Search for the low-lying T=5 states in ^{48}Ca

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Particle-hole excitations near closed shells carry information on single-particle energies and on two-body interactions [1,2]. The particle-hole excitations near the doubly magic nuclei are of special interest. Information on the charge-changing particle-hole excitations (T= 5 negative parity states) in ^{48}Ca is not available (Fig. 1). We performed an experiment to establish the level scheme of the low-lying negative parity T=5 states in ^{48}Ca. Excitation functions for the ^{1}H (^{47}K, p) ^{47}K reaction in the c.m. energy range from 1 MeV to 4.5 MeV were measured. The T= 5 states are expected to show up in the p+^{47}K excitation function as narrow resonances.

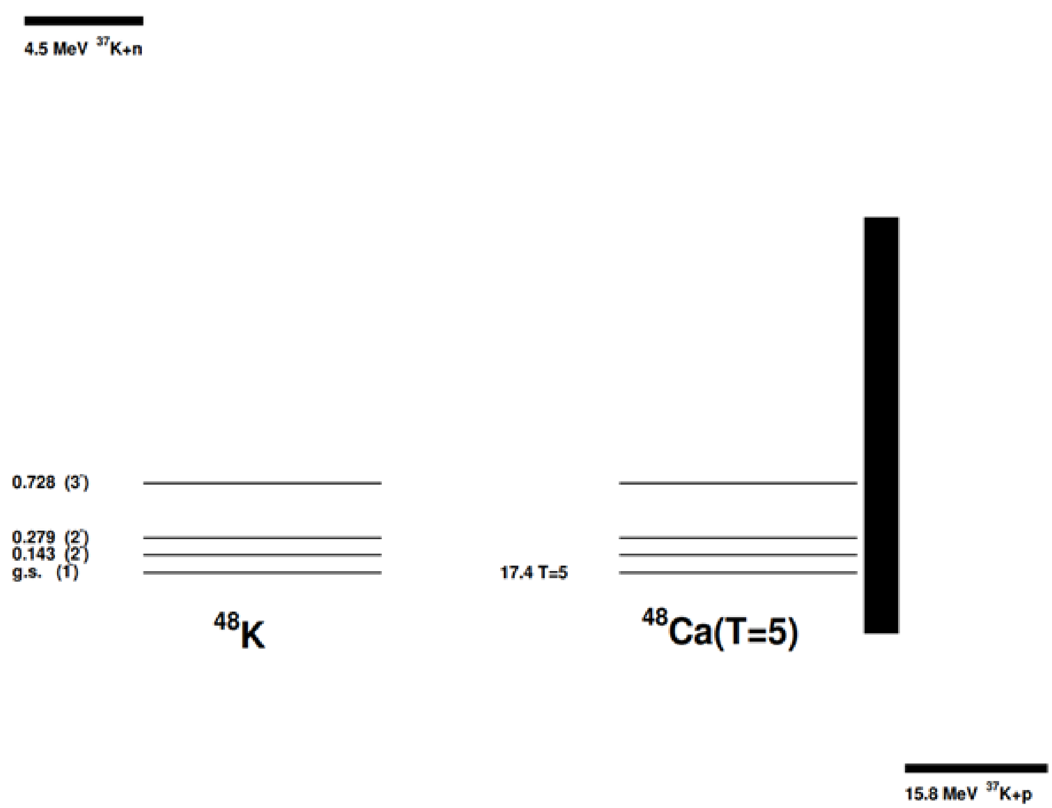

FIG. 1. Level scheme of ^{48}K from [4] and the corresponding (unknown) T=5 isobaric analog states in ^{48}Ca with relevant decay thresholds. Bold vertical line indicates the measured excitation energy range in this experiment.

This experiment was performed at NSCL using the ReA3 beam of ^{47}K at energy of 4.6 MeV/u with an intensity of 10^4 particles per second. The Array for Nuclear Astrophysics and Structure with Exotic Nuclei (ANASEN) [3], set in active target mode, was used for this experiment. Position sensitive silicon barrel and forward annular detector arrays were used along with a cylindrical proportional counter that was installed along the beam axis. Methane gas was used as the active gas volume for the proportional counter wires as well as the target. A 5μm scintillator read out by two PMTs was set up by the entrance of the chamber. There was another thick scintillator that was installed downstream of the beam in the middle of the annular forward detector array. These two scintillators were used in conjunction to allow us to measure the overall beam normalization as well as to identify any beam contaminants. The gas pressure was set to 95 Torr, allowing the beam ions to make it to the downstream scintillator.

The thick target inverse kinematics technique [4], combined with active target capabilities of ANASEN detector allows us to measure entire excitation function for ^{47}K+p without changing the energy of the incident beam. The recoil protons were detected by the silicon array, which provided the main trigger for the data acquisition system. These recoil protons were identified using their energy loss in the proportional counter cells (Fig. 2). The position of the hit in the silicon along with the position detected in

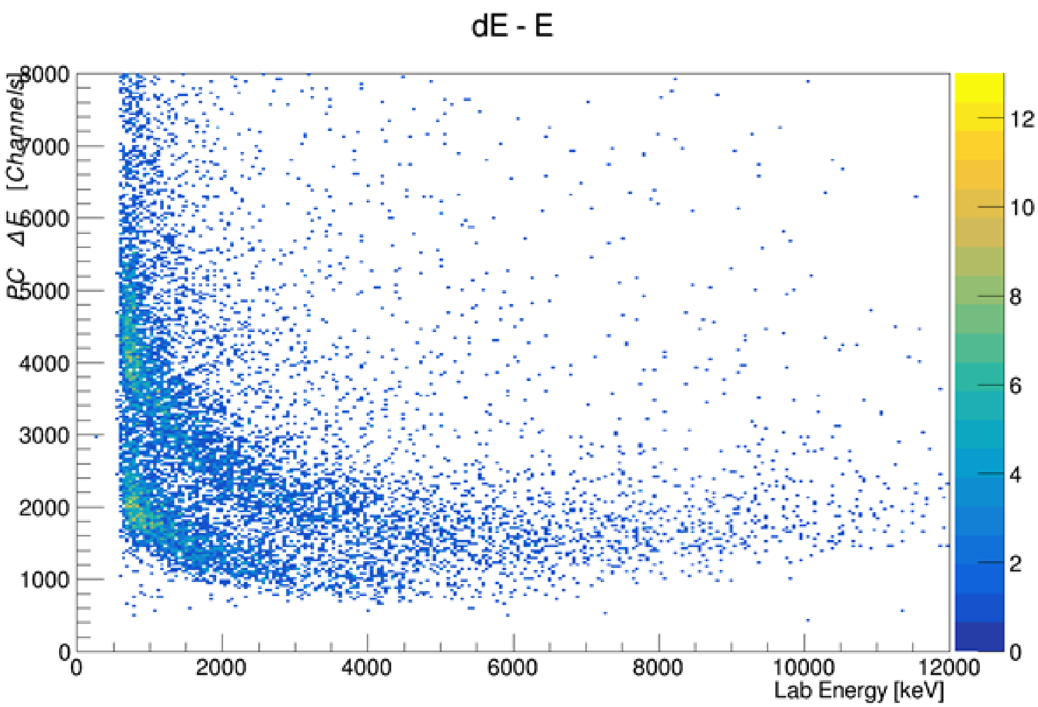

FIG. 2. dE-E plot to identify protons.

the proportional counter allows us to reconstruct the reaction vertex location for event identification (Fig. 3).

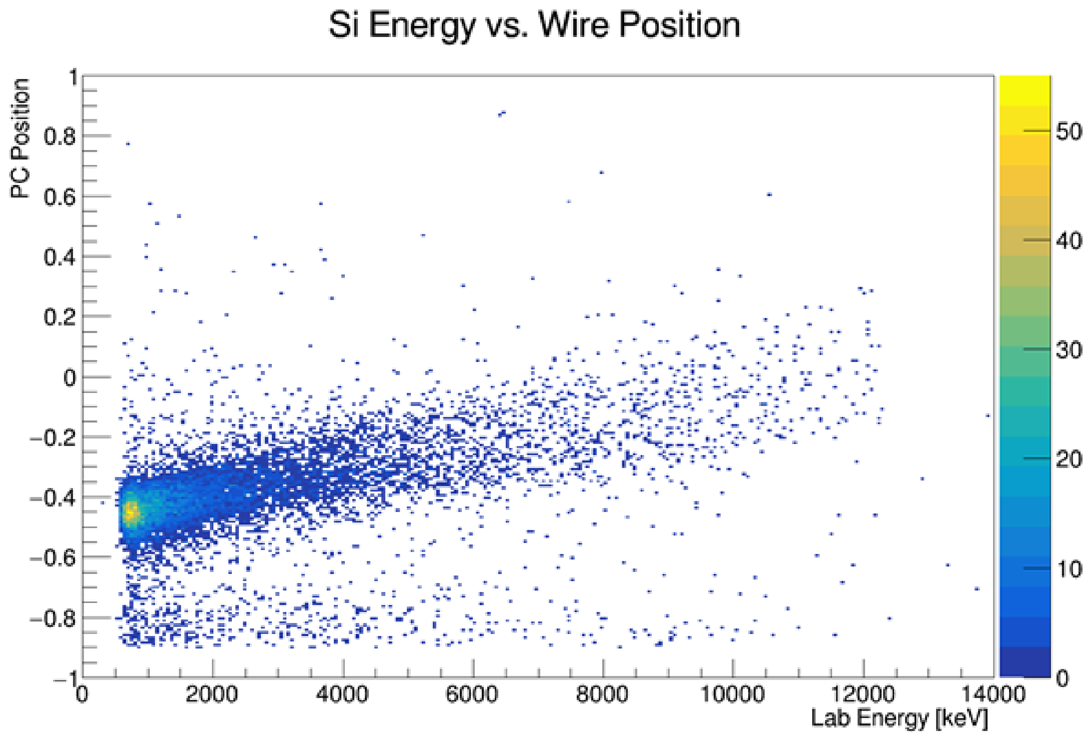

FIG. 3. Uncalibrated position in proportional counter wire.

The main goal of this experiment is to establish the level scheme of the low-lying negative parity T=5 states in ^{48}Ca. These states are expected to show up as relatively narrow resonances between the excitation energy range from 17 MeV to 22 MeV. Preliminary excitation function for ^{47}K+p is shown in Fig. 4 (about 10% of the data). There is an indication of narrow states, but the spectrum is dominated by

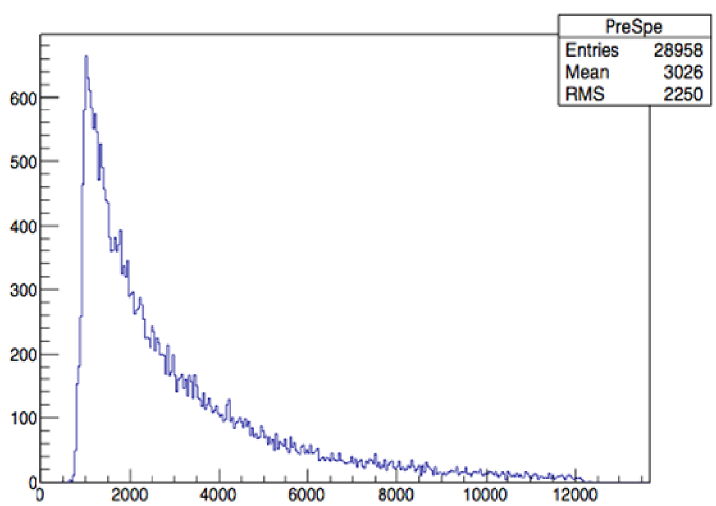

FIG. 4. Preliminary excitation function with about 10% of statistics. We see a peak of interest around 4 MeV.

Rutherford scattering, as expected. Further analysis is needed to confirm existence of the IAS states (with higher statistics) and to extract the excitation function for p+^{47}K elastic scattering. The excitation energies, spin-parities and proton decay widths will be determined using R-Matrix analysis.

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