

Massachusetts Institute of Technology

Department of Physics

Course: 8.701 – Introduction to Nuclear and Particle Physics

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Instructor: Markus Klute

TA : Tianyu Justin Yang

Discussion Problems

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Problem 1: Gell-Mann Nishijima equation

Check that the Gell-Mann Nishijima formula works for the quarks u , d , and s .

What are the appropriate isospin assignments for \bar{u} , \bar{d} , and \bar{s} ? Check your answer with the Gell-Mann Nishijima formula.

Problem 2: The alpha particle

The α particle is a bound state of two protons and two neutrons, that is, a ${}^4\text{He}$ nucleus. There is no isotope of hydrogen with an atomic weight of four (${}^4\text{H}$), nor of lithium ${}^4\text{Li}$. What do you conclude about the isospin of an α particle?

The reaction $d + d \rightarrow \alpha\pi^0$ has never been observed. Explain why.

Would you expect ${}^4\text{Be}$ to exist? How about a bound state of four neutrinos?

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