We want to calculate the rate of change of the flux passing through a superconducting loop. First, let's calculate the flux of a monopole sitting a distance z below the loop along the axis of the loop. We will orient the loop so that the surface element $d\vec{a}$ is pointing in the positive z direction. The expression for this flux is then:

$$\Phi = \int d\vec{a} \cdot \vec{B} = \int_0^{2\pi} d\phi \int_0^R dr \frac{s}{r^2 + z^2} \hat{r}' \cdot \hat{z} = \int_0^{2\pi} d\phi \int_0^R dr \frac{s}{r^2 + z^2} \frac{z}{\sqrt{r^2 + z^2}}$$

where s is the magnetic charge and $\hat{r}'$ is the radial vector from the monopole. We have take θ to be the angle between the z-axis and the vector $\vec{r}'$. Keep in mind that $\vec{r}'$ points from the monopole to a point on the superconducting ring. Evaluating the integral, we find:

$$\Phi = 2\pi s z \left(-\frac{1}{\sqrt{R^2 + z^2}} + \frac{1}{z} \right) = 2\pi s \left(1 - \frac{vt}{\sqrt{R^2 + (vt)^2}} \right)$$