RESONANCE REACTIONS INDUCED BY BEAMS OF LIGHT RADIOACTIVE NUCLEI

Abstract

by

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In the analysis of the experimental studies reported in this thesis, three light nuclei were investigated via resonance elastic scattering using the Thick Target Inverse Kinematics technique (TTIK). All of those results were published or submitted to scientific journals.

The structure of the unbound proton-rich isotope ^{19}Na was studied in resonance elastic scattering of a radioactive ^{18}Ne beam on a proton target. The experiment covered the excitation energy range from 0.5 to 2.7 MeV in the center-of-mass system. Only one state of ^{19}Na (the second excited state) was observed. A combined R-matrix and potential model analysis was performed. The spin and parity assignment of this second excited state was confirmed to be $1/2^+$. It was shown that the position of the $1/2^+$ state significantly affects the reaction rate through that state, but the total reaction rate remains unchanged since the ^{18}Ne(2p,γ) proceeds mostly via the ground and first excited states in ^{19}Na at stellar temperatures.

An excitation function of ^{12}N+p was measured in the center of mass energy range of 0.8 - 2.7 MeV. The data were analyzed in the framework of the R-matrix formalism. A spin-parity assignment is given for the first excited state of ^{13}O.

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An indication of the presence of a new level in ^{13}O at an excitation energy of 3.29 MeV, with tentative spin-parity assignment ($1/2^-$, $3/2^-$), was obtained. The impact of this measurement on the ^{12}N(p,γ)^{13}O reaction rate is discussed.

An excitation function has been measured for ^{12}B+p elastic scattering in the excitation-energy region from 18.5 to 21.0 MeV in ^{13}C. Five new states were found, and evidence is presented for a $T = 3/2$ assignment to all of them. No anomalies related to the possible manifestation of $T = 1/2$ states in the region were observed. The properties of the new states are in reasonably good agreement with shell-model predictions. A comparison with the ^{13}B level scheme shows that even more $T = 3/2$ states should be present in the region under investigation.