



RD_MUCOL 2025-2026

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Multi-TeV Muon Collider

BA BO FE FI GE MI MIB LNF LNL LNS PD PI PV RM1 RM3 TO TS

Physics, Detector R&D, MDI, Crystals/Targets, Accelerator Activities

RD_MUCOL @ CSN1 – ESPP_A_MUCOL @ GE – UE-MUCOL – UE-I_FAST

125 persone → ~ 35 FTE

- Progressi notevoli sul disegno della macchina @ 10 TeV
- Disegno esperimento @ 10 TeV → full simulation su canali di fisica benchmark
- R&D su tecnologie di accelerazione (magneti HTS in sinergia)
- R&D su tecnologie di rivelatori (proposta call CSN5) - DRD e test beam



HORIZON-INFRA-2022-DEV-01-01

LDG review - February 24-26, 2025 @ CERN

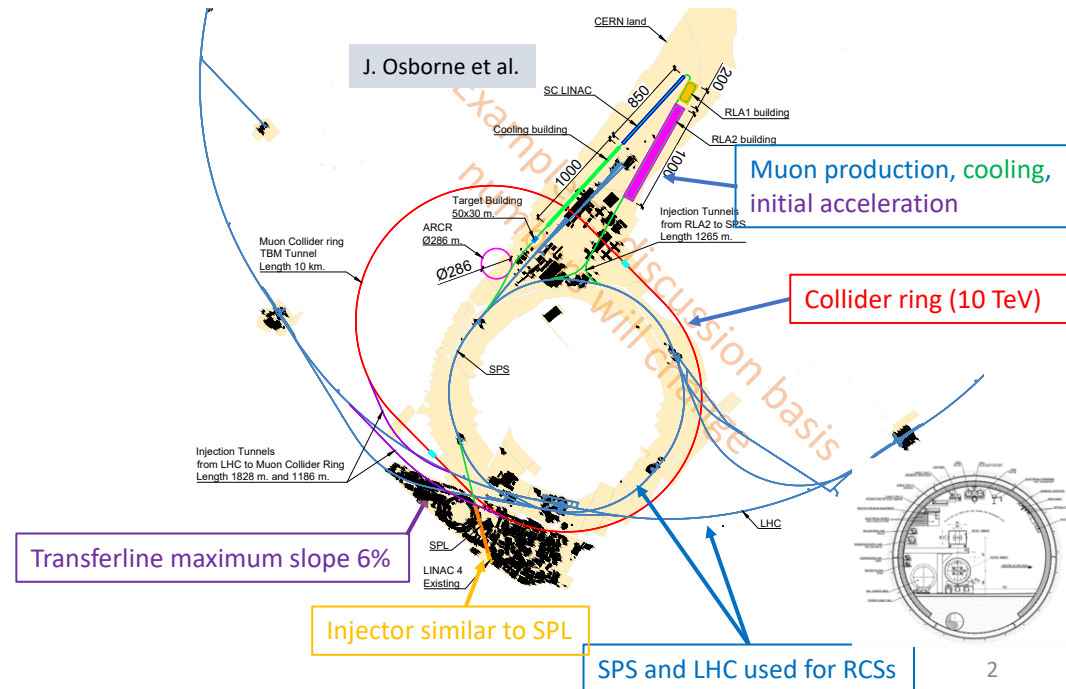
to review:

- R&D plan
- Demonstrator design and proposal

10 TeV Muon Collider Beam Requirements

Parameters	Symbol	$\sqrt{s} = 10 \text{ TeV}$
Particle energy [GeV]	E	5000
Luminosity [$10^{34} \text{ cm}^{-2} \text{ s}^{-1}$]	$\mathcal{L}$	20
Bunch population [10^{12}]	N_p	1.8
Transverse normalized rms emittance [μm]	ε_n	25
Longitudinal emittance ($4\pi \sigma_E \sigma_T$) [eVs]	ε_l	0.314
Rms bunch length [mm]	σ_z	1.5
Relative rms energy spread [%]	p_T	0.1
Beta function at IP [mm]	β^*	1.5
Beam power with 10 Hz repetition rate [MW]	P_{beam}	14.4

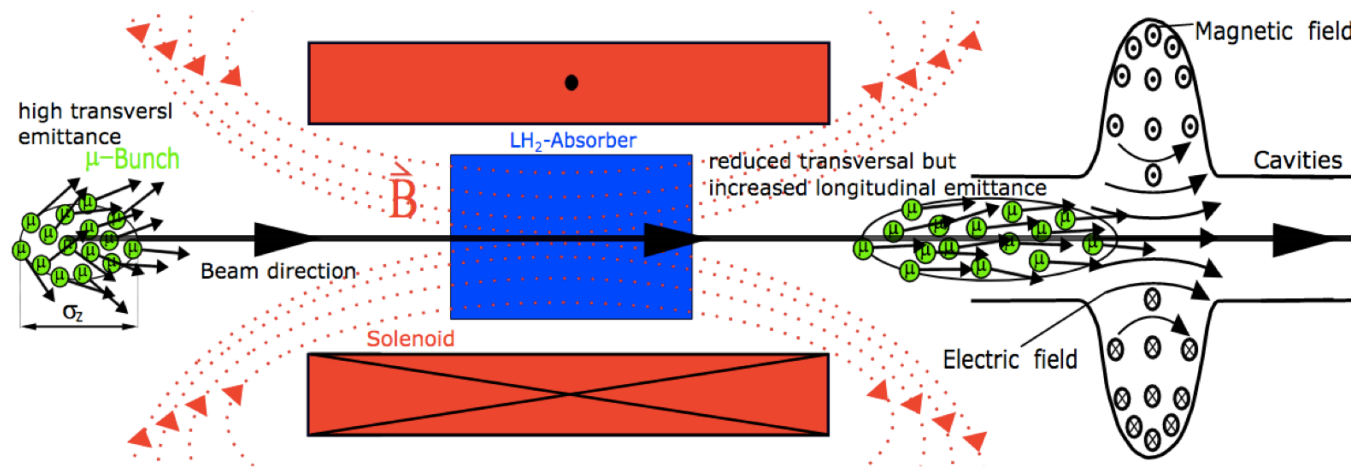
- First collider ring site identified @ CERN
- SPS and LHC tunnels reused
- All construction on CERN
- Energy stages maybe 2.5 and 8 TeV



Muon Cooling and its challenges

- Cooling is necessary after production to reduce the 6D emittance of the captured beam

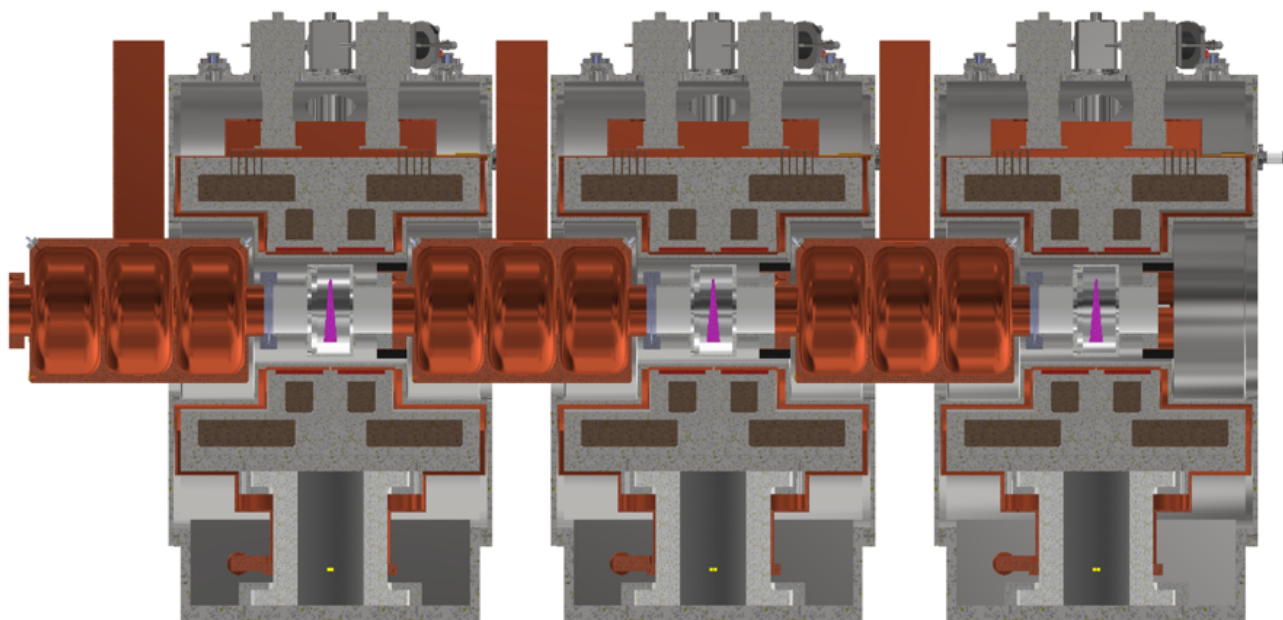
Activities in
charge to INFN
Milano



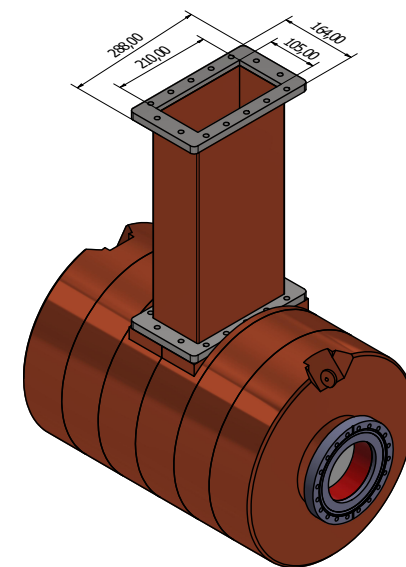
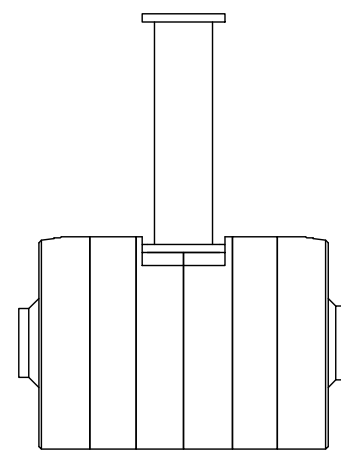
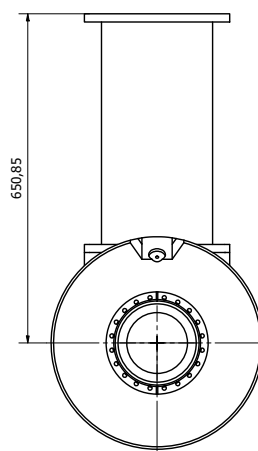
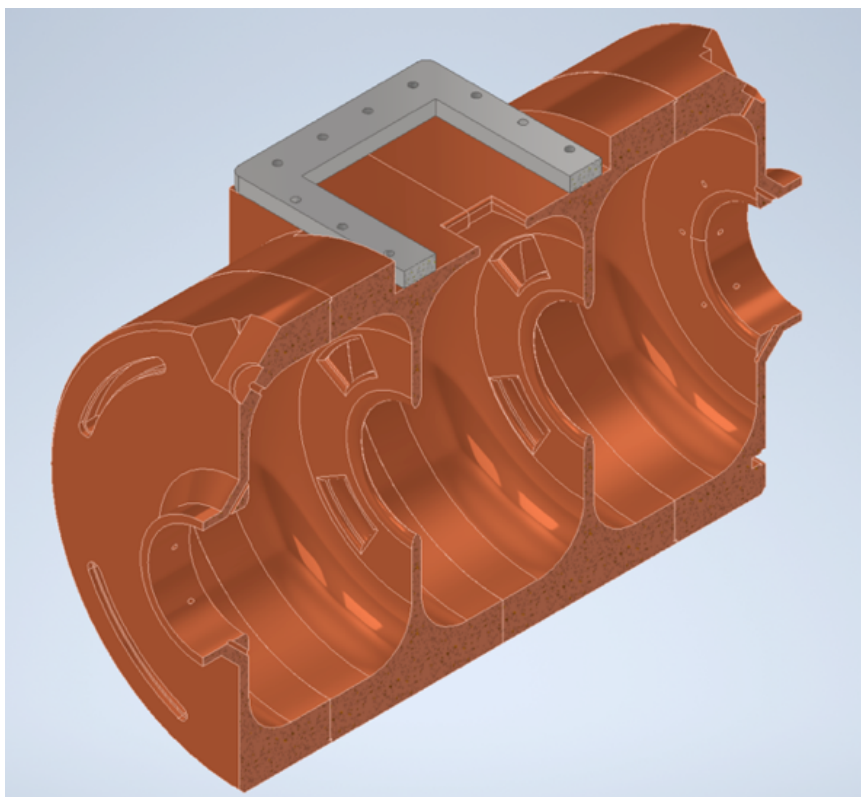
**High magnetic
field
superconducting
solenoids**

**High electric
field normal
conducting RF
cavities**

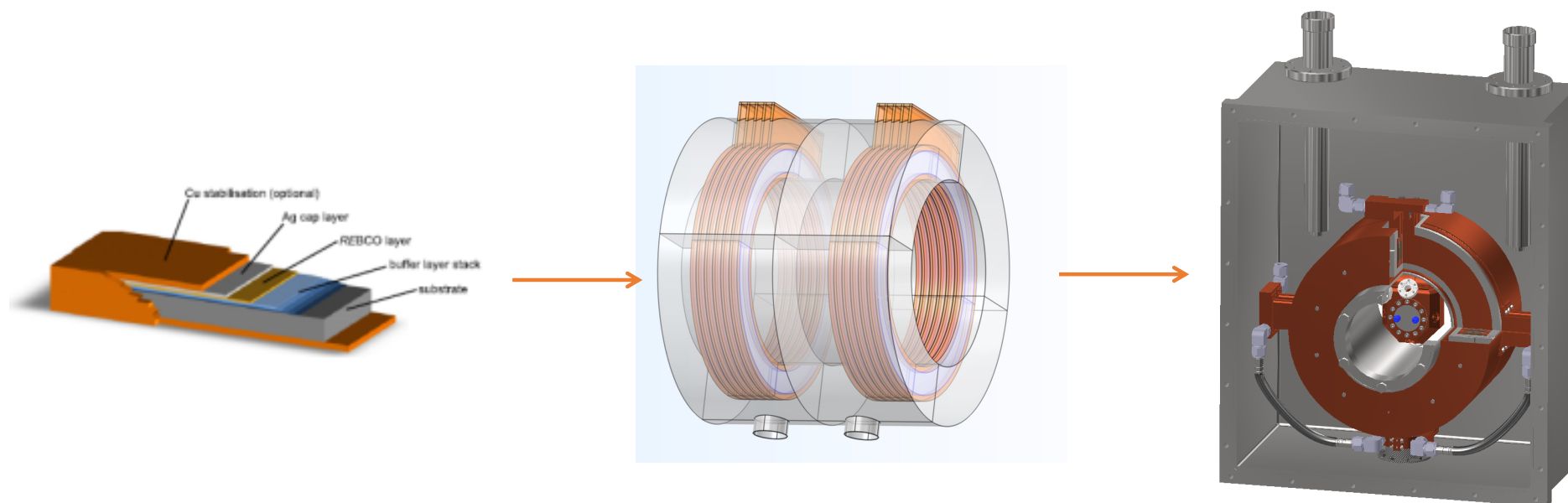
Cooling Cell Integration study: first concept



RF 3 cells 704 MHz: first concept



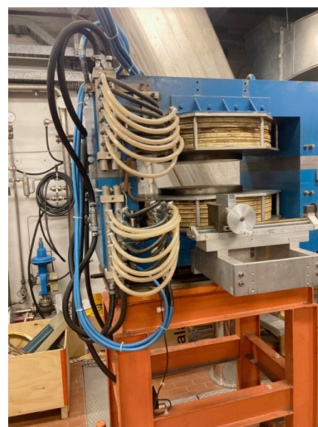
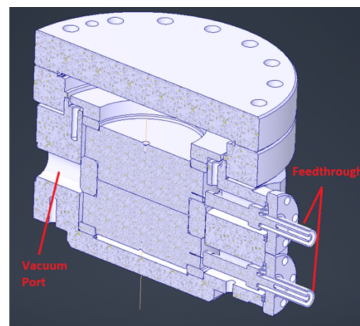
- RFMFTF.1: free bore > 450 mm (> 5 M€) good for 700 MHz test
- RFMFTF.2: free bore ~ 320 mm (> 3 M€) good for 1.3 GHz test
- RFMFTF.3: free bore ~ 180 mm (> 1.5 M€) good for 3 GHz test



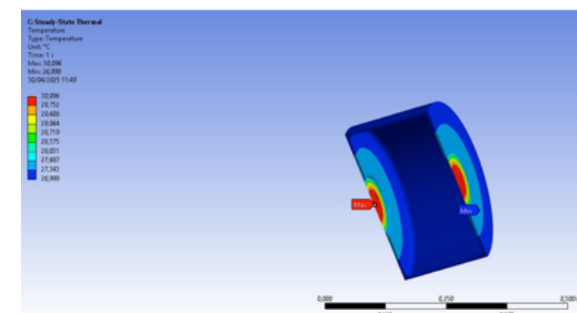
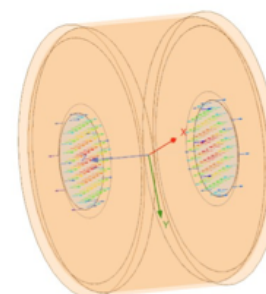
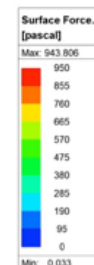
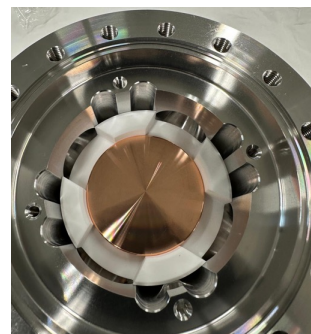
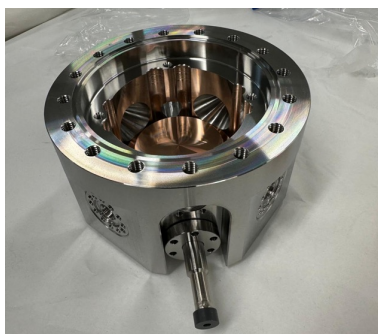
Test facilities: high electric fields in magnets and RF laminas



The PVX-4110 pulse generator is a direct coupled, air cooled, solid state half-bridge (totem pole) design, offering equally fast pulse rise and fall times, low power dissipation, and virtually no over-shoot, undershoot or ringing. It has overcurrent detection and shutdown circuitry to protect the pulse generator from potential damage due to arcs and shorts in the load or interconnect cable.



Suitable to test different materials, surface finishing and treatments up to 50 MV/m



The RF cavities design foresees the presence of thin (100 micron) metallic windows at the cells iris.

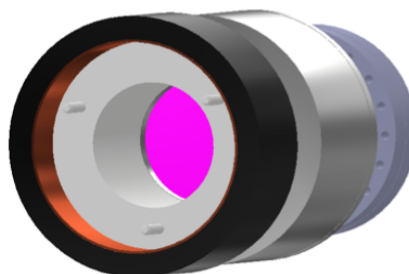
This will simplify the RF e.m. design but introduces a challenging element related to the mechanical design, the soldering procedures and the capability to sustain RF pressures and thermal stresses.

Test facilities: Shape Memory Alloy and Pillow Seal Systems

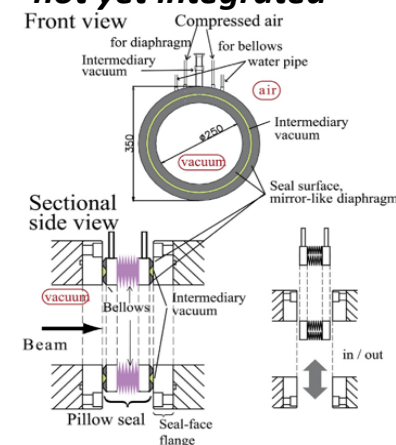


SMA-based UHV chambers with external diameters in the range 15-150 mm, DN16, DN25, DN100 pipe compatible. Heterogeneous joints (St/Ti, St/Alu, St/Cu)

Requires good pre-alignment



Pillow seal system not yet integrated



Richieste finanziarie 2026

Capitolo	Descrizione	Parziali (K-EUR)
consumo	forme di avvolgimento e anelli in 316 LN per stress containment	10.00
consumo	Sistema di tenuta da vuoto a memoria di forma	20.00
consumo	Passanti ceramici per vuoto e applicazione HV	5.00
consumo	Schede acquisizione dati	3.00
consumo	Test saldatura ad electron beam di lamine per celle RF	20.00
consumo	Test brasature su rame	7.00
consumo	realizzazione di n. 8 dischi in differenti materiali per test su sistema pulsato HV	15.00
inventario	Nastro HTS per realizzazione bobina	170.00
inventario	Lamine in alluminio a spessore variabile e curve	10.00
inventario	Lamine in Berillio a spessore variabile e curve	15.00
inventario	Lingotto da 100 kg in rame per prototipi celle	18.00
inventario	Guida d'onda lavorata da pieno in rame	3.00
inventario	Flange speciali per guide d'onda	5.00
inventario	Passante ceramico per pickup probe RF (n.3)	15.00
inventario	Sonde di temperatura non a contatto	5.00
inventario	Sensori di spostamento laser (triangolatori micrometrici) e sistema di lettura	4.00

Totale FTE:

Ricercatori: 3.2
Tecnici: 1.4