Consider a nonconducting disk of radius $R$ with a uniform surface charge density $\sigma$. The disk rotates with angular velocity $\vec{\omega}$.

**Calculation of the magnetic moment $\vec{\mu}$:**

- Total charge on disk: $Q = \sigma(\pi R^2)$.
- Divide the disk into concentric rings of width $dr$.
- Period of rotation: $T = \frac{2\pi}{\omega}$.
- Current within ring: $dI = \frac{dQ}{T} = \sigma(2\pi rdr) \frac{\omega}{2\pi} = \sigma \omega dr$.
- Magnetic moment of ring: $d\mu = dI(\pi r^2) = \pi \sigma \omega r^3 dr$.
- Magnetic moment of disk: $\mu = \int_0^R \pi \sigma \omega r^3 dr = \frac{\pi}{4} \sigma R^4 \omega$.
- Vector relation: $\vec{\mu} = \frac{\pi}{4} \sigma R^4 \vec{\omega} = \frac{1}{4} QR^2 \vec{\omega}$.