# 26. Spin 1 and Higher



The procedure that Griffiths follows in Subsection 4.4.1 for spin 1/2, deriving the matrix forms of the operators and then finding their eigenvectors, generalizes straightforwardly to higher values of $s$.

Recall that $s$ can be any integer or half-integer, and that $m$ (sometimes called $m_s$) then ranges from $-s$ to $s$ in integer steps. We need an independent eigenvector of $S_z$ for every $m$ value, so the dimension of the vector space, for a given $s$, equals the number of $m$ values: 2 for $s = 1/2$, 3 for $s = 1$, 4 for $s = 3/2$, and so on. By convention we always use the $S_z$ eigenvectors as our basis, ordered so the 1 goes in the first (top) component for the highest $m$, in the second component for the next-highest $m$, and so on down to the last (bottom) component for the lowest $m$ value.

Using these conventions, you should be able to immediately write down the $S_z$ matrix for any $s$. Then, using the general formulas for the actions of the raising and lowering operators (including the ugly square-root normalization factors), you should be able to find the matrices for $S_+$ and $S_-$, and use these to construct $S_x$ and $S_y$. Finally, you should be able to find the eigenvectors of $S_x$ and $S_y$, and use any of the eigenvectors to calculate probabilities involving spin measurements on an arbitrary initial state.

Please review these steps (for spin 1/2) in Griffiths, and come to class prepared to carry out the steps for spin 1.