

ESAC REVIEW OF THE HIGH FIELD DIPOLE DESIGN

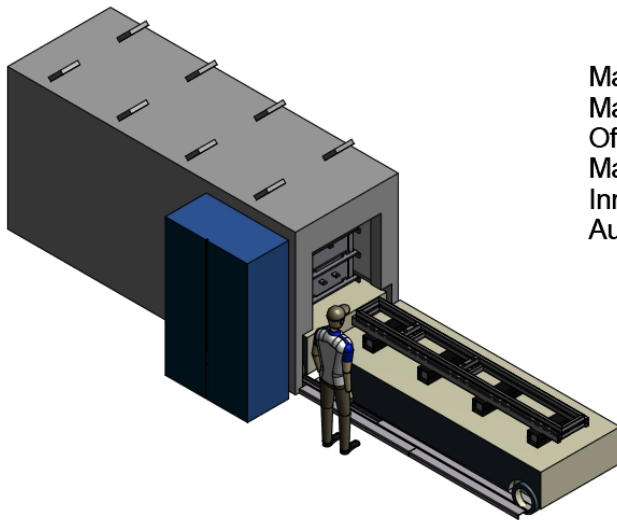
REACTION OVEN, SPLICING AND IMPREGNATION

**MARCH 2012
FOR EUCARD-WP7-HFM**

J.C. Perez

- Reaction Oven
- Vacuum Impregnation tank
- Impregnation mold
- Splicing design and tests
- Instrumentation and Traces
- Sub-scale models activities

- Technical specification ready beginning 2011
- We had issues in Spring 2011 concerning the price proposed in EU
- Market survey in US on Spring 2011
- Repeat market survey in summer 2011
- Acceptable offer received from GERO (Germany) summer 2011
- Final contract with GERO placed in September 2011

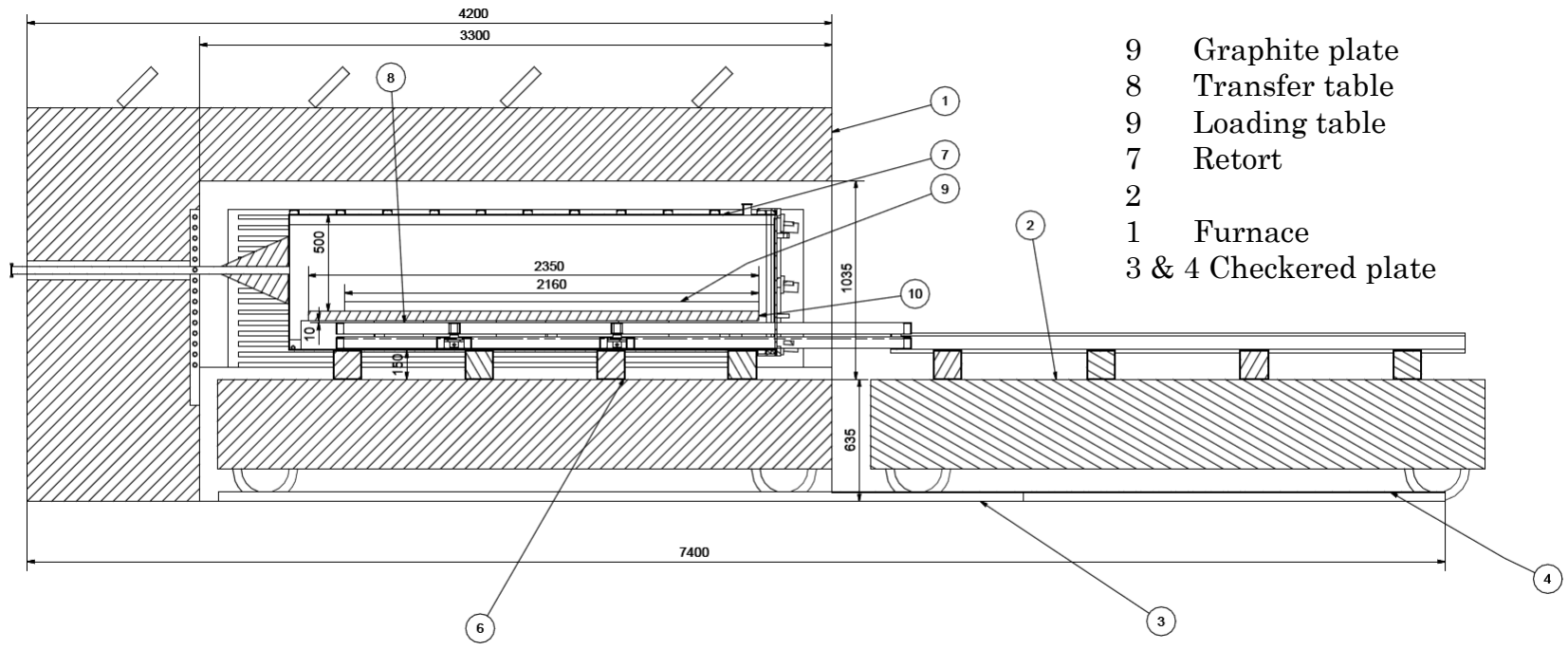
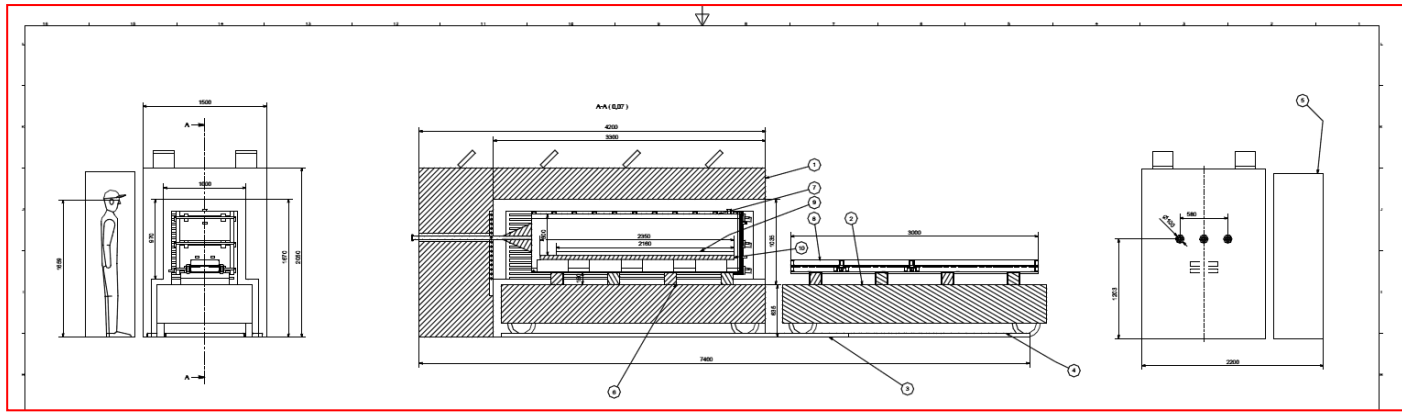


Max. Ofentemperatur: 1000°C
 Max. Chargengewicht: 1500Kg
 Ofengewicht: ca. 2800Kg
 Max. Arbeitstemperatur: 900°C
 Innenabmessungen Ofen(mm): 1000breitx4200tiefx1950hoch
 Außenabmessungen Ofen(mm): ca. 1500breitx4200tiefx1950hoch



Pos.	Ans.	Beschreibung	Menge	Zeichnungs-Nr.	Bestellnummer	VL	Teil
10	1	Übersicht	1	75KE/09-1G	ESAC/028430		Standard
8	2	Übersicht	1	75KE/09-1G	ESAC/028430		Standard
8	1	Übersicht	1	75KE/09-1G	ESAC/028430		Standard
7	1	Übersicht	1	75KE/09-1G	ESAC/028430		Standard
6	1	Übersicht	1	75KE/09-1G	ESAC/028430		Standard
5	1	Übersicht	1	75KE/09-1G	ESAC/028430		Standard
4	2	Übersicht	1	75KE/09-1G	ESAC/028430		Standard
3	4	Übersicht	1	75KE/09-1G	ESAC/028430		Standard
2	2	Übersicht	1	75KE/09-1G	ESAC/028430		Standard
1	1	Übersicht	1	75KE/09-1G	ESAC/028430		Standard

COMPONENTS



- 9 Graphite plate
- 8 Transfer table
- 9 Loading table
- 7 Retort
- 2
- 1 Furnace
- 3 & 4 Checkered plate



Task	Schedule	Persons
CAD design approval, electrical layout	February 21 st	GERO Kisir, Geiger
Transfer table and inert gas piping layout	February 27 th	GERO Kisir, Geiger
Approval/comments to design	March 1 st	CERN
Ordering further components	March 2 nd	GERO
Reception furnace box at GERO	Week 21 (May 21 st - 27 th)	GERO
Electrical wiring, control assembly, VDE	Week 22 (May 28 th - June 3 rd)	GERO
Acceptance test at GERO	Week 23 (June 4 th - June 10 th)	GERO and CERN
Delivery to CERN	Week 24 (June 11 th - June 17 th)	GERO and CERN

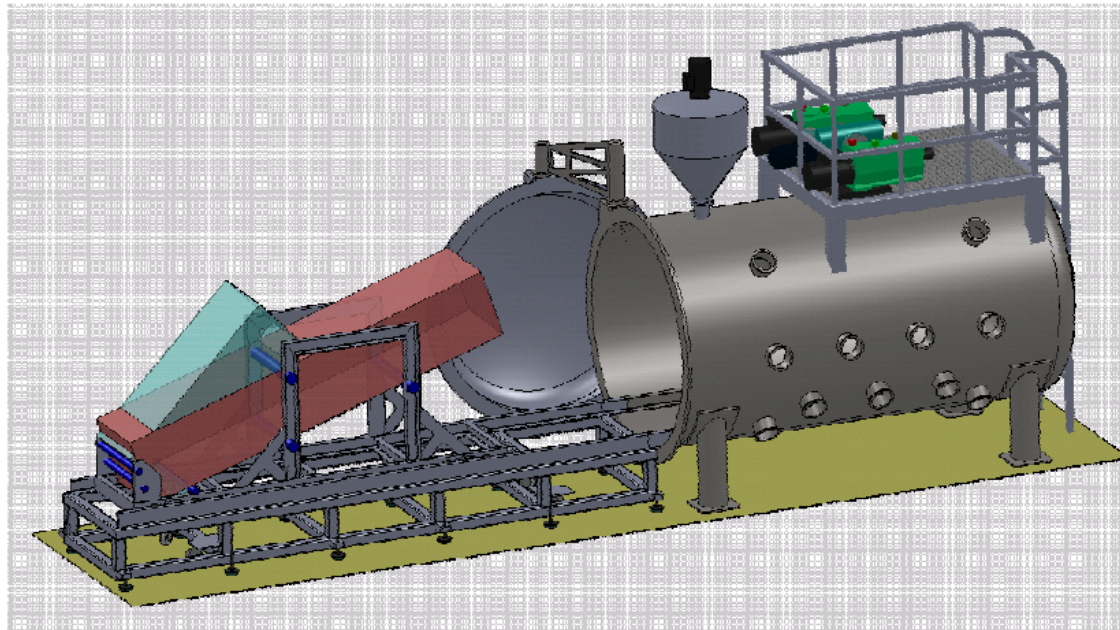
Transport risk:



A special transport to CERN will be organized from GERO. Shock sensors will be applied to the furnace.

Risk of small cracks on the inner brickwork. The status will be investigated after delivery. Smaller cracks will be filled with a special Cement.

- A vacuum impregnation facility will be installed in building 927 near the heat treatment furnace
- The technical specification has been approved in December 2011
- 3 confirming offers have been received
- The order has been placed middle of March 2012 (TELSTAR-Spain)
- Dedicated electrical power lines are installed in 927 laboratory

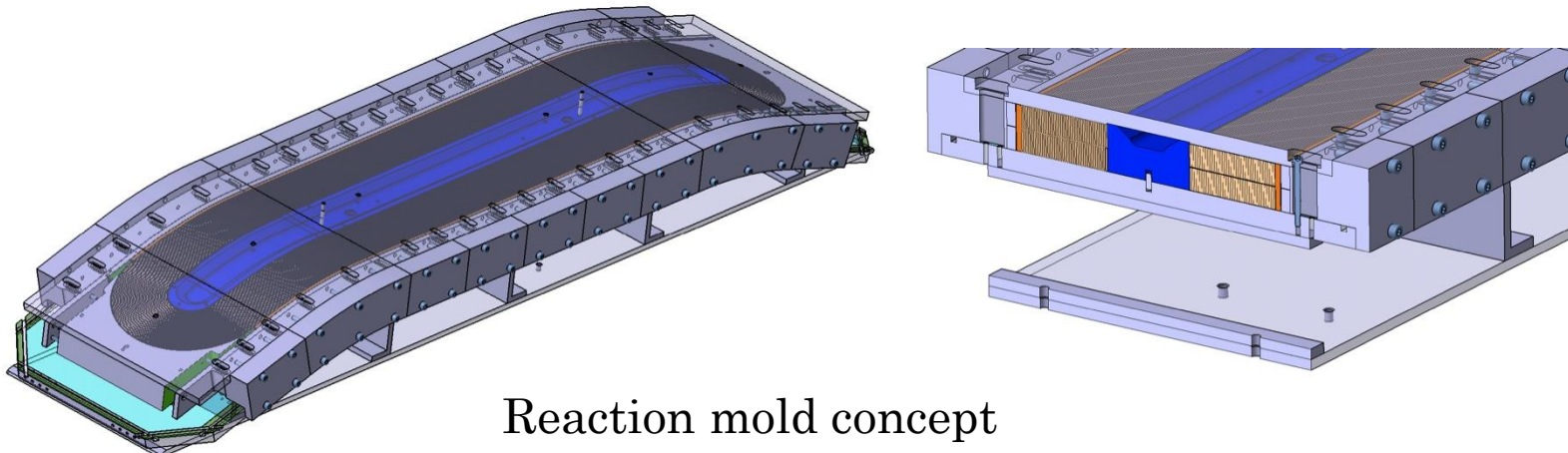


Loading the mold

VACUUM TANK DELIVERY SCHEDULE

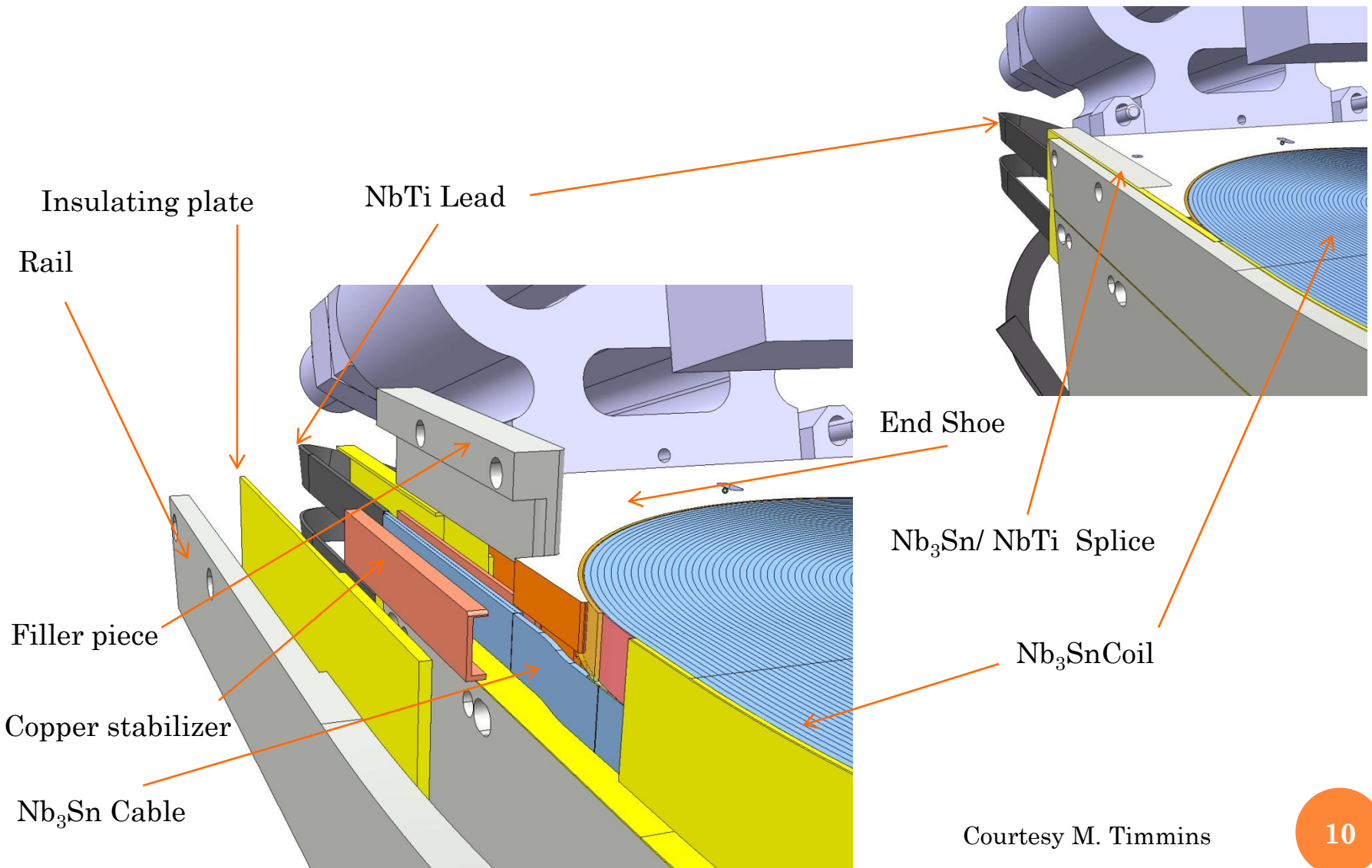
Milestones	Relevant Dates
Signature of the contract	March 15 th 2012
Preliminary design review and definition	April 12 th 2012
Preliminary manufacturing plan	April 19 th 2012
Final design file and Risk assessment presentation	May 2 nd 2012
Design file and risk Assessment approval by CERN	June 9 th 2012
Tests at supplier premises	August 22 nd August
Vacuum tank delivery at CERN	September 6 th 2012
Final installation and commissioning	September 20 th 2012

- Technical meeting on impregnation mold concept held at CEA on 16th of March 2012
- CERN team will provide all required information for mold design
- The mold concept will be inspired from the reaction tooling
- Al alloy with O-rings will be used
- CEA will produce the fabrication drawings for impregnation mold layer 3-4 by June the 15th 2012
- CERN will launch the price inquiry and follow-up the fabrication
- First mold to be delivered at CERN by September the 15th 2012



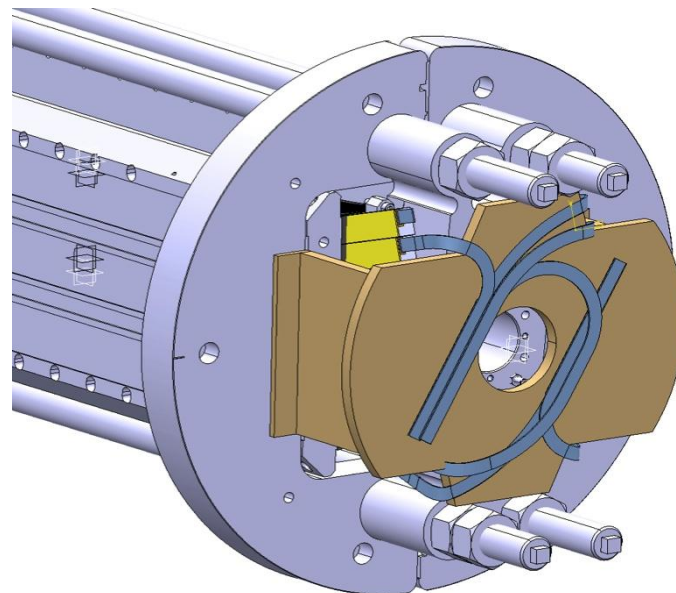
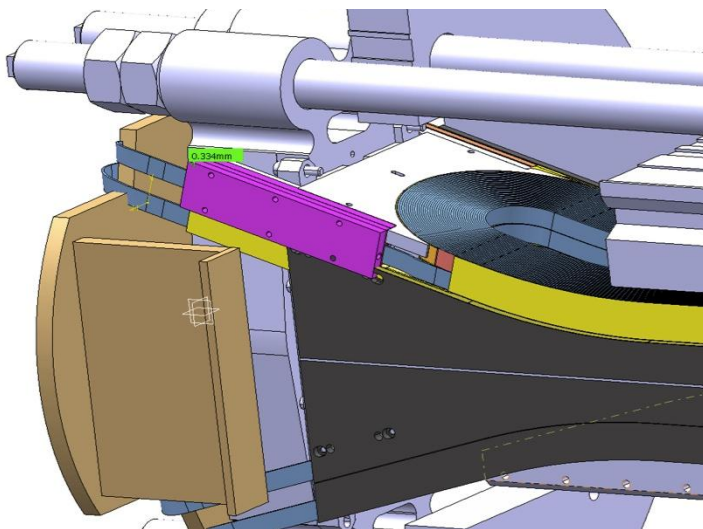
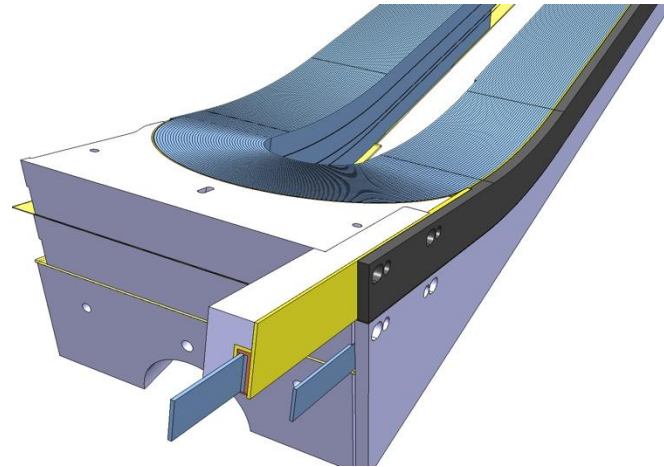
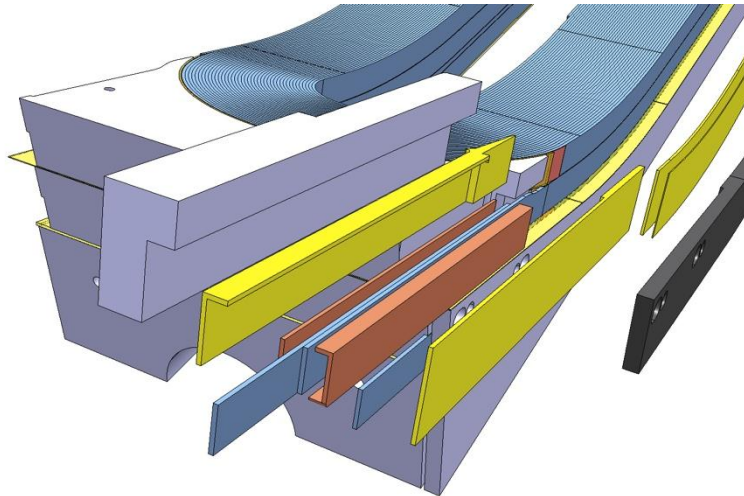
Reaction mold concept

SPLICE AREA DESIGN

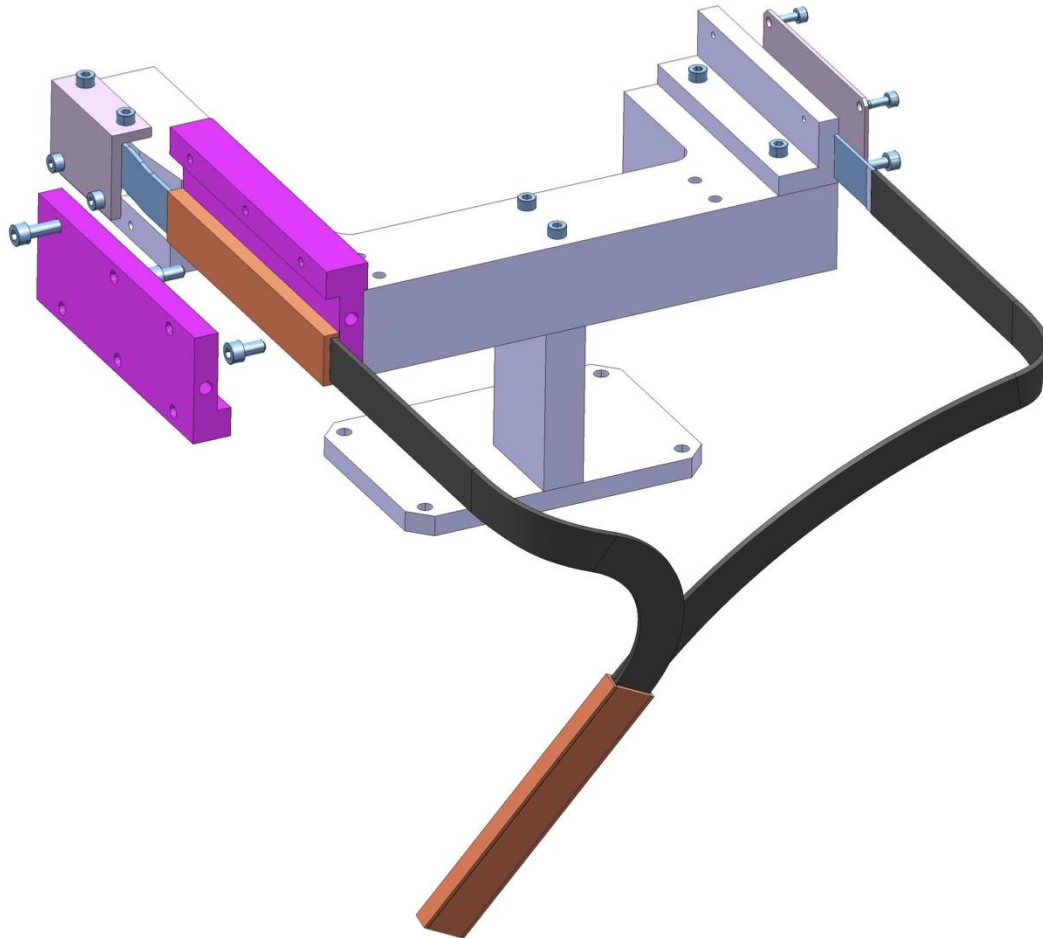


Courtesy M. Timmins

FRESCA2 INTERCONNECTION

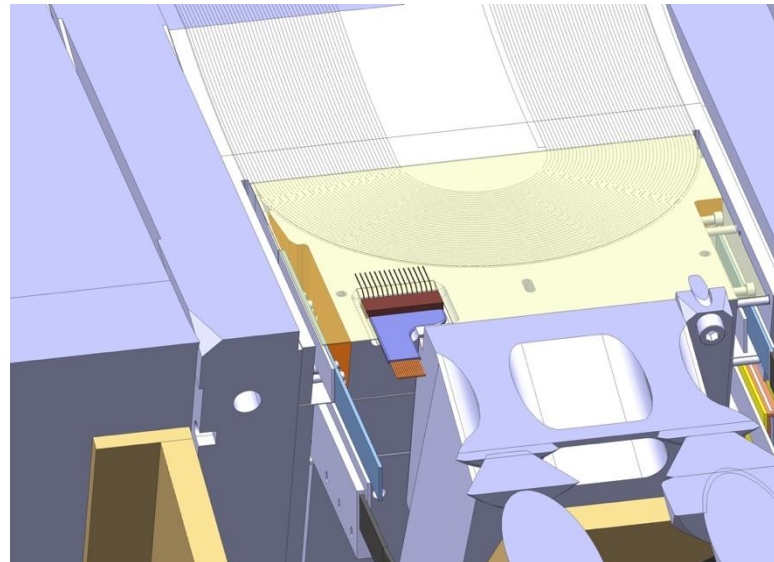
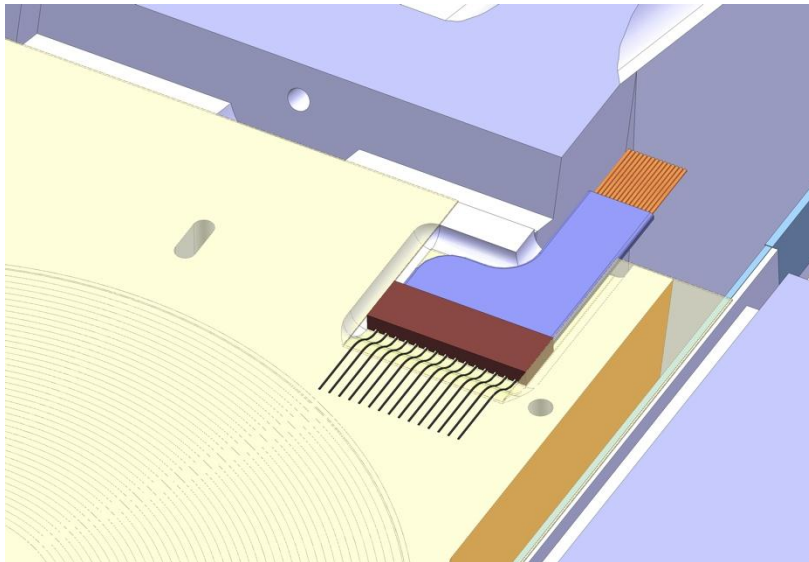


INTERCONNECTION MOCK-UP



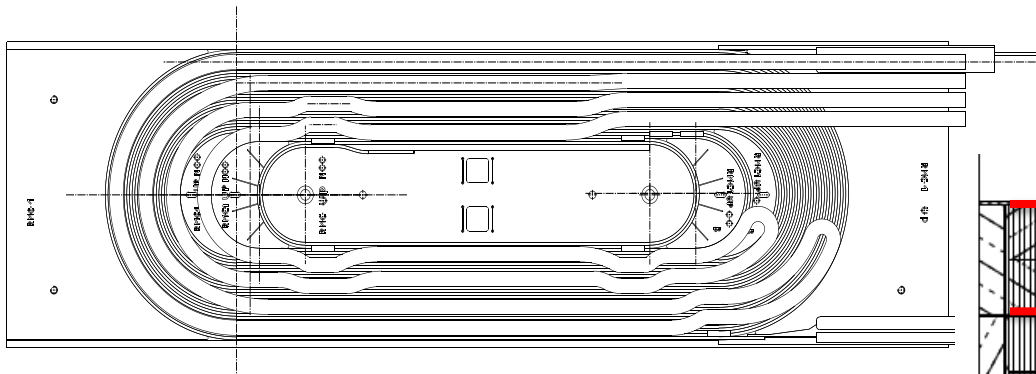
An interconnection mock-up has been designed to validate splice operations. The delivery is expected on last week of March. Validation tests are scheduled on April 2012.

- The traces will cover the total surface of the coil
- The connections will be hidden in a pocket machined on the end-shoe connection side (mold released)
- No wires will come out from the mold during impregnation process
- After coil impregnation, wires will be soldered to the traces and routed via a groove machined on the end-shoe (local impregnation)

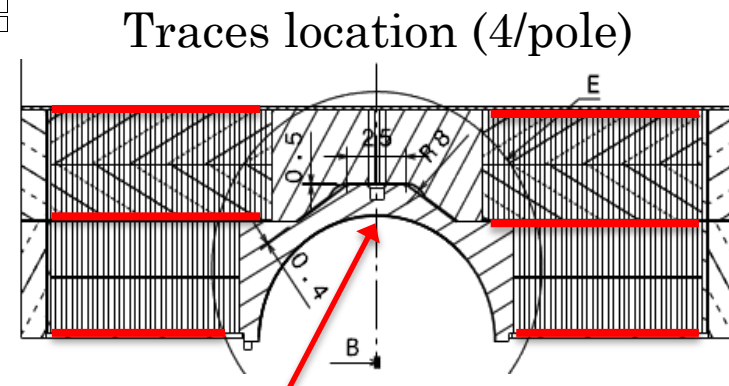


- Inputs for Quench Heaters design will be provided by M. Durante and M. Bajko
- E. Todesco will be the reference Engineer at CERN for trace design. He will visit different laboratories in the coming weeks to collect all required information on programs and calculation methods presently used to design Quench Heaters (Base line HD3/HQ/LQ?)
- Fresca2 traces design and fabrication @ CERN using 50 μm kapton and 25 μm stainless steel sheets (delivery time about 2 months after final design validation)
- Final Fresca2 traces are expected for end of October 2012 (on time for the first real coil)
- A preliminary trace will be used on the first copper coil

- Each double pancake will be equipped with 2 traces
- The coils will be equipped with about 8 Vtaps/layer
- No strain gauge in the trace (gauges will be glued layer 1 pole)
- 6 stations will be placed on the shell mid-plane (12 gauges)
- 3 stations located on the magnet bore measuring along azimuthal and longitudinal direction
- Axial roads will be instrumented (longitudinal direction)



RMC trace preliminary design
based on HD3 traces

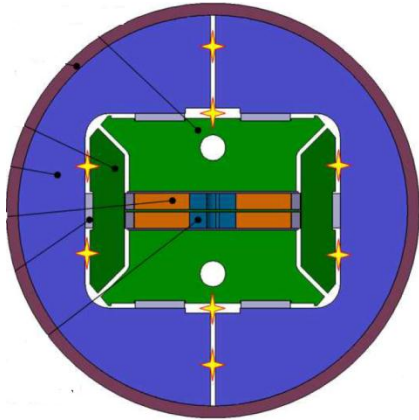


Gauges will be placed
in the magnet bore

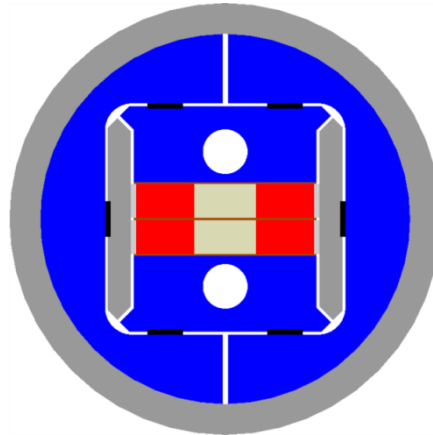
- Characterization on strand and cable performance
- Layer jump area
- Splicing area
- Insulation method
- Traces connection
- Impregnation method
- Qualification of new vacuum impregnation tank
- Qualification of new oven

FROM SMC TO RMC TOWARDS FRESCA2

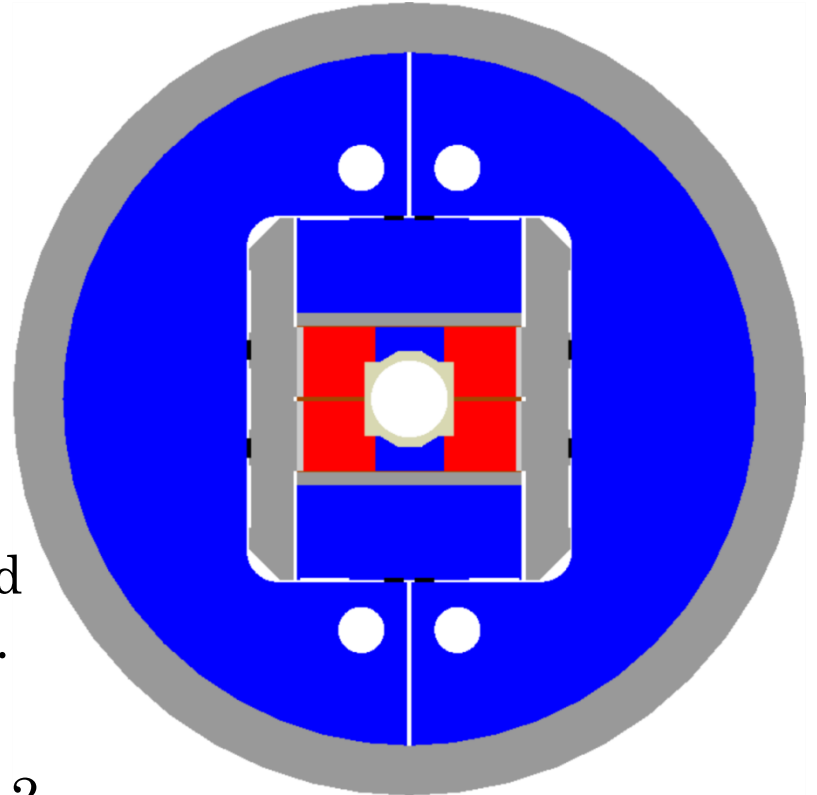
SMC



RMC



FRESCA2

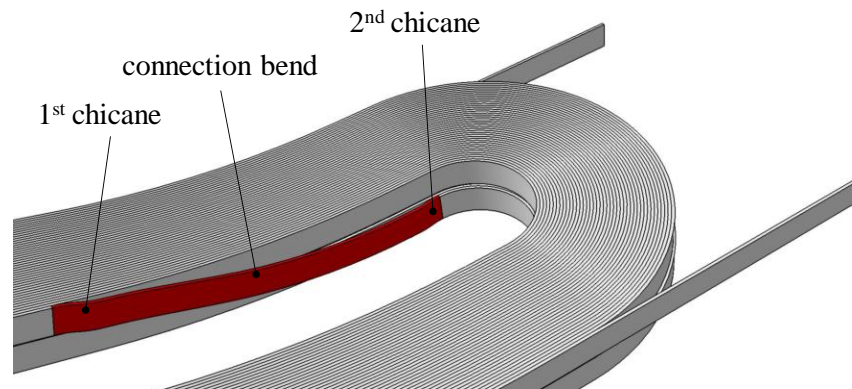
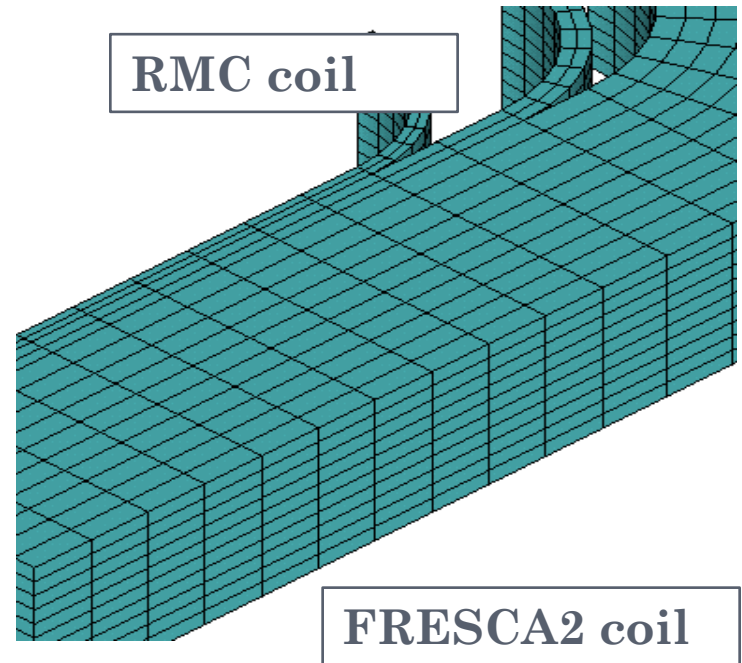


- **RMC goals:** test FRESCA2 cable and FRESCA2-type coils in realistic cond.

- Constraints

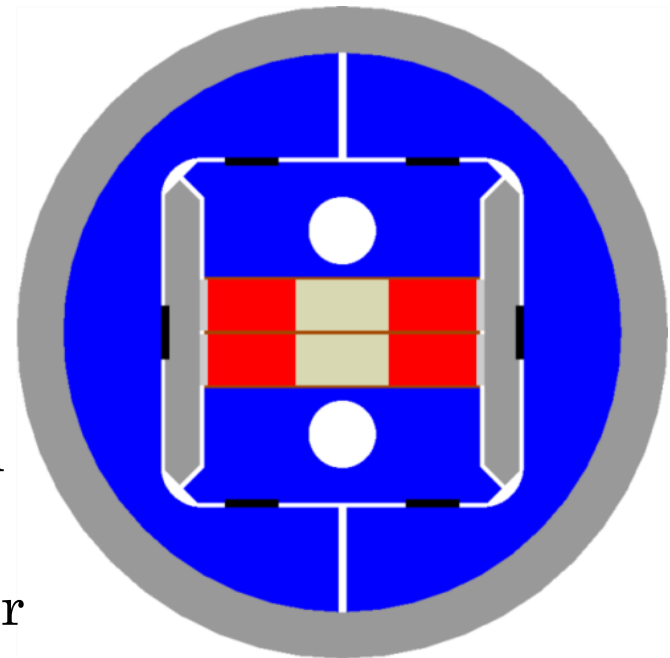
1. Layer jump similar to FRESCA2
2. Power supply limit ~20 kA
3. Magnet OD: 570 mm

- Same design as SMC
 - 2 end spacers
 - 33 turns (like FRESCA2)
- FRESCA2-type layer jump
- As a result
 - Straight section: 300 mm
 - 150 mm in SMC
 - Coil length: 820 mm
 - 500 mm in SMC
 - 96 m of cable per coil
 - 4.0 km of strand



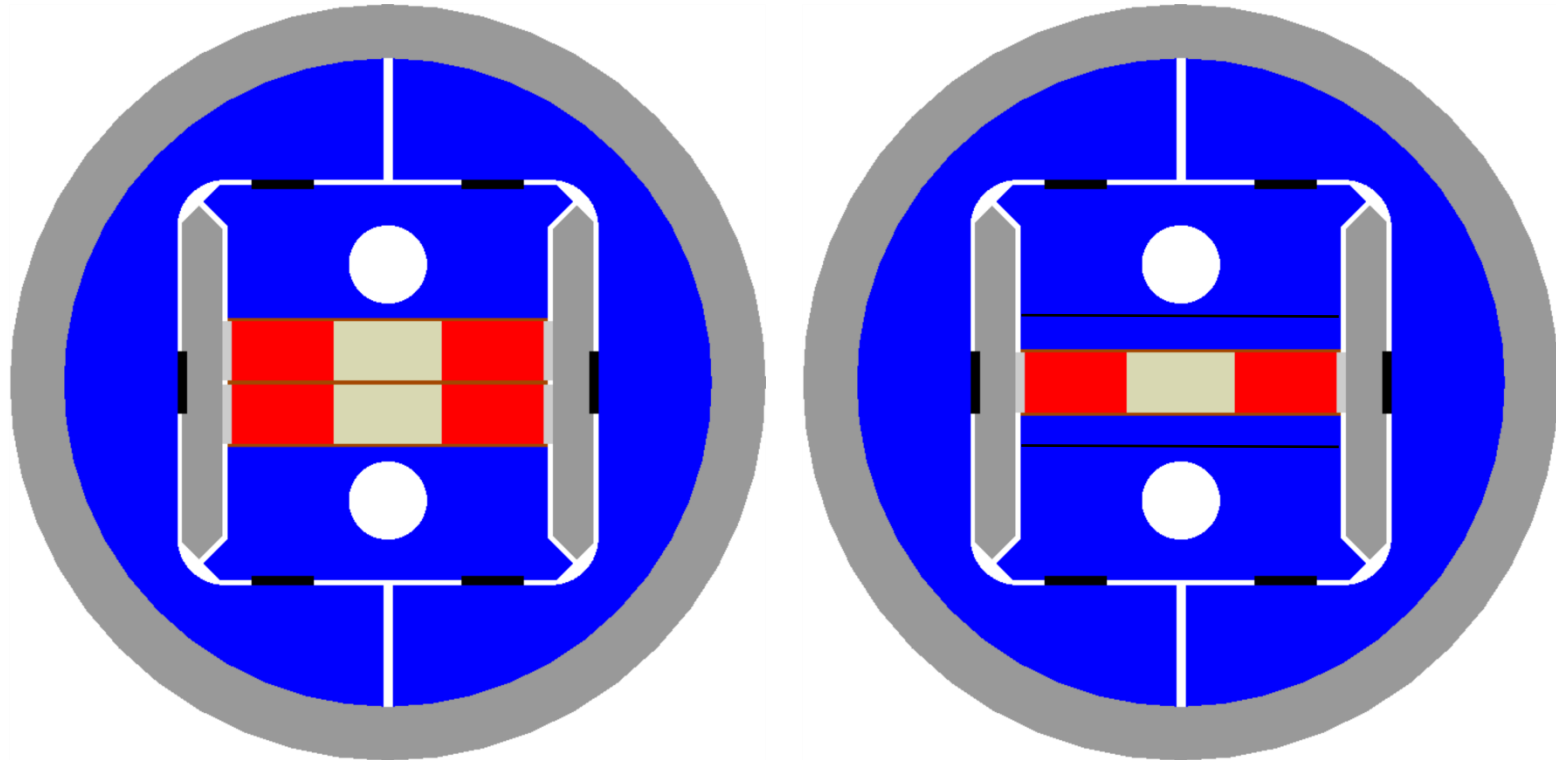
- RMC configuration
 - 2 RMC coils
 - I_{ss} (1.9 K) = 18.3 kA
 - Below power supply limit
 - $B_{peak} = 16.0$ T
 - Significantly higher forces
 - From 2.2 MN/m in SMC to 5.4 MN/m
 - New structure required
 - Thicker shell, new yoke design, larger bladders, larger axial rods

RMC



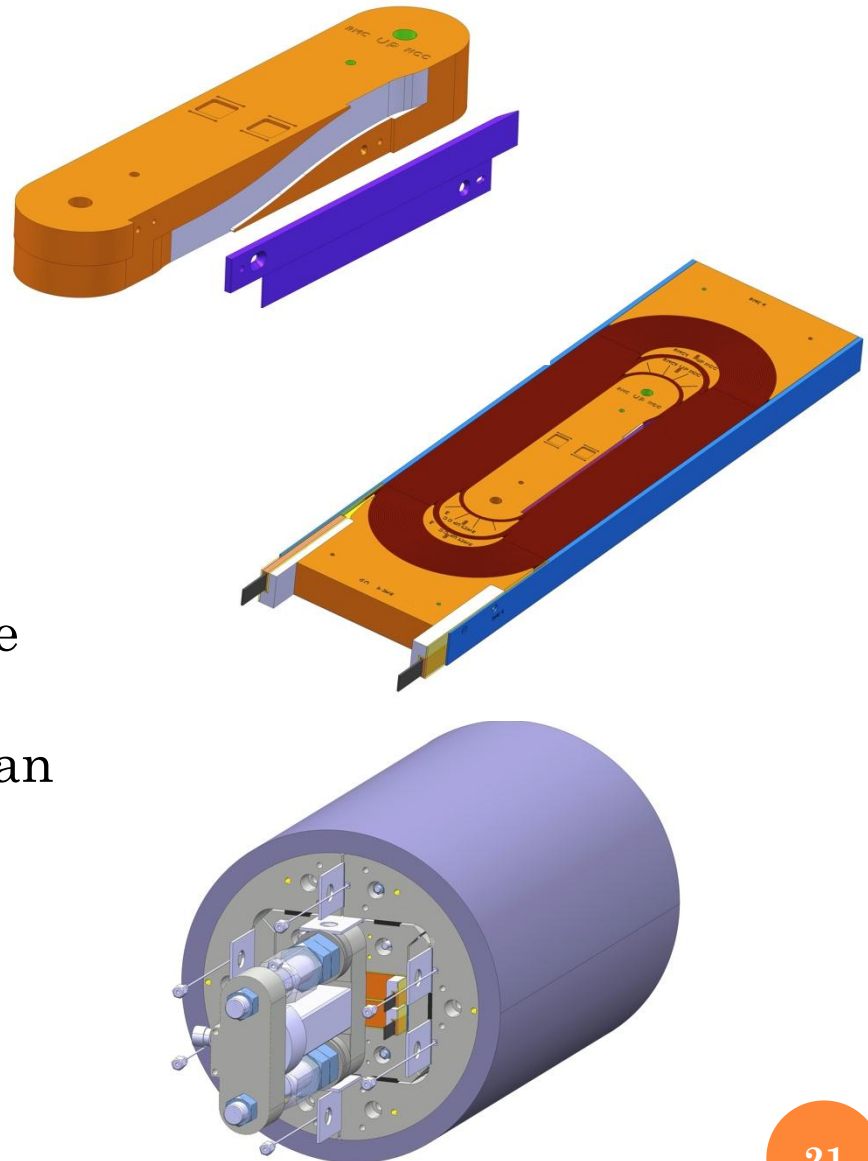
RMC

1 DOUBLE PANCAKE VS. 2 DOUBLE PANCAKES



- Still possible to test individual coils up to 20 kA
 - Corresponding to about 93% of I_{ss} @ 4.2 K

- Fabrication drawings for coil components, reaction and impregnation tooling approved for execution.
- First winding scheduled for September 2012
- Mechanical structure design finished. Fabrication drawings are expected within two weeks.
- First mechanical assembly using an instrumented aluminum dummy coil scheduled for September.
- First cold test expected Q4-2012



ON GOING ACTIVITIES ON SUB-SCALE MODELS

- Characterization on strand performance in realistic conditions (SMC4 & SMC5)
- Characterization on strand and cable performance in realistic conditions (RMC)
- Layer jump area (RMC)
- Splicing area (RMC)
- Braided insulation (RMC)
- Traces connection (RMC)
- Impregnation method for Fresca2 type coils (RMC - Close mold)
- Qualification of new vacuum impregnation tank
- Qualification of new oven (RMC)

SMC Assembly	Cable Type	Cable Insulation	Scheduled
SMC#3_b	PIT 14 * Ø 1.25 mm	S2-Glass sleeve FNAL type	2 Coils waiting for reaction
SMC#11T_a	OST RRP 108/127 40 * Ø 0.7 mm	33 Tex S2-glass braided	Q2-2012
SMC#11T_b	OST RRP 108/127 40 * Ø 0.7 mm	11 Tex S2-glass braided & Mica 90 µm	Q2-2012
SMC#4	PIT 18 * Ø 1.00 mm	S2-Glass sleeve 100 µm or S2- glass braided	Q3-2012
SMC#5	RRP 18 * Ø 1.00 mm	TBD	Q4-2012

RMC Assembly	Cable Type	Cable Insulation	Scheduled
RMC#1 coil 1	PIT 40 * Ø 1.0 mm	S2-Glass braided Or according to FRESCA2 choice	Q3-2012
RMC#1 coil 2	PIT 40 * Ø 1.0 mm	S2-Glass braided Or according to FRESCA2 choice	Q3-2012
RMC#2 coil 1	RRP 40 * Ø 1.0 mm	S2-Glass braided Or according to FRESCA2 choice	Q4-2012
RMC#2 coil 2	RRP 40 * Ø 1.0 mm	S2-Glass braided Or according to FRESCA2 choice	Q4-2012

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- Fresca2 collaboration team

THANKS FOR YOUR ATTENTION