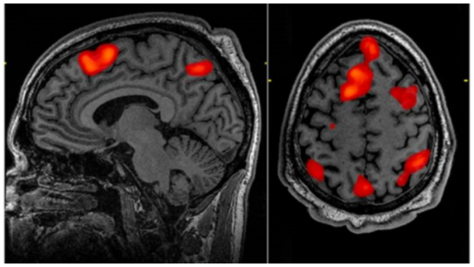
Inclass 26.1. A nuclear (proton) magnetic resonance machine is operated with a magnetic field of 21 Tesla. What is the electromagnetic wave frequency used in the machine to perform the imaging? g= 5.6 and mass of proton $= 1.67\times10^{-27} kg$.

RPI Professor William Edelstein: (from GE) Magnetic Resonance Imaging (MRI): APS Industrial Applications of Physics Award (2006)

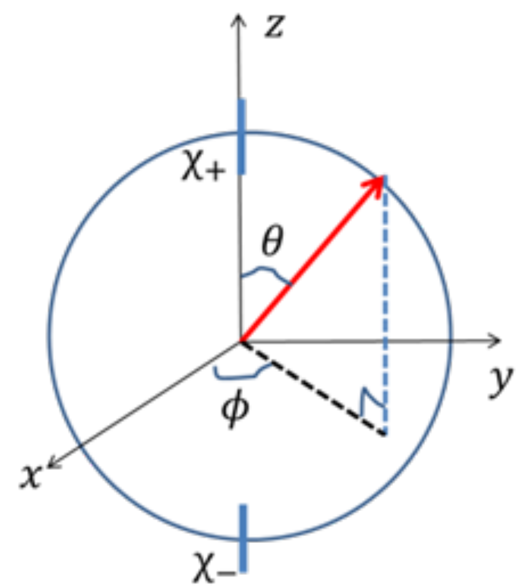


Inclass 26.2. The wavevector of a qubit from a spin ½ system can be described by $\psi = A(\cos\frac{\theta}{2}\,\chi_+ + e^{i\phi} sin\frac{\theta}{2}\chi_-)$ where A is the normalization factor, θ and ϕ are polar angles shown in the figure, and χ_+ and χ_- are the up and down spin states.

(a) What are the values of θ and ϕ in order to achieve a state of the form

$$\psi = A\,(\chi_+ + \chi_-).$$

(b) Determine the normalization constant A and show that it is an eigenvector of the spin operator $\hat{S}_x = \frac{\hbar}{2}\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$. What is the eigenvalue?



Inclass 26.3. Given a spin state of a spin ½ system: $\chi = \frac{1}{\sqrt{2}}\begin{pmatrix}1\\1\end{pmatrix}$, determine ΔS_z, the uncertainty in S_z.

Inclass 26.4. Assume that at $t = 0$, a hydrogen atom is in its first excited state $\Psi(r, \theta, \phi, t = 0) = \psi_{2,1,0}(r, \theta, \phi)$ with energy $E = E_2$. What is the probability of finding the atom in its ground state $\psi_{1,0,0}(r, \theta, \phi)$ with energy E_1 at time t later?