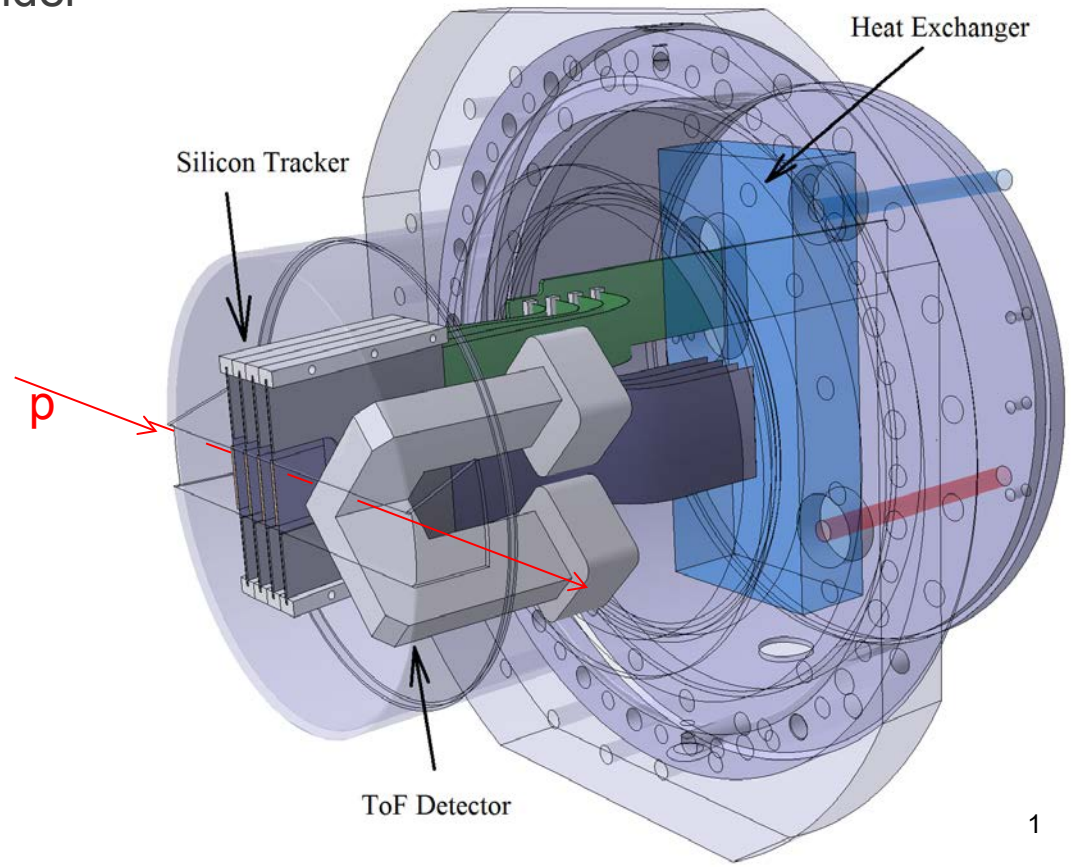
AFP BLM

Michael Rijssenbeek

- Draft Design of the SiT Card
- Draft Design of the SiT Holder

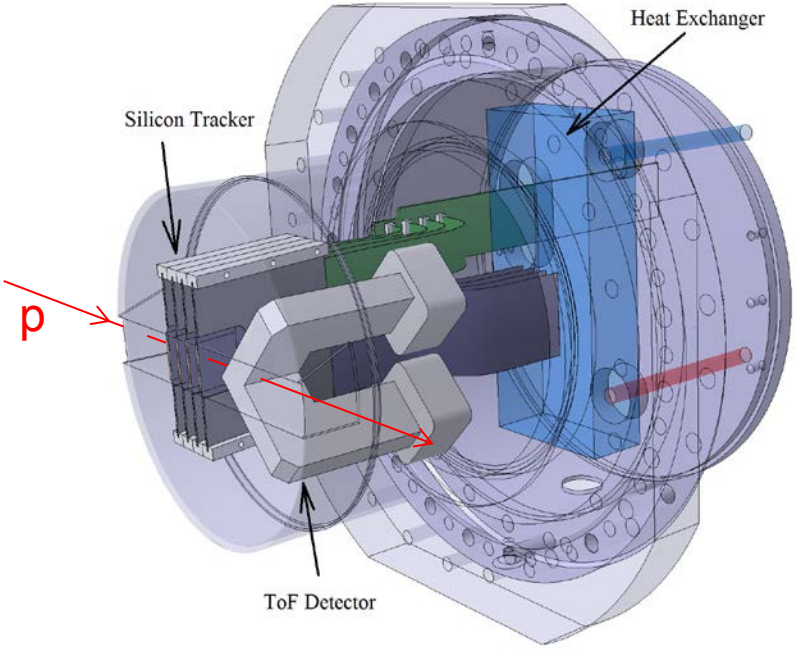


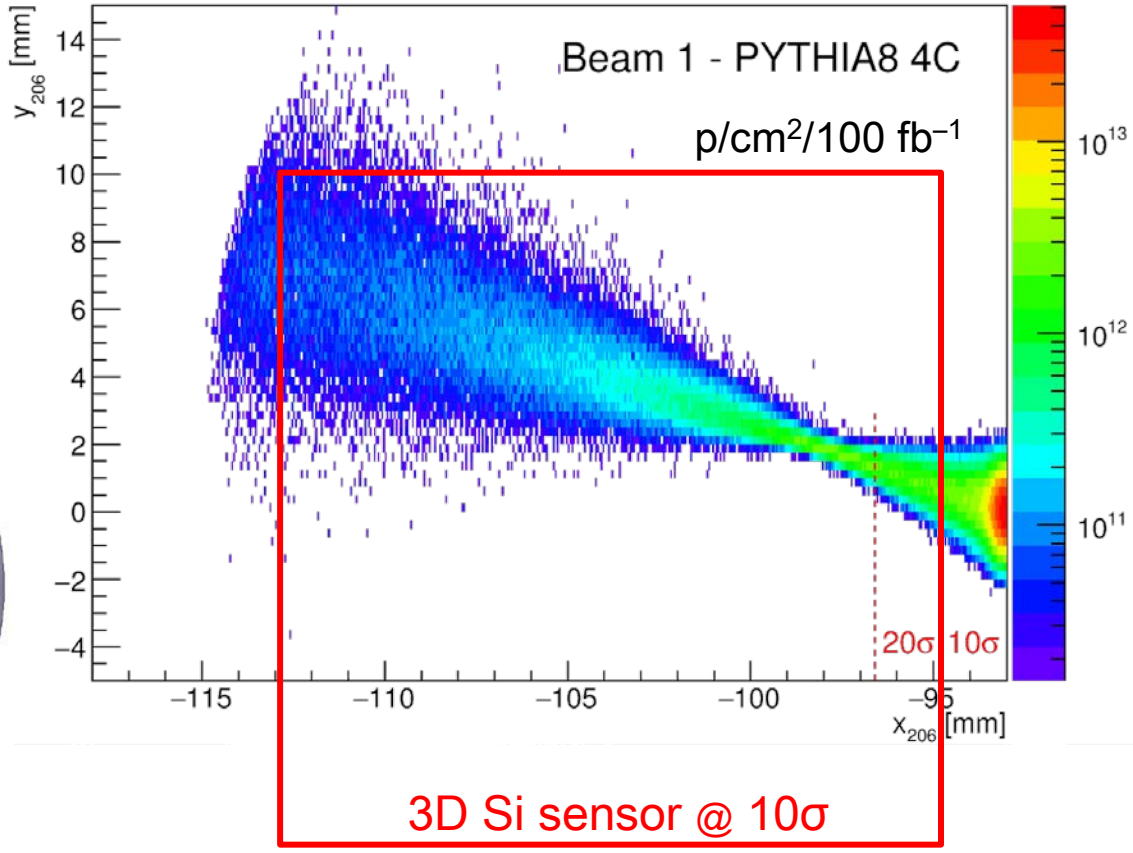
ATLAS Forward Protons at 206 m

Hit pattern in AFP is determined by the LHC optics

For β*=0.55 m:

- upward tilt for protons with energy loss is caused by vertical crossing angle in Point 1





Approval History

AFP TDR:

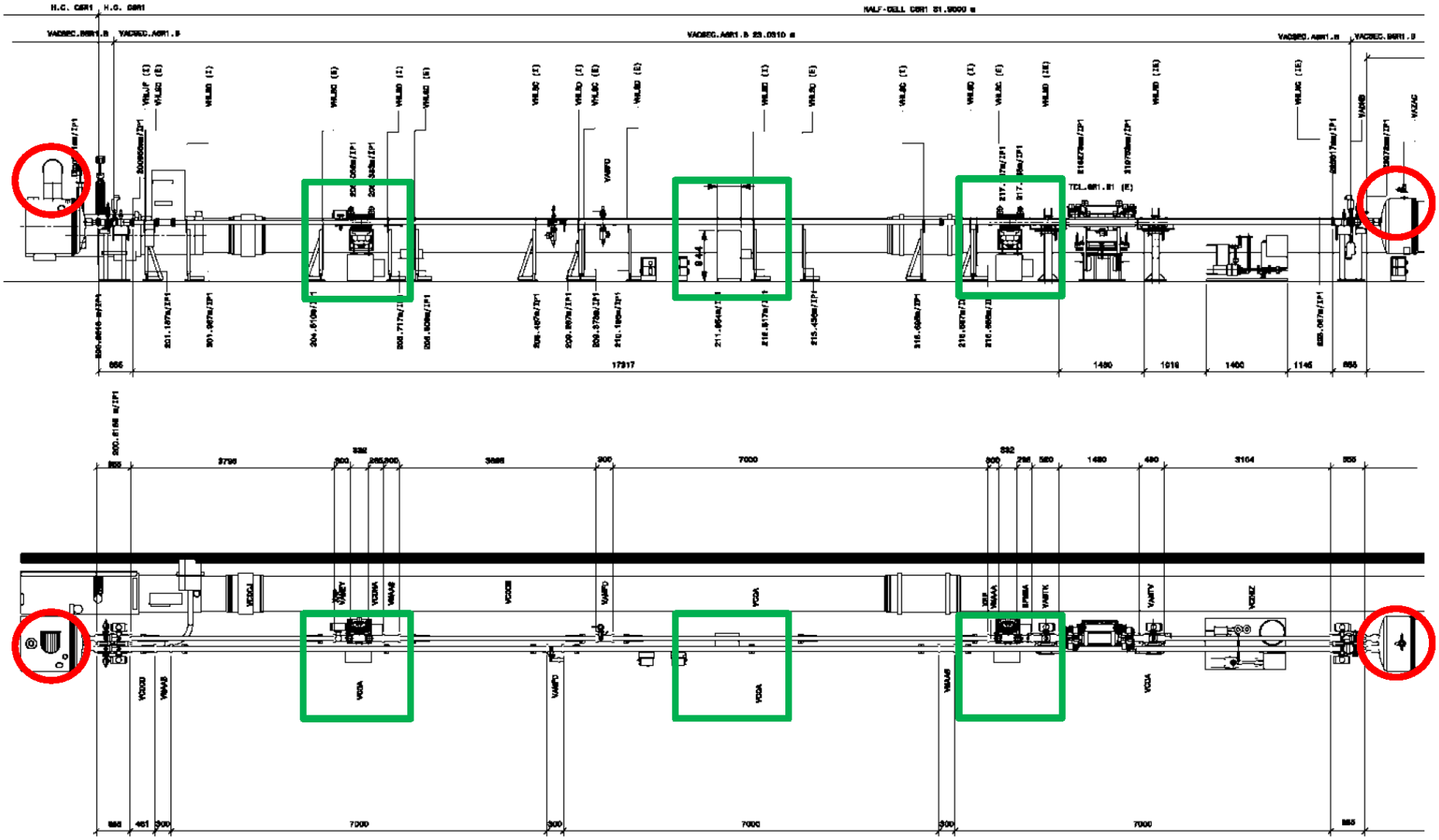
The ATLAS Collaboration , "Technical Design Report for the ATLAS Forward Proton Detector", CERN-LHCC-2015-009 ; ATLAS-TDR-024; url: https://cds.cern.ch/record/2017378/

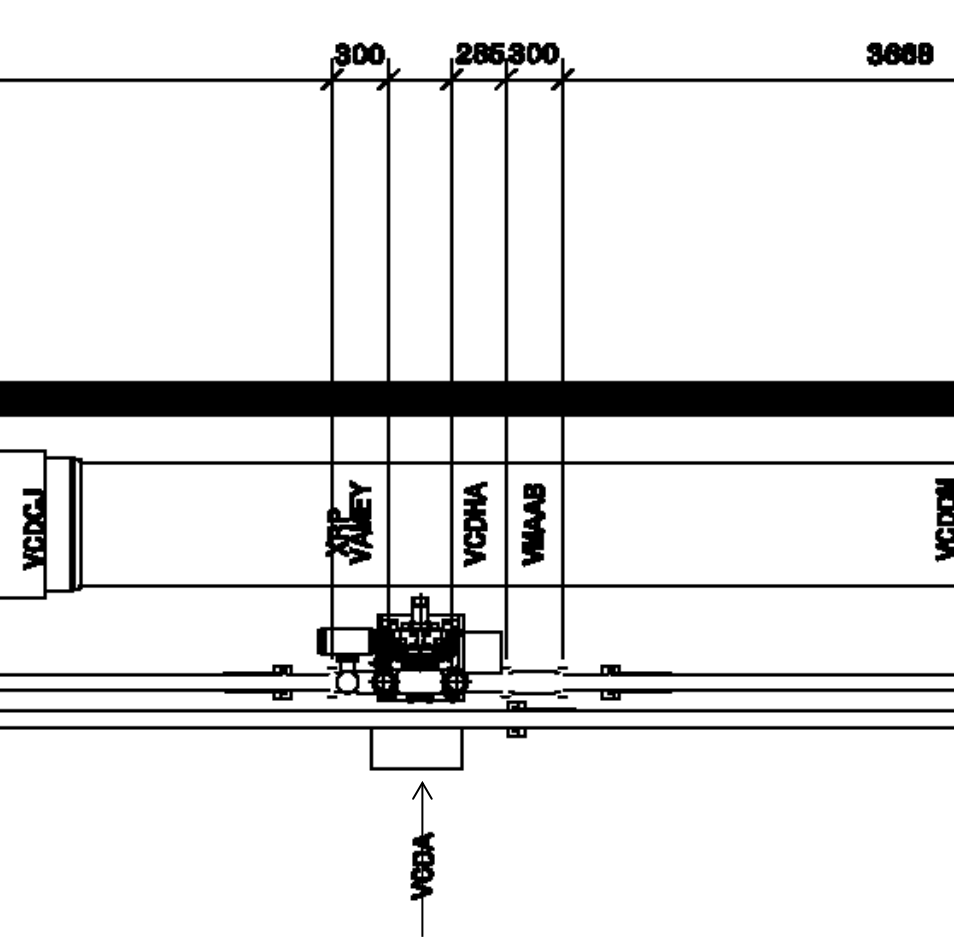
Engineering Change Request:

second review of vs. 0.3 closed on Aug 7 …

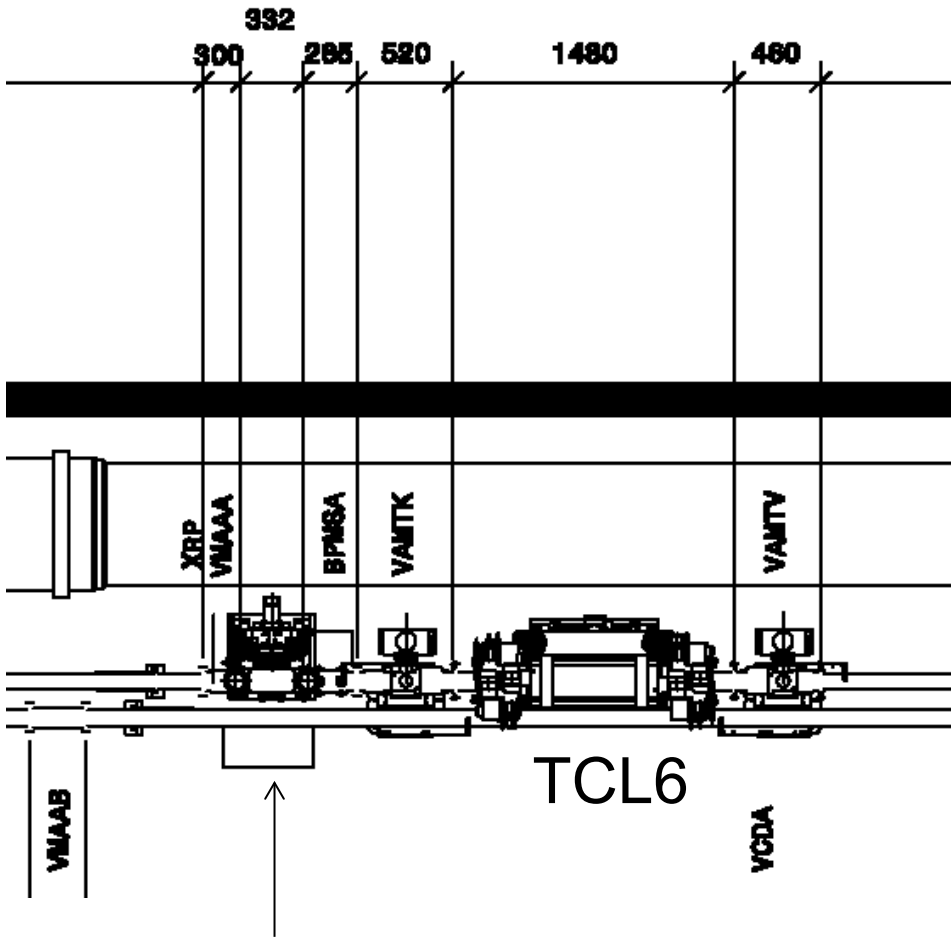
Accepted at LMC meeting Aug 26

Locations



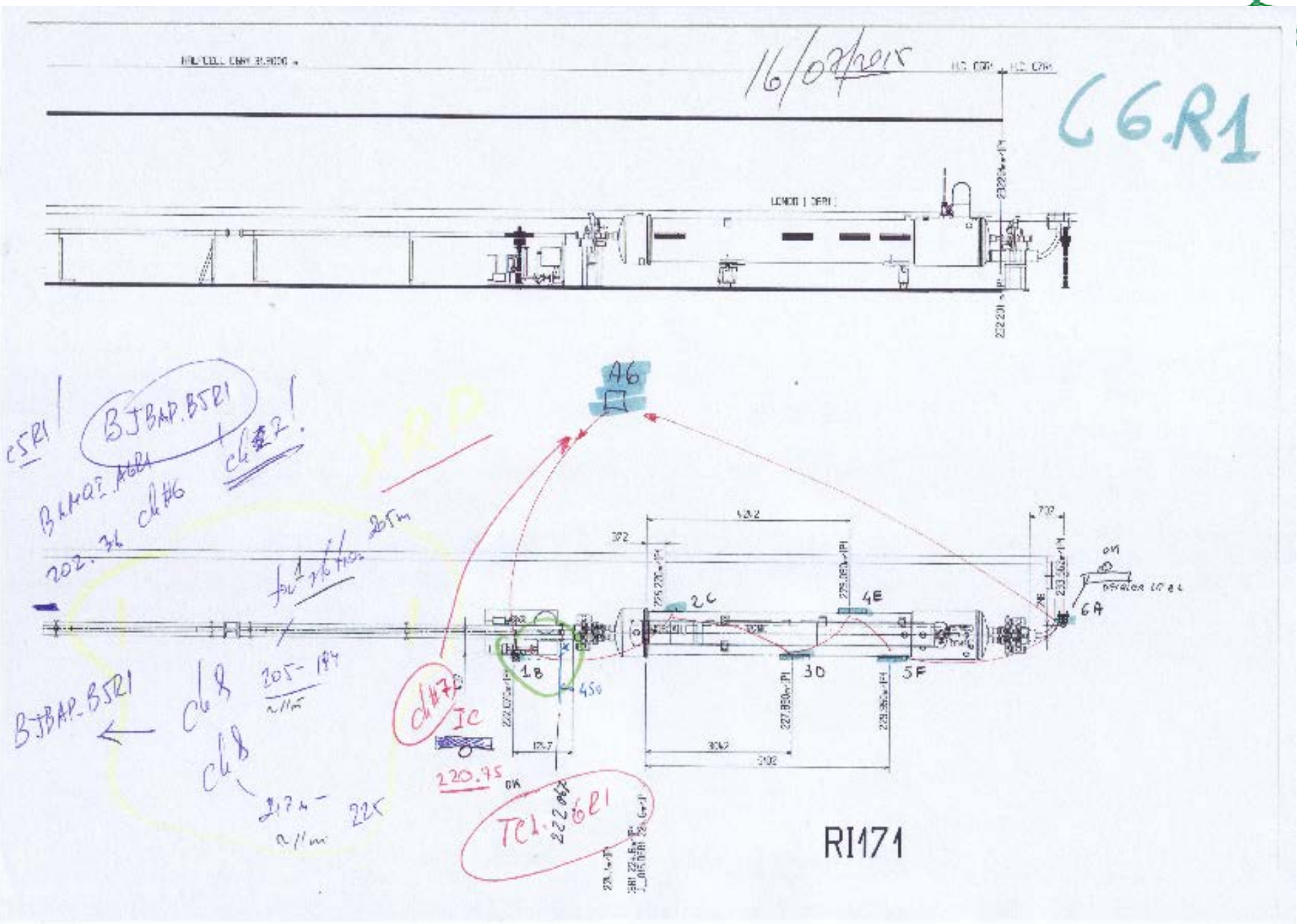


205.2 m



TCL6

217.3 m


16/07/2015
C6.R1
A6
2C
4E
6A
1B
3D
5F
RI171

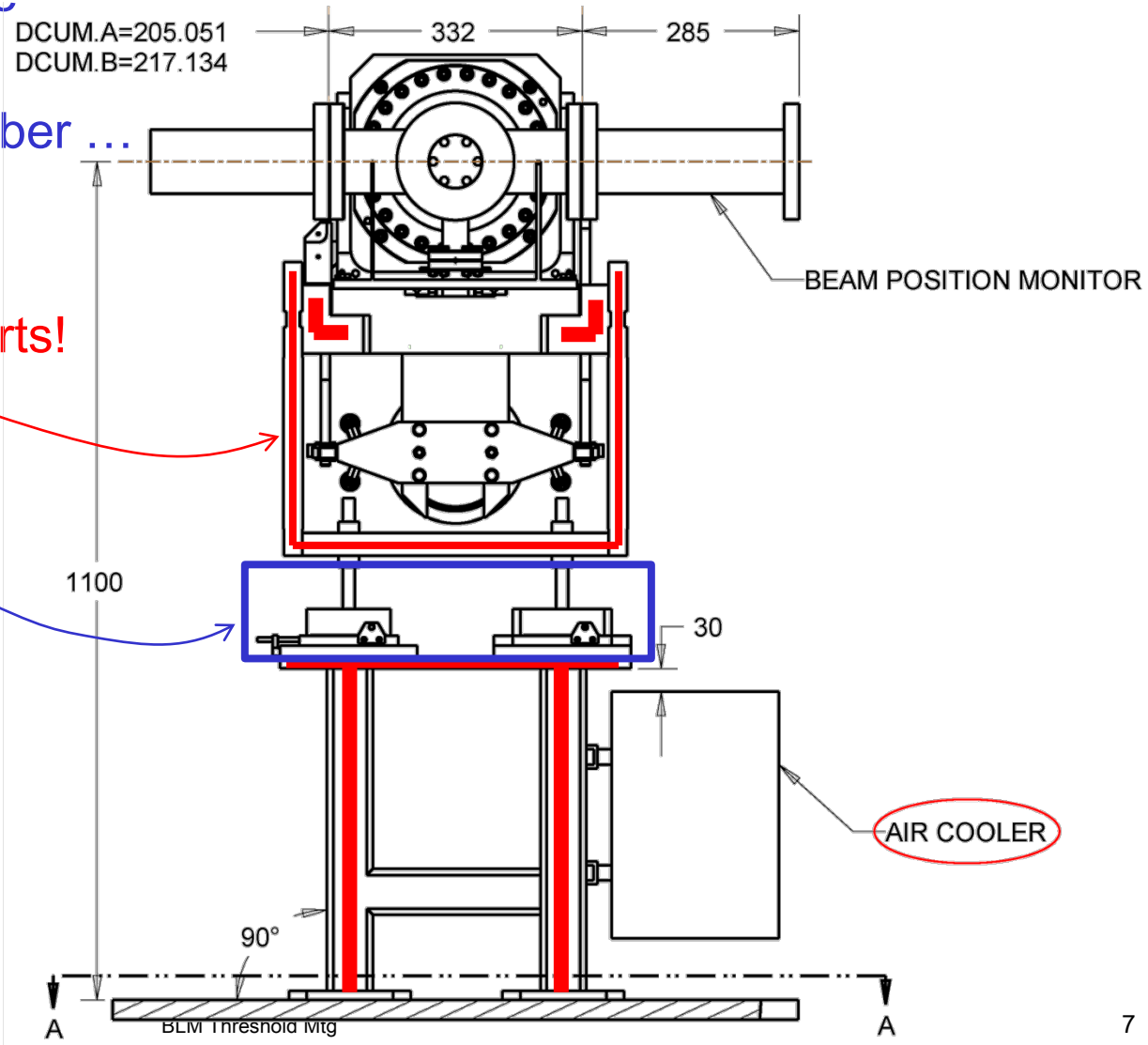
Roman Pot Stations

Vakuum Praha started

- close contact in Prague
  - Vit Vorobel will assist
- MR will visit in September …

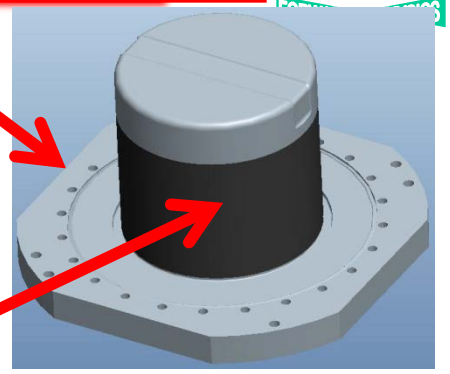
Michel Raymond's shop produced two XRP supports!

- delivered to SR1
- we still need:
  - the adjustable feet !
  - all the nuts & bolts

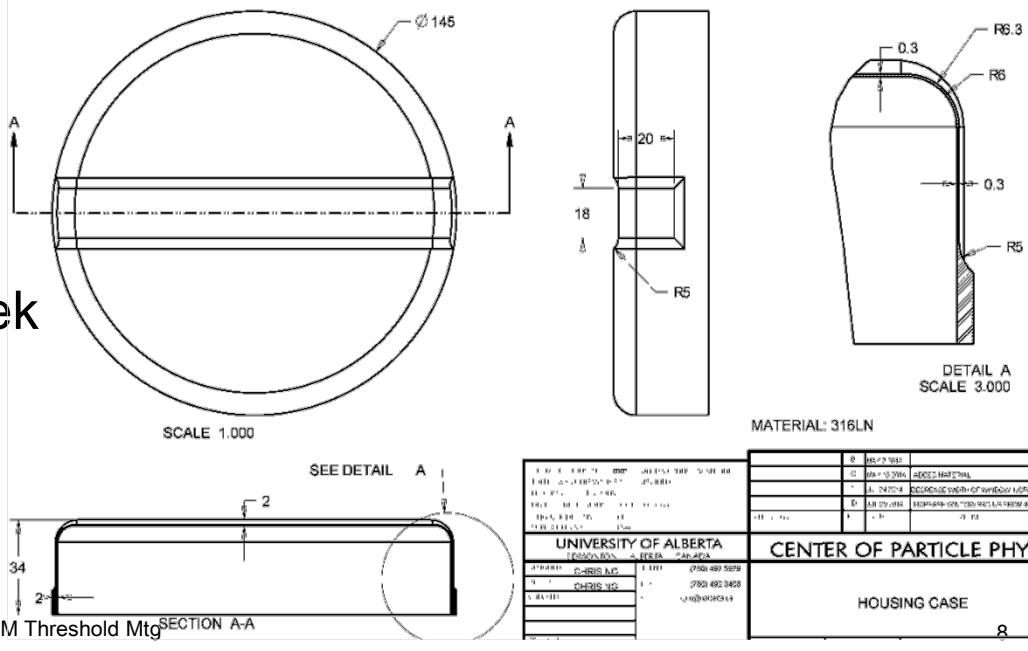


Roman Pot

- Have 2 pc 316LN rough flange (295 mm OD)
  - arrived at Alberta on June 26
  - machined



- Have 2 pc 316LN cylinders manufactured into “tubes”
  - manufactured tube at CERN (Chris Ng)
    - ID 141 mm, OD 145 mm, 83 mm long (0.7 kg)
  - ordered 4 pc more …
- 6 pc 3D Forged 316LN for pot bottom
- First pot back at CERN next week



Choice of Card material

- Requirements:
  - Need good thermal conductivity, do NOT need electrical circuitry
  - Need minimal interaction & radiation length
  - Stiff and precise
- Good heat conduction:
  - Conductivity PGS ~ Cu (in practice), Cu ~ 2x Al, Carbon-Fiber
  - Thus: Cu (+C-based substrate), or Al (+C-based substrate),
- Long Interaction length, X0:
  - PGS (+ C-based substrate), Al, Cu (2.5 times worse than Al)
- Stiffness, Precision:
  - PCB: OK, Al: OK

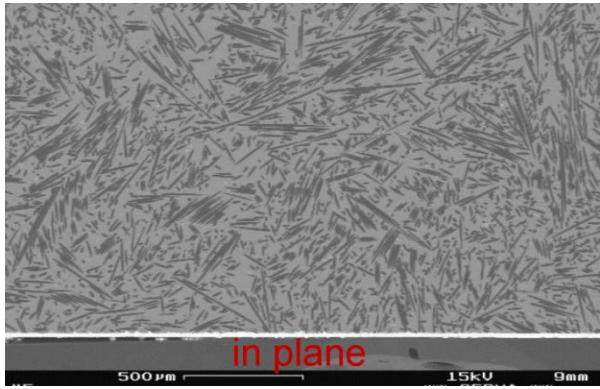
Fall-back: Al, 1mm,
with local thinning to 0.3 mm

Material	Thickness	θ_0	P_{Coll}	P_{Int}
	(cm)	(μrad)	(%)	(%)
Be	0.03	0.041461597	0.10%	0.07%
Al	0.03	0.088421083	0.12%	0.08%
Inconel 718R	0.02	0.184210737	0.19%	0.12%
SS 316L	0.03	0.217801393	0.29%	0.18%
Ti	0.02	0.116958447	0.12%	0.07%
Si	0.095	0.161507946	0.30%	0.20%
Cu	0.015	0.164194035	0.16%	0.10%
Kapton	0.085	0.068076487	0.14%	0.10%

Better Card Material

NOVAPACK: Carbon fibers embedded in Al matrix (4ppm: Cf 45% by mass)

- Excellent thermal conductivity (in plane)
- Low expansion coefficient
- Low density
- stiffer than Al



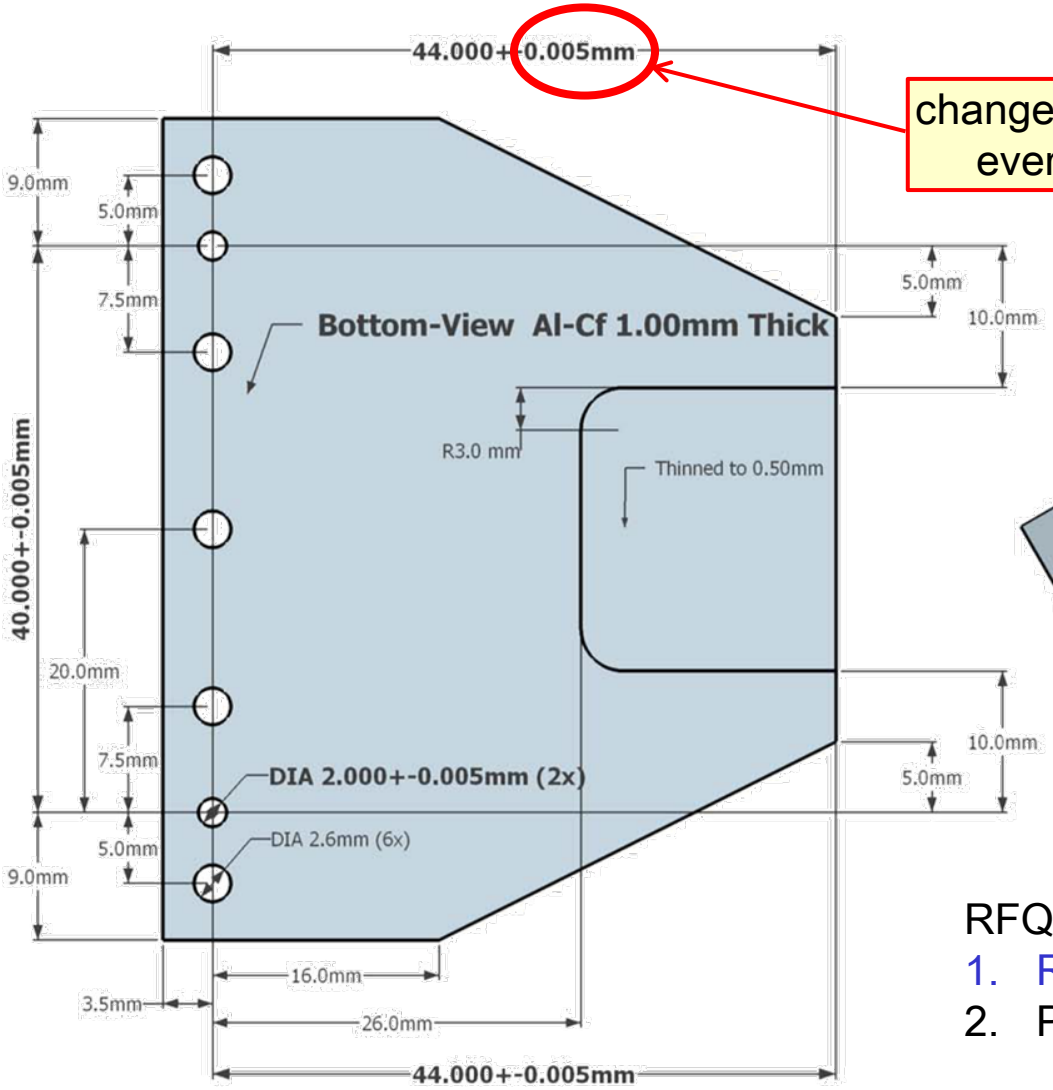
Proposed by Sebastien Michal

- possibly used in iTK

PROPERTIES	- 7	- 4
Thermal properties		
Thermal conductivity (W/m.K) / (X-Y)	200	230
Thermal conductivity (W/m.K) / (Z)	125	120
Specific Heat Capacity (J/kg.K)	880	850
Physical properties		
CTE 25 - 150°C (ppm/°C) / (X-Y)	7	4
CTE 25 - 150°C (ppm/°C) / (Z)	24	24
Density (g/cm^3)	2.46	2.4
Mechanical properties		
Young's modulus (GPa)	90	98
Flexural Strength (MPa)	160	185
Electrical properties		
Electrical resistivity (µohm.cm)	6.9	

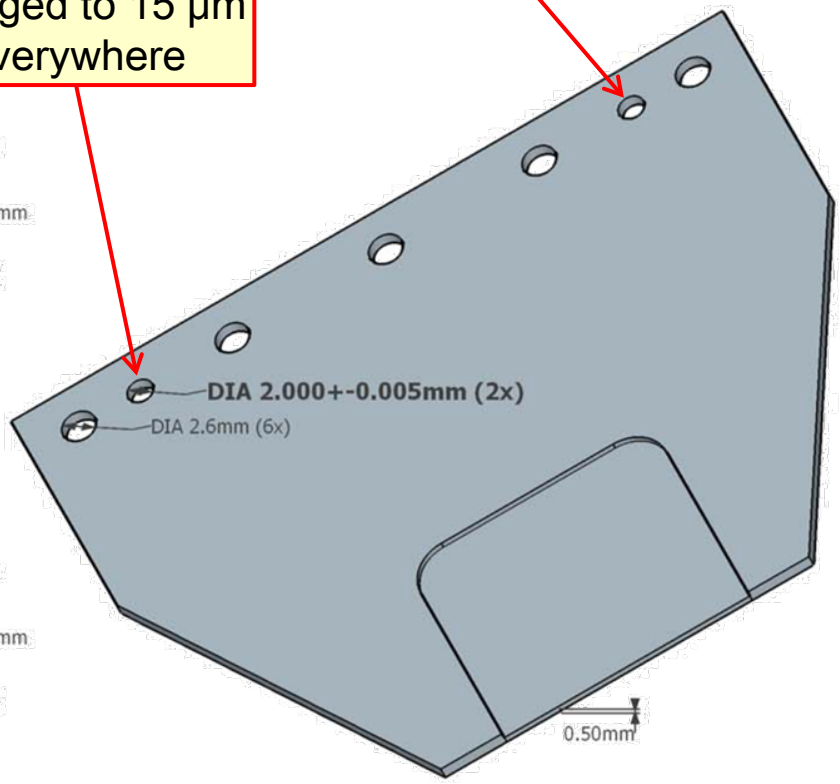
SiT Layer Card

- Card from Al-Carbon-Fibre (NOVAPACK)



changed to 15 µm everywhere

2.00 mm Ø dowel pin holes



RFQ sent to Frédéric Caillot at NOVAPACK:

1. Raw sheets with production in Bergen
2. Production by NOVAPACK

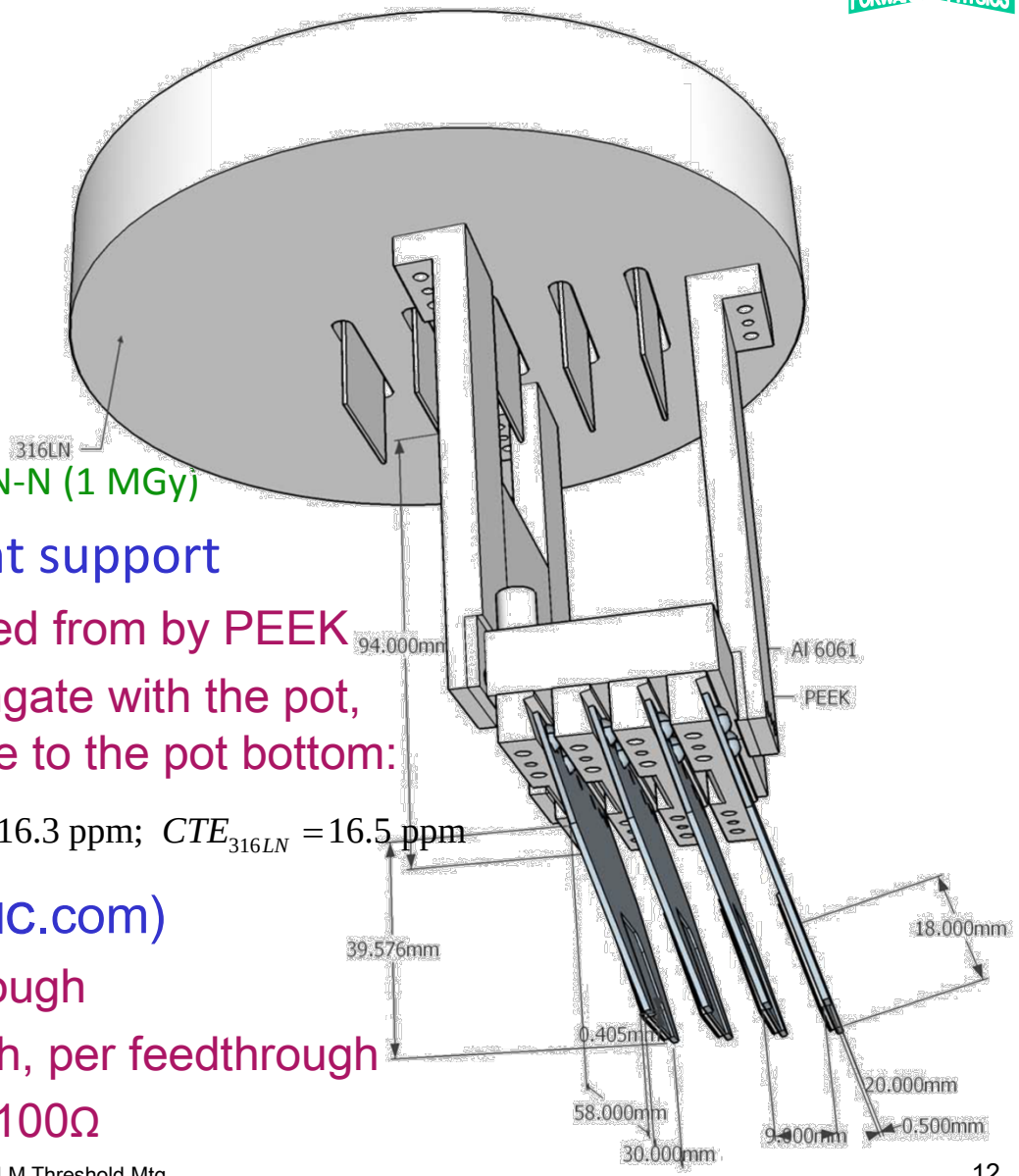
Holder (Draft Design)

Most material (except layer cards) outside the beam aperture (40 mm)

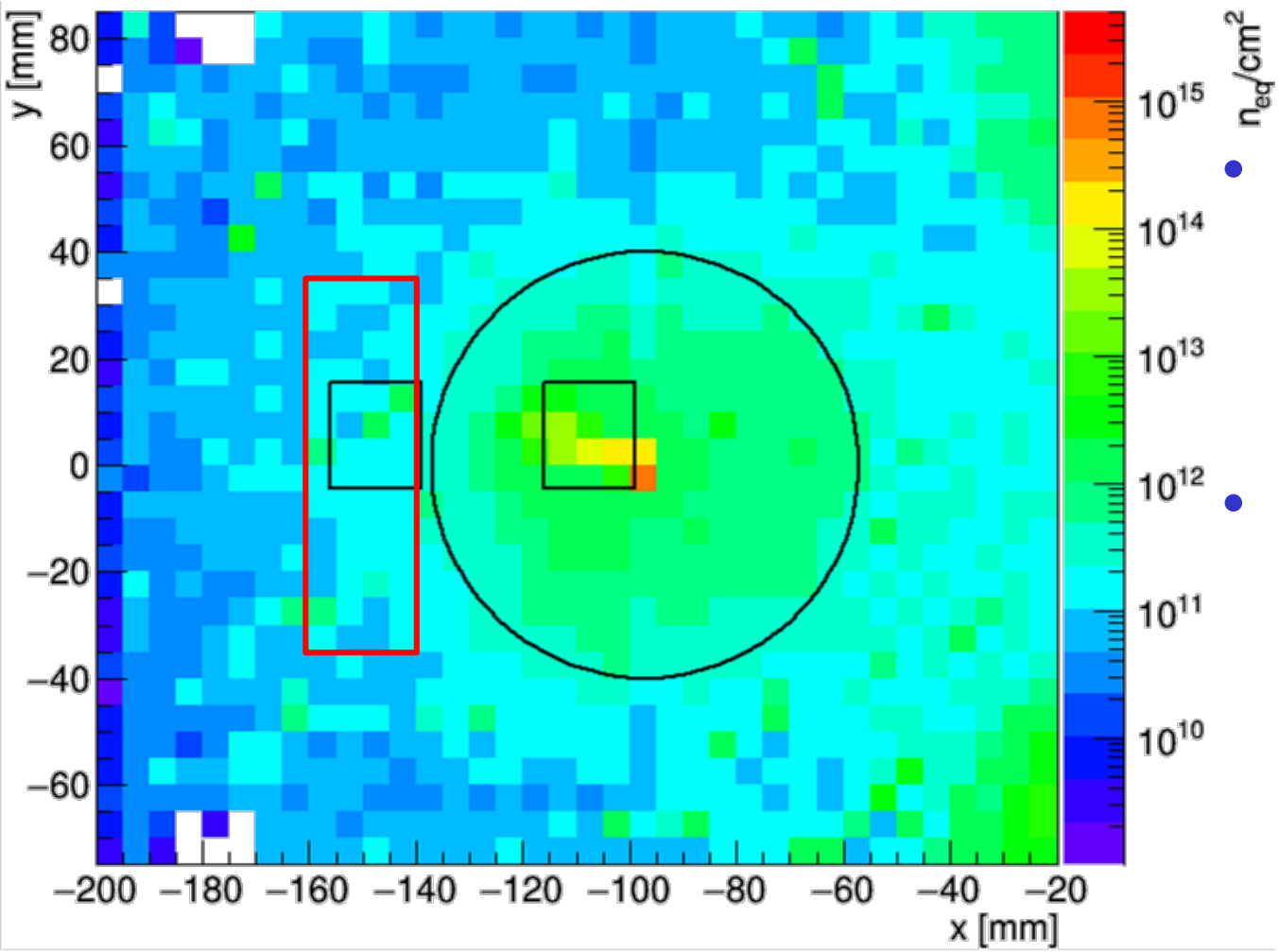
- Alu Tilt bars:
  - hold the cards at ~14°
  - thermal coupling between card and Al Heat-Exchanger
    - thermal vacuum grease APIEZON-N (1 MGy)
- Al (6061) pillars provide 3-point support
  - thermally/electrically de-coupled from by PEEK
  - same T as pot/flange; will elongate with the pot, and maintain constant distance to the pot bottom:

$$CTE_{Holder} = \frac{93\ \text{mm}}{134\ \text{mm}} CTE_{Al} = \frac{93\ \text{mm}}{134\ \text{mm}} 23.6\ \text{ppm} = 16.3\ \text{ppm};\quad CTE_{316LN} = 16.5\ \text{ppm}$$

- Feedthroughs: (www.NICOMATIC.com)
  - vacuum flat flex cable feedthrough
  - e.g. 50 strip lines, 0.5 mm pitch, per feedthrough
  - impedance options 50Ω, 75Ω, 100Ω



Interaction Length of the Holder



- Detector (black):
  - ~10^{14}neq/cm^2
  - Area 100 mm^2
  - λ_{int} = 1%
- Holder (red outline)
  - ~1×10^{11} n_{eq}/cm^2
  - note: statistics is poor …
  - Area 1400 mm^2
  - eff depth ~25 mm
  - λ_{int} = 6%

- relative interaction rate expected from frame compared to sensors:

$$\frac{1\times10^{11}}{1\times10^{14}}\frac{1400\ \text{mm}^2}{100\ \text{mm}^2}\frac{6\%}{1\%}\approx 10\%$$

Back-up

FFCs:

- Nicomatic + Hirose ZIF connectors
- Molex
- JAE, 20-100 cm long, 0.5,1 mm pitch, Z0=100 Ohm, price ~$10 @digikey, conns $2 @digikey