Development of AstroBox2 detector

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In past years we have done several studies of beta-delayed proton emitters of astrophysical interest by implantation technique [1-5]. It was realized rather soon that shrinking the physical detection volume of elements in Si detector did not reduce the beta-background enough to create background free spectrum in the typical energy range of astrophysically interesting decays
(E_p ~ few hundred keV). To further reduce the beta-background a novel detector, AstroBox, based on Micro Pattern Gas Amplifier Detector (MPGAD) was developed [6].

We are now building an upgraded version, AstroBox2. The major change to the earlier version will be the change of geometry of the MPGAD pad structure. The earlier cylindrical symmetry of the pads has been replaced by a set of rectangular pads that are arranged into a geometry along the beam axis to improve implantation control. The geometry of the pads is demonstrated in Fig. 1 showing a sample of the PCB onto which the detectors will be mounted. Total amount of active elements is 29. The readout electronics will be changed to accommodate the requirements of higher number of channels. We are planning to use mesytec MPR-16 preamplifiers coupled to MSCF-16 shapers which include also timing filter amplifiers and constant fraction discriminators for timing.

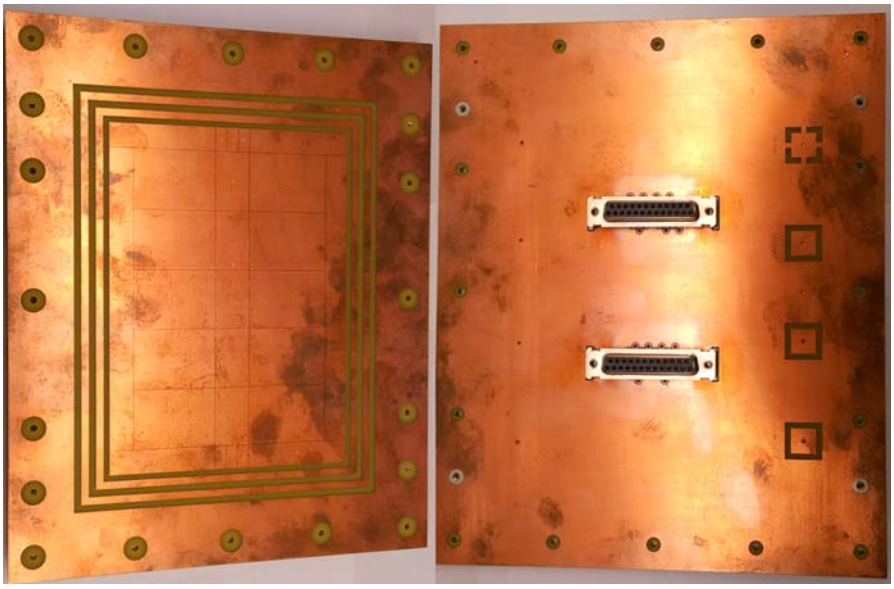

FIG. 1. A sample PCB of AstroBox2 detector. On left is the top side onto which the active elements are housed. On right is the bottom side which will face the vacuum chamber flange. The dSUB25 connectors for the signals and the high-voltage connections (the four squares) will be in air, eliminating the need for feed-throughs and cabling inside the gas volume.

The detector will be housed in a vacuum chamber illustrated in Fig. 2. The detector PCB will be mounted directly into one of the flanges, eliminating signal cabling from the gas volume. Furthermore the

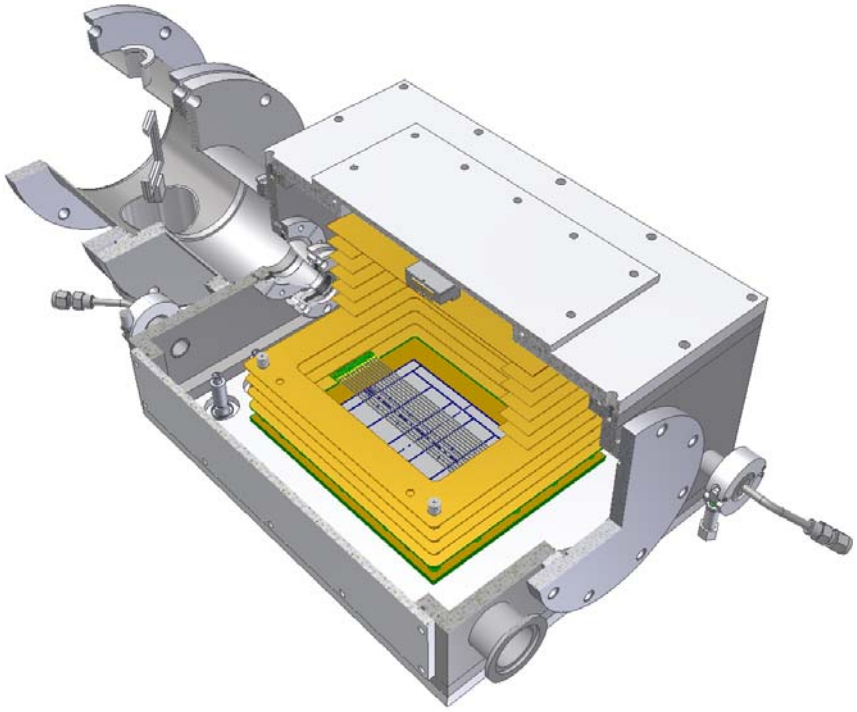

FIG. 2. Mechanical design of the AstroBox2 detector. The chamber is connected to the existing degrader chamber.

gas inlet and outlet are moved to opposite sides of the chamber to ensure more efficient circulation of the gas. For checking the detector functionality in online conditions, a holder and covering system for an alpha source is on top of the cathode. The window separating beam line vacuum and detection gas volume can be mounted either into the chamber wall or brought closer to the field cage. This will reduce straggling when stopping low energy (~10 MeV/u) beams. The side flanges are made thinner to improve gamma detection efficiency. Optionally these can be changed to dedicated flanges with cups that bring Ge detectors even closer (though the minimum distance will still be limited due to the safety gap between the field cage and the chamber wall).

The detector components are currently under construction and the detector will be assembled and tested during the summer and fall of 2014.

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