

Week 6 Worksheet 1

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Exercise 1. Consider a spin-1/2 system.

- a) Find the eigenvalues and eigenspinors of S_z .
- b) Do the same for S_x and S_y , and write them in terms of $|+\rangle$ and $|-\rangle$, the eigenspinors of S_z .
- c) Consider the raising and lowering operators $S_{\pm} = S_x \pm iS_y$. Act with them on $|+\rangle$ and $|-\rangle$. How many states do you obtain?

Exercise 2. A beam of spin-1/2 particles moving along the y -axis goes through two collinear Stern-Gerlach apparatuses, both with lower beams blocked. The first has its $\mathbf{B}$ field along the z -axis and the second has its $\mathbf{B}$ field along the x -axis (i.e., is obtained by rotating the first by an angle $\pi/2$ about the y -axis).

- a) What fraction of particles leaving the first will exit the second?
- b) If a third filter that transmits only spin up along the z -axis is introduced, what fraction of particles leaving the first will exit the third?
- c) If the middle filter transmits both spins up and down (no blocking) the x -axis, but the last one transmits only spin down the z -axis, what fraction of particles leaving the first will leave the last?