

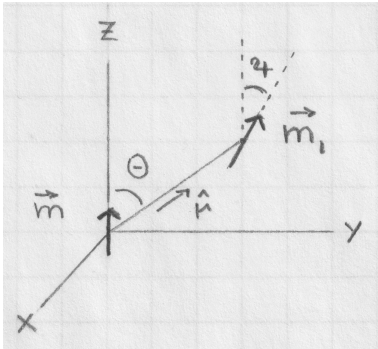
### [lex148] Magnetic dipole interaction IV

This is an extension of [lex130], where we have expressed the interaction potential of two magnetic dipoles  $\mathbf{m}$  and  $\mathbf{m}_1$  as shown in the form,

$$U = -\mathbf{m}_1 \cdot \mathbf{B}(\mathbf{x}) = \frac{\mu_0}{4\pi} \frac{m m_1}{r^3} \bar{U}(\theta, \psi),$$

as a function of the angles  $0 \leq \theta \leq \pi$  and  $-\pi \leq \psi \leq \pi$ .

- Establish a contour plot of  $\bar{U}(\theta, \psi)$ .
- Determine the energetically most favorable orientation  $\psi_{\text{mf}}(\theta)$  of  $\mathbf{m}_1$  at angular positions  $0 \leq \theta \leq \pi$ . Include the result as a dashed line in the contour plot.
- Determine the energetically most favorable angular position  $\theta_{\text{mf}}(\psi)$  for a magnetic moment  $\mathbf{m}_1$  oriented at angle  $0 \leq \psi \leq \pi$ . Include the result as a dotted line in the contour plot.
- Describe the relation of the two lines to specific contour features.



**Solution:**