

The Status of the Construction of MICE Step IV

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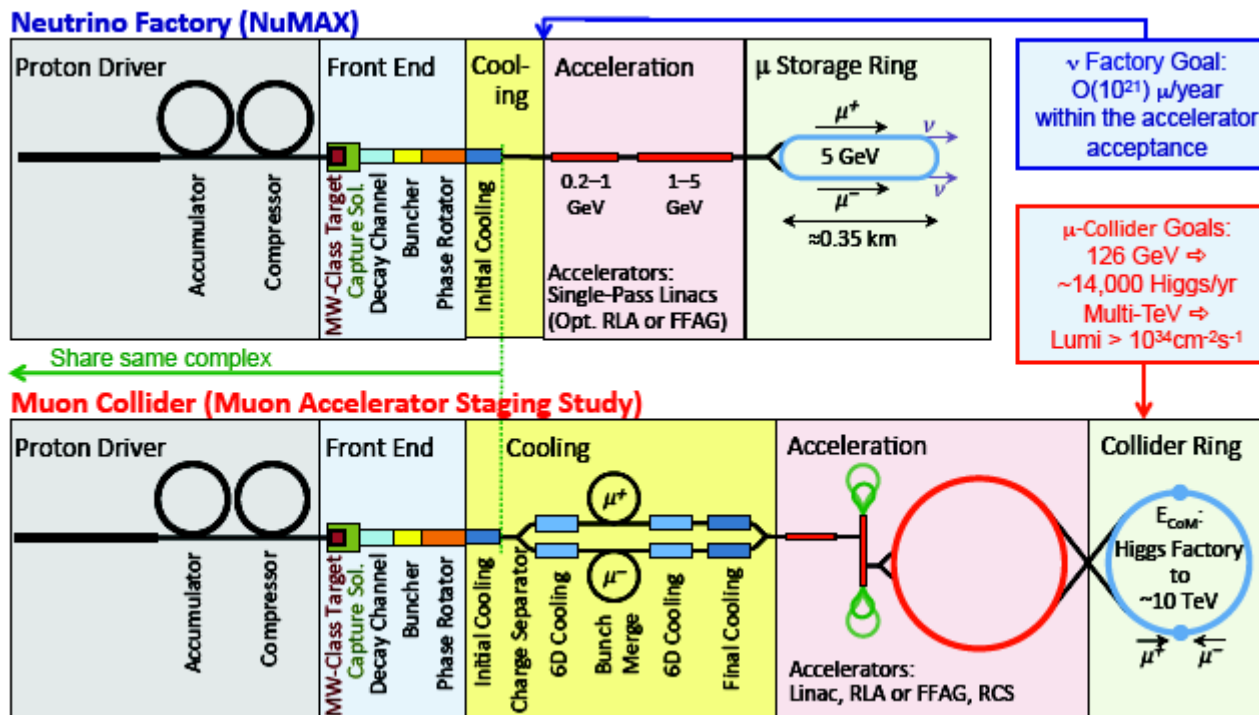
Outline

- Ionization Cooling and MICE
- Stages of MICE
- Status of Step IV Components
- Summary

Ionization Cooling and MICE

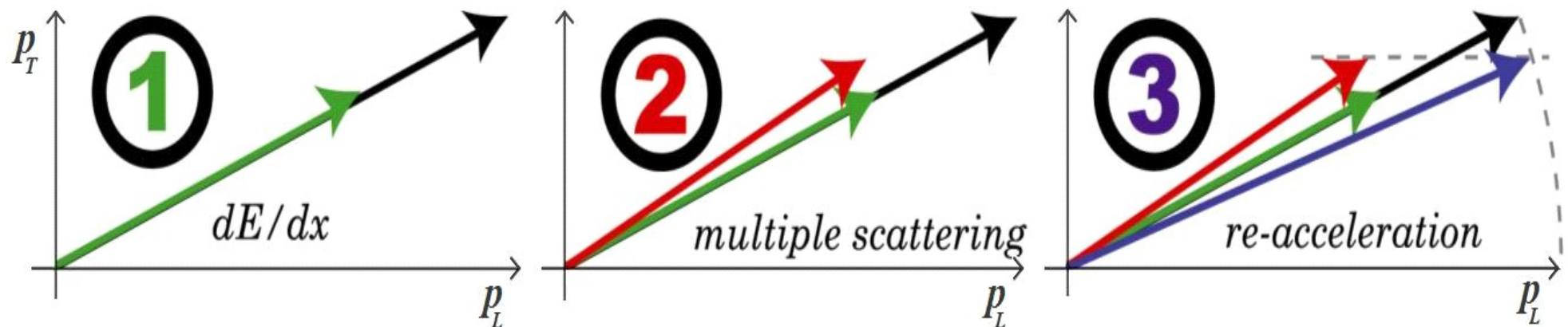
Emittance - Area in phase space the particles occupy.
Cooling - Reduction of normalised emittance.

- Cooled muon beams are required by both a Neutrino Factory and Muon Collider.



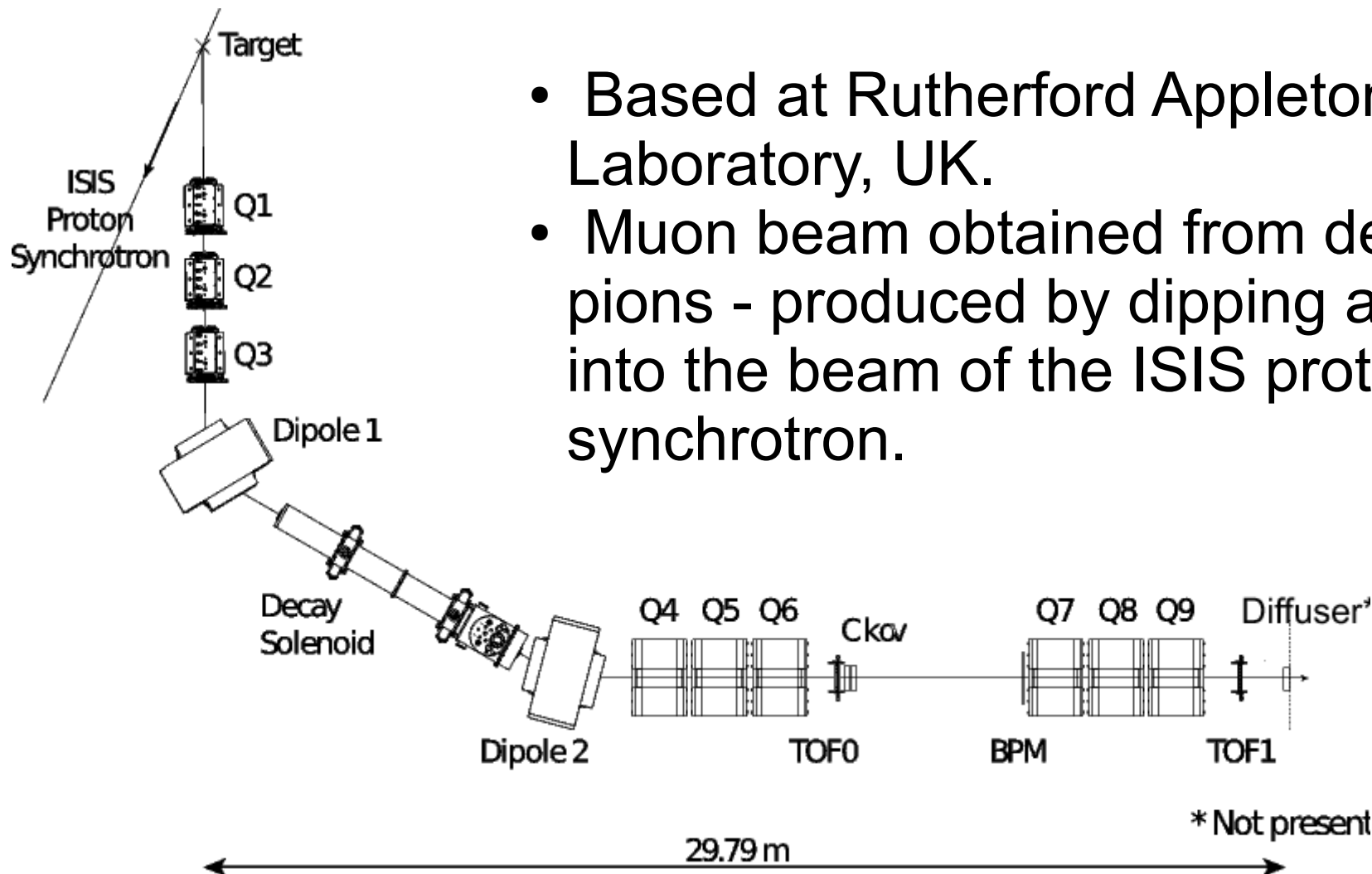
Ionization Cooling and MICE

- Existing cooling methods too slow given the short muon lifetime.
- Ionization cooling is proposed:
 - 1) Energy loss (cooling) in absorber,
 - 2) Multiple scattering (heating) occurs; absorber material must be chosen to optimise cooling vs heating, for which low Z materials, i.e. H, He, Li, Be etc., are best,
 - 3) Acceleration in RF cavities restores longitudinal momentum.



Ionization Cooling and MICE

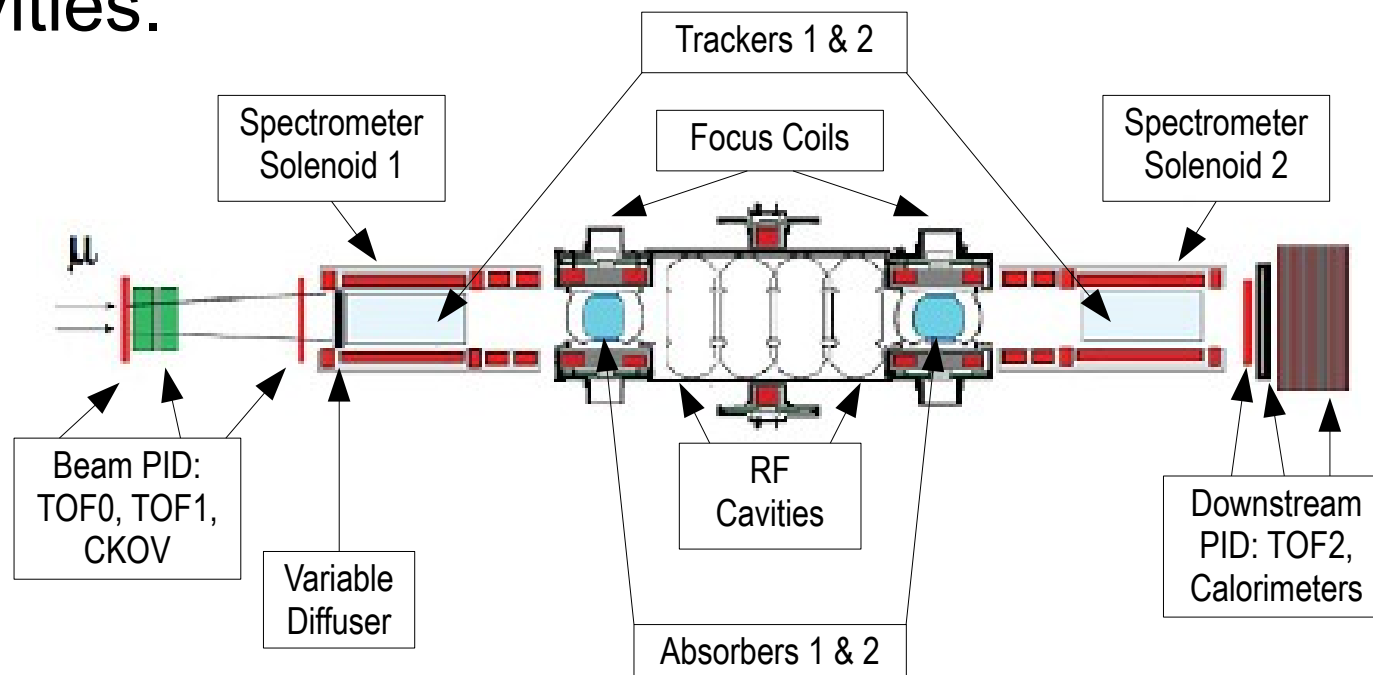
- The Muon Ionization Cooling Experiment will demonstrate ionization cooling as a method of reducing emittance.



- Based at Rutherford Appleton Laboratory, UK.
- Muon beam obtained from decaying pions - produced by dipping a target into the beam of the ISIS proton synchrotron.

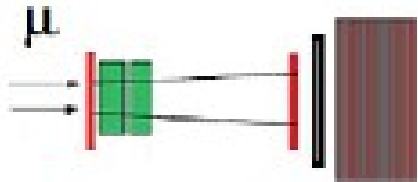
Ionization Cooling and MICE

- Particles pass through absorbers and lose energy.
- RF cavities replace longitudinal momentum.
- Tracking spectrometers upstream and downstream of cooling channel perform emittance measurement.
- PID detectors used to achieve 99.9% μ purity.
- TOF detectors also time muons with respect to phase of RF in the cavities.



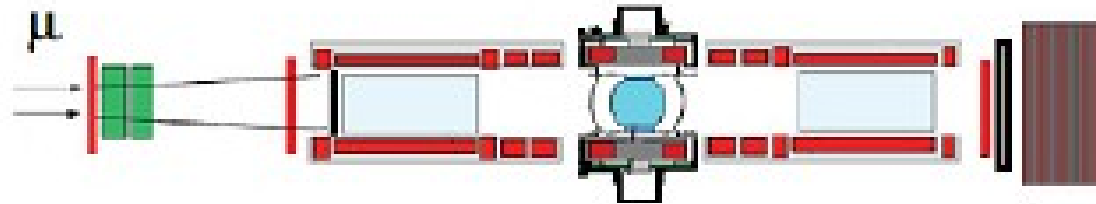
Step V design

Stages of MICE



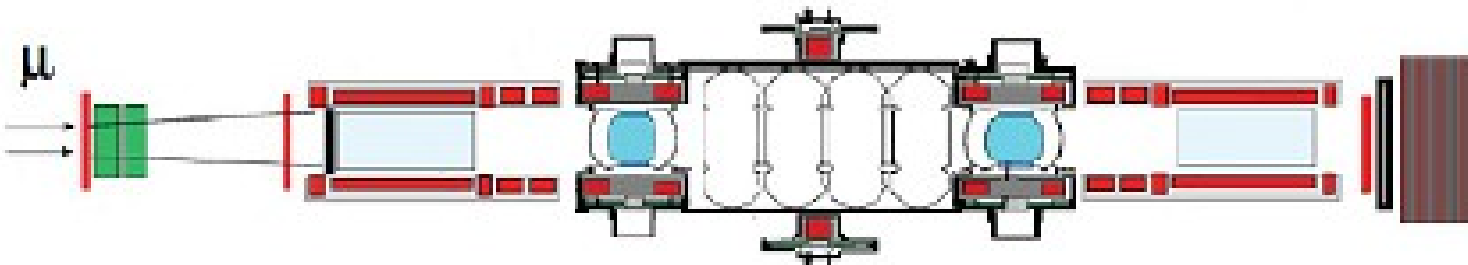
Step I

Beamline commissioning, complete.
Beamline understood, published.
Small pion contamination.



Step IV

Tracking spectrometers and
single Absorber Focus Coil.



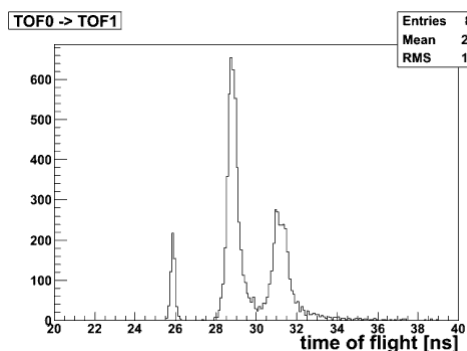
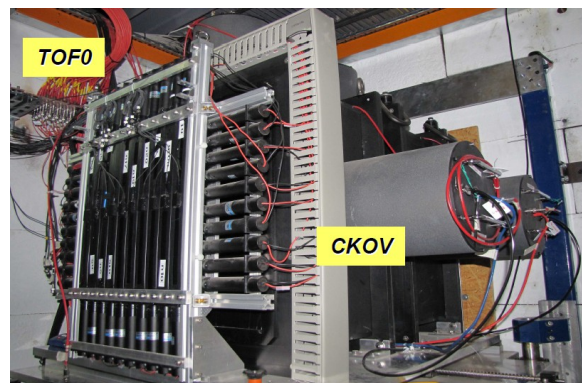
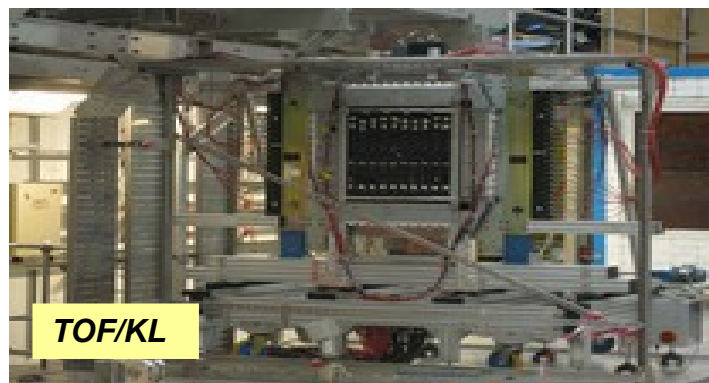
Step V

2 AFC modules and one RF module – demonstration of sustainable cooling. See Pierrick Hanlet's talk for more details.

Status of Step IV Components

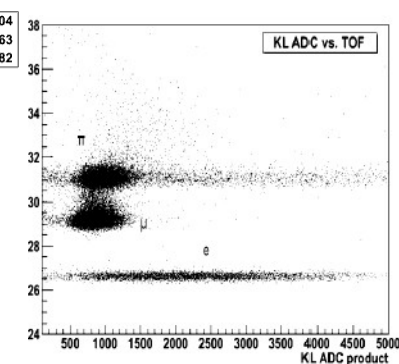
PID – TOFs, Cherenkovs, KL and EMR

KL (KLOE Light) and EMR (Electron Muon Ranger) calorimeters separate muons from decay electrons and pions.

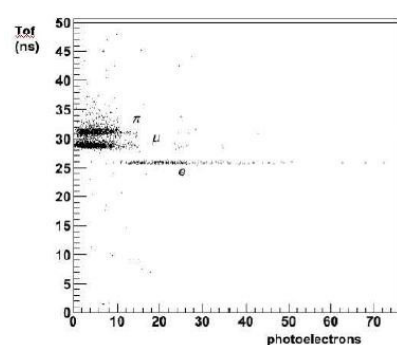


TOF Performance

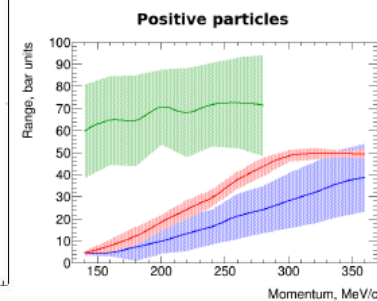
Above plots taken from talk by P.Soler, ICHEP12, Melbourne, 7 July 2012.



Performance KL vs TOF

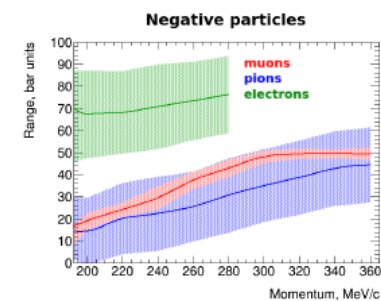


Preliminary CKOV performance



Preliminary EMR performance

Above plots taken from talk by R.Asfandiyarov, MICE CM39, 27 June 2014.

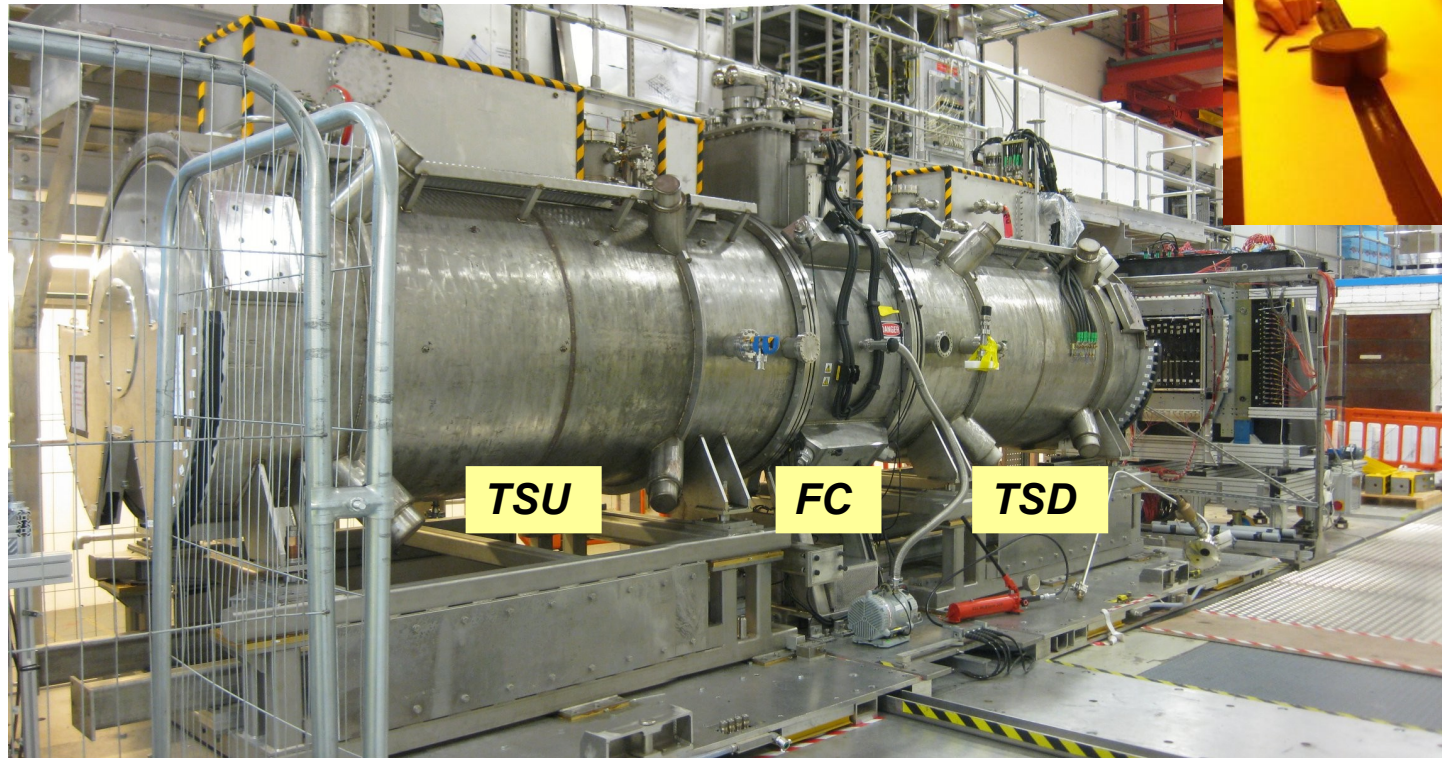
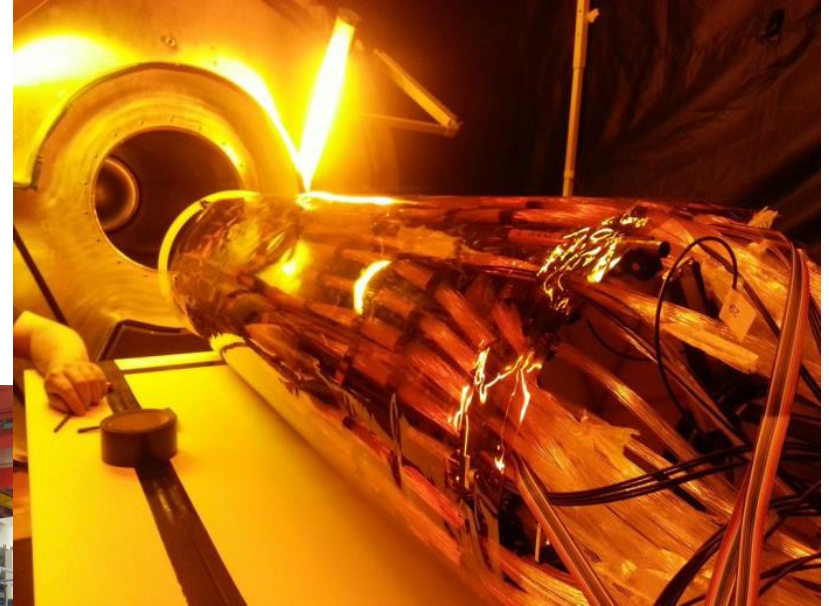


All detectors installed in MICE hall. Data taken with all detectors Oct 2013.

Status of Step IV Components

Tracking Spectrometers and Spectrometer Solenoids

Spectrometer Solenoids have been mapped. Both upstream and downstream Sci Fi trackers fitted into solenoids, and installed into MICE hall.



Status of Step IV Components



Focus Coil

- A single focus coil module consists of two coils that can operate in “solenoid” (same polarity) or “flip” (opposite polarity) mode.
- With absorber inserted into focus coil module have one AFC module.
- FC1 and FC2 both manufactured, but only one required for Step IV.
- FC1 trained and mapped and installed in MICE hall.
- FC2 currently being trained.

Status of Step IV Components

Absorbers

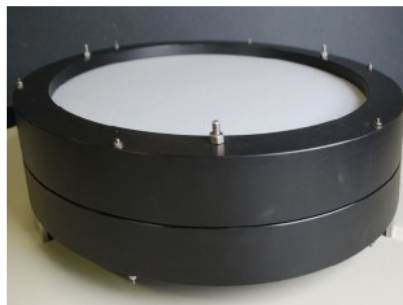
LH₂ Absorber

- Aluminium containers hold 21 litres of liquid hydrogen.
- Absorber bodies designed and supplied by KEK.
- Ultra thin (160 micron) aluminium windows designed and made by Oxford/U Miss.
- LH2 system designed and commissioned.



LiH Absorber

Disk absorbers made in USA and awaiting delivery to RAL.

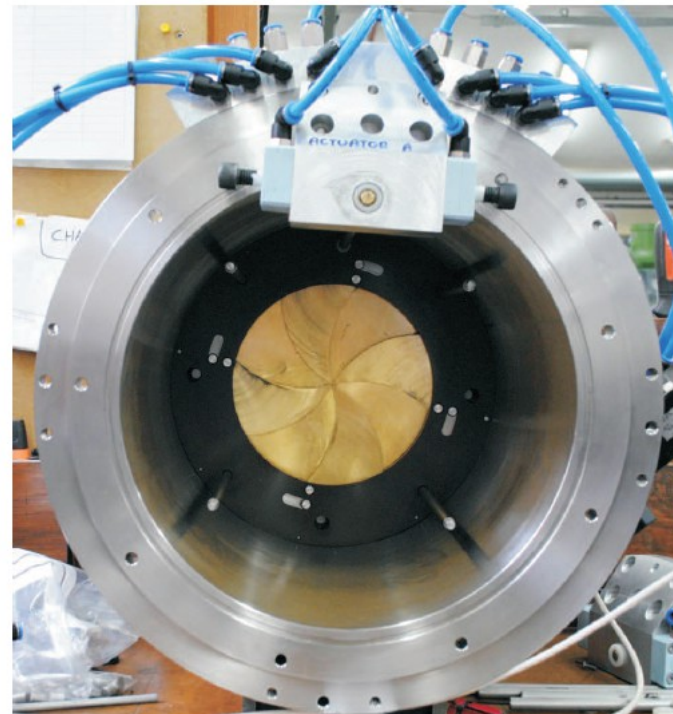
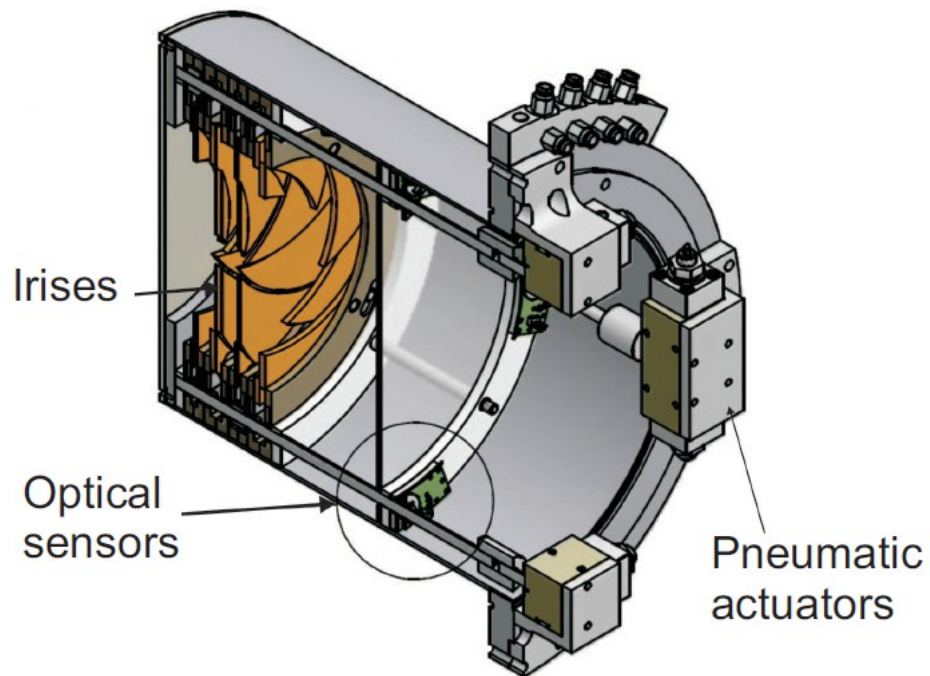


Status of Step IV Components

Diffuser

Four irises of brass and tungsten, with different thicknesses, can introduce up to $3X_0$ of material into beam (in 15 steps), enlarging the emittance.

Ready for installation in upstream spectrometer solenoid.



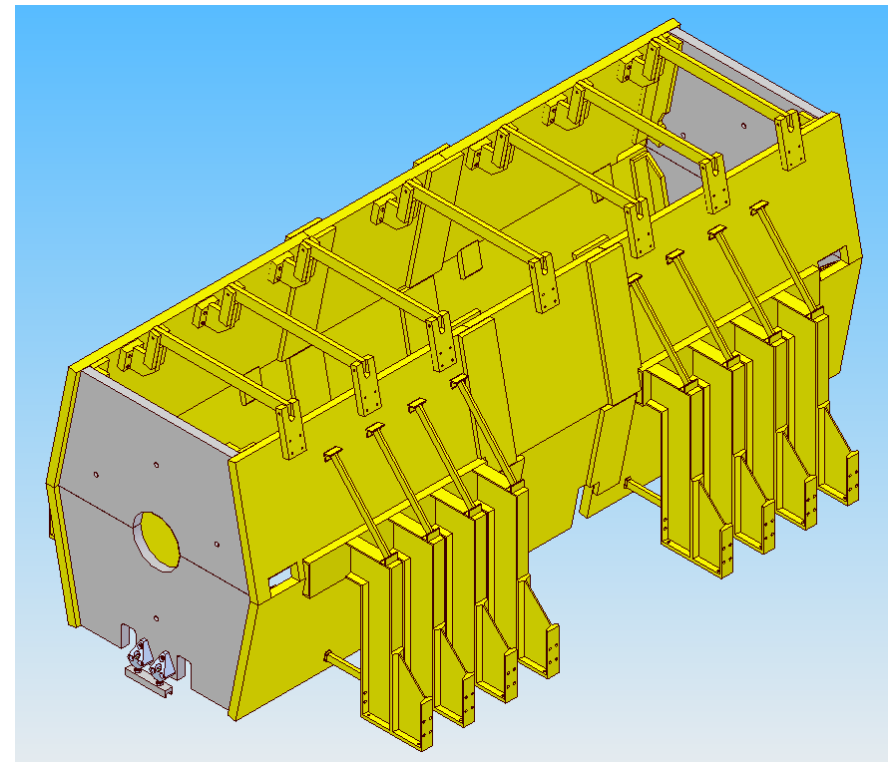
Status of Step IV Components

Partial Return Yoke

MICE magnets built without yokes- the PRY mitigates the effects of the external magnetic field, reducing 3-4T on axis to a safe level of <1mT outside the PRY.

- PRY ~55t of iron.
- Manufacturing drawings complete.
- Order has been placed for US parts.
- UK deliverables significantly complete.

Installation due to be completed
29/04/15



Status of Step IV Components

	SS#2 Mechanically installed in MICE Hall	AFC installed in R9 ready for field mapping	Downstream Solenoid arrives at RAL	SS#1 Mechanically installed in MICE Hall	AFC#1 ready for installation in MICE Hall	West Mezz build Complete - milestone	South side yoke material delivered	Rack Room 2 BPG work Complete	South side return yoke installation complete	Compressor services Complete	North side yoke material delivered	Compressors ready for Cooling channels tests	Rack Room Complete	North side return yoke installation complete	Combined magnet operational tests complete	MICE step IV installation complete
Feb-14	24/04/14	23/05/14	08/05/14	01/10/14	18/07/14	25/03/14	15/07/14	24/06/14	03/09/14	30/06/14	15/07/14	13/10/14	13/11/14	05/11/14	18/02/15	25/02/15
Mar-14	24/04/14	23/05/14	08/05/14	01/10/14	18/07/14	19/03/14	15/07/14	24/06/14	03/09/14	30/06/14	15/07/14	13/10/14	13/11/14	05/11/14	18/02/15	25/02/15
Apr-14	07/05/14	30/05/14	16/05/14	21/11/14	14/08/14		11/08/14	09/07/14	12/11/14	20/08/14	15/12/14	19/01/15	02/02/15	23/02/15	13/05/15	04/03/15
May-14	09/05/14	23/05/14	30/04/14	21/11/14	14/08/14		11/08/14	12/05/14	12/11/14	20/08/14	15/12/14	19/01/15	02/02/15	23/02/15	13/05/15	04/03/15
Jun-14				01/08/14	13/06/14		15/12/14		16/01/15	20/08/14	16/01/15	19/01/15	02/02/15	18/03/15	22/06/15	13/04/15
Jul-14				01/08/14			15/12/14		16/01/15	20/08/14	16/01/15	19/01/15	02/02/15	18/03/15	22/06/15	13/04/15
Aug-14				30/07/14			26/11/14		12/02/15	20/08/14	02/03/15	19/01/15	02/02/15	29/04/15	03/08/15	25/05/15
Sep-14																
Oct-14																
Nov-14																
Dec-14																
Jan-15																
Feb-15																
Mar-15																
Apr-15																
May-15																
Reduction	Date	No Change	Date	1-2 weeks	Date	2-4 Weeks	Date	1-2 months	Date	2+ months	Date	Complete	Date			

Summary

- Most components of Step IV already manufactured.
- Many components installed in MICE hall.
- Others ready to deliver and install.
- Work on PRY underway.

MICE Step IV installation due to be completed

25/05/15

