87(2): Effect of Spin Connection Resonance

If we consider a Schrödinger equation

$$-\frac{\hbar^2}{2m}\frac{d^2 P}{dr^2} = \left(E + V_{eff}^{(0)}\right) P \quad -(1)$$

where:

$$V_{eff}^{(0)} = \frac{e^2}{4\pi\epsilon_0 r} - \frac{\ell(\ell+1)\hbar^2}{2mr^2} \quad -(2)$$

the effect of spin connection resonance as in paper 63 is to make the change:

$$V_{eff}^{(0)} \longrightarrow V_{eff}^{(0)} - V_{SCR} \quad -(3)$$

where

$$V_{SCR} := e\phi . \quad -(4)$$

This is because SCR in paper 63 added a positive potential energy, causing the electron to be repelled from the nucleus.

The Lamb shift equation of papers 85 and 86 is:

$$-\frac{\hbar^2}{2m}\frac{d^2 P}{dr^2} = \left(E + V_{eff}\right) P \quad -(5)$$

where:

2)

$$V_{eff} = \frac{e^2}{4\pi\epsilon_0(r+r(vac))} - \frac{l(l+1)\hbar^2}{2m(r+r(vac))^2} \quad -(6)$$

Therefore:

$$\boxed{\begin{aligned} V_{SCR} := e\phi &= \frac{e^2}{4\pi\epsilon_0}\left(\frac{1}{r} - \frac{1}{r+r(vac)}\right) \\ &\quad - \frac{l(l+1)\hbar^2}{2m}\left(\frac{1}{r^2} - \frac{1}{(r+r(vac))^2}\right) \quad -(7) \\ &= \frac{r(vac)}{r(r+r(vac))}\left(\frac{e^2}{4\pi\epsilon_0} + \frac{l(l+1)\hbar^2}{2m}\frac{(r(vac)+2r)}{r(r+r(vac))}\right) \end{aligned}}$$

So it is possible to find the analytical dependence of r(vac) on ϕ of paper 63.

It is seen that as $V_{SCR} \rightarrow \infty$, one solution is $l \rightarrow \infty$, i.e. the angular momentum becomes infinite at spin connection resonance