Spin – Internal Angular Momentum

- 1925: Uhlenbeck and Goudsmit proposed that each electron rotates with angular momentum $\hbar/2 (\sim 10^{-34} \text{ Js})$ and carries $\mu_B = e\hbar/2m$

Paul Ehrenfest (1925): “This is a good idea. Your idea may be wrong, but since both of you are so young and without any reputation, you would not lose anything making a stupid mistake.”

…. spin (internal angular momentum) is a fundamental property of particles …

Spin: purely quantum mechanical phenomenon, does not exist in classical mechanics!
The electron behaves as if it were spinning about an axis through its center. The two directions of spin correspond to the two possible values for the spin quantum number, $m_s$. 
Spin of the electron (intrinsic property of the particle):

- **Spin quantum number:**
  \[ s = \frac{1}{2} \]
  \[ m_s = \pm \frac{1}{2} \]

- **Spin angular momentum:**
  \[ S^2 = s(s + 1)\frac{\hbar^2}{2} \]
  \[ S_z = m_s \frac{\hbar}{2} \]