Problem#4

Consider two electrons outside a closed shell. Suppose these are p electrons. Use an angular momentum coupling scheme in which first orbital momenta and spins are coupled to total orbital angular momentum and total spin, and then subsequently to total angular momentum. List all the possible states and use spectroscopic notation according to ${}^{2S+1}L_J$. Which states are allowed when the particles occupy the same p state? To solve this problem, consider the state

$$\left|\ell^2 L M_L S M_S\right\rangle = \frac{1}{\sqrt{N}} \sum_{m_\ell m'_\ell m_s m'_s} (\ell m_\ell \ell m'_\ell | L M_L)\, (1/2 m_s\, 1/2 m'_s | S M_S)\, a^\dagger_{\ell m_\ell m_s} a^\dagger_{\ell m'_\ell m'_s} |\Phi_0\rangle \tag{1}$$

and normalize it (or use the symmetry properties of CG-coefficients and addition operators). This will lead to a condition on L and S which reduces the number of allowed states substantially.

Experimental data will be provided for comparison during the meeting on Monday, September 18, at 3pm.