Coulomb Dissociation of ^{27}P*

J. Marganiec[1,2], S. Beceiro-Novo[3], S. Typel[4], C. Wimmer[5], T. Aumann[1,4], D. Cortina Gil[3], M. Heil[4], K. Sümmerer[4], and the R^{3}B collaboration

[1]TU Darmstadt, Germany; [2]EMMI, GSI Darmstadt, Germany; [3]Universidade de Santiago de Compostela, Santiago de Compostela, Spain; [4]GSI Darmstadt, Germany; [5]Goethe-Universität, Frankfurt am Main, Germany

To model explosive hydrogen burning in nova, X-ray burst or γ-ray burst scenarios, the rp process has to be understood in detail. In this process, the light to medium-mass nuclei near the proton-drip line play an important role and their nuclear structures should be well known. The aim of the present experiment is the investigation of the nuclear structure of ^{27}P and the reaction ^{26}Si(p,γ)^{27}P, which can indirectly give rise to the famous 1.8 MeV γ-ray that was observed in the Milky Way galaxy [1, 2]. The radiative-capture reaction on ^{26}Si was studied by the Coulomb dissociation (CD) method. By the detailed balance theorem, the one-proton-removal CD cross section can be converted to the radiative-capture cross section and subsequently to the resonance strength [3].

The experiment was performed at GSI Darmstadt using the R^{3}B-LAND setup. A secondary ^{27}P ion beam, with energy $E = 500$ MeV/nucleon, was produced by fragmentation of a ^{36}Ar primary beam. The incoming ^{27}P beam was identified by means of energy-loss, position, and time-of-flight measurements. In order to investigate the CD reaction the ^{27}P beam was focused onto a secondary ^{nat}Pb target (515 mg/cm^2). To accurately subtract the background and to properly estimate the nuclear contribution, several runs without target and with a ^{12}C target (660 mg/cm^2) were also performed. The reaction products were identified using one Si-microstrip detector placed before a large-gap dipole magnet. After the magnet the heavy fragments were detected with two scintillating-fibre arrays and a two-layer time-of-flight (ToF) wall. For proton identification two drift chambers and a two-layer ToF wall were used.

The outgoing silicon fragment and the proton were tracked and their masses and momenta determined. The excitation-energy spectrum was reconstructed. The preliminary inclusive integral one-proton removal CD cross section up to 5 MeV of relative energy was calculated to be $\sigma_{tot} = 84.7 \pm 6.1$(stat.) mb; the spectrum is shown in Fig. 1.

The CD cross-section spectrum was fitted using four resonances and one direct-capture component. The free parameters for the fit were the heights and locations of the four peaks. The widths of the resonant peaks were fixed to the experimental resolutions, the shape of the direct-capture component was predicted by [4]. The measured relative energies for the first two states ($E_{rel} = 0.27$ and 0.73 MeV) are consistent with the excitation energies of the states obtained previously [5, 6, 7] and the third state

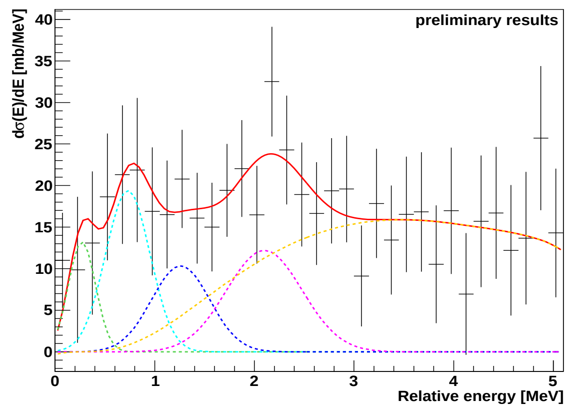

Figure 1: Preliminary inclusive differential one-proton removal CD cross section.

($E_{rel} = 1.26$ MeV) with [5]. Compared to a previous CD study [5], we have carefully subtracted the nuclear contribution, a component not removed in the data of [5]. To explain the structure above the third peak, a fourth resonance corresponding to $E_{rel} = 2.1$ MeV had to be introduced. The nature of this resonance is not clear yet.

The analysis is in progress. As the next step, the CD cross section to the ground state will be determined and converted to the radiative-capture cross section, $\sigma(^{26}$Si(p,γ)^{27}P). To study the nuclear structure of ^{27}P, the experimental data are also compared to theoretical predictions by [4] using the simulation package R3BROOT.

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