

PROTON SCATTERING FROM ^{206}Pb :
NEUTRON DENSITIES IN THE NUCLEAR INTERIOR

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During the spring of 1987 we took data from $^{206}\text{Pb}(\vec{p}, p')$ at 200 MeV using the new K600 spectrometer at IUCF. Theoretical studies indicate that, of all nuclei, ^{206}Pb can exhibit the most significant qualitative and quantitative differences between neutron and proton transition densities. Due to the closure of the proton shell, transitions to low lying states are overwhelmingly dominated by two neutron holes distributed among the $3p_{1/2}$, $3p_{3/2}$, $2f_{5/2}$, and $1i_{13/2}$ orbits. The large size of the nucleus and the unusual multi-lobed character of the transition densities, such as the first 2^+ state for example (Fig. 1), will allow the most precise determination of the penetration of the proton probe into the interior, and its utility as a quantitative probe of neutron densities.¹ This experiment is part of an electron-proton-pion multi-probe study, with the electron experiment completed.^{2,3}

The ^{206}Pb experiments were performed mixed with the K600 development runs. The relative size of the elastic to inelastic cross sections at low momentum transfer caused some difficulty in acquiring inelastic data, finally overcome by careful shifting of the elastic beyond the active region of the focal plane. Data were obtained at angles between 6° and 42° in 3° steps. Finer angular steps were made at forward angles.

After careful replay of the data we have obtained clean spectra. Fig. 2 shows the spectrum obtained at a scattering angle of 16° . The first 2^+ state is clearly separated

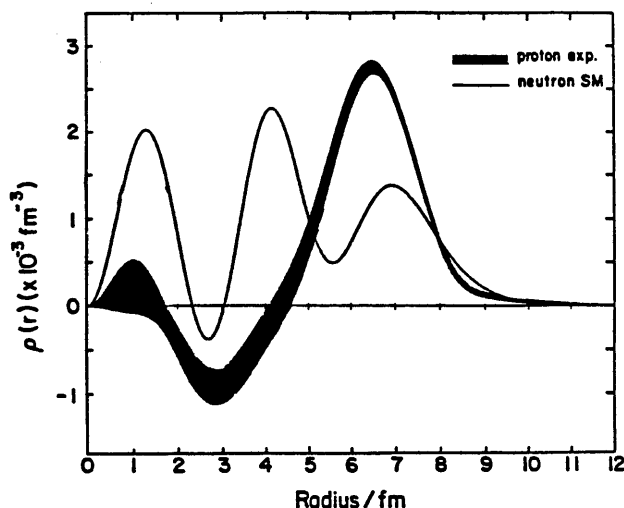


Figure 1. Transition charge density for the first 2^+ state in ^{206}Pb with a prediction for the neutron density.

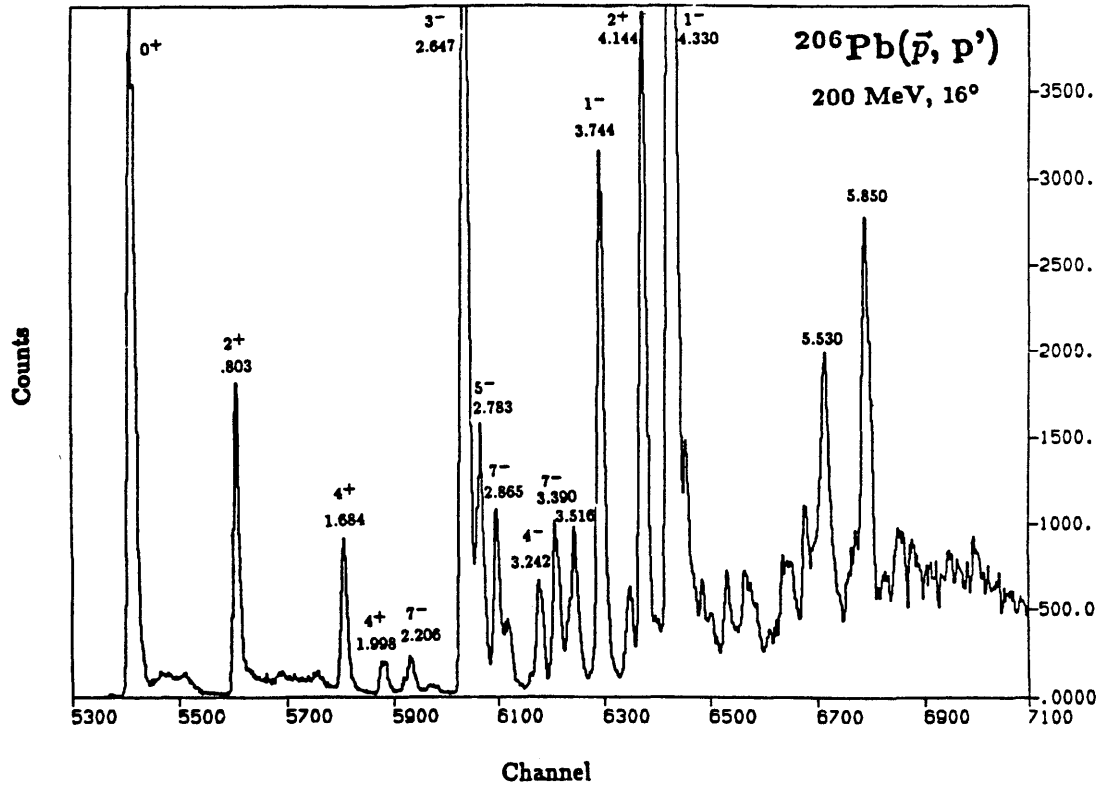


Figure 2. Spectrum of scattered protons from ^{206}Pb at an incident energy of 200 MeV.

from the elastic and other states. In addition, two or three 7^- states and some 10^+ or 12^+ states are resolved. Data are currently being analyzed at UNH.

1. S. E. Frohling, M.S. Thesis, University of New Hampshire, 1983 (unpublished).
2. C. N. Papanicolas, Ph. D. Thesis, MIT, 1979 (unpublished).
3. C. N. Papanicolas et al., Phys. Rev. Lett. **52** (1984) 247.