$$\left(-\frac{\hbar^2}{2\mu}\frac{\mathrm{d}^2}{\mathrm{d}r^2}+\frac{\hbar^2\ell(\ell+1)}{2\mu r^2}-\frac{Ze^2}{4\pi\epsilon_0 r}\right)P_{n\ell}(r)=EP_{n\ell}(r). \tag{1}$$

The following dimensionless variables were defined:

$$\begin{aligned} \xi &= r/Da_0 \\ E' &= E/\left(Z^2\mu\hbar^2/(2m_e^2a_0^2)\right) \end{aligned} \tag{2}$$

In principle, E' should take the values $-1, -1/4, -1/9, \ldots$. The variable ξ is on the interval $[0,1]$. Then we get

$$\hat{H}u = -\beta^2\left(\frac{\mathrm{d}^2}{\mathrm{d}\xi^2}-\frac{\ell(\ell+1)}{\xi^2}+\frac{2}{\beta\xi}\right)u = E'u \tag{3}$$

where $\beta = m_e/(Z\mu\alpha)$. The numerical solution to (3) as a linear combination of n B-splines of degree k:

$$\hat{u}(\xi)=\sum_{j=0}^{n-1}c_jB_{j,k}(\xi). \tag{4}$$

Inserting this into equation (3), multiplying by $B_{i,k}(x)$ and integrating over $(0,1)$ yields:

$$\sum_{j=1}^{n-2}c_j\int_0^1 B_{i,k}\hat{H}B_{j,k} = E'\sum_{j=1}^{n-2}c_j\int_0^1 B_{i,k}B_{j,k} \tag{5}$$

which is a generalized eigenvalue problem of the form $A\mathbf{c}=E'B\mathbf{c}$.