E823 Safety Report: for Beamtime Schedule 109

E823: Superallowed Fermi Beta Decays

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Description

This experiment will use ISAC separated beams delivered to the 8pi spectrometer which has been reconfigured to optimize its performance for a vigorous program of decay studies with the non-accelerated radioactive beams available in the low-energy area of ISAC. In its new configuration the 8© spectrometer is comprised of two sub-systems. The first is a close packed array of 20 High Purity Germanium (HPGe) detectors used to measure very precisely the energy of one or more gamma-rays emitted by the decaying nucleus. Gamma rays that do not deposit all their energy in a HPGe detector are eliminated by surrounding Bismuth Germanate (BGO) detector shields (Compton-suppression shields). The second subsystem is an inner array of 20 plastic scintillator detectors that is used to detect the beta (i.e. an electron) particles (SCEPTAR).

The vacuum chamber for SCEPTAR is a machined black delrin shell divided into two hemispheres, each containing half of the SCEPTAR array.. The upstream half of SCEPTAR is connected directly to the last box on the 8pi LEBT. A valve located on the upstream side of this box isolates the experimental chamber from the main LEBT system. The low-energy radioactive beams from ISAC are implanted onto a moving tape collector at the center of the 8© spectrometer. The tape is feed from a large aluminum storage chamber connected to the vacuum chamber containing the downstream half of the SCEPTAR array The tape collector box is pumped by a separate 300 l/s turbo pump. The entire assembly is mounted on a moving carriage to provide easy access. The pumping system for SCEPTAR also includes the 1000 l/s turbo pump located in the last LEBT box on the 8pi beamline. It is interfaced to the ISAC control computer system and standard interlock procedures have been followed.

The full SCEPTAR array and the moving tape collector were commissioned in the summer of 2003 and since then they have been used in several experiments, most recently in a measurement of the branching ratio for the superallowed emitter ^{62}Ga in Dec., 2005. For the present experiment, which is a measurement of the non-analog Fermi decay of ^{38m}K to the excited 0^+ level at 3.377 MeV in ^{38}Ar the experimental setup is identical. Since the half-life of ^{38m}K and the only known isobaric contaminant ^{38}K are relatively short lived, the experiment should not pose any radiation hazard.

Definition of Hazards

1) Radiation and Activity: The experiment uses the low energy ion beams from ISAC which have insufficient energy to penetrate the beamline vacuum enclosure. The isotope species are expected to be highly pure samples of relatively short-lived activities (usually less than a few seconds) with no long-lived daughters. Therefore, the expected level of residual activity which will accumulate on the moving tape should be negligible. The ~ 450 ft continuous loop of 0.5 inch wide computer tape is stored in a large Al box located at the back of the 8pi array. Access to the tape box is provided by a large hinged door. As a result, should long-lived activity build up on the tape it can be easily removed and put in the radioactive waste. Activity levels during the collection and counting periods will vary but will never exceed approximately 10^7/s. Calibration sources will be used during setup and running. It will be necessary to open the SCEPTAR vacuum chamber during the course of a run. In this case, standard ISAC procedures will be followed and a permit will be obtained from operations.

2) Electrical, vacuum and other industrial hazards: The 8pi spectrometer and SCEPTAR have been installed and connected to meet acceptable industrial and engineering standards. The computer controlled liquid nitrogen filling system which has been operational since July 2001 has a flexible stainless steel line to connect the self pressurizing 200 liter dewar to the main inlet solenoid.