( e \) is the charge of the particle,
- \( A \) is the vector potential of the electromagnetic field,
- \( B \) is the magnetic field,
- \( \mu_0 \) is the permeability of free space.

The Lagrangian is the function that is minimized (or maximized) by the particle's trajectory. It is given by the difference between the kinetic energy and the potential energy of the particle:

\[ L = T - V \]

where:
- \( T \) is the kinetic energy,
- \( V \) is the potential energy.

The kinetic energy is given by:

\[ T = \frac{1}{2} m v^2 \]

The potential energy is given by:

\[ V = -eA \cdot v - \frac{1}{2} \mu_0 e^2 B^2 \]

The Lagrangian is a mathematical function that describes the motion of the particle in the electromagnetic field. It is a function of the particle's position and velocity, and the electromagnetic field. The Lagrangian is used to derive the equations of motion of the particle using the principle of least action.

The Lagrangian is a fundamental concept in physics, and it is used in many areas of physics, including classical mechanics, quantum mechanics, and field theory. The Lagrangian is a powerful tool for studying the motion of particles in various fields, including electromagnetic fields, gravitational fields, and other external fields.

For more information, see the Wikipedia articles on Lagrangian mechanics, electromagnetism, and quantum mechanics.