DS-LM. Options to reduce LAr contact with TPB, Clevios or ITO coatings

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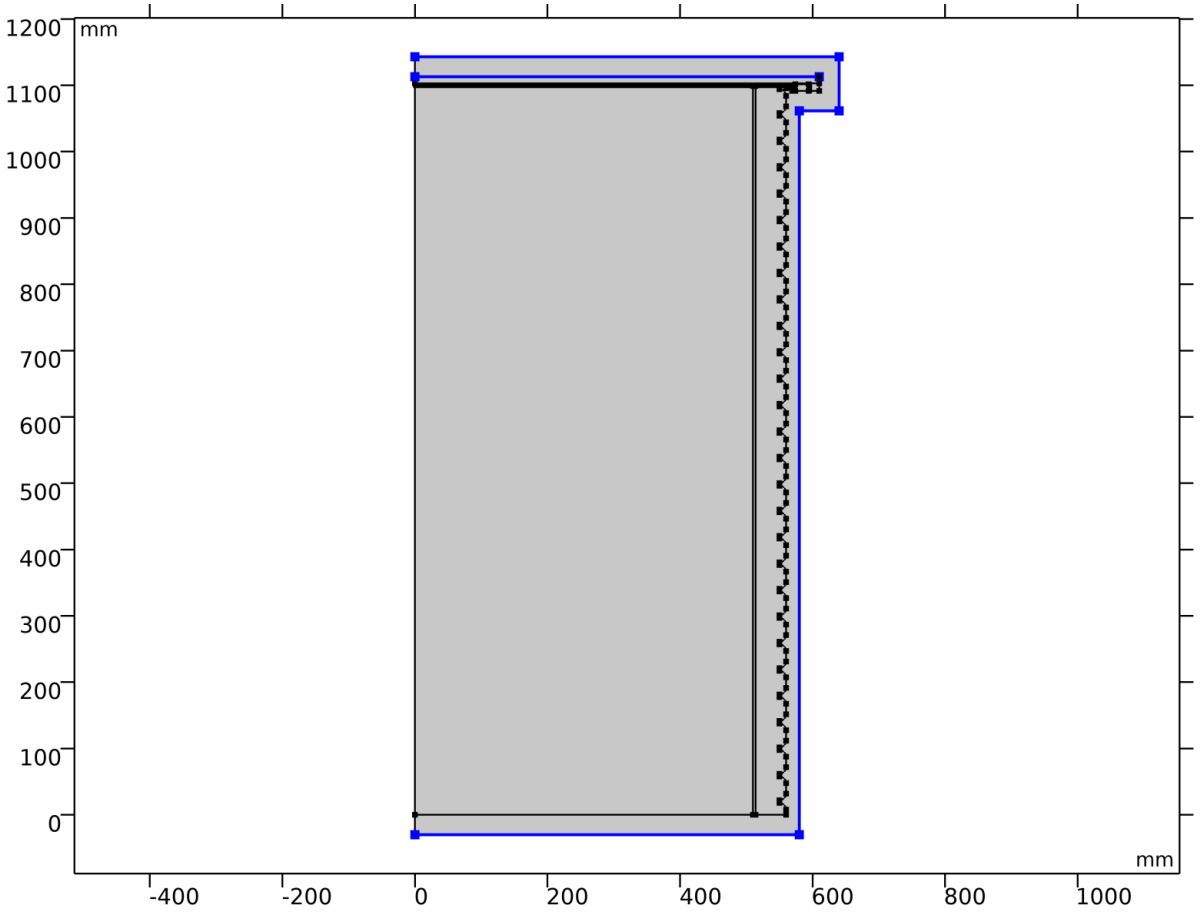
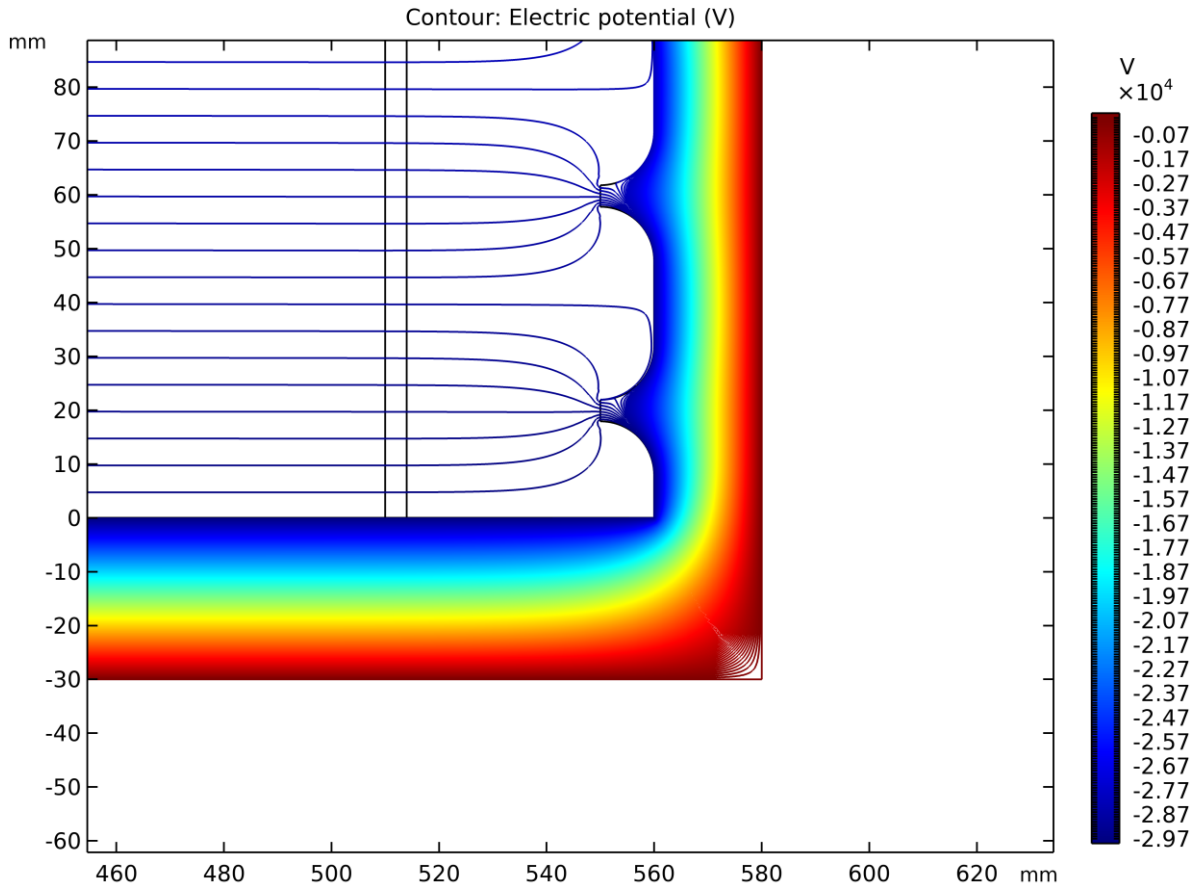
How to minimize the amount of impurities in LAr due to contact with TPB, Clevios or ITO coatings?

- Place field forming rings on the outer surface of the TPC. But there is still the question of ESR placement and TPB coating. And avoiding LAr contact with the anode and cathode surface is not possible by this.
- Place a "protective" coating of PMMA or PEN on the inside of the TPC. But the coating must have a minimum electrical resistance, which means its thickness should not exceed ~1 µm (needs to be clarified).
- If contact with "problem" coatings cannot be avoided, minimize mixing of contacting volumes of LAr with LAr in the central region of the detector.

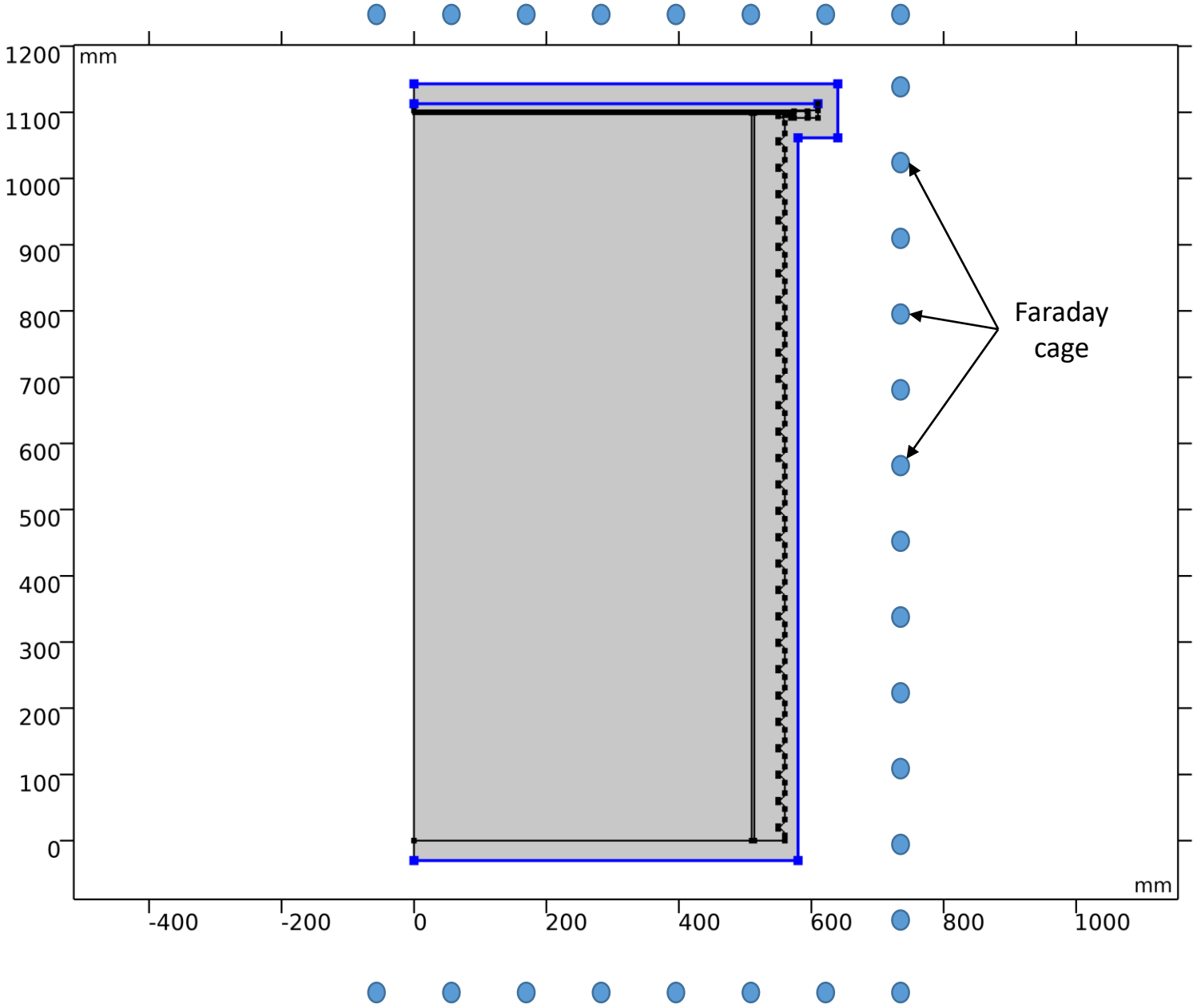
Place field forming rings on the outer surface of the TPC





In the current configuration, the outer surface of the TPC is grounded. This allows to lock the entire electric field inside the TPC and thus avoid possible problems with the influence of the electric field on the operation of the veto system.

Place field forming rings on the outer surface of the TPC



It is necessary either to surround the TPC with a faraday cage or to make sure that the veto system is stable in external electric fields.

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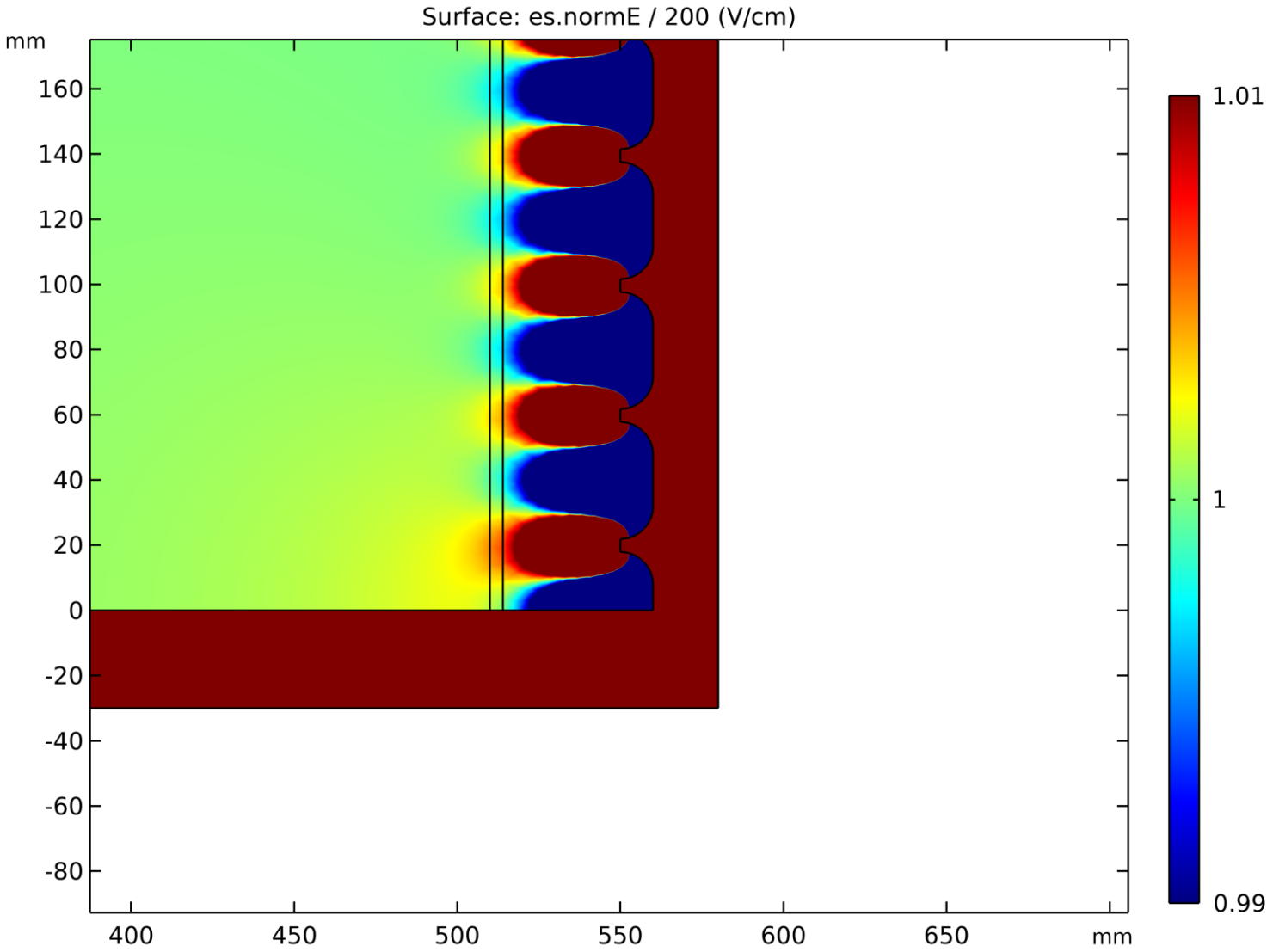
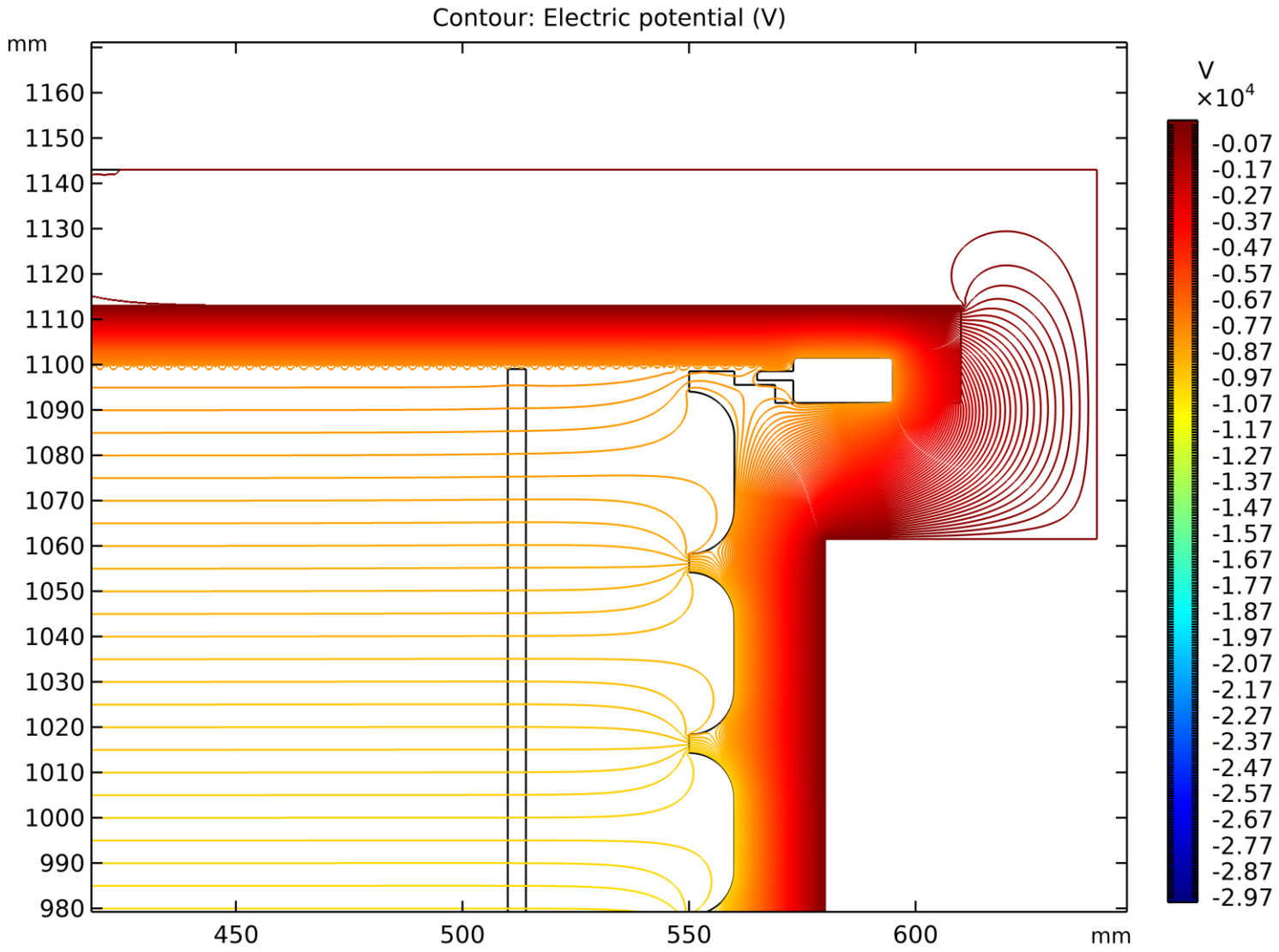


In addition to this, it may be necessary to either increase the thickness of the walls or to reduce the size of the field forming rings to prevent the accumulation of charge on the walls of the chamber.

It is necessary that the area of nonuniform field near the rings is completely inside the acrylic walls (it will require additional simulations, but it is possible)

Place field forming rings on the outer surface of the TPC



There will be the added difficulty of "squeezing" the field with the rings under the net. The homogeneity of the field in this area will in any case be slightly worse because of the difference in field leakage inside the acrylic and LAr.

And probably we will have to extend the wire frame even more than we do now.

Place a "protective" coating of PMMA or PEN on the inside of the TPC

If it were possible to apply a protective coating of PMMA or PEN, that would solve most problems. But this coating must not prevent the charge from flowing through it, which means that its thickness must be very small (preliminary, ~1 μm, but this value requires separate clarification) if it is applied to surfaces with an applied electric potential. Such thin coatings can only be deposited, which raises the question of their integrity during detector operation. Instead of solving the problem, they may turn out to be an additional source of dust.

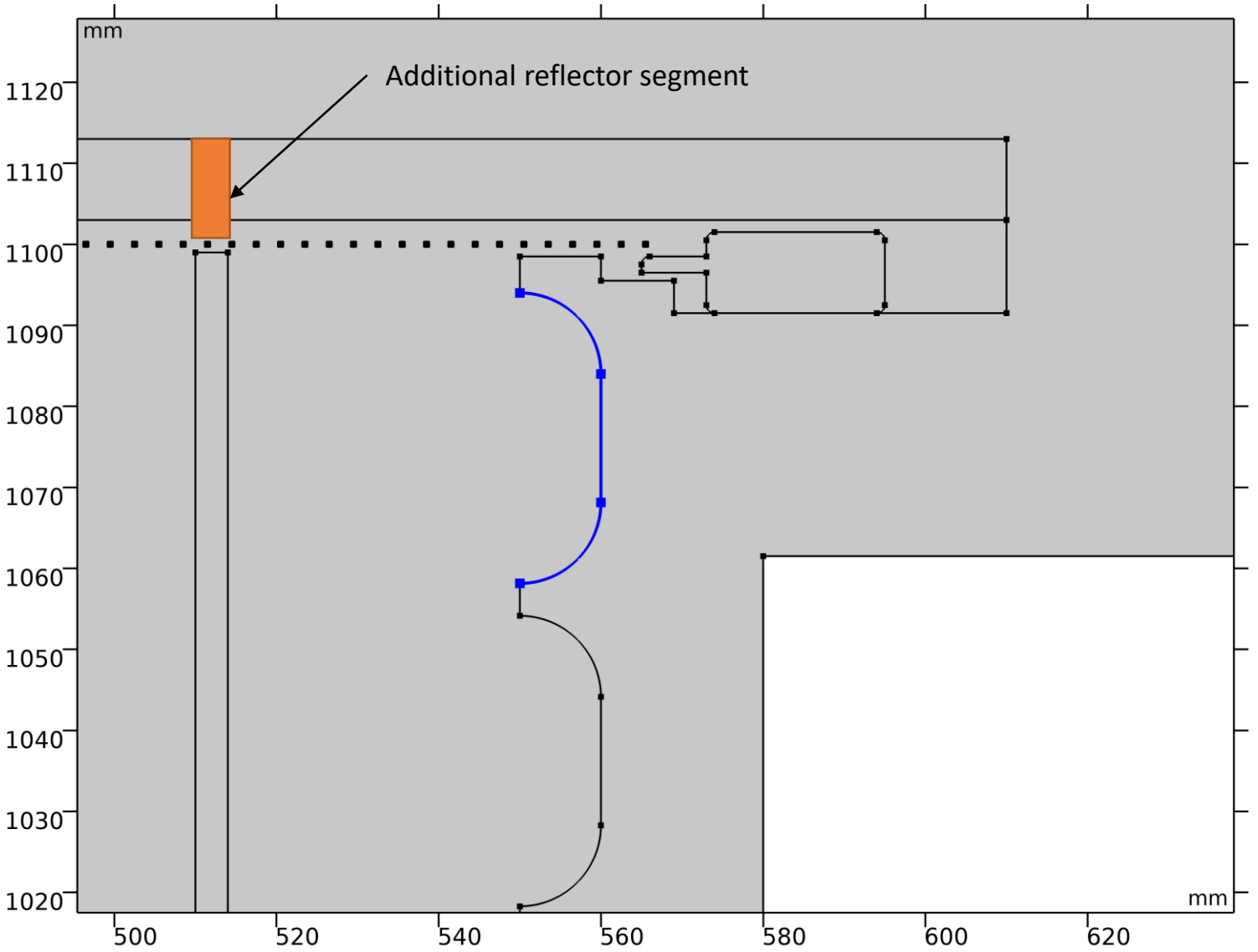
But if you can't apply a protective coating to the conductive surfaces, maybe you can apply it to the reflector surface? At what thickness does PMMA become opaque to 128 nm? Can we use PEN instead of TPB for the reflector? For example, place the ESR between the PEN film and the acrylic base.

A separate question is how insulating is the TPB coating? Can it build up a charge? Can an electric current flowing through it destroy it?

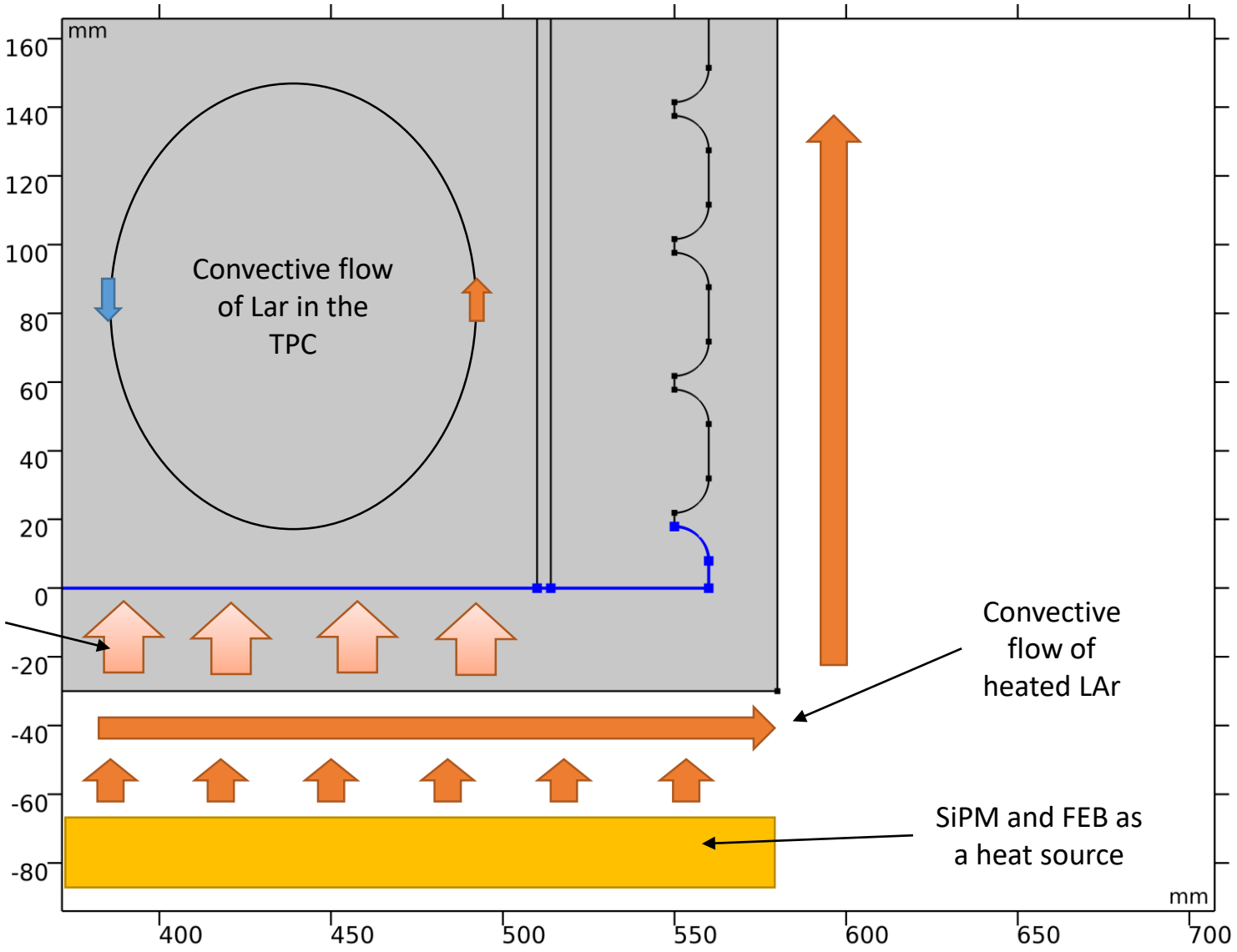
Minimization of mixing of contacting volumes of LAr with LAr in the central area of the detector

The easiest way is to add a reflector section above the grid and so divide the LAr inside the TPC into an inner volume and an outer volume.

Perhaps it makes sense to make a solid reflector instead of a reflector made of separate segments (apart from dividing it into sections under and over the grid). In this way, LAr mixing of inner volume and an outer volume of the TPC will be minimized.

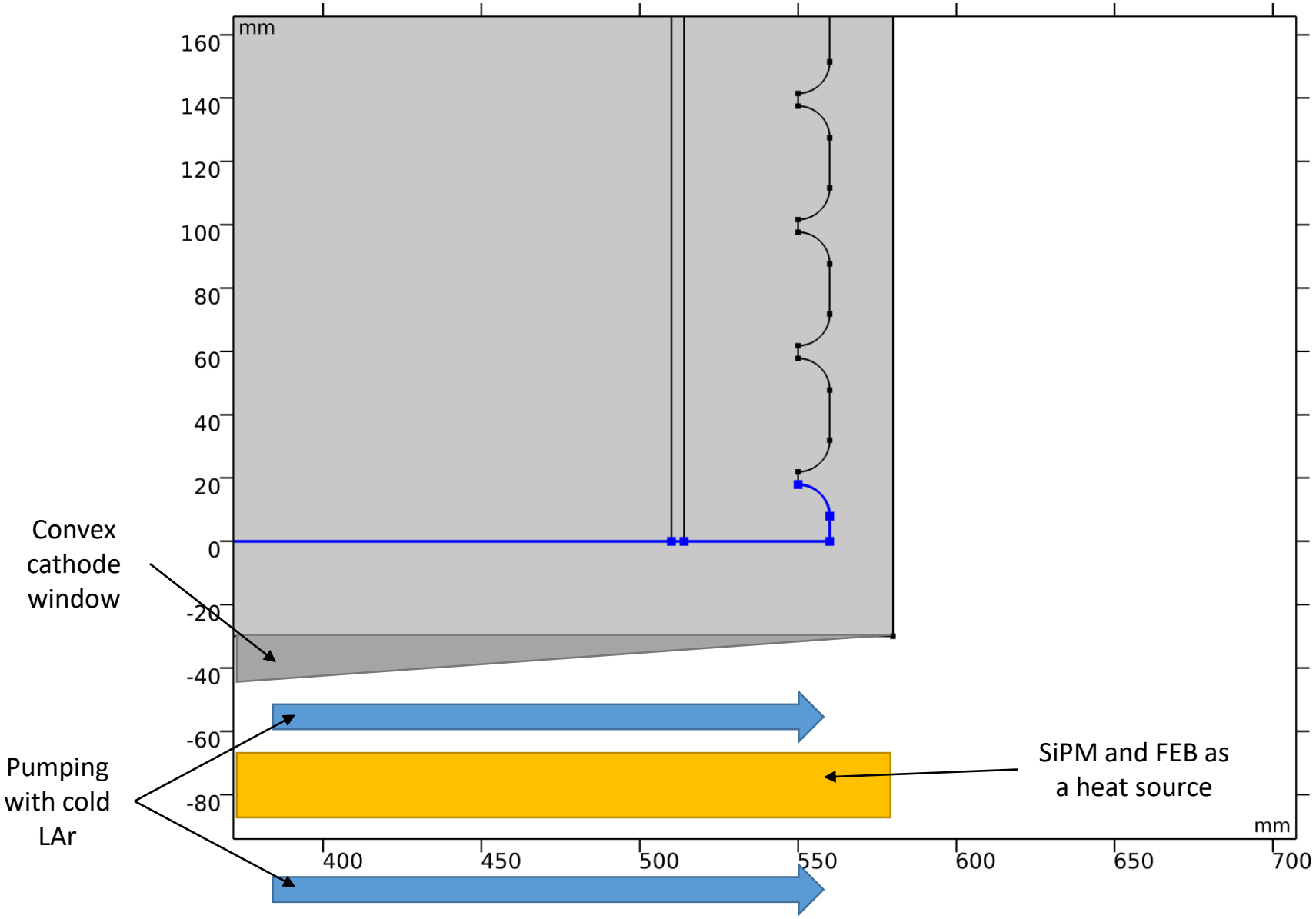


Minimization of mixing of contacting volumes of LAr with LAr in the central area of the detector



The main reason of argon mixing in TPC will be heating of LAr from working SiPM and FEB through the cathode window and as a consequence the occurrence of convective streams in the detector chamber

Minimization of mixing of contacting volumes of LAr with LAr in the central area of the detector



To reduce LAr heating in the TPC, you can try increasing the gap between the cathode window and the SiPM, making the cathode window convex, or adding forced argon pumping in this area. But all this would require a separate simulation to evaluate the effectiveness and necessity of such modifications.