Spectroscopy of ^{7}He by the ^{9}Be(^{6}He,^{7}He)^{8}Be transfer reaction

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The ground state of the neutron rich nucleus ^{7}He is unstable by 0.44MeV with respect to the decay into ^{6}He+n [1]. It has been observed in several experiments, the first one, more than 30 years ago [2]. Until recently, however, no evidence was found for excited states at energies up to at least 10MeV. A number of calculations have been published on ^{7}He in the last decade [3-6]. While the results differ in some aspects, they all agree in predicting at least two resonances, $1/2^-$ and $5/2^-$, above the $3/2^-$ ground state. Only in the last few years the advent of radioactive ion beams has opened new experimental possibilities, renewing interest in the study of this isotope. For the first time, two resonances corresponding to excited states were seen in various experiments [7-10]. However, uncertainties are present in the spin assignment of these resonances, because they were not observed together in any of the experiments performed so far. The experiment performed at the CRC-UCL, aimed at investigating the ^{7}He nucleus using the reaction $^9Be(^6He,^8Be)^7He$. The detection of the two α particles resulting from the break-up of ^{8}Be is a clear signature of the reaction channel, and the ^{7}He spectrum can be reconstructed by the missing-mass method. In addition, the measurement of the angular distribution allows determining the spin of the possible states. Prior to the study of ^{7}He, and in order to test the proposed experimental method, the reaction $^9Be(^6Li,^8Be)^7Li$ was used to investigate the ^{7}Li nucleus. The energy levels of ^{7}Li are reproduced with excellent precision and resolution, showing the suitability of the method to study ^{7}He. In a second step, the reaction $^9Be(^6He,^9Be)^7He$ was studied using a 17 MeV ^{6}He beam and a ^{9}Be self-supporting target. The α particles from ^{8}Be were detected by the LEDA silicon strip array system [11] covering laboratory angles from 5 to 12 degree. The unambiguous identification of α particles was performed in a Time-Of-Flight versus Energy spectrum. The coincidence of two α particles in one event was used as signature to reconstruct the ^{7}He level scheme. The observed energy of the ground state is in agreement with previous results and the good statistics will allow extracting the angular distribution and, therefore, establishing the spin of this state. The spectrum shows no other narrow state.

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