Experimental observation of ^{7}H.

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One of the main goals of the nuclear physics nowadays is to understand how does the nuclear force work and build the nuclei. Despite the efforts made to give a complete description of the known nuclei we only have a fragmented vision of the whole picture, with questions about the interaction between the nucleons still unresolved, and different theoretical approximations trying to explain the experimental results.

Systematic measurements of nuclei far from the stability help to test the predictions of the different nuclear models. The localization of the proton and neutron drip lines, as well as the identification of resonances beyond the bounding limit are fruitful sources of information. These studies help to understand the force which holds the nucleons inside the nuclei, one of the main ingredients to build a general description.

We have focused our experimental research on the predictions about the existence of neutron-rich Hydrogen isotopes resonances. The study of these species is a direct test of the strength of the nuclear interaction between protons and neutrons. Recent theoretical predictions [1] as well as experimental evidences [2] point out the possible existence of the ^{7}H resonance as a limit in the nuclear force. Our work has consisted in the experimental search and characterization of this resonance state.

The ^{7}H resonance was produced with one-proton transfer reaction between a ^{8}He beam at 15.4A MeV, prepared at the GANIL-Spiral facility, on a ^{12}C target. The main part of the experimental setup was the Time-Charge Projection Chamber MAYA [3], as a detector for the reaction products. The detector MAYA works essentially as a drift chamber with the filling gas (isobutane C_4H_{10} in this case) playing the role of reaction target. The reaction channel was selected via the identification of the recoil and scattered products, whereas the 3-D tracking of the recoil particle stopped in the gas allowed a complete reconstruction of the reaction kinematics.

The analysis of the data resulted in the positive identification, for the first time, of the ^{7}H state, with an estimated mass 0.60 MeV above the mass of the ^{3}H+4n subsystem. The width of the resonance is estimated in less than 100 KeV. The total cross-section associated to the process is close to 50 μbarn/sr.

The successful results confirm low-energy transfer reactions as a valuable method for testing nuclear properties in regions far from stability. The concept of active-target detectors proved to be useful, and in many applications a unique tool for studying low cross-section reactions where low-energy recoil particles need to be detected, and a very high efficiency is required.

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