1) $m(4)$: Calculation of Force Eigenvalue of the H Atom

In the simplest case of the 1s radial wave function:

$$\phi_{10} = 2\left(\frac{1}{a}\right)^{3/2} \exp\left(-\frac{r}{a}\right) \quad -(1)$$

$$:= A e^{-r/a}$$

where a is the Bohr radius. The relevant equation is:

$$\left(\hat{H} - E\right)\frac{d\phi_{10}}{dr} = F\phi_{10} \quad -(2)$$

The hamiltonian is:

$$\hat{H} = \left(-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial r^2} + V\right) \quad -(3)$$

where

$$V = -\frac{e^2}{4\pi\epsilon_0 r} + \frac{l(l+1)\hbar^2}{2mr^2} \quad -(4).$$

where l is the orbital angular momentum quantum number.
For the 1s orbital:

$$l = 0, \quad -(5)$$

and the energy level is:

$$E = -\frac{\hbar^2}{2ma^2} \quad -(6)$$

Therefore:

$$\frac{\partial\phi_{10}}{\partial r} = -\frac{1}{a}\phi_{10} \quad -(7)$$

$$\frac{\partial^2\phi_{10}}{\partial r^2} = \frac{1}{a^2}\phi_{10} \quad -(8)$$

$$\frac{\partial^3\phi_{10}}{\partial r^3} = -\frac{1}{a^3}\phi_{10} \quad -(9)$$

Therefore:

2)

$$(\hat{H} - E)\frac{\partial \phi_{10}}{\partial r} = \left(\frac{\hbar^2}{2ma^3} + \frac{e^2}{4\pi\epsilon_0 r a} - \frac{\hbar^2}{2ma^3}\right)\phi_{10} \qquad -(10)$$

$$= F_{10}\phi_{10}.$$

So:

$$\boxed{F_{10} = \frac{e^2}{4\pi\epsilon_0 r a}} \qquad -(11)$$

Conclusion

This is a positive valued, pure quantum, force that counterbalances the classical force of attraction

$$F(\text{classical}) = -\frac{e^2}{4\pi\epsilon_0 r^2} \qquad -(12)$$

from eq. (4)
