less steel,with a bar width of 0.182 mm and 2.0 mm × 2.0 mm square holes, insuring good optical transmission. The cathode, at the bottom of the PTFE cylinder, and the gate grid define the TPC 15 cm drift distance. Field shaping rings, made of 0.5 mm thick copper and spaced by 0.76 cm, are mounted outside the PTFE cylinder to insure a uniform electric field across the drift volume.

A 5 mm gap separates the gate grid from the anode and the anode from the top grid. The liquid level is between anode and gate grid and determines the extraction field. The liquid level, 2.5 mm above the gate grid, is kept constant by the use of a pressurized cylinder closed on the top, similar to a diving bell. The pressure is provided by the return of the gas circulating through the purifier (see Section II E). Custom-made capacitors are used to monitor the liquid level: one cylindrical capacitor is used to measure the liquid level and four parallel-plate capacitors are used to measure the inclination of the detector, to ensure that the liquid level is parallel to the grids and thus that the extraction field is uniform. One of the parallel-plate capacitors is filled with PTFE and is used as a reference capacitor: the capacitances of other parallel-plate capacitors are compared with the reference value to control the inclination of the detector. The XENON10 cryostat was equipped with leveling feet which could be adjusted from outside the shield structure to achieve the required degree of leveling.

To minimize passive LXe outside the TPC, the PTFE cylinder is surrounded by an outer PTFE cylinder, with cut-outs for the resistors of the voltage divider network, directly mounted on the field shaping wires. A photo of the assembled TPC structure, with the top three meshes clearly visible, is shown in Figure 5. For most of the data acquired with XENON10, the top and gate grids were biased to -1.15 kV, with the anode and cathode at +3.5 kV and -13 kV, respectively. With these voltages, the drift field in the liquid was 0.73 kV/cm while the field in the gas was 12 kV/cm. The high voltage for the gate, anode, and top meshes was provided by CAEN 1733 and 1833 power supplies [29], while the higher voltage for the cathode was provided by a Heinzinger power supply [30]. Commercial HV feedthroughs and cables carried these voltages to the cryostat. To carry the high voltages from the vacuum of the cryostat to the cathode mesh, a custom-made PTFE insulated feedthrough was used. Inside the TPC structure and below the LXe level, bare wires were used to carry the HV to the upper meshes, taking advantage of the excellent dielectric properties of LXe and of PTFE.

Results from electric fields simulations for the XENON10 TPC are shown in Fig. 6, for a drift field of 1 kV/cm. The field is uniform up to 3 mm from the PTFE wall. For the dark matter search results, only events with at least 10 mm distance from the edge of the active volume were accepted. Gamma-ray calibration data confirmed that no charge was lost for events in this region. On the bottom of the detector, a region of reversed field direction exists between the cathode and the bottom PMT array, separated by a distance of 1.2 cm. The field reversal extends slightly into the sensitive volume, affecting a region less than 0.9 mm above the cathode.

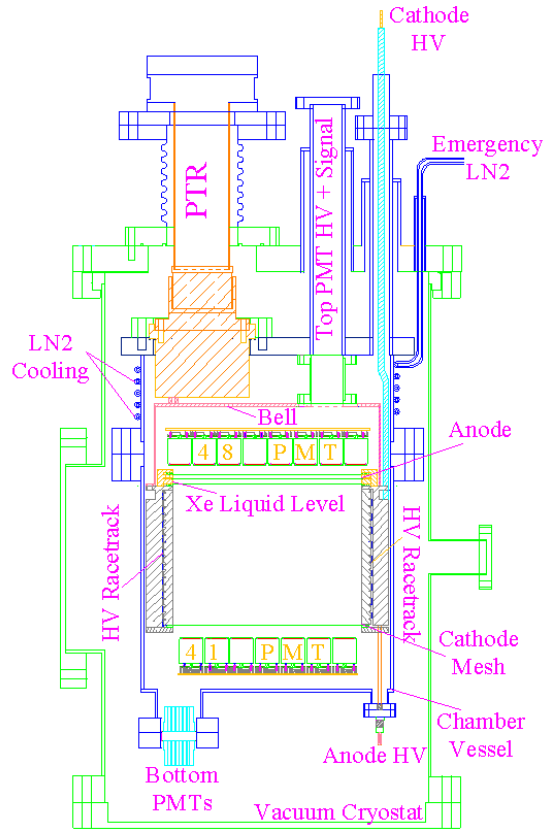

FIG. 2: (Color online) Schematic drawing of the XENON10 detector.

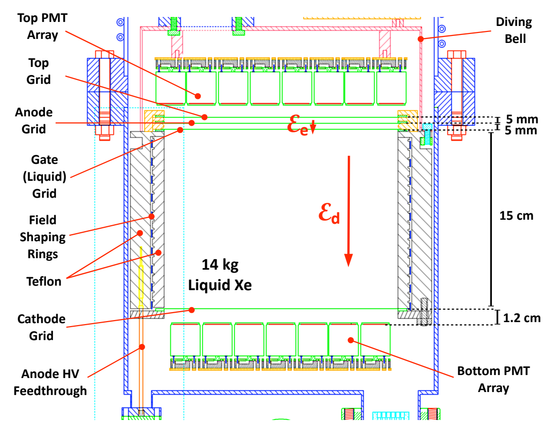

FIG. 3: (Color online) A close-up view of the XENON10 TPC structure.

The same set of field simulations was used to establish that the displacement of the true XY event position