Electromotive force and current in a superconducting solenoid with limited length induced by a bar magnet and a monopole\(^1\) LIANXI MA, Blinn College - Bryan — The magnetic flux \(\Phi_B\), electromotive force, EMF, and current \(I_{\text{in}}\), induced by a moving magnetic bar and an imaginary magnetic monopole in a superconducting solenoid of multiple turns and length \(L\), are numerically calculated. The magnetic field of the bar magnet is approximated with the magnetic field along \(z\) axis of a solenoid with length \(l\) and radius \(a\) and current \(I\), while the magnetic field of the monopole is supposed to be inversely proportional to \(r^2\). Calculations show that, for a bar magnet, \(\Phi_B\) and \(I_{\text{in}}\) essentially saturate when the bar moves inside superconducting solenoid, so EMF is zero while \(I_{\text{in}}\) is constant. EMF is only induced when the bar enters and exits the solenoid and \(I_{\text{in}}\) is zero after the bar leaves the solenoid. For a magnetic monopole, \(\Phi_B\) is discontinuous (from positive maximum to negative maximum) when the it moves through each turn of the superconducting solenoid, but EMF caused by \(d\Phi_B/dt\) is continuous while the EMF induced by the a moving monopole is a delta function (moving monopole produces a ring-shaped \(E\) field). The total EMF\(_{\text{Tot}}\) in solenoid is the superposition of EMF of each turn of coil and the plateau appears. The current \(I_{\text{in}}\) continues to grow while the monopole leaves the solenoid.

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