Development of NEW, towards the first physics results of NEXT

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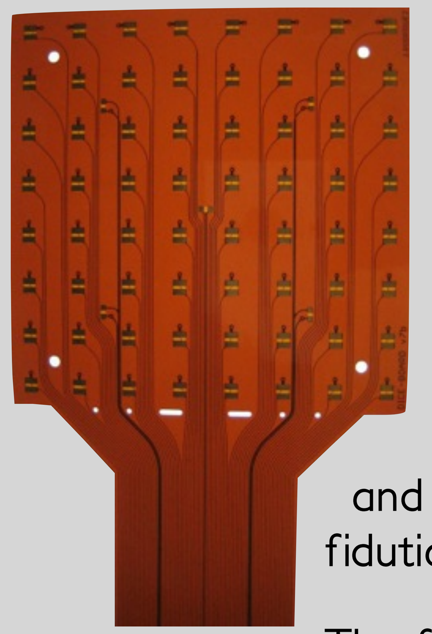
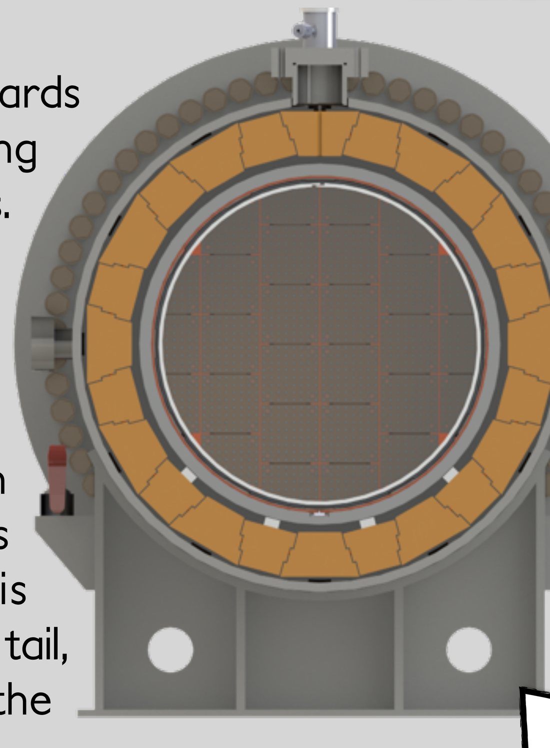
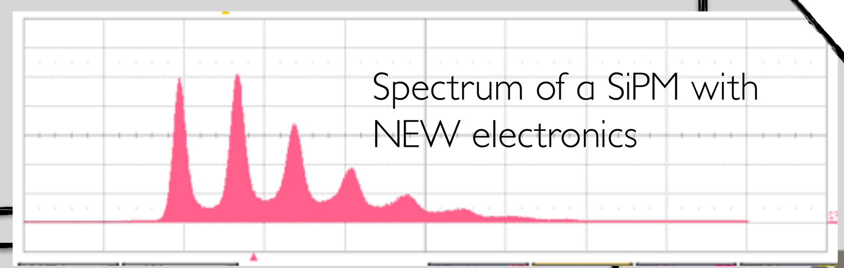
Tracking Plane

The NEW tracking plane is made of 28 Kapton DICE Boards (KDB). The KDBs over-cover the fiducial region ensuring that there are no dead regions. The measured radioactivity budget (only upper limits) indicates that kapton is a cleaner material than other alternatives. The SiPMs can be soldered in an oven and the circuit comes with its own pigtail. The connector is located at the end of the long tail, and is screened from the gas, in the fidutial volume, by a thick copper shield.



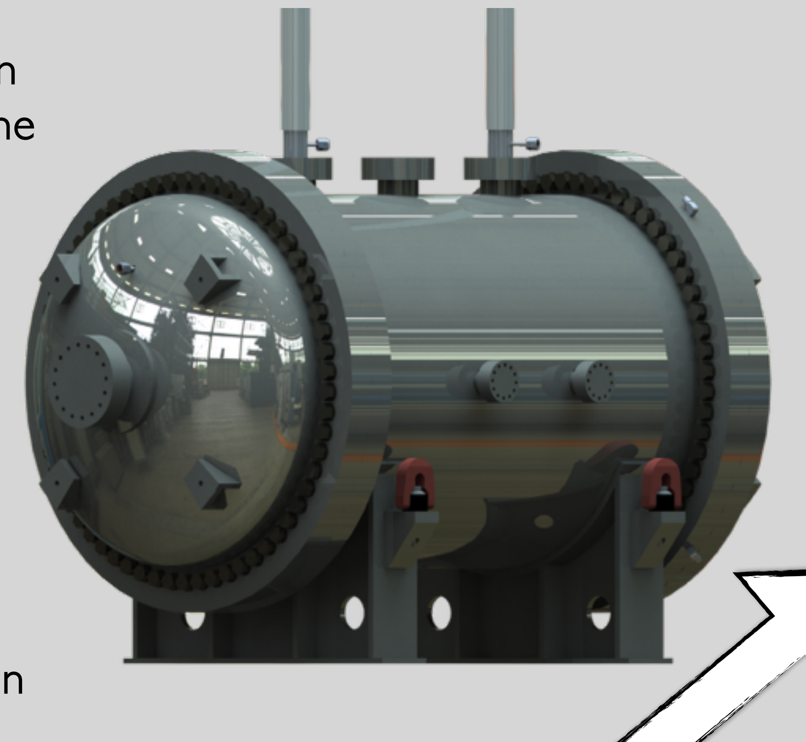


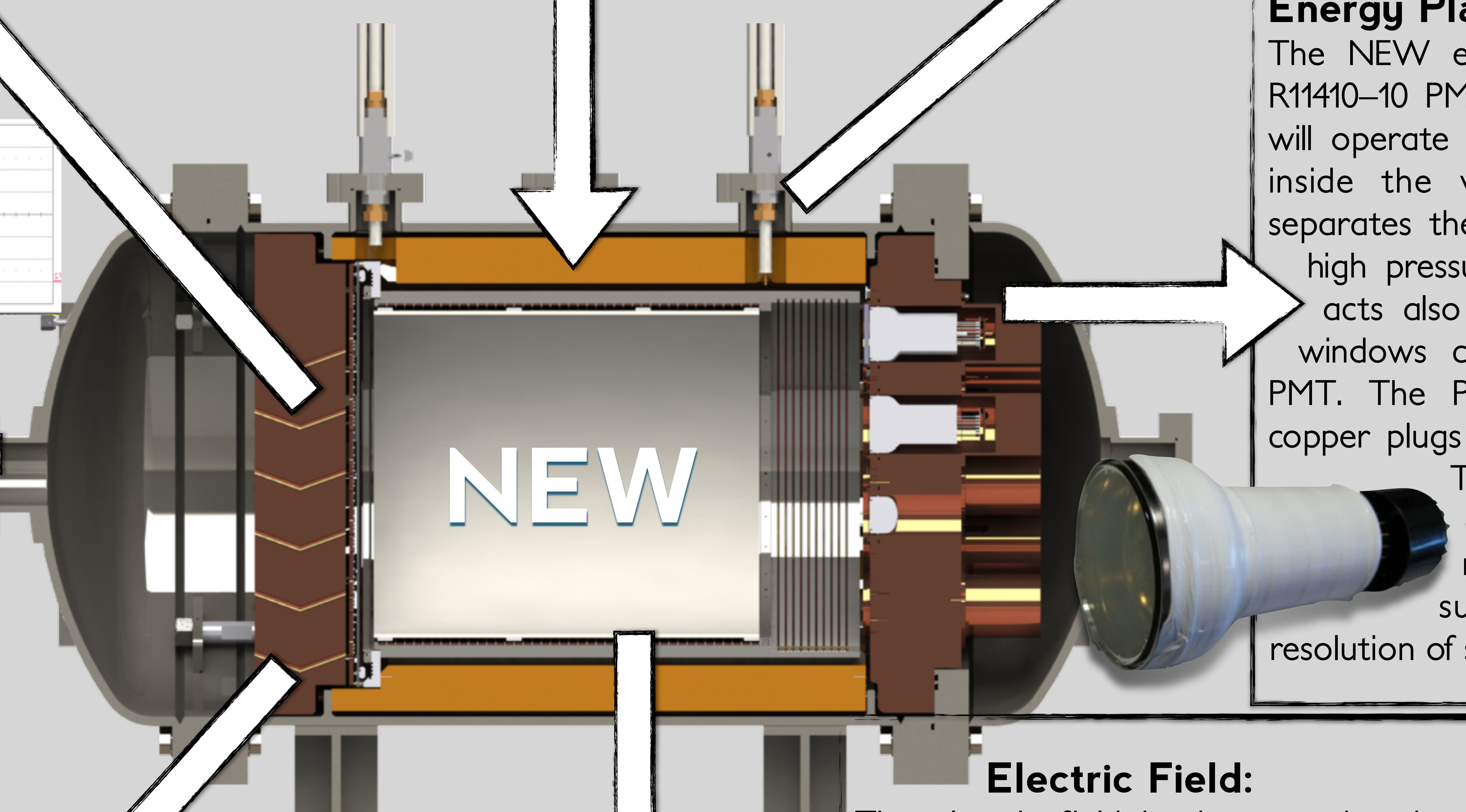
The final version of the DICE boards operates with a differential signal output that permits a better reduction of the noise during signal acquisition. Such design has been tested in a realistic set-up with 4 meter long cables, an operative DICE board and a front-end and it has proven to be able to separate single photoelectrons. That will allow for a direct calibration of the SiPMs.



NEW Detector

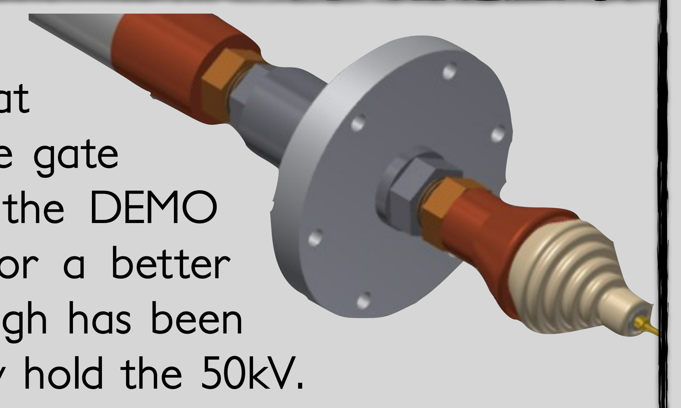
The primary goal of NEW is to provide an intermediate step in the construction of the NEXT-100 detector that would allow the validation of the technological solutions proposed for NEXT. NEW would permit a measurement of the energy resolution at high energy, and the characterisation of the 2-electron topological signature, by measuring the $\beta\beta2\nu$ mode. Finally, NEW will permit a realistic assessment of the NEXT background model before the construction of the NEXT-100 detector.

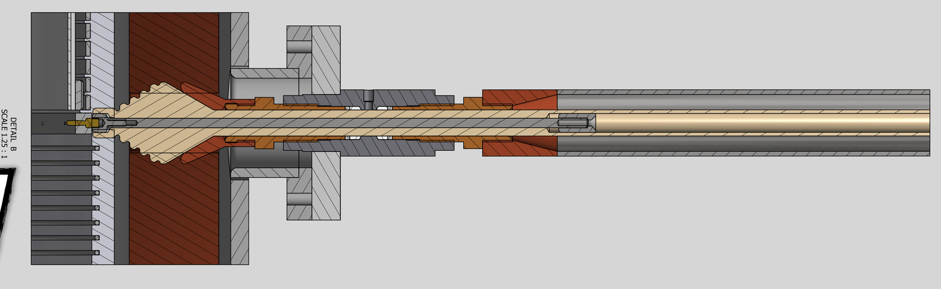




HHV Feedthroughs

NEW HHV feedthroughs need to operate at 50kV on the cathode and 20kV on the gate. The gate feedthrough is very similar to the one used in the DEMO detector, only small modifications are needed for a better connexion with the gate. The cathode feedthrough has been completely redesigned to ensure that it can easily hold the 50kV.

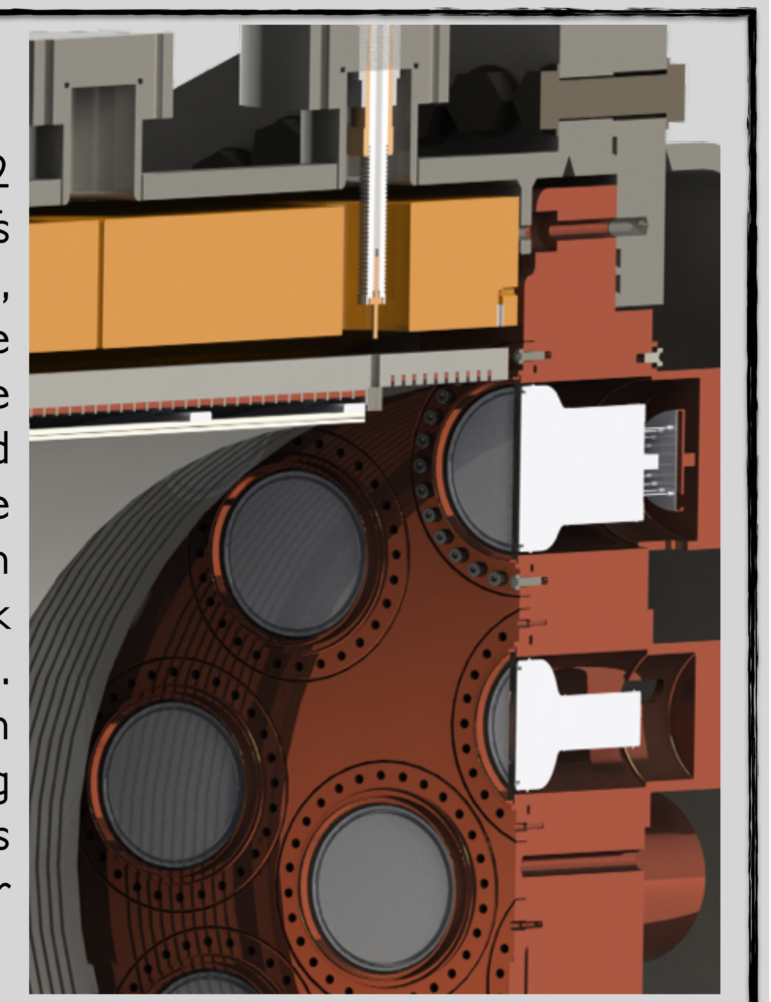




The design has a conical shape to avoid field concentration on the edges of the polyethylene and phosphor bronze contact. It is based on an idea by H. Wang.

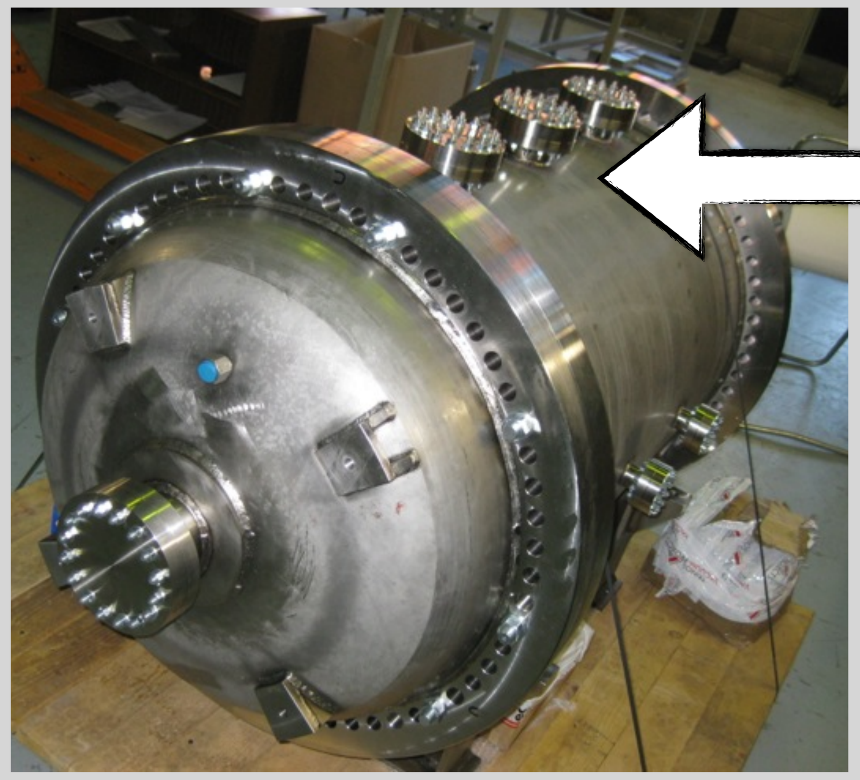
Energy Plane:

The NEW energy plane (NEP) will use 12 R11410–10 PMTs from Hamamatsu. The PMTs will operate with a gain of $5\cdot10^6$ in vacuum, inside the vessel. A thick copper plate separates the PMT-vacuum region from the high pressure region in the chamber, and acts also as a radiation shield. Sapphire windows coated with TPB protect each PMT. The PMT cans and the thick back copper plugs also act as shields of radiation. The signal will be read in differential mode. The resulting noise in each channel is sufficiently small to allow for resolution of single photoelectrons.



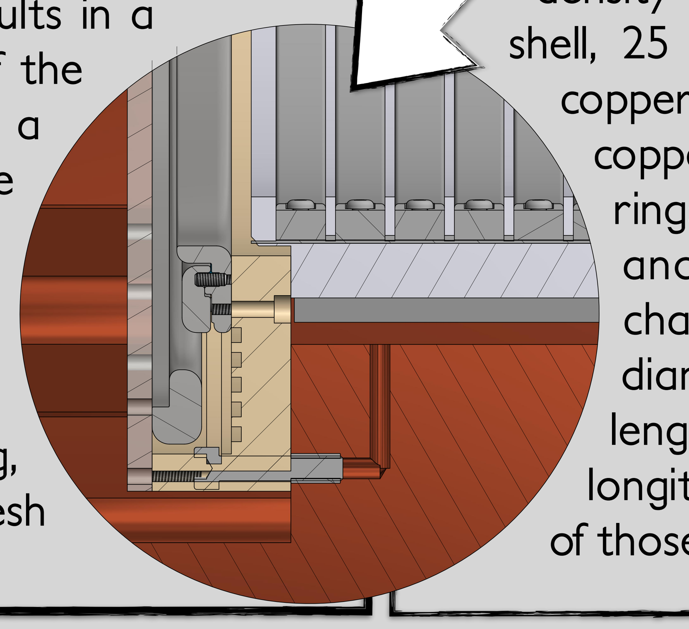
Pressure Vessel

The NEW pressure vessel (NPV) has been manufactured with the same steel alloy selected for the NEXT-100 detector. With an internal diameter of 64 cm and a length of 950 cm, the dimensions of the NPV are intermediate between NEXT-DEMO and NEXT-100. The NPV can hold pressures of up to 50 bar. Each end-cap has one of the photosensor detection systems attached (energy plane or tracking plane).



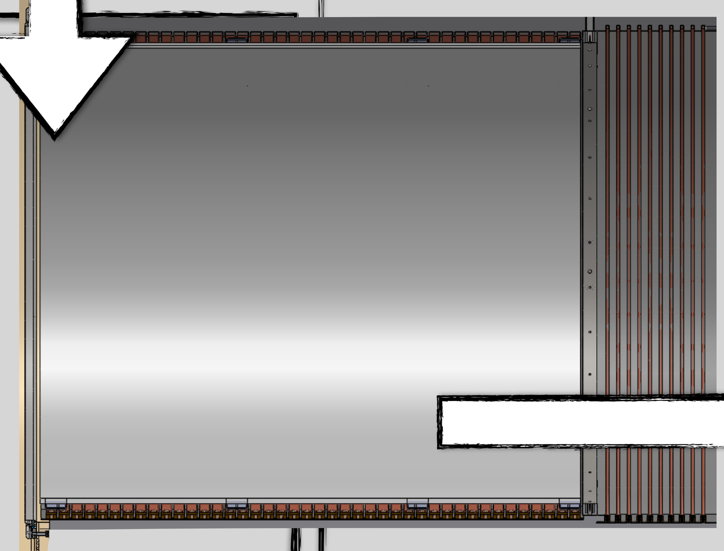
Electroluminescent Region

The EL region makes use of the combination of a mesh for the gate and a solid quartz plate coated with Indium-Tin Oxide (ITO). This coating results in a 90% transparency conductive layer that permits the application of the voltage on the surface of the quartz plate and the creation of a homogeneous field in the EL region. The quartz plate has to be coated with TPB to shift the VUV light of the Xenon electroluminescence to blue to be detected by the tracking plane. A guard ring is needed to prevent concentration of electric field lines in the border of the TPB coated region. The quartz plate solution has multiple advantages. It protects the SiPMs from sparking, removes the necessity of tension and strength one side of the mesh and simplifies the production of the EL region.



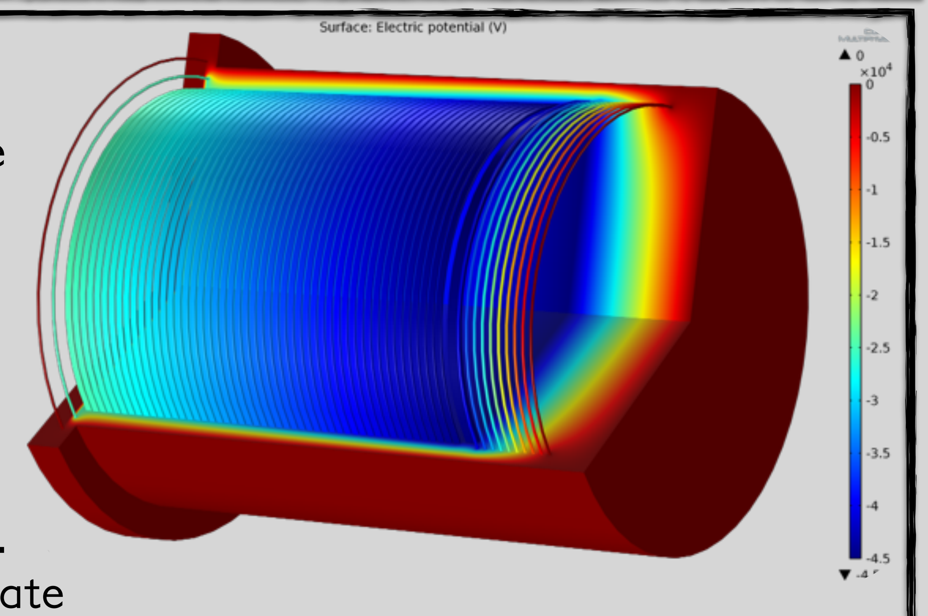
Field Cage:

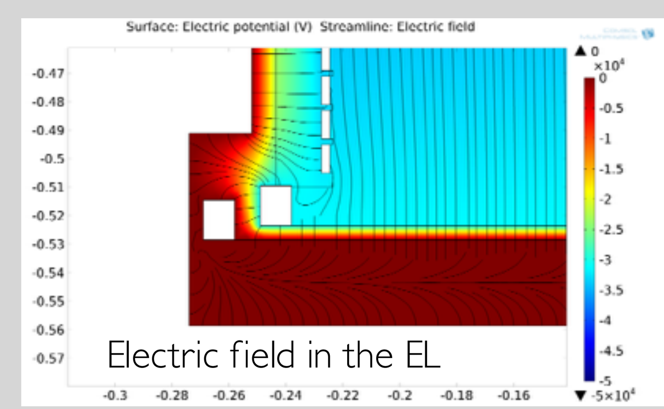
The design consists of a high density polyethylene (HDP) cylindrical shell, 25 mm thick, which isolates the copper shield from the voltage in the copper rings and the cathode. The rings are placed inside grooves and connected by a resistor chain. The field cage has an outer diameter (OD) of 484 mm and a length of 510 mm. Thus, both the longitudinal and radial dimensions are roughly half of those of NEXT-100.



Electric Field:

The electric field in the cage has been simulated with finite element algorithms using COMSOL Multiphysics. Critical regions of the cage (Drift, EL,...) have been carefully studied to optimise the geometrical and electrical design of the detector. The simulation of the electric field has been essential in choosing the right values of the different parameters. The drift region requires a moderate electric field (300- 600 V/cm). This electric field is enough to avoid electron recombination in gas and drift the charges towards the anode. This electric field should be highly uniform and homogeneous to avoid distortion of thoraces during drift. The buffer zone is necessary to degrade the electric potential from the cathode to nearly zero volts at the PMT window surface. In this region of the TPC we do not demand the electric field to be highly uniform.





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