Student handout

In this unit, you will explore the quantum mechanics of a simple system: a particle confined to a one-dimensional ring.

Motivating Questions

- What are the energy eigenstates, i.e. eigenstates of the Hamiltonian?
- What physical properties of the energy eigenstates can be measured?
- What other states are possible and what are their physical properties?
- How do the states change if this system and their physical properties depend on time?

Key Activities/Problems

- Activity: Working with Representations on the Ring
- Problem: Ring Table
- Activity: Visualization of Quantum Probabilities for a Particle Confined to a Ring
- Activity: Time Dependence for a Quantum Particle on a Ring

Unit Learning Outcomes

At the end of this unit, you should be able to:

- Describe the energy eigenstates for the ring system algebraically and graphically.
- List the physical measurables for the system and give expressions for the corresponding operators in bra/ket, matrix, and position representations.
- Give the possible quantum numbers for the quantum ring system and describe any degeneracies.
- For a given state, use the inner product in bra/ket, matrix, and position representations, to find the probability of making any physically relevant measurement, including states with degeneracy.
- Use an expansion in energy eigenstates to find the time dependence of a given state.

Equation Sheet for This Unit

- Quantum Ring Equation Sheet