

## Tutorial 1

### 1. Twirl in the Magnetic Whirl

A spin-1 particle with magnetic moment  $\mu = \frac{gq}{2m}\mathbf{S}$  is situated in magnetic field  $\mathbf{B} = B_0 \hat{k}$ , where  $g$  is the Lande g-factor,  $q$  is charge of the particle, and  $m$  is its mass. At time  $t_0$ , the particle is in the state with  $S_y = \hbar$ . Determine the state of the particle at time  $t$ . Calculate how  $\langle \hat{S}_y \rangle$  varies with time.

### 2. The Mystery State

A large number of spin- $\frac{1}{2}$  particles are in the state  $|\psi\rangle$ .

- (a) We measure  $\hat{S}_z$  for some of the particles and find that  $\frac{3}{4}$  of them are in the state with  $S_z = +\frac{\hbar}{2}$ . Write the general form of  $|\psi\rangle$  satisfying this measurement.
- (b) We measure  $\hat{S}_y$  for some of the remaining particles and find that  $\frac{1}{8}$  of them are in the state with  $S_y = -\frac{\hbar}{2}$ . Find all the possible states that satisfy both of these measurements.