Swiss Institute of Particle Physics

CHIPP Plenary Meeting, PSI, 15-16 October 2007

Status of MICE

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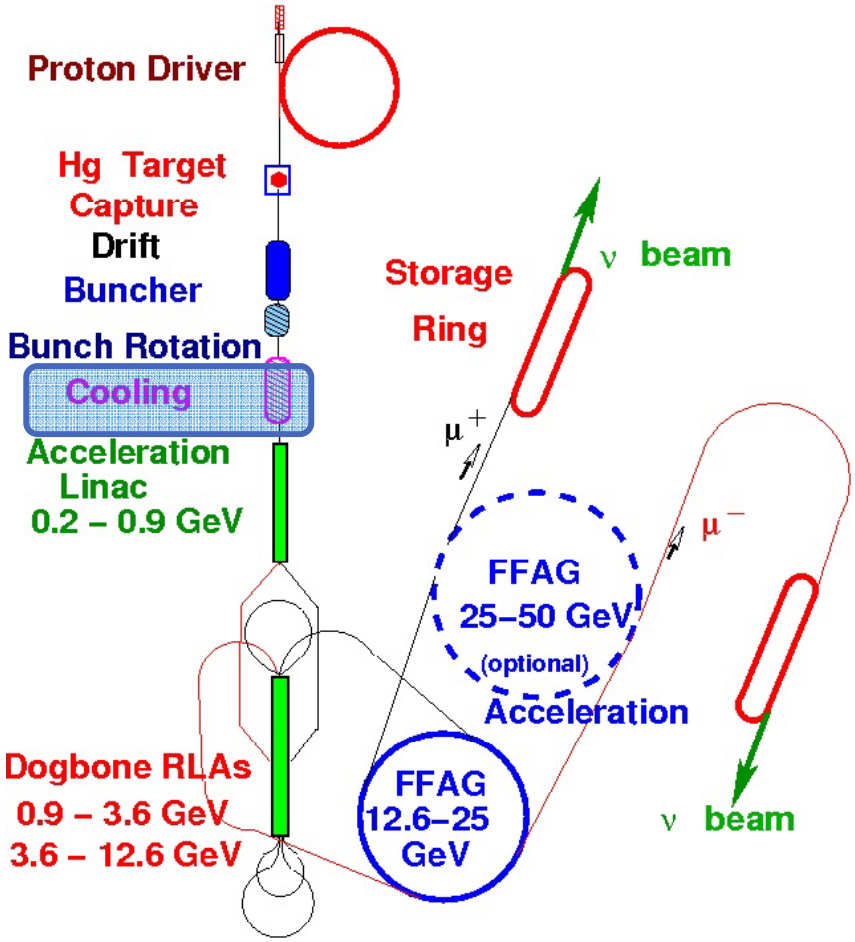
- Introduction
- Beam Line
- Technical Design
- PID detectors
- Geneva in MICE
- Conclusion

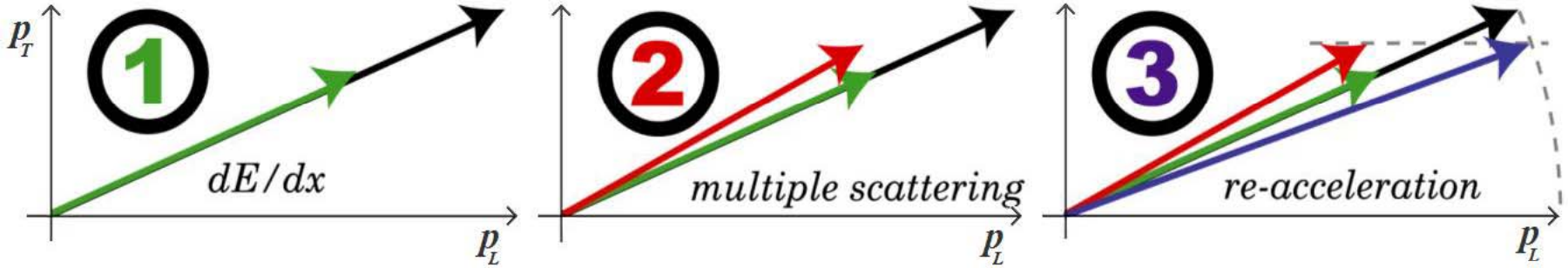
Introduction



- MICE is part of the R&D program towards the neutrino factory
- ν – Factory is the most precise tool for ν - Physics
- Cooling of muon beam is unexplored
- Large source of uncertainty on the cost and feasibility of ν factory (and Muon Collider)
- Demonstrate it's possible to engineer and operate safely and reliably a cooling channel with the required performances
- Validate new software tools

How to cool a muon beam ?

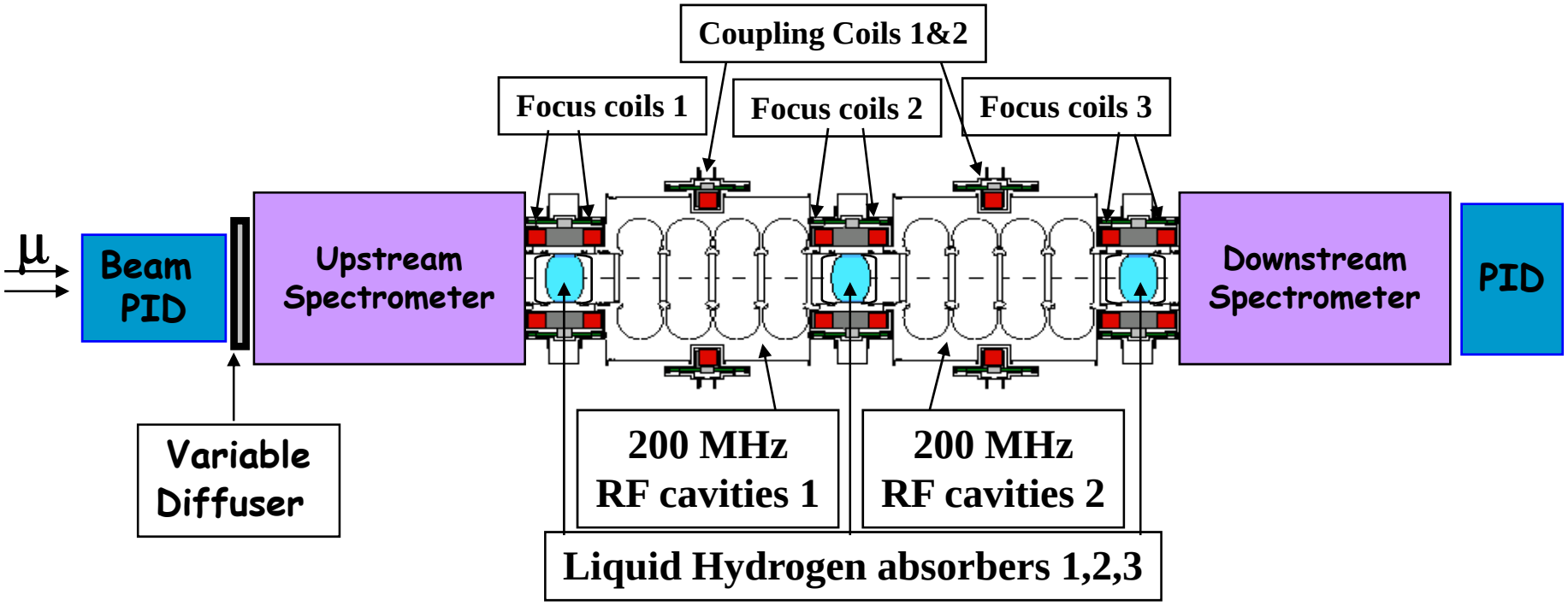
- Cooling = emittance reduction
- Stochastic cooling and electron cooling are too slow
  - compared to τ_μ = 2.2 μs
- Ionization cooling is the only solution
  - Never demonstrated experimentally !



- Limited by Multiple Scattering

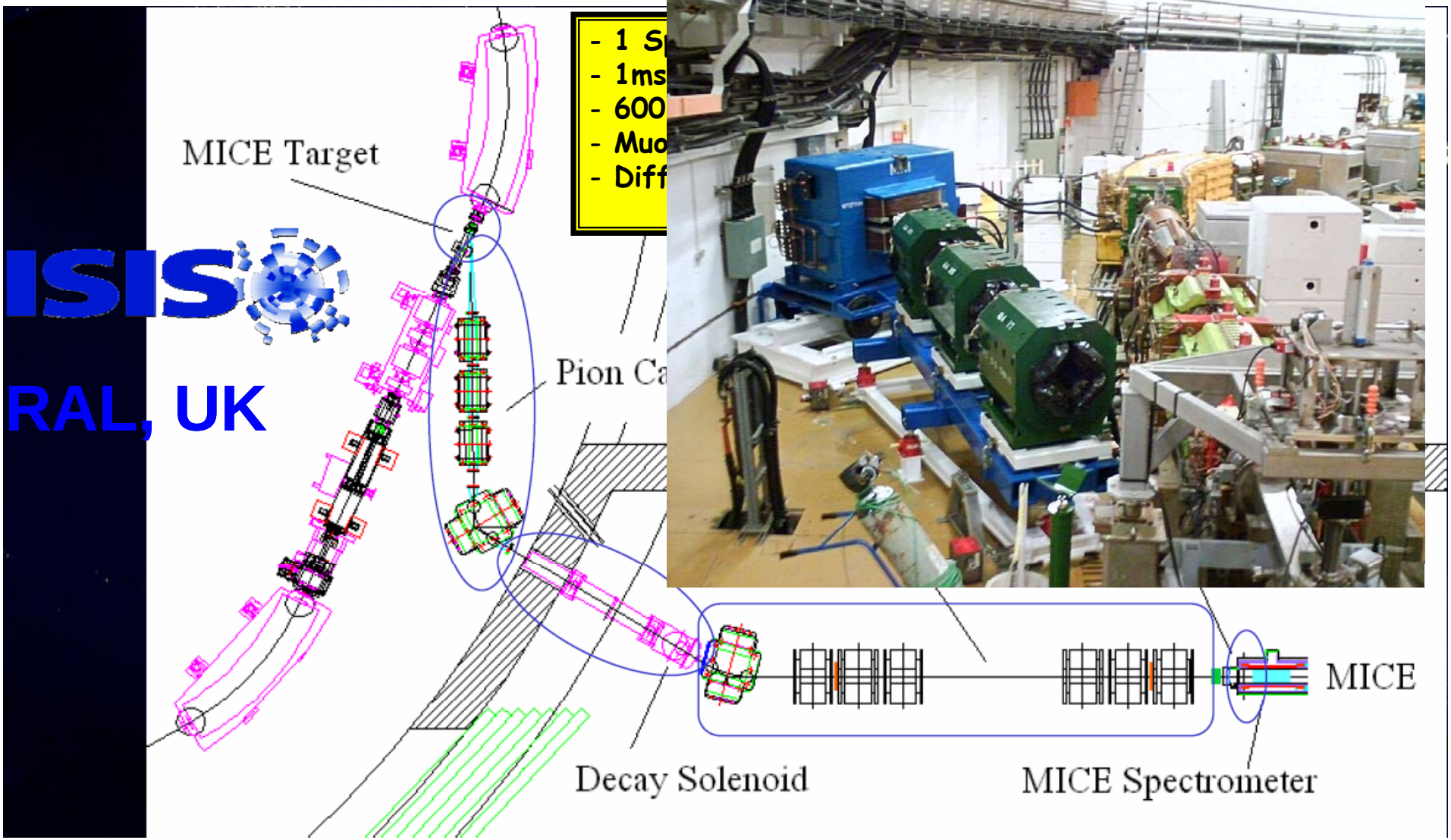
  -> low Z material -> Liquid Hydrogen

Conceptual design



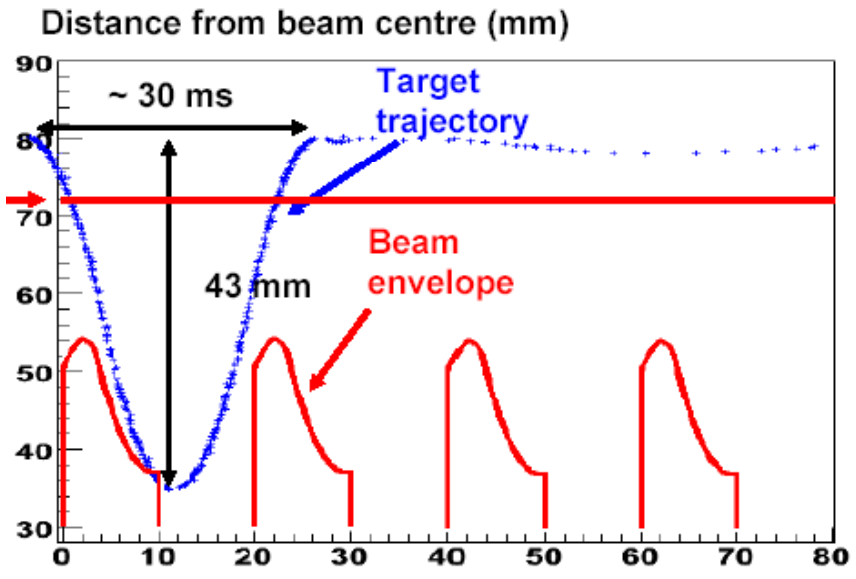
- 10 % Cooling, measured with 1 % precision -> emittance @ 0.1 %
- Beam Diagnostic using particle per particle tracking
- PID necessary
- Diffuser allows varying emittance (from ~2π to 10π mm rad)

MICE Beam Line

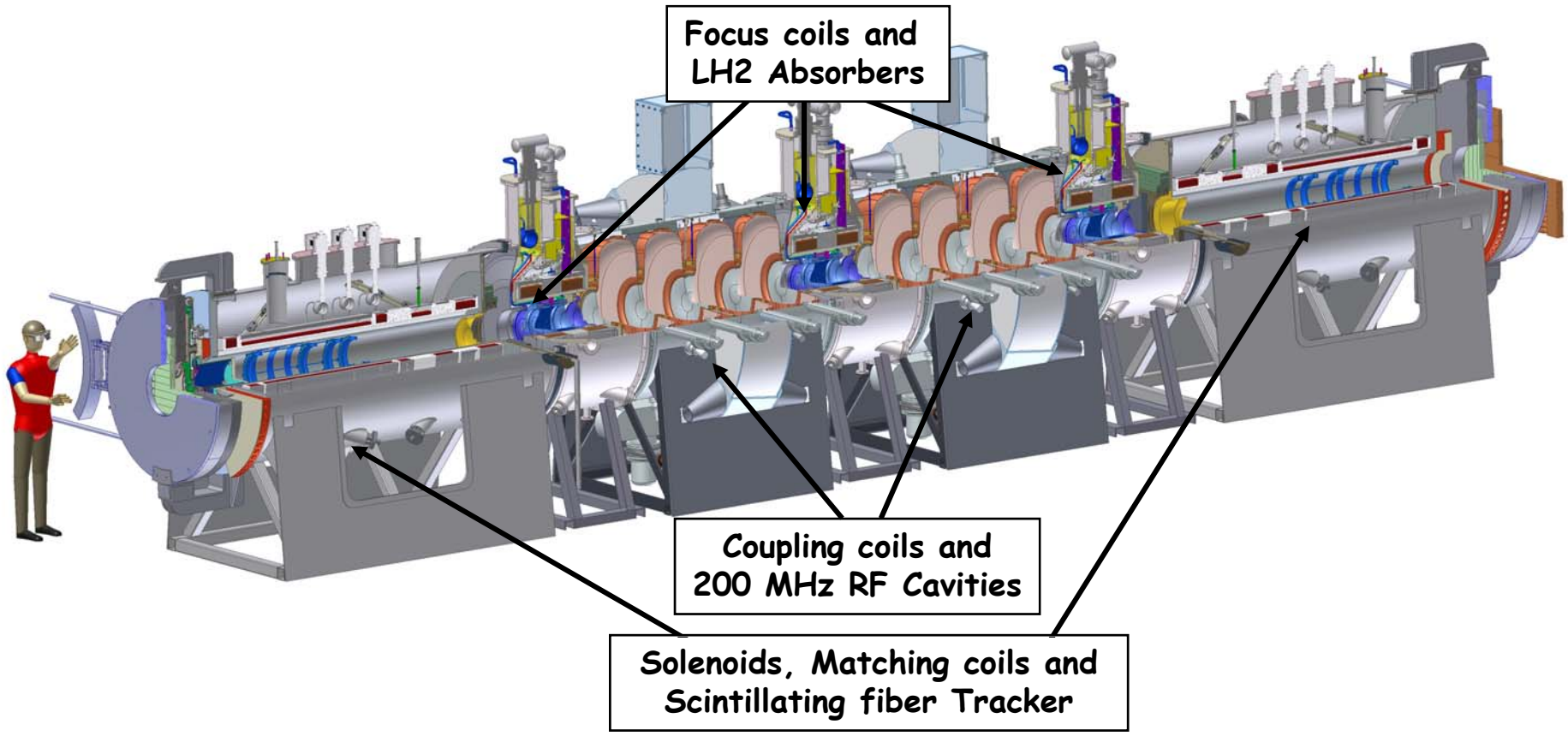


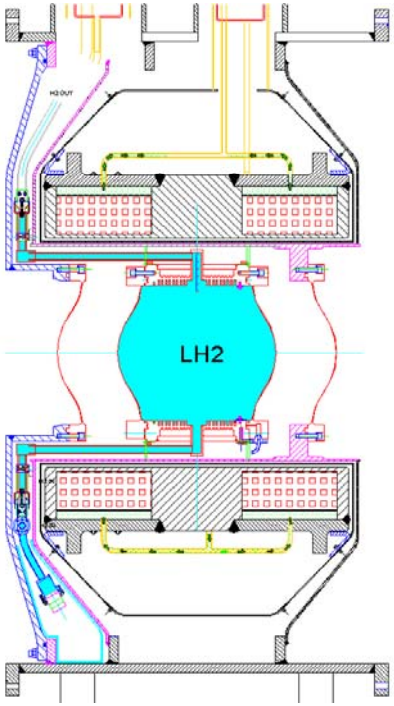
MICE Target

- **Target mechanism has been developed to dip Ti target into ISIS beam in the last ms of ISIS cycle**
  - 80 g acceleration achieved
  - 1 Hz rate
  - Tested with 3.7M actuations in 12 weeks
  - Wearing problem being solved



Technical Design

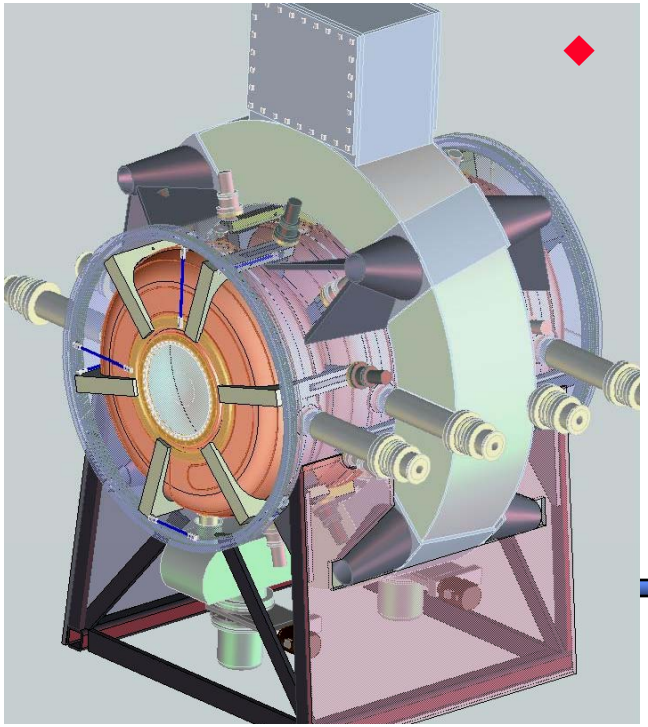




Absorbers and RFCC

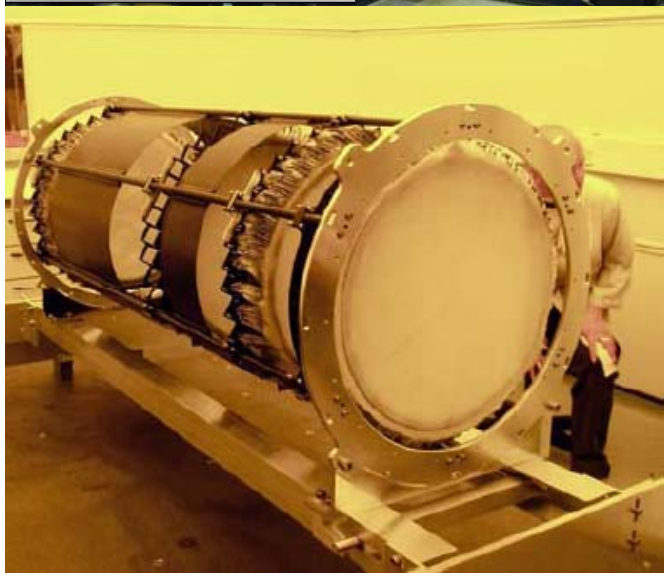
Absorbers Module

- developed at KEK and tested at MuCool Test Area (Fermilab)
- Double wall all around LH2
- Module presently out for tender
- SC Focus coils needed to have minimum bT function in the absorber



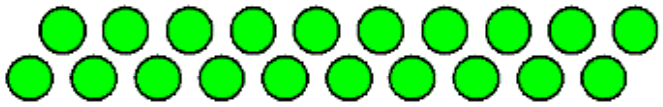
RFCC

- 201.25 MHz cavities, cupper water cooled
- 1 module compensates for Energy loss in the absorber
- 8 MV/m E-Field in a few Tesla B-Field
- RF Background has been simulated and is now being measured at MTA (Fermilab)
- Detailed Design nearly finished
- Coupling coil will be produced in Harbin, China

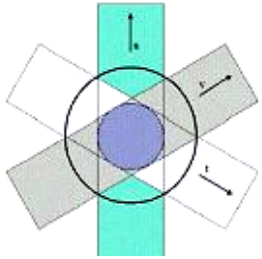


Spectrometer

- 5 stations of scintillating fibers in 4 T magnetic field
- 3 projections per station
- Two layers, each 350 μm diameter
- Minimize material in beam line
  - Few photons
  - VLPC readout (same as D0)
    - QE = 85%, gain = 50000, dedicated FEE
- Simulated Performance
  - ΔP_T = 1.5 MeV/c ΔP_Z = 3 MeV/c for 200 MeV/c muons (mean P_T)



a)



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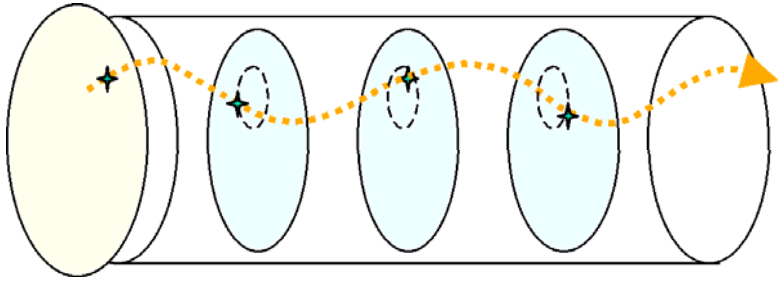
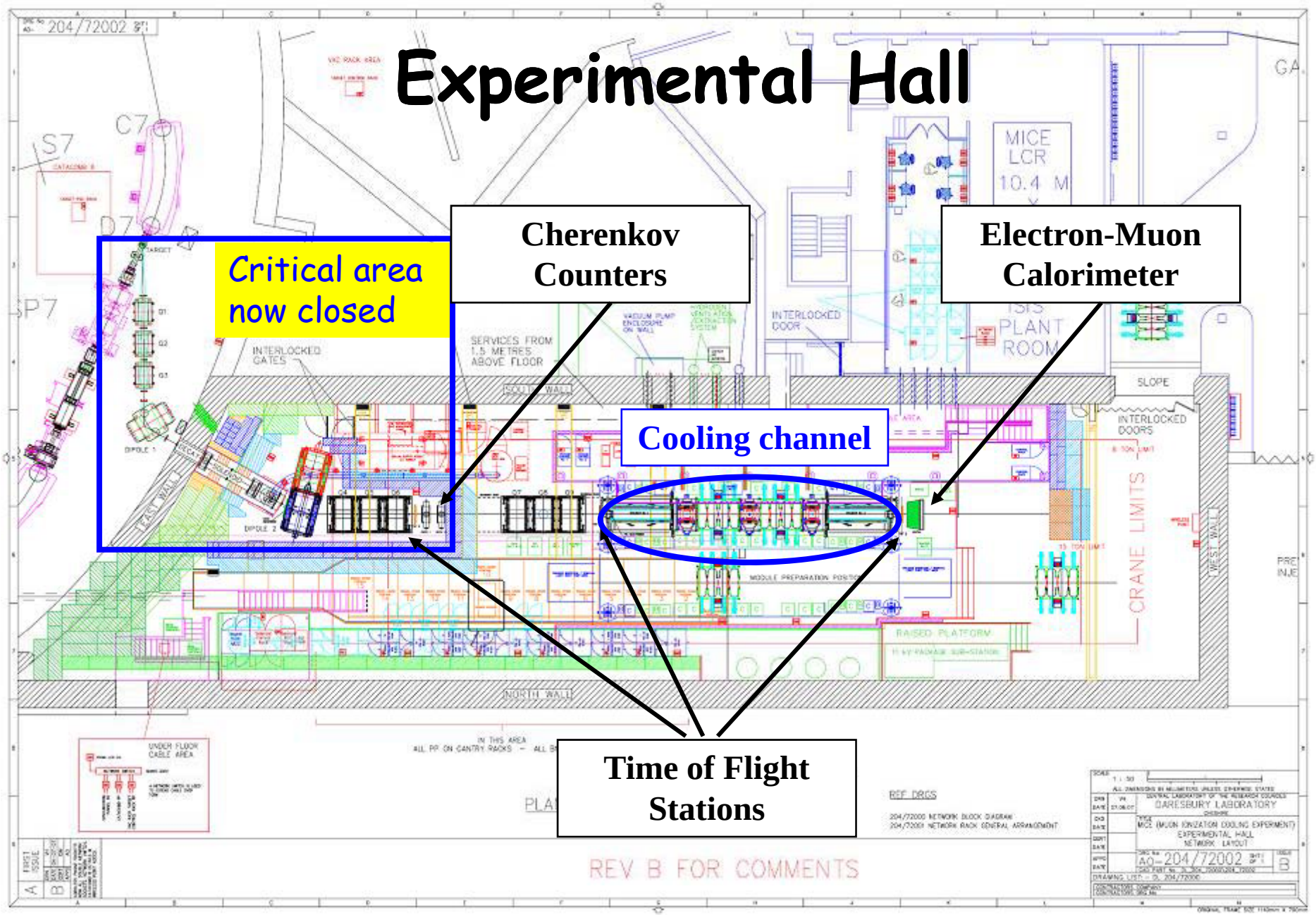
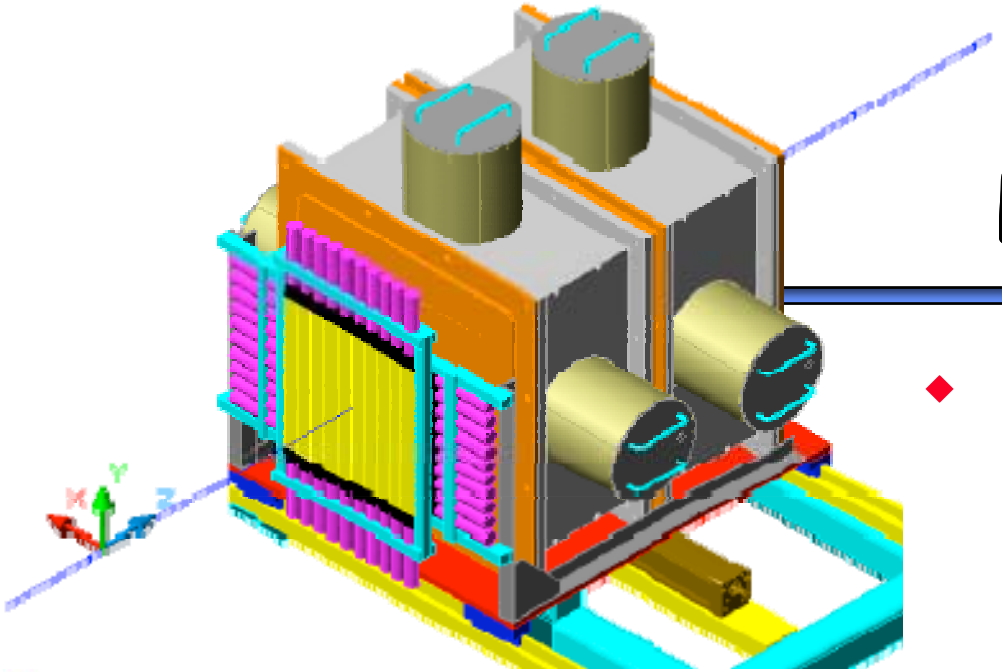


Experimental Hall

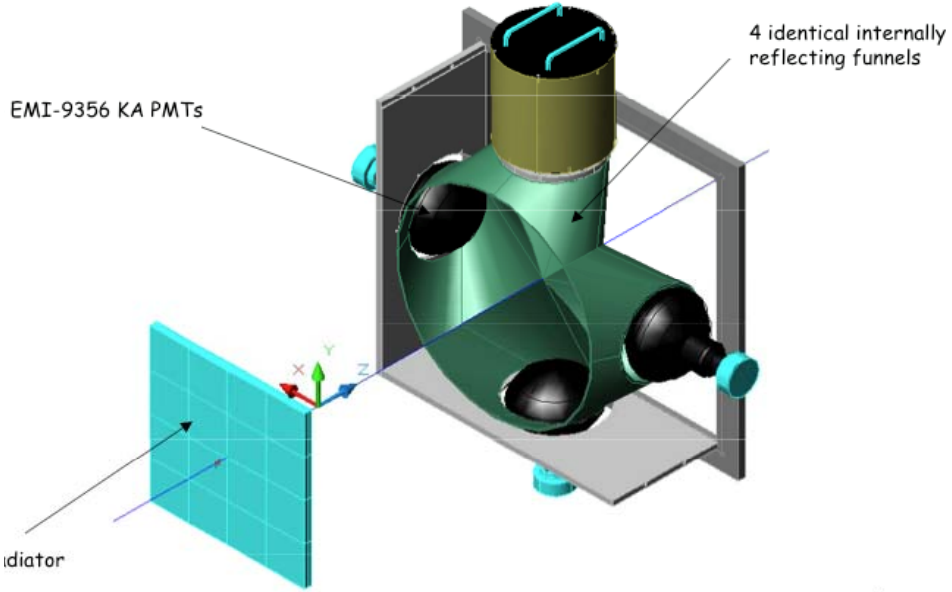


PID



Cherenkov Unit

UCL



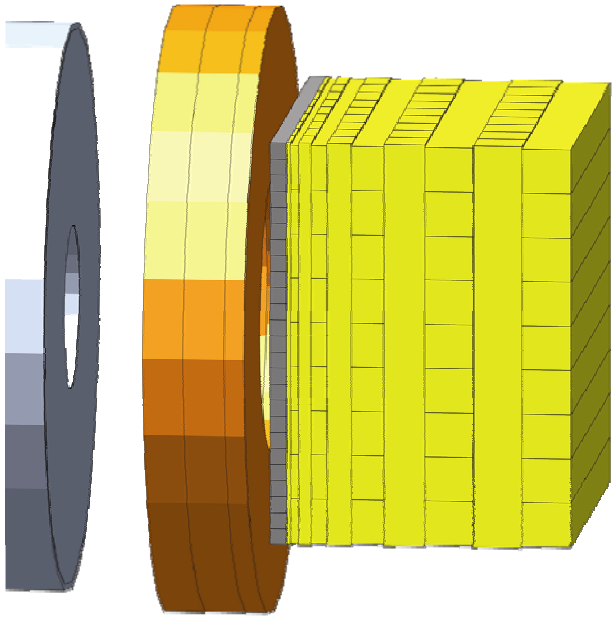
TOF

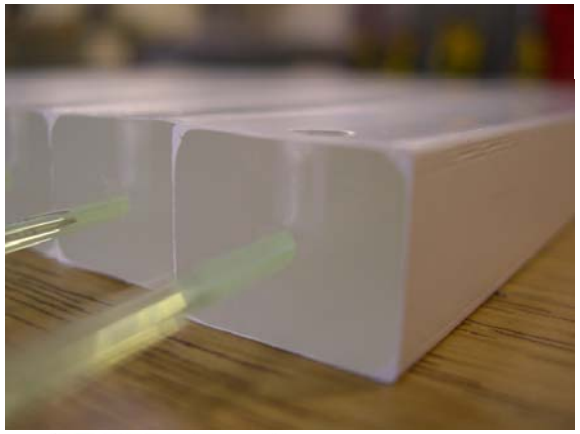
- Made of crossed scintillator slabs, 1" thick, conventional PMTs
- 70 ps resolution
- TOF0-TOF1 allow pion rejection.
- TOF1-TOF2 allow electron rejection
- 3.6° resolution in RF phase and 6D emittance measurement
- TOF1 and TOF2 PMTs need heavy iron shields (against B).

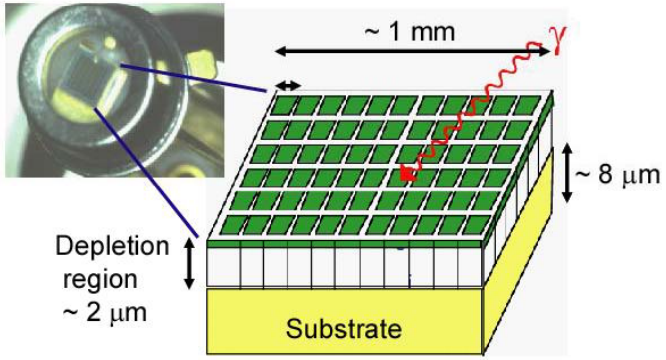
Cherenkov

- Two aerogel Cherenkov, 8" PMTs
- refractive index: 1.07 and 1.12
- Pion rejection at large momentum
- clean low momentum e^+ sample
- CKOV_A being assembled @ RAL
- Cosmic ray test for CKOV, TOF and DAQ planned in November.

Electron-Muon Calorimeter

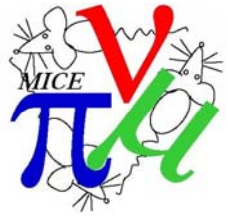






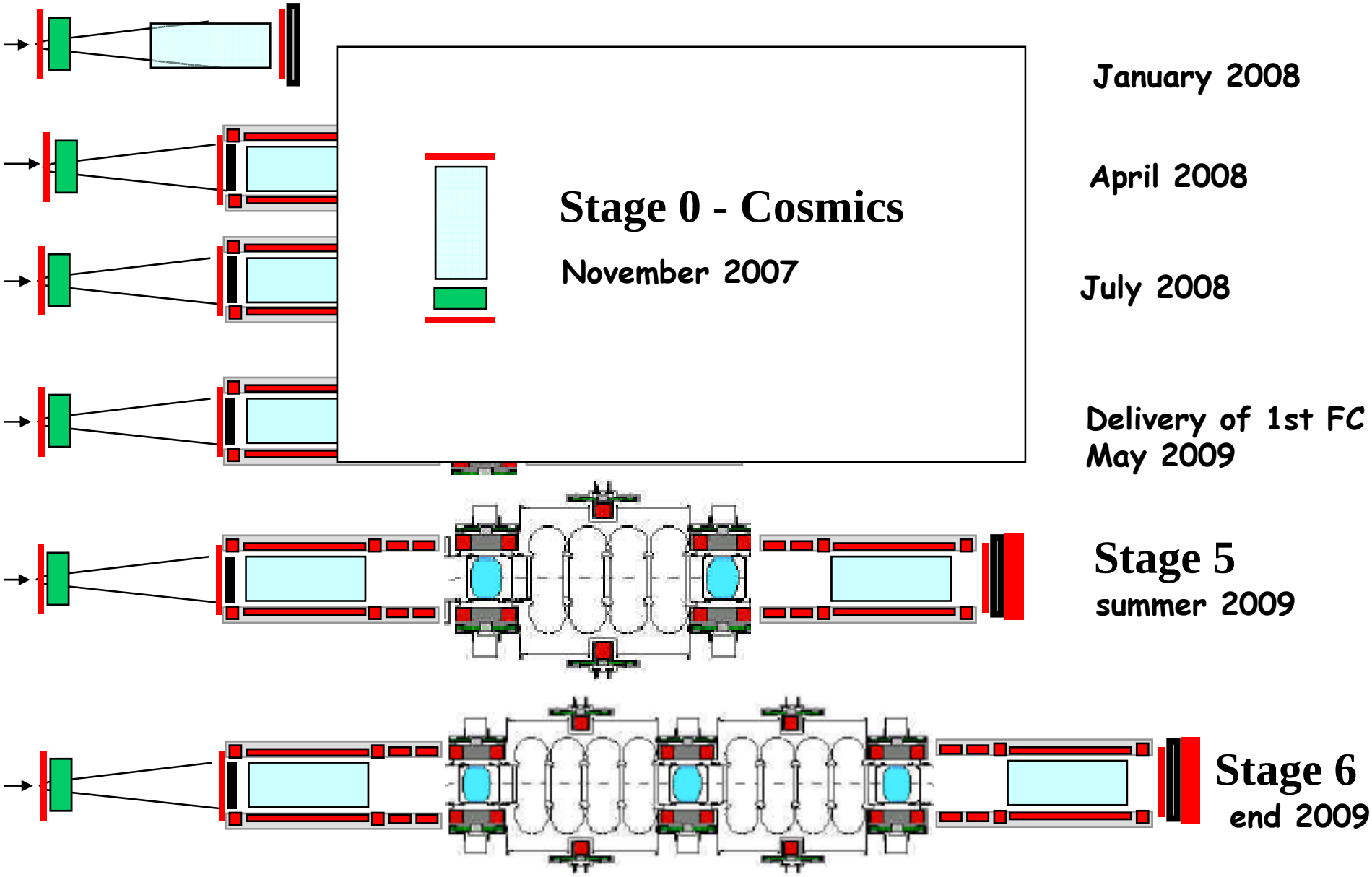
- **Two Parts:**
  - 4 cm preshower layer: grooved lead foils + scintillating fibers, forces electrons to shower
  - 10 layers of plastic scintillator: measure energy, range and track integrity
- **Design proposed by Geneva**
  - Based on detailed simulation
- **Part 1 nearly finished**
- **Part 2 being prototyped**
  - Use extruded scintillators + WLS fibers
  - Considering Light Detection by SiPM (or Hamamatsu MPPC)
    - New technology
    - Very Promising

Geneva in MICE

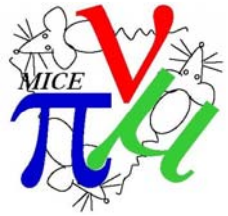


- **Management:**
  - Alain Blondel re-elected as spokesmouse
- **Simulation / Design**
  - Rikard Sandtröm's thesis on RF Background and PID in MICE
  - Detailed analysis on how the PID bias the emittance measurement
- **Trigger and DAQ**
  - Vassil Verguilov and myself working on
    - Readout Code
    - Trigger logic
    - Data Storage
    - Synchronization between Target, RF and DAQ

Aspirational MICE Schedule - July 2007

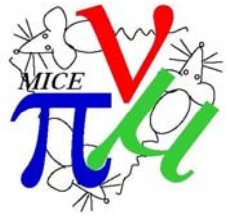


Summary



- MICE is part of the Neutrino Factory R&D program
- Aims at demonstrating that it's possible to design, engineer, and build a section of cooling channel giving the desired performances
- MICE is using particle physics detectors to perform high precision emittance measurement by muon per muon tracking
- Construction is underway at RAL
  - Staged start-up, starting soon with Particle Detectors commissioning
- First beam this winter
- Final results by 2010

Collaborators



- Bulgaria
  - University of Sofia
- China
  - The Harbin Institute for Super Conducting Technologies
- Italy
  - INFN Milano,
  - INFN Napoli,
  - INFN Pavia
  - INFN Roma III
  - INFN Trieste
- Japan
  - KEK
  - Kyoto University
  - Osaka University
- Switzerland
  - CERN
  - Geneva University
  - Paul Scherrer Institute
- UK
  - Brunel
  - Cockcroft/Lancaster
  - Glasgow
  - Liverpool
  - ICL London
  - Oxford
  - Darsbury
  - RAL
  - Sheffield
- The Netherlands
  - NIKHEF,
- USA
  - Argonne National Laboratory,
  - Brookhaven National Laboratory
  - Fairfield University
  - University of Chicago
  - Fermilab
  - Illinois Institute of Technology
  - Jefferson Lab
  - Lawrence Berkeley National Laboratory
  - UCLA, Northern Illinois University
  - University of Iowa
  - University of Mississippi
  - UC Riverside
  - University of Illinois at Urbana-Champaign