1 Expectation Uncertainty

Consider measuring the z-component of spin for each particle listed below.

(i) List the possible outcomes of your experiment and determine the probability associated with each. *Use a Different Representation:* Draw a histogram of the probabilities.

(ii) Find the expectation value and the uncertainty for your experiment. *Compare:* Does your result seem reasonable given your histogram?

(a) A spin-1/2 particle described by $|+\rangle$.

(b) A spin-1 particle described by $\frac{2}{3}|1\rangle + \frac{i}{3}|0\rangle - \frac{2}{3}|-1\rangle$.

(c) A spin-1/2 particle described by $\frac{i}{2}|+\rangle - \frac{\sqrt{3}}{2}|-\rangle$.

2 Spin Uncertainty

Consider the state $|-1\rangle_y$ in a spin 1 system.

(a) Discuss the direction of the spin angular momentum for this quantum system.

(b) Calculate the expectation values and uncertainties for measurements of S_x, S_y, and S_z.

3 Probabilities of Energy

(adapted from McIntyre Problem # 3.2)

(a) Show that the probability of a measurement of the energy is time independent for a general state:

$$|\psi(t)\rangle = \sum_n c_n(t)\,|E_n\rangle$$

that evolves due to a time-independent Hamiltonian.

(b) Show that the probabilities of measurements of other observables that commute with the Hamiltonian are also time independent (neither operator has degeneracy).