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:

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

where N is the normalization constant.

(a) Find N.

(b) Plot this wave function.

(c) Plot the probability density.

(d) Find the probability that if you measured L_z you would get $3\hbar$.

(e) 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:

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

(a) 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 $3\hbar$.

(b) 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 $\frac{9\hbar^2}{2I}$.

(c) Calculate the probability that the particle can be found in the region $0 < \phi < \frac{\pi}{3}$ at some time, $t > 0$.

(d) 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