



THE INTERNATIONAL DESIGN STUDY  
FOR THE NEUTRINO FACTORY

Muon Front End  
Buncher, Phase Rotation,  
Cooling Schematics & CAD model  
based on MICE Cavities

Alan Grant

Daresbury

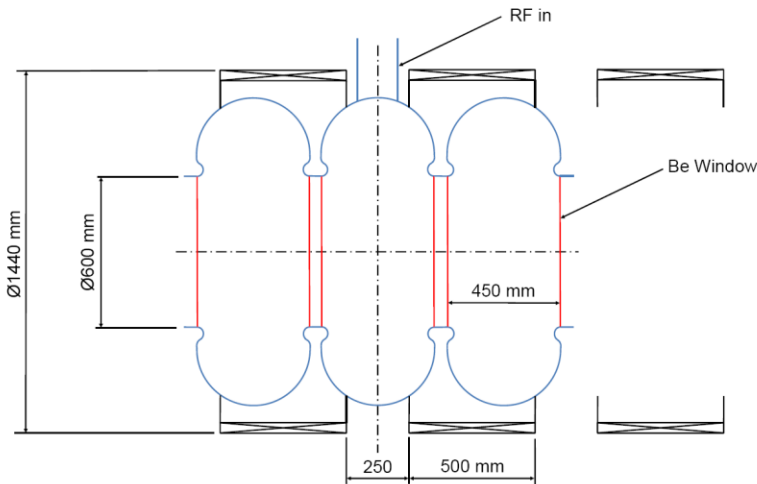
(April 10, 2012)



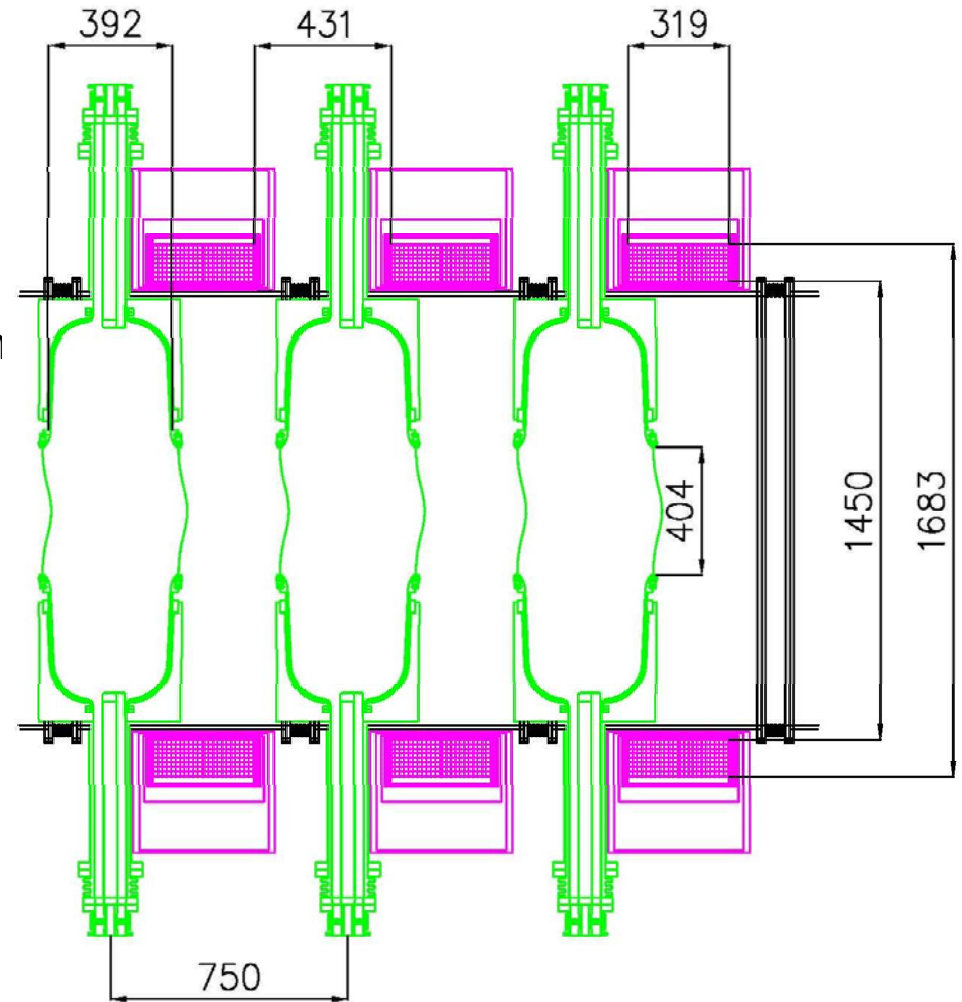
# Buncher Cavity / Coil Module

## CAD Cavity/Coil Model – Based on MICE

- coil length 0.319m – **NOT** 0.5m as schematic
- coil dia 1.45m
- coil radial thickness 0.116m
- cell length 0.75m
- gap between coils 431mm – **NOT** 120mm as in schematic, bellows & vessels required.

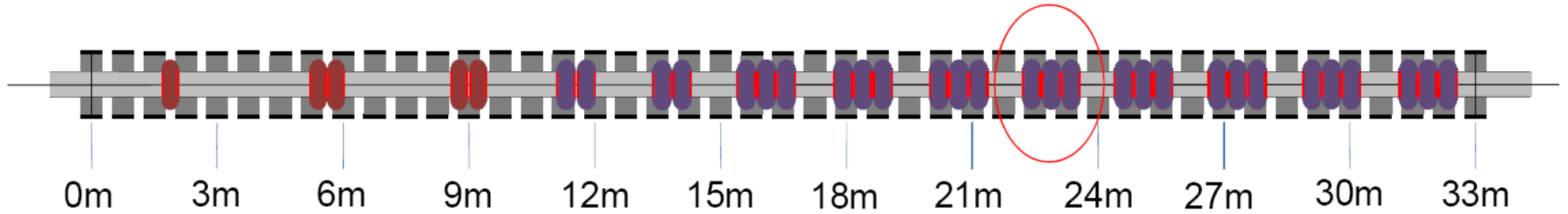


Schematic Cavity/Coil Model

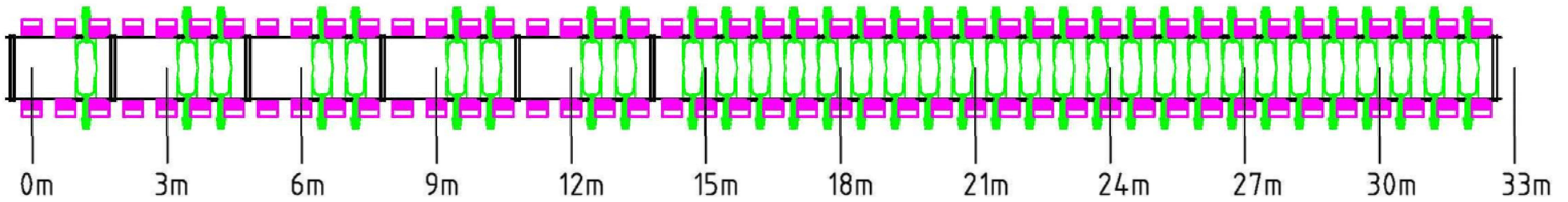


Buncher Cell

# Buncher



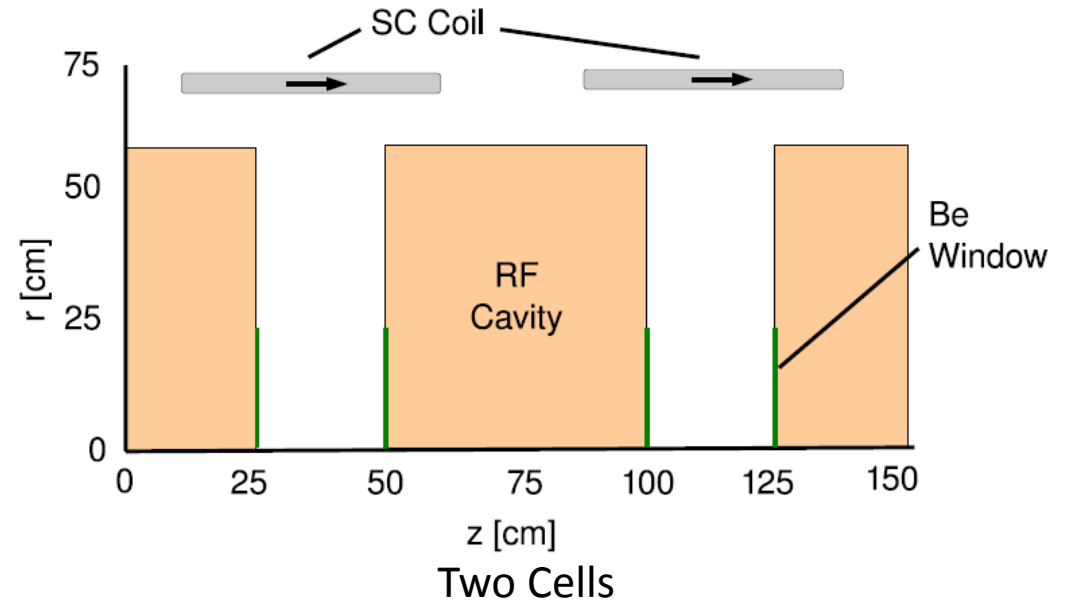
Schematic Layout



CAD Layout based on MICE cavities

# Phase Rotation

- Phase Rotation section consists of 56 cells 0.75m in length
- Total section length 42m
- 56 normal conducting RF cavities and 56 superconducting coils
- Cavities organised in 15 groups of the same RF frequency over range 230.2 – 202.3 MHz, gradient 12 MV/m.
- Cavity and coil length 0.5m



cavity :	group with same frequency	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	frequency [MHz]	230.19	226.13	222.59	219.48	216.76	214.37	212.48	210.46	208.64	206.9	205.49	204.25	203.26	202.63	202.33
	Voltage total [MV]	18	18	18	18	18	18	18	18	24	24	24	30	30	30	30
	n of cavities of the same MHz	3	3	3	3	3	3	3	3	4	4	4	5	5	5	5
	Gradient [MV/m]	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Power peak [MW]	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.6	2.6	2.6	2.6
	phase shift [deg]	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	length of cavity [m]	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	length of cell [m]	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	z start of the 1st cell in group [m]	112.98	115.23	117.48	119.73	121.98	124.23	126.48	128.73	130.98	133.98	136.98	139.98	143.73	147.48	151.23
	Iris Radius [m]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	wall thick of Be window [m]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
coil :	Length [m]	0.5														
	Inner radius [m]	0.68														
	Radial thickness [m]	0.04														
	Current Density [A/mm <sup>2</sup> ]	47.5														
	Total Number of coils	180														
	<b>TOTAL LENGTH OF SECTION [m] total cavities</b>	<b>42 (56)</b>														

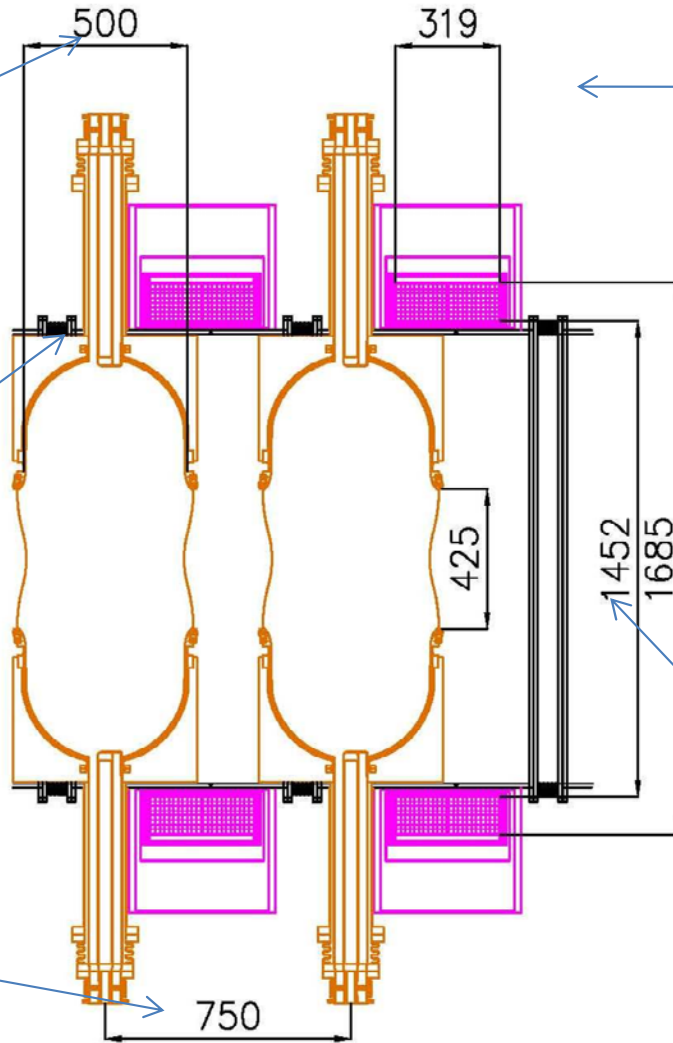


# Phase Rotation CAD Model

Cavity based on MICE cavity but stretched to 0.5m.

Bellows required. Only place to position these is between coupling coils.

Cell length 0.75m as schematic.



Coupling coil shown at 0.319m **NOT** 0.5m as schematic.

Coupling coil radial thickness 116.5 mm.

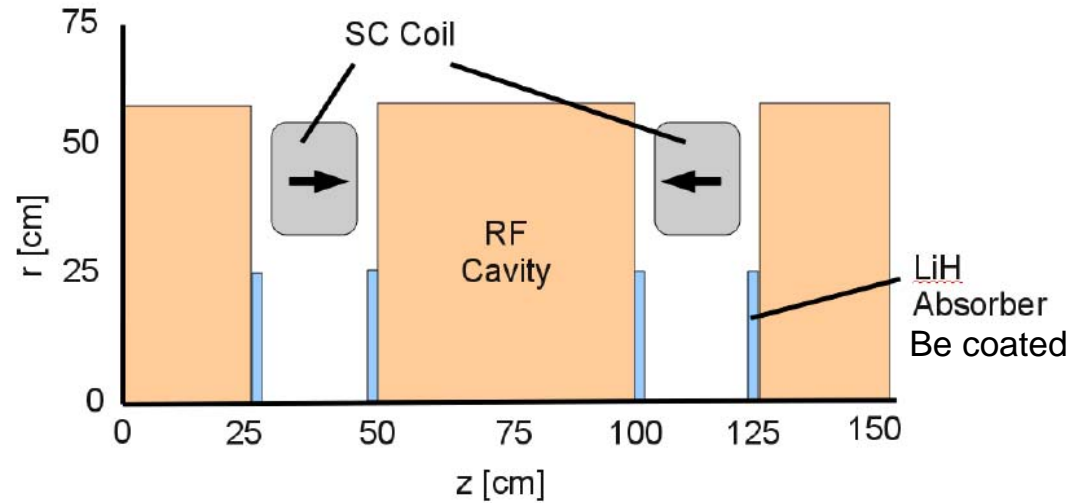
Coupling coil diameter slightly larger than schematic by 92mm

## Phase Rotation Cell

# Muon Front End

## Cooling

- Cooling section consists of 100 cells 0.75m in length
- Total section length 75m
- 100 normal conducting RF cavities and 100 superconducting coils
- Cavities RF frequency 201.25 MHz, gradient 15 MV/m.
- Cavity length 0.5m, Coil length 0.15m



Two Cells

Cavity :

(number of cells) length [m]	(50) 75
cell length [m]	1.5
frequency [MHz]	201.25
gradient [MV/m]	15
phase [ deg ]	35
voltage [MV]	750
length of 1 cavity [m]	0.5
radius of 1 cavity [m]	No data
length of LiH [m]	0.011
radius of LiH [m]	No data
length of vacuum space [m]	No data
z start position of first cell [m]	155.1

Coil :

number of coils	100
length of 1 coil [m]	0.15
radius of 1 coil [m]	0.35
radial thickness [m]	0.15
current density [A/mm <sup>2</sup> ]	±107
Peak value on-axis [T]	2.8

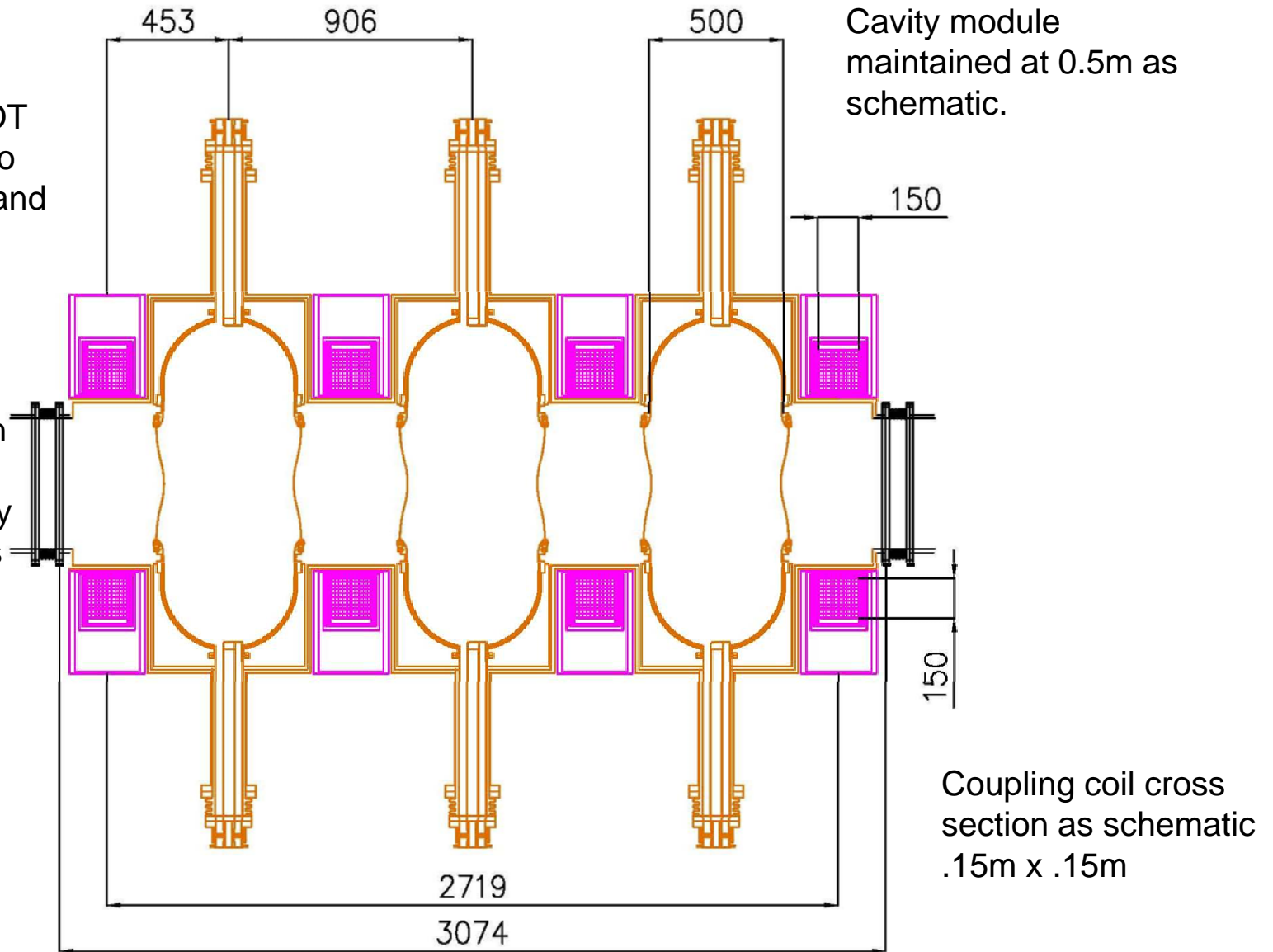


# Cooling Section CAD Model - 1

Cell length 0.9m NOT 0.75m. This is due to addition of bellows and vacuum vessels.

Total Cooling Section length is 100 cells at 1.06m approximately 1060m. **NOT** 75m as schematic.

Bellows required between each cavity / coil assembly.



Cooling Cell Section 1

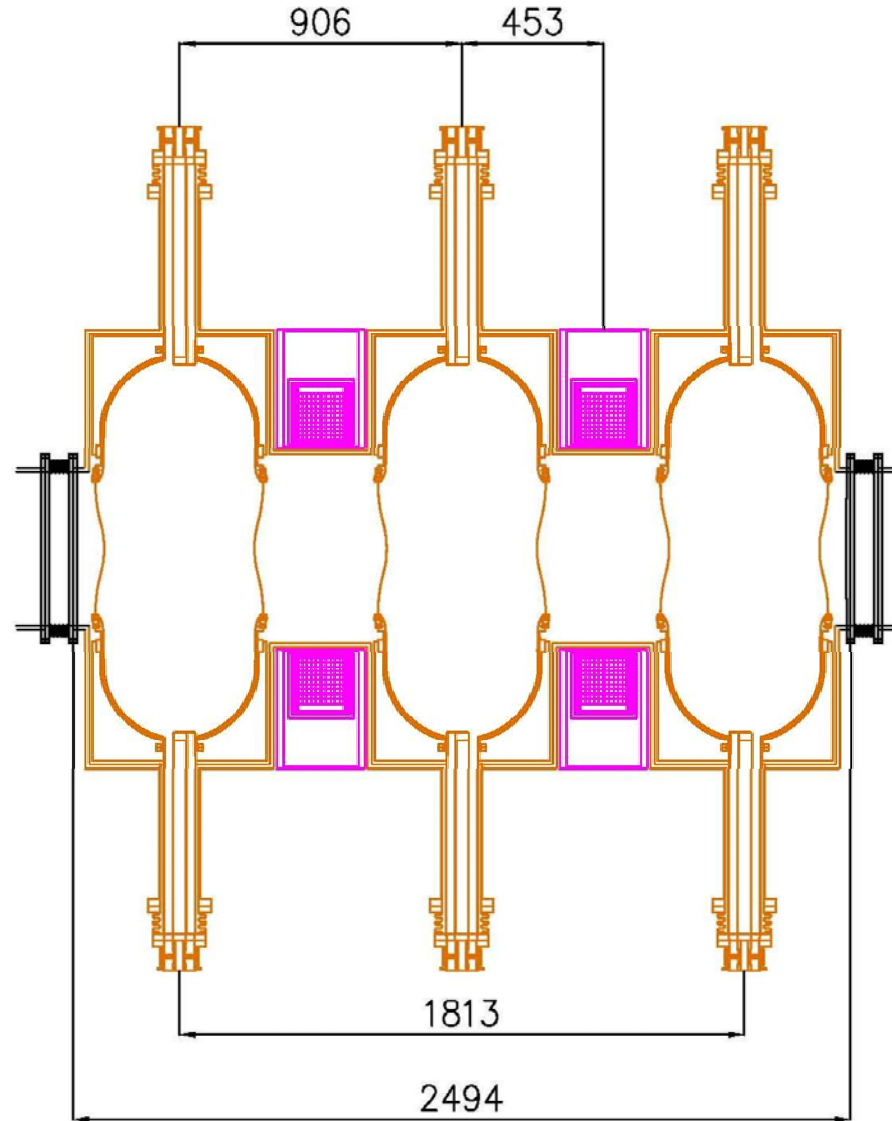




# Cooling Section CAD Model - 2

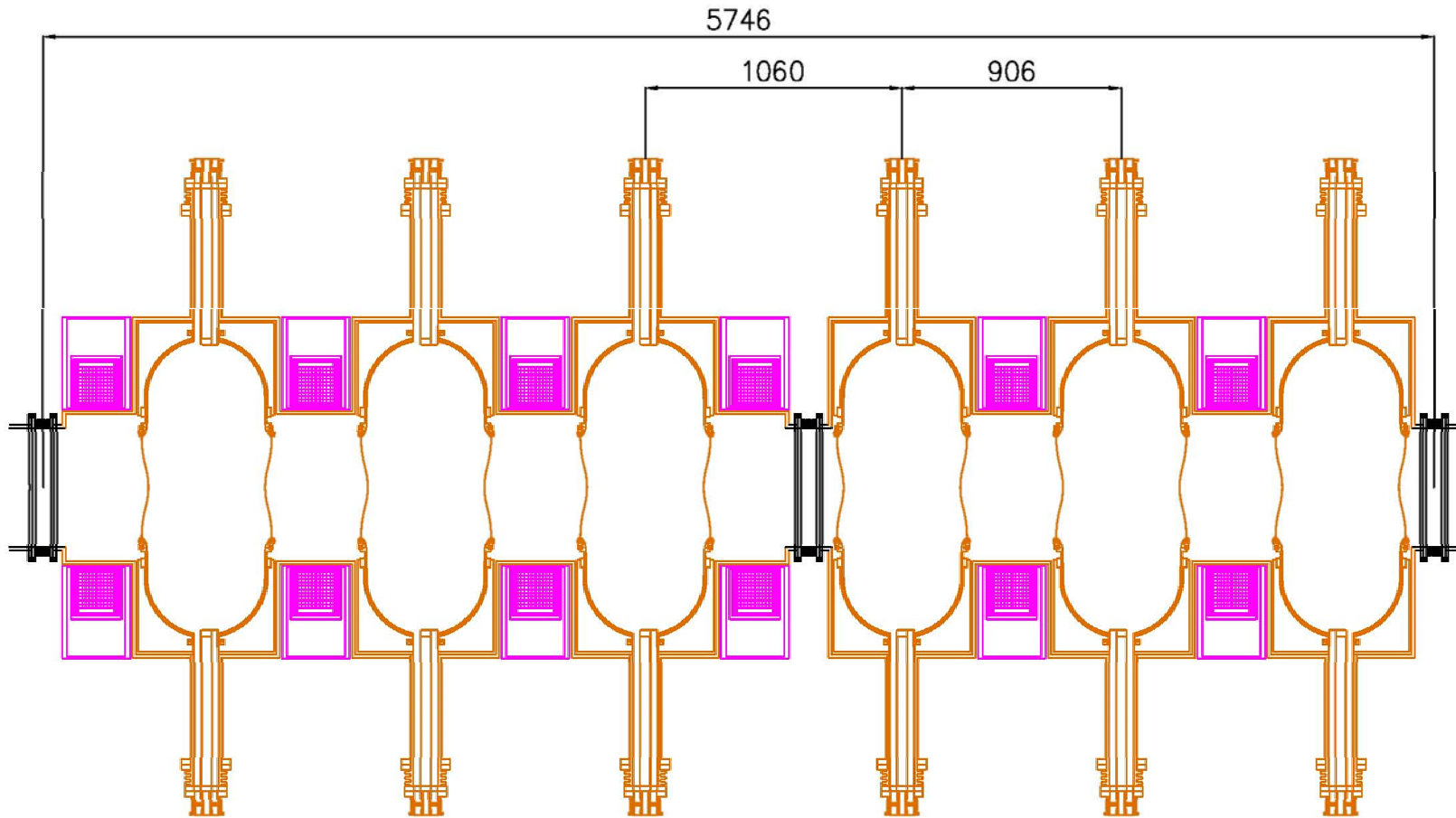
Cell length 0.9m NOT 0.75m. This is due to addition of bellows and vacuum vessels.

Cavity module maintained at 0.5m as schematic.



Cooling Cell Section 2

# Cooling Section CAD Model - 3

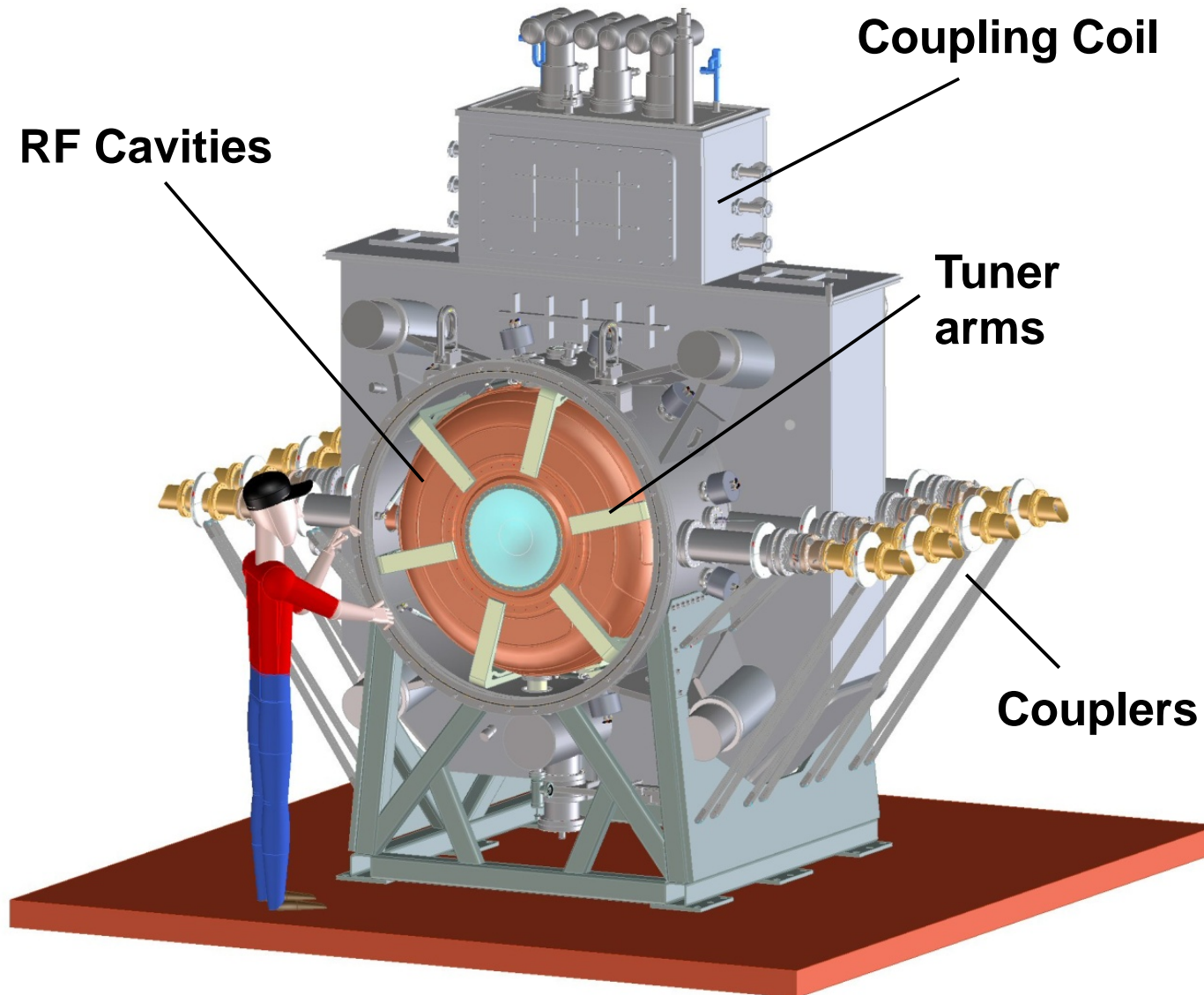


Total Cooling Section length is approximately 95.7m. **NOT** 75m as schematic.

Combined Cooling Cell Sections 1 & 2

Contains 6 coils & 6 cavities = total length 5.746m

# MICE RFCC Module Overview



Overview of MICE RF system, Derun Li, LBNL, MICE CM32 @ RAL, UK (Feb. 8<sup>th</sup> 2012)