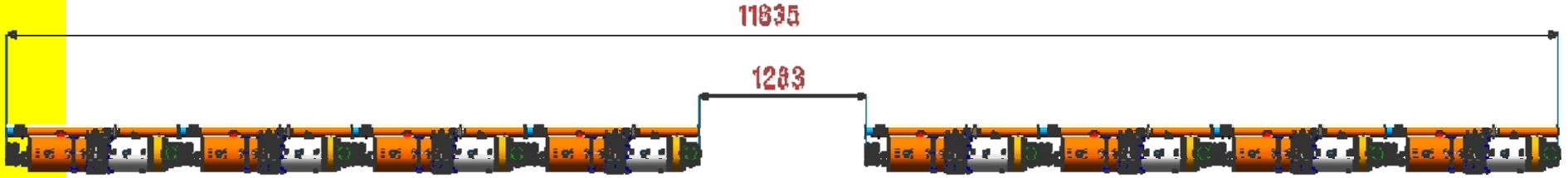
INFN MI Cryomodule design activities since Meeting #1

By Paolo Pierini

What we did and why



- We developed a **simplified** parametric model of CRY4
  - *Internal training activity* on a relatively large collaborative model
  - No nuts and bolts…
  - *Ground up from our CRY3 2D original tables*
  - Test bench for *new components* (blade tuner)
  - Spreadsheet based
  - Need to do in-house this first if we want to contribute to EDMS
  - 4 part time persons contributed to it
- String of eight cavities plus a “ghost” quadrupole
  - Cavity itself shortened from CRY3 model
- UGS NX, but using many Ideas parts

Design spreadsheets

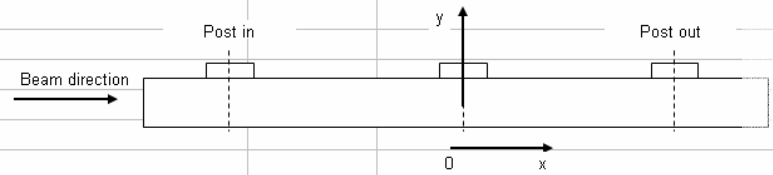
Generation IV cryomodule meeting at FNAL

Microsoft Excel - cry4.xls [Shared]

File Edit View Insert Format Tools Data Window Help

C17 — Distance of vessel support (in side) from the central post

Cryomodule type 4 input data



	Variable name	value	Notes	Check	
	General variables				
	Post_in_distance	5000.00 mm	Distance of lateral post (in side) from the central post	0.00	
	Post_out_distance	5000.00 mm	Distance of lateral post (out side) from the central post	0.00	
	Support_in_distance	4150.00 mm	Distance of vessel support (in side) from the central post	0.00	
	Support_out_distance	4150.00 mm	Distance of vessel support (out side) from the central post	0.00	
	Al_thermal_contraction_70K	-0.0040 mm/mm	Thermal contraction of Al shields from 300K to 70K	0.00	
	Al_thermal_contraction_4K	-0.0042 mm/mm	Thermal contraction of Al shields from 300K to 4K	0.00	
	SS_thermal_contraction_2K	-0.0031 mm/mm	Thermal contraction of SS from 300K to 2K	0.00	
	Ti_thermal_contraction_2K	-0.0016 mm/mm	Thermal contraction of Ti from 300K to 2K	0.00	
	Invar_thermal_contraction_2K	-0.0004 mm/mm	Thermal contraction of Invar from 300K to 2K	0.00	
	Cold mass related				
	Cavity_distance	1319.00 mm	Distance from the couplers of two subsequent cavities	0.00	
	coupler_from_flange_distance	60.00 mm	Distance of coupler axis from the cavity flange	0.00	da controllare
	Cavity_connection_length	63.00 mm	Length of steel bellow and flanges of cavities connections	0.00	
	Quad_pack_length	1220.00 mm	Length of quadrupole and steering package (without bellows of connection to the cavities)	0.00	da controllare
	Quad_distance	100.00 mm	Longitudinal distance of quadrupole center from the central post	0.00	da definire
	Pad_from_flange_distance	410.00 mm	Distance of pad B vertical midplane from the cavity flange	0.00	da controllare
	Rod_fixing_from_flange_distance	250.00 mm	Distance of fixing point of the cavity to the invar rod from the cavity flange	0.00	da controllare
	Rod_fixing_from_zero	200.00 mm	Distance of fixing point of the invar rod from the center post midplane	0.00	
	HeGRP_in_projection_length	200.00 mm	Length of HeGRP outside the first beamline flange	0.00	
	HeGRP_out_projection_length	100.00 mm	Length of HeGRP outside the last beamline flange	0.00	
	String_length_with_quad	11772.00 mm		0.00	
	String_length_without_quad	10489.00 mm			
	4K shield related				
	in_projection_length_4K	200.00 mm	Length of 4K shield outside the first beamline flange	0.00	

CRY4 / VV / 70K / 4K / ColdMass / String / Cavity / Tubing /

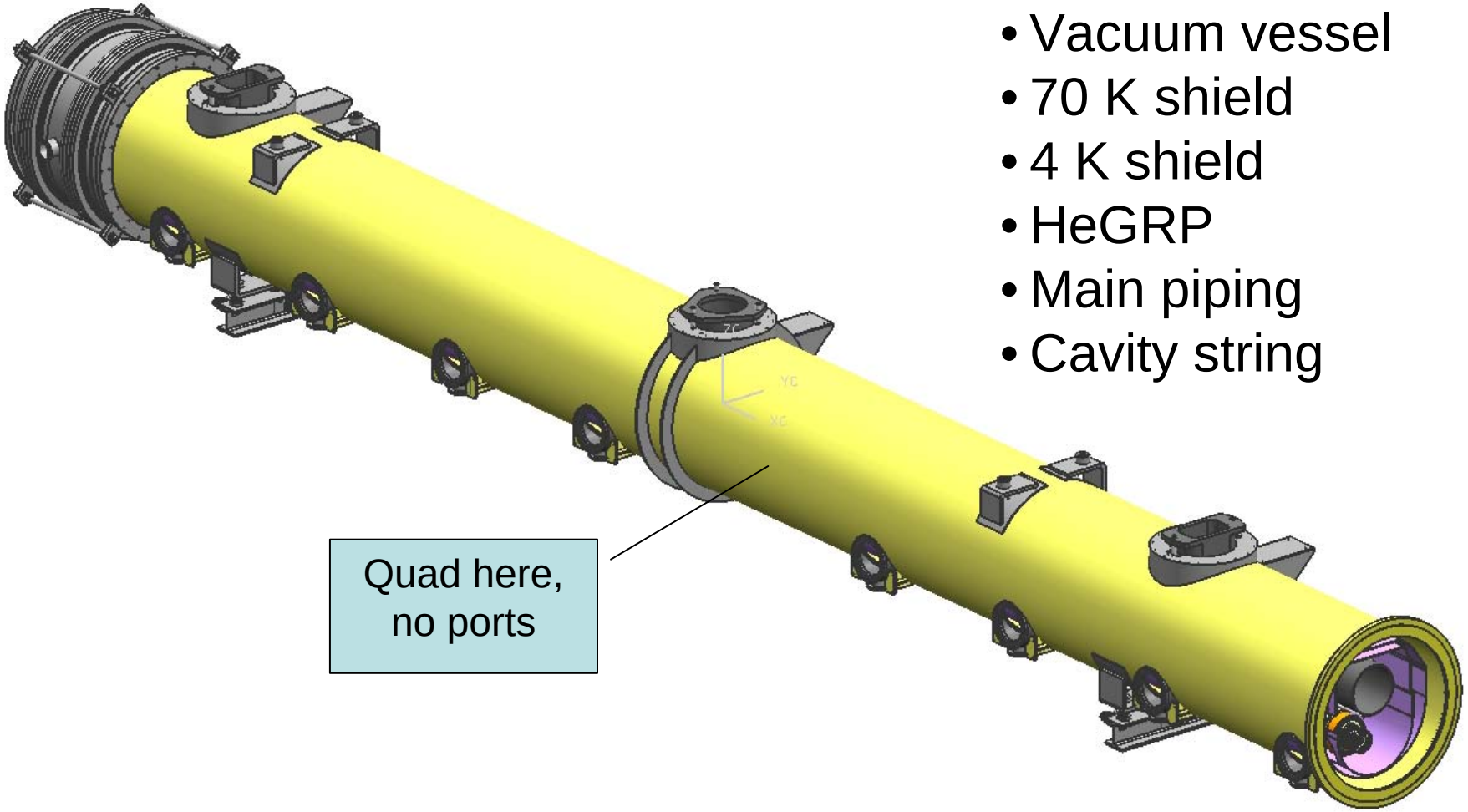
Draw AutoShapes

Ready

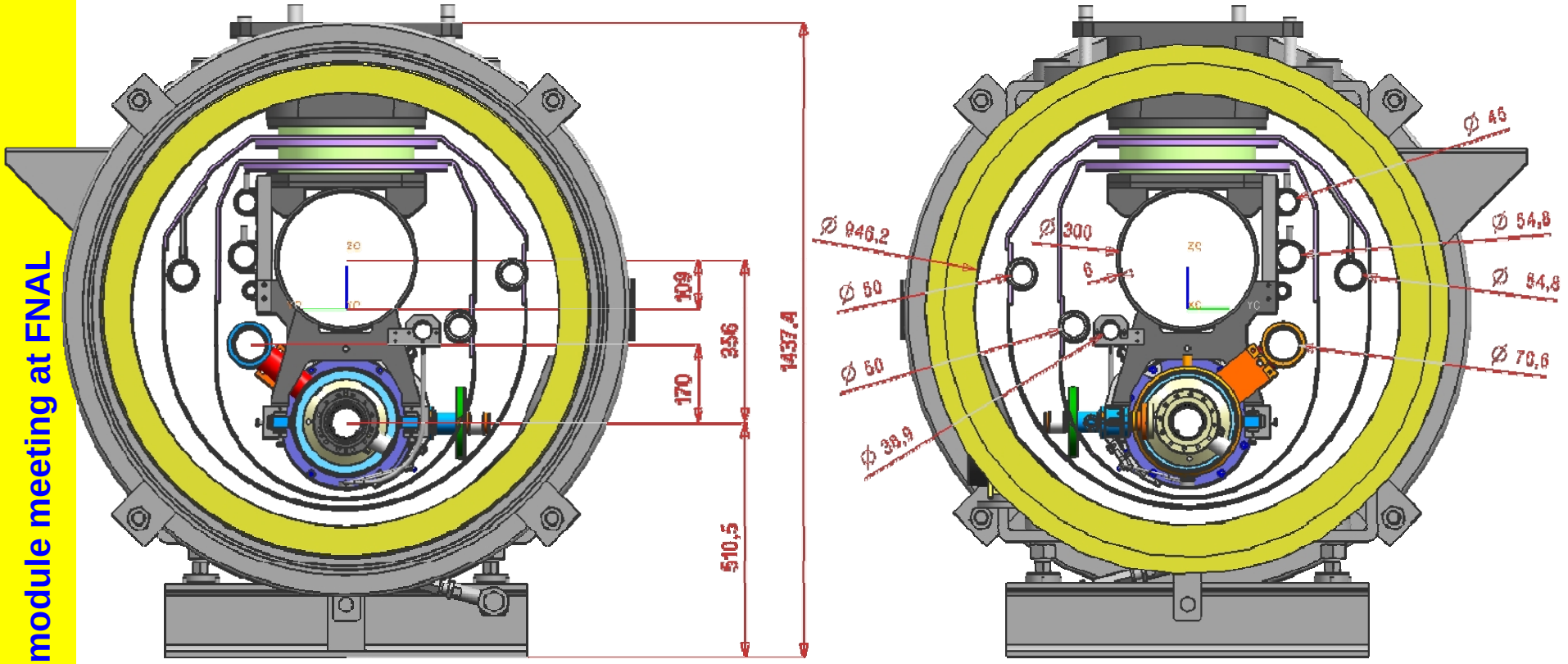
Dimensioning is driven from spreadsheet, in a very similar way to Don modeling

Main components were modeled

- Vacuum vessel
- 70 K shield
- 4 K shield
- HeGRP
- Main piping
- Cavity string

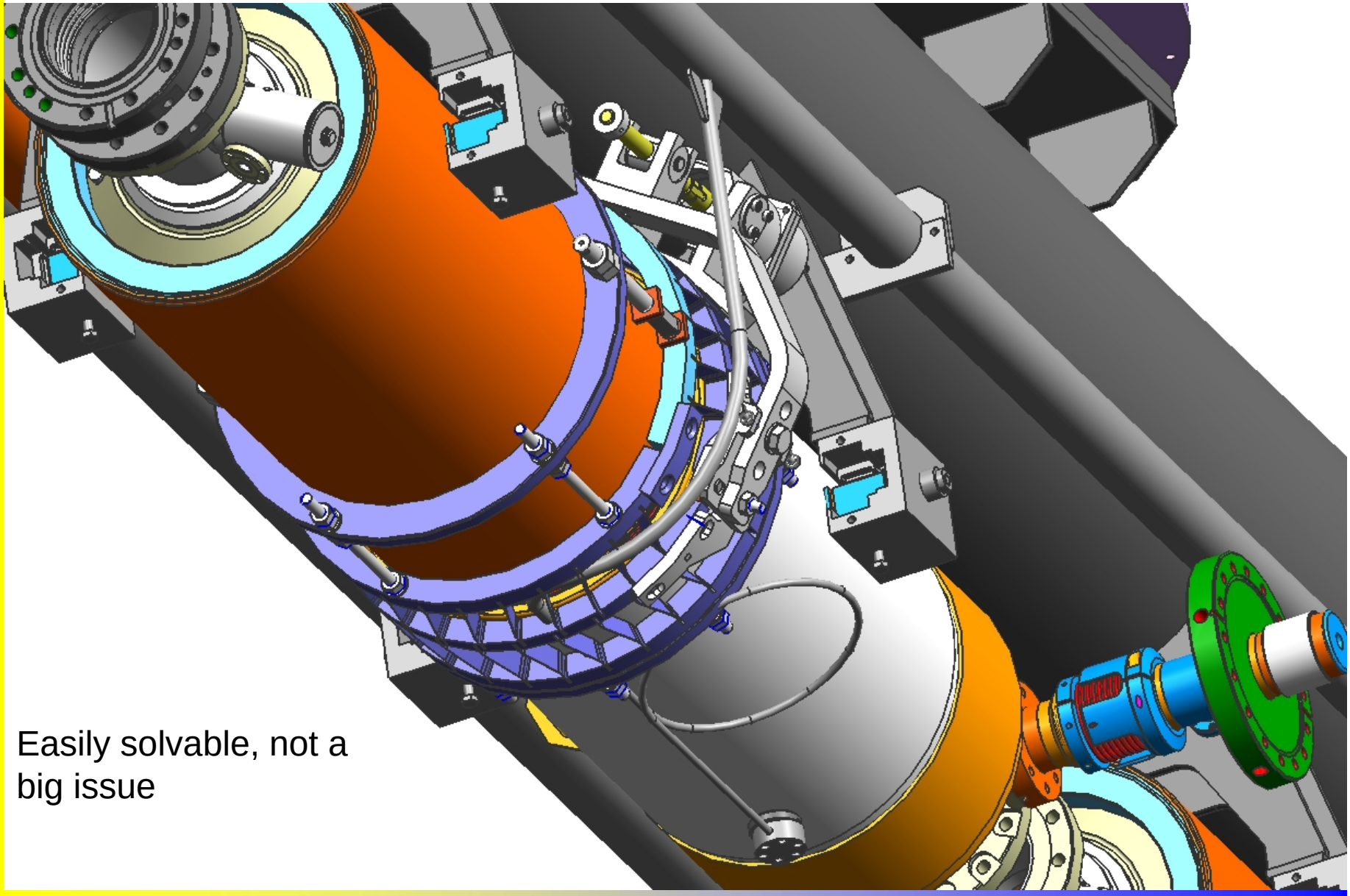


Cross sections



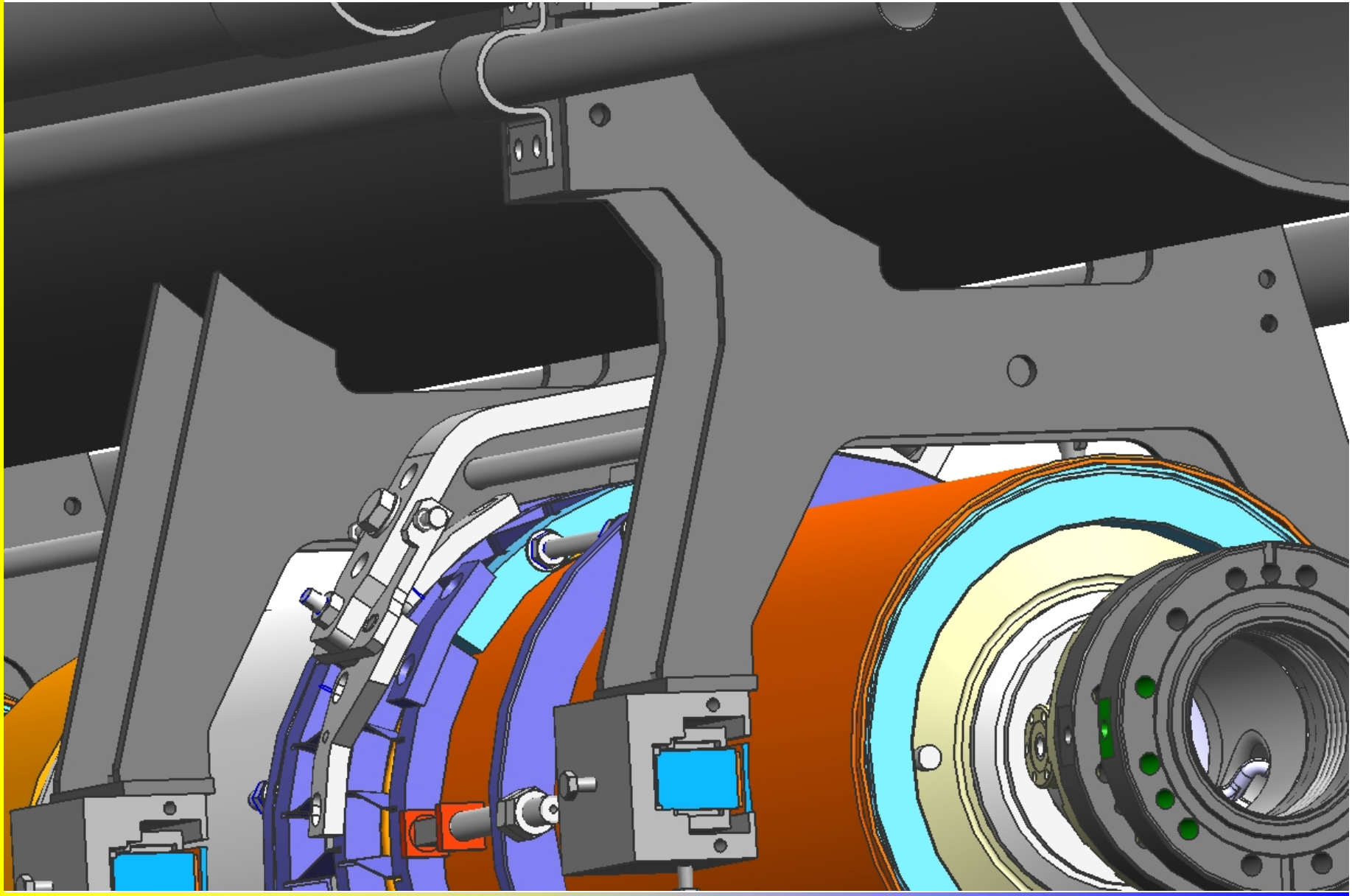
- Model has been our test environment for module design issues
  - Mechanical interferences
  - Modifications to main components

Small interference with cooldown/warmup pipe



Easily solvable, not a big issue

Clearance for the blade tuner/invar rod



Checking increase of pipe sizes

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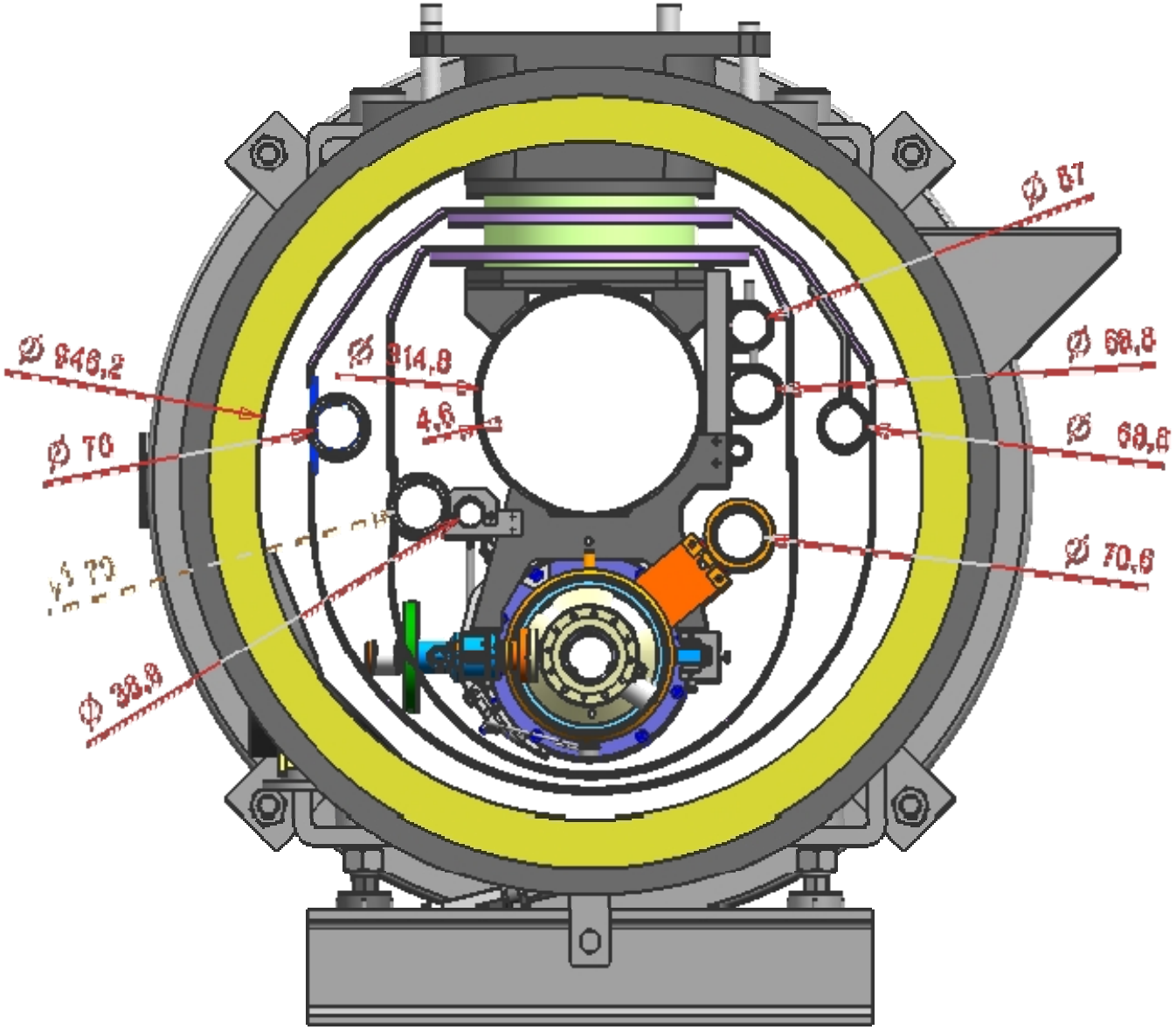
Parametric model allows to check increase of inner pipes

This is an example of the impact of larger piping (dimensions converted to standard inch pipes)



Contribution to T4CM

- We feel we can start contributing soon to the T4CM in EDMS integrating the model for the blade tuner
  - This exists in two flavours:
    - Existing complete prototypes (2) using “superstructures” ring assemblies (and we have other 4 ring assemblies)
    - “Light” version (the one presented here) for cost reduction (less material, less machining and welds)
  - Will load Italian drawing package and 3D assembly, that can be used for US drawing package