SVT Support Structure

Preliminary, Qualitative Design Study

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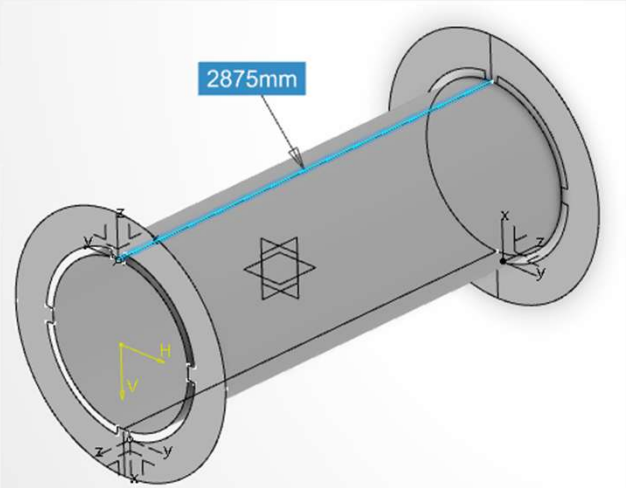
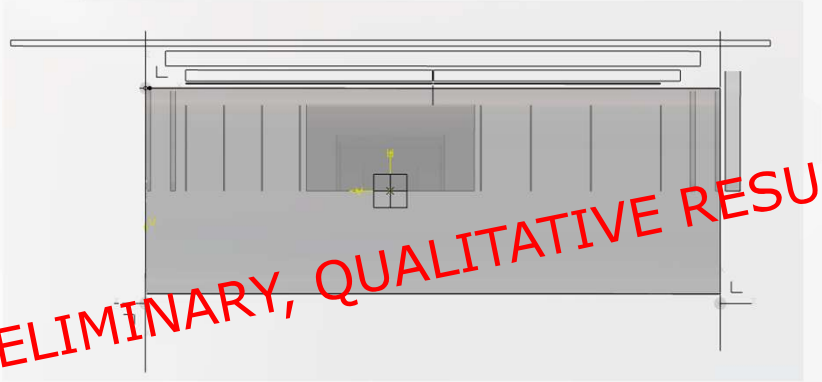
PRELIMINARY, QUALITATIVE RESULTS

Preliminary Design Study of SVT Support

- 3 design approaches to determine structure/mass efficiency of designs
- Generic tube of “correct” diameter 1028mm
  - HR40/EX1515 UD properties
- 300kg spread inside tube surface
- Engagement ring surrogate at each end
- Max deflection goal: <1mm



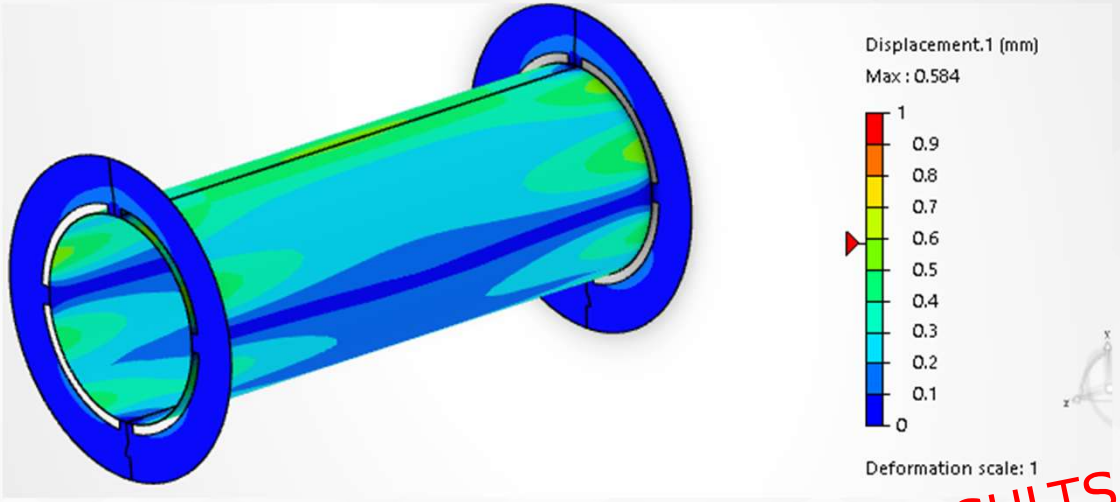


PRELIMINARY, QUALITATIVE RESULTS

- Option 1: solid tube
- Option 2: thinner solid tube with ribs
- Option 3: skeleton of ribs/stringers

Option 1a: Solid CFRP Tube

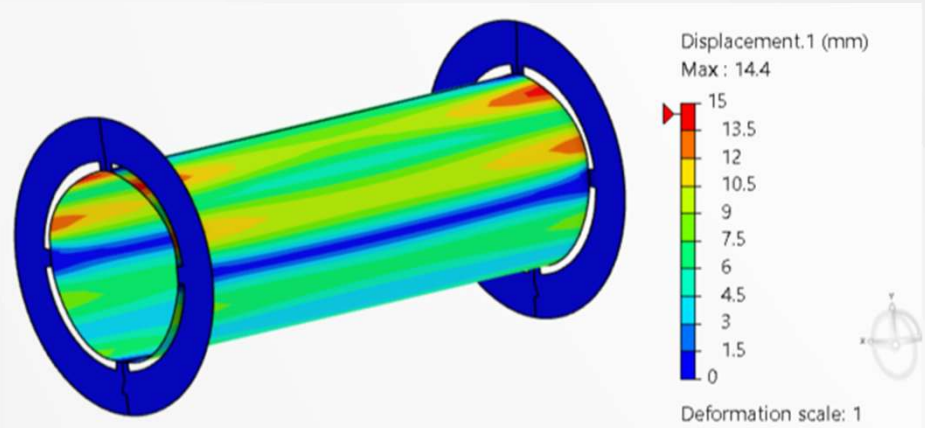
- 24 plies, 3.43mm thick cylinder
  - [0/45/-45/90]3s quasi-isotropic
- 0.6mm deflection



PRELIMINARY, QUALITATIVE RESULTS

Option 1b: Solid CFRP Tube

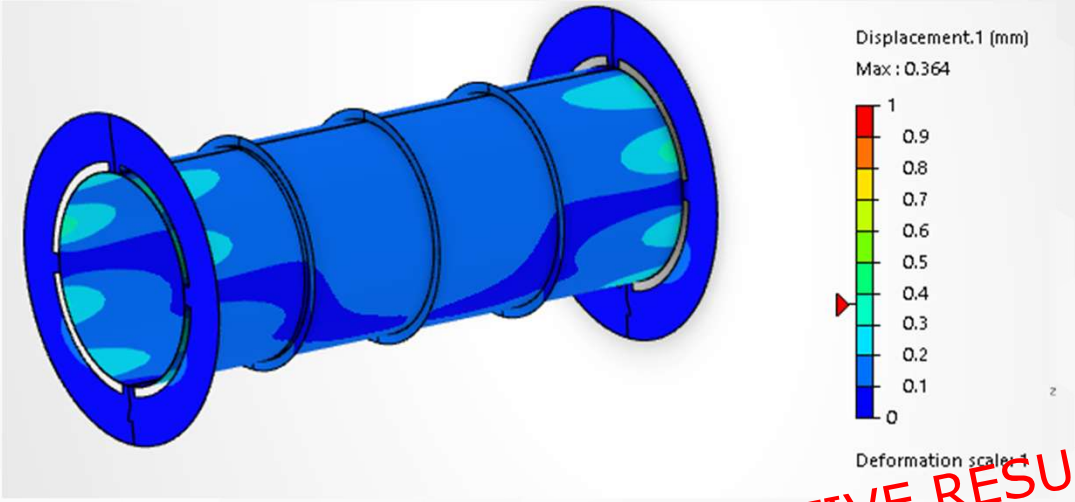
- 8 plies, 1.13mm thick cylinder
  - [0/45/-45/90] s quasi-isotropic
- 14.4mm deflection



PRELIMINARY, QUALITATIVE RESULTS

Option 2a: Solid CFRP with Ribs

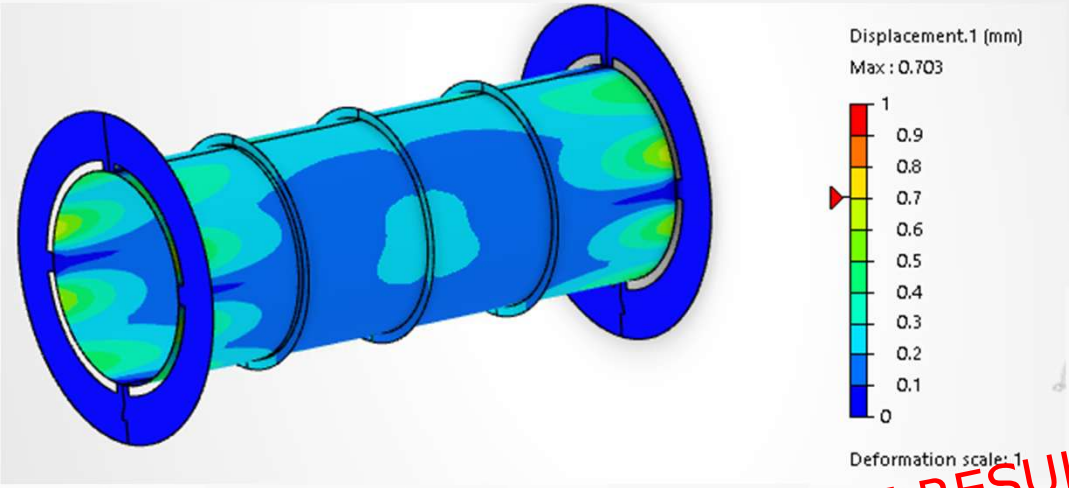
- 24 plies, 3.43mm thick cylinder
  - [0/45/-45/90]3s quasi-isotropic
- 50mm tall ribs, 1.14mm thick
  - [0/45/-45/90]3s quasi-isotropic
- 0.4mm deflection



PRELIMINARY, QUALITATIVE RESULTS

Option 2b: Thin Solid CFRP with Ribs

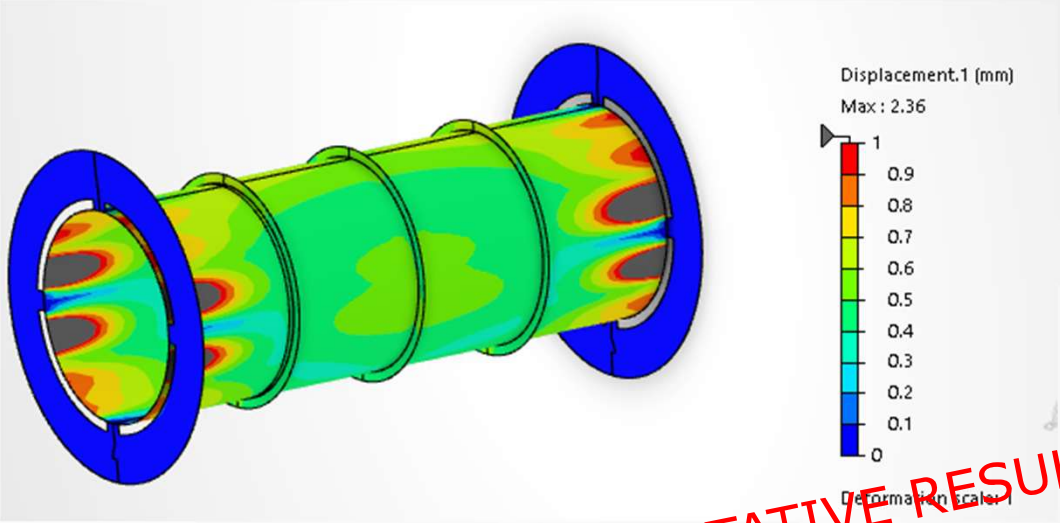
- 16 plies, 2.28mm thick cylinder
  - [0/45/-45/90]2s quasi-isotropic
- 50mm tall ribs, 1.14mm thick
  - [0/45/-45/90]2s quasi-isotropic
- 0.7mm deflection



PRELIMINARY, QUALITATIVE RESULTS

Option 2c: Thinner Solid CFRP with Ribs

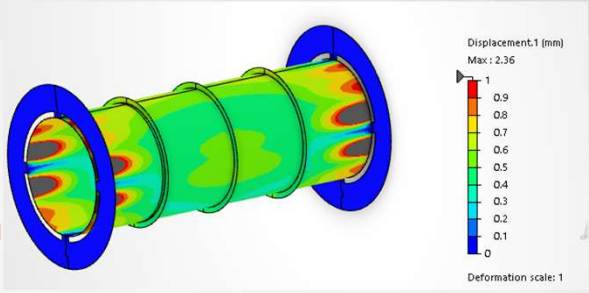
- 8 plies, 1.14mm thick cylinder
  - [0/45/-45/90]s quasi-isotropic
- 50mm tall ribs, 1.14mm thick
  - [0/45/-45/90]s quasi-isotropic
- 2.4mm deflection



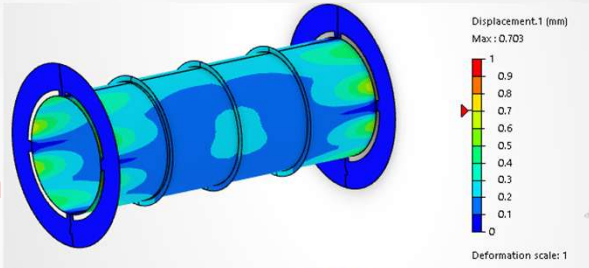
PRELIMINARY, QUALITATIVE RESULTS

Option 1 VS 2

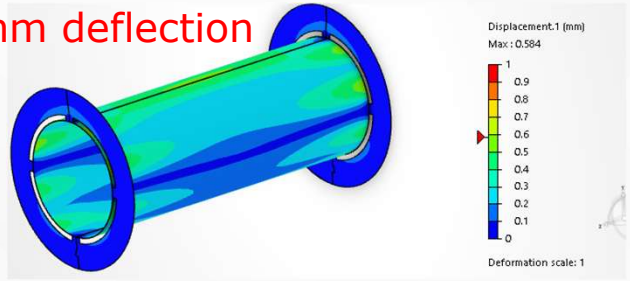
1.14mm thick
2.4mm deflection



2.28mm thick
0.7mm deflection



3.43mm thick
0.6mm deflection



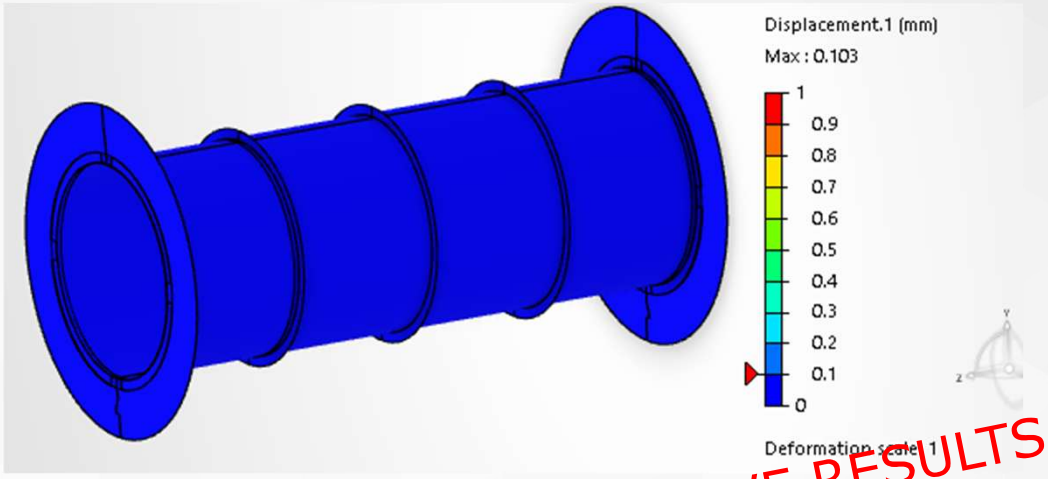
3.43mm thick
0.4mm deflection

PRELIMINARY, QUALITATIVE RESULTS

Option 2b: Thin Solid CFRP with Ribs

- 8 plies, 1.14 mm thick cylinder
  - [0/45/-45/90]s quasi-isotropic
- Add end ribs
- 50mm tall ribs (5), 1.14mm thick
  - [0/45/-45/90]2s quasi-isotropic
- 0.1mm deflection

- LESSON: stiffen the ends of open cylinders!
- We can add pass throughs to the 50mm tall ribs

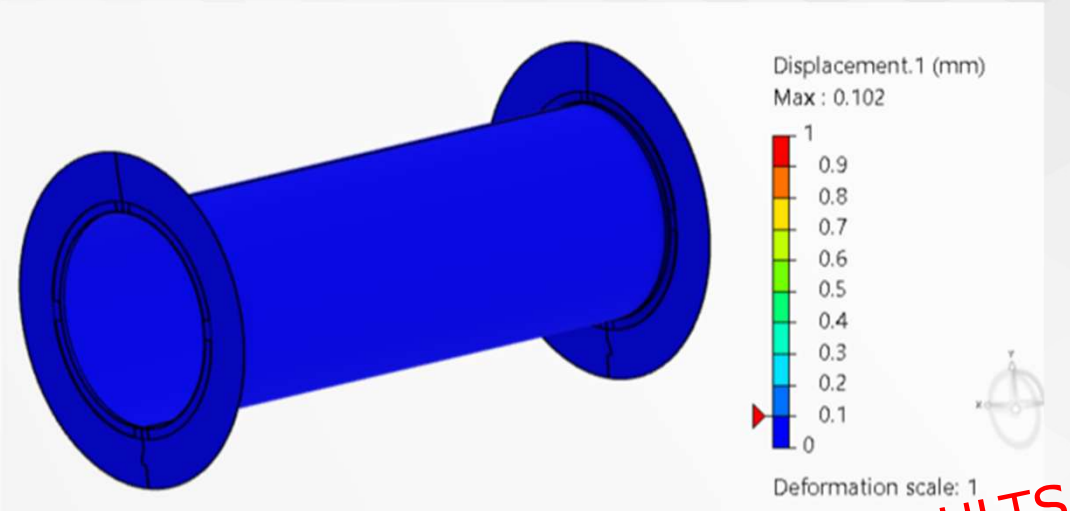


PRELIMINARY, QUALITATIVE RESULTS

Option 2c: Thin Solid CFRP with ONLY END Ribs

- 8 plies, 1.14 mm thick cylinder
  - [0/45/-45/90]s quasi-isotropic
- Add end ribs
- 50mm tall ribs (2), 1.14mm thick
  - [0/45/-45/90]2s quasi-isotropic
- 0.1mm deflection

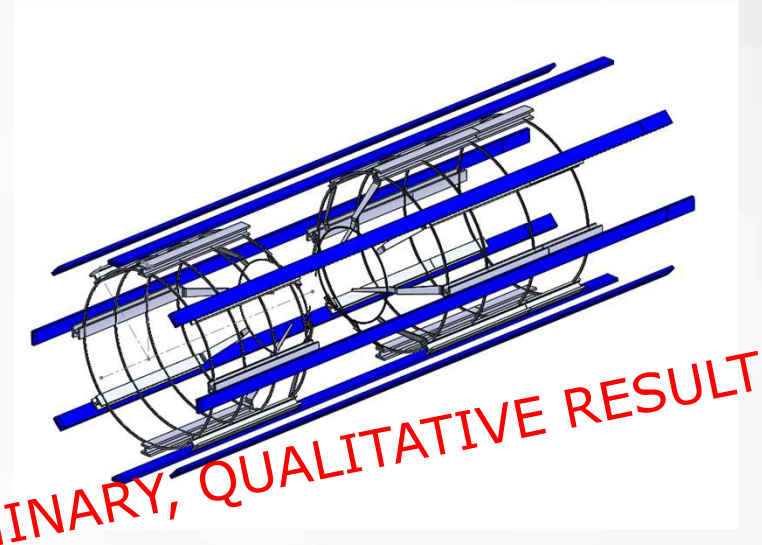
- LESSON: end stiffeners do all the work!



PRELIMINARY, QUALITATIVE RESULTS

Option 3: “Skeleton” Ribs and Stringers

- Design in progress, rough example proposal below



NOTES 29 January 2025

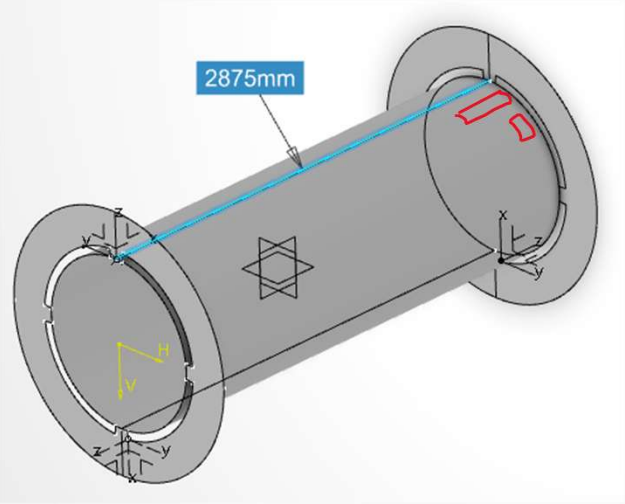
- Roland provide
  - Appx services exit locations and cross sections
  - Access to mass tables for discs and services
  - CC Ernst, Georg, Ben,
- Ben add better mass distribution, service cutouts

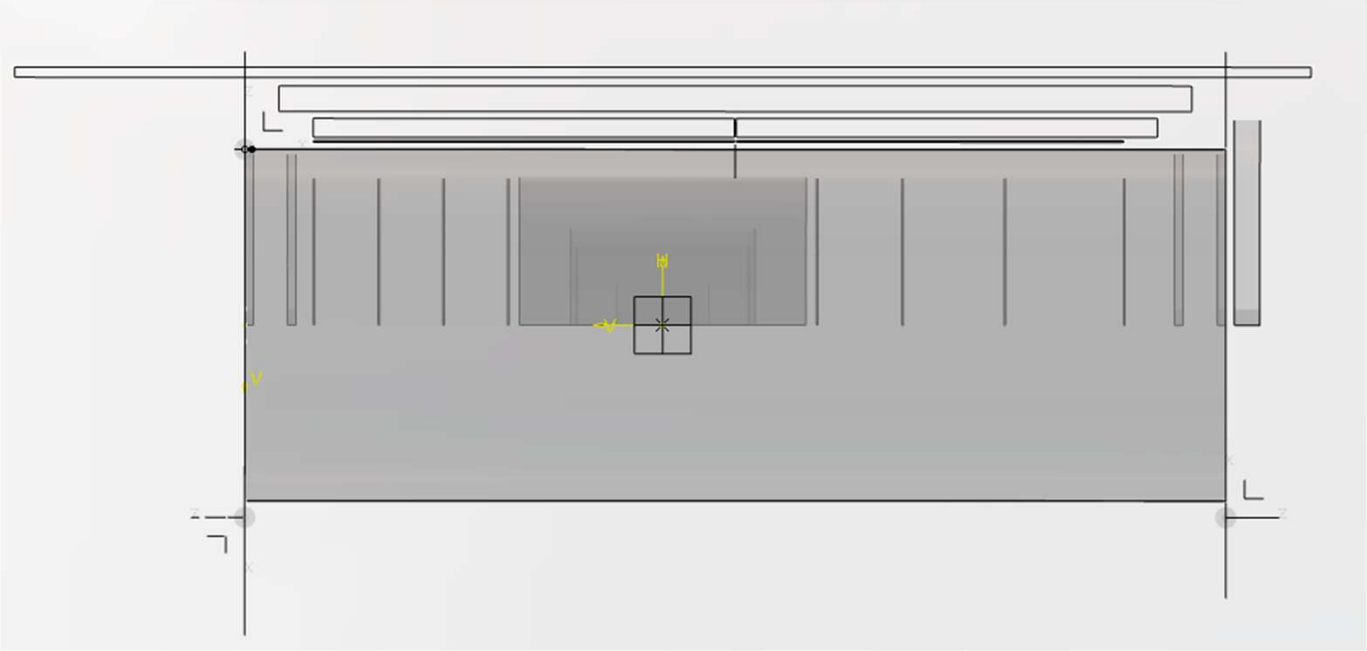
SVT Support FEA Plan

- Basic requirements
  - Support and connect ~300kg mass
    - SVT disks
    - SVT barrel “cone” with internal ribs
    - MPGD disks
  - Maximum deflection (<= ~0.5mm)
  - Split along X-Z plane for SVT assembly
  - Join cylinder halves mechanically prior to insertion
  - Supported by engagement rings (at least end two)
  - Pass through and support services
- Input needed – iterating with Roland
  - Service cross section data, sorted by
    - Z position
    - Radius min/max
    - Phi targets for cutouts
    - Total # of cutouts
  - Service mass/location estimates
  - Disk, barrel mass estimates
- Design refinement
  - Add preliminary services/disks mass
  - Add preliminary services cutouts
  - Use stress map to optimize material use

Services Cutouts

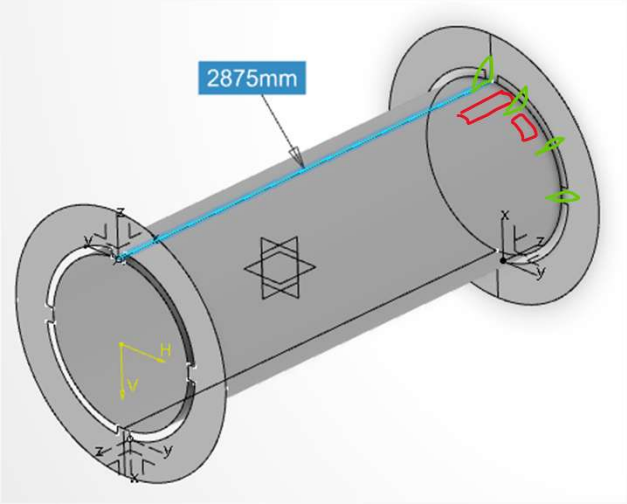
- From “Services Space Estimates”
  https://brookhavenlab.sharepoint.com/:x:/s/EICPublicSharingDocs/EdH38QZE9HpJrl039jn2-q4BbPvrMv7dTFiLV8--atclKw?rtime=GvZMjqdH3Ug

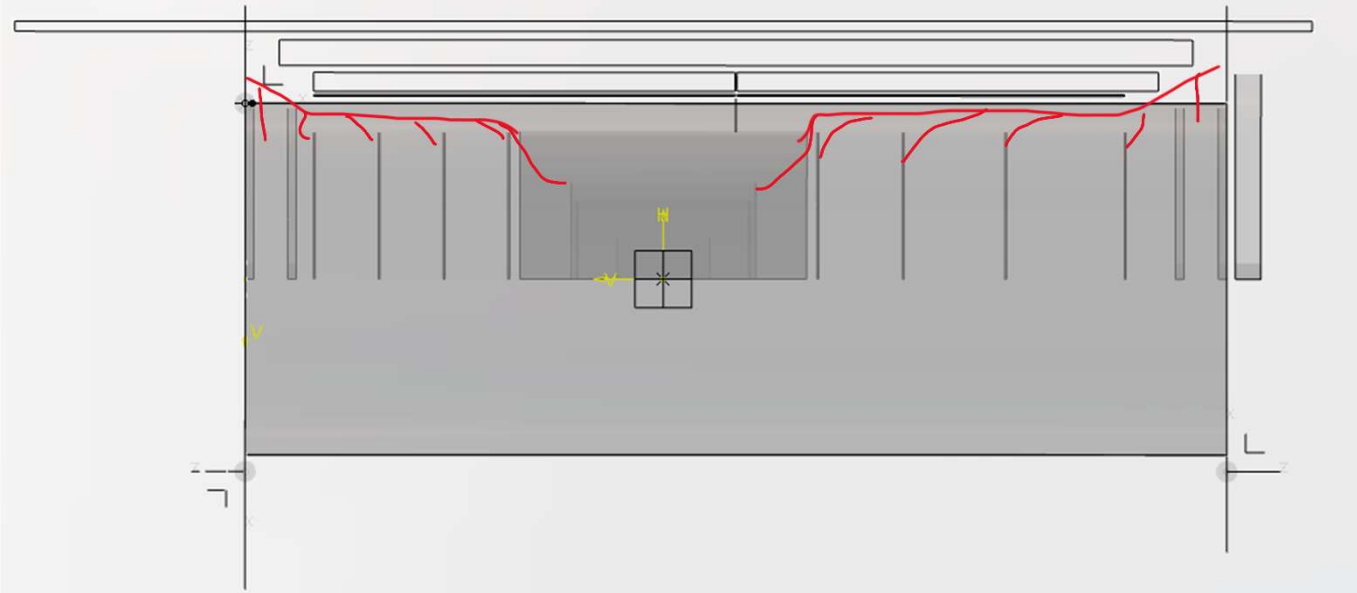




Services Cutouts

- Service routed “inside” of SVT support structure until end
- May require “gussets” to connect engagement ring to rest of support wth minimal cross section remaining after services openings added
- Work in 12 segments circumferentially





Services Totals Estimate – Roland Email 12 Feb 2025

- Total cross-sectional area needed for the backward SVT = Vertex + Sagita + Disks -> 147.66 + 275.25 + 867.34 = 1290.25 cm^2
- Total cross-sectional area needed for the backward MPGD disks = 154.20 cm^2
- Values are the same for forward direction services (right now)

Subsytem	Type	Item	Material	Quantity	Diameter (cm)	Cable Shape	Cross Area (cm^2)	+50% Packing for Bundles	+50% for MISC spacing needs	Available Space		
Red Path IP to pfRICH Inner face												
Vertex Silicon	Power	LV digital	Aluminium	12	0.8		6.03	9.05	13.57			
	Signal	Sensor Bias	Aluminium	34	0.2		1.07	1.60	2.40			
	Signal	Data *	Fibers?	204	0.6		57.68	86.52	129.78			
	Cooling	Cooling		12	0.3		0.85	1.27	1.91	147.66		
Sagita Silicon	Power	LV serial power	Aluminium	29	0.9		18.45	27.67	41.51			
	Signal	Signal Bias	Aluminium	771	0.3		54.50	81.75	122.62			
	Signal	Data *	Fibers?	771	0.2		24.22	36.33	54.50			
	Cooling	Cooling *		356	0.3		25.16	37.75	56.62	275.25		
Silicon Disks	Signal	Sensor Bias	Aluminium	1100	0.3		77.75	116.63	174.95			
	Cooling	cooling	tygon	550	0.63		171.45	257.17	385.76			
	Power	LV current	Aluminium	92	0.9		58.53	87.79	131.69			
	Signal	Data	Fibers?	1100	0.3		77.75	116.63	174.95	867.34		
Inner MPGD	Power	Hv	Copper	16	0.32		1.29	1.93	2.90			
	Power	LV		64	1.163		67.99	101.98	152.97			
	Cooling	Gas		32	0.4		4.02	6.03	9.05			
	Cooling	Cooling		128	0.625		39.27	58.90	88.36			
	Signal	Signal		64	1.1x0.2		0.44	0.66	0.99	254.26		
MPGD Disk	Power	Hv		16	0.32		1.29	1.93	2.90			
	Power	LV		32	0.9		20.36	30.54	45.80			
	Cooling	Gas		8	0.4		1.01	1.51	2.26			
	Cooling	Cooling		16	0.625		4.91	7.36	11.04			
	Singal	Signal	Ribbon	64	2x0.3		38.40	57.60	86.40			
	Signal	Fibers	Fibers	32	0.32		2.57	3.86	5.79	154.20		
AC LGAD TOF	Power	LV FEE		72	0.63		22.44	33.67	67.33			
	Power	HV FEE		144	0.15		2.54	3.82	7.63			
	Signal	Fiber *	Fiber	144	0.6		40.72	61.07	122.15	281.93		
	Cooling	Aluminum	Tygon	144	0.5		28.27	42.41	84.82	Available Space: Gap from CF tube to EEEMCAL is 71cm vs 67.3cm outer radii (dodecagon)		
	Total			6007			848.96	1273.44	2178.71	2252.05	Used space:	96.74%

NOTES 12February 2025

NEW

- Global Mech and Integration March 24th @BNL
  - Access process for visitors?
- TDR content due to Rahul
- SVT General 18 Feb
- SVT work fest maybe July 8-11

OLD

- Appx services exit locations and cross sections - Roland
- Access to mass tables for discs and services - Ernst
- Ben add better mass distribution, service cutouts