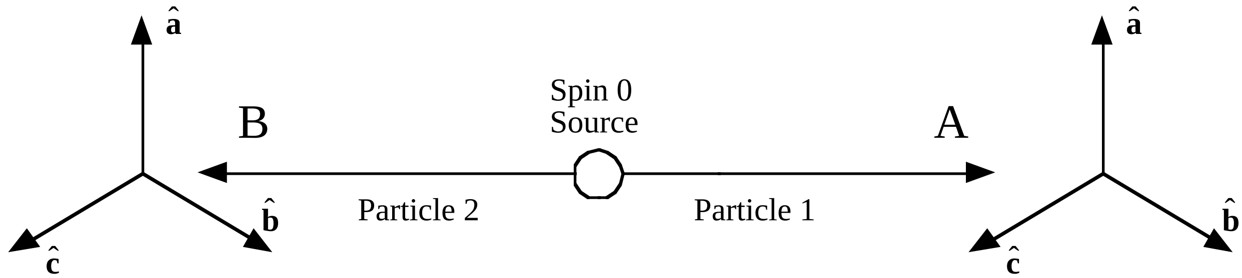
Einstein-Podolsky-Rosen Paradox



Instruction Sets (Hidden Variables)

Population	Particle 1	Particle 2
N_1	$(\hat{\mathbf{a}}+,\hat{\mathbf{b}}+,\hat{\mathbf{c}}+)$	$(\hat{\mathbf{a}}-,\hat{\mathbf{b}}-,\hat{\mathbf{c}}-)$
N_2	$(\hat{\mathbf{a}}+,\hat{\mathbf{b}}+,\hat{\mathbf{c}}-)$	$(\hat{\mathbf{a}}-,\hat{\mathbf{b}}-,\hat{\mathbf{c}}+)$
N_3	$(\hat{\mathbf{a}}+,\hat{\mathbf{b}}-,\hat{\mathbf{c}}+)$	$(\hat{\mathbf{a}}-,\hat{\mathbf{b}}+,\hat{\mathbf{c}}-)$
N_4	$(\hat{\mathbf{a}}+,\hat{\mathbf{b}}-,\hat{\mathbf{c}}-)$	$(\hat{\mathbf{a}}-,\hat{\mathbf{b}}+,\hat{\mathbf{c}}+)$
N_5	$(\hat{\mathbf{a}}-,\hat{\mathbf{b}}+,\hat{\mathbf{c}}+)$	$(\hat{\mathbf{a}}+,\hat{\mathbf{b}}-,\hat{\mathbf{c}}-)$
N_6	$(\hat{\mathbf{a}}-,\hat{\mathbf{b}}+,\hat{\mathbf{c}}-)$	$(\hat{\mathbf{a}}+,\hat{\mathbf{b}}-,\hat{\mathbf{c}}+)$
N_7	$(\hat{\mathbf{a}}-,\hat{\mathbf{b}}-,\hat{\mathbf{c}}+)$	$(\hat{\mathbf{a}}+,\hat{\mathbf{b}}+,\hat{\mathbf{c}}-)$
N_8	$(\hat{\mathbf{a}}-,\hat{\mathbf{b}}-,\hat{\mathbf{c}}-)$	$(\hat{\mathbf{a}}+,\hat{\mathbf{b}}+,\hat{\mathbf{c}}+)$

Hidden Variables

$$\left.\begin{aligned}\mathcal{P}_{opp} &= 1\\ \mathcal{P}_{same} &= 0\end{aligned}\right\}\text{ types } 1\,\&\,8$$

$$\left.\begin{aligned}\mathcal{P}_{opp} &= \frac{5}{9}\\ \mathcal{P}_{same} &= \frac{4}{9}\end{aligned}\right\}\text{ types } 2\to 7$$

$$\mathcal{P}_{opp} = \frac{1}{\sum_i N_i}\left(N_1+N_8+\frac{5}{9}\left(N_2+N_3+N_4+N_5+N_6+N_7\right)\right)\geq\frac{5}{9}$$

$$\mathcal{P}_{same} = \frac{1}{\sum_i N_i}\frac{4}{9}\left(N_2+N_3+N_4+N_5+N_6+N_7\right)\leq\frac{4}{9}$$

Quantum Mechanics

$$\mathcal{P}_{opp} = \cos^2\frac{\theta}{2} \qquad \mathcal{P}_{same} = \sin^2\frac{\theta}{2}$$

$$\theta = \begin{cases}0 & \frac{1}{3}\text{ time}\\ 120^\circ & \frac{2}{3}\text{ time}\end{cases}$$

$$\mathcal{P}_{opp} = \frac{1}{3}\cdot 1+\frac{2}{3}\cdot\frac{1}{4}=\frac{1}{2}$$

$$\mathcal{P}_{same} = \frac{1}{3}\cdot 0+\frac{2}{3}\cdot\frac{3}{4}=\frac{1}{2}$$