

Announcements

- ▶ Third mid-term exam next Thursday, April 17 from 7:00–9:00 pm
- ▶ Optional review session Tuesday, April 15 at 8:00 pm in Olin 268
- ▶ You may bring a third note card for this unit. You do NOT need to put the spin states from Table 5.1 or Schrödinger's equation on your note card

Physics & Astronomy presents:

Alia Wofford
George Mason University



"Breaking the Ice: The
Dynamics Behind Snowball
Earth's Meltdown"

April 10th at noon in OLIN 268
Pizza will be served

You can also join Alia at 4pm in OLIN 264 for
diamond painting!
Attendees will make a space-themed coaster
or other diamond art to keep



Funding provided by ULC

Lecture 20 — Concept Test 1

Consider an electron-positron pair in the state

$$|\psi\rangle = \sqrt{\frac{2}{9}} |\uparrow \uparrow\rangle + \sqrt{\frac{1}{9}} |\uparrow \downarrow\rangle + \sqrt{\frac{1}{3}} |\downarrow \uparrow\rangle + \sqrt{\frac{1}{3}} |\downarrow \downarrow\rangle$$

What is the probability that a measurement of the z -component of the **positron** spin will find a value $S_z^{\text{pos}} = +\hbar/2$?

1. $1/9$

3. $4/9$

5. $5/9$

2. $1/3$

4. $1/2$

6. $2/3$

Lecture 20 — Concept Test 2

Given the electron-positron state

$$|\psi\rangle = c_+ |\uparrow\rangle \left(\frac{1}{c_+} \sqrt{\frac{2}{9}} |\uparrow\rangle + \frac{1}{c_+} \sqrt{\frac{1}{9}} |\downarrow\rangle \right) + c_- |\downarrow\rangle \left(\frac{1}{c_-} \sqrt{\frac{1}{3}} |\uparrow\rangle + \frac{1}{c_-} \sqrt{\frac{1}{3}} |\downarrow\rangle \right)$$

determine the value of c_- .

1. $\sqrt{1/9}$

3. $\sqrt{1/3}$

5. $\sqrt{8/9}$

2. $\sqrt{1/6}$

4. $\sqrt{1/2}$

6. $\sqrt{2/3}$

Lecture 20 — Concept Test 3

Consider the electron-positron state

$$|\psi\rangle = \sqrt{\frac{1}{3}} |\uparrow\rangle |\phi_1\rangle + \sqrt{\frac{2}{3}} |\downarrow\rangle |\phi_2\rangle$$

where

$$|\phi_1\rangle = \sqrt{\frac{2}{3}} |\uparrow\rangle + \sqrt{\frac{1}{3}} |\downarrow\rangle \quad \text{and} \quad |\phi_2\rangle = \sqrt{\frac{1}{2}} |\uparrow\rangle + \sqrt{\frac{1}{2}} |\downarrow\rangle$$

If we measure the z -component of spin for the electron and find a value $S_z^{\text{elec}} = +\hbar/2$, what is the new state of the electron-positron system?

1. $|\psi\rangle$ (no change)

3. $|\uparrow\rangle |\phi_1\rangle$

5. $|\downarrow\rangle |\phi_1\rangle$

2. 0

4. $|\uparrow\rangle |\phi_2\rangle$

6. $|\downarrow\rangle |\phi_2\rangle$

Lecture 20 — Concept Test 4

Given this new state $|\psi\rangle = |\uparrow\rangle |\phi_1\rangle$ with $|\phi_1\rangle = \sqrt{\frac{2}{3}} |\uparrow\rangle + \sqrt{\frac{1}{3}} |\downarrow\rangle$, what is the probability that a measurement of the z -component of the **positron** spin will find a value $S_z^{\text{pos}} = +\hbar/2$?

1. $1/9$

3. $4/9$

5. $5/9$

2. $1/3$

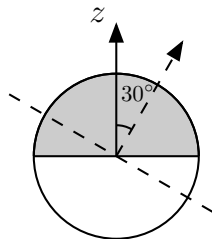
4. $1/2$

6. $2/3$

Lecture 20 — Concept Test 5

An electron-positron pair is created. A measurement is made that reveals $S_z^{\text{elec}} = -\hbar/2$.

According to our hidden variable theory, what is the probability that a subsequent measurement of the positron spin will find a value $S_{30^\circ}^{\text{pos}} = +\hbar/2$?



1. $1/6$

3. $1/2$

5. $5/6$

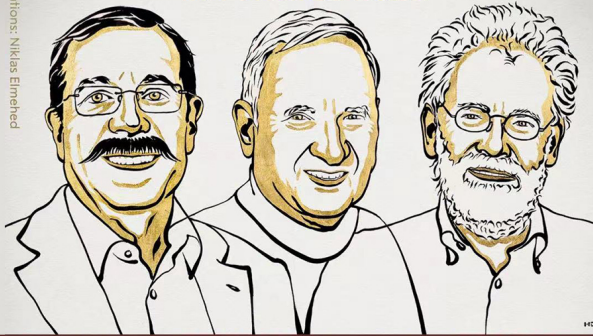
2. $1/3$

4. $2/3$

6. 1

THE NOBEL PRIZE IN PHYSICS 2022

Illustrations: Niklas Elmehed



Alain
Aspect

John F.
Clauser

Anton
Zeilinger

"for experiments with entangled photons,
establishing the violation of Bell inequalities
and pioneering quantum information science"

THE ROYAL SWEDISH ACADEMY OF SCIENCES