

# Tilting Analyzers, Bell's Inequality

Physics II: Modern Physics

College of the Atlantic

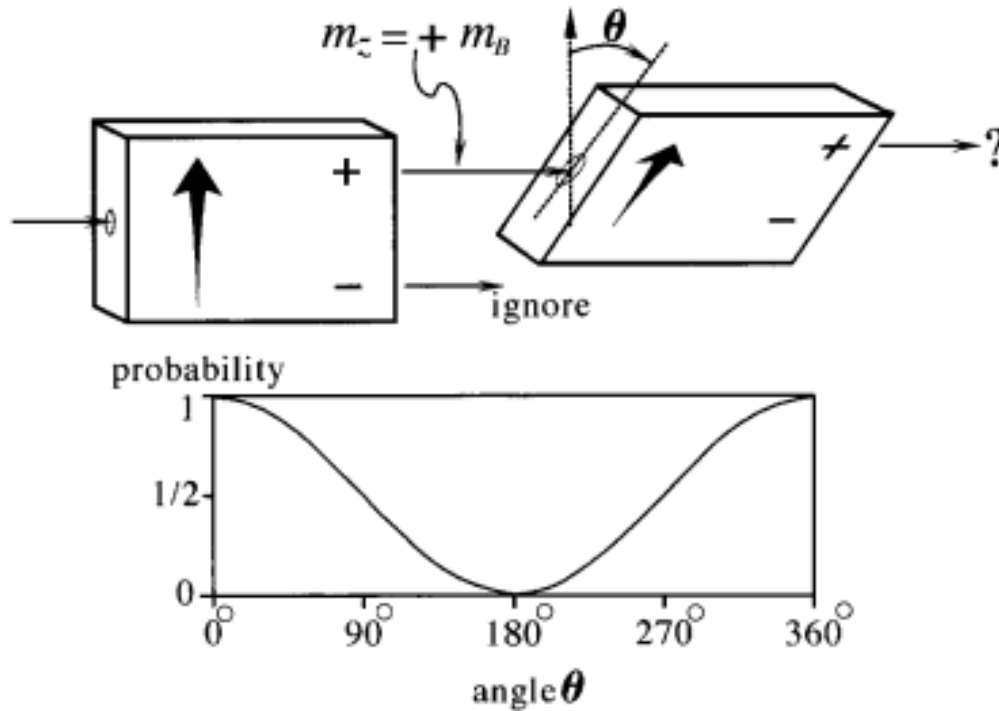


Fig. 4.1. The probability of an atom leaving the + exit of the second analyzer as the tilt angle  $\theta$  between the two analyzers is varied. The probability is 1 for  $\theta = 0^\circ$ ,  $\frac{3}{4}$  for  $\theta = 60^\circ$ ,  $\frac{1}{2}$  for  $\theta = 90^\circ$ ,  $\frac{1}{4}$  for  $\theta = 120^\circ$ , 0 for  $\theta = 180^\circ$ , etc.

Figure 1: Figure 4.1 from Styer, *The Strange World of Quantum Mechanics*, Cambridge University Press, 2000. The probability is given by  $\cos^2(\theta/2)$ .

1. Suppose an atom leaves the + exit of a z analyzer and enters an analyzer that is oriented 90 degrees clockwise from the z analyzer. What is the probability that the atom leaves the + exit of the second analyzer?
2. Suppose an atom leaves the + exit of a z analyzer and enters an analyzer that is oriented 120 degrees clockwise from the z analyzer. What is the probability that the atom leaves the + exit of the second analyzer?
3. Suppose an atom leaves the + exit of a z analyzer and enters an analyzer that is oriented 270 degrees clockwise from the z analyzer. What is the probability that the atom leaves the + exit of the second analyzer?

4. In March in Maine  $\frac{1}{3}$  of the days are snowy,  $\frac{1}{3}$  of the days are rainy, and  $\frac{1}{3}$  of the days are sunny. On snowy days, Beowulf always has oatmeal for breakfast. On rainy or sunny days, there is a  $\frac{1}{4}$  chance the Beowulf has oatmeal.
  - (a) What is the probability on a given day in March that Beowulf has oatmeal for breakfast?
  - (b) Suppose Beowulf moves to a different climate, and the relation between the weather and what he eats for breakfast remains the same. Is there any climate that Beowulf could move to in which he would end up eating oatmeal  $\frac{1}{6}$  of the time? Why or why not?
5. Suppose the left-moving atom has the instruction set **GRR**.
  - (a) What is the instruction set for the right-moving atom?
  - (b) What is the probability that the two lights flash different colors?
6. Suppose the left-moving atom has the instruction set **GGG**.
  - (a) What is the instruction set for the right-moving atom?
  - (b) What is the probability that the two lights flash different colors?