
Tiara
YACHTS
2011
PREVIEW

Imperial College London

K. Long, 24 February, 2011

TIARA WP7: Ionisation Cooling Test Facility

- WP7 management:
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  - Deputy: E. Montesinos

Tiara

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- Motivation:
  [Muon accelerators for particle physics]
- Ionisation cooling
- Muon Ionisation Cooling Experiment
- Developing a facility
  [the Ionisation Cooling Test Facility]
- TIARA WP7

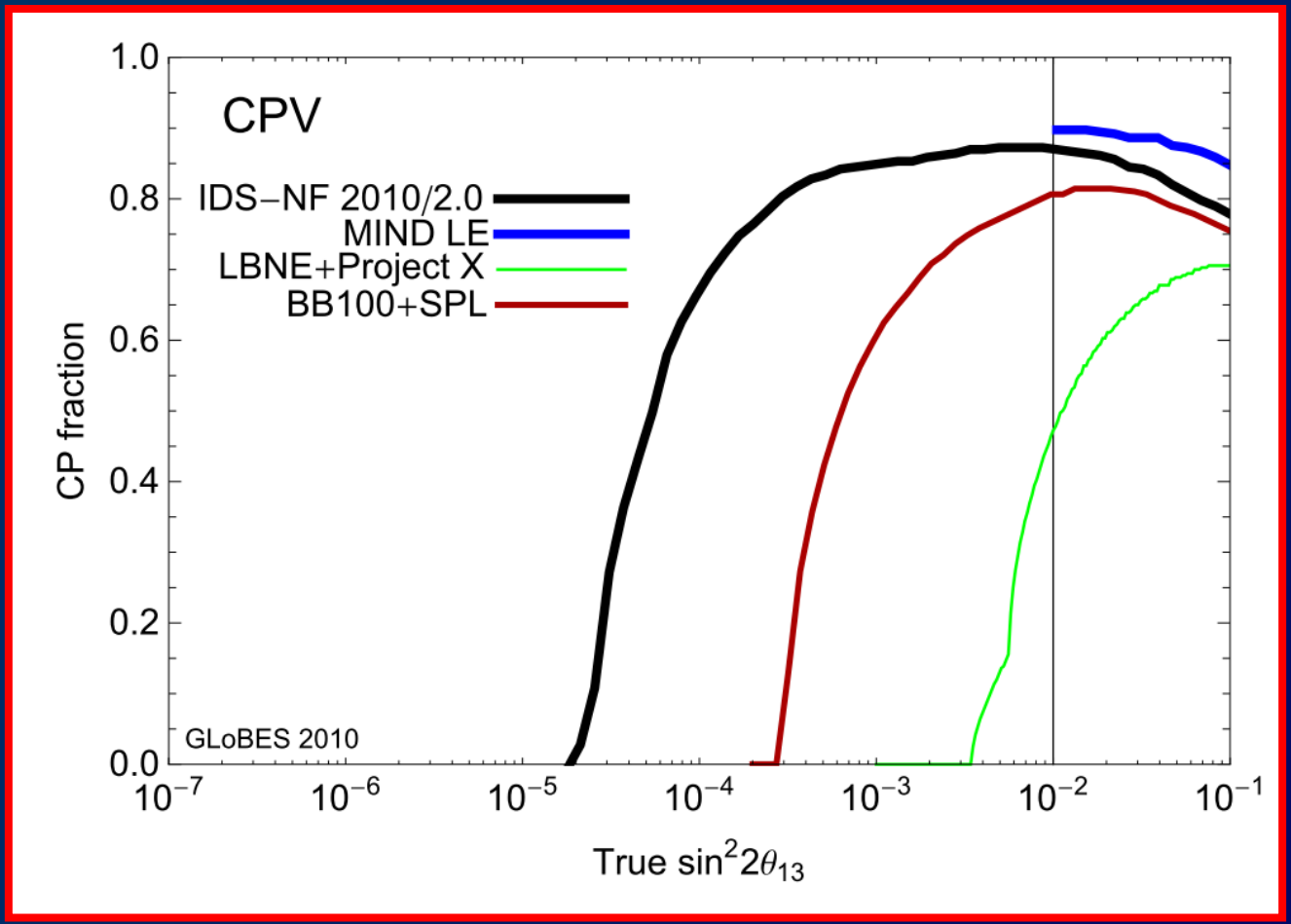
Ionisation Cooling Test Facility:

Motivation:

Muon Accelerators for Particle Physics

The Neutrino Factory:

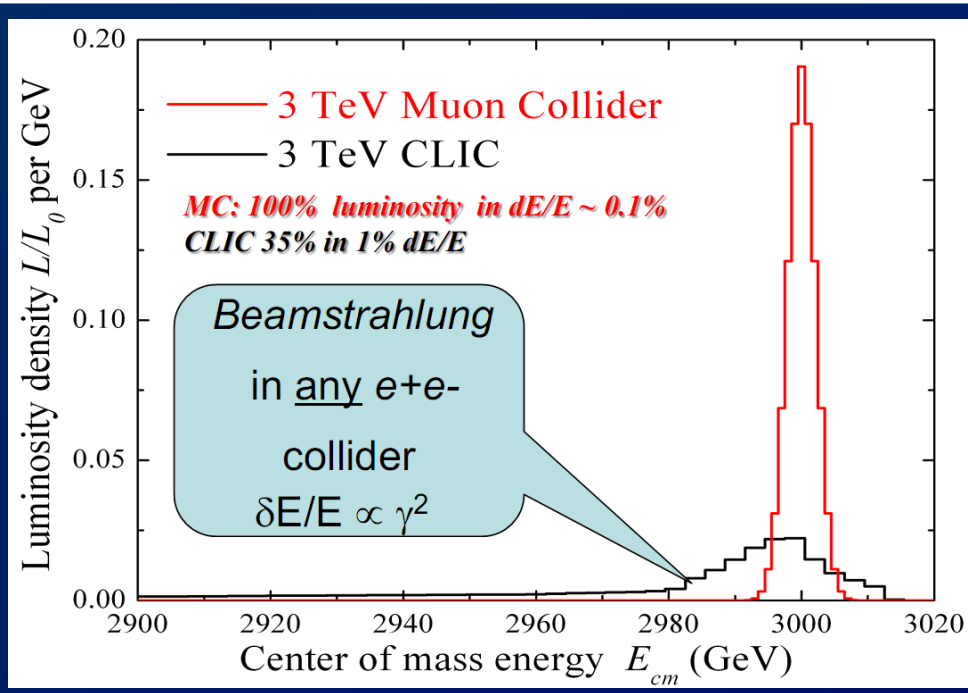
- **Optimise discovery potential:**
  - **Requirement:**
    - **Large, high energy ν_e (ν_e) flux**

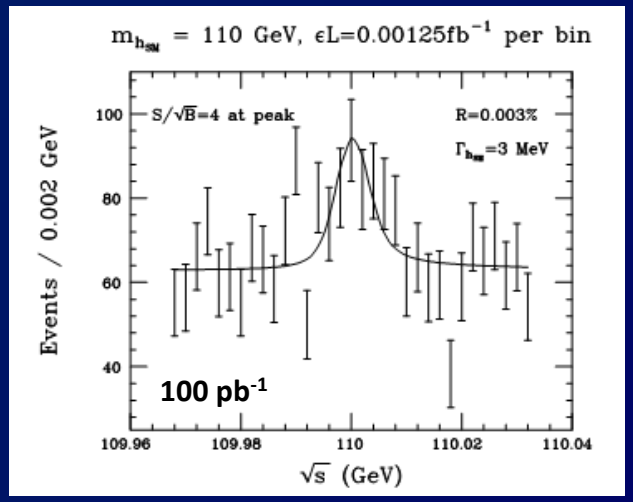


Muon Collider: basis of advantages:

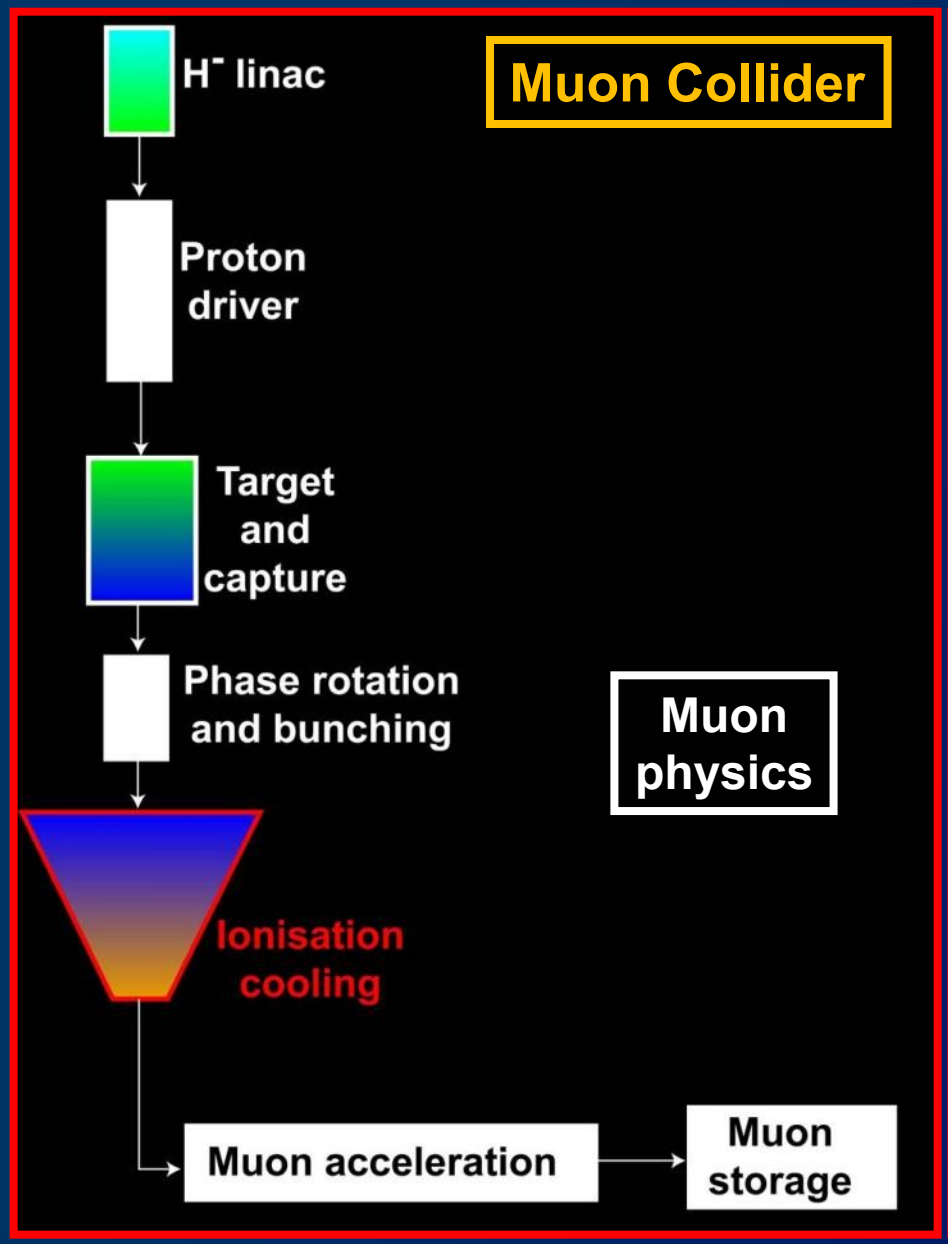
- Muon mass: 106 Mev/c^2 Electron mass: 0.511 MeV/c^2

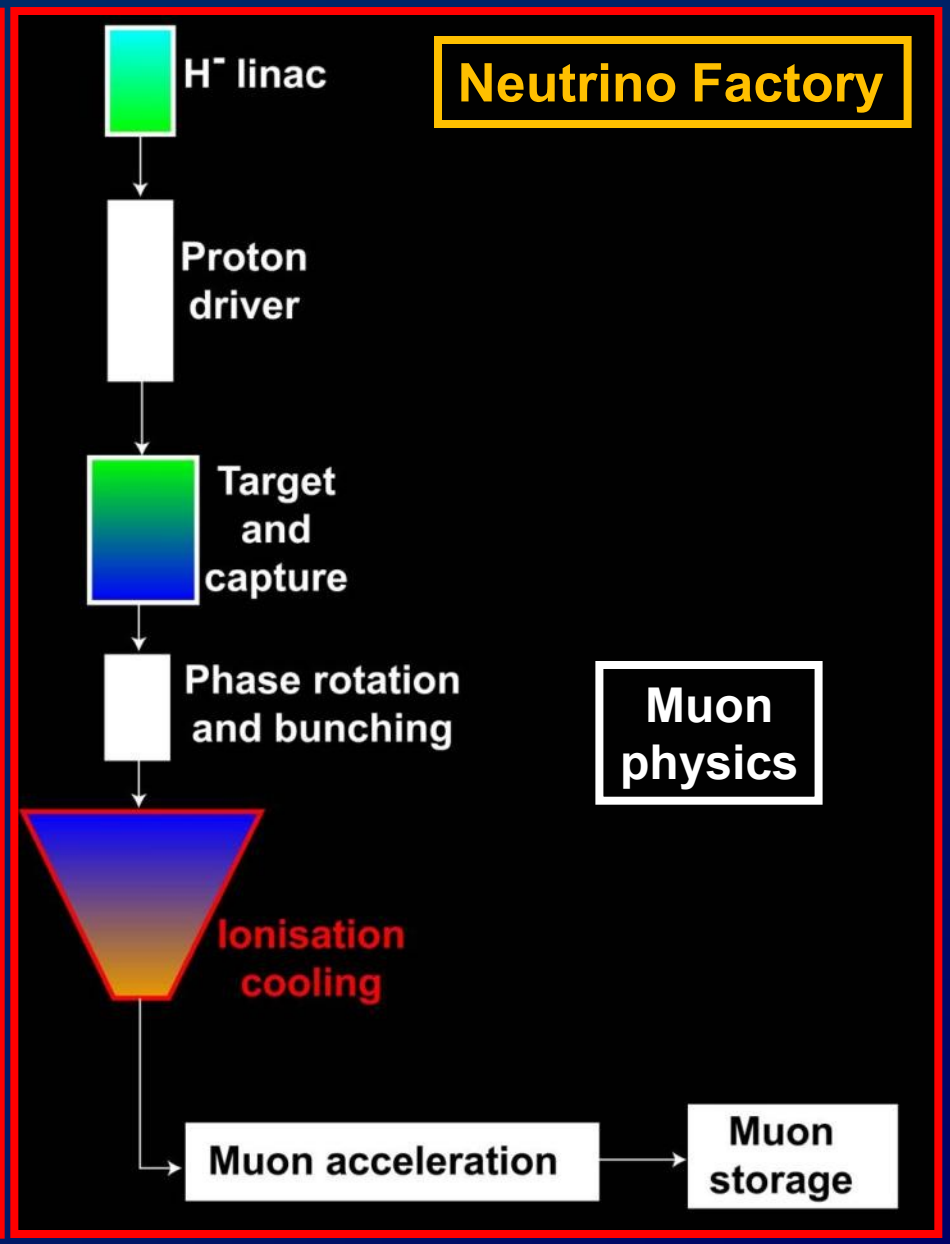
- Consequences:
  - Negligible synchrotron radiation at Muon Collider:
    - Rate $\propto m^4$:
      $\Rightarrow$ Muon Collider reduction factor: 5×10^{-10}
    - Compact, *circular,* accelerator
    - Small energy spread
    - Possible to preserve polarisation at ~30% level
      - Yields possibility to determine beam energy precisely (0.003%) using $(g-2)$ precession
  - Strong coupling to Higgs:
    - Production rate $\propto m^2$:
      $\Rightarrow$ Muon Collider enhancement factor: 5×10^4
    - Large data set allows branching ratios to be measured





Muon accelerators for particle physics:

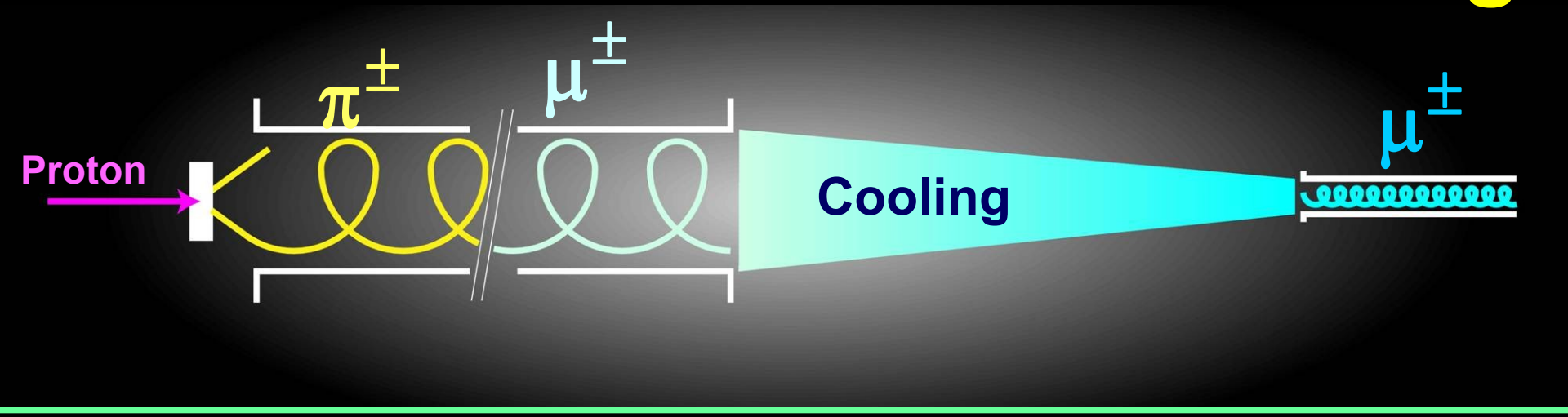


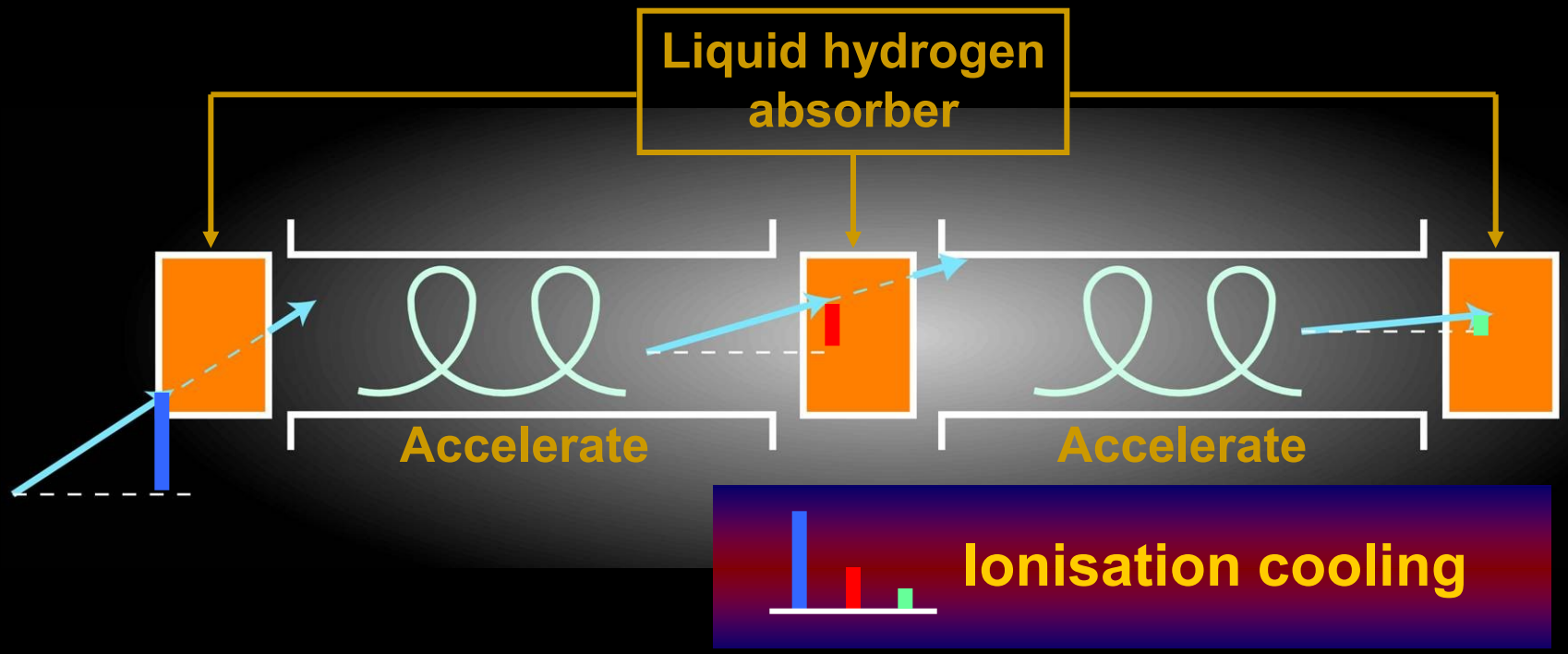


Ionisation Cooling Test Facility:

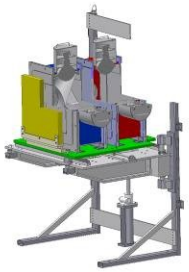
Ionisation cooling:

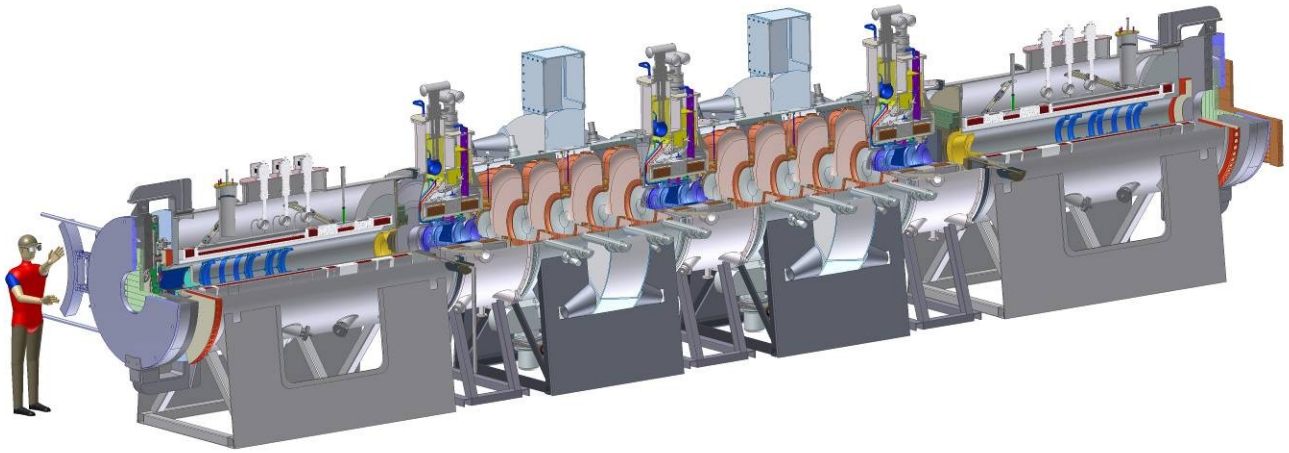
Ionisation cooling:





Muon ionisation cooling experiment





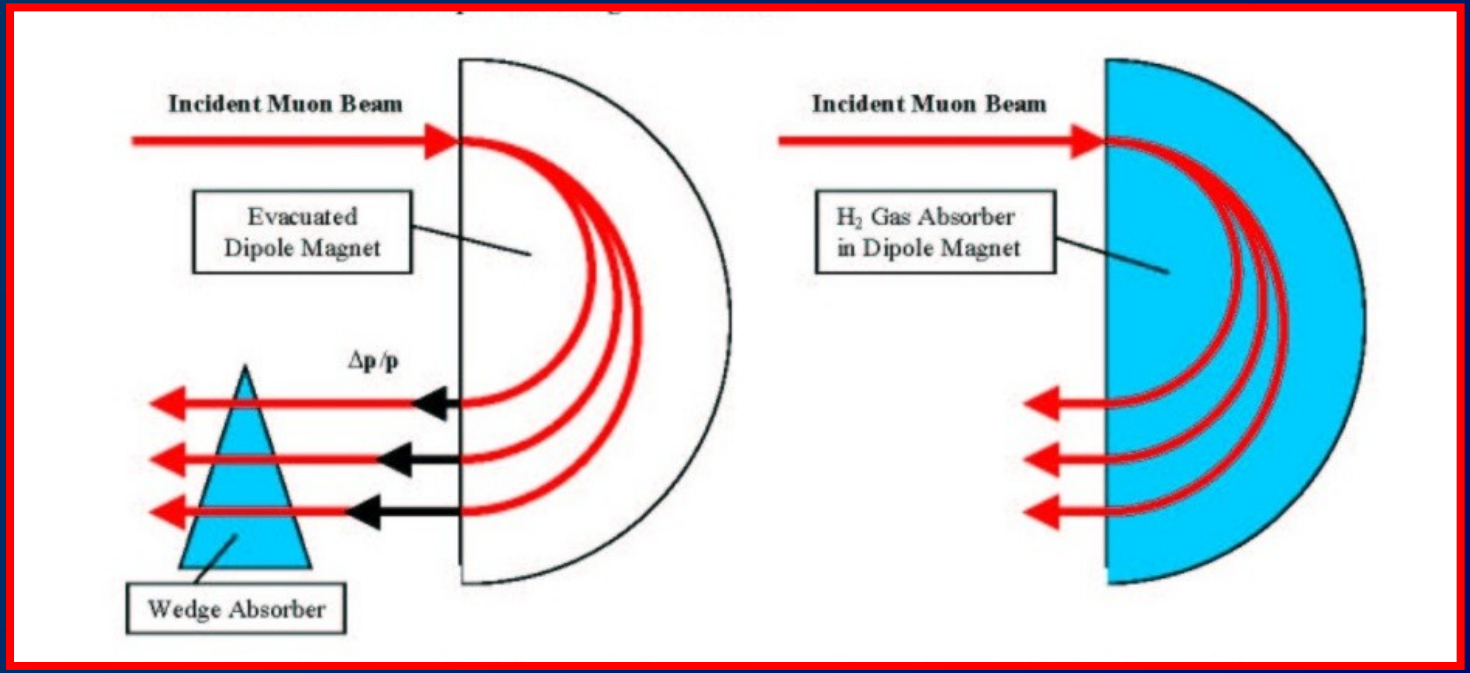
- **MICE:**
  - Design, build, commission and operate a realistic section of cooling channel
  - Measure its performance in a variety of modes of operation and beam conditions …

  … i.e. results will allow Neutrino Factory complex

  to be optimised

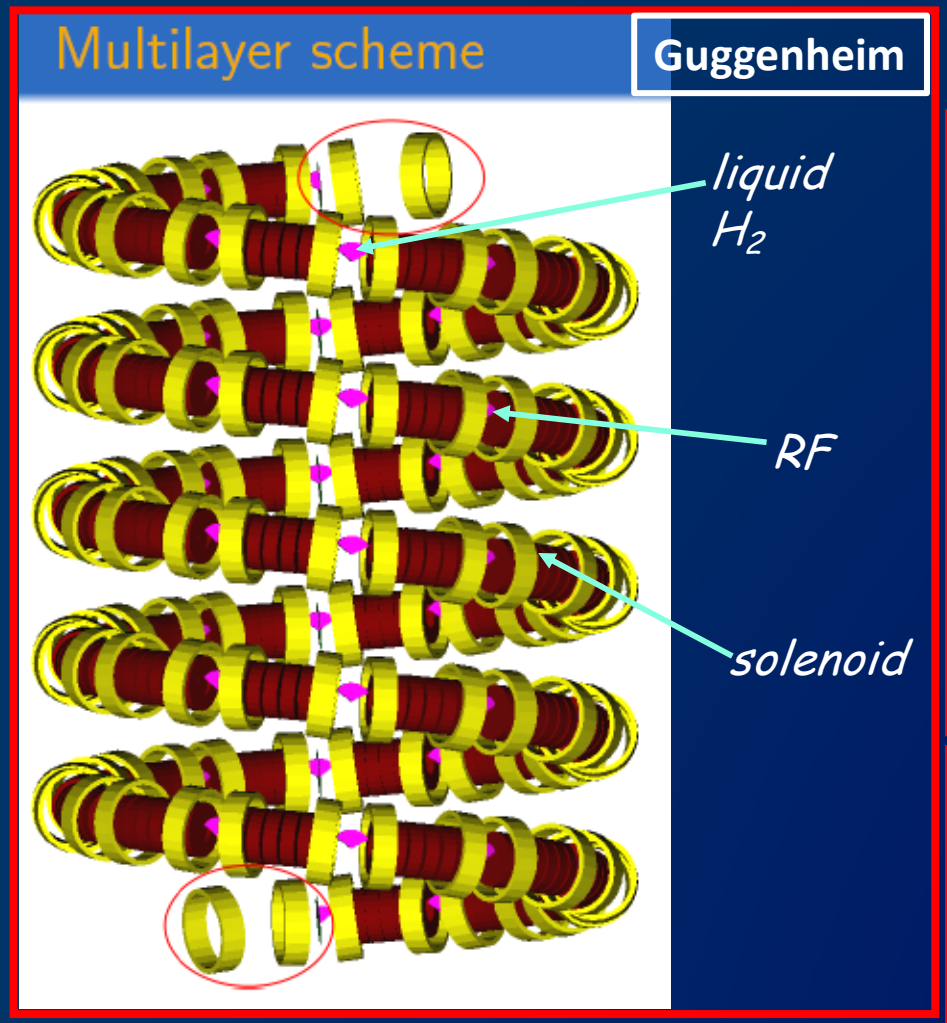
Ionistion cooling and the Muon Collider:

- Muon Collider requires much more aggressive cooling:
  - Must reduce emittance in all 6 phase-space dimensions
  - Requires 'emittance' exchange

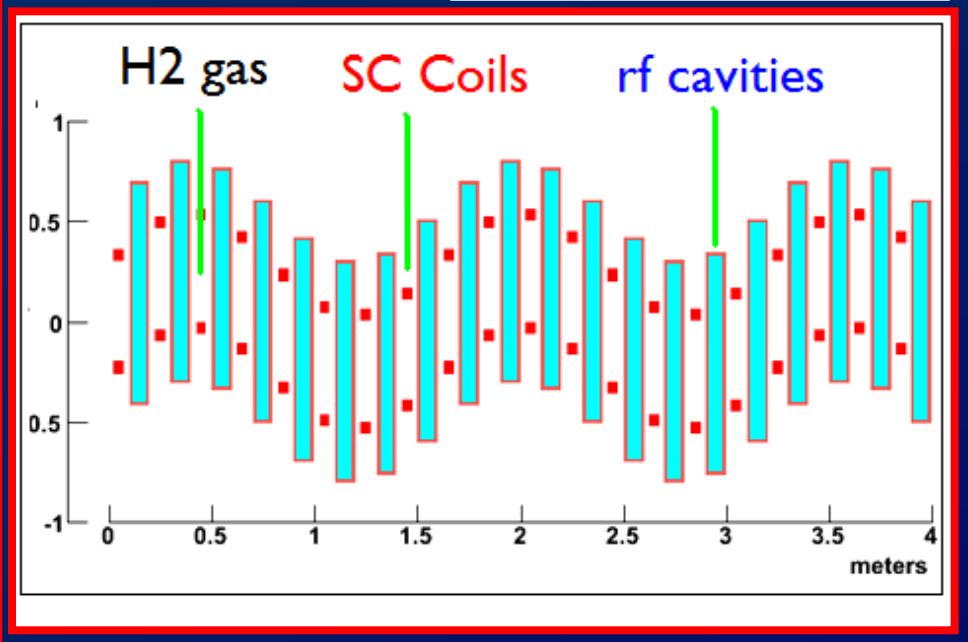


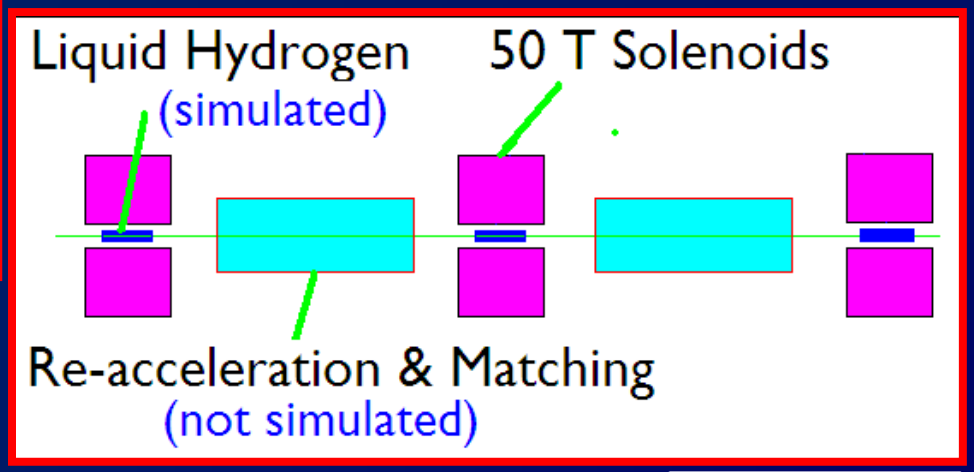
  - *The* most challenging R&D programme for the Muon Collider

6D cooling scheme components:



Helical cooling channel





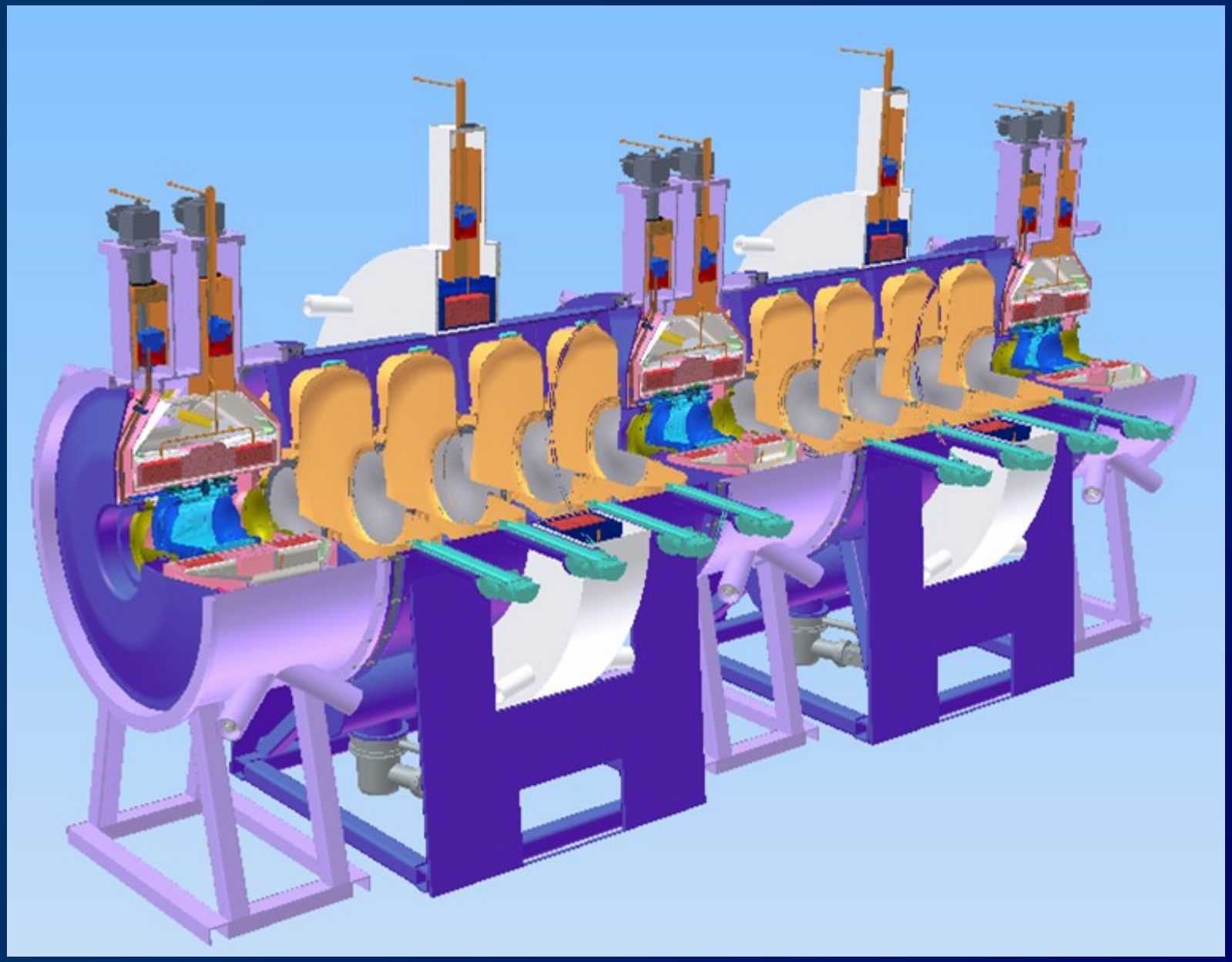
Final cooling

- 6D ionisation cooling experiment under discussion:
  - Possible use of MICE Muon Beam once MICE is complete
  - Critical issue: high-gradient RF in magnetic field

Ionisation Cooling Test Facility:

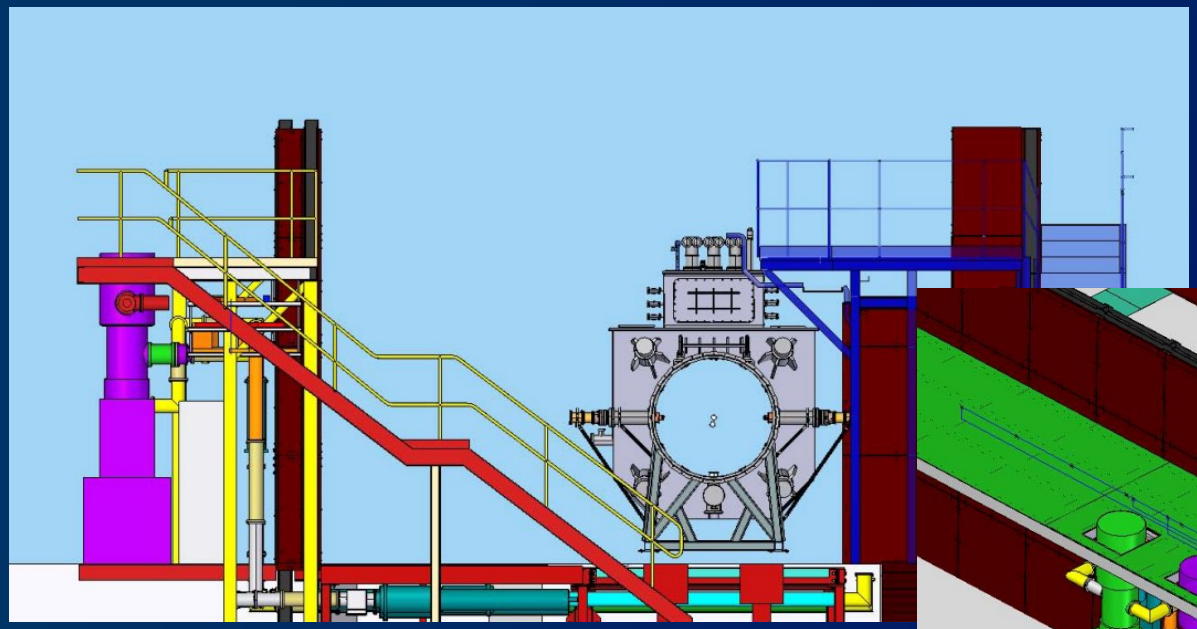
Muon Ionisation Cooling Experiment

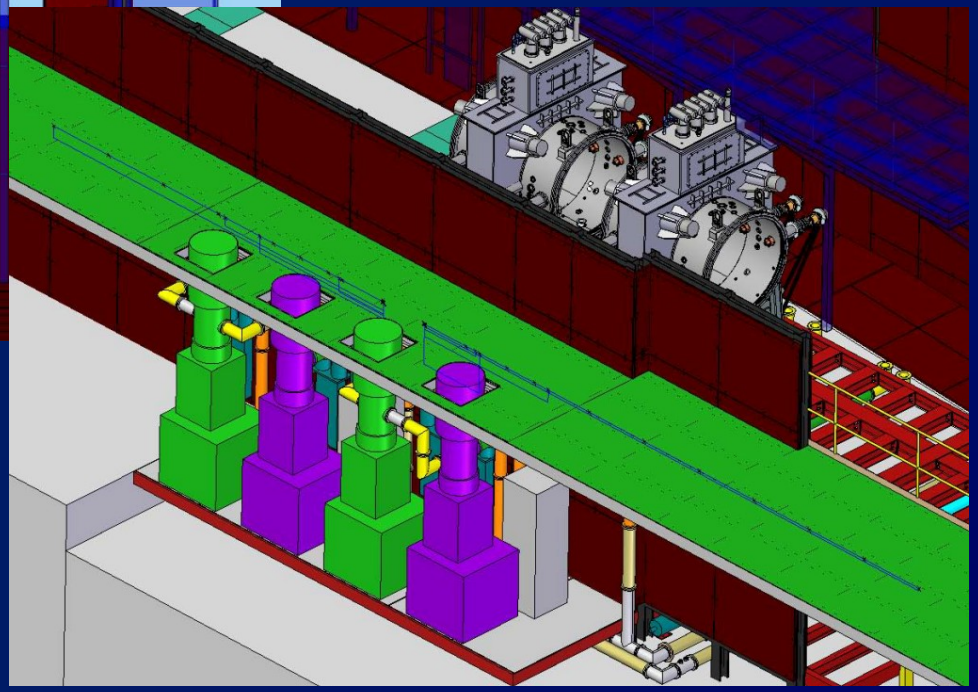
Cooling channel:



RF power infrastructure:

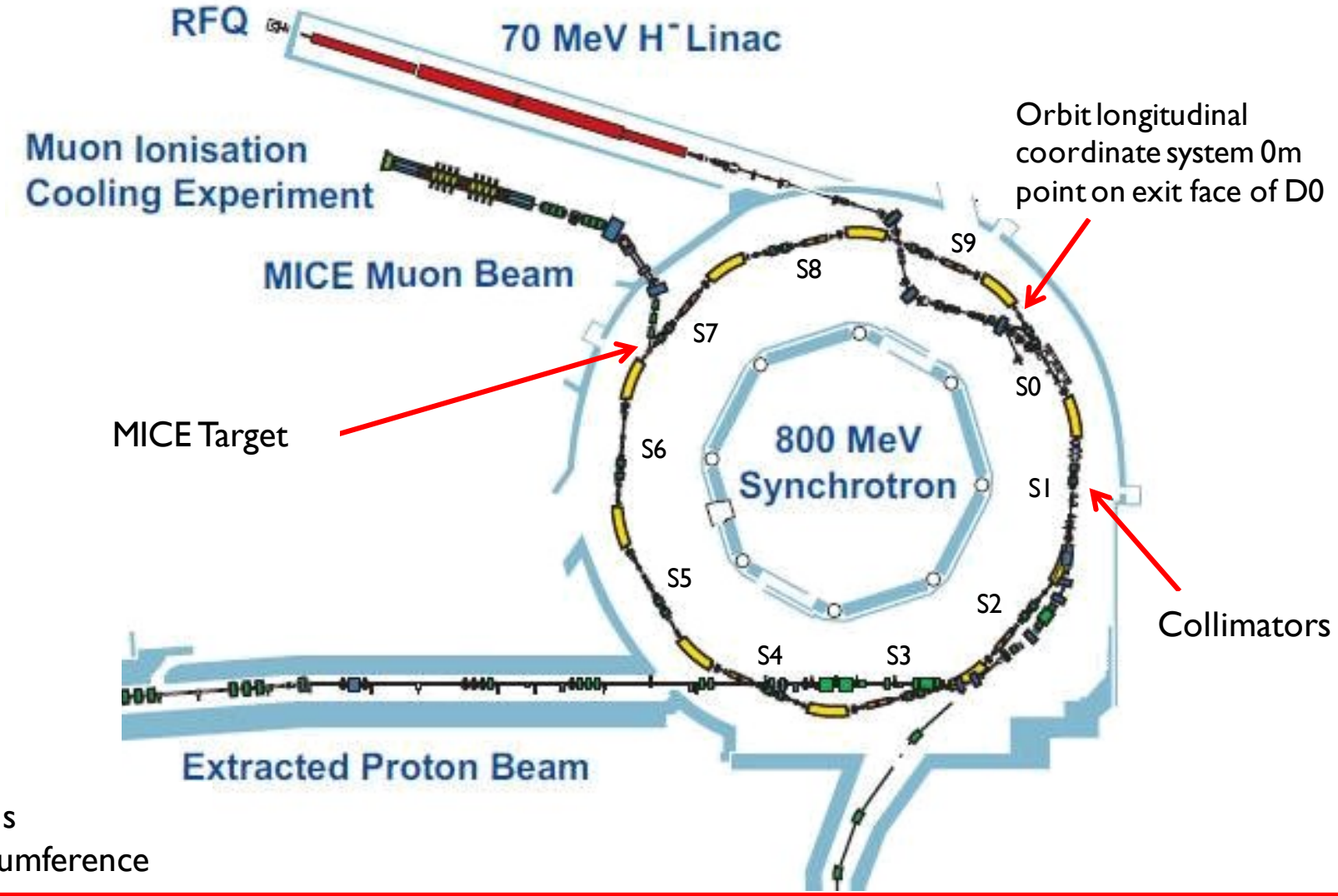
- **Layout of RF-power distribution:**
  - **Development of RF power-distribution layout underway:**



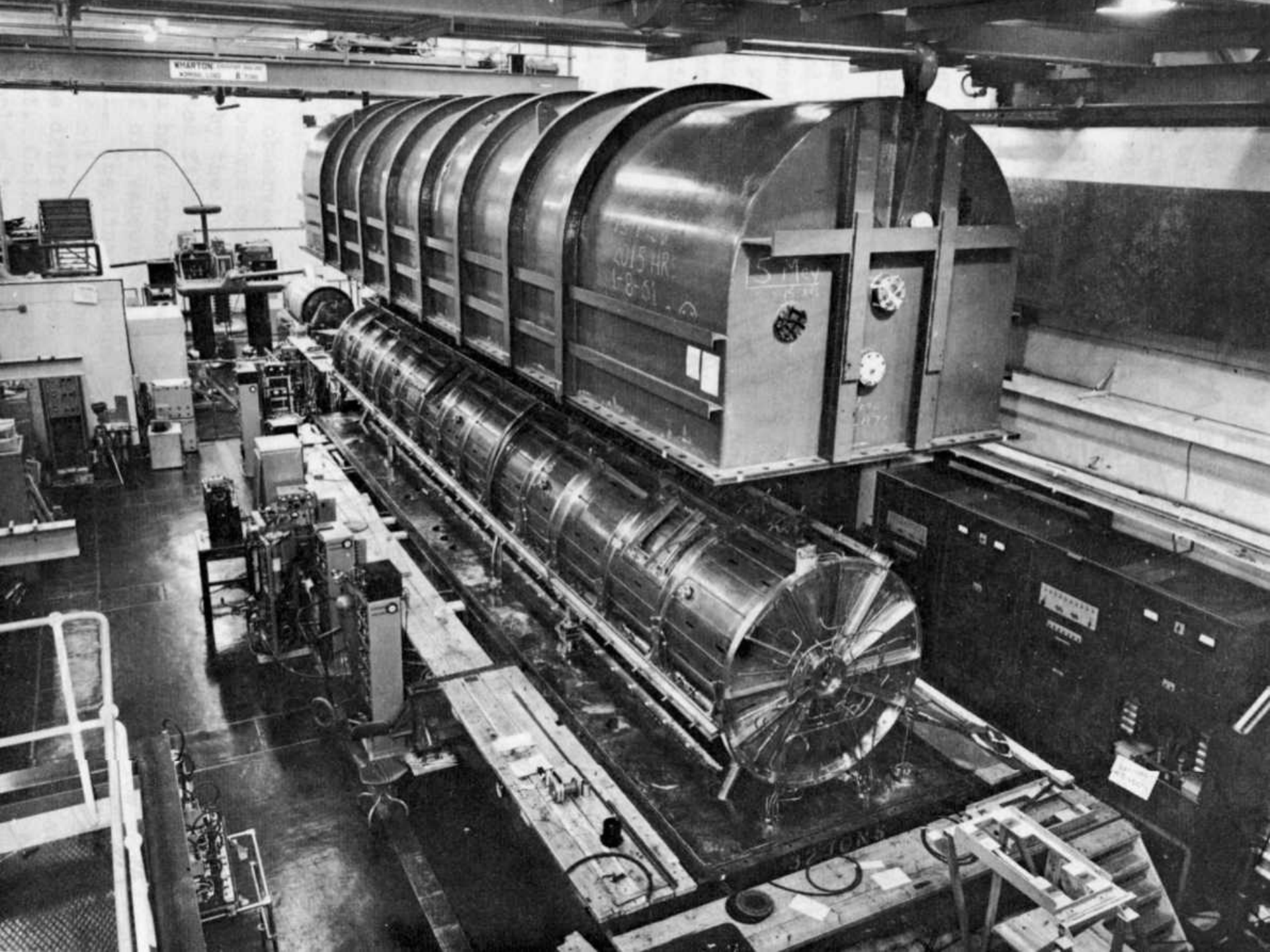


Ionisation Cooling Test Facility:

Developing a facility:

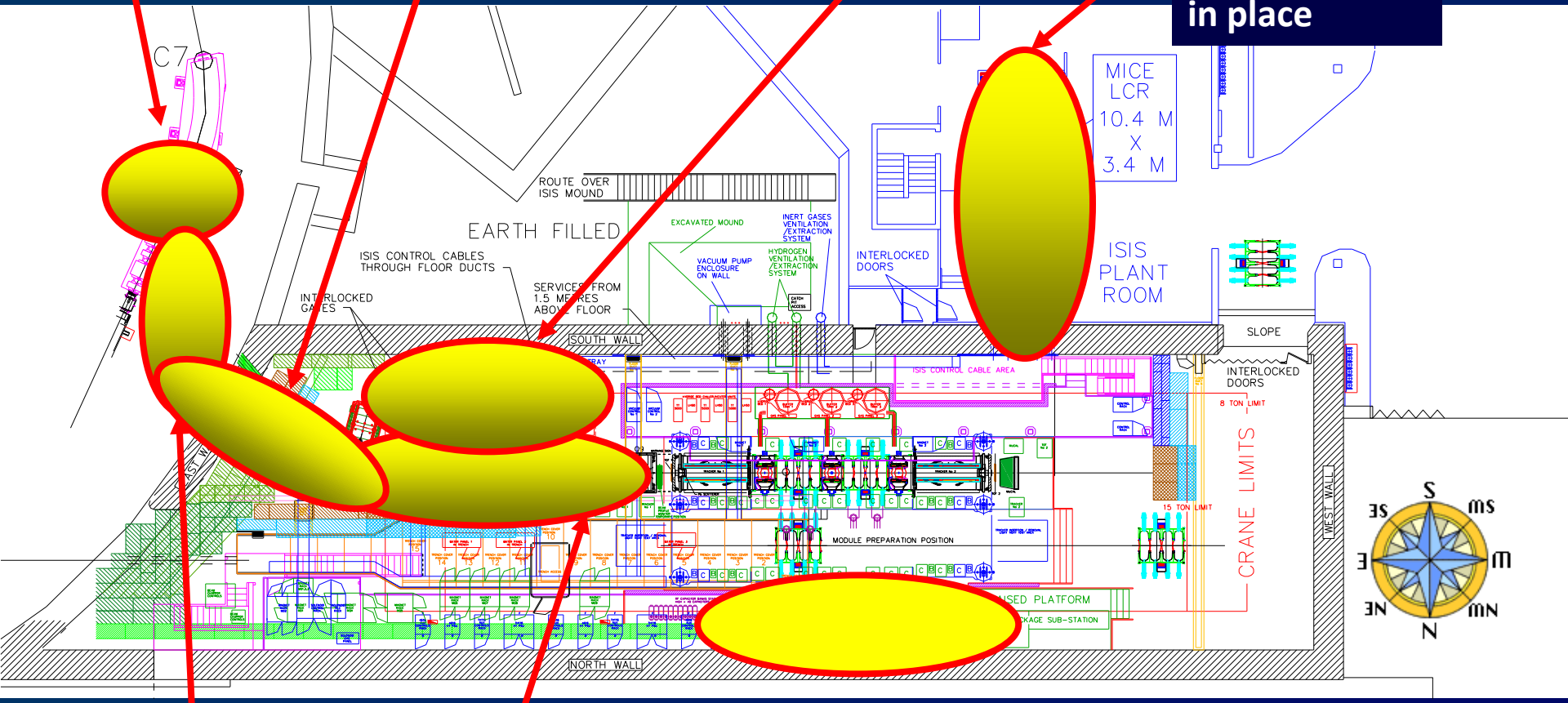


26m radius
163m circumference


WHARTON
2015 HR
1-8-51
327 TONS


West Wall

Status of MICE:



Upstream beam line

Downstream beam line

Instrumentation in place:

Beam profile monitors

Trigger/rate scintillators

CKovA&B, TOF0,1&2, KL

Ionisation Cooling Test Facility:

TIARA WP7:

TIARA WP7:

- Contribute to developing the ***Ionisation Cooling Test Facility!***

- Short term:
  - RF power distribution system for MICE

- Longer term:
  - Novel RF power amplifier for 6D test facility

TIARA WP7: milestones and deliverables:

Milestone number [59]	Milestone name	Lead beneficiary number	Delivery date from Annex I [60]	Comments
MS27	RFSysReq	9	8	Report on RF system layout and requirements
MS28	SymDiac	2	19	Simulation of Diacrode complete

Deliverable Number [61]	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature [62]	Dissemination level [63]	Delivery date [64]
D7.1	RFSysV-Spec	9	10.00	R	PU	15
D7.2	RFAmp1-Test	9	17.00	R	PU	33
D7.3	RFSysVI-Spec	9	8.50	R	PU	36
D7.4	RF_Ampl-DR	2	12.00	R	PU	36

Description of deliverables

D7.1) RFSysV-Spec: Report on the design and specification of ICTF RF power distribution system for MICE Step V [month 15]

D7.2) RFAmp1-Test: Report on commissioning of the first RF amplifier system in the ICTF Hall. [month 33]

D7.3) RFSysVI-Spec: Report on the design and specification of ICTF RF power distribution system for MICE Step VI (full ICTF implementation) [month 36]

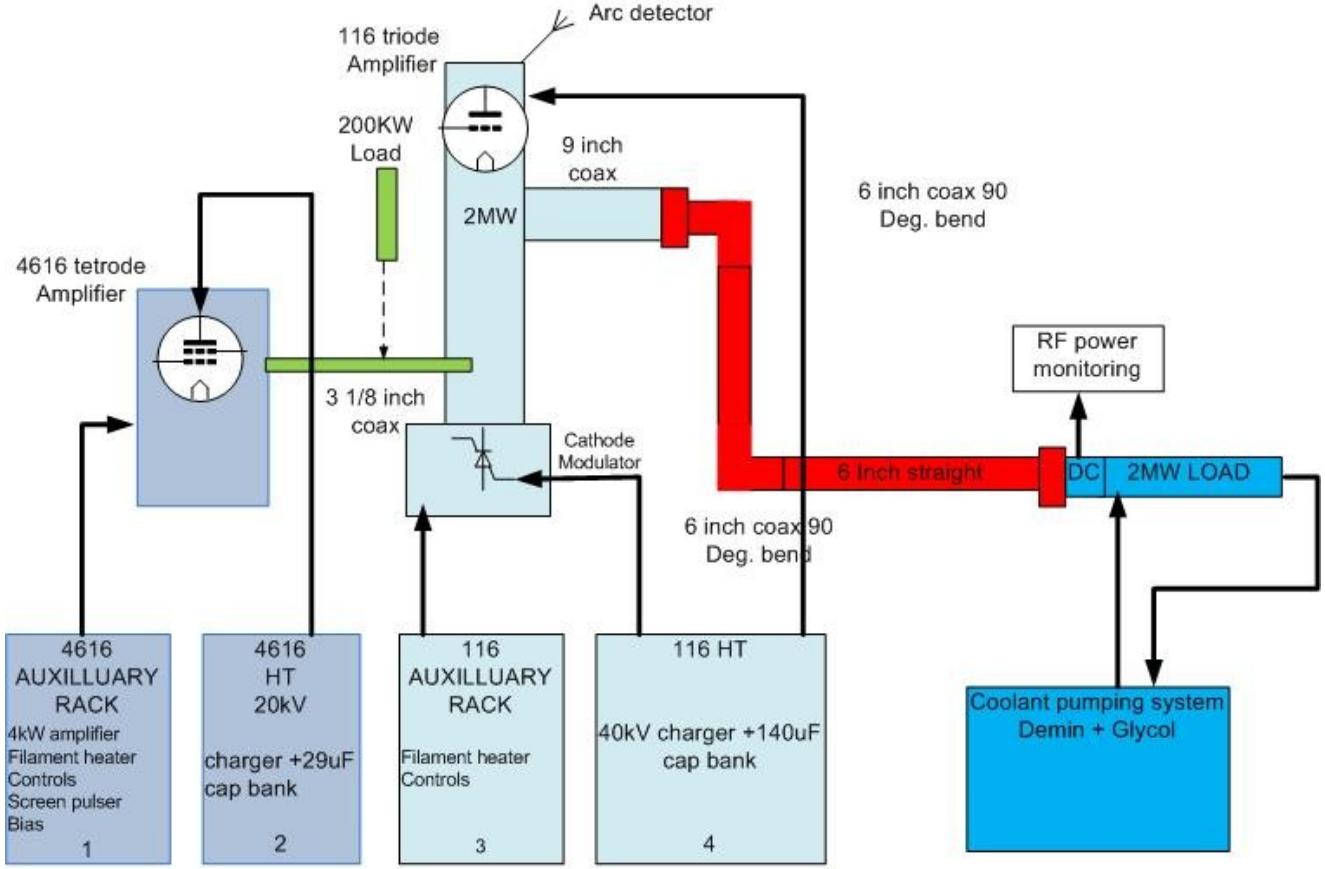
D7.4) RF_Ampl-DR: Design report of a 3 MW power amplifier [month 36]

Progress on commissioning of amplifier #1:

Radio Frequency & Diagnostics Group

ASTeC

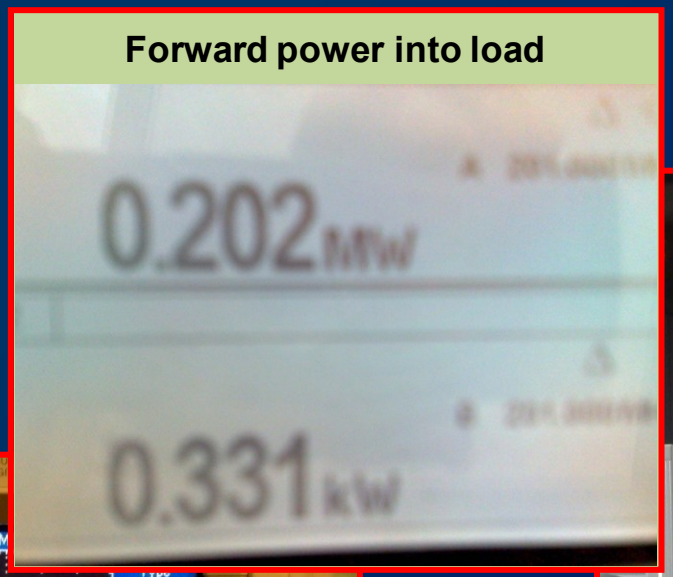
Test system at Daresbury

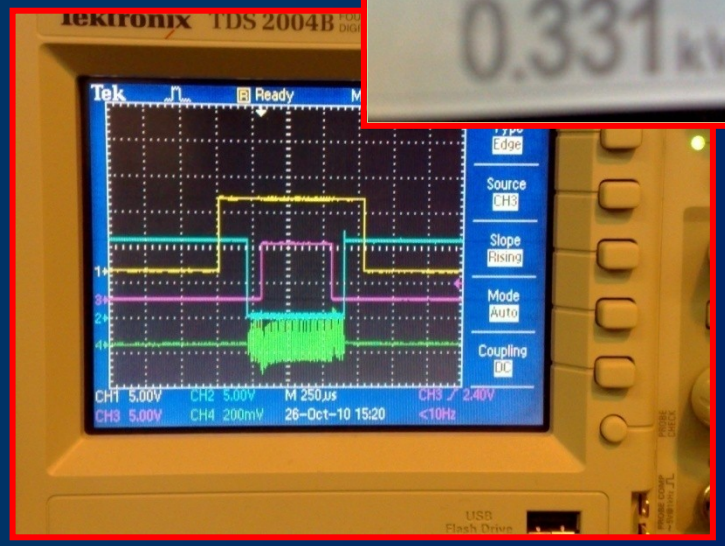


Daresbury test setup for proving amplifiers/power supplies

Andrew Moss

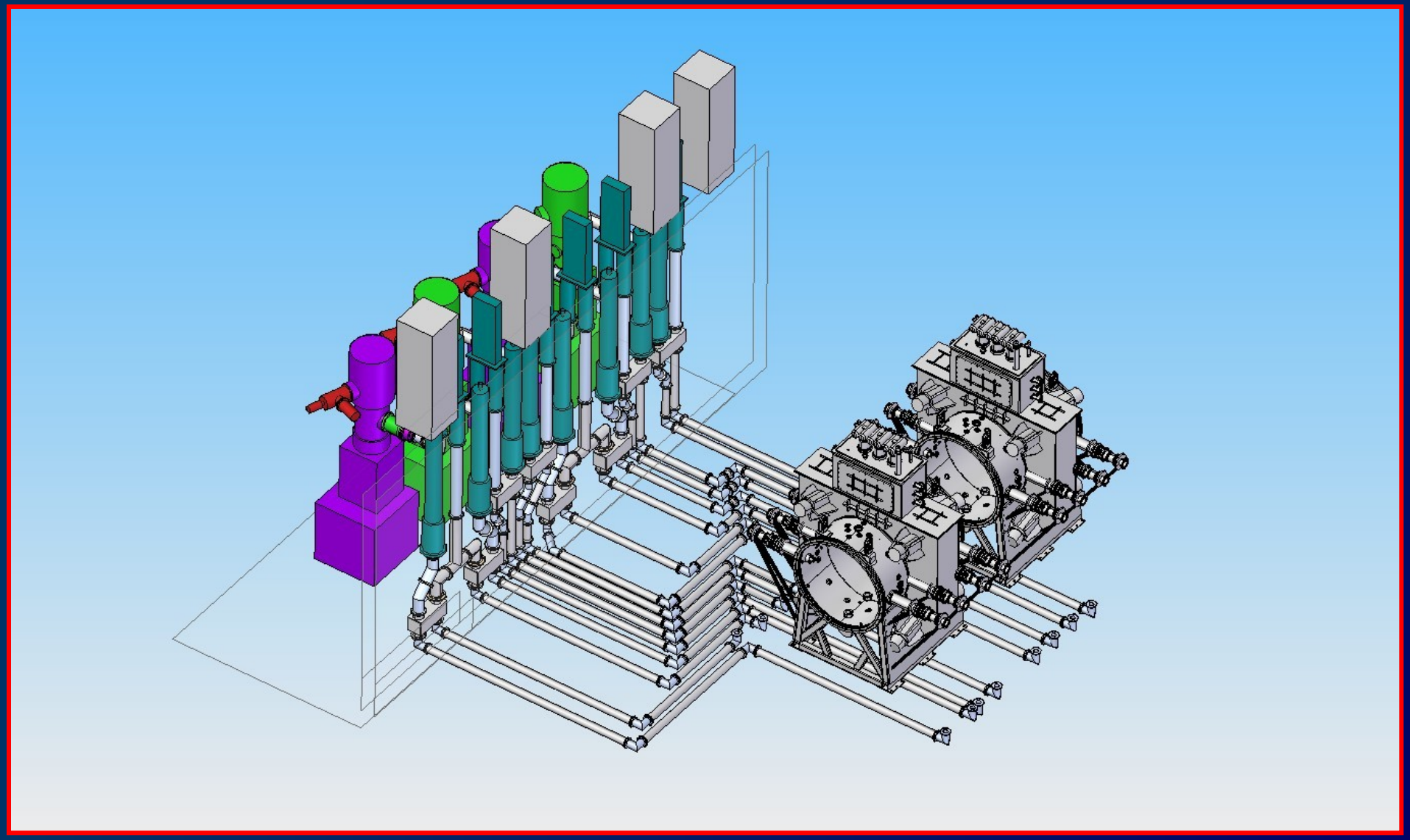
Test rig and status:





Noise issue presently being addressed … testing continues

Status of development of layout:



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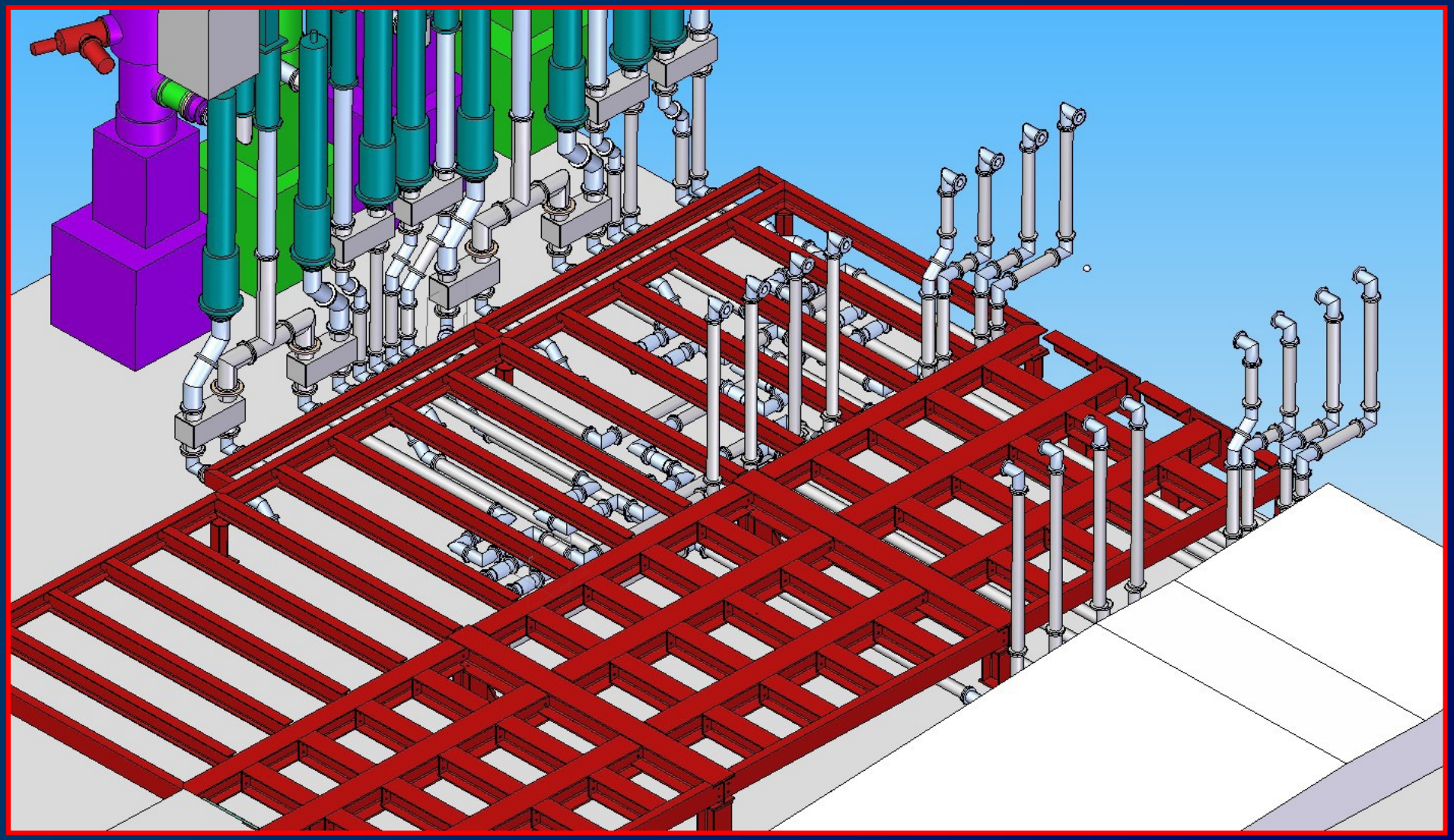


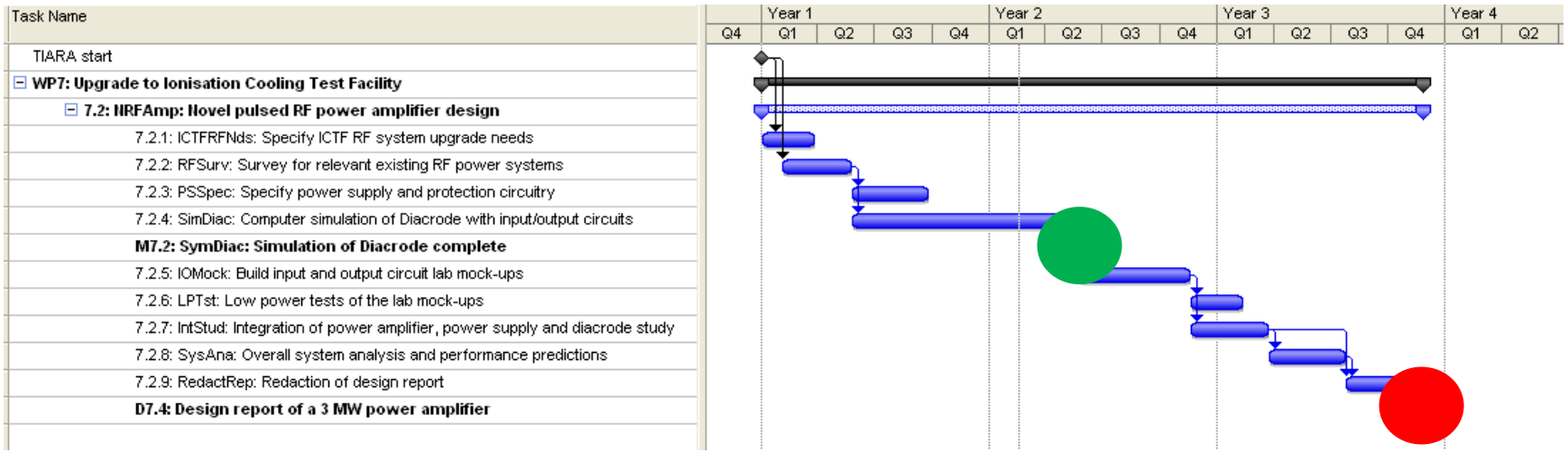
Novel Pulsed RF Power Amplifier Design:

Alternative 201 MHz 3 MW pulsed power amplifier

- Existing ICTF power amplifiers based on relatively old technology
- Sufficient tubes procured, but will be discontinued
- Future multi-megawatt RF power system will have to use more modern tubes
- For ICTF to serve ionization cooling R&D program, it is essential to develop an alternative 201 MHz RF power source
- Diacrodes are a possible solution
- Objective of task 7.2 is a Design Study of a 3 MW pulsed power amplifier based on Diacrode tube
- Fully exploit synergy since similar RF systems may be required at many other facilities (CERN's SPS, RAL's ISIS,…)

E. Montesinos

Summary tasks and milestones



- 6 months : Specification of the needs
- 18 months (M7.2) : Computer simulation of a Diacrode amplifier
- 25 months : Low power Mockups tests
- 36 Months (D7.4) : Design reports including
  - Simulations and mockups tests results
  - Integration study, HVPS and Amplifier
  - Performance prediction

E. Montesinos

Next steps:

- Existing work excellent basis for carrying out work defined in TIARA GA
- Regular (weekly) RF meetings used to develop RF power system to be extended to include amplifier design
- Over next two months develop intermediate milestone plan to allow progress of projects to be monitored in more detail
- Ambitious, but cautiously optimistic!