Electromagnetic Dissociation of Relativistic ^{28}Si by Nucleon Emission

by

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Abstract

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A detailed study of the electromagnetic dissociation of ^{28}Si by nucleon emission at E_{lab}/A = 14.6 GeV/nucleon was carried out with ^{28}Si beams interacting on ^{208}Pb, ^{120}Sn, ^{64}Cu, ^{27}Al and ^{12}C targets. The measurements were made in the fixed target relativistic heavy ion experiment E814 operating at the Brookhaven National Laboratory. The E814 apparatus consists of detectors in the target area which measure the energy and charged multiplicity, and a forward spectrometer which measures the position, momentum and energy of the reaction fragments.

The exclusive electromagnetic dissociation cross sections for decay channels having multiple nucleons in the final state have been measured with the aid of the E814 apparatus which enables the selection of events produced in pure electromagnetic interactions. The measured cross sections agree well with previous measurements obtained for the removal of a few nucleons with the E814 apparatus as well as with measurements on total charge removal cross sections from other experiments. The dependence of the integrated cross sections on the target charge Z_T and the target mass A_T confirms that for higher Z targets the excitation is largely electromagnetic.

Direct measurements of the excitation energy for the electromagnetic dissociation of $^{28}\mathrm{Si} \rightarrow \mathrm{p}+^{27}\mathrm{Al}$ and $^{28}\mathrm{Si} \rightarrow \mathrm{n}+^{27}\mathrm{Si}$ have been obtained through a calculation of the invariant mass in kinematically reconstructed events. The excitation energy spectrum for all targets peak near the isovector giant dipole resonance in ^{28}Si. These distributions are well reproduced by combining the photon spectrum calculated using the Weizsäcker-Williams approximation with the experimental data on the photonuclear reactions $^{28}\mathrm{Si}(\gamma,\mathrm{p})^{27}\mathrm{Al}$ and $^{28}\mathrm{Si}(\gamma,\mathrm{n})^{27}\mathrm{Si}$.

The possibilities of observing double giant dipole resonance excitations in ^{28}Si have been investigated with cross section measurements as well as with excitation energy reconstruction. Effects due to the surviving peripheral nuclear interactions and the contribution from double interactions on experimental observations are discussed.

To my parents

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