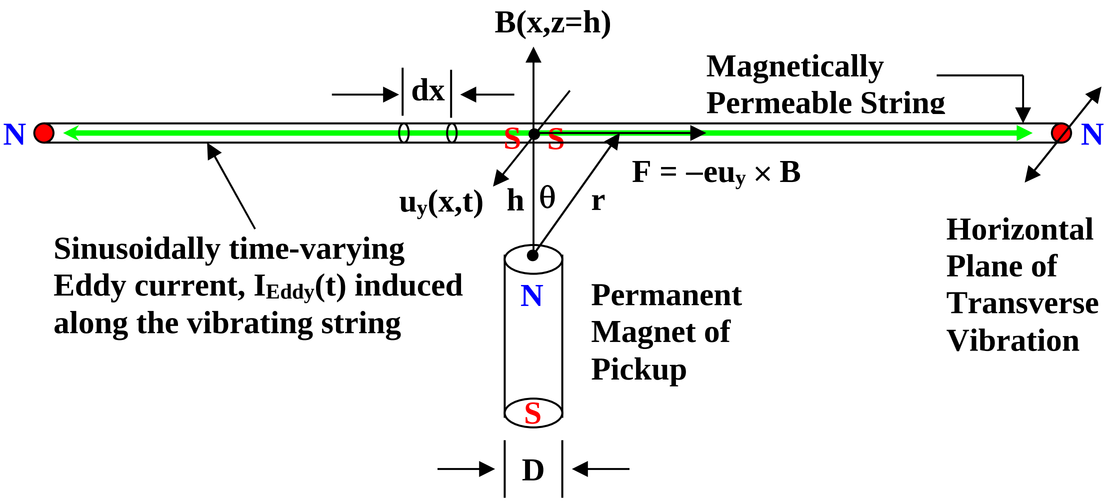
Using the approximation that the magnetic field of the permanent rod magnet of the electric guitar pickup is equivalent to that of a point magnetic dipole (which it is not, due to its spatial extent), the magnitude of the magnetic field intensity, $|\mathbf{B}(\mathbf{r})|$ associated with a permanent magnetic pole of the guitar pickup decreases ~ as the *cube* of the perpendicular distance, z from the end of the permanent rod magnet, i.e. $|\mathbf{B}(\mathbf{r})| \sim 1/z^3$. {Permanent magnets, due to their finite physical size (and H x D aspect ratio), do indeed have higher-order magnetic field multipole moments (magnetic quadrupole, octupole, etc.), however the B-fields associated with each of these higher-order moments decrease (significantly) faster than $1/z^3$.}



As an electric guitar string vibrates in the magnetic field of a pickup, because the string is made of a electrically conducting metal, the free electrons in the metal of the strings in proximity to the magnetic poles of the guitar pickups experience a force, known as the Lorentz force, due to the fact the string (and thus the free electrons in the metal of the string) is moving with transverse velocity, $u_y(x,t)$ in the magnetic field B(x,z=h) provided by the magnetic pole(s) of the guitar pickups, as shown in the figure below.

The Lorentz force is a vector force - it has both a magnitude and a direction, and is given by $\mathbf{F} = q\mathbf{v} \times \mathbf{B}$, where $q = -e$ is the electric charge of the electron, $\mathbf{v}$ is the velocity vector, $\mathbf{v}(x,t) = u_y(x,t)\mathbf{y}$, where $\mathbf{y}$ is a unit vector in the +y direction, and $\mathbf{B}(x,y,z) = B(x,y,z=h)\mathbf{z}$ near the magnetic pole of the pickup, and $\mathbf{z}$ is a unit vector in the +z direction (up). The direction of the Lorentz force acting on the free electrons is along the axis of the string (in the x direction), from application of the so-called "right-hand rule" in taking the cross product $\mathbf{u}_\mathbf{y} \times \mathbf{B}$. Thus, the free electrons will collectively move along the axis of the string as a consequence of the Lorentz force acting on them in over the poles of the magnetic pickup(s). The "gas" of free electrons moving along the axis of the string due to the Lorentz force acting on them is an electrical flow of current!

Because the metal of the string has resistance, the "gas" of free electrons drift through the metal of the string along (i.e. parallel to) the axis of the string with a *terminal* velocity, $\mathbf{v}_\mathbf{d} = v_d\mathbf{x}$. The resulting macroscopic current density, $\mathbf{J} = \sigma\mathbf{E} = (1/\rho)\mathbf{E}$ (units = Amperes/m^2) where σ is the conductivity of the metal (units = Ohm^{-1} m^{-1}), $\rho = 1/\sigma$ is the resistivity of the metal (units = Ohm-m) and $\mathbf{E}$ is the electric field in the metal, which arises from the Lorentz force acting on the