Summary of lecture 7

Fundamentally indistinguishable particles arise in Quantum Theory and they can only be either bosons or fermions.

Fermions have the property that the wavefunction for a multi-fermion system is *anti-symmetric* under the interchange of any two fermions.
e.g. for a two fermion system

$$\psi_{ij}(x,y) = -\psi_{ij}(y,x)$$

The Pauli Exclusion Principle follows directly from this property.

Bosons have the property that the wavefunction for a multi-boson system is *symmetric* under the interchange of any two bosons.
e.g. for a two boson system

$$\psi_{ij}(x,y) = +\psi_{ij}(y,x)$$

Fermions have half-integer spin and bosons have integer spin: the link between spin and the symmetry of the wavefunction is called the “spin-statistics theorem” and its proof needs an understanding of relativistic quantum mechanics (causality).