SAMURAI TPC: Conceptual design of a time projection chamber

A. B. McIntosh, J. Barney, J. Dunn, J. Gilbert, T. Isobe, K. Klein,
M. Famiano, F. Lu, W. G. Lynch, N. W. Maass, T. Murakami,
R. Olsen, A. Taketani, M. B. Tsang, and S. J. Yennello

A conceptual design for a new time projection chamber, the SAMURAI TPC, has been developed. The utility of the device and some specifications have been previously described [1]. Design considerations, sketches and detailed 3D mechanical drawings are posted and archived online [2]. The conceptual design was produced using Autodesk Inventor 2011.

An exploded view of the SAMURAI TPC conceptual design is shown in Figure 1. The TPC is largely based on the original "EOS" (equation-of-state) TPC [3]. The TPC will consist of a main volume of detection gas (P10) at one atmosphere enclosed in a field cage 144.4cm long, 96.4cm wide and 53.3cm

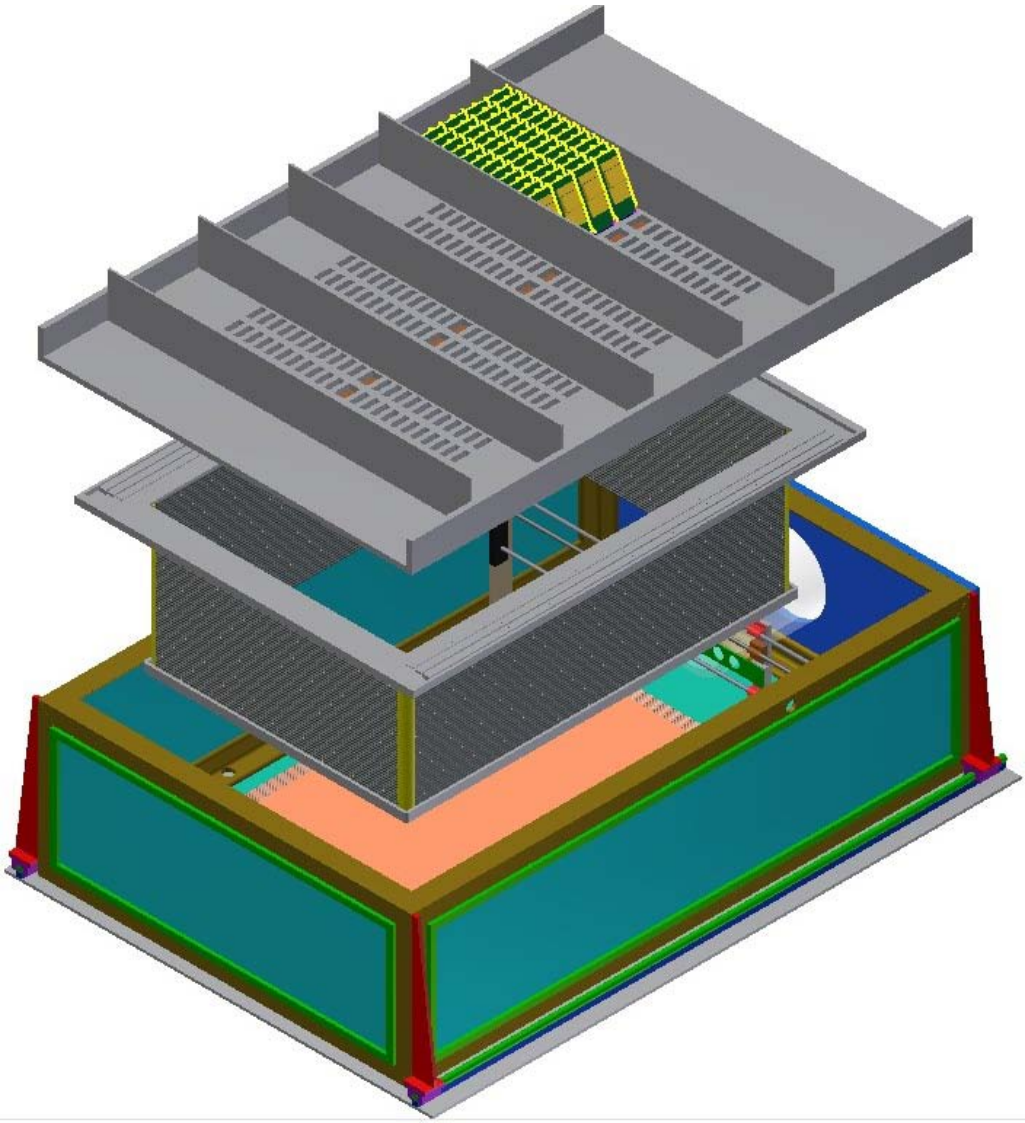

FIG. 1. Exploded view of the SAMURAI TPC conceptual design.

high. A uniform electric field of ~375V/cm will be maintained with 1cm wide copper strips on the field cage held at the appropriate potentials. Electrons liberated by the passage of energetic charged particles through the gas will drift past a gating wire grid and Frisch wire grid; amplification will occur at a third plane of wires. The signal will be measured on a pad plane with dimensions of 134.4cm x 86.4cm; each of the 12096 pads will be 1.2cm x 0.8cm in size. The liquid-cooled electronics to read out and digitize the signals from the pads will be located directly above the pad plane. The field cage will be surrounded by inert gas (N_2) at zero differential pressure. A motorized target-ladder mechanism will be located immediately upstream of the field cage. The walls of the TPC will be made as thin as possible to allow downstream measurement of neutrons and very energetic charged particles. For calibration purposes, a laser and beam-splitting system will be included. Light charged particles and charged pions will be measured and identified via energy-energy loss and magnetic rigidity in a magnetic field of approximately one Tesla. The spatial resolution of the TPC will be sufficient to simultaneously resolve up to 200 particle tracks.

The conceptual design was completed on schedule by May 15, 2011. The conceptual design underwent a thorough review, and the minor revisions necessary are nearly complete. A full detailed design is expected to be complete by August 15, 2011. Construction of the TPC will commence at the TAMU Cyclotron Institute soon after. Development of some of the sensitive detector components will be conducted at Michigan State University.

Following its completion and testing, the SAMURAI TPC will be installed in the SAMURAI magnet at the RIKEN laboratory in Wako Japan. There it will be used for experiments to constrain the density dependence of the asymmetry energy in the nuclear equation of state at supra-saturation density through measurements of pion production and through flow of light particles.

[1] http://rarfaxp.riken.go.jp/RIBF-TAC05/10_SAMURAI.pdf
[2] http://groups.nscl.msu.edu/hira/sep/sepwiki/doku.php/start
[3] H. Wieman *et al.*, Nucl. Phys. **A525**, 617c (1991).