Status of MICE
&
Goals of the meeting

1. Towards the finish line for Phase I

2. Preparing for phase II

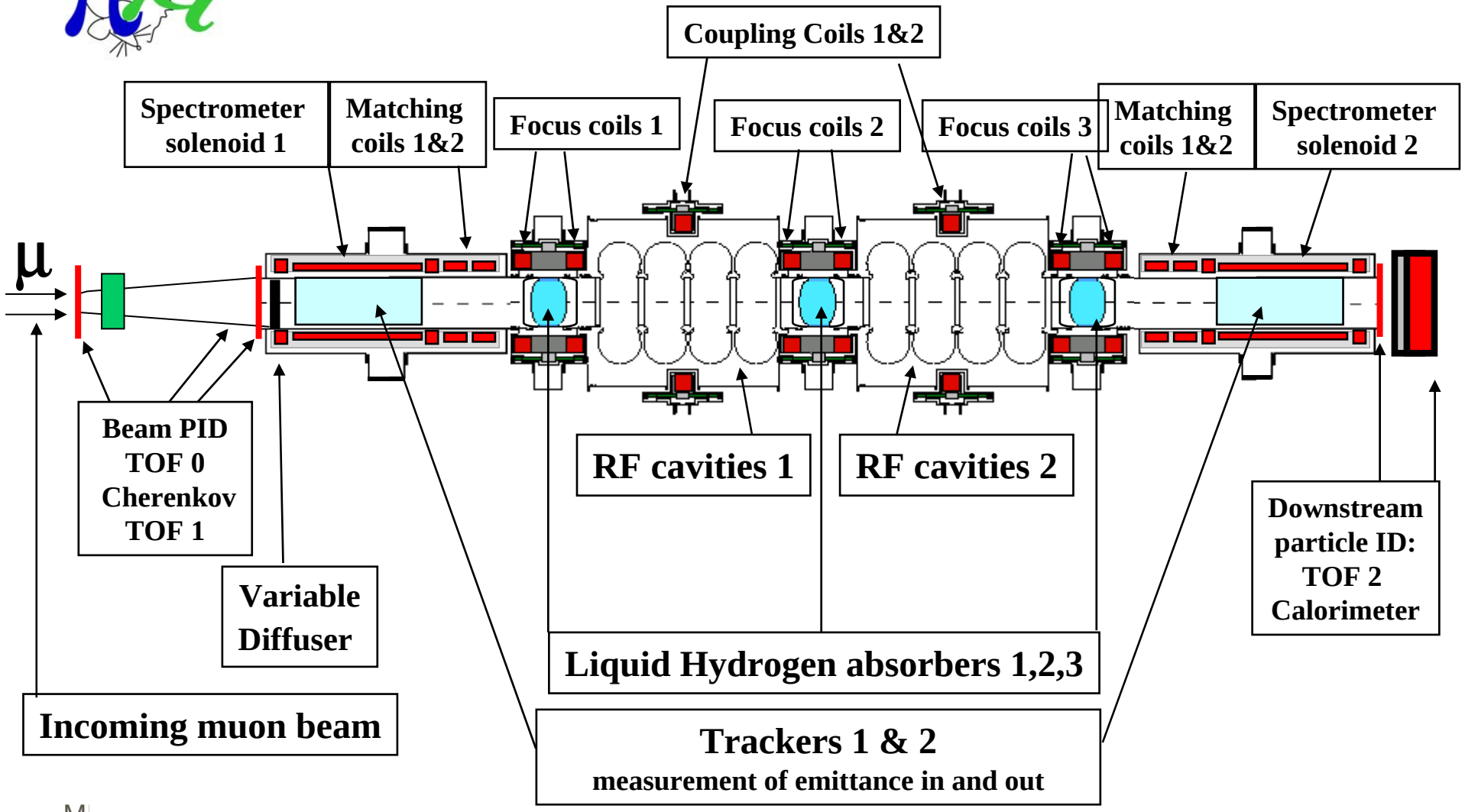
3. Outstanding issues

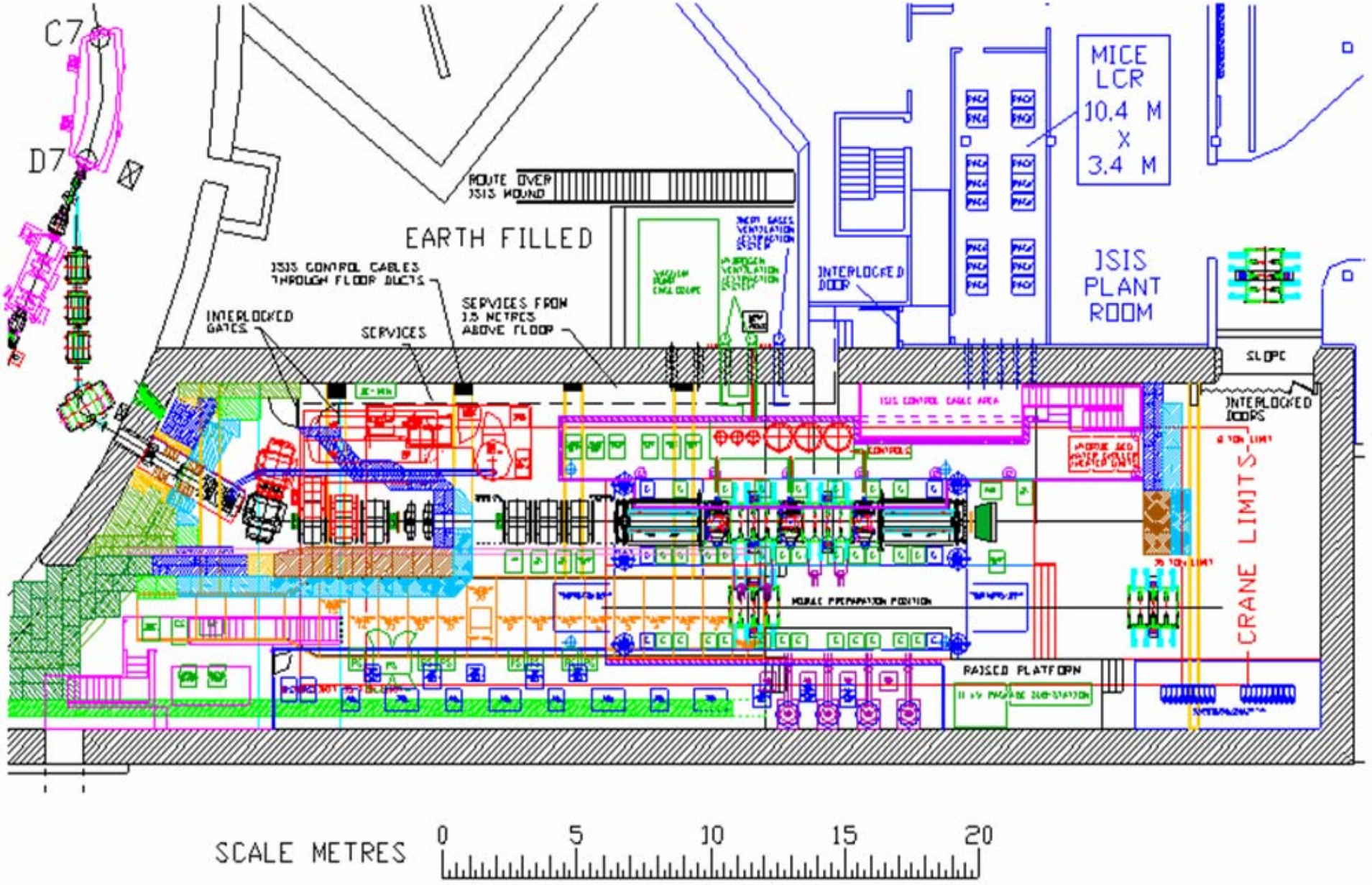
10% cooling of 200 MeV/c muons requires ~ 20 MV of RF

single particle measurements =>

measurement precision can be as good as

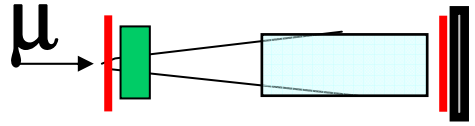
$\Delta (\varepsilon_{out} / \varepsilon_{in}) = 10^{-3}$ **never done before!**



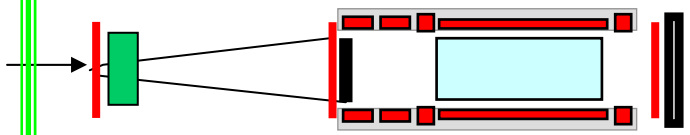

C7
D7
ROUTE OVER ISIS MOUND
EARTH FILLED
ISIS CONTROL CABLES THROUGH FLOOR DUCTS
SERVICES FROM 1.5 METRES ABOVE FLOOR
INTERLOCKED GATES
SERVICES
INTERLOCKED DOOR
MICE LCR 10.4 M X 3.4 M
ISIS PLANT ROOM
SLOPE
INTERLOCKED DOORS
CRANE LIMITS
RAISED PLATFORM
SCALE METRES
0
5
10
15
20

Aspirational MICE Schedule now (unchanged since march 2006)

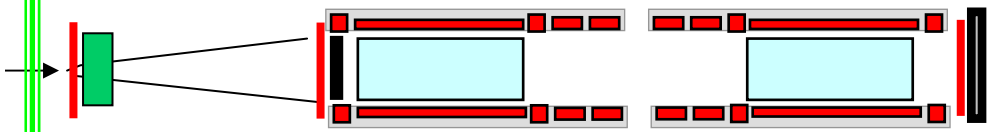
PHASE I



STEP I beam line commissionning starts August 2007! — 15 September 2007

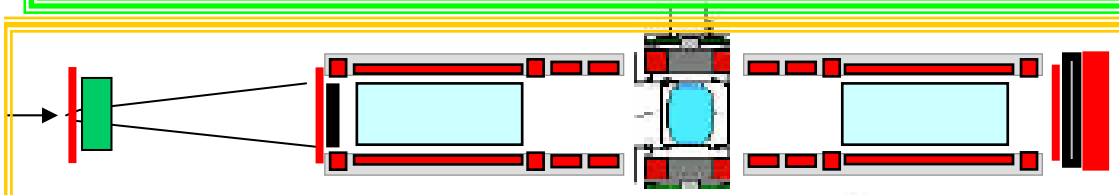


STEP II — November 2007

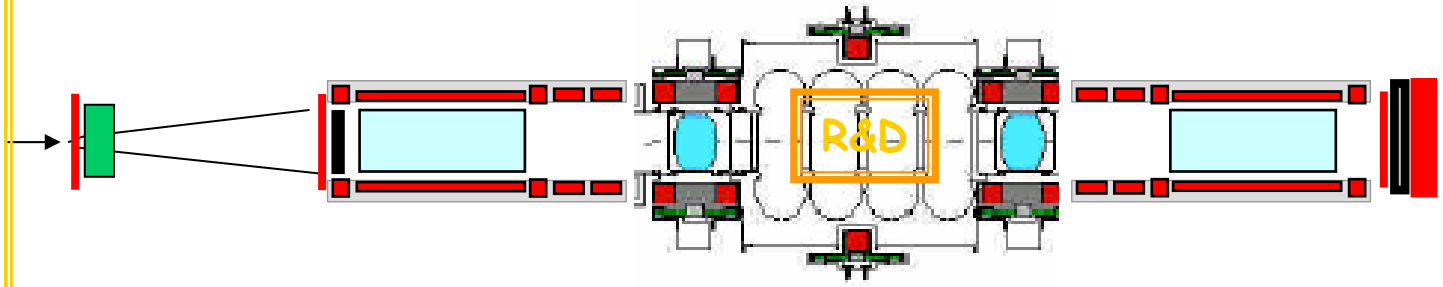


STEP III: begin winter 2008

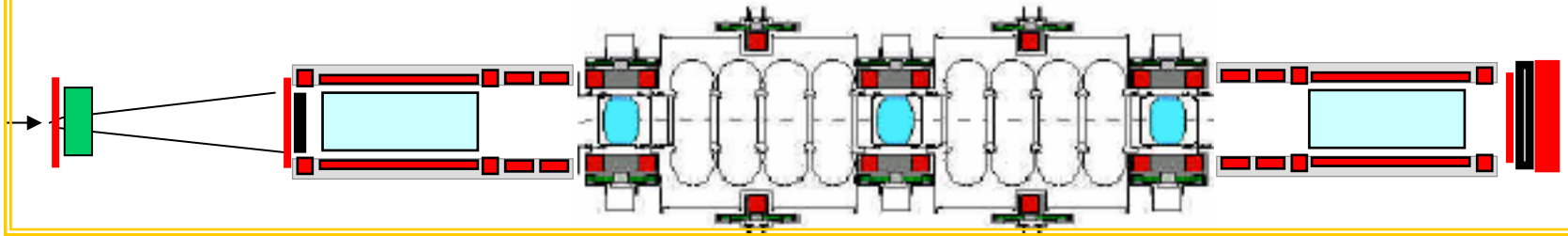
PHASE II



STEP IV: fall 2008

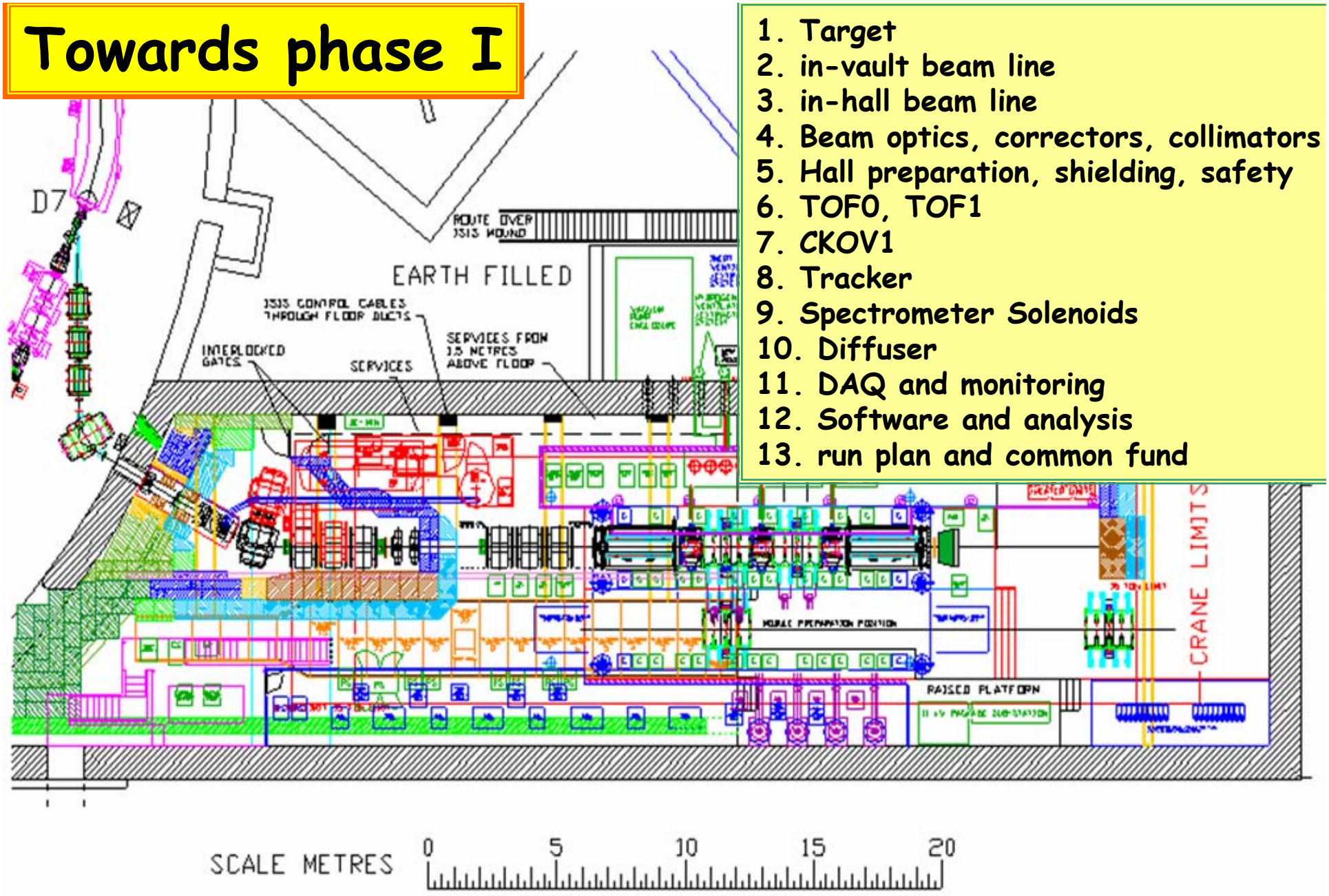


STEP V: summer 2009



STEP VI end 2009

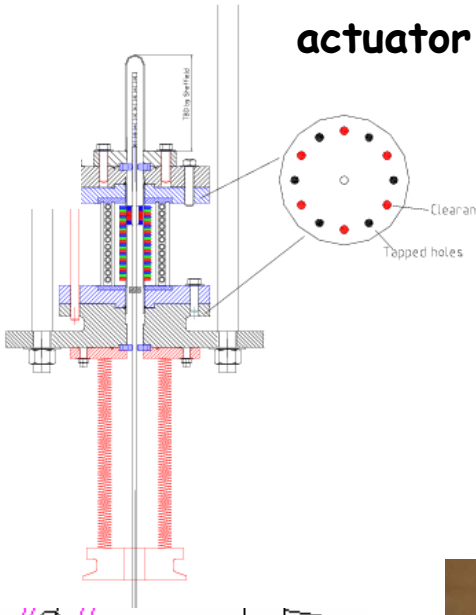
Towards phase I



1. Target
2. in-vault beam line
3. in-hall beam line
4. Beam optics, correctors, collimators
5. Hall preparation, shielding, safety
6. TOF0, TOF1
7. CKOV1
8. Tracker
9. Spectrometer Solenoids
10. Diffuser
11. DAQ and monitoring
12. Software and analysis
13. run plan and common fund

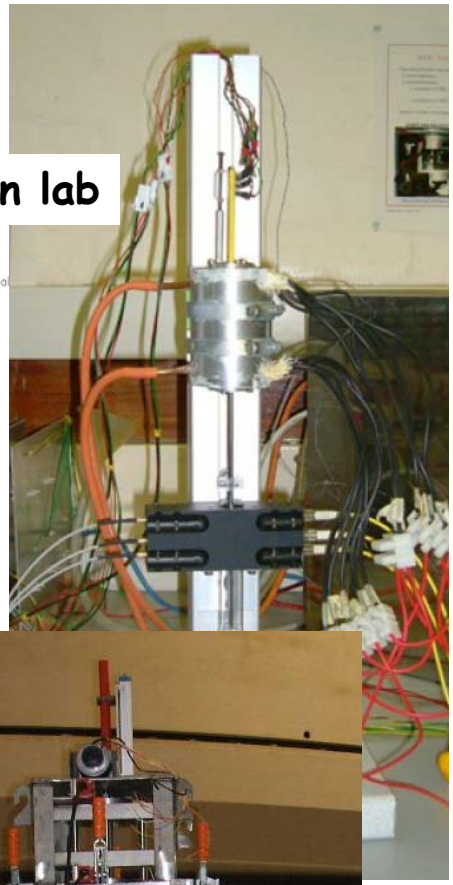
MICE Target

design: ISIS pulses at 50Hz with flat top for ~2ms. Electromagnetic driver dips target in and out in~3ms. Resp: Sheffield, Glasgow



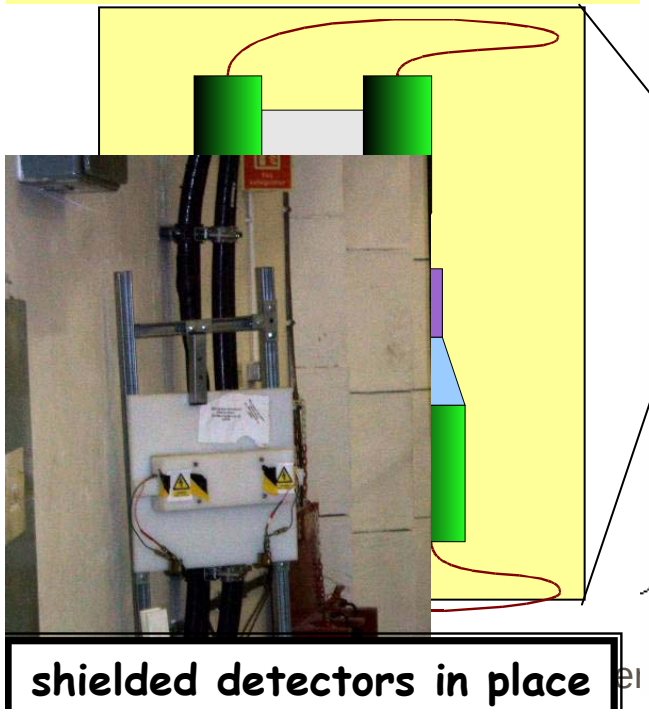
actuator:

in lab

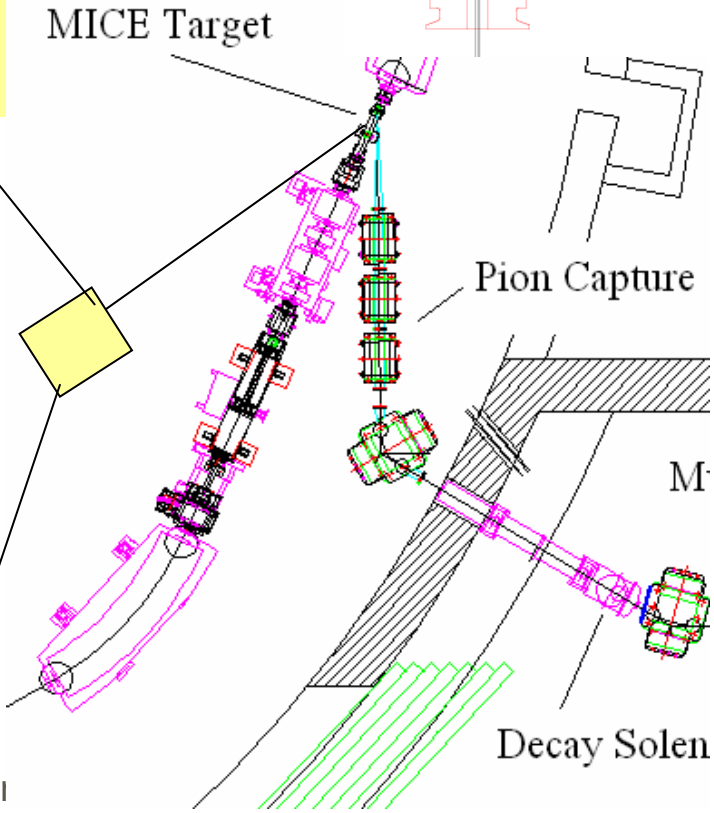


Target test

Oct-Nov06
beam at 50Hz/64 (1.28s)
only 10 A target drive (need 40)
measured:
hadron production/activation
sampled beam edge vs time
analysis still in progress



shielded detectors in place

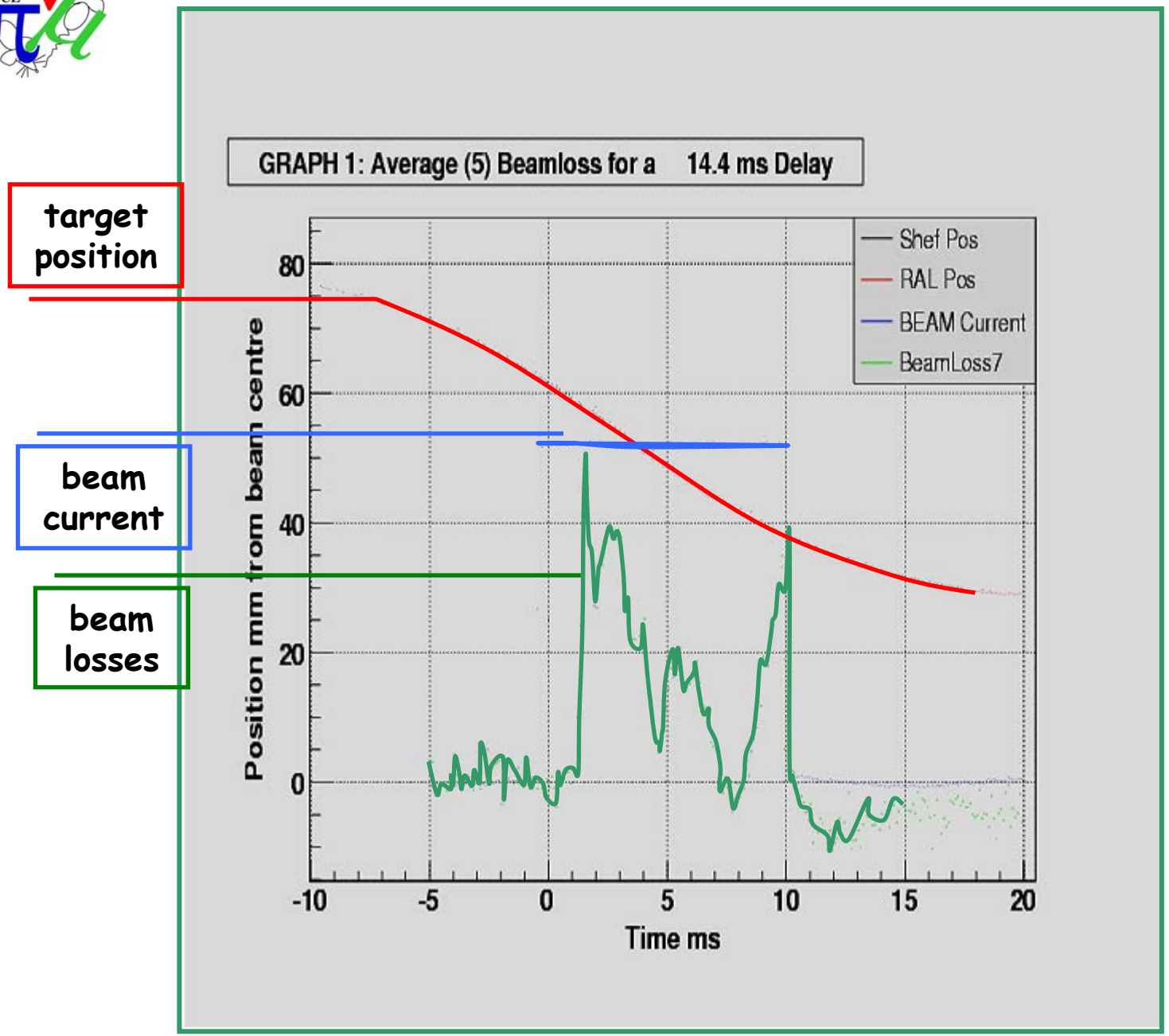


on the bea MSZ2 line

Slide 6

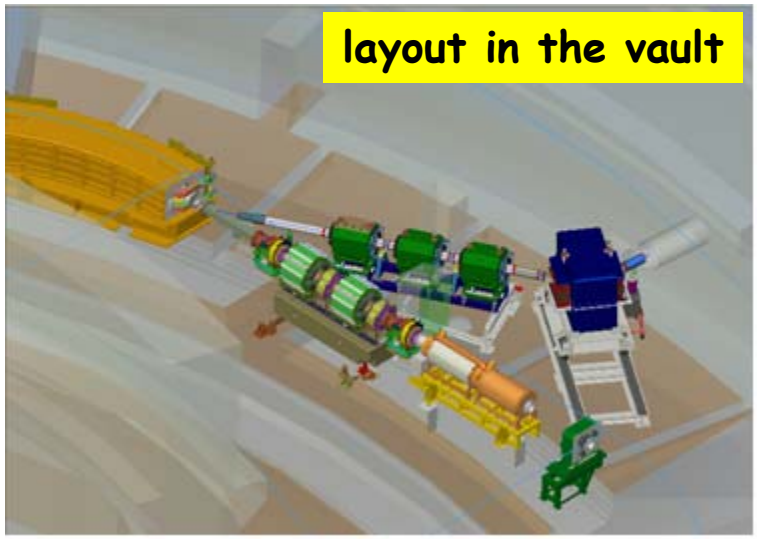
MSZ2 Are we sure we need 40 A with the new lighter shaft?

Michael S. Zisman, 9/6/2006


target position
beam current
beam losses
GRAPH 1: Average (5) Beamloss for a 14.4 ms Delay
Shef Pos
RAL Pos
BEAM Current
BeamLoss7
Position mm from beam centre
80
60
40
20
0
-10
-5
0
5
10
15
20
Time ms

Beam line and infrastructure

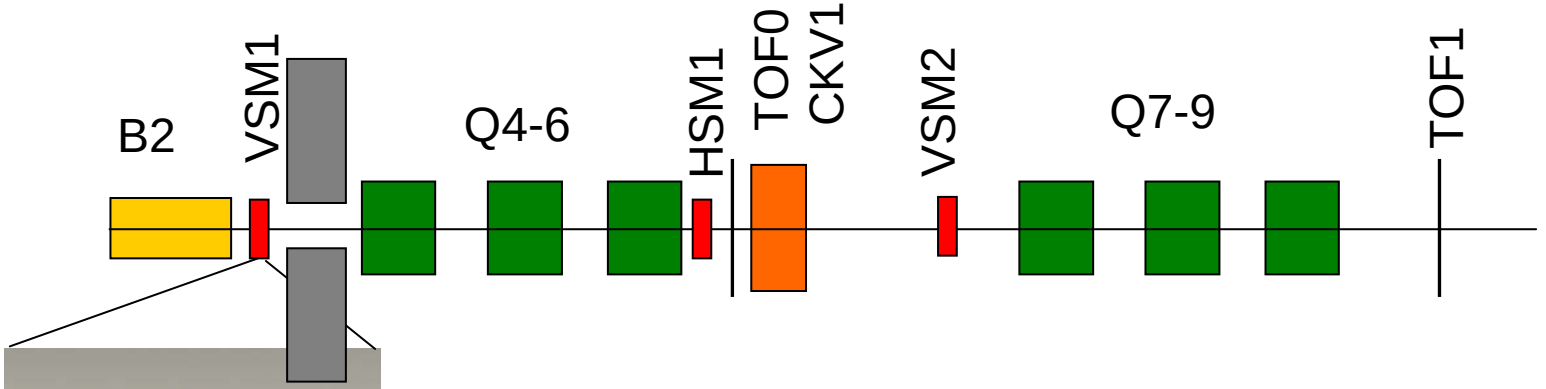
Resp: RAL -- local team is working very very hard !!
Upstream part is urgent! (needs to be completed before ISIS closes again)

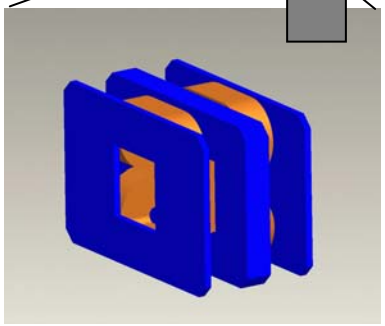


quads refurbishment

Beam line optics, correctors, collimators

Designed both with optics code (Turtle) and Monte-Carlo (G4BL)
Progress being made accross the {p = 140-240 MeV/c,ε = 1-10 mm.radian} matrix.
Figure of merit: TOF1/TOF0 rate as large as ~ 0.1
==> MICE can take 200-400 muons per second.





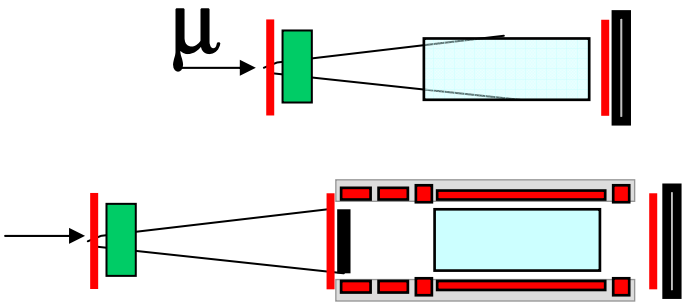
ISIS TS2 steering magnet

corrector/collimator scheme being developped

commissionning plan under study for >=August 2007
detectors being investigated (test TOF detectors)

Preliminary run plan elaborated leads to
70 days of beam for 2007

Run plan -- steps I and II



STEP I
Aug.- oct. 2007

STEP II
Nov.-dec. 2007

Goal:
Establish beam match and whether we have all knobs necessary to draw emittance vs. transmission curve. Measure emittance

Very preliminary estimate (not a beam request!) total for 2007: 70 days

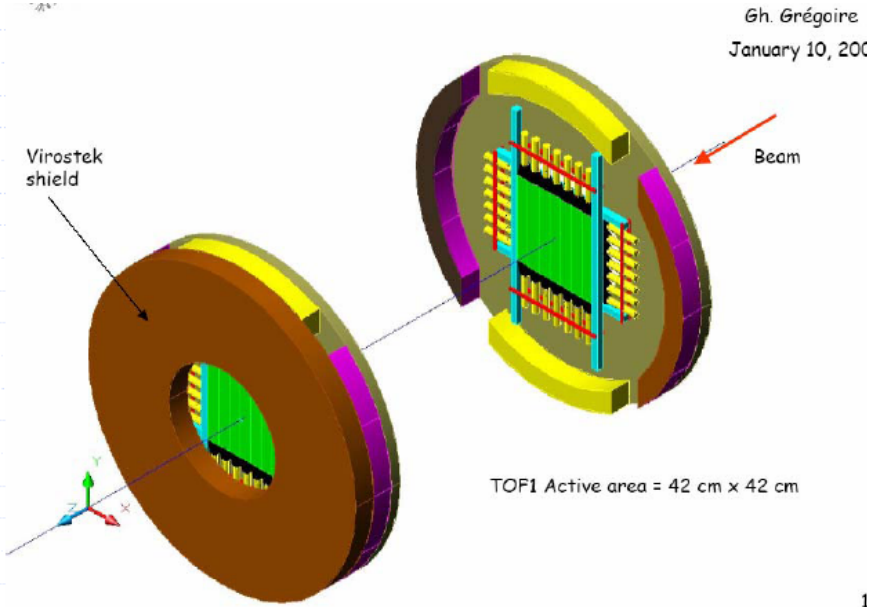
STEP I requires 60 shifts (20 days of running)
beam line commissionning, target tuning (rates), detector shake down

STEP II requires 150 shifts (50 days)
Alignment of beam x,x',y,y', (Lack of) dispersion,
check range of transverse emittance, and range of momenta
measure emittance
(may extend to 2008)

TOF0, TOF1

Responsibility of M. Bonesini et al (INFN Milano, Pavia, Roma + Gva & Sofia)

Technically:
60 ps resolution achieved in test beam
phototubes and electronics defined
magnetic shield needed, sketch exists
==> essentially ready to build TOF0,TOF1
(and even TOF2)



construction of TOF0 and TOF1 underway
all phototubes and scintillator purchased
electronics purchased
or
production planned in Sofia/Geneva

possible issues/caveats:
manpower for assembly, cosmic ray tests and support mechanics.
195 k€ is proposed by RAL for completion… agreement with INFN under discussion

==> on course for delivery at RAL in August 2007
Very useful tools for beam diagnostics alignment etc…

CKOV1

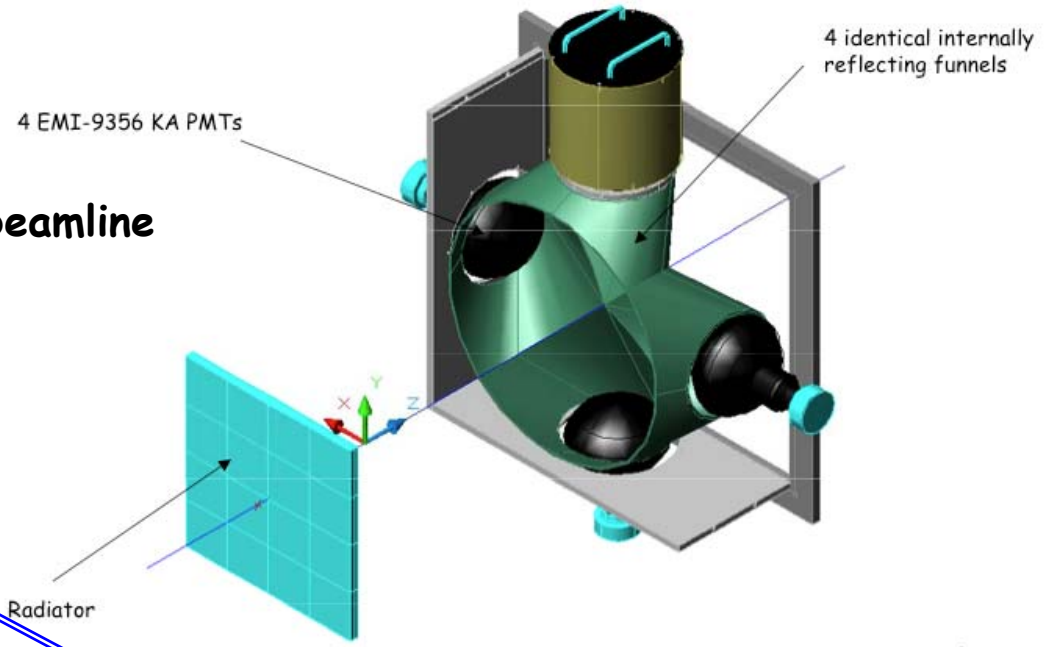
Detection unit — UCL

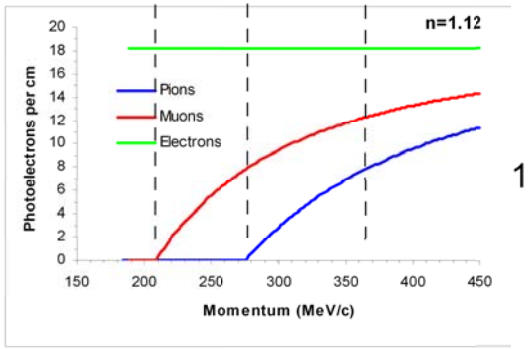
resp: Mississipi

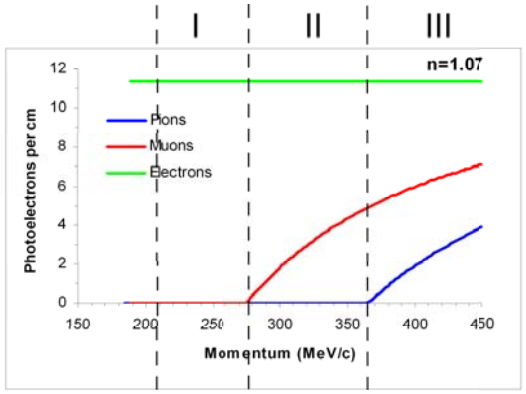
additional detector on upstream beamline
to enhance pi/mu separation
above 220 MeV/c where TOF
is more difficult

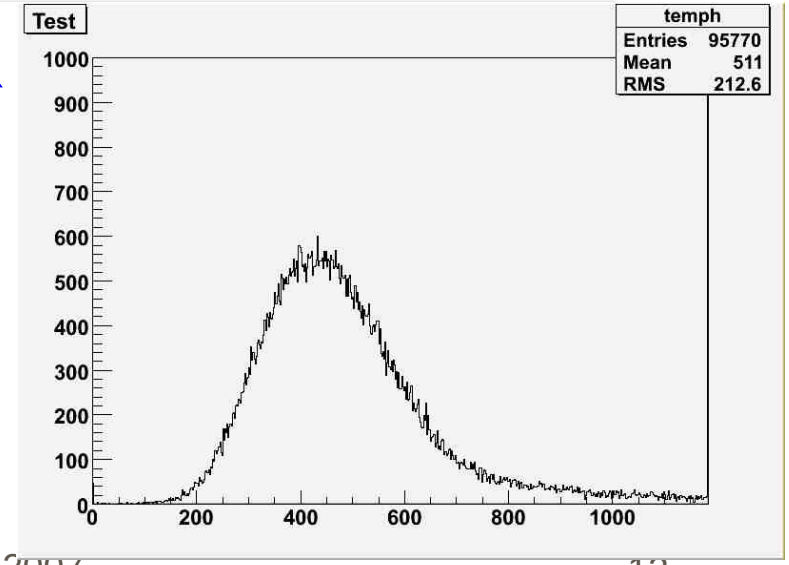
Prototype tested in summer 2006
on 125 GeV protons

will feature two detectors
n=1.07 n=1.12



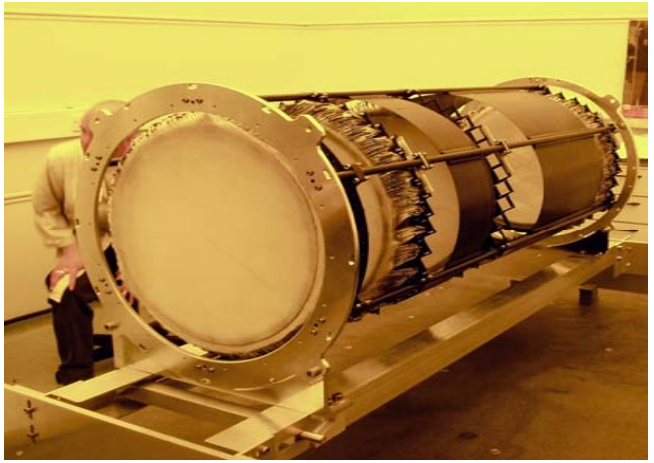






Tracker

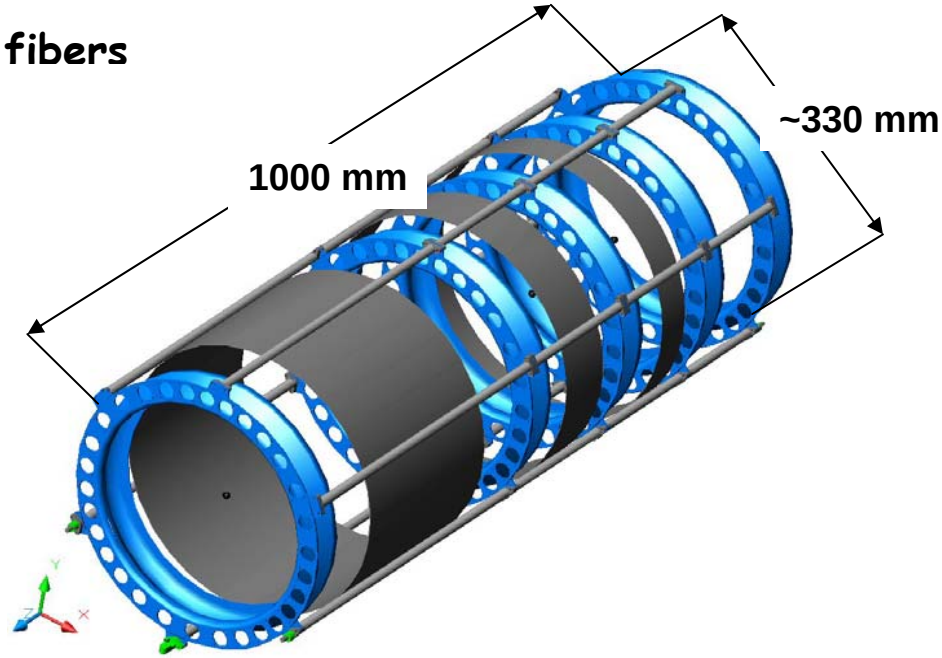
resp: Japan,UK,US



two identical trackers with 5 planes of 3-views,
440 μm resolution achieved
scintillating fiber detector read-out with VPLCs
(7-fold ganging of 350 μm diameter fibers)

Prototypes with 3 and 4 triple-planes of sci-fibers were built and tested on cosmics and test beam at KEK (in 1 T mag field)
==> curvature measurement OK.
Low light yield observed on station 4
+ difficult location of channels in space.

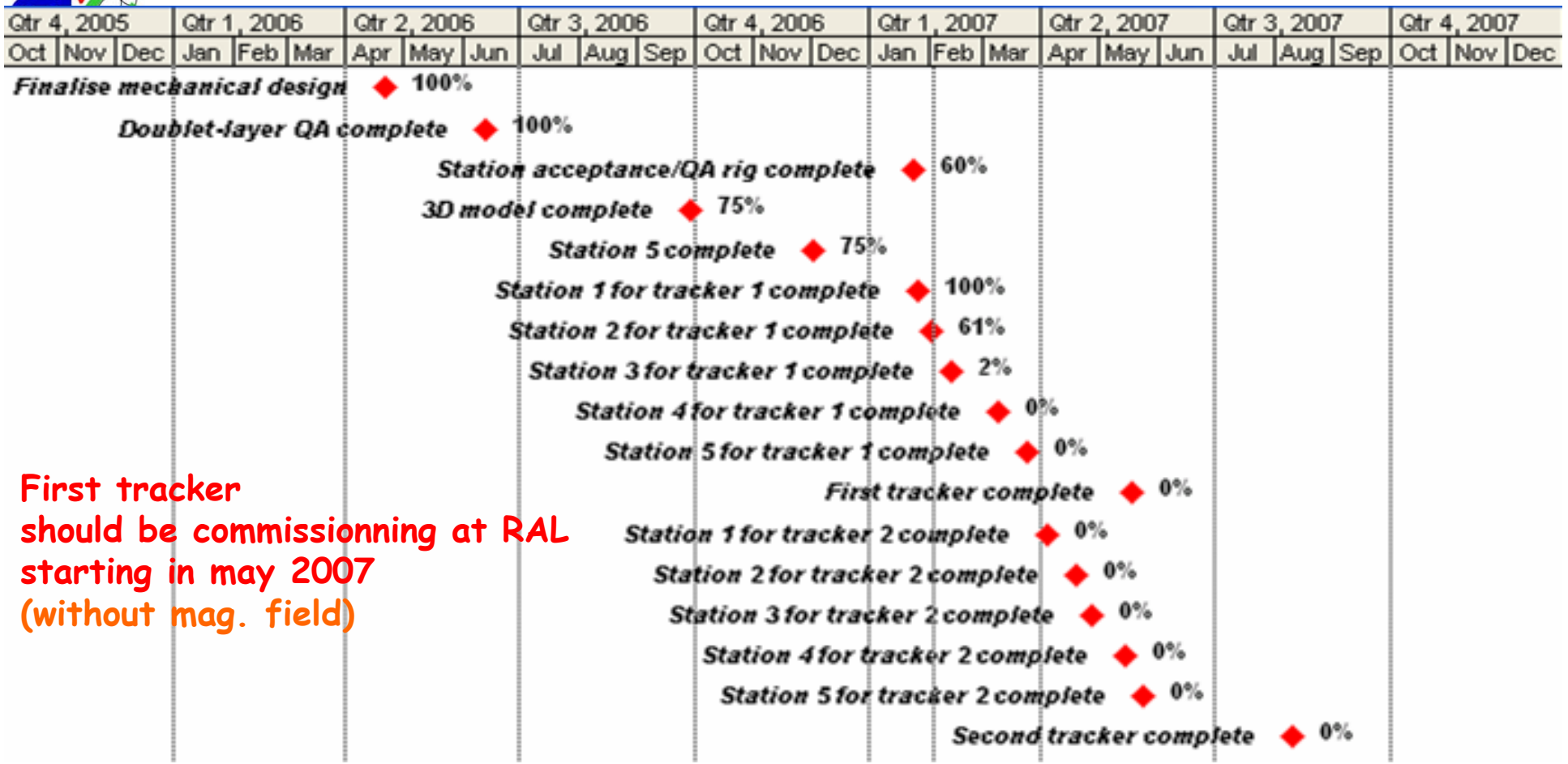
'Station 5' was built according to new procedures to avoid above problems.
construction finished November 2006.
Station acceptance rig under development



Full production of tracker has started in January

Fibre preparation & ribbon production at FNAL complete
First production VLPC cryostat is under construction
Still under development: DAQ Firmware AFE-IIt / VME LVDS Serdes Buffer (VLSB)
Zero suppression, Synchronisation with ISIS, Distribution of trigger signal

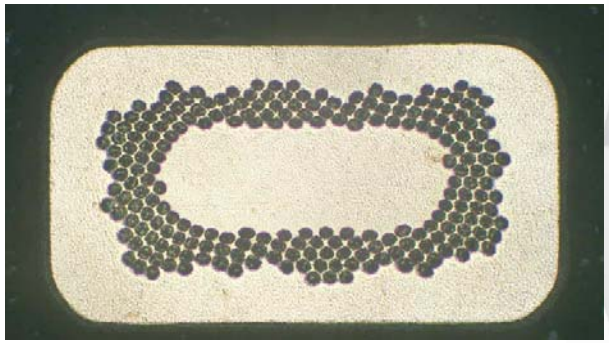
Tracker milestones



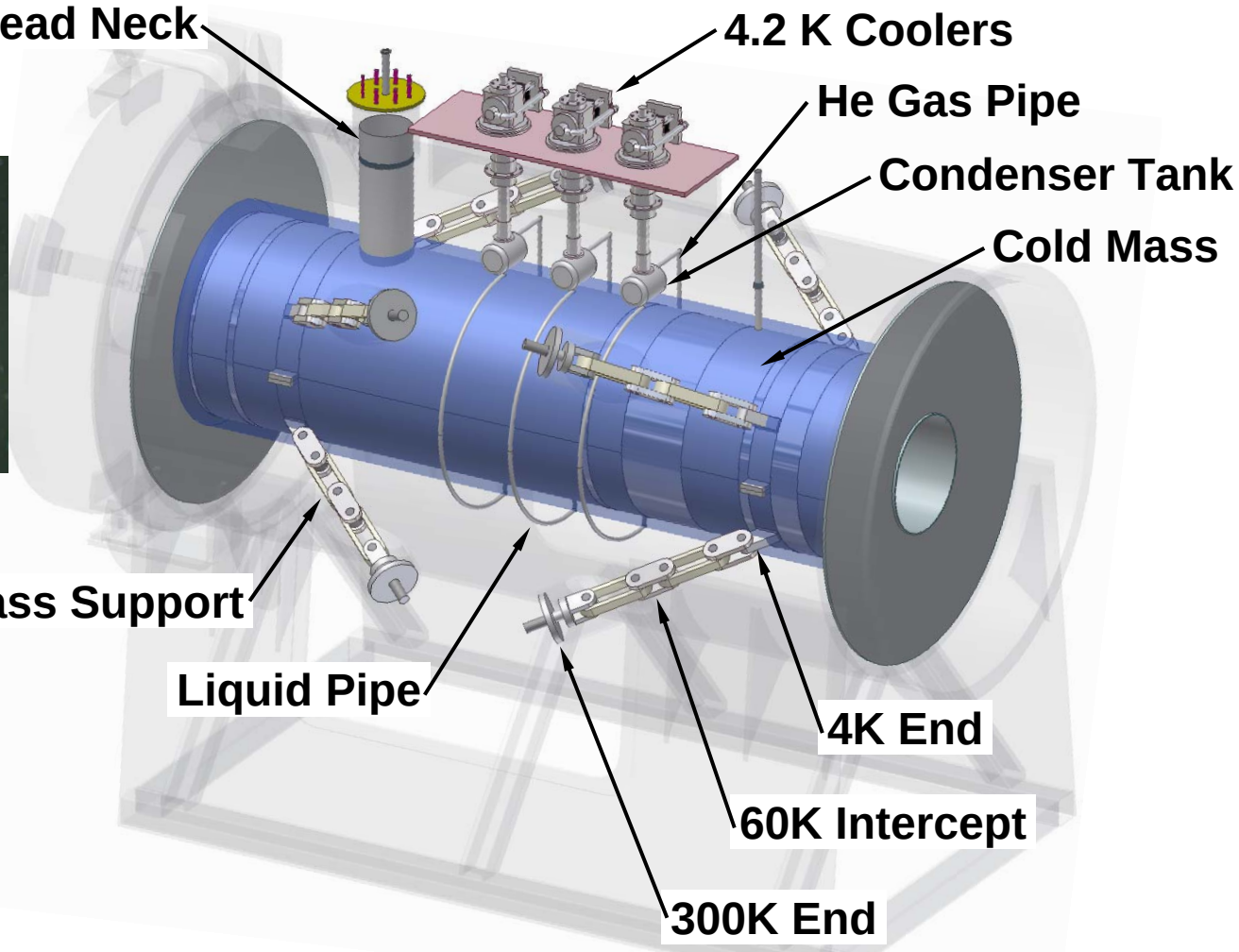
First tracker
should be commissionning at RAL
starting in may 2007
(without mag. field)

SPECTROMETER SOLENOIDS

USA NFMCC-- Berkeley



conductor(delivered)



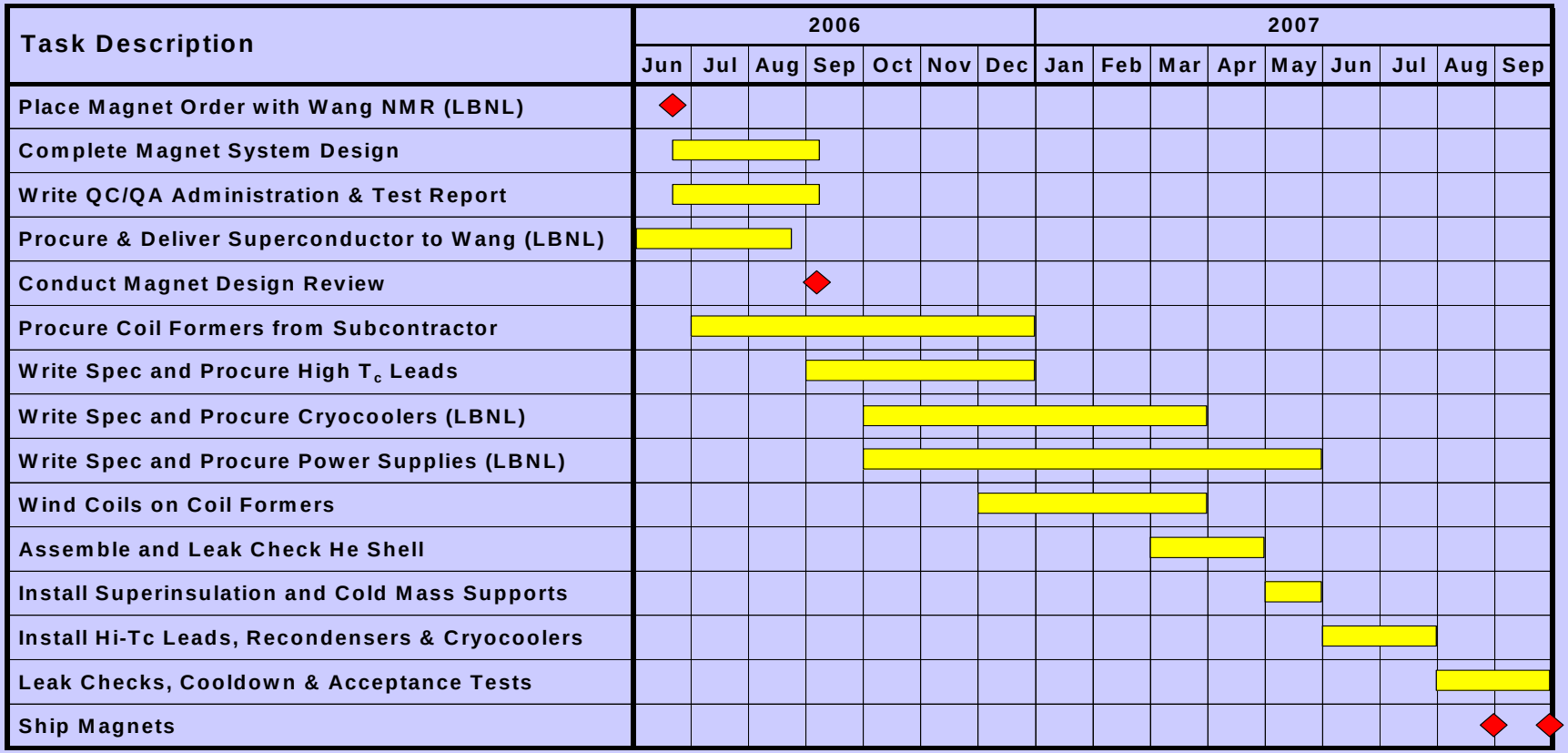
First Completed Coil Winding Form

Spectrometer Solenoid will provide homogeneous field + 2 matching coils. Ordered to spec from WangNMR (Ca, USA) construction proceeding according to plan.

Magnetic measurement probes provided by NIKHEF

clarify where how when?

Spectrometer Solenoid Schedule



Two more months for magnetic field measurements at FNAL and shipping to RAL ==> arrival of first spectrometer solenoid at RAL in November 2007!

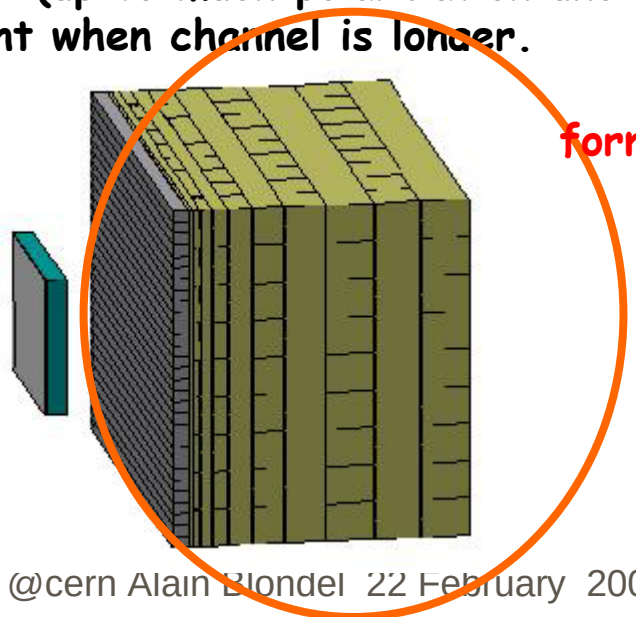
TOF2 and Calorimeter

Resp: INFN Milano, Pavia, Trieste, Roma + Sofia & Geneva

provide time measurement (70ps) and particle ID. Calorimeter is 4 X_0 of lead scint. spaghetti (KL), followed by pure scintillator ~1m^3 ranger (SW).

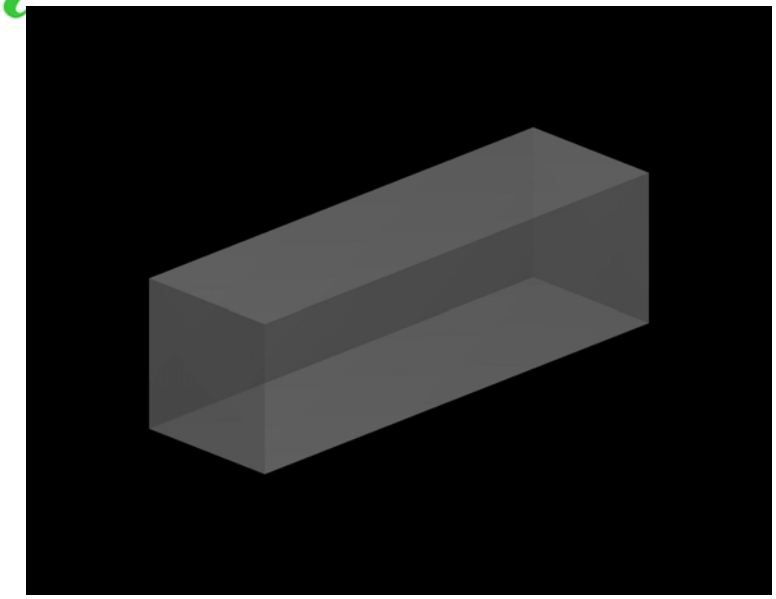
these detectors are needed for step III -- i.e. early spring 2008.
TOF2 absolutely CRUCIAL.

SW is beyond reach ? -- delayed to later in 2008 or phase II ?
main function is to monitor/reject muon decays in flight
This can be calculated (up to muon polarization uncertainty) and will become more seriously relevant when channel is longer.

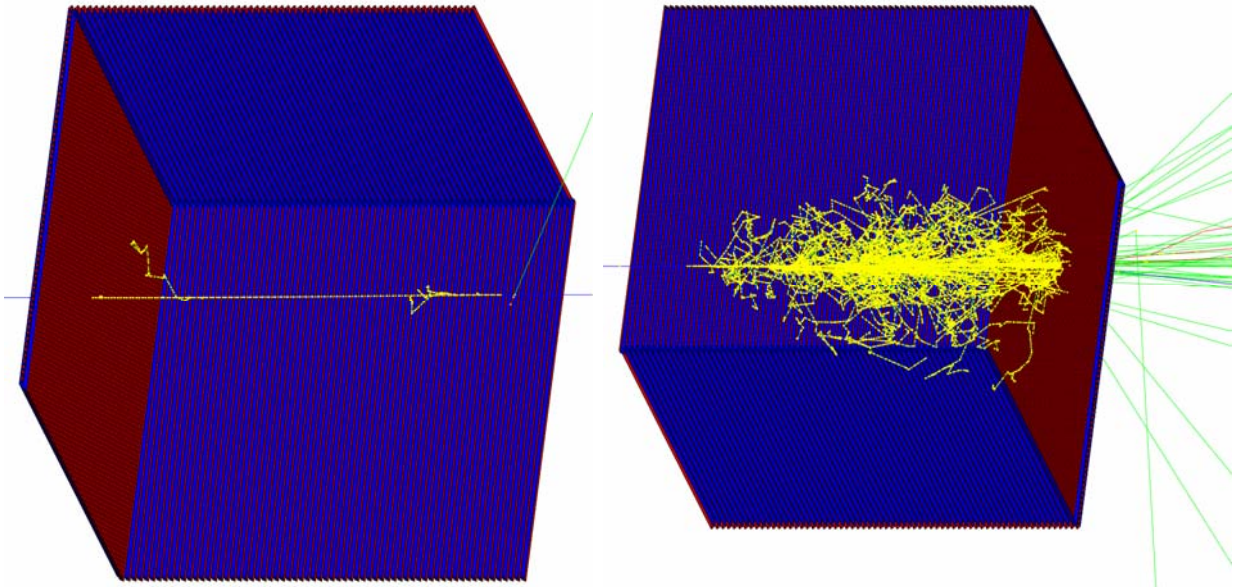


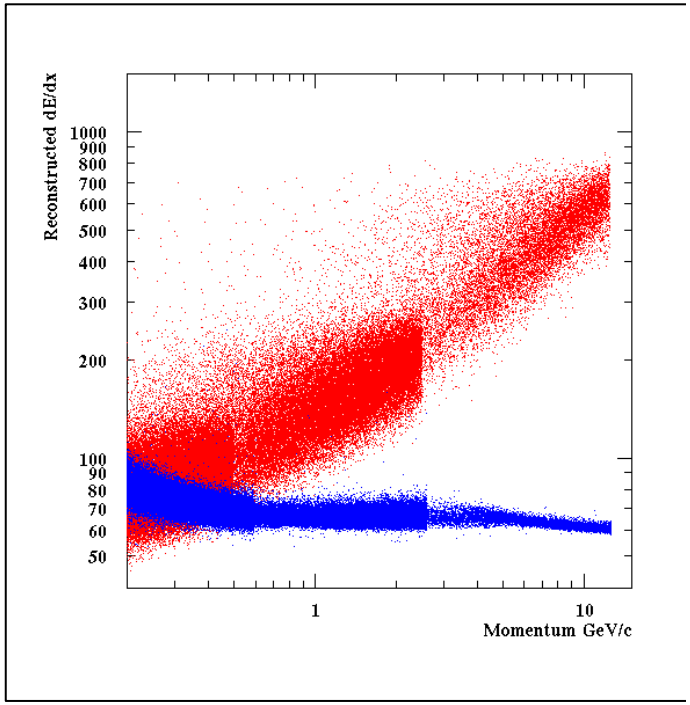
forming a collaboration to build SW?…

Magnetized fully active detector



studies (A. Ellis)

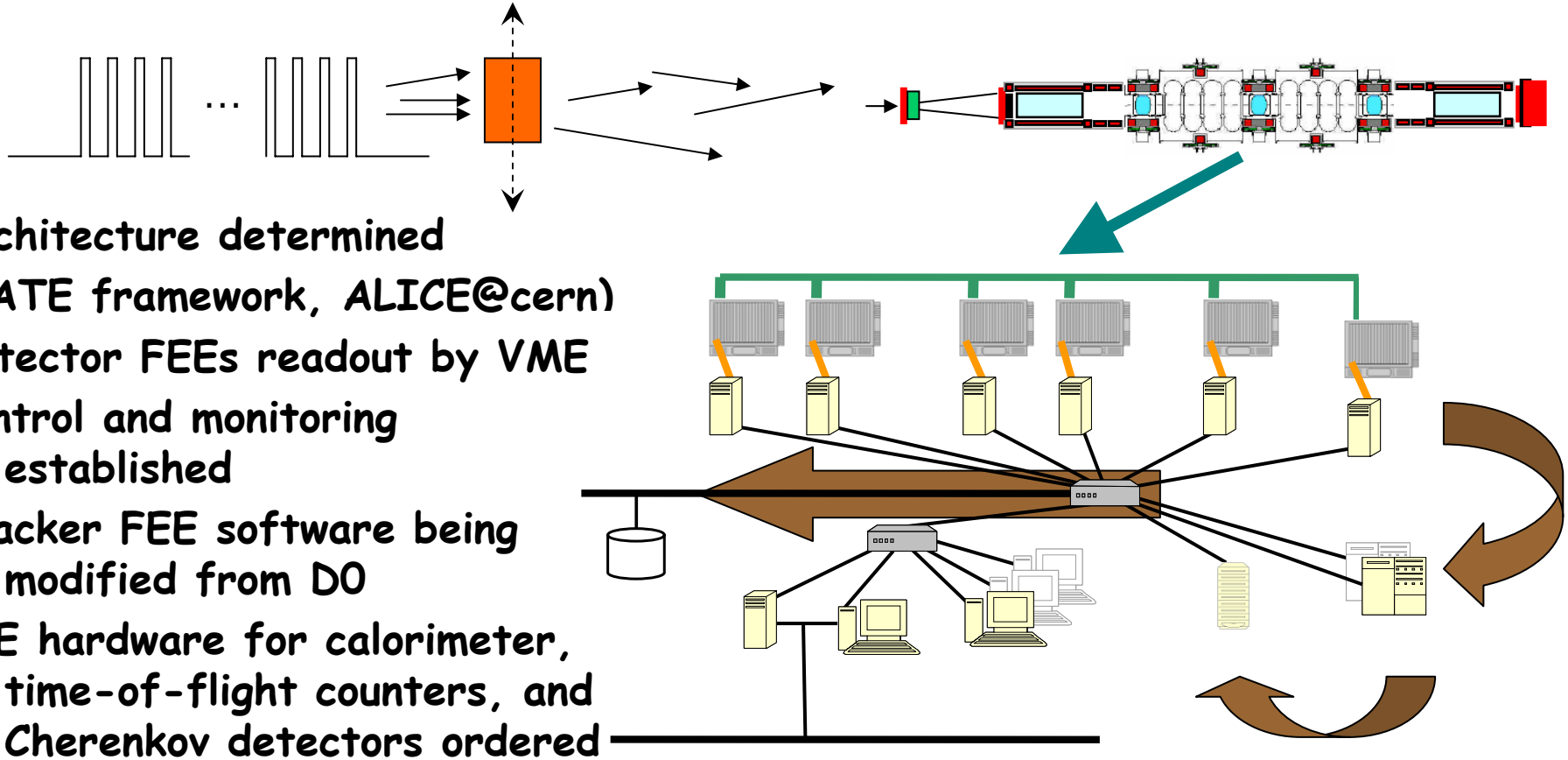




MICE DAQ & Trigger

Gva, UK, IIT, Osaka

data rate ~1MHz



- Architecture determined (DATE framework, ALICE@cern)
- Detector FEEs readout by VME
- Control and monitoring established
- Tracker FEE software being modified from D0
- FEE hardware for calorimeter, time-of-flight counters, and Cherenkov detectors ordered
- Trigger signals and run modes established

February, 2007: DAQ test bench set up at Uni-Geneva
March, 2007: Order MICE Stage 1 FEE hardware
July, 2007: Move MICE DAQ system to RAL
September, 2007: DAQ working in MICE Stage 1

Preparing for PHASE I : software, analysis & DATA Challenge

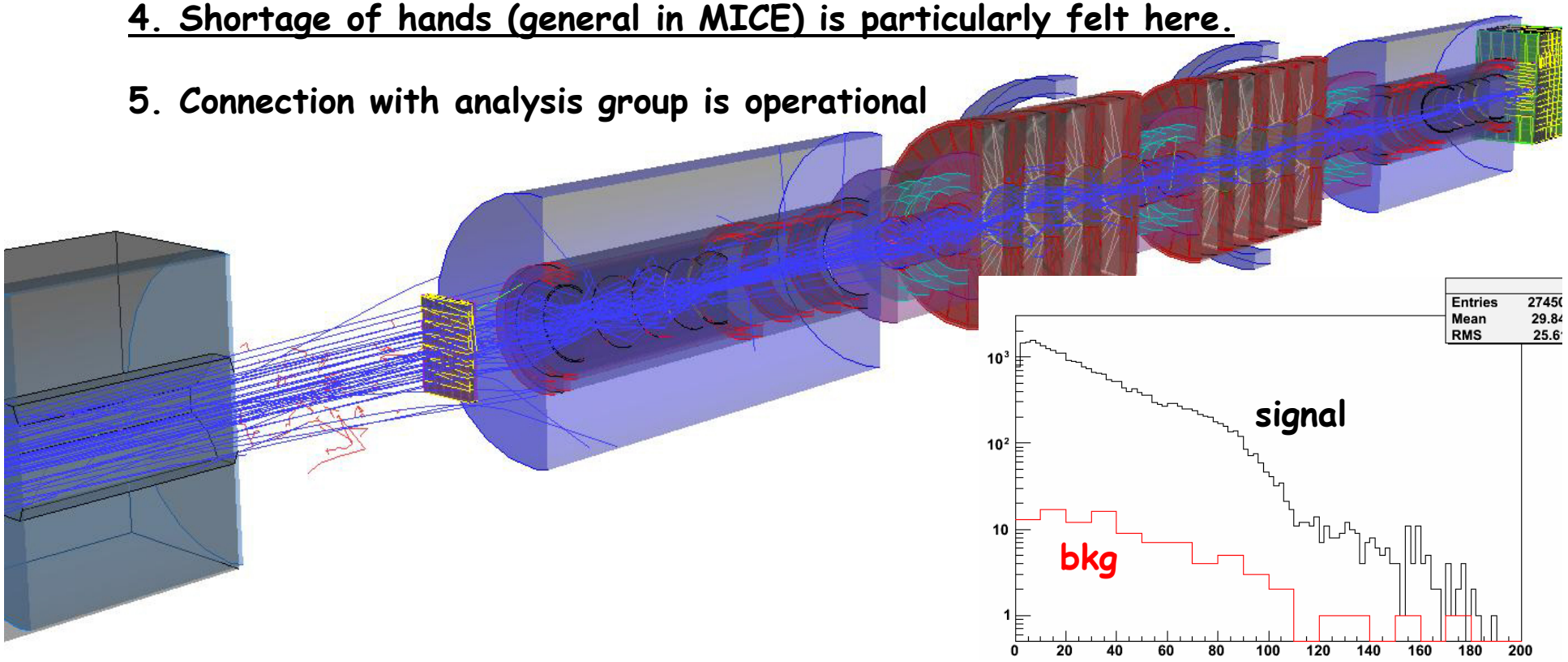
1. Basic simulation and reconstruction of MICE is complete for the various steps

2. Putting it all together to do analysis is beginning (particle amplitude, emittance calculations, particle ID test variables, etc…)

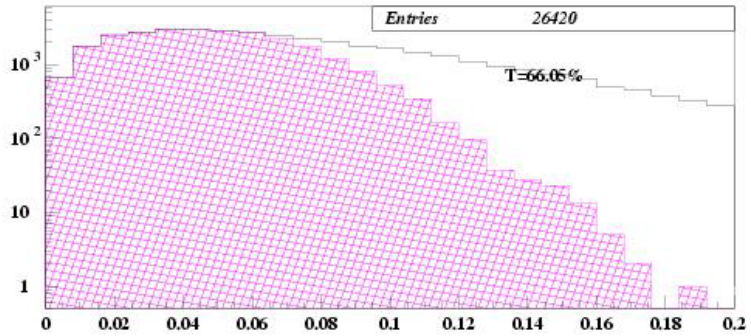
3. Data challenge being prepared. Will be launched at CM17

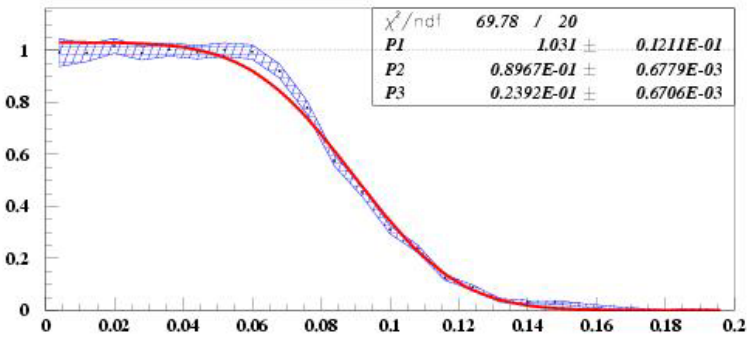
4. Shortage of hands (general in MICE) is particularly felt here.

5. Connection with analysis group is operational



Single particle *Amplitude Measurements* in MICE

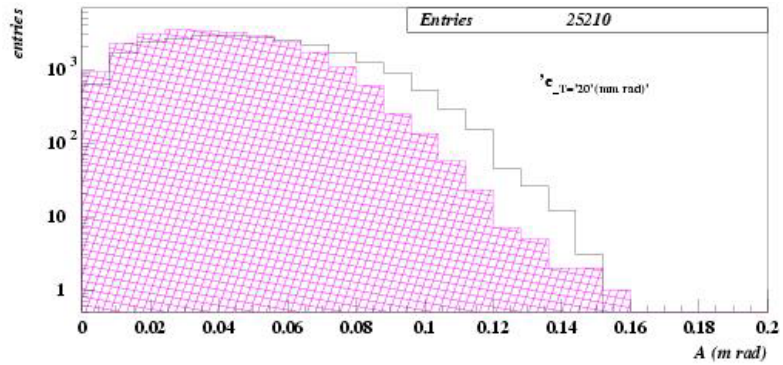


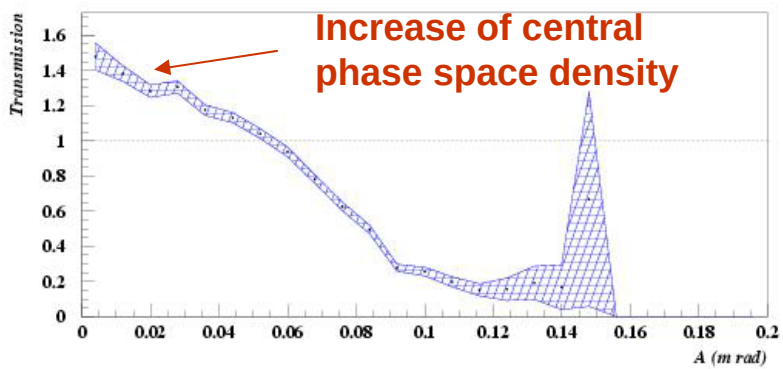


Transmission *versus* amplitude

Large emittance beam

Empty channel





Transmission *versus* amplitude

Large emittance beam

Channel with absorbers & RF

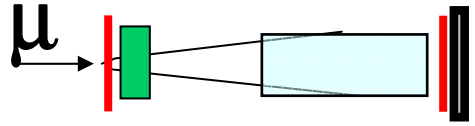
Emittance = RMS *amplitude* of muons in beam

MICE can measure the *amplitudes* of *single muons*

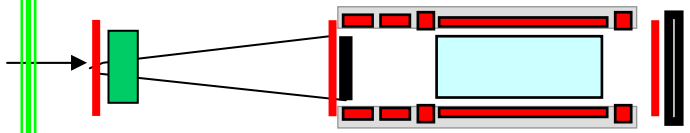
Increase in central phase space density ➔ Dramatic demonstration of Cooling

Aspirational MICE Schedule now (unchanged since march 2006)

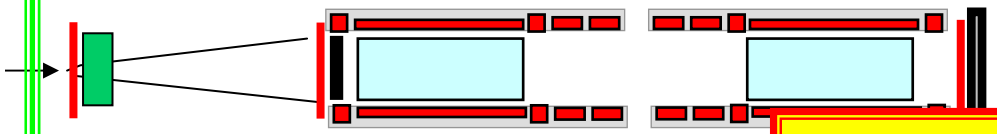
PHASE I



STEP I 15 September 2007



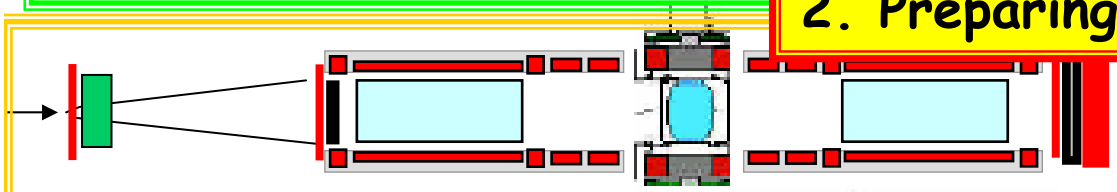
STEP II November 2007



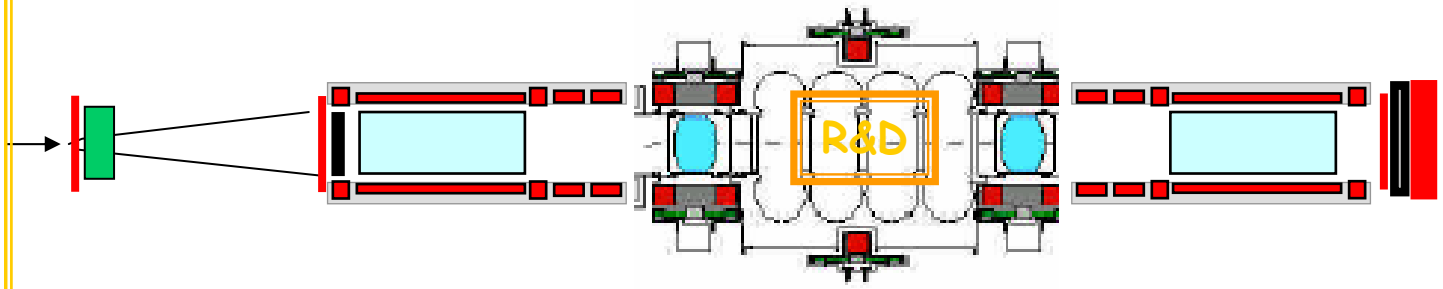
STEP III: winter to summer 2008

2. Preparing for phase II

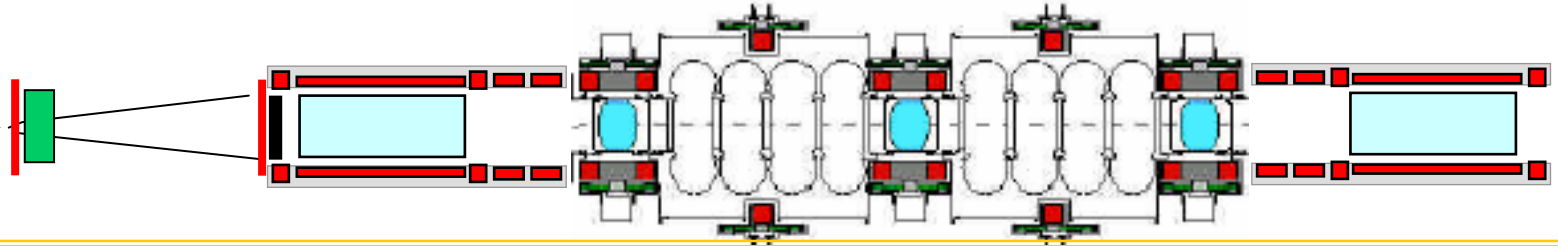
PHASE II



STEP IV: fall 2008



STEP V:
summer 2009



STEP VI
end 2009

2. Preparing for phase II

LH2 Absorber (UK, US, Japan)
AFC module (UK)

RF R&D (Mucool-NFMCC)
RF power (LBNL-> Daresbury lab, CERN)

Coupling Coils (Harbin-LBNL)

SW calorimeter (collaboration?)

Summary of funding situation (I)

-- UK: 9.7M£ (OST+ rolling grants + CCLRC contribution)
Phase II bid under review -- absolutely crucial and not too soon
(18 mo - 2 yrs lead time needed for FC module)
Manpower requested is absolutely needed.

-- USA:
funding from the NFMCC (DOE baseline scenario 4.125M$)
+RF source
+ NSF grant (IIT) 300k$
+ MRI grant (tracker + tracker solenoid) 750k$
(NB tracker part was reduced substantially by D0 electronics deal)
+ DOE suppl. for MUCOOL coupling coil 300k$

further requests submitted:
+ NSF MRI for MUCOOL CC (refused in 2006--resubmitted)
+ NSF cooling funding proposal by Pr G. Hanson and coll. pending
+ NSF tracker proposal by Pr G. Hanson et coll pending
(1postdoc + 2 PhD students)
+ *NEW* PIRE proposal by Cremaldi et al
Partnerships for International Research and Education
support for postdocs and students in international collaboration
-- was not selected in 2006
-- prepare a new one

Summary of funding situation (II)

-- Japan:
working hard on it

-- Switzerland:
PSI solenoid
Uni-Geneva+SNF (DAQ, trigger+TOF0 ~200k€) + 2PhD+1RA
+ Bulgaria collaboration (PID electronics) (70k€)

-- CERN: 1 RF station providing 4MW (173kCHF 110k€ + 0.3 FTE)
agreed on 3 Nov 2006: Maurizio Vretenar charged of execution

-- Netherlands: Mag probes (in production)

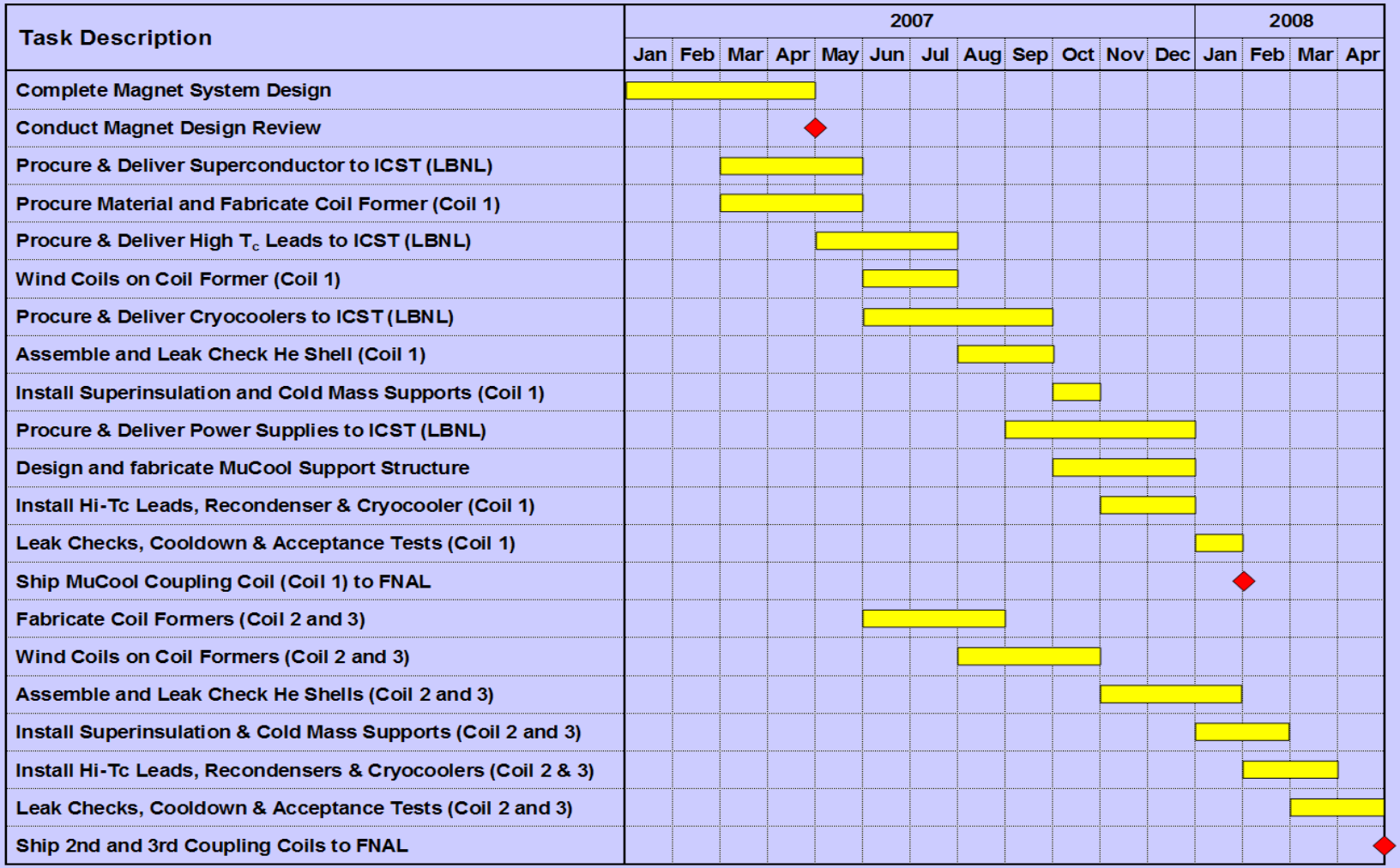
-- Italy (TOF, Calorimeter) 500 k€ so far,
200 k€ missing for completion of PID, happening.

-- China (MICE coupling coils) under study 1st presentation at CM16,
bid submitted from ICST to HIT. (local)

Goals of the ICST/LBNL Collaboration

- **Develop a coupling coil design for MICE, MuCool**
  - Preferably one design that meets both project's needs
- **Fabricate and test three coupling coils at ICST**
  - Coil for MuCool is needed as soon as possible
  - Two MICE coils can follow later (if appropriate)
- **Integrate the coil design with the requirements of the MICE RF/Coupling Coil Module**
  - Issues: RF vacuum vessel, RF couplers, tuners, forces

Timeline – Early MuCool Coil Delivery



funding status at ICST Harbin:

In the middle of this January, Dr.Jia and I directly talked to the President of HIT (Prof. Wang, Shu Guo) on the status of the MICE coupling coil project.
We submitted the proposal for funding application. The President expressed the strong interest in the project. Also, he has some concerns, such as how to ship the hardware out of China once all the work done. At the end of this January, the President submitted one formal business letter on the MICE project to the Chinese Science & Technology Department in Beijing, and still wait for reply.

ICST is working on the detailed engineering design for the coupling coil cryomodule

Lin will give the talk on our progress in the collaboration meeting.

Dr Li Wang

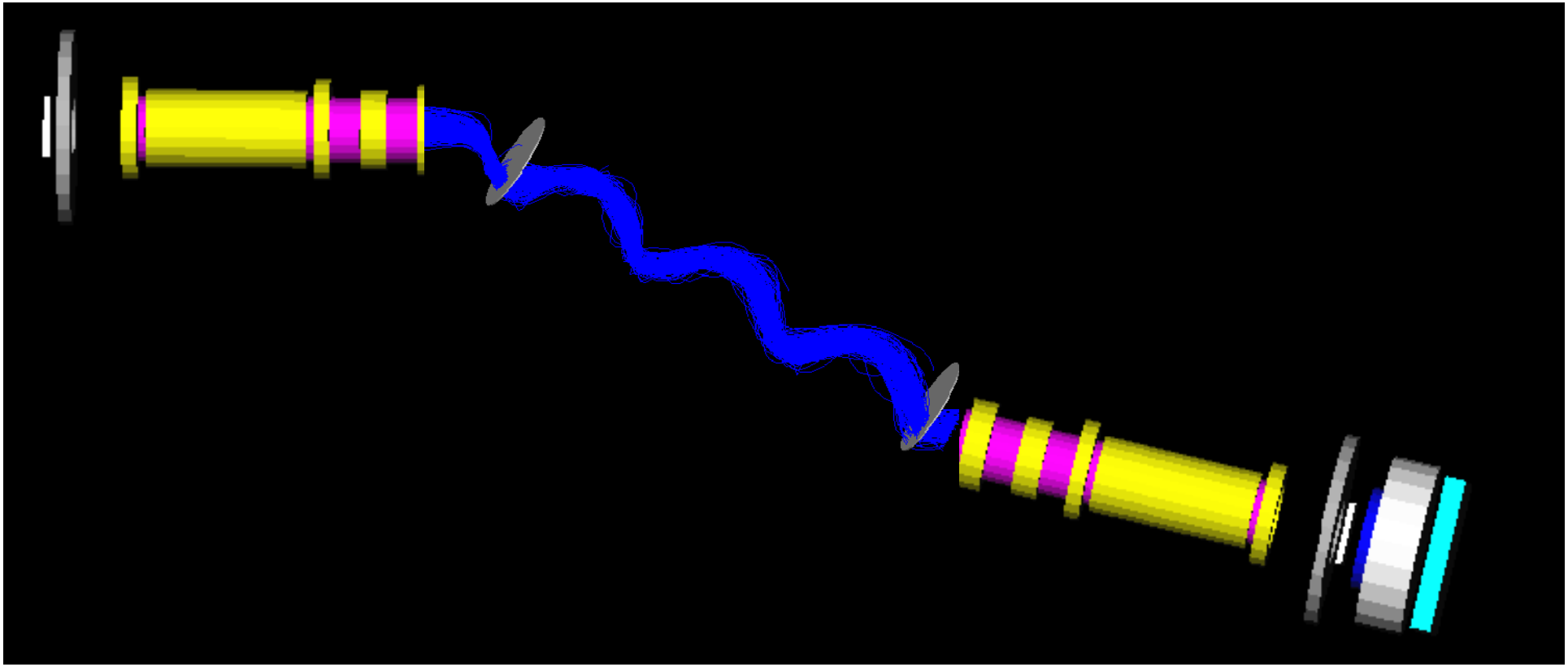
« PHASE III: »

or: *of MICE and MANX*

MANX is a cooling system based on a helicoidal focusing channel
a very challenging magnet (3-5m long SC) around L.He. absorbers.
Claim of large cooling (vs 10% for MICE) incl. long. emittance reduction.

It is suggested that MANX can eventually be tested in the RAL muon beam,
using the spectrometers and diagnostics of MICE

MANX minimal step (no RF) (T.Roberts in june 2006)



CONCLUSIONS

Scientifically and technically MICE is making good progress

1. MICE Phase I
The collaboration is focused on getting ready to take data in 2007.
BUT MANY POINTS ARE VERY TIGHT!
nevertheless it is crucial not to make shortcuts with precision goal

2. Phase II
   - ++ critical R&D (200 MHz RF)
     absolutely need MUCOOL coupling coil
   - ++ Harbin ICST proposal for MICE coupling coils
   - ++ Phase II UK proposal under review.

3. phase III possibilities open

IF all the above comes through we should be able to realize
MICE aspirational schedule:

demonstration of ionization cooling by 2010

MICE SUCCESS IS CRUCIAL FOR THE FUTURE OF NEUTRINO FACTORY (and MUON COLLIDER)

GOALS of the Meeting

1. status of preparations for step 1
2. get the hardware built and running
2. organize ourselves to run the experiment
3. run plan
4. DAQ plan (monitoring?)
5. software plan
6. analysis plan

still a few decisions and unknowns to solve:

-- beam tuners and configurations

-- size of extremities: diffuser and downstream shield -- clear the issue & decide!

-- SW calorimeter? can we have it for september?

a nice project...should form collaboration to build it. synergy with T2K ND280 and NF baseline&BBL detectors

-- TOF issue not completely solved

-- personel organization for the run! people have to be ready to spend sizeable amount of time in UK starting august 2007

-- organize safety training!

-- CB agenda

D. M. Kaplan
2/10/07

MICE Collaboration Board

Saturday, 24 February, 2007, 17:15 CERN IT Auditorium

Preliminary Agenda

1. Approval of the Minutes of the last meeting (5 min)

2. Spokesman's Remarks (A. Blondel) (20 min)
   Executive Board Report, funding, etc.

3. Technical Coordinator's Report (P. Drumm) (15 min)

4. Report on Commissioning Plan (K. Long) (15 min)

5. Report on Common Fund collaborator tally (C. Booth) (10 min)

6. Report on Spokesperson election (D. Kaplan) (10 min)

7. Date and location of next and future MICE Meetings (V. Palladino) (10 min)