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What's the expectation values of Sx

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The expectation value of the x-component of the spin operator, denoted as ⟨Sx⟩, for a spin-1/2 particle (e.g., an electron) described by the given wave function ψ can be calculated using the formula:

$$\langle Sx \rangle = \langle \psi | Sx | \psi \rangle$$

where Sx is the x-component of the spin operator, and ψ is the given wave function.

The spin operator Sx in terms of the Pauli matrices is given by:

$$Sx = \frac{\hbar}{2} \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

Given the wave function ψ = A * [2i, -1], and A = 1/√5 (as previously determined for normalization), we can calculate ⟨Sx⟩:

First, normalize the wave function:

$$\psi = \frac{1}{\sqrt{5}} \begin{pmatrix} 2i \\ -1 \end{pmatrix}$$

Now, calculate ⟨Sx⟩:

$$\langle Sx \rangle = \langle \psi | Sx | \psi \rangle$$

$$= \frac{1}{5} \begin{pmatrix} -2i & 1 \end{pmatrix} \left(\frac{\hbar}{2} \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \right) \begin{pmatrix} 2i \\ -1 \end{pmatrix}$$

$$= \frac{\hbar}{5} \begin{pmatrix} -2i & 1 \end{pmatrix} \begin{pmatrix} 0 \\ -2i \end{pmatrix}$$

$$= \frac{\hbar}{5} (2i)$$

$$= \frac{2i\hbar}{5}$$

So, the expectation value of the x-component of the spin operator is:

$$\langle Sx \rangle = \frac{2i\hbar}{5}$$