Reply to "Comment on 'Electroexcitation of $M4$ transitions in ^{17}O and ^{18}O' "

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Some possible problems in Millener's suggested spin assignments for states at high excitation energy in ^{17}O are pointed out.

It is expected from various weak-coupling and shell-model calculations[1,2] for ^{17}O that two levels with J^π; T assignments of $\frac{13}{2}^-;\frac{1}{2}$ and $\frac{11}{2}^-;\frac{3}{2}$ will be excited most strongly in electron scattering by stretched $(p_{3/2}\rightarrow d_{5/2})$ $M4$ transitions. States at excitation energies of 15.78, 20.14, and 20.70 MeV are the most plausible experimental candidates for these states, based upon strengths observed in inelastic electron-scattering data at high momentum transfers.[2]

In the preceding Comment,[1] Millener argues that states observed in pion spectra[3] at 15.78 and 17.06 MeV are likely to have $T=\frac{1}{2}$, while (unobserved) states at 20.14 and 20.70 MeV are likely to have $T=\frac{3}{2}$, since inelastic pion-scattering measurements strongly favor isoscalar excitations over isovector excitations. While this argument has merit, it is unclear from the pion spectrum presented in Fig. 2 of Ref. 3 whether the 20.14-MeV state is absent or simply unresolved from a strong ^{16}O contaminant. This argument also assumes negligible isospin mixing for the states in question—an assumption that may not be valid, considering the importance of known isospin mixing for 4^- states in ^{16}O.[4] Direct evidence for isospin mixing in the predominantly $T=\frac{3}{2}$ states of ^{17}O has been presented by Hinterberger *et al.*[5]

Millener suggests that the predicted $\frac{13}{2}^-;\frac{1}{2}$ state most plausibly corresponds to the 15.78-MeV level; previously, Manley *et al.*[2] had suggested that the 20.14-MeV level, which is the most strongly excited state in the high-q electron spectra, is the most plausible candidate. Millener's arguments rely, in part, upon the assumption that the observed states can be described as 2p-1h (two-particle, one-hole) states; however, shell-model calculations using the Reehal-Wildenthal interaction,[6] which describe high-spin states with only 4p-3h configurations, predict levels that could mix with those calculated by Millener. For example, the first 4p-3h states with $J^\pi;T=\frac{13}{2}^-;\frac{1}{2}$ and $\frac{11}{2}^-;\frac{3}{2}$ are calculated to lie at 13.3 and 18.6 MeV, respectively. The degree to which Millener's calculations would change if 4p-3h configurations were included is uncertain.

Millener is correct in his criticisms regarding the simple model that was used in Ref. 2 to suggest $J^\pi;T$ assignments; however, there may also be problems associated with his perhaps more tempting assignments. For example, the $M4$ strength calculated by Millener for the $\frac{13}{2}^-;\frac{1}{2}$ level agrees rather poorly (see Table I of Ref. 1) with the electron data[2] for the 15.78-MeV level. Also, the experimental π^+ peak cross sections for the levels observed at 15.7 and 17.1 MeV are comparable ($\sim$0.03 mb/sr),[3] whereas Millener's theoretical estimates give 0.12 mb/sr for the $\frac{13}{2}^-;\frac{1}{2}$ level and 0.07 mb/sr for the $\frac{11}{2}^-;\frac{1}{2}$ level (Millener's suggested assignment for the 17.06-MeV level). Furthermore, Millener's calculations predict $\sigma(\pi^+)/\sigma(\pi^-)\sim 9$ for the $\frac{13}{2}^-;\frac{1}{2}$ level, since it is a pure proton excitation; the experimental ratio is ~ 3. His calculations also predict $\sigma(\pi^+)/\sigma(\pi^-)\sim 0.8$ for the $\frac{11}{2}^-;\frac{1}{2}$ level; experimentally, the π^+ cross section is several times larger than the π^- cross section.[3]

We agree with Millener that the level in ^{18}O at 22.39 MeV is very likely the strongest 4^- state with $T=2$.

It is very gratifying to see theoretical interest stimulated by the electron data presented in Ref. 2; however, we believe that conclusive assignments for the levels in question must await more detailed calculations and further measurements with both electron scattering and isospin-selective reactions.[7]

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[1]D. J. Millener, Phys. Rev. C **36**, 1643 (1987), the preceding paper.

[2]D. M. Manley *et al.*, Phys. Rev. C **34**, 1214 (1986).

[3]C. L. Blilie *et al.*, Phys. Rev. C **30**, 1989 (1984).

[4]D. B. Holtkamp *et al.*, Phys. Rev. Lett. **45**, 420 (1980); C. E. Hyde-Wright *et al.*, Phys. Rev. C **35**, 880 (1987).

[5]F. Hinterberger *et al.*, Nucl. Phys. **A352**, 93 (1981).

[6]B. S. Reehal and B. H. Wildenthal, Part. Nucl. **6**, 137 (1973).

[7]For example, the (n,p) reaction now being investigated at TRIUMF would excite only $T=\frac{3}{2}$ states in the ^{17}O(n,p) reaction and only $T=2$ states in the ^{18}O(n,p) reaction.

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