Low-energy states of ^{11}N and two-proton radioactivity of ^{12}O*

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The properties of light exotic nuclei are a major source of interest in nuclear physics research [1]. The ^{11}N nucleus, mirror nucleus of ^{11}Be, is unstable to one proton decay. While understanding the low-energy resonances of ^{11}N is an important test of nuclear models, the energy and decay width of the ^{11}N ground state are the most important ingredients in predicting the two-proton decay width of the ground state of ^{12}O [2]. A comprehension of the factors influencing two-proton decay rates, and the associated mechanisms for two-proton decay, is a major challenge for nuclear physics theory and experiment [3,4,5].

A considerable experimental and theoretical effort has been devoted to elucidating the low-energy structure of ^{11}N [6] but there remains important disagreement between experimental results and also with theoretical predictions, particularly with respect to the ground state properties. Here, we presents a new, high precision, study of the low-energy resonances of ^{11}N using the resonant elastic scattering method in inverse kinematics [7]. We have used a ^{10}C beam and a $(CH_2)_n$ target at the CYCLONE facility at Louvain-la-Neuve to study the centre-of-mass energy range from 0.7 to 2.8 MeV above the ^{10}C+p threshold. Recoil protons were detected using a Compact Disk silicon strip detector based ΔE-E telescope called "CD-PAD" which allows for a clean separation of protons, α- and β-particles [8]. The absolute ^{10}C+p elastic cross sections have been analysed in the framework of the R-matrix model [9] and precise values of the energies and the widths of the $1/2^+$ ground and the $1/2^-$ first excited states of ^{11}N have been obtained. The present results are used to calculate the two-proton decay width of the ^{12}O ground state.

* This work is supported by the Belgian program P5/07 on inter-university attraction poles of the Belgian-state Federal Services for Scientific, Technical and Cultural Affairs and the UK Engineering & Physical Science Research Council (EPSRC).

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