

831 Homework set I (due Sept.15)

[Hit: If the solutions do not fit in one page, you haven't found the simple way.]

Problem 1

Define a spin operator $\vec{S} = \frac{\hbar}{2} \vec{\sigma}$, where $\vec{\sigma}$ are the Pauli matrices. Prove the identity

$$(\hat{A} \cdot \vec{S})(\hat{B} \cdot \vec{S}) = \frac{\hbar^2}{4} \hat{A} \cdot \hat{B} + i \frac{\hbar}{2} \hat{A} \times \hat{B} \cdot \vec{S}.$$

where \hat{A} and \hat{B} are arbitrary operators that commute with $\vec{\sigma}$,

Problem 2

A heavy nucleus N of mass M fragments into two lighter nuclei n_1 and n_2 of masses m_1 and m_2 . Find the energies for n_1 and n_2 in the N rest frame.