CHAPTER OVERVIEW

8: Identical Particles

We have so far looked at the quantum mechanical description of a few particles with spin in the previous section, and particles that exhibit entanglement in section 5. In all these cases, we assumed that the individual particles could be distinguished from each other. For example, the two-electron state $(|\uparrow\downarrow\rangle - |\downarrow\uparrow\rangle)/\sqrt{2}$ assumes that we have two electrons, one held "over here", and the other "over there", and we can talk meaningfully about their respective spins. The tensor product structure of our Hilbert space is a manifestation of our ability to label our particles unambiguously.

However, what happens when we place the two electrons inside a sealed box? The wave functions of the electrons will quickly start to overlap. Since the electrons are identical particles, which according to basic quantum mechanics do not have well-defined paths, we cannot keep track of which electron is which inside the box. Not even in principle.
