

## Probabilities for a Quantum Particle on a Unit Sphere in Spherical Harmonic Functions

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Consider the following state for a quantum particle confined to the surface of the unit sphere.

$$\psi(\theta, \phi) = \sqrt{\frac{2}{9}}Y_2^{-2}(\theta, \phi) - \sqrt{\frac{4}{9}}Y_5^{-2}(\theta, \phi) + i\sqrt{\frac{3}{9}}Y_5^3(\theta, \phi) \quad (1)$$

1. Write this state in Dirac notation.
2. Write out the energy eigenvalues for particle on a sphere from  $E_0$  to  $E_5$ .
3. What is the probability that a measurement of the  $z$ -component of angular momentum will return a result of  $-2\hbar$ ?
4. What is the probability that an energy measurement will return a result of  $E_5$ ?