Final
Due date: 2019.12.23

Problem 1. In class, under the assumption that the color part of the wave function is completely anti-symmetric, we constructed the baryon octet spin-flavor wave function, as

$$\psi(\text{baryon octet}) = A[\psi_{12}(\text{spin})\psi_{12}(\text{flavor}) + \psi_{23}(\text{spin})\psi_{23}(\text{flavor}) + \psi_{13}(\text{spin})\psi_{13}(\text{flavor})]\,.$$

1) Start with the ψ_{12}(spin), ψ_{12}(flavor), ψ_{23}(spin), ψ_{23}(flavor), ψ_{13}(spin) and ψ_{13}(flavor) given in class, find the real normalization factor, A. Remember that ψ_{13} is not independent of ψ_{12} and ψ_{23}. Please note that you need to show that A is the same for every member of the baryon octet. [3 points]
2) In class, we have derived the magnetic moment for the proton, $\frac{4}{3}\mu_u - \frac{1}{3}\mu_d$. Derive the expressions of the magnetic moments for the other seven members of the baryon octet from their spin-flavor wave functions, in terms of μ_u, μ_d and μ_s. [3 points]

Problem 2. If there were no color quantum number, then the spin-flavor wave function for the baryon octet should be completely anti-symmetric. We have given the form of this wave function in class. Find the magnetic moment ratio of proton and neutron, and compare with the corresponding one obtained from Problem 1. [3 points]