2 - 27 Research Progress in Group of RIB Physics in 2014

Sun Zhiyu, Zhang Xueheng, Yu Yuhong, Yue Ke, Wang Shitao,
Tang Shuwen, Chen Jinda and Fang Fang

The progress of research going on in Group of Rare Isotope Beam Physics (RIB), Experimental Physics Research Center, in 2014 is in the following three aspects.

1. Detector construction for the Dark Matter Particle Explorer (DAMPE) project. DAMPE is a large space telescope aimed at the evidence of dark matter existence through the measurements of their decay products. It is a part of the "Strategic Priority Research Program" of the Chinese Academy of Sciences for space science, and will be launched in 2015. In this project, the RIB group is involved in the design and construction of the plastic scintillator detector array (PSD), which is a key component of the load with an active area of 0.8 m × 0.8 m. Within 2014, we finished design and construction work for the Engineering and Qualification Model (EQM) of the DAMPE, which is a replica of the final flight model and will be used to check the design and performance. The EQM of PSD passed successfully all the tests for space environmental adaptation, such as vibration, large range temperature change, EMC and so on. And all the performance required are satisfied by a long-term test in our specific large testing system and used the cosmic ray to simulate the MIPs particles. Then, the EQM of PSD has been shipped to Shanghai for the fully system testing and to CERN for beam test by using electron and proton beams with different energy, as shown in Fig. 1. All the results in those tests are consistent with our previous results, which approved our design and the quality control work in the construction. The construction work for the final flight model has started also in later 2014.

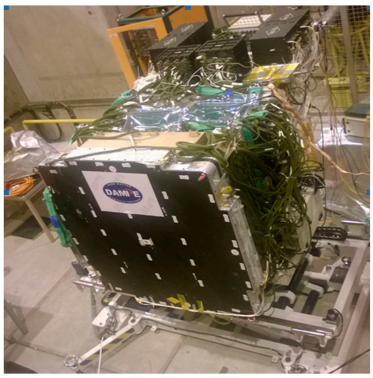

Fig. 1 (color online) Accumulative adsorption capacity of uranium from brine.

2. Study on the knockout reactions at around 300 AMeV in RIBLL2. Knockout reactions at intermediate and high energies have been proved to be a powerful and successful tool for probing the single-particle structure of rare isotopes. However, the mechanisms in the knockout of strongly bound nucleons are still not well understood. Recently, study shows that the experimental cross sections are much smaller than reaction theory predictions in this case, and some calculations suggest that nucleon evaporation from the one-nucleon removal residues plays a major role in the reduction of cross sections. We studied the knockout reactions from ^{14}O at around 300 MeV/n at the Heavy Ion Research Facility in Lanzhou. This work has been done at the CSR External Target Facility. A primary ^{16}O beam of 360 AMeV from the CSRm impinged on a Be production target and the secondary cocktail beams were separated and identified by using the fragment separator RIBLL2. The reaction residues were measured by a combination of dipole magnet, MWPCs and TOF detectors, and the extracted cross section of ^{12}N was 30(6) mb on a C target. Such a large cross section is expected to receive a contribution from an indirect process, namely, one-neutron knockout followed by proton emission. If this was the case, the missing one-neutron knockout strength from ^{14}O could be found in the unbound ^{13}O, and the eikonal reaction model then might be not valid for the cases of knockout of strongly bound valence nucleons.

3. Facility development. In order to push forward our study with RIBs, many detector development works, especially some front-end electronic modules, have been done in 2014. For example, we finished the test works for the prototypes for the neutron wall, TOF wall and MWDC detectors, and the mass production of those modules have also been finished. We also designed and built the new data acquisition system for the ETF, and started the system integration and test works. With all those new modules and software coming into service, we'll expect a large boost in the ability and performance of the CSR-ETF.