Study of *M1* Quenching in ^{28}Si by a (p, p') Measurement at zero-degrees

H. Matsubara[1], A. Tamii[1], T. Adachi[2], J. Carter[3], M. Dozono[4], H. Fujita[5], K. Fujita[1], Y. Fujita[2], H. Hashimoto[1], K. Hatanaka[1], M. Itoh[1], T. Kawabata[6], K. Nakanishi[1], L. Popescu[7], A. Perez[8], B. Rubio[8], H. Sakaguchi[9], Y. Sakemi[1], Y. Sasamoto[6], Y. Shimbara[1], Y. Shimizu[1], F.D. Smit[5], Y. Tameshige[1], M. Yosoi[1], and J. Zenihiro[9]

[1] *Research Center for Nuclear Physics (RCNP), Osaka University, Ibaraki, Osaka 567-0047, Japan*
[2] *Depertment of Physics, Osaka University, Toyonaka, Osaka 560-0043, Japan*
[3] *School of Physics, University of the Witwatersrand, Johannesburg 2050, South Africa*
[4] *Department of Physics, Kyusyu University, Fukuoka 812-8581, Japan*
[5] *iThemba LABS, Somerset West 7129, South Africa*
[6] *Center for Nuclear Study, University of Tokyo, Bunkyo 113-0033, Japan*
[7] *Vakgroep Subatomaire en Stralingsfysica, Universiteit Gent, B-9000 Gent, Belgium*
[8] *Instituto de Fisica Corpuscular, CSIC-Universidad de Valencia, E-46071 Valencia, Spain*
[9] *Depertment of Physics, Kyoto University, Sakyo, Kyoto 606-8502, Japan*

It is famous that the quenching problem of Gammow-Teller (GT) strengths with respect to " Ikeda-sum-rule" has been discussed for a long time. Similarly the $M1$ strengths are expected to have the some quenching problem because they are mediated by the same operator " $\sigma\tau$" with the GT one. Since $M1$ strengths have two types of transitions, isoscalar (ΔT = 0) and isovector (ΔT = 1), another aspect of the quenching can be found from their difference. Although several studies of (p, p') measurements for *sd*-nuclei were performed previously [1, 2], their results had relatively large ambiguities for deriving reliable conclusions. High quality data are essential.

We realized ^{28}Si(p, p') measurements at forward angles including zero-degrees at $E_p = 295$ MeV at the WS-course of RCNP with high resolution [3, 4]. A good scattering angle resolution of $0.5-0.8^\circ$ and a good energy resolution of 20 keV in FWHM were achieved. Remaining small instrumental background contribution was determined experimentally and was subtracted from excitation energy spectra. By comparing the measured angular distribution with distorted wave Born approximation calculations, isospin value as well as J^π was assigned for each state. Three 1^+, $T = 0$ states were newly observed. It has been confirmed that flatter angular distribution of the 1^+, $T = 0$ states is their common nature. Four states, which had been known as 1^+, $T = 0$, were assigned as 0^+. The measured (p, p') cross sections were converted to B(σ) strengths using unit cross sections. Note that the unit cross sections were determined by theoretical calculations. The cumulative sums of B(σ) up to $E_x = 16$ MeV were compared with the predictions of shell model calculations using the USD interaction (Fig. 1 (A), (B)). Ratios of observed to predicted sums were less than unity as drawn in Fig. 1 (C). Significant difference between the isoscalar and the isovector ratios was not seen. The Δ-hole admixture plays little role in the $M1$ quenching of ^{28}Si.

The accuracy of the unit cross sections will be checked by using other experimental results.

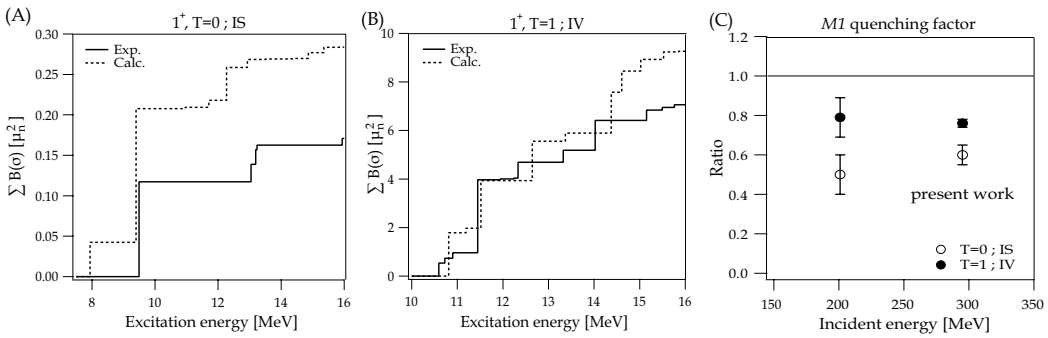

Figure 1: (A), (B) : Measured cumulative sums of B(σ) up to $E_x = 16$ MeV of the 1^+, $T = 0$ strength (A) and the $T = 1$ one (B) are compared with shell model calculations (dotted). (C) : Ratios of observed to predicted sums, where the uncertainties are statistic and systematic errors. The present results are consistent with the previous ones at $E_p = 201$ MeV [2].

References

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