Muon Collider WP7-Task 2 Target, Capture and Cooling Magnets

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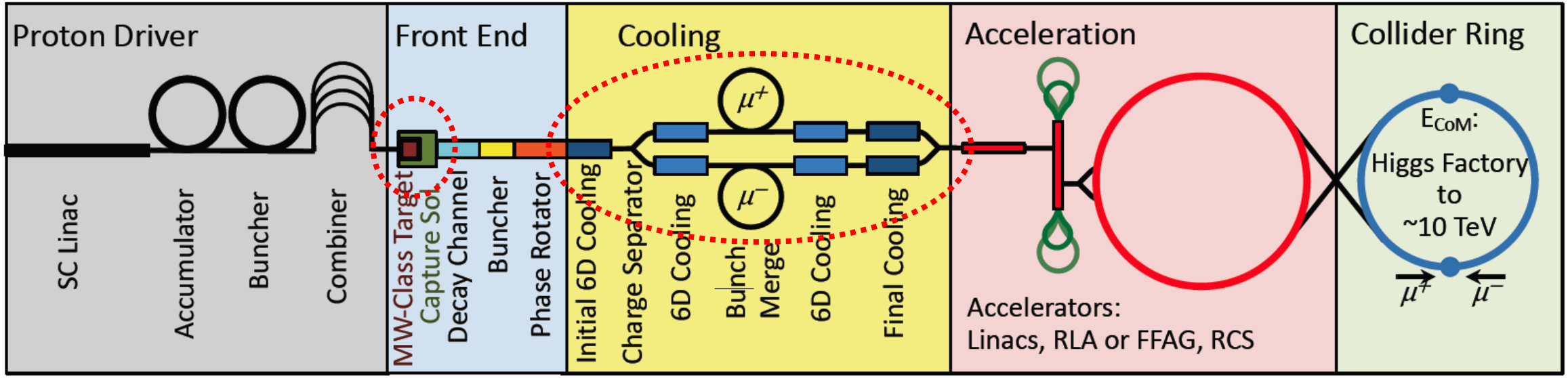
Outline

- Motivation
- Highligths of the challenges
- Discussion

Motivation 1 - where



Partecipating institutes

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contact person: Prof. Y. Yang

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CEA, Dr. L. Quettier

Motivation 2

- The objective of this work package is to address feasibility and technology limits of the magnet and powering systems, assess technology readiness and R&D timeline. The leading topics are:
  i. the value of the maximum field and free bore of the solenoids for the target, capture and cooling complex,
  ii. the concept and feasibility, and
  iii. design options
- We address the above topics through a combination of conceptual design work, targeted tests and specific characterization measurements. We also plan to exploit synergies with on-going developments in other fields (high magnetic field science, NMR, fusion) and programs (EU High-Field Magnets R&D, US-MDP).

Solenoid zoo

- Target solenoid

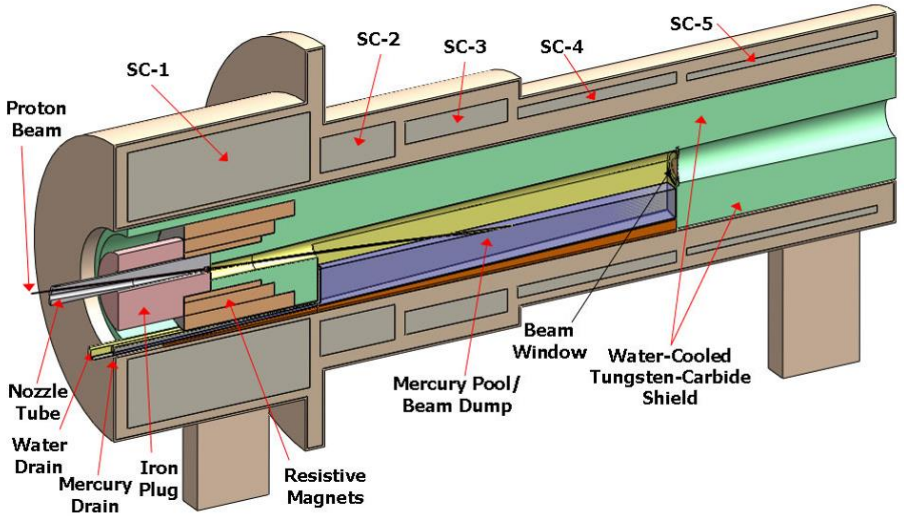
  1.5 m 20 T 2MW

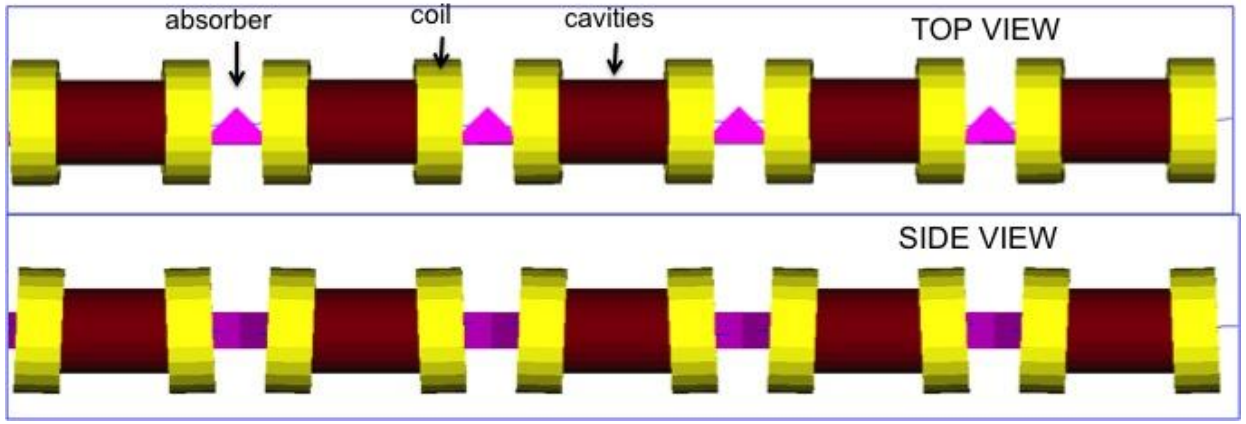
- Muon coolig

  1km 2 T to14 T

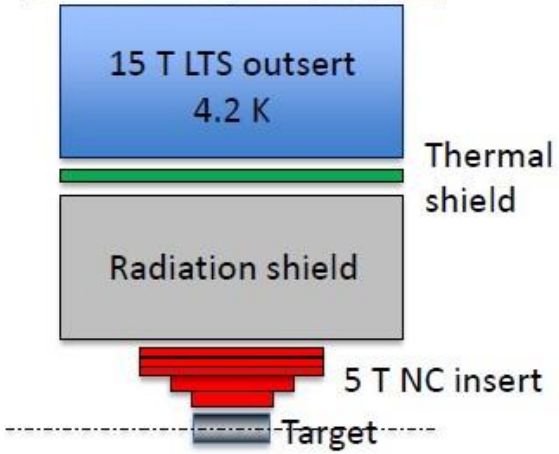
- Final cooling

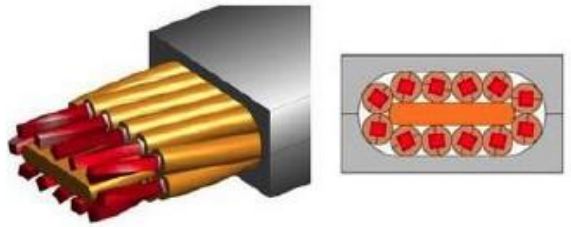
  8.5 m – 40 T or 60 T

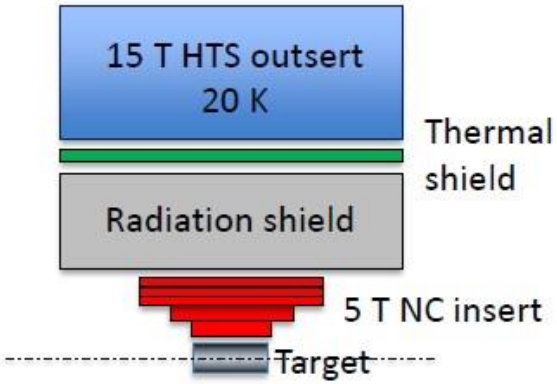


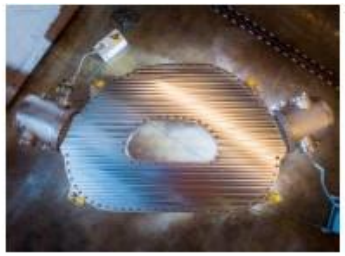


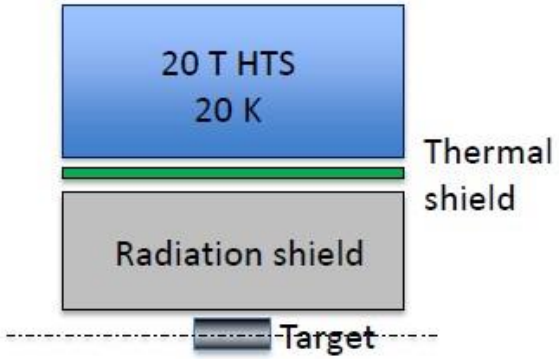
Challenges – Target solenoid











Challenges
Cost optimization
Sustanaibility

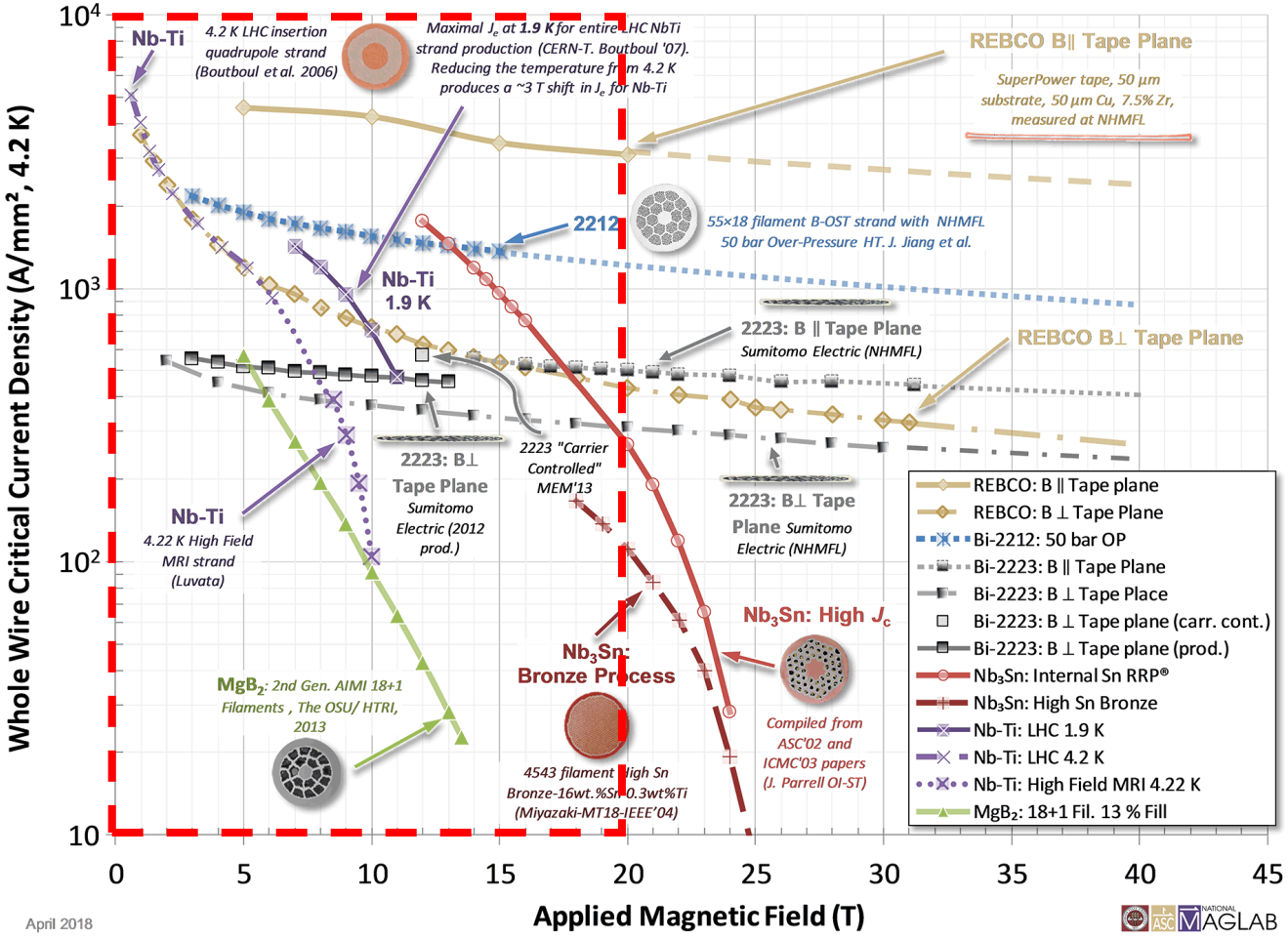
Same optimization for **cooling solenoid**

Based on exististing technology (ITER CS NB3SN CICC)
- 4.2 K cryogenics
- Resistive insert large power consuption

HTS internally cooled magnet wound with cable developed for fusion (CFS/MIT)
- Solenoid bore may be reduced by reducing shielding
- Improved cryogenic efficiency (a factor 5 better Carnot)

All-HTS internally cooled magnet, no resistive insert
- Minimal solenoid bore radius
- Reduced power consumption
- Large field on SC cable

Challenges - final cooling solenoids



- Target field 60T (40 T baseline)
- Length 500 mm
- Inner diameter 60 mm

- **Will be HTS**
- **Mechanics and protection will most likely be the limit**

Ultra High Field tests

Collaboration to high field inserts for tests 30 T - 40 T

Questions (and possible answers)

- What is the maximum field that can be achieved in HF (target 20 T) and UHF (target 40…60 T) solenoids?
- What is the R&D required to reach such field?
- Can we increase the sustainability of such devices?

A Review concepts and options for the target and final cooling solenoid (Hybrid/HTS only – Is Bi-2212 an option?) and preliminary design of solenoid families – **the discussion we will initiate with the spotlights of today**

B Establish mechanical and protection limits of HF and UHF solenoids, in particular HTS tapes (internal adhesion, internal resistance, mechanical properties, radiation resistance, …)

- Instrument and test crucial properties on existing or new set-ups in order to establish the “technology reach”: **Technology and Performance Limits experiments (TPL)**

Discussion – ideas of topics

- What is happening in the wider community?
- Where do we stand with our solenoid challenges and options?
- In practice, how can we
  - **Unite and leverage our efforts to achieve more than our single contributions? (this is the reason for the spot presentations)**
  - Profit from on-going programs other than muon collider R&D?
  - Ensure our work is complementary and goes beyond the work of others?


THANKS

Deliverables

T_0+ 20 months	M7.3 Workshop on Ultra High Field Solenoids
T_0+ 33 months	D 7.1 Intermediate Report
T_0+ 45 months	D 7.2 Consolidated report