180 MeV PROTON SCATTERING FROM ^{16}O and ^{9}Be AS PART OF A UNIFIED STUDY OF THESE NUCLEI

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During the past year, we have completed a preliminary analysis of all states observed in ^{9}Be and ^{16}O below 14 MeV. On the basis of a combined analysis of our 135-MeV (p,p') data and electron scattering data obtained at the MIT Bates Linear Accelerator, we have previously reported[1] the discovery of strong density dependence in the isocalar spin-independent central component of the two-nucleon effective interaction near 150 MeV. Calculations are underway to extend this analysis to our 180-MeV data, and to look for signatures of coupled-channel effects in the energy dependence of the data.

In our last report,[2] we presented a figure depicting a fit to a 180-MeV $^{9}Be(p,p')$ spectrum, including several broad resonances. Excellent fits were obtained over a wide angular range. However, the apparent position of the $7/2^-$, 6.76-MeV state exhibited a systematic shift with scattering angle, as displayed in Fig. 1. This indicated the presence of an additional state in the ^{9}Be excitation spectrum at approximately 6.4 MeV, with a cross section falling more rapidly with angle than the 6.76-MeV state. A subsequent analysis was performed including such a new

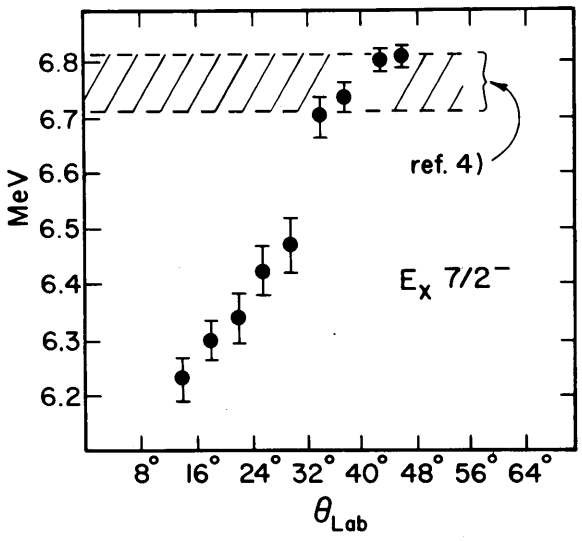

Figure 1. Apparent position (excitation energy) of the $7/2^-$ state in ^{9}Be, from initial analysis of the 180-MeV data.

state. The excitation energy and decay width of this new state, together with the decay width of the 6.76-MeV state, were free parameters in the fit. These free parameters converged to consistent values, as shown in Fig. 2. The resulting cross-sections and analyzing powers are displayed in Fig. 3. Both analyzing powers follow a pattern common to collective natural parity transitions in intermediate energy proton scattering.

The absence of a strong interference in our excitation spectra indicates that these two states do not have the same spin and parity. It is not certain which of the two states has spin-parity $7/2^-$. An early (e,e') experiment[3] identified a $7/2^-$ state at 6.4 ± 0.1 MeV, whereas a recent compilation[4] lists one state with spin $7/2^-$ and energy 6.76 MeV.

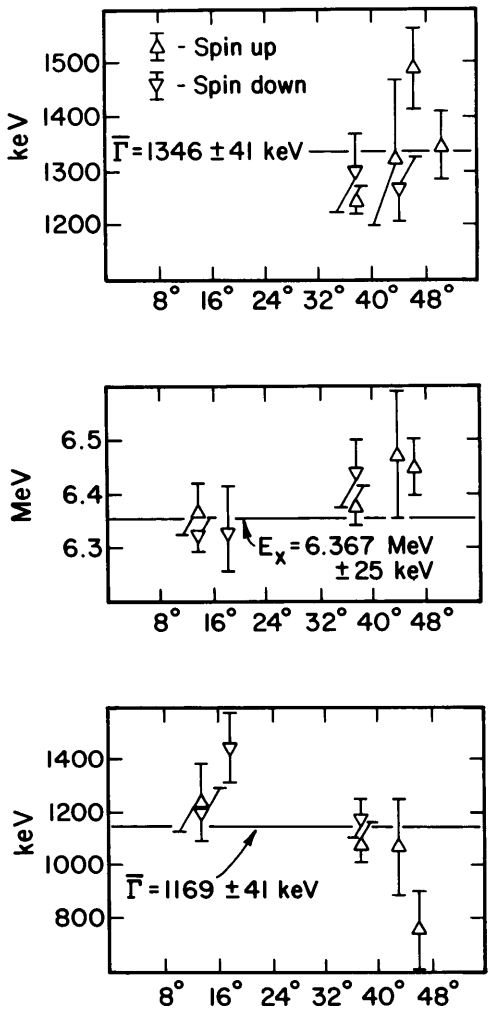

Figure 2. Results of analysis of ^{9}Be data including a new state at approximately 6.4 MeV. Top: Decay width (FWHM) of 6.76-MeV state; Middle: Excitation energy of new state; Bottom: Decay width (FWHM) of new state. Upward directed triangles are from spin-up data, downward directed triangles are from spin-down data.

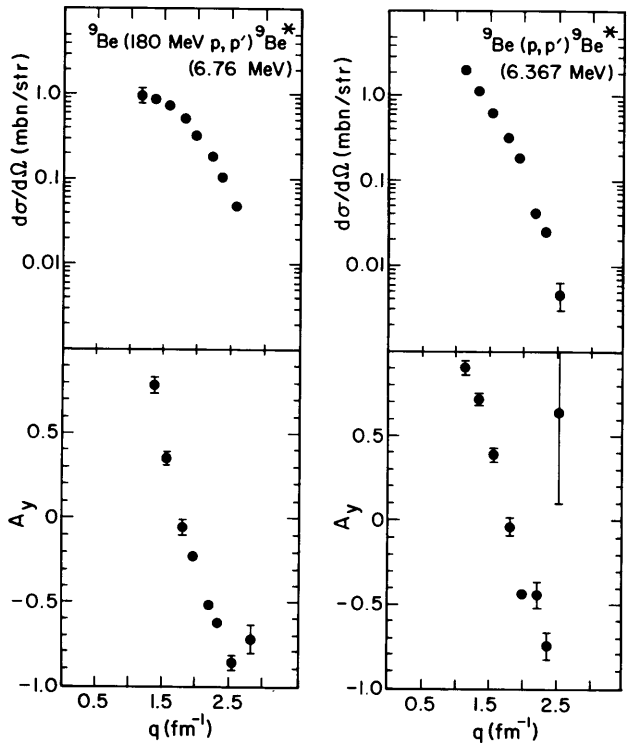

Figure 3. 180-MeV proton scattering cross sections and analyzing powers from ^{9}Be 6.37-MeV and 6.76-MeV states.

1) J. Kelly, Ph.D. Thesis, M.I.T. (1981); J. Kelly et al., Phys. Rev. Lett. 45, 2012 (1980)

2) IUCF Annual Report 1981, p. 10.

3) H. Nguyen Ngoc et al., Nucl. Phys. 42, 62 (1963).

4) F. Ajzenberg-Selove, Nucl. Phys. A320, 117 (1979).