MOVING TAPE COLLECTOR

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The combination of a moving tape collector (MTC) and a recoil mass spectrometer (RMS) constitutes a fast mass separator for the spectroscopy of short-lived radioisotopes with half-lives $>$100ms. We have designed and constructed an MTC for radioactive decay spectroscopy at the focal plane of the HRIBF RMS. This device forms the heart of many possible spectroscopic systems assembled at the RMS focal plane for radioactive decay spectroscopy. The possibilities include an array of up to 5 Ge clover photon detectors (with or without shields), an internal-pair/internal-conversion spectrometer (IP/IC), low-energy photon detectors, DSSD detectors, or Si and plastic β detectors. The objective underlying our development of this device and associated spectroscopic systems is to increase both the sensitivity and the selectivity to such a degree that we will be able to perform statistically significant spectroscopic measurements at the very limits of nuclear stability, particularly when radioactive ion beams (RIBs) are utilized.

The MTC is a unique system in that it has no reels, -uses a continuous tape, -only a small fraction of the tape is under tension, -there is little ”threading” of tape, -it is extremely versatile, and it is fast. The outer dimensions of the MTC are 15” $\times$ 24” $\times$ 5”. At the heart of the system is a canister which contains a continuous loop of up to 300 feet of 1.3 inch (35mm) polyester tape. The tape inside the canister is not under tension, while the tape outside is under constant tension. The direction the tape moves can be reversed by a simple computer command. The 0.0045 inch thick aluminized tape can be move at speeds up to 10 feet per second. Since only a small amount of tape is under tension, there is little inertia to inhibit rapid “starts” and “stops”. Spring-loaded “shock-absorbers” are incorporated into the drive systems inside the vacuum to prevent damage to the tape due to the rapid starts and stops. This arrangement makes the system versatile in that all tension can be removed simply by moving the stepping motor away from the drive gears (all external to the vacuum system). Then, after the tape has been connected to the user’s “custom designed” detector station, the tension is re-established and the gears engaged. The system is quite “forgiving” in that one can perform this procedure without even removing the cover - just by the “feel” of one’s hand.

The MTC drive unit contains a standard stepping motor. The motor is controlled by an electronic drive unit which is itself controlled by a notebook computer. The system consists of four components: A PC interface, a controller, a translator/driver, and a stepping motor. With windows based software, the control program is generated and edited on the PC and downloaded to the motor controller. The controller has the capability to run open or closed loop and has programmable speed and ramping.

The vacuum “piping” to the RMS and to the detectors is made entirely out of NW 50 Klamp-Flange stainless steel or aluminum pipe and flanges. That pipe has an I.D. of 1.88 inches, and the design is such that different configurations can be readily assembled to meet the varied requirements at both the RMS and at the detector station. Experimenter designed modules at each of these positions can then be easily connected. During an experiment, the tape is periodically moved a fixed distance (user controlled - any time interval and any distance) in order to carry the deposited radioactivity to the detectors. A set of PIN diodes in the front of the “turn-around” device just behind the position sensitive avalanche counter (PSAC) enables one to know exactly what mass is being deposited on the tape by gating the PSAC signals with the PIN diode signals. The “turn-around” device can also be moved back to the point of deposit so that the activity accumulating there can be counted continuously. The tape is then moved periodically to “take-away” the daughter and granddaughter activities in order to provide a new “clean” point of deposit.

References

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