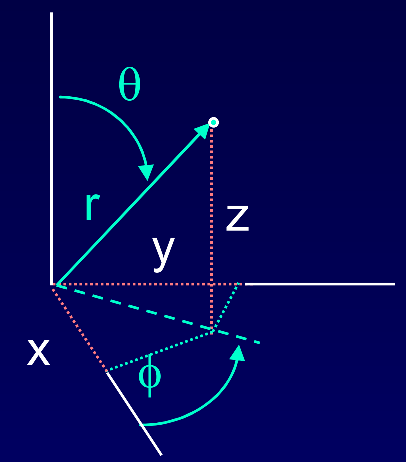
Wave Function in Spherical Coordinates

We saw that because U depends only on the radius, the problem is separable. The hydrogen SEQ can be solved analytically (but not by us). We will show you the solutions and discuss their physical significance.



We can write: $$\psi_{nlm}(r,\theta,\phi) = R_{nl}(r)Y_{lm}(\theta,\phi)$$

What before we called $\Theta(\theta)\Phi(\phi)$

There are three quantum numbers:

- *n* "principal" ($n \geq 1$)
- *l* "orbital" ($0 \leq l < n-1$)
- *m* "magnetic" ($-l \leq m \leq +l$)

The Y_{lm} are called "spherical harmonics."
Today, we will only consider $l = 0$ and $m = 0$.
These are called "s-states". This simplifies the problem, because $Y_{00}(\theta,\phi)$ is a constant and the wave function has no angular dependence:

These are states in which the electron has no orbital angular momentum. This is not possible in Newtonian physics. (Why?)

$$\psi_{n00}(r,\theta,\phi) = R_{n0}(r)$$

Note:
Some of this nomenclature dates back to the 19th century, and has no physical significance.