Experimental studies of nucleon-nucleus optical model potentials with rare isotope beams

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A better understanding of nucleon-nucleus interactions is crucial for nuclear reaction studies. The optical model potential (OMP) approximates the many-body interaction between a nucleon and a nucleus and allows one to describe the nucleon-nucleus scattering processes relatively well. The purely phenomenological approaches at establishing the optical model potentials is now being replaced by microscopic calculations. In particular, effective field theory is employed in [2] to establish the optical model potentials and dispersion theory is applied in [1,3].

The OMP has been calculated and is well studied for a plethora of stable nuclei. Naturally, much less experimental data is available for nucleon-nucleus OMPs for radioactive isotopes. Benchmarking the performance of microscopically-motivated OMPs with new experimental data on elastic scattering of nucleons (protons) off of radioactive nuclei is of paramount importance. We plan to use the Texas Active Target (TexAT) detector to perform these measurements [4].

Prior to running experiments, we have to study the best configuration of TexAT, i.e., silicon detectors, cesium iodide scintillation detectors, field cage, micromegas, etc. To accomplish testing the silicon detector parameters a versatile detector chamber was designed and built. We used the data collected from this chamber to determine which silicon detectors had the best resolution.

The first TexAT OMP related experiment was ^{14}O(p,p). A preliminary particle identification plot is shown in Fig. 1. A simulation of this experiment was performed and the analysis of the simulated data is currently underway to ensure the proper understanding of the information that must be extracted from the data collected in the experiment. During the experiment, the incoming beam energy was approximately 10 MeV/u of ^{14}O produced using the Momentum Achromat Recoil Separator (MARS). The active target consisted of methane gas at 200 Torr. To achieve an increased gain from the small proton signal, the thin Gas Electron Multipliers (GEMs) with a thickness of 50 μm were used. The analysis of this first test run is in progress. It has clear, however, that higher statistics run will be required and better angular resolution than the one TexAT can provide is highly desirable. Future OMP related experiments will be performed using high resolution TeBAT active target under development [5].

After the successful completion of the ^{14}O+p project with TeBAT we will move on to study isotopes of Ca: ^{48}Ca and ^{50}Ca.

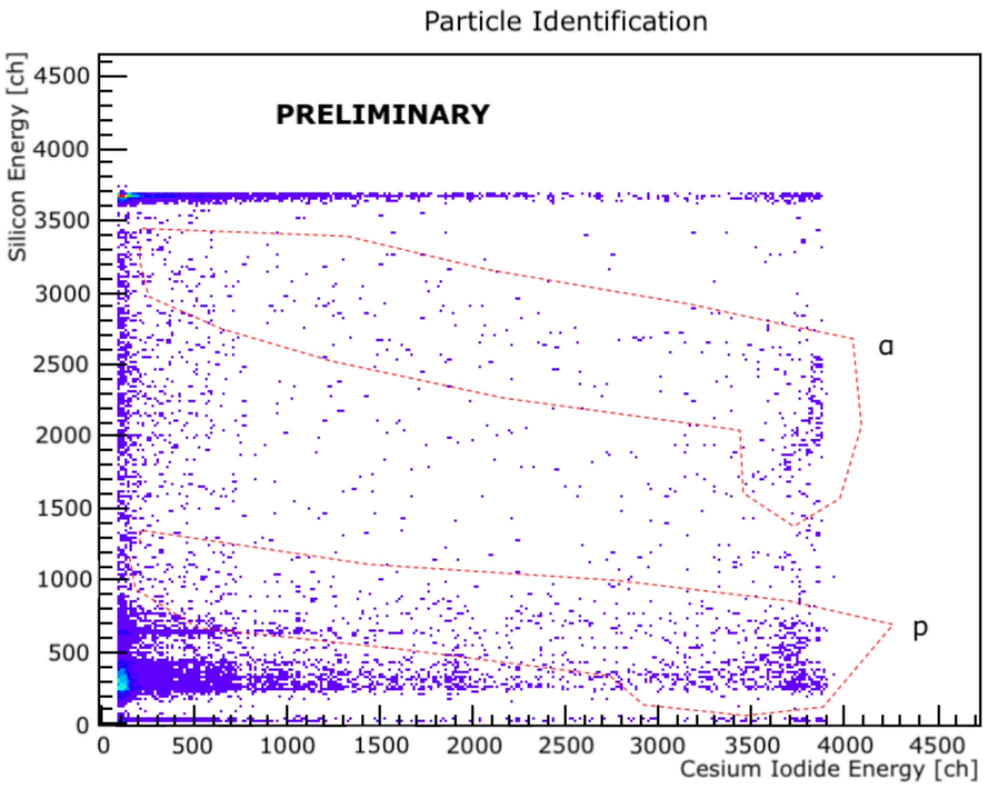

Fig. 1. Preliminary particle identification plot showing the energy deposited in the Si-CsI telescopes. There are two loci shown, representing alpha particles and protons. The shape of the loci is determined by signal saturation in CsI**.**

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