4-2a Degrees of Freedom Associated with Spatial Rotations

Rotational motion in two dimensions (rotation about a fixed axis) has a very simple structure. The orientation is characterized by the azimuthal angle ϕ, and the state of motion by the eigenvalue M of the conjugate angular momentum. The associated rotational wave function is

$$\varphi_M(\phi) = (2\pi)^{-1/2}\exp\{iM\phi\} \tag{4-5}$$

→ 2D - rotation
↓
rotation about a fixed axis

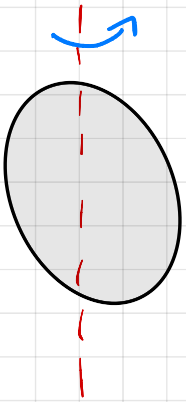
The orientation of a body in three-dimensional space involves three angular variables, such as the Euler angles, $\omega = \phi, \theta, \psi$ (see Fig. 1A-1, Vol. I, p. 76), and three quantum numbers are needed in order to specify the state of motion. The total angular momentum I and its component $M = I_z$ on a space-fixed axis provide two of these quantum numbers; the third may be obtained by considering the components of $\mathbf{I}$ with respect to an intrinsic (or body-fixed) coordinate system with orientation ω (see Sec. 1A-6a). The

→ orientation

2D - rotation → azimuthal angle ϕ

→ M → eigenvalue of the conjugate angular momentum

→ state of motion



→ $\varphi_m(\phi) = \frac{1}{\sqrt{2\pi}} e^{iM\phi}$