Nuclear and Particle Physics and Advanced lab I

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1. Recall the basic information regarding nuclear radius and charge distribution, binding energy, angular momentum, parity, magnetic dipole moment, and electric quadrupole moment.

2. Solve the Schrodinger equation for the ground state of a deuteron using a three-dimensional square well potential, and determine properties such as the non-existence of an excited bound state of an n-p system and the estimation of the force between nucleons.

3. Analyze low-energy n-p scattering cross-sections through experimental observations, partial wave analysis, and phase shifts, including singlet and triplet interactions of nucleons, spin dependence of nuclear forces, and the calculation of the energy of a neutron-proton bound state for singlet spin orientation.

4. Evaluate the energetics of beta decay, including the energy and momentum distribution of beta particles, and understand Pauli's neutrino hypothesis, Fermi's theory of beta decay, Fermi-Kurie plot, and the selection rules for Fermi and Gamow-Teller transitions.

5. Understand nuclear models such as the Liquid Drop model, Bethe-Weizsacker semi-empirical mass formula, Bohr-Wheeler's theory of fission, and the Spherical Shell model, to analyze nuclear reactions and determine scattering cross-sections and reaction cross-sections based on partial wave analysis.

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