7.3: Internal and Space-Time Symmetries

Above I have mentioned angular momentum, the vector product of position and momentum. This is defined in terms of properties of space (or to be more generous, of space-time). But we know that many particles carry the spin of the particle to form the total angular momentum,

$$\vec{J} = \vec{L} + \vec{S}.$$

The invariance of the dynamics is such that $\vec{J}$ is the conserved quantity, which means that we should not just rotate in ordinary space, but in the abstract "intrinsic space" where $\vec{S}$ is defined. This is something that will occur several times again, where a symmetry has a combination of a space-time and intrinsic part.