

1 Ring Function

Consider the normalized wavefunction $\Phi(\phi)$ for a quantum mechanical particle of mass μ constrained to move on a circle of radius r_0 , given by:

$$\Phi(\phi) = \frac{N}{2 + \cos(3\phi)} \quad (1)$$

where N is the normalization constant.

- Find N .
- Plot this wave function.
- Plot the probability density.
- Find the probability that if you measured L_z you would get $3\hbar$.
- What is the expectation value of L_z in this state?

2 Time Dependence for a Quantum Particle on a Ring

Consider a quantum particle on a ring. At $t = 0$, the particle is in state:

$$|\Phi(t=0)\rangle = \sqrt{\frac{2}{3}}|-3\rangle + \frac{1}{\sqrt{6}}|-1\rangle + \frac{i}{\sqrt{6}}|3\rangle \quad (2)$$

- You carry out a measurement to determine the z -component of the angular momentum of the particle at some time, $t > 0$. Calculate the probability that you measure the z -component of the angular momentum to be $3\hbar$.
- You carry out a measurement to determine the energy of the particle at some time, $t > 0$. Calculate the probability that you measure the energy to be $\frac{9\hbar^2}{2I}$.
- Calculate the probability that the particle can be found in the region $0 < \phi < \frac{\pi}{3}$ at some time, $t > 0$.
- Under what circumstances do measurement probabilities change with time?

3 Ring Table

Attached, you will find a table showing different representations of physical quantities associated with a quantum particle confined to a ring. Fill in all of the missing entries. Hint: You may look ahead. We filled out a number of the entries throughout the table to give you hints about what the forms of the other entries might be. [pdf link for the Table](#) or [doc link for the Table](#)