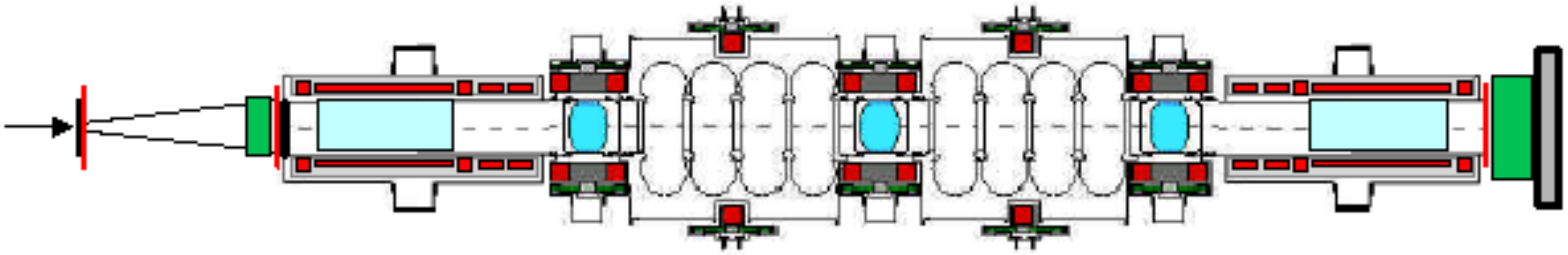
Muon Collaboration

MICE Status



Daniel M. Kaplan
Deputy Spokesperson, MICE Collaboration

ILLINOIS INSTITUTE OF TECHNOLOGY
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ICAR

MICE

Muon Collaboration Meeting
Mission Inn
Riverside, CA
30 January 2004

MICE approved!

- October 6 letter from John Wood (Chief Executive, Council for the Central Laboratory of the Research Councils) and Ian Halliday (Chief Executive, Particle Physics and Astronomy Research Council) stated (in part):

  The International Peer Review Panel chaired by Prof. Alan Astbury was established to review the MICE proposal, submitted on the 10th January 2003. The Panel "strongly recommends approval of the project", "endorses the scientific case for MICE" and considers that "proposed experimental technique is appropriate".

- We then asked "Does this mean MICE is approved?"

- Answer: "No."

- Reply: "Why not? Wouldn't approval be helpful in our search for funding?"

→October 24 letter from John Wood:

CCLRC accepts the strong endorsement of the proposal by the Astbury panel and consequently considers the proposal to have full scientific approval.

Next steps:

- More from October 6 letter (emphasis addded):

  The Panel recommends that there should be an independent cost and schedule review, that there should be a formal project management methodology (e.g. a work breakdown structure or equivalent), the appointment of technical liaison staff for the key components, the establishment of a technical advisory committee and an agency committee...

  ...the project is progressing through the "Gateway" procedure, in order to seek funding for the investment in the beam and infrastructure from the UK capital facilities funding line.

  - "Gateway" process is new UK gov't policy for large procurements
  - Gateway 1 is supposed to assess the "business case"
- Gateway panel met 12/12/03:
  - MICE passed Gateway 1 " on deep amber"
- Gateway 2 will "confirm procurement strategy" and certify "full funding availability"
  - prerequisite: successful international funding negotiation
  - this is the major initial purpose of the agency committee (assembly in progress...)

More next steps:

- Paul Drumm of RAL named Project Manager
  - Paul is compiling WBS and schedule
- Collaboration structure set up:
  - Executive Board:

Alain Blondel (Chair), Geneva	Alan Bross, Fermilab
Peter Dornan, Imperial	Paul V. Drumm, RAL
Rob Edgecock, RAL	Steve Geer, Fermilab
Helmut Haseroth, CERN	Yuri Ivanyushenkov, RAL
Daniel M. Kaplan, IIT	Yoshitaka Kuno, Osaka
Kenneth Long, Imperial	Vittorio Palladino, INFN Naples
Yagmur Torun (secretary), IIT	Michael S. Zisman, LBNL

  - Technical Board (WBS Level 2 leaders):

Paul Drumm:	Technical Coordinator - Chair of TB
Mike Zisman:	Deputy Technical Coordinator, Cooling Channel Coordinator
Yury Ivanyushenkov:	Beam and Infrastructure Manager, Hall Manager for Installation, Document Librarian
Edgar Black:	Integration and Verification Manager
Alan Bross:	Detector Integration Coordinator
Yagmur Torun:	Software Coordinator
Elwyn Baynham:	Safety Overview
Alain Blondel:	MICE Spokesperson
Dan Kaplan:	MICE Deputy Spokesperson

  - Collaboration Board (representatives from each institute)
- Spokesmouse election in progress (Blondel is Acting Spokesmouse)

Highlights of Technical Progress:

1. Tracker decision
2. Simulation
3. Beamline design
4. Conceptual framework
5. AFCSWG
6. RF system
7. PID design
8. Integration
9. Preparations at RAL

Tracker Decision

- Recall MICE Proposal described 2 tracking technologies
  - SciFi (baseline): "good enough"
  - TPG (option): "better and cheaper" but more speculative (never been done before)
  - some collaboration members pushed for "baseline↔option interchange"
- At Columbia collab. mtg. (June '03) we agreed:
  - tracker decision to be made at Abingdon mtg (Oct. '03)
- Decision: SciFi remains the baseline
  - decision criteria (in a nutshell):
    - demonstrated working prototype
    - simulation showing adequate performance with realistic noise & efficiency
  - still needed:
    - demonstration of offline trackfinding with SciFi
      (not yet achieved due to inadvertent scrambling of channel ordering)
    - establishment of absolute p.e. yield & efficiencies
  - TPG group encountered difficulties fabricating "hexaboard"
  - TPG R&D will continue → we have a backup solution in case of need

The SciFi Group

Japan

K. Yoshimura

KEK

Y. Kuno, H. Sakamoto, A. Sato, M. Yoshida,

Osaka

UK

P. Kyberd

Brunel

A. Khan, L. Tong

Edinburgh

G. Barber, M. Ellis, K. Georgiou, R. Goncalo,
K. Long, J. Sedgbeer, A. Tapper

Imperial College London

P. Cooke, R. Gamet

Liverpool

US

A. Bross, J. Estrada, J. Krider,
R. Rucinski, P. Rubinov

FNAL

D. Kaplan, Y. Torun

Illinois Institute of Technology

G. Hanson, A. Klier

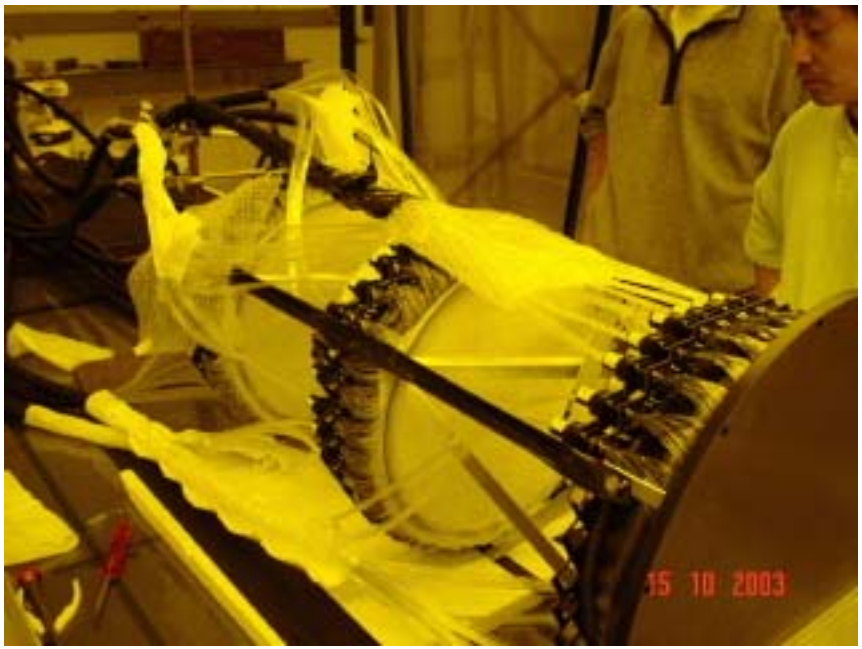
Riverside

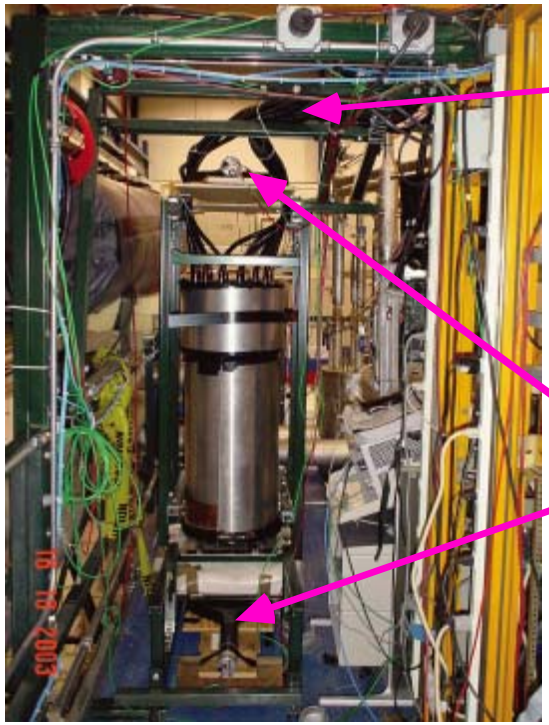
X. Yang

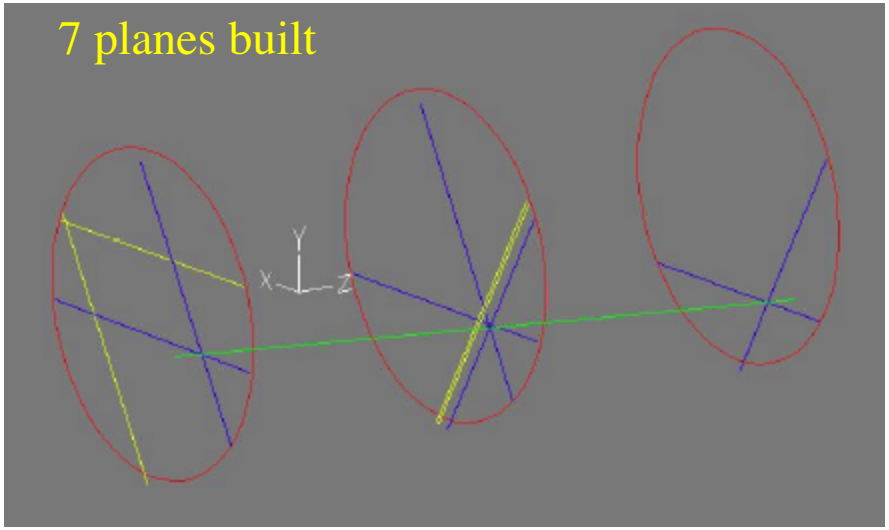
UCLA

SciFi R&D picture gallery:

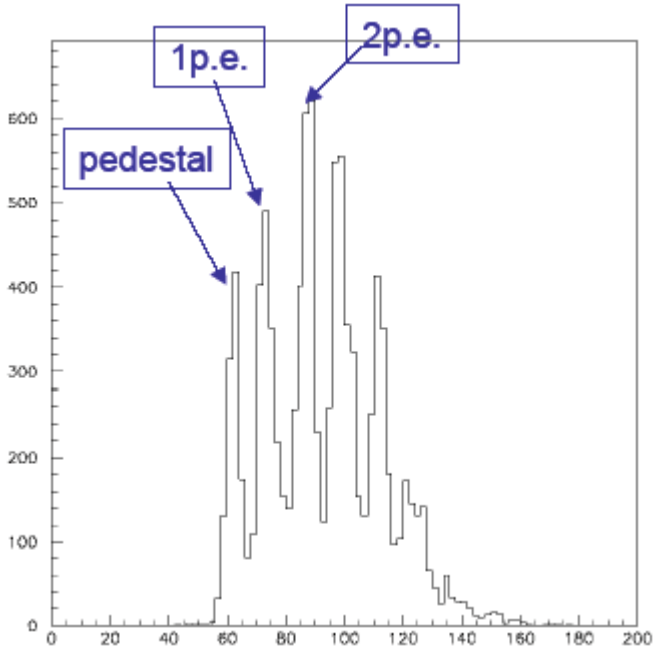
Assembly of 3-station SciFi prototype







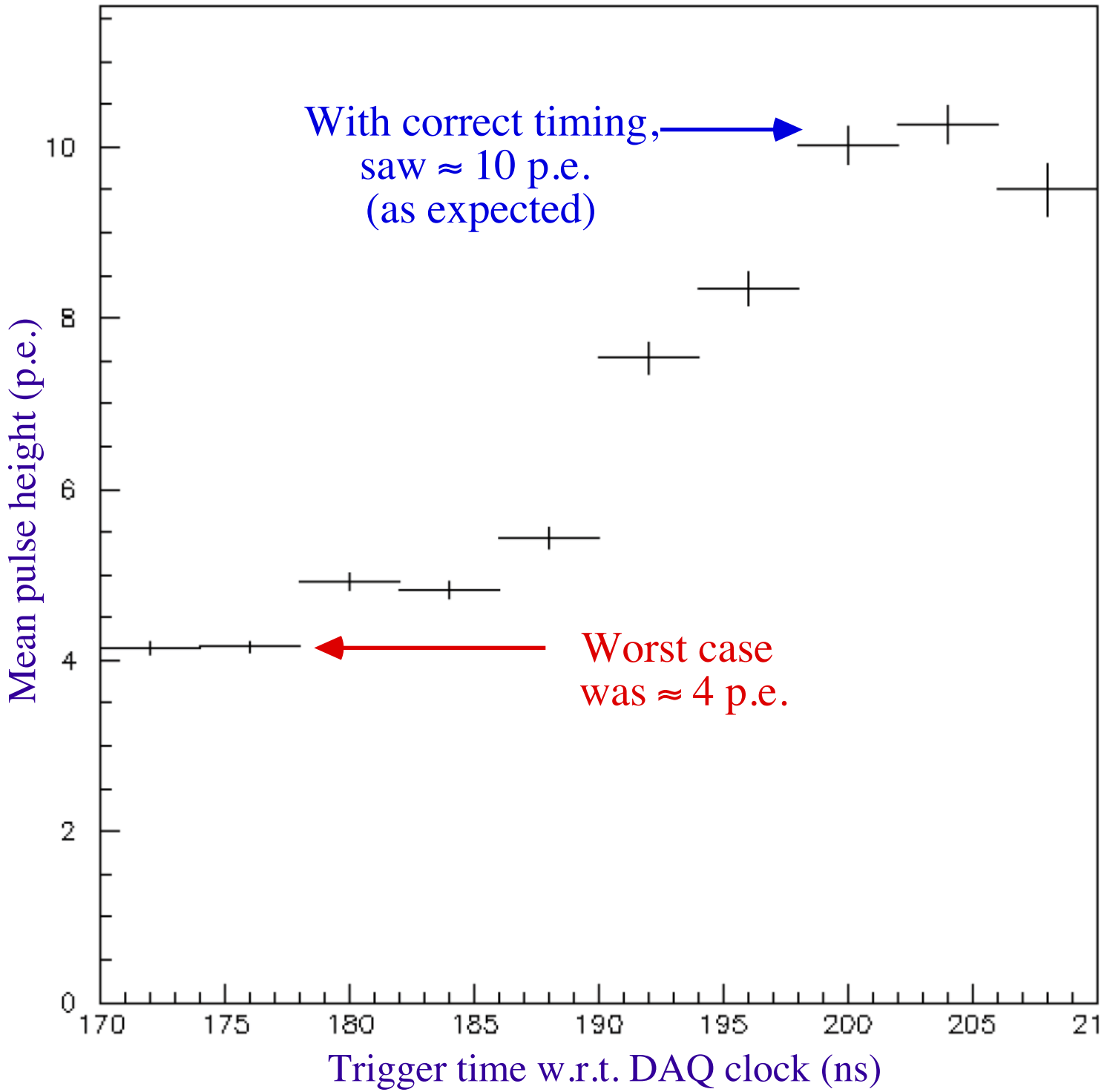
"Typical" event



VLPC performance (w/ LED & pulser)

(for more photos see www-kuno.phys.sci.osaka-u.ac.jp/~yoshida/MICE/photos/prototype/index.html)

Early light-yield worries were due to mistiming:



- TDC data added only towards end of run
- Can probably recover efficiency in data already taken
- More data-taking planned in ≈March

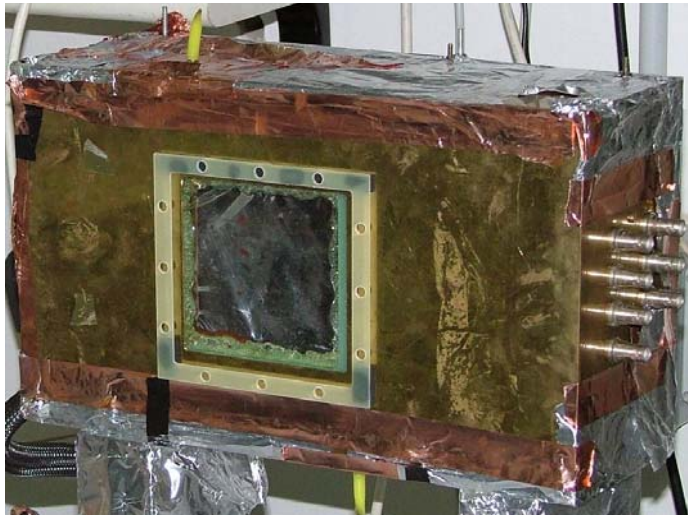
Ongoing SciFi work:

- Confirm map of fibers to readout channels
- Study pattern recognition efficiency & cleanliness vs # p.e.
- Study light-yield optimization of scintillating fiber
- Measure rate of dead channels
- Feed results into G4MICE to verify that proposed design meets MICE performance specs
- Prototype and test new readout board for MICE & D0 (with D0 group)
  - people needed soon at FNAL to help with testing (e.g. students or postdocs)
  - opportunity for MICE collaborators to get involved, make a contribution, & start climbing the VLPC-readout learning curve

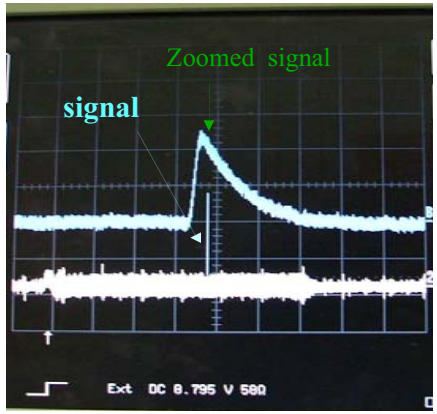
RF test of a small TPG detector prototype

F. Ambrosino, C. D'Addio, F. Caspers, U. Gastaldi, E. Gschwendtner, E. Radicioni, G. Saracino

INFN Bari/Legnaro/Napoli, U. Geneva



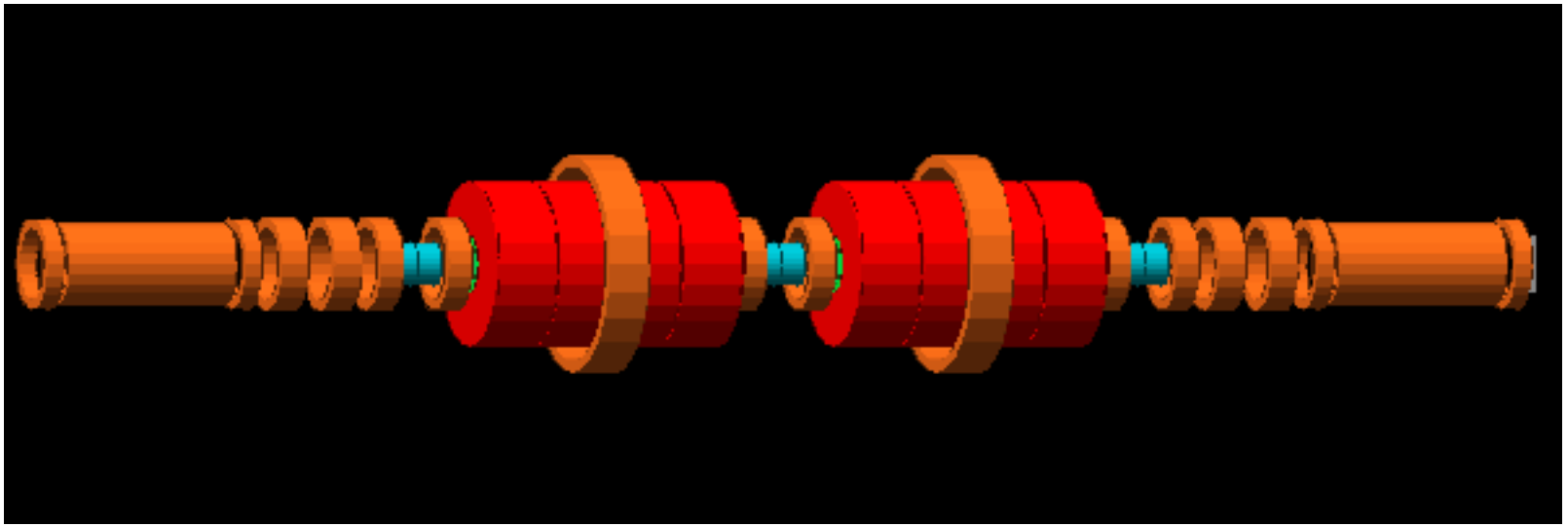
- **We tested a GEM based detector, with cables and grounding not optimized for RF immunity, in the vicinity of the CERN LINAC 3 accelerator (2 RF accelerator tanks of 200 MHz, power supply of ~ 250 KW).**
  - **The noise response of the detector can be improved by a factor ~5 (400mV/80mV peak to peak) with home-made shielding of the cables, electronics, etc.**
  - **More effective and professional shielding can be provided in the MICE setup. Proof of concept is anyway valid.**
  - **The signal to noise ratio of a 55Fe X-ray source is ~8 (300mV/40mV) when the RF is on!**



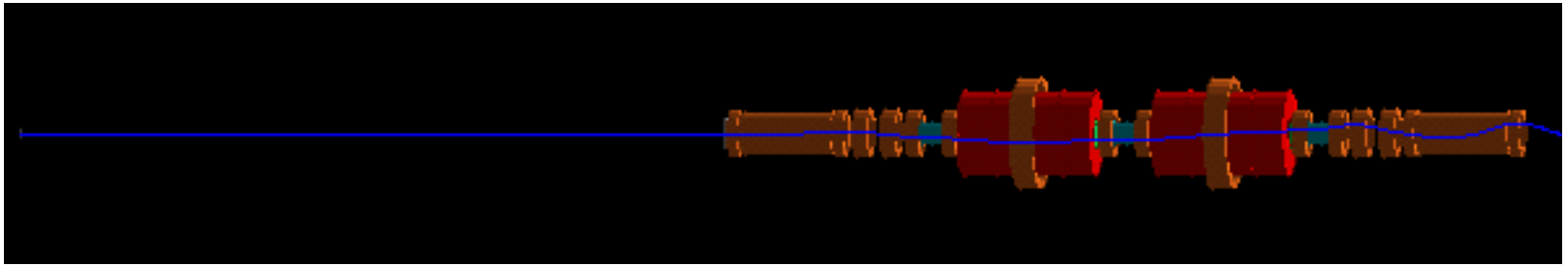
- **We were able to shield a GEM detector setup such that the presence of RF field at the order of E=20 V/m did not significantly increase the detector noise.**

Simulation

- ICOOL has been used for MICE design at BNL & elsewhere
- G4MICE simulation under development by worldwide team led by YT
  - now producing useful output



Geometry of spectrometers & cooling section

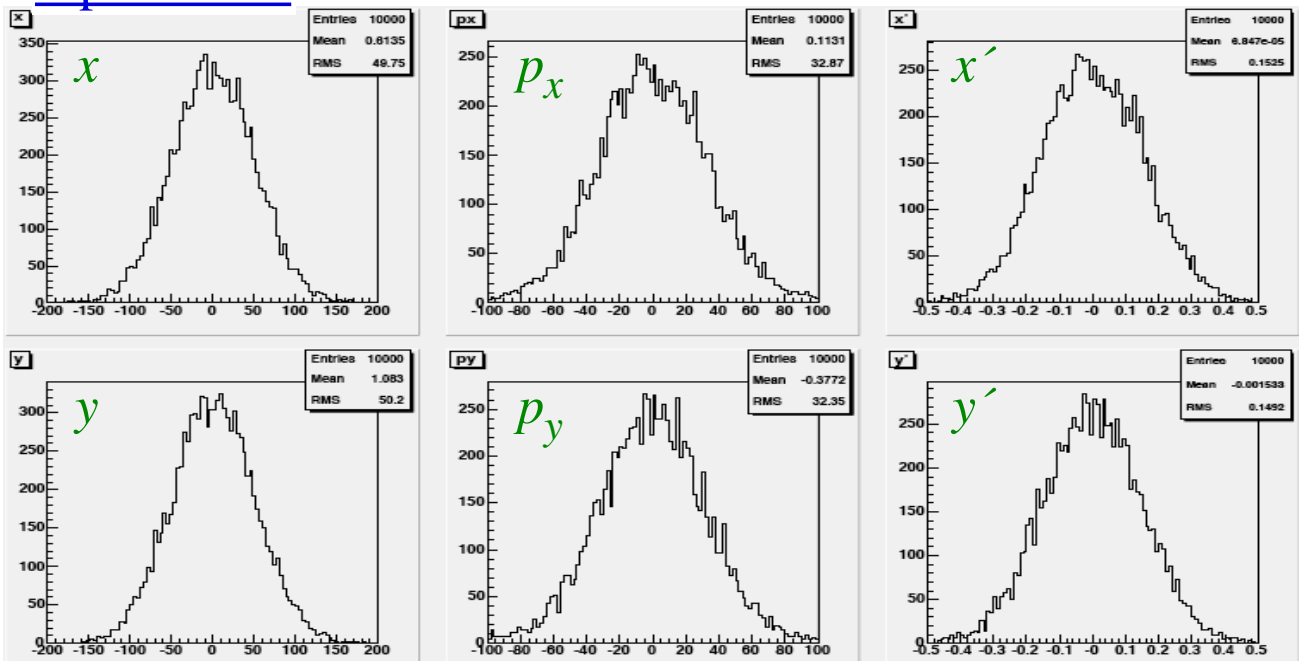


Trajectory of 1 muon starting at TOF0

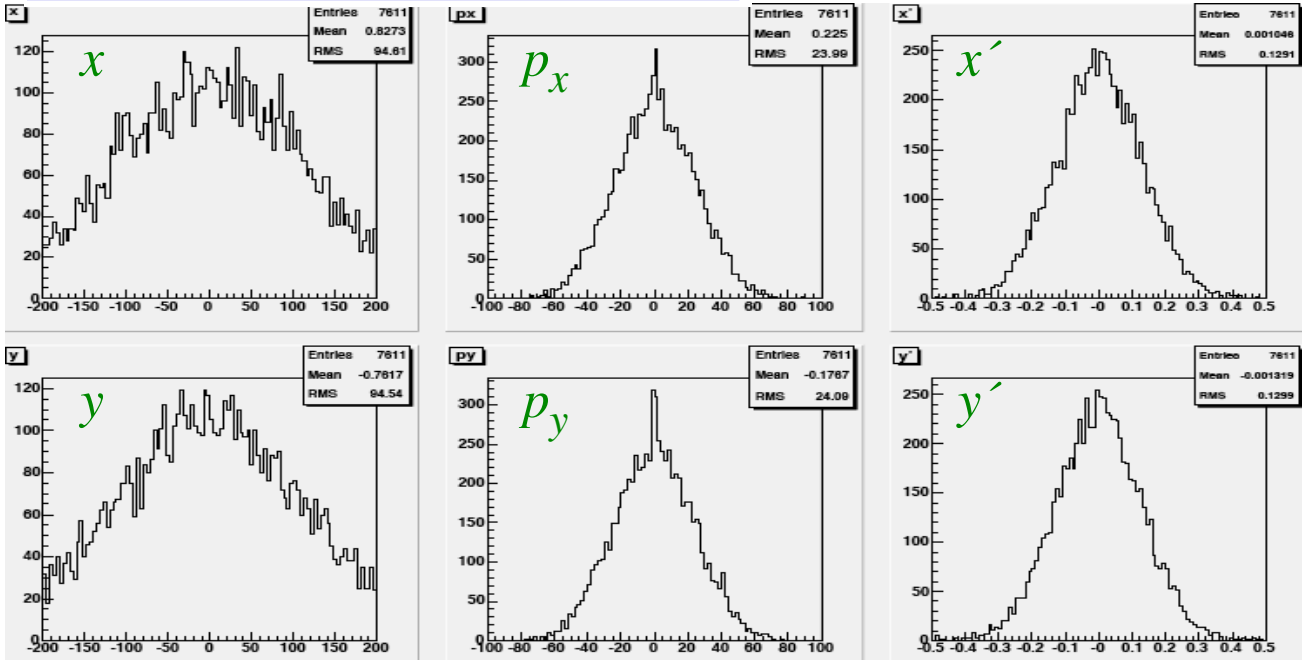
  - e.g. distribution of particles emerging out back of 2nd spectrometer (HW,YT@IIT)
    - needed for optimization of PID detector designs

Some G4MICE results:

Input beam:



Beam at downstream Cherenkov:



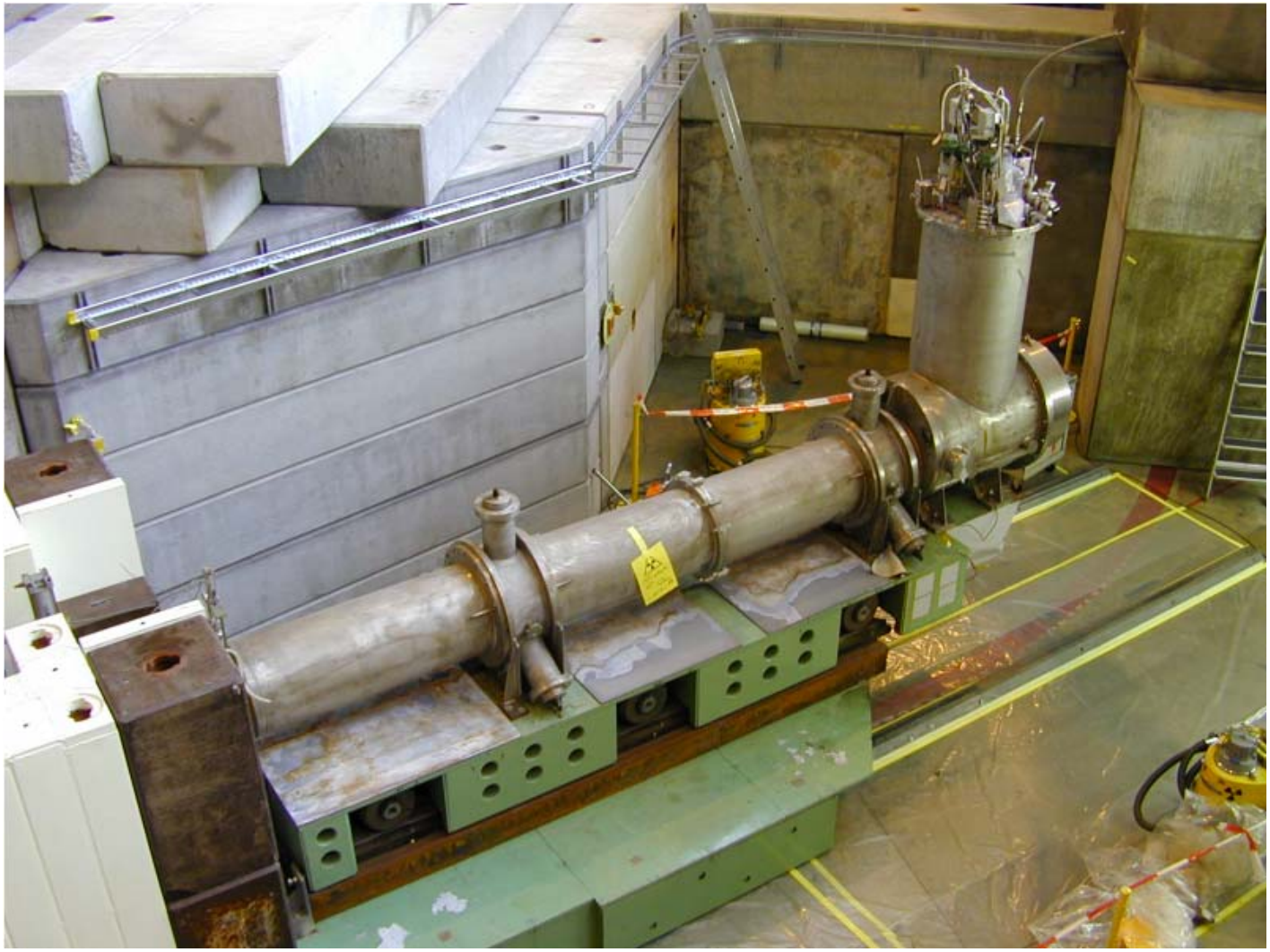
(Note decay electron peak at $p_x = p_y = 0$)

Beamline progress

- Beamline design being iterated by a strong team (using multiple codes) towards satisfactory solution (K. Tilley@RAL / TJR@IIT / RBP@BNL)
  - incorporating add'l focusing elements needed to match beam into spectrometer
    - large-aperture (35″) quads found at RAL by PD:

PSI Solenoid

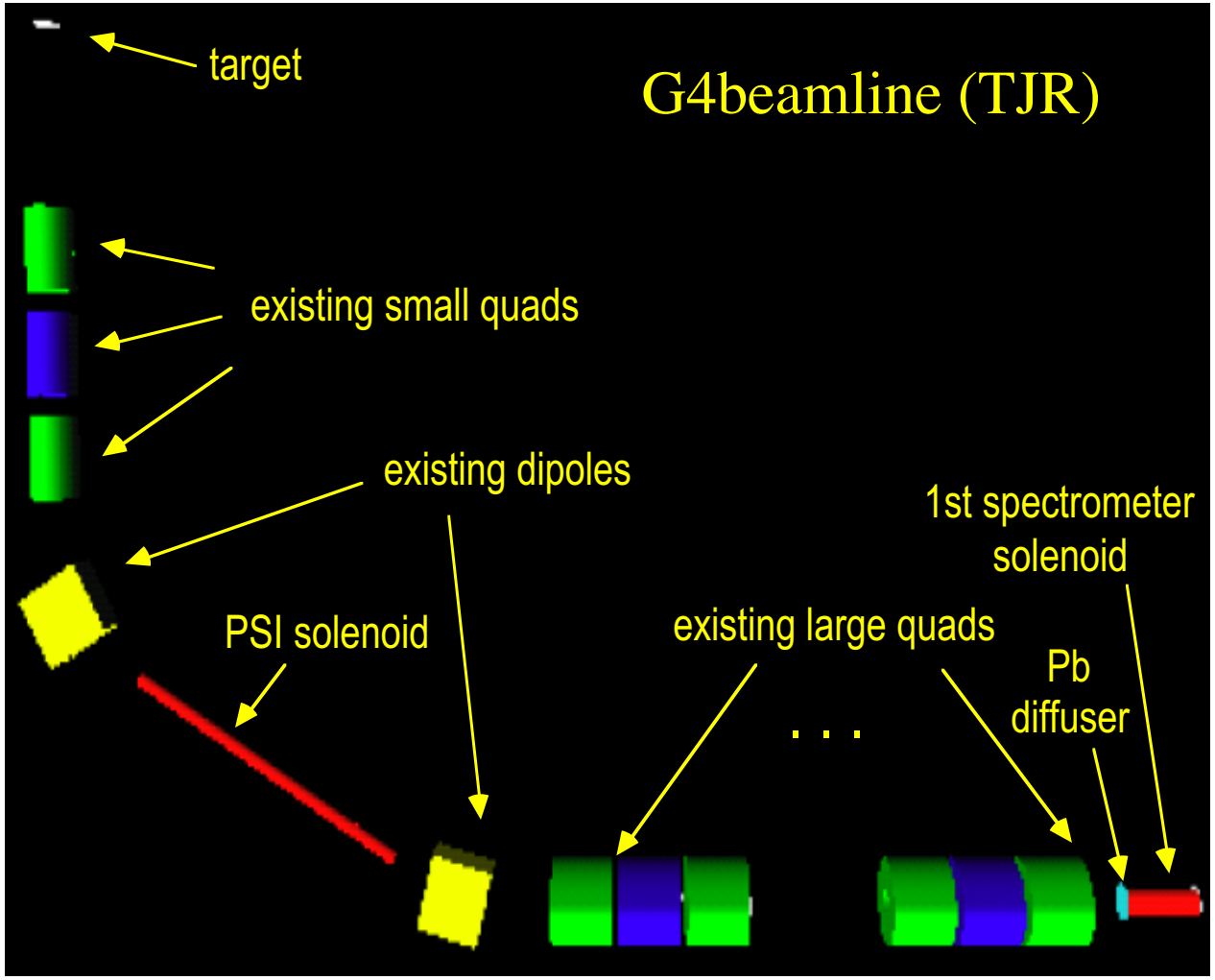
- PSI agreed to contribute π-decay solenoid from decommissioned μ beam



- gains order of magnitude in μ rate over conventional (quadrupole) decay channel
- solenoid now removed from beamline, in prep for shipping to RAL

Beamline simulation results:

- Detailed design now beginning to achieve muon rates of same order of magnitude as in proposal:



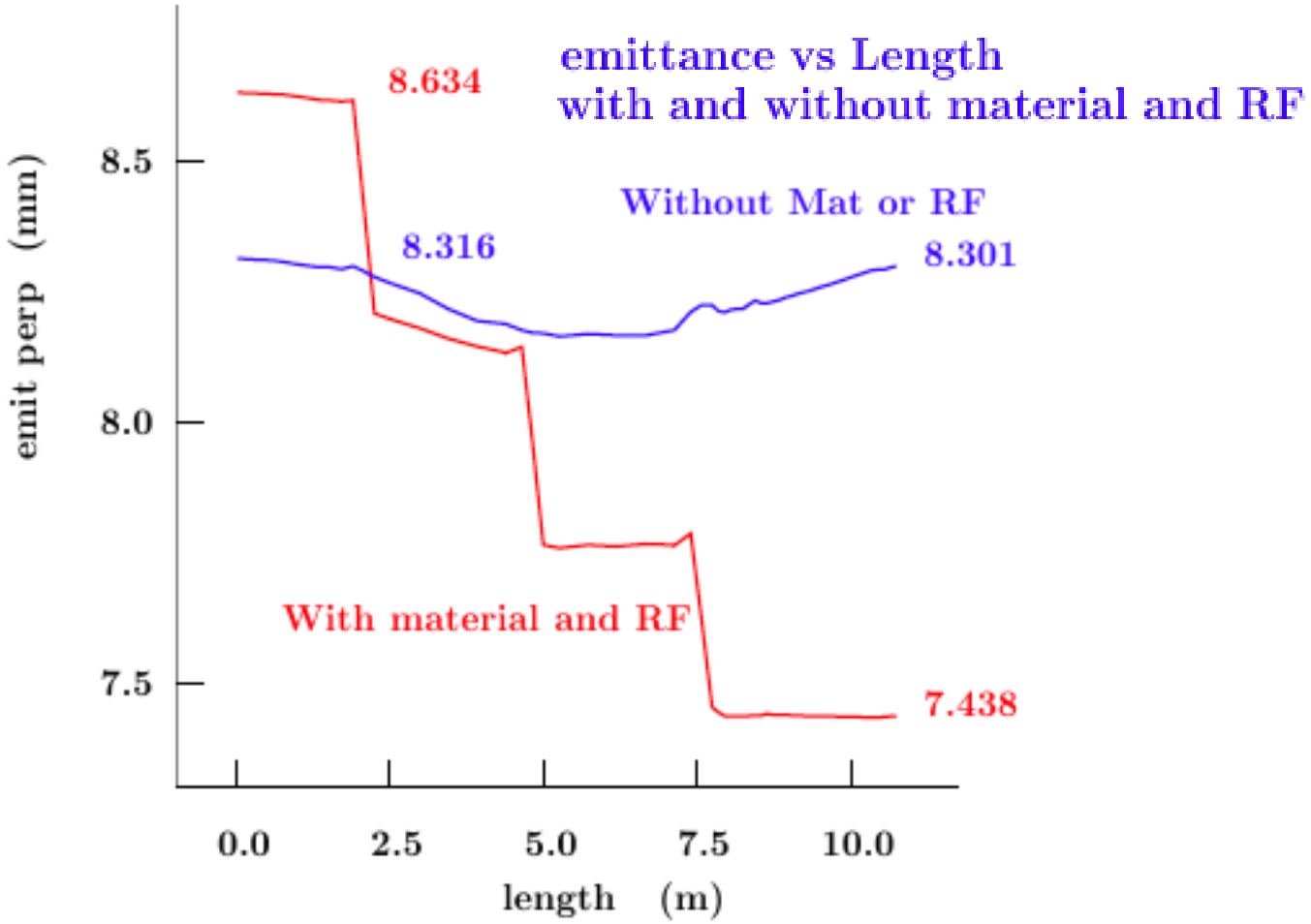
Singles per Millisecond of Good Beam

Location	LAHET	geant4
After Q4	2114	1345
After Q5	1467	933
After Q6	1264	804
After Q7	444	282
After Q8	348	222
After Q9	336	214
After Tracker1	321	204
Good π^+ (40°)	157	100
Good π^+ (90°)	170	108
Good π^+ (no LH2, no RF)	178	113

LAHET and geant4 differ by 57% in overall normalization, for this beam tune.

Conceptual Framework

- Evolution of MICE conceptual framework:
  - at Abingdon MICE mtg (Oct. '03), RBP & U. Bravar (Oxford) showed r.m.s. emittance is not a well defined quantity at 10^{-3} level:

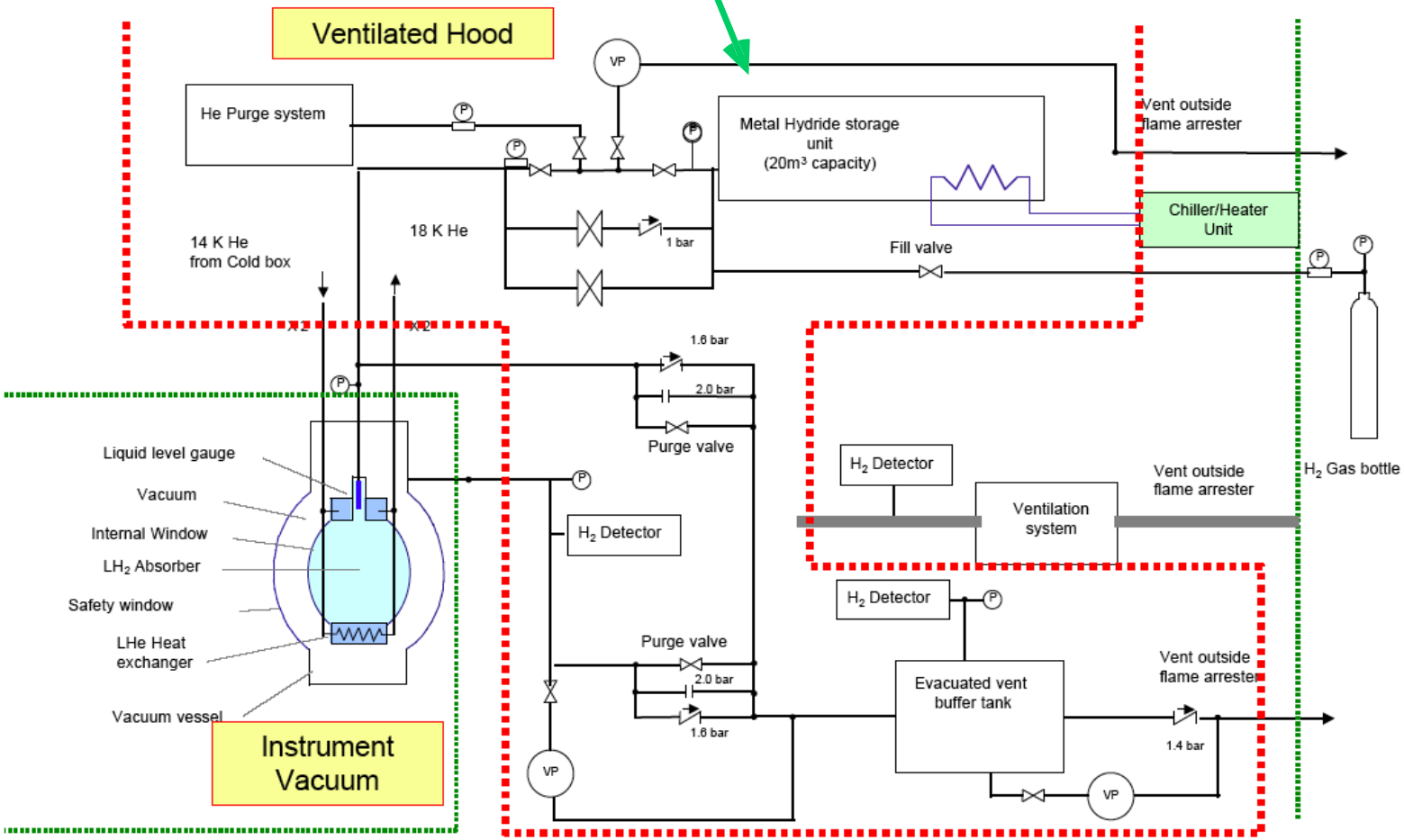


  - MICE is designed to measure *something* to 10^{-3}
    - the question is, what? (work in progress)

(see also Gallardo & Berg talks at Emitt. Xch. W'kshop, Riverside, CA, 21–26 Jan. 2004)

AFCSWG

- Absorber/Focus-Coil Safety Working Group (AFCSWG)
  - good progress under MSZ's leadership via periodic phone & occasional in-person mtgs
  - plan: store hydrogen in metal-hydride beds (devel. for "H_2 Economy") rather than tanks



  - experienced review panel assembled, members from CERN, FNAL, JLab, NASA, RAL, & SLAC, met at LBL Dec. 9-10
  - design passed review, useful comments made:

Preliminary Safety Review of the MICE Absorber Focus Coil Project

12/10/03

(MICE Note 69)

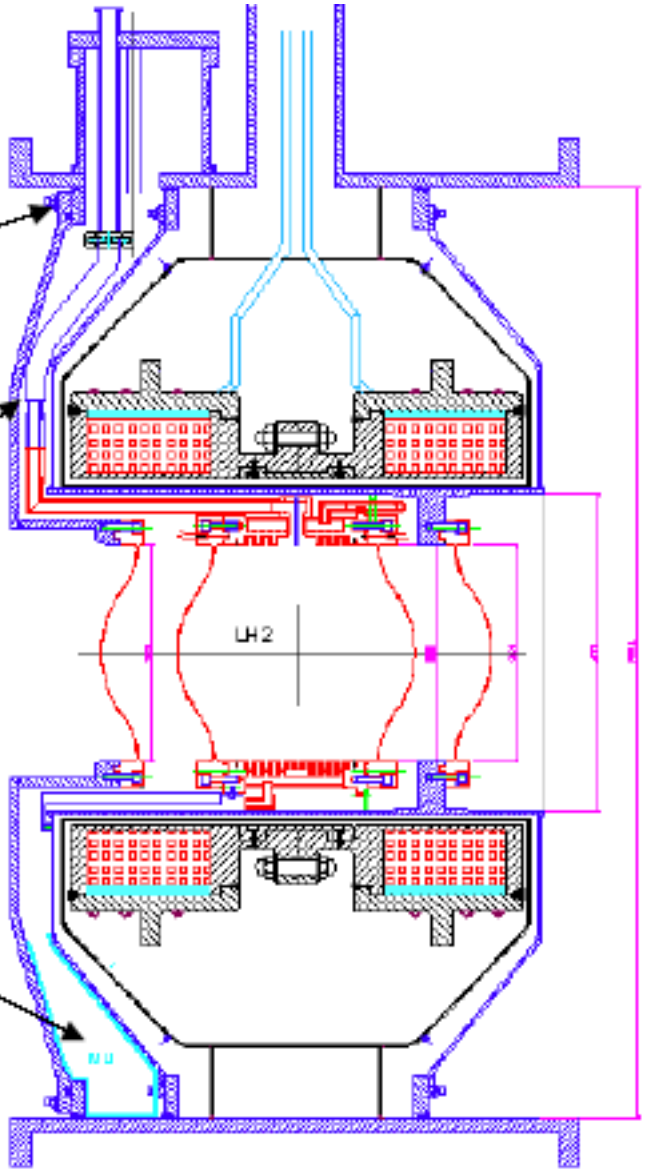
Review Committee

D. Allspach (FNAL)
G. Benincasa (CERN)
M. Seely (Jlab)
L. Starritt (NASA/WSTF)
J. Weisend (SLAC) Chair
J. Wells (RAL)

The committee was impressed by the amount of thought and effort expended on the safety aspects of this project. The MICE collaboration clearly understands the seriousness of the hazards involved and has done a laudable job of designing safety into the system from the start. The early consideration of quality control issues and formal failure mode analysis is particularly valuable. We believe that the MICE collaboration is ready to proceed to detailed engineering design and eventual review by the RAL External Safety Committee. We did not see any significant safety issues that were omitted nor do we find any technical show stoppers. There are 3 issues that we believe need additional development.

1. Hydrogen Gas Handling and Venting System
2. Research and Development of the Metal Hydride System
3. Windows Development

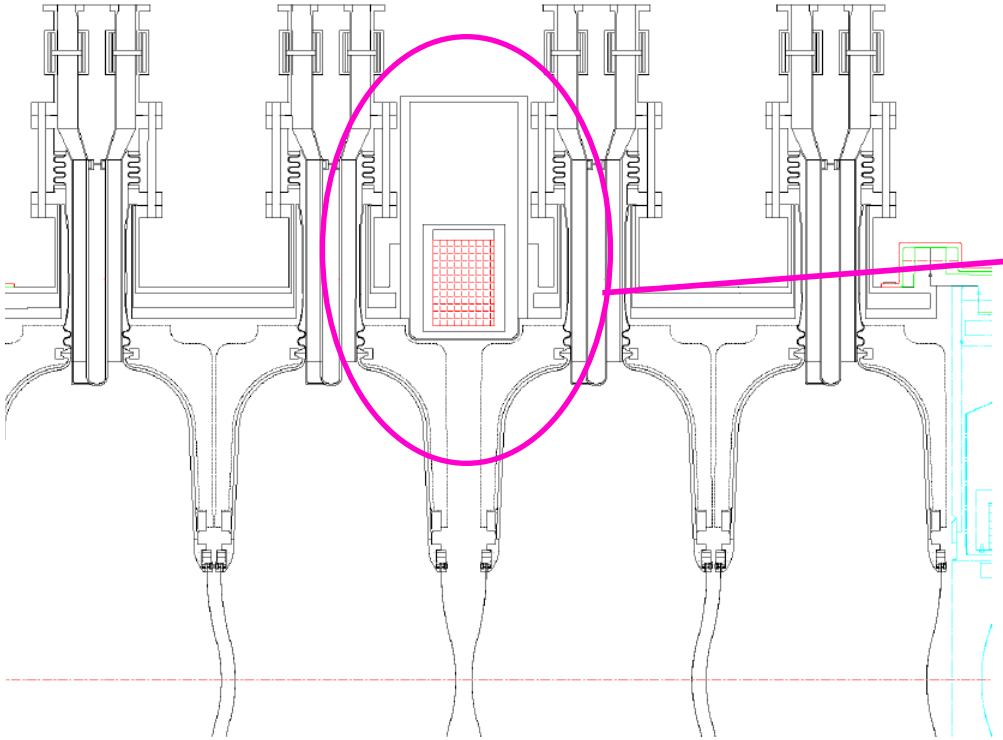
- Concept presented:
  a) Windows are mounted off RT interface – see thermal model later
  b) Space for change in pipe dimension close to magnet
  c) Large "bucket" at base to contain any rupture

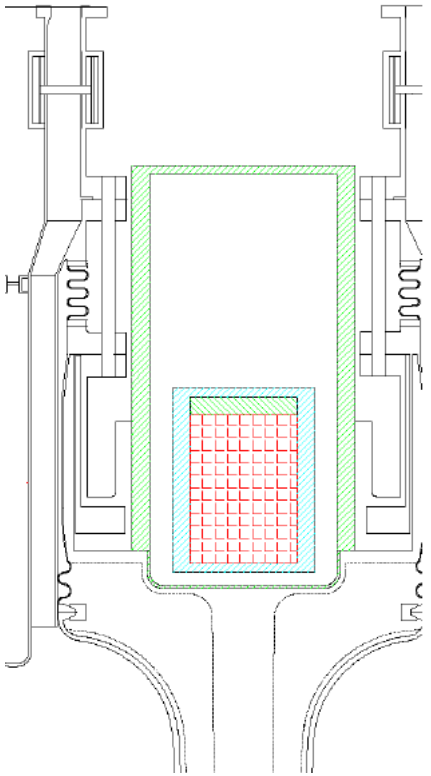


- Work is ongoing…

RF Cavities

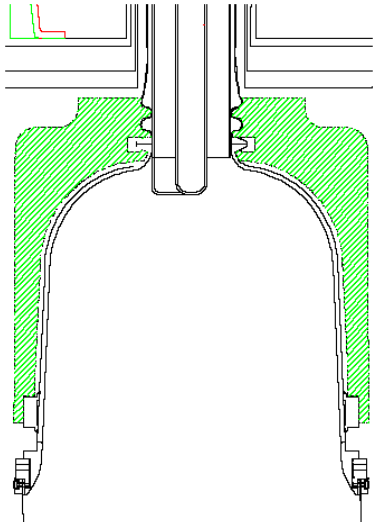
- Detailed design proceeding apace @ LBL (Steve Virostek et al.):



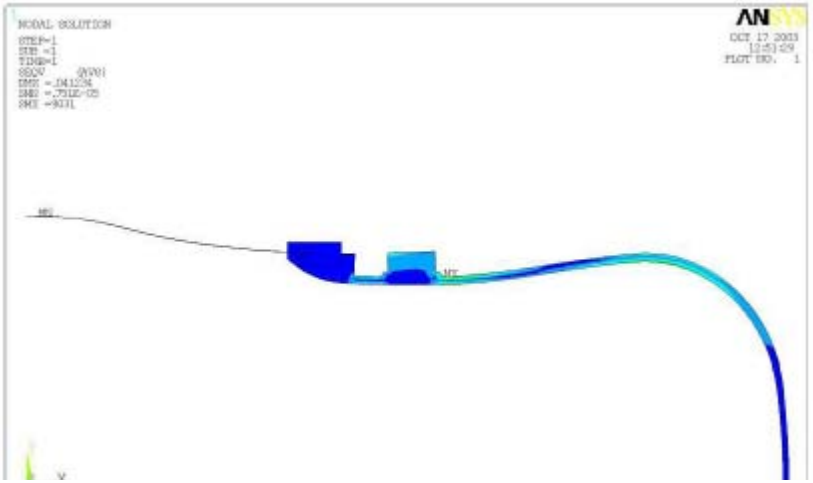


Revised coil design much narrower than previously

allows normal coupler geometry and increases interior clearance for tuners



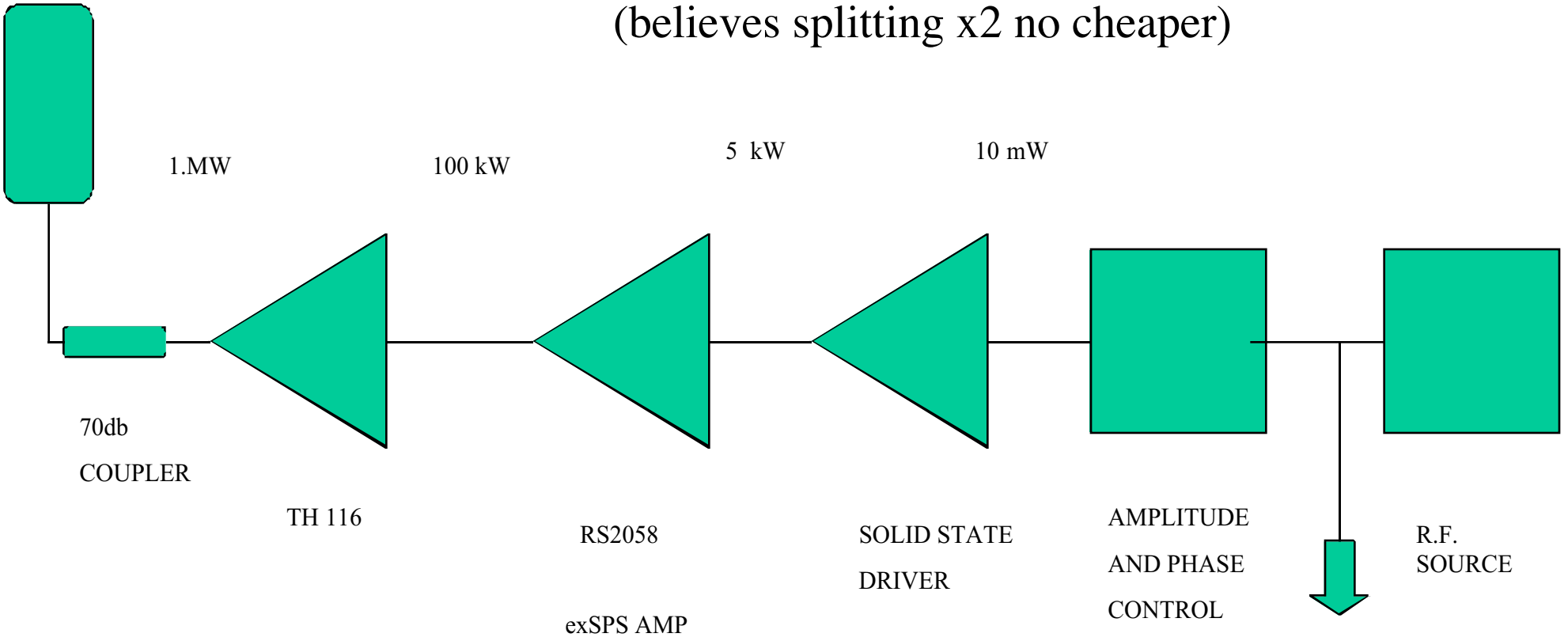
Tuner design verified by FEA



- Prototype now in fabrication

RF Power

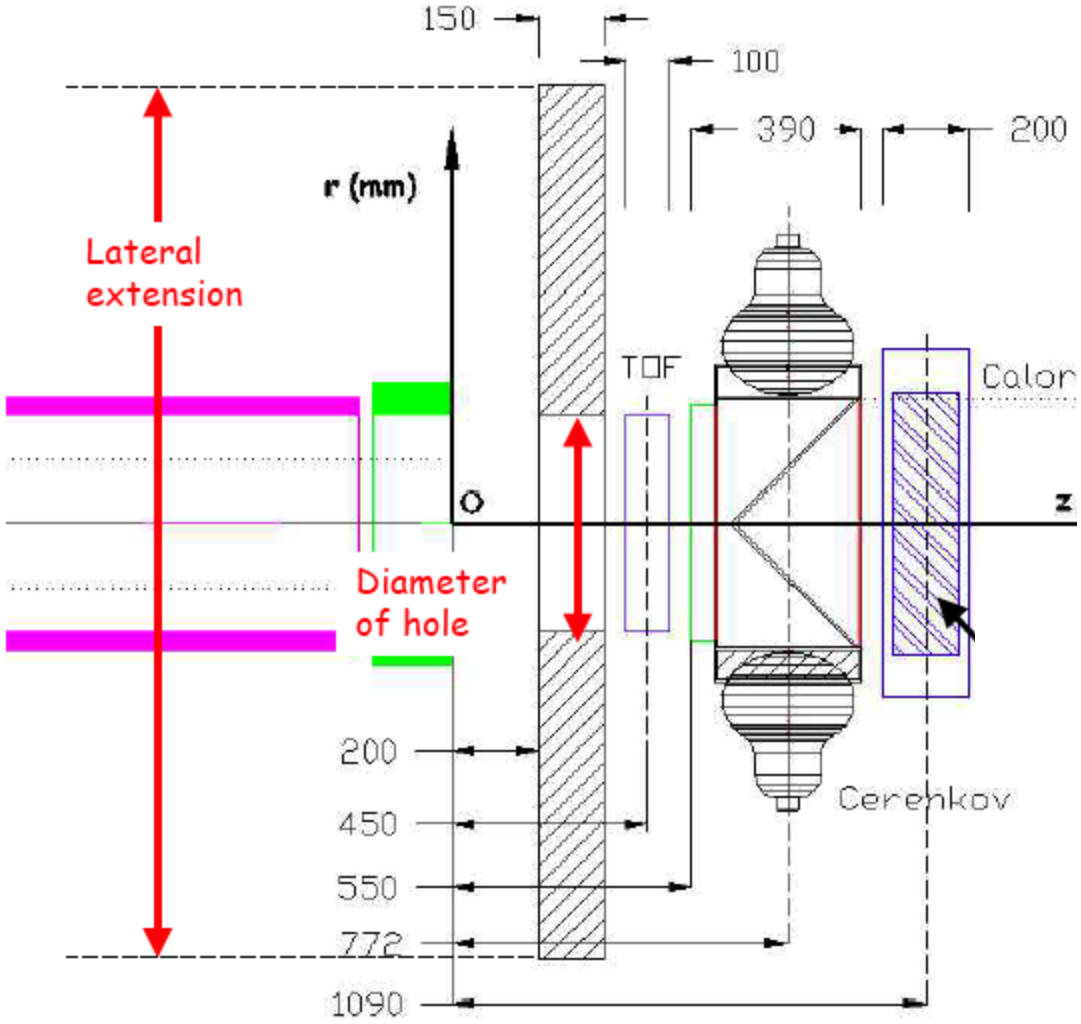
- Roy Church (RAL) proposes separate drive for each cavity:
  (believes splitting x2 no cheaper)

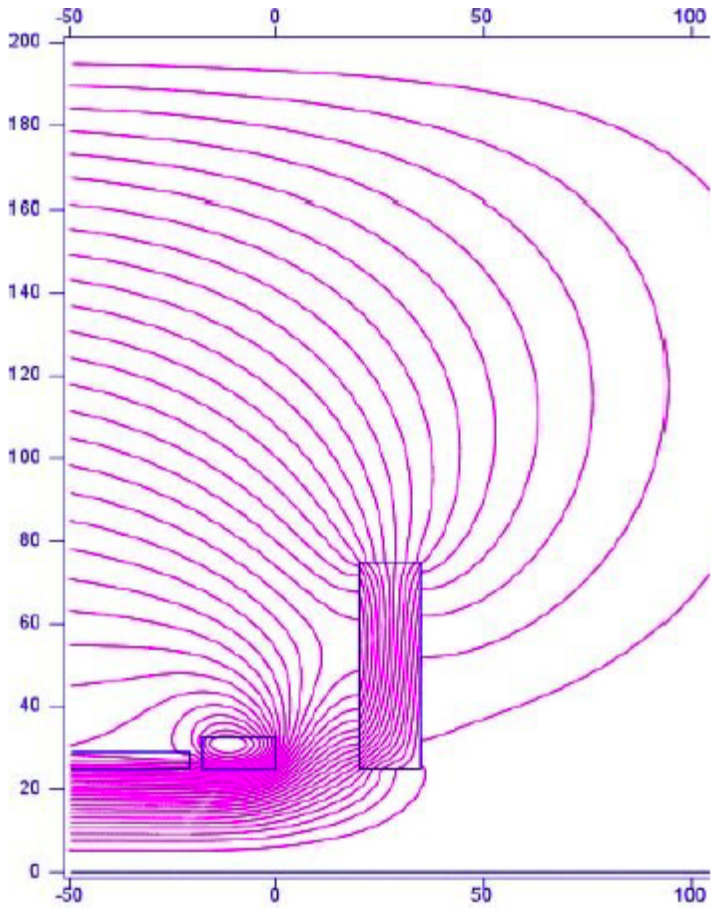


- Requires 8 ≥1-MW tubes and circuits
  - ∃ surplus TH116s from ISIS (taken out of service when fall to ≈2 MW)
  - 2 high-power RF circuits and 3 driver amplifiers to be supplied by LBNL
    - will go 1st to Daresbury Lab for refurb & testing
  - negotiations ongoing at CERN to refurbish a 4MW power source plus 1 add'l ckt
  - would need to buy 4 new tubes & ckts for 2nd set of cavities

Particle ID

- Need to ensure that detected particle starts as a muon & remains a muon
  - proposed to use combination of TOF, Cherenkov counters, & EM calorimeter:





Hole diameter = 50 cm diameter

Shield radius = 75 cm

- Working through details of needed apertures, magnetic shielding, etc.
  (G. Gregoire@Louvain / M. Bonesini@INFN Milano / L. Tortora, A. Tonazzo@Roma III / L. Cremaldi, D. Summers@UMiss)

Integration & Re-Baselining

- Evolution of each subsystem design can impact other subsystems
- Example:
  - RF-cavity conditioning produces high flux of x rays & dark current
  - requires protection of SciFi to minimize aging
    ⇒ need Pb "gate valves" surrounding cooling section
  - these widen gap between matching and focus coils & change required *B* fields

  ⇒ need iterative design process
- Each iteration is significant work for many people

  ⇒ need "change control" to keep process manageable
  - procedure specified by P. Drumm in MICE Note 51:
    - formal change requests, approved by relevant members of Technical Board
- Subsystem designs have been evolving since 1/03 RAL Proposal baseline
  - Goal: iterate towards new baseline by March MICE mtg @ CERN
  - requires intensive work between now & then

Preparations at RAL

- MICE Hall has been cleared in preparation for beamline installation:

Before

After

- Next step (~ spring '04): cut hole in shield wall between ISIS and hall

Funding

- UK has a £ figure from OST/PPARC: £10M over duration of project (≈50% of request)
- Swiss groups expect funding at ≈50% of request (≈1M€/5 yrs)
- Japanese groups expect funding at ≈1M$ over duration of project
- US-MICE request to NSF/DOE for $24M under review - hope for word later this spring
- Small contributions expected from Belgium, France, Netherlands
- CERN, PSI promise in-kind contributions of RF P/S parts, π-decay solenoid
- We hope (add'l) contributions from CERN & INFN can be negotiated
- Role of Agency Committee to refine/rationalize world's contributions – expect iterative process over next ≈ 6 months to 1 year

→ Clearly, would be highly beneficial to bring in new collaborators, especially ones with money! (work in progress...any ideas???)

Outlook

- Technical designs proceeding apace via subsystem-design working groups, coordinated by biweekly phone mtgs of Technical Board
- Parallel “Integration mtgs” also scheduled biweekly
- Project Manager refining MICE WBS and cost estimate
- Members of Executive Board contacting potential new collaborators
- Everyone can help get the word out by including MICE in their seminars