01-222N(B) -- HIGH ACCURACY ENERGY CALIBRATIONS FOR RIBS

Principal Investigators: P. Ostroumov, Physics
R. C. Pardo, Physics
K.W. Shepard, Physics

Funding Profile:

FY 1999	-0-
FY 2000	-0-
FY 2001	$139K
FY 2002	-0-
FY 2003	-0-

Purpose: Since the early 1990's in the field of low energy nuclear science there has been worldwide interest in an advanced facility capable of producing energetic, high-quality beams of radionuclides. The purpose of this LDRD project is to develop design concepts for the major components of the Rare Isotope Accelerator (RIA). This project aims to develop techniques to monitor the energy of low intensity radioactive beams which is a critical issue for experiments observing narrow resonances on what is often very thin gaseous targets. It is also in general important for high-precision experiments.

Approach: The precise determination of the energy of weak beams is a significant problem both because of the weak signal and the high absolute accuracy often required by the experimentalists. We have undertaken a study of the limitations of a beam pick-up technique that has been used before at ATLAS to determine if it can fulfill the requirements set forth for RIA.

Technical Progress and Results: The present ATLAS facility relies on a resonant beam-pickup time-of-flight system for beam energy measurements. This system provides a continuous, nondestructive energy determination that is accurate to a few part in 10^4 for relative measurements and also provides absolute energy determination to at least 1 part in 10^3. It is useful to beam currents down to approximately 2-3 electrical nanoamperes.

This year studies of system noise and phase drifts were made in an effort to improve both the sensitivity of the system to even lower beam currents and to improve the energy resolution. A number of areas for improvements were identified which we believe should allow the system to be useful with beam currents into the picoampere regime. Changes in cabling, an improved reference oscillator, and more phase stable RF detection circuitry have been initiated. With these changes we hope to demonstrate a 'few picoampere' beam current sensitivity and improved beam resolution for higher current beams. Demonstrating a picoampere level of sensitivity will already be a useful range for many RIA beams.

It was also realized that using this technique with superconducting resonators instead of normal conducting ones would significantly increase the Q of the pickup circuits and hence the signal that can be obtained from weak beams. This was investigated at

ATLAS, and it was found that cavities not being used in the acceleration process could be used to pickup signal from the beam. This has important applications in particular for the tuning of the driver accelerator at RIA where the tuning could now be done by locking a cavity and then looking at the signal induced in the next cavities to determine the energy of the beam. This would represent a great simplification over the tuning procedure that had been envisaged so far which involved having to transport the beam through all the cavities not yet operating to bring the beam to a solid state detector at the end of the linac where the energy could be measured and then repeat the procedure after each cavity.

The limits of sensitivity with the superconducting cavities will also be further investigated once the improved electronics are installed. It is expected that a further factor of 100 gain in sensitivity is possible.

Specific Accomplishments: The R&D work is still progressing. It is expected that it will be published in appropriate technical journals once completed.