SuperB Drift Chamber mechanical structure: preliminary considerations

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and on behalf of

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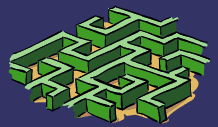
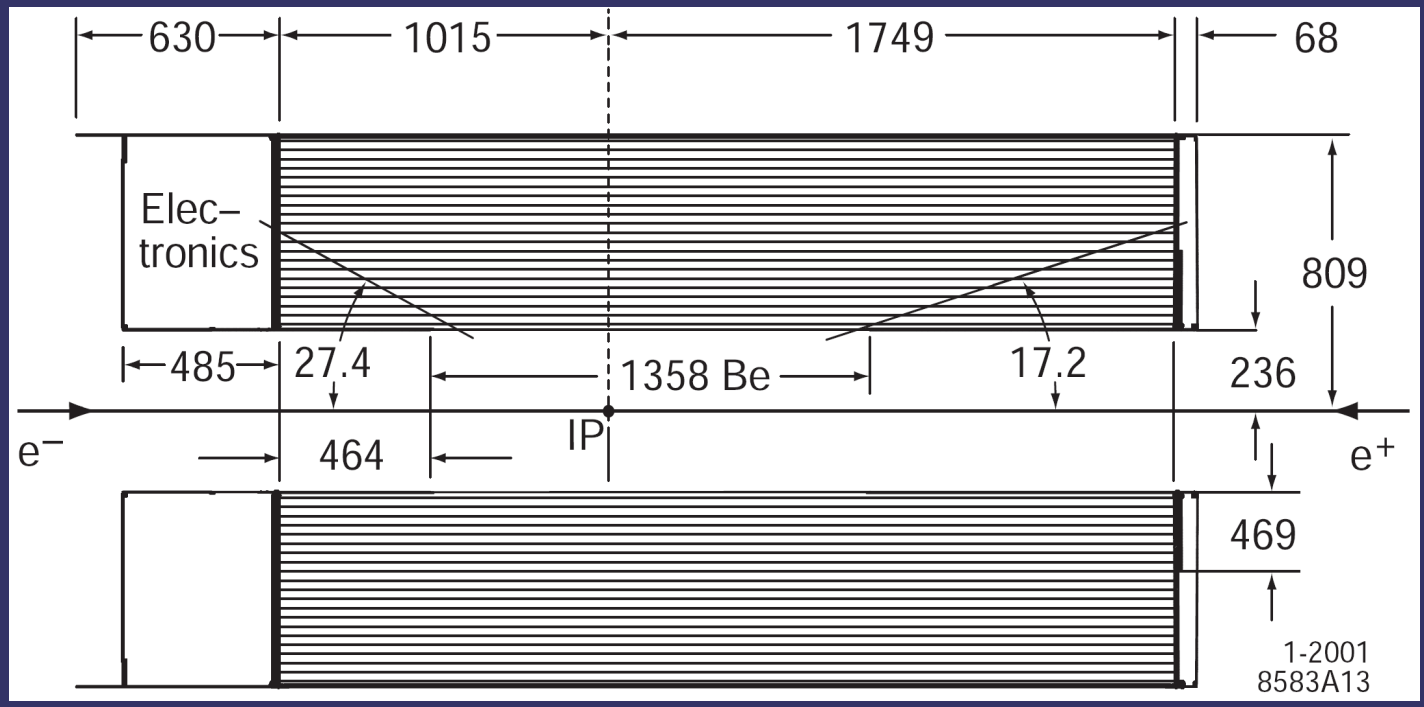


Current BABAR design



Total wire load about 3.5tons

Flat Al end-plates

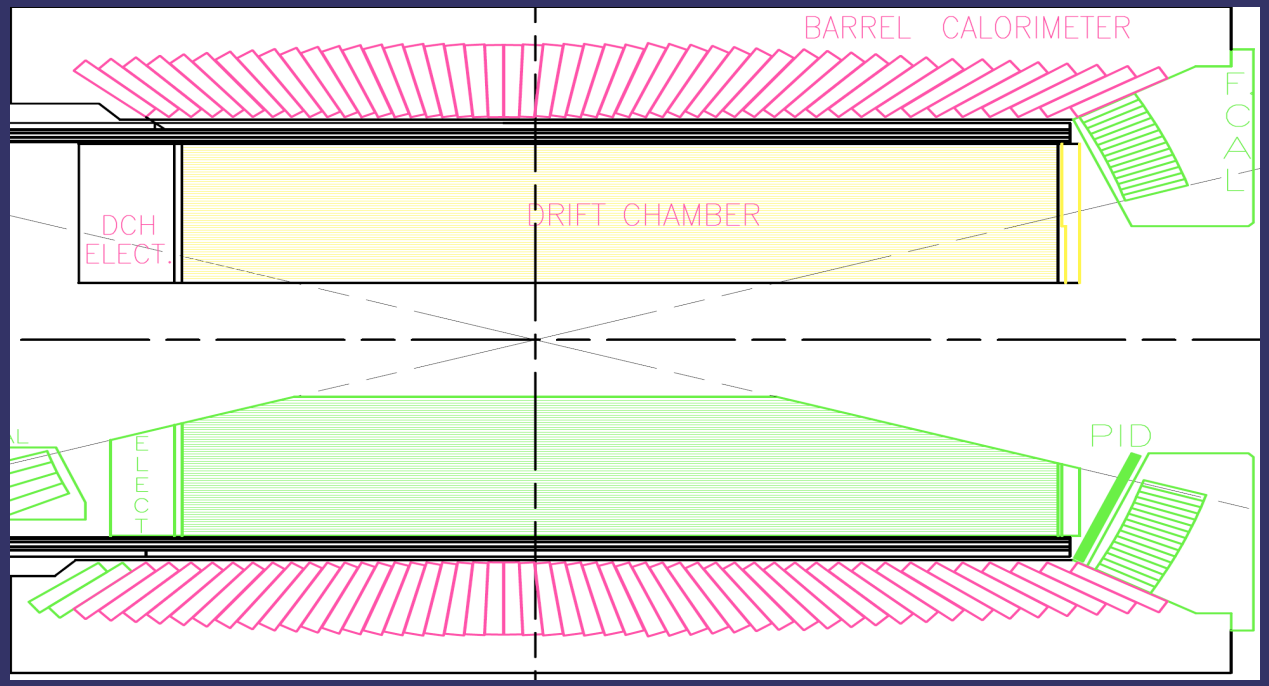
- Backward: 24mm (27% X_0)
- Forward: 24mm for R<47cm, 12mm (13% X_0) for R>47cm

Max. plate deflection under wire load ~2mm

Options for Carbon-Fiber end plates

3 options considered for the end-plates

- Flat
- Spherical
  - Reduce thickness
- Conical
  - Reduce occupancy in forward direction

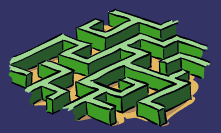


For all options, the E.P.'s are only constrained at the OUTER radius

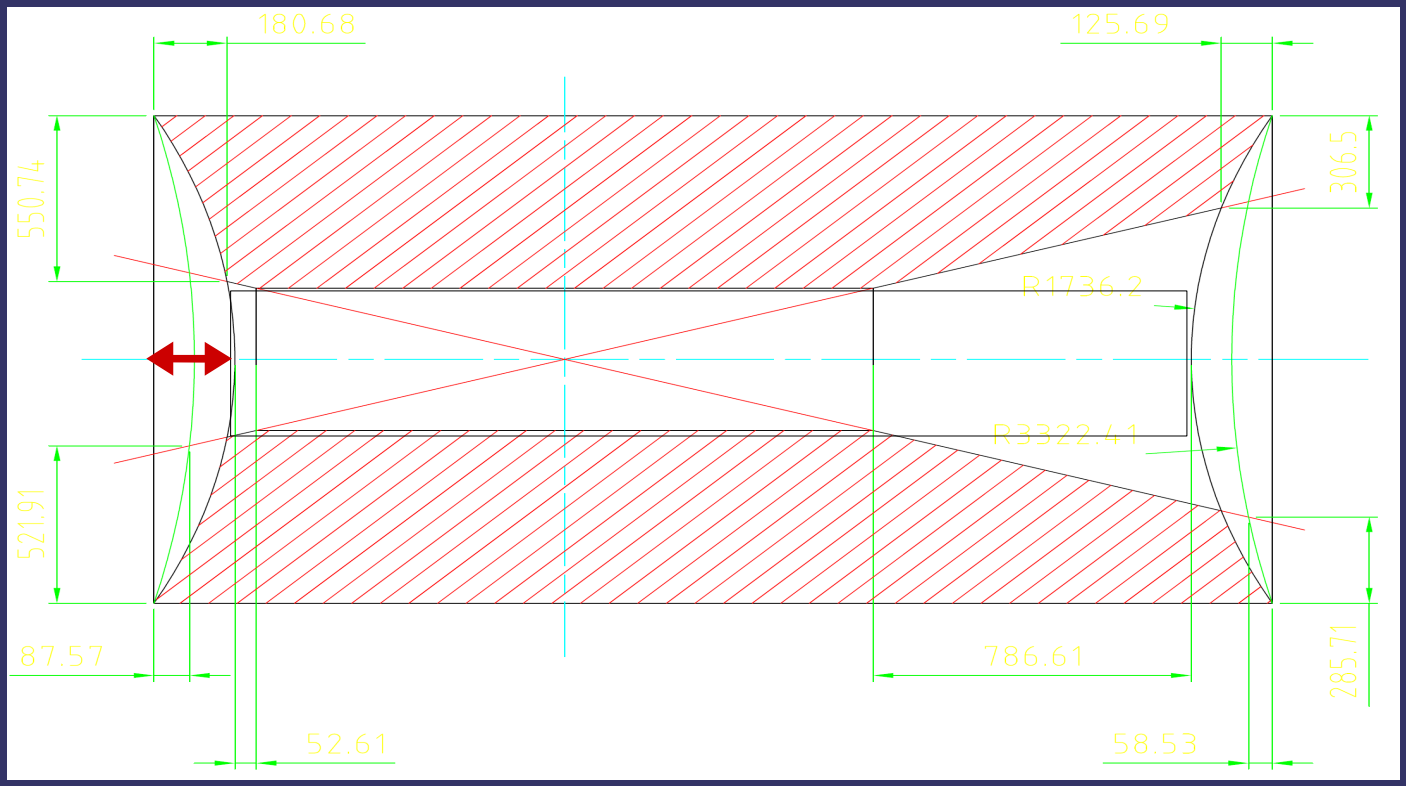
Disclaimer: what follows is VERY preliminary

Option(s) #1: flat CF end-plates

- 25mm thick CF sandwich of
  2mmCF + 21mm honeycomb + 2mm CF
  - ~0.015X_0, max deformation δ_{max}~1 mm
- 10mm thick CF sandwich of
  2mmCF + 6mm honeycomb + 2mm CF
  - ~0.015X_0, δ_{max}~7 mm
- 20mm thick CF
  - ~0.075X_0, δ_{max}~1 mm
- 10mm thick CF
  - ~0.04X_0, δ_{max}~6 mm



Option #2: spherical end-plates



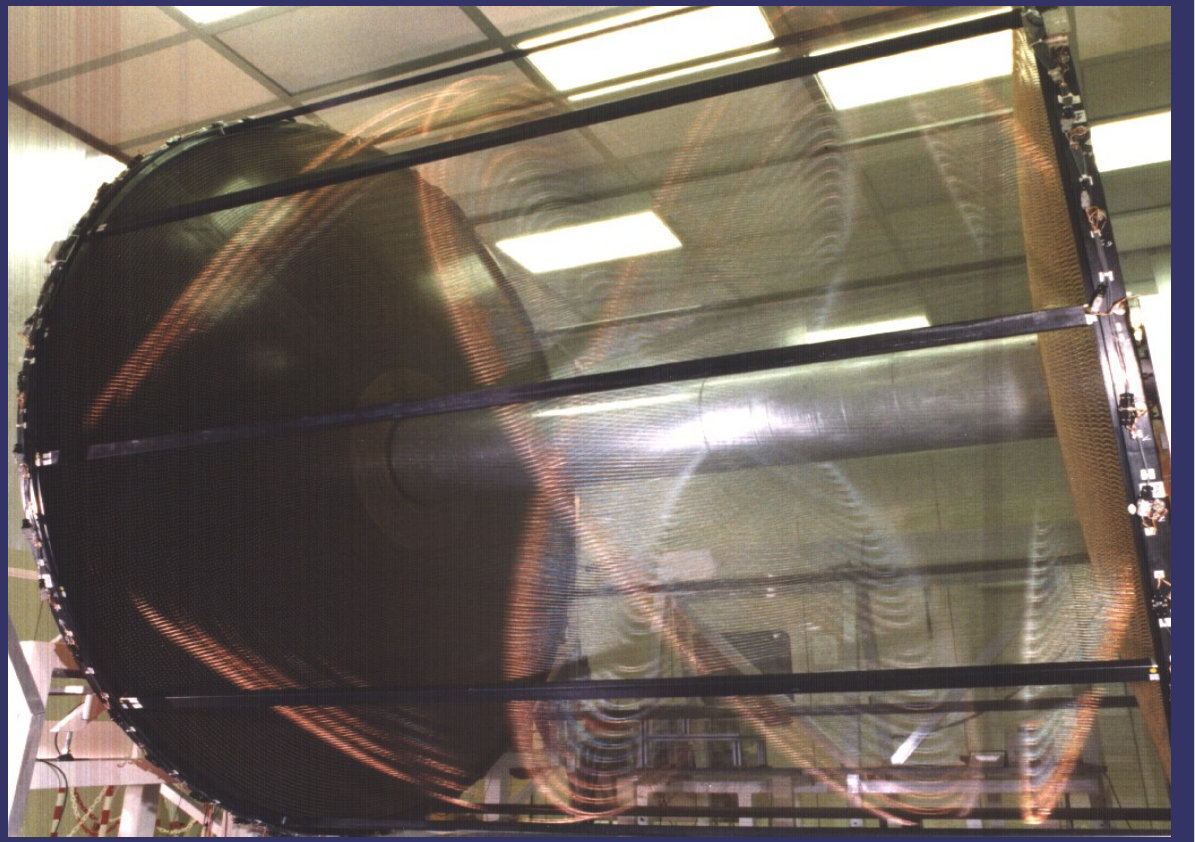
Thickness O(4mm), or *0.015 X_0*

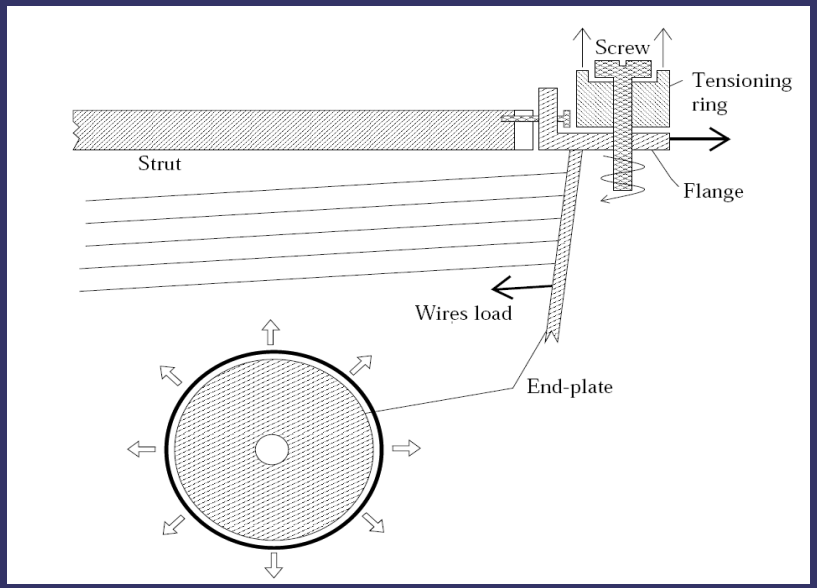
sagitta=200 mm ➡ $\delta_{max200} \leq 0.5$mm

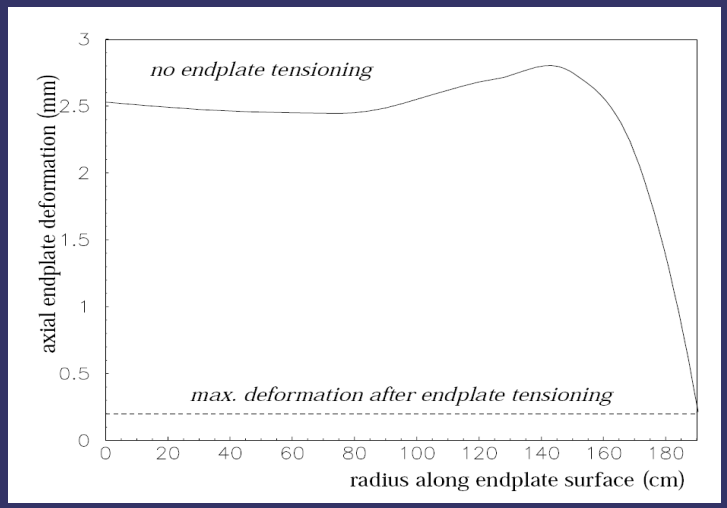
sagitta=100 mm ➡ $\delta_{max100} \sim 2 \times \delta_{max200}$

Spherical EP concept proved in the KLOE DC

- R_{max} ~ 2m
- 52,140 wires
- total load ~ 3.5 tons
- EP thickness 9 mm
- Plate deformations recovered with CF “stiffening ring”
  - Given the smaller radius of the SuperB DCH, we can probably avoid this complication

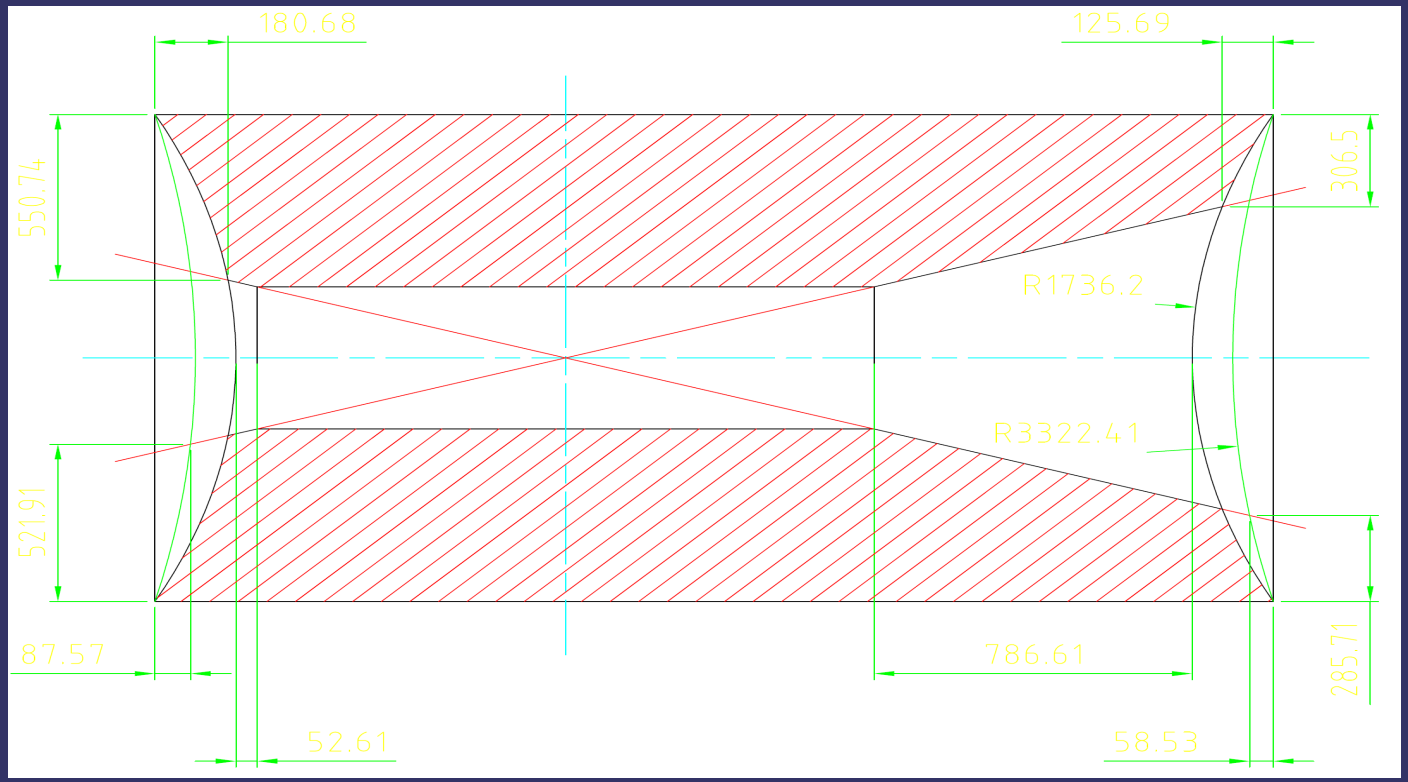


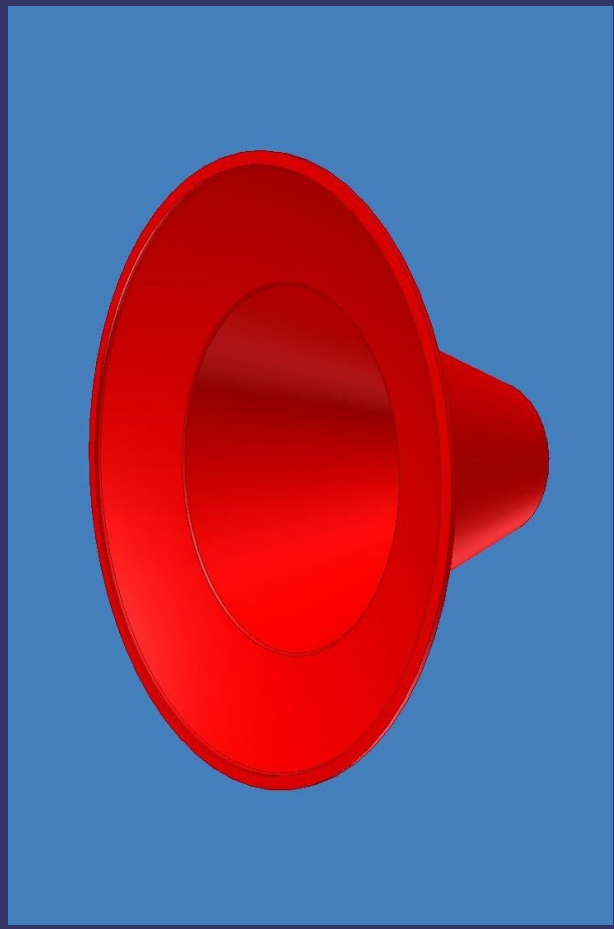




Option #3: conical end-plates

Expect high particle flux in forward direction. Conic-shaped EP's might help reducing occupancy in inner layers.

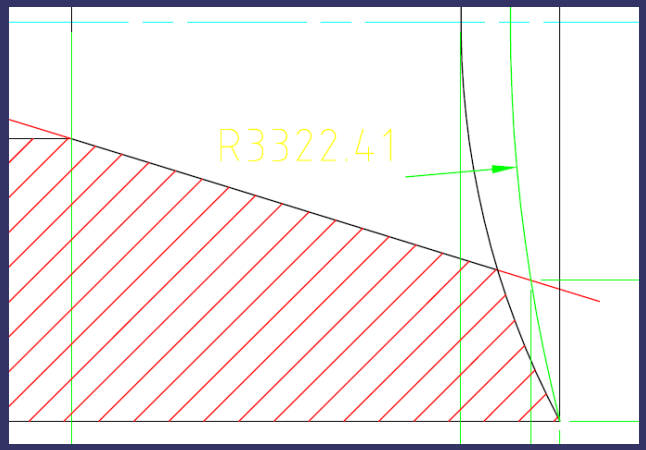




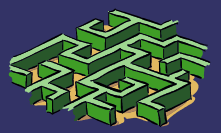
Thickness O(4mm), or *1.5% X_0* (perp. to walls)

δ_{max} ~0.5mm

Option #3: conical end-plates (cont.)



- Besides the trickier structural analysis, conical end-plates would pose several problems though:
  1) drilling the holes at a very small angle
  2) ensuring a flat seat for the feed-throughs
  3) stringing the wires in the conical section
  4) a lot of material seen by electrons tangential to the cone ⇨ a lot of background produced
- None of the above (excluding 4), which needs careful investigation) looks unsurmountable, but we should be aware that conic end-plates are not exempt from issues.

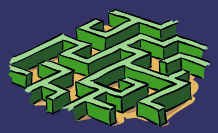


An alternative: variable-gain sense wires

- Electron amplification at the sense wire is obtained by the very high electric field due to the small wire diameter (~20μm)
- If we could vary the wire diameter, we could tune the amplification along the wire length.

- The big question is HOW
- With a dedicated extrusion, or coating process?
  - Replies from wire-drawing company experts were not encouraging
- Alternatively, one could just stop the electron drift before amplification starts
  - Encapsulating part of the wire in a tiny plastic tube?
  - With a layer of insulator, ~100μm thick?

- All of the above is clearly very non-standard and still in a pre-preliminary stage, but worth being pursued, IMHO.



Summary and outlook

- Once more – no detailed calculation (e.g. of restraints), or FEA performed yet.

- All options considered for a drift chamber with carbon-fiber mechanical structure seem feasible from the structural point of view, allowing CF thickness O(few %) with deformations < 1mm.
- The spherical EP solution has been successfully demonstrated to work.
- Conical EP solution has still many unknowns (both known and unknown) at this point.