Electroweak $L = 1$ Strength in Hadronic Charge Exchange Reactions

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Charge exchange reactions $(A_Z, A_{Z\pm1})$ induced by hadronic projectiles are a powerful tool for probing spin-isospin degrees of freedom in nuclei [1]. The spin-isospin parts of the operators that mediate charge exchange reactions such as (p, n) are the same as those involved in the corresponding processes induced by electromagnetic and weak interactions. As a result, the matrix elements that describe hadronic charge exchange reactions are closely related to those that describe the rates of β decay or the cross sections of reactions induced by neutrinos during supernova explosion.
An eikonal model has been used to assess the relationship between calculated strengths for first forbidden β decay and calculated cross sections for (p, n) charge exchange reactions. It is found that these are proportional for strong transitions, suggesting that hadronic charge exchange reactions may be useful in determining the spin-dipole matrix elements for astrophysically interesting leptonic transitions.

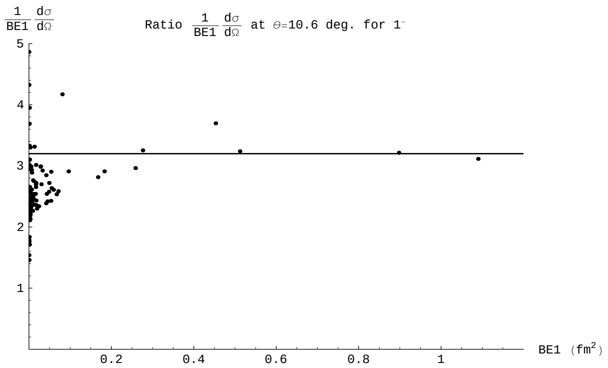

Figure 1: Ratios of the cross sections for excitation of the 1^- spin-dipole states, taken at their maximums, to the corresponding spin-dipole strengths B_1.

Our results [2] imply that there will be an approximate proportionality of the observed cross section at the maximum of the charge exchange reaction exciting spin-dipole modes and the leptonic strength. Having established here the basic apparatus to examine this issue, it will next be important to examine transition densities for heavier nuclides, so as to determine whether their shapes are similar enough that cross sections and B_J strengths will be proportional.

References

[1] H. Ejiri, Phys. Rep. **338** (2000) 265.
[2] V.F. Dmitriev, V. Zelevinsky and Sam M. Austin, Phys. Rev. C **65** (2002) 015803.