Current status of the TAMUTRAP measurement Penning trap

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The Texas A&M University Penning Trap Facility (TAMUTRAP) is a new ion trap facility dedicated to the study of fundamental interactions and symmetries and providing a low-energy radioactive ion beam (RIB) for various other applications. Over the past year, the geometry for the large, open-access Penning trap has been finalized and shown to be theoretically competitive with traps employed in other prominent facilities.

The initial experimental program for TAMUTRAP will be centered on measuring the beta-neutrino correlation parameter, $a_{\beta\nu}$, in $T = 2, 0^+ \rightarrow 0^+$ superallowed beta-delayed proton decays. In these experiments, $a_{\beta\nu}$ will be determined by observation of the proton energy distribution, which imposes three primary constraints on the design geometry of the apparatus: (i) the trap must provide a cold, spatially localized source of ions; (ii) the geometry must allow for the full containment of the primary decay products of interest; (iii) provision should be made for position sensitive detectors held at arbitrary voltage to be placed at the ends of the trap in order to detect decay products. In addition, the trap geometry should generate an electric field that is harmonic in shape to allow for the possibility of performing precision mass measurements, and the electrodes must be able to be machined, assembled, and must fit within the 210 mm diameter bore of the existing 7T solenoidal magnet.

In work recently published in *Nuclear Instruments and Methods in Physics Research Section A* [1], the final geometry of the TAMUTRAP measurement Penning trap was determined, taking into account the aforementioned design constraints. The resulting structure is a novel, cylindrical Penning trap with a new length/radius ratio different from all existing Penning traps, and an unprecedented 90 mm inner electrode radius (see Fig. 1). The analytic solutions to the electric field were checked against simulation, and match to high precision. These values, which are comparable to those presented by

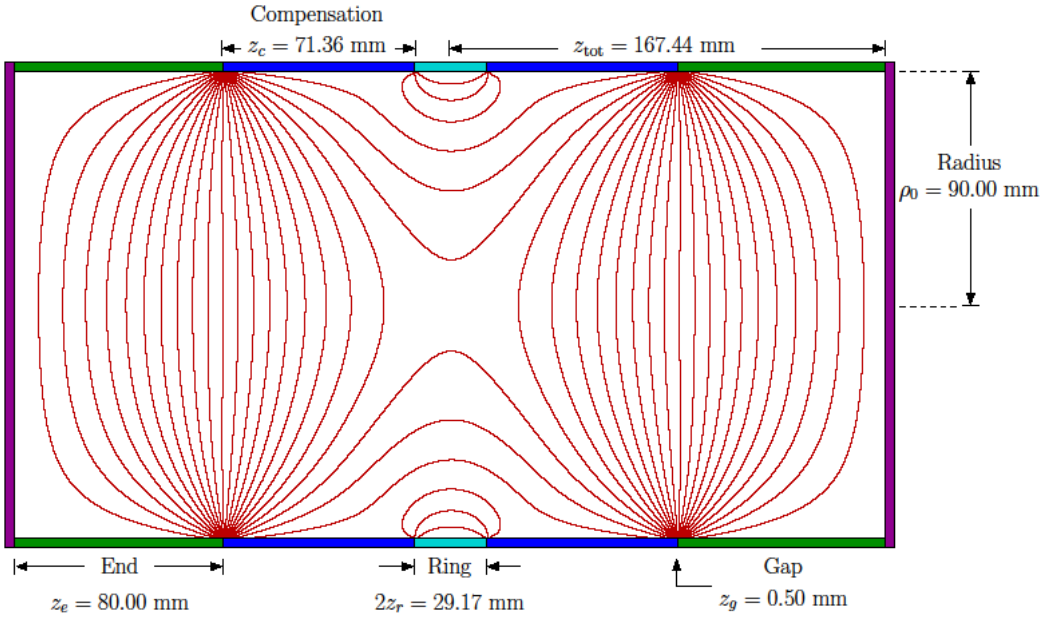

FIG. 1. The optimized trap geometry with calculated electric field lines overlaid.

existing mass measurement facilities, suggest that TAMUTRAP should be capable of performing mass measurements in addition to its primary program.

In the upcoming year, work on the TAMUTRAP Penning trap system will be centered on the development of the mechanical design of the trap structure itself and further work on the beam line leading up to it. Progress on the mechanical design will include investigation into the position-sensitive silicon detectors to be placed at the ends of the trap, development of mounting schemes for trap electrodes, and research of materials and machining processes to be involved in fabrication. It is expected that significant progress toward these milestones will be made in the upcoming year.

[1] M. Mehlman *et al.*, Nucl. Instrum. Methods Phys. Res. **A712**, 9 (2013).