EM 209
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Homework - Magnetism II

1 Force between magnetic dipoles

A magnetic dipole with dipole moment $\vec{m}_1$ is placed at the origin. Another dipole with dipole moment $\vec{m}_2$ is placed at $\vec{r}$. Find the force between the dipoles. What is the force in the case that all vectors involved are pointing in the same direction, i.e.

$$\vec{m}_1 = m_1\hat{z}, \qquad \vec{m}_2 = m_2\hat{z}, \qquad \vec{r} = r\hat{z}?$$

2 Expansion in spherical harmonics [*]

A magnetic dipole with dipole moment $\vec{m} = m\hat{z}$ is placed at $\vec{r} = R\hat{z}$. Expand the resulting magnetic scalar potential Φ_m in spherical harmonics. ($\vec{B} = -\vec{\nabla}\Phi_m$)

3 Levitation of a superconductor [**]

A magnetic dipole moment $\vec{m}$ is at a distance R from the center of a superconducting ball of radius a. (Of course, $R > a$.) Assume that the dipole moment vector $\vec{m}$ is pointing in the direction of the center of the ball. Find the force between the ball and the dipole moment. **Hint:** You can use the results from the previous problems.