Gamow-Teller transition strengths from the ground state of ^{16}O studied via high resolution (^{3}He,t) reaction at 140 MeV/nucleon

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From the high resolution ^{16}O(^{3}He,t) data at 0° and at 140 MeV/nucleon taken in the E159 and E197 beam time, reduced Gamow-Teller strengths, B(GT) values from the ground state of the ^{16}O were deduced. As the ^{16}O target, Mylar foil (Polyethylene Terephthalate) and $^{11}B_2O_3$ were used in E159 and E197, respectively.

In a naive Shell-Model picture, the ^{16}O nucleus is expected to be fully occupied up to $p_{1/2}$ orbit and thus it forms the doubly closed nucleus, therefore no GT strength is expected. However, empirically 1^+ states are known in ^{16}F nucleus at 3.758 MeV and 4.654 MeV, suggesting such a naive picture is not realistic. Recently, via the ^{16}O(p,d)^{15}O reaction, possibility of large components of high-momentum neutrons in the ^{16}O ground state configuration due to the tensor interaction was suggested [1]. Investigation of the Gamow-Teller transition strengths to these 1^+ states will give additional information of the ^{16}O ground state structure.

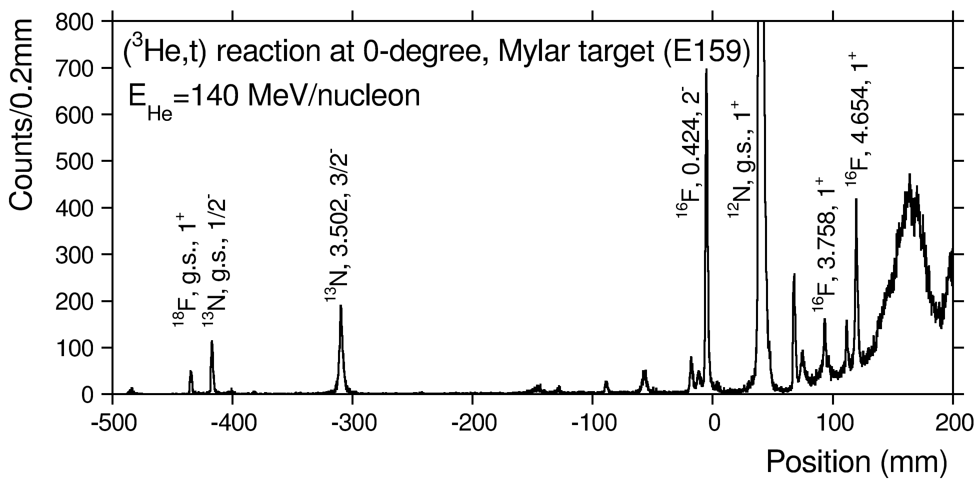

Figure 1: The spectrum taken at 0° obtained in the E159 experiment. Scattering angle of less than 0.5° is included.

As shown in Fig. 1, the known 1^+ states in ^{16}F at 3.758 MeV and 4.654 MeV and the 1^+ ground state in ^{18}F were clearly observed. In order to deduce B(GT) values, proportionality between reaction cross sections and B(GT) values was assumed. The GT unit cross section in the $A = 18$ system was deduced by using the strong GT transition from the ^{18}O to the ^{18}F ground state. The corresponding B(GT) value was determined by using the β decay of ^{18}F, which connects the same states in the opposite direction. Applying the mass dependence of the GT unit cross section given in Ref. [2] and the natural abundance ratio of ^{18}O and ^{16}O, the GT unit cross section at $A = 16$ was estimated. Distortion and kinematic factors in the proportionality were taken into account. As shown in Table 1, consistent results within the error bars were obtained.

Table 1: Obtained B(GT) values from the E159 and E197 data.

E_x	E159	E197
3.758	0.016(2)	0.017(2)
4.654	0.071(9)	0.058(7)

References

[1] H.J. Ong *et al.*, Phys. Lett. B **725**, 277 (2013).

[2] R.G.T. Zegers *et al.*, Phys. Rev. Lett. **99**, 202501 (2007).