

# Field Cage and Beam Window

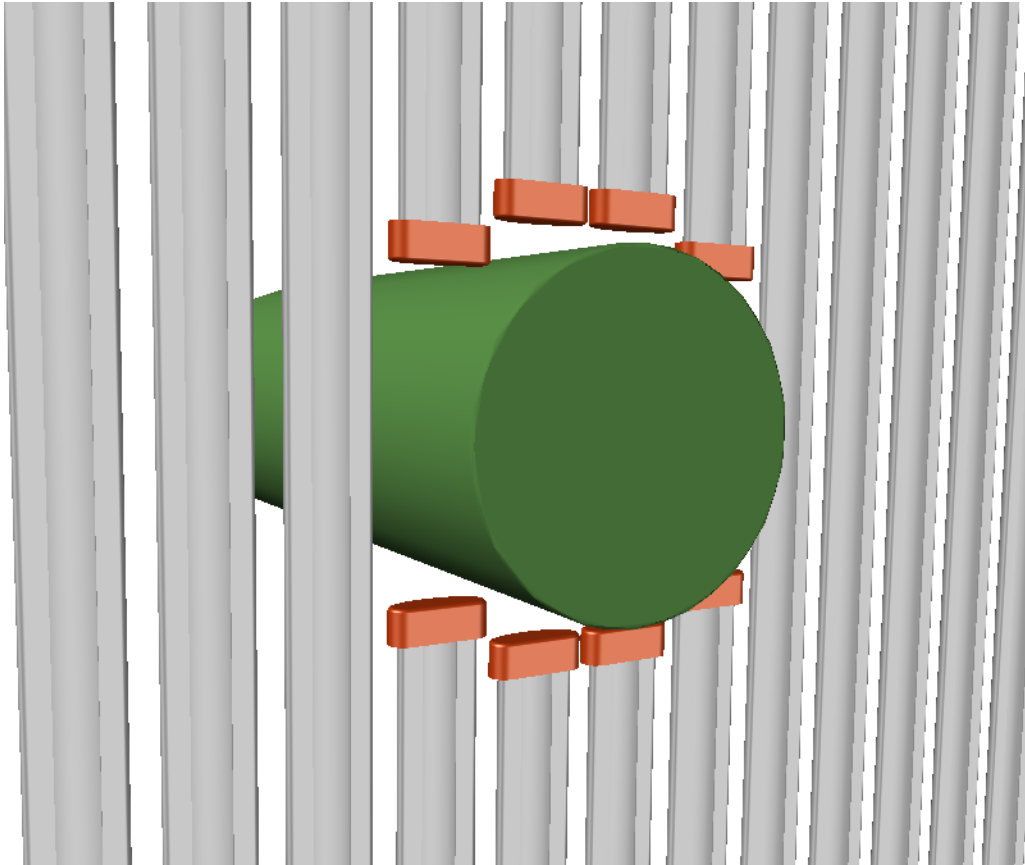
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# Intro

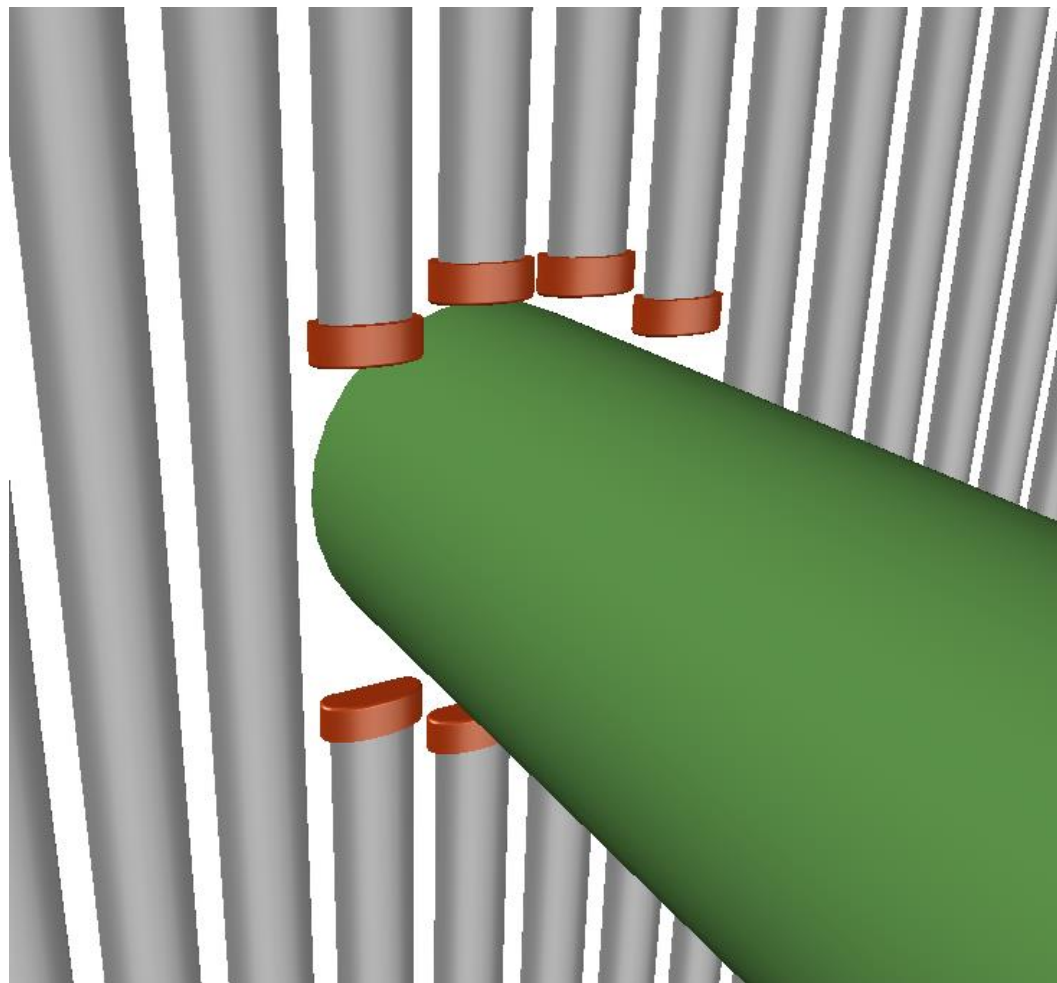
- The field cage profile is of the order of 1mm of stainless steel. The actual profile has about 1cm of total thickness, surrounded by LAr.
- If the beam window is positioned directly against the field cage surface, there will be  $\sim 1$ mm of steel and 1cm of argon before the beam enters into the TPC.
- The field cage is also offset  $\sim 5$ cm from the TPC's active volume (defined by the APA wire frame aperture). In this space, the E field is non-uniform, but gradually reaching a few % non-uniformity at the active volume boundary.
- Due to the positive ion buildup inside the TPC, there is a transverse component of the E field, which pulls the electrons at the field cage inner surface into the active volume. The 5cm offset is not at all dead, but the field non-uniformity may complicate the  $dE/dx$  calibration in this region.
- The following is a quick look at the option of extending the beam window through the field cage, into the active volume. The field near the cryostat wall is not included in this model.

# Beam Window Extends into the Field Cage

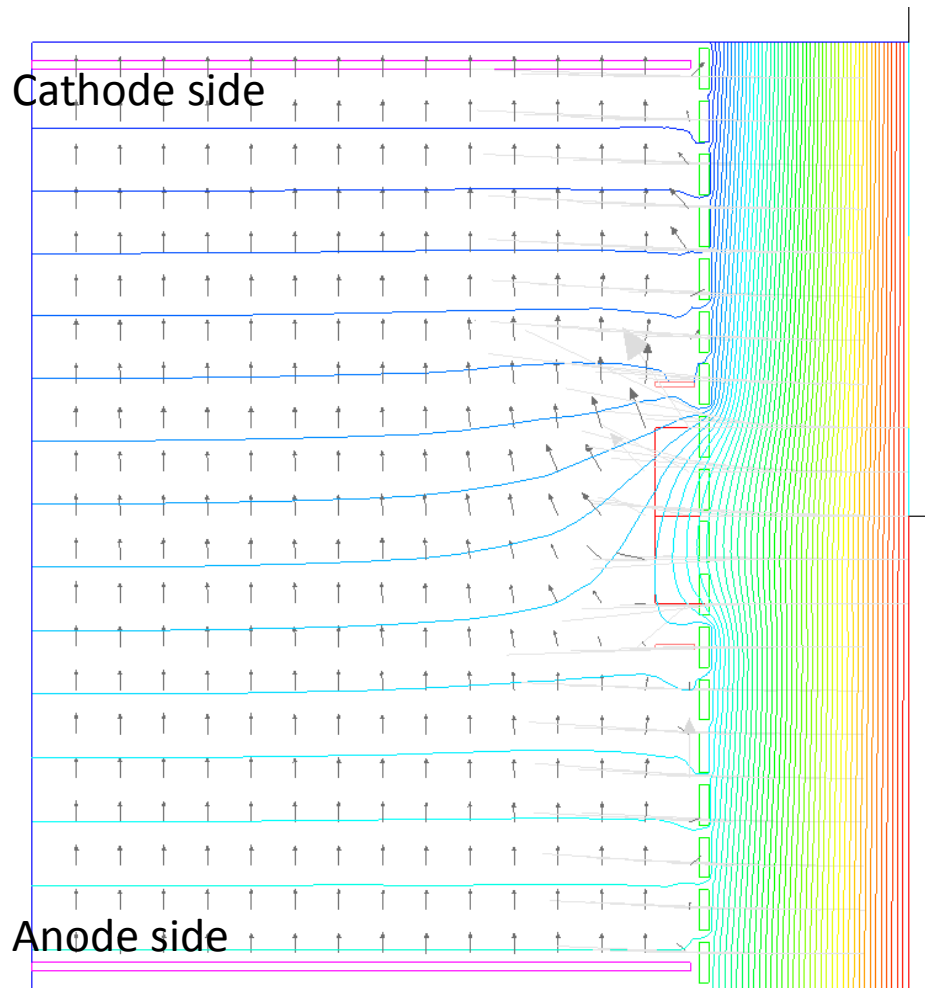


Proposed implementation of the hole in the field cage

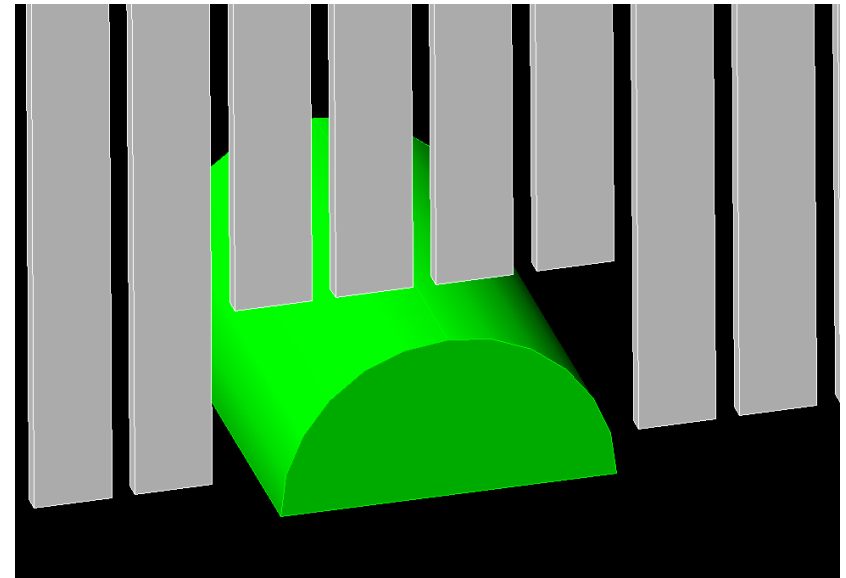
# View from Outside of the Field Cage



# Potential Contours at Beam Window Center Plane

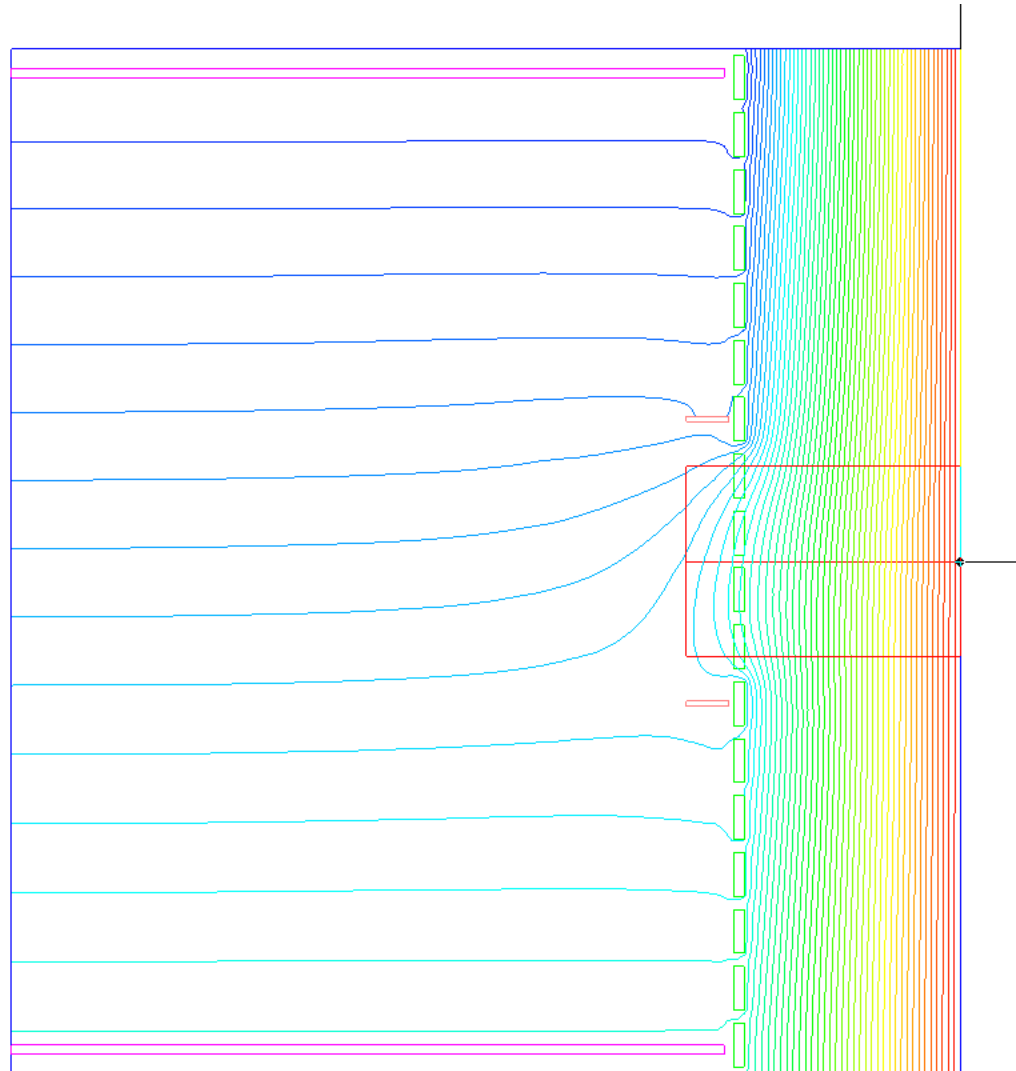


The field cage has a cutout, and the 20cm beam window (insulating plug) is placed through this opening, 5cm into the field cage. This plug is assumed to be air (thin wall ignored) in this model.

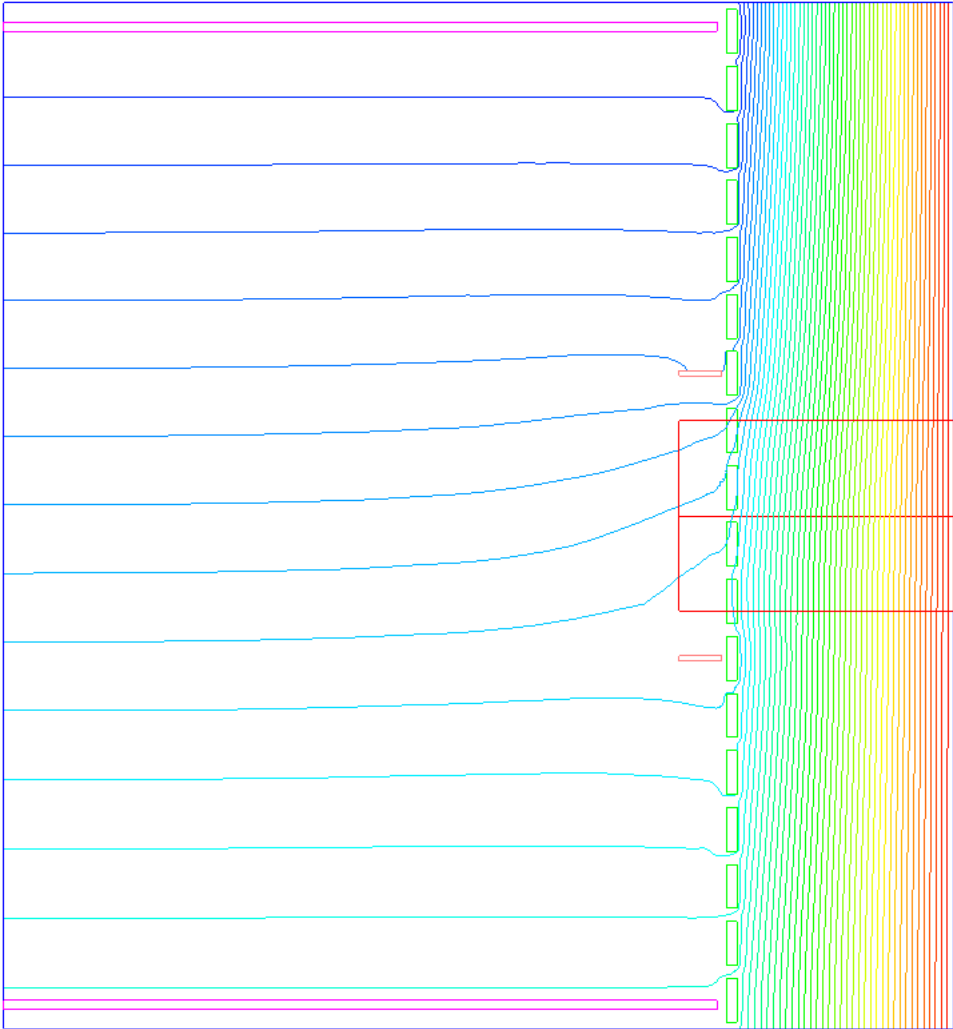


Due to the ground plane (cryostat wall, ~30cm away in this model) and the hole in the field cage, there is a strong E field pushing electrons toward the face of the plug. If the plug penetrates much deeper, the distortion near the beam window face diminishes. However, there could be surface charging on the side wall of the insulating plug, causing other kind of field distortion.

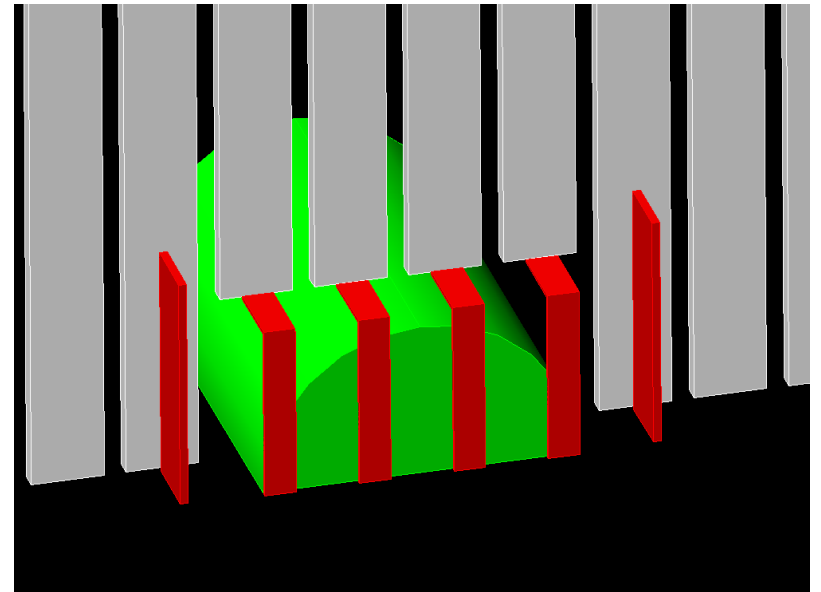
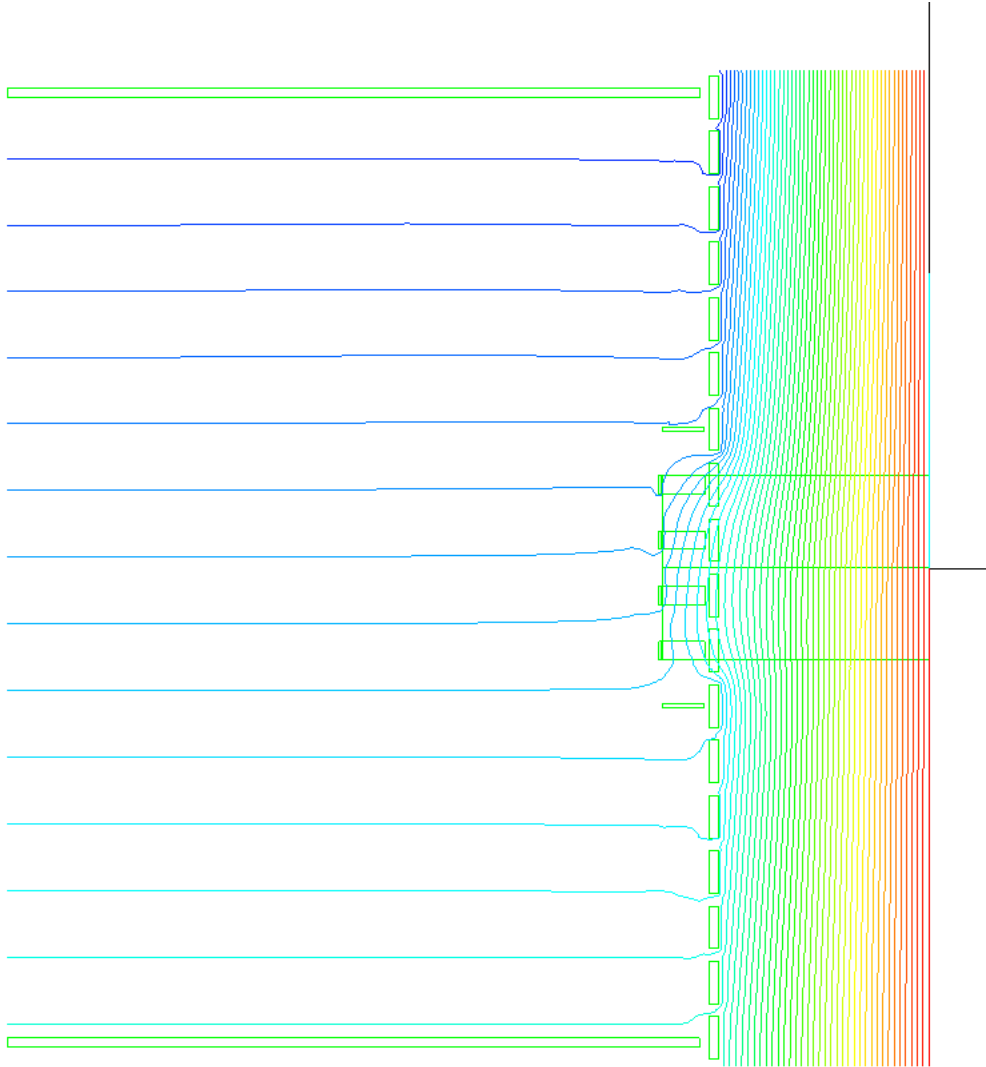
# Potential Contours at 5cm above Beam Window Center Plane



# Potential Contours at 10cm above Beam Window Center Plane (top edge of the plug)

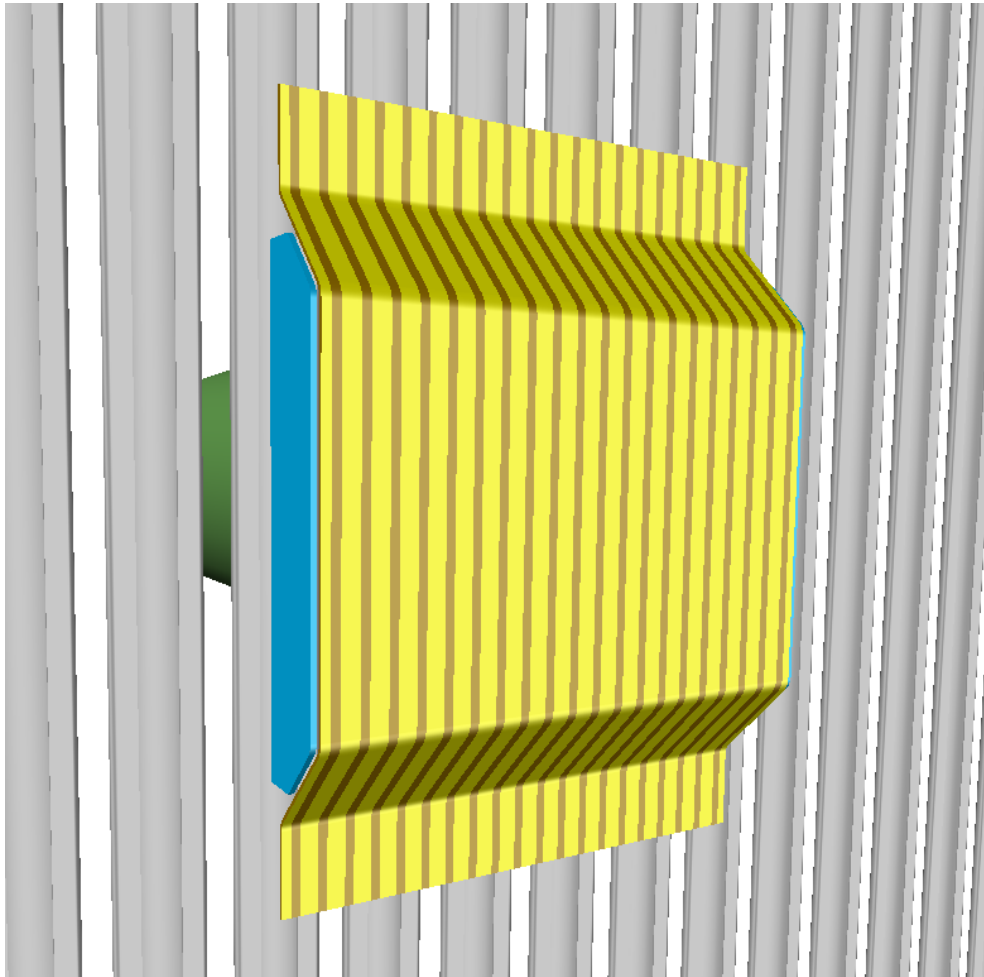


# Potential Contours at Beam Window Center Plane with Field Shaping Strips over the Beam Plug





# Build a Mini Field Cage Around the Beam Window



A rigid-flex printed circuit board forms this field cage: top and bottom portion are rigid for ease of connection to the field cage profiles; middle portion is thin (flexible) to minimize material.

A finer strip pitch reduces the field at the strip edges. Implement additional edge protection à la 35ton?

Local resistive divider on the PCB (chip resistors directly soldered on strips?)

If the beam plug is extended further into the TPC, this mini cage is needed to avoid field distortion due to charge buildup on the plug surface.

# Outside View

