These plots were produced using the IQ program from the book “Quantum Mechanics on the Macintosh” by Siegmund Brandt and Hans Dieter Dahmen (Springer Verlag, 1991).

All the relevant mathematics is in Liboff, sections 9.3, 10.2, 10.3. (These kind of figures are usually in introductory QM texts; Liboff is weak on figures). Here we set $\hbar = 1$, so we measure energy in units of $\text{sec}^{-1}$. We also set $m = 1$, so distance is measured in units of $\text{energy}^{-1/2}$ or $\text{sec}^{1/2}$. Kinda funny, but perfectly consistent.

The figures are then made with the following parameters:

Page 2. The associated Legendre functions $P_l^m(x)$ vs. $x = \cos \theta \in [-1,1]$.

Page 3. The magnitude of the spherical harmonics $|\tilde{Y}_{lm}|$ is plotted as the radial coordinate, as a function of $\theta$.

Page 4. The radial eigenfunction for hydrogen $R_{nl}$ vs. $x = r/a$, $a$ = the Bohr radius. Note that $R_{nl}(0)$ is non-zero for $l = 0$, else 0. The number of radial nodes is $n - l - 1$. The main peak shifts further out with $l$ for fixed $n$, and with $n$ for fixed $l$.

Page 5. The radial eigenfunction for the 3D isotropic QHO $R_{n,l}$ (not $R_{nl}$).

Page 6. The radial eigenfunction for hydrogen $rR_{nl}$, “in” the potential, for $l = 2$.

Page 7. The radial eigenfunction for the 3D isotropic QHO $R_{nl}$ “in” the potential, for $l = 3$.

Page 8. The radial eigenfunction for the 3D deep “square” (spherical) well, “in” the potential, for $l = 0$.

Page 9. The radial eigenfunction for the 3D finite “square” (spherical) well, “in” the potential, for $l = 0$.

Page 10. The eigenfunction squared for hydrogen $\rho_{nlm}(r,\theta) = |\psi_{nlm}(r,\theta)|^2$ vs. $r/a$ and $\theta$. Note that $R_{nl}(0)$ is non-zero for $l = 0$, else 0. The number of radial nodes is $n - l - 1$. The main peak shifts further out with $l$ for fixed $n$, and with $n$ for fixed $l$.

Page 11. The same, for the 3D deep “square” (spherical) well.

Come by if you want to play around with this program; it is quite interesting!
Three dimensional harmonic oscillator

\[ R_n^1(r) = 1 \]

\[ n = 3 \]
Three dimensional deep square well
Three dimensional square well potential with finite depth

\[ R^m_J \left( \xi \right) \]

\[ 0 \leq \xi \leq 1 \]
Infinitely Deep Spherical Square Well Potential

Infinitely Deep Spherical Square Well Potential