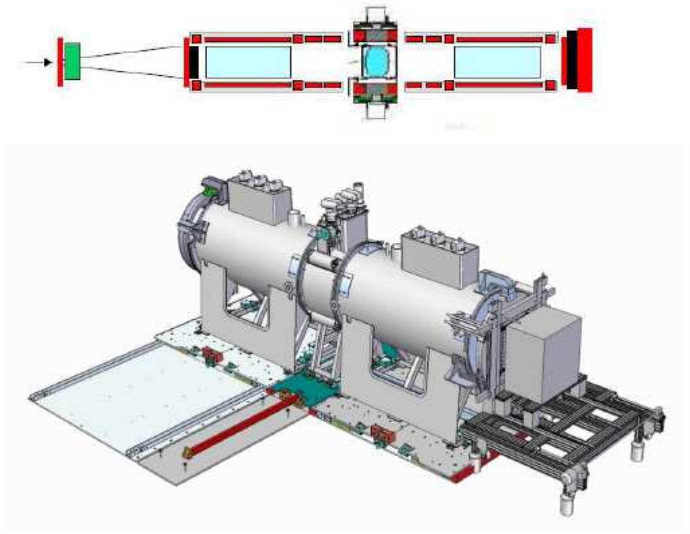
STEP IV Schedule



Subsystem	Date
Spectrometer solenoid #1 + #2	June'12
Fibre tracker #1 + #2	Ready
Focus coil #1	Sept'11
LH_2 system A	Dec '11
Solid absorber(s)	June '12
Liquid absorber	Ready
Diffuser	June'11
Virostek plate	Feb. '12
Substation upgrade	Ready
EMR installation	Dec'11
Radiation shutter	June '12
AFC Moving platform #1	Nov'11

Step IV ready...Q3, 2012

Figure 2 to be changed MICE Step IV top level schedule (17 June 2011). Color code of individual items : in red the key schedule drivers. In orange the high risk items. In green, the items that are considered complete.

Step IV run plan (Pavel and Ulisse)

First test in Step IV configuration is to check that the magnets perform as expected and have the correct field on. The way to do this is with a dedicated magnet alignment run that should be complete in two weeks. This can be done with an empty channel, prior to installing liquid hydrogen assembly.

- Ramp each coil individually to several different current settings. Track particles through. Compare with Monte Carlo predictions:
  - Look for effect on beam centre indicating a misalignment or dipole component to the field.
  - Look for asymmetry in x/y focusing indicating a quadrupole component to the field.
  - Look for incorrect focusing (too much/too little) indicating power supply problem or iron effects.
  - Check polarity using beam rotation angle.
  - Ramp from below and from above; check that we get the same resultant beam (hysteresis effects).

12 coils, 3 different currents on each coil, approximately two hours to set up and run each setting => 72 hours or 7 days of running.

- Ramp each module and repeat:
    - o Checks for forces between coils causing problems or iron saturation effects.

3 modules, 3 different currents on each coil, approximately two hours to set up and run each setting => 2 days of running.

- Ramp the whole system.

The second job is to check that we understand the lattice properly (momentum acceptance, aperture, etc.) That means looking at transverse amplitude and momentum response with empty channel for the baseline emittance of 6 mm rad and reference momentum of 200 MeV/c setting on the magnets and big emittance beam. Another test is to scan the beam momentum while keeping the MICE cooling channel nominal momentum fixed to study the response of particles with different momenta to that channel.

Repeat test for the beta function different from the nominal 42 cm at the symmetry plane. Of special interest is the 7 cm beta function setting where the momentum acceptance is particularly narrow as illustrated in Figure 3.

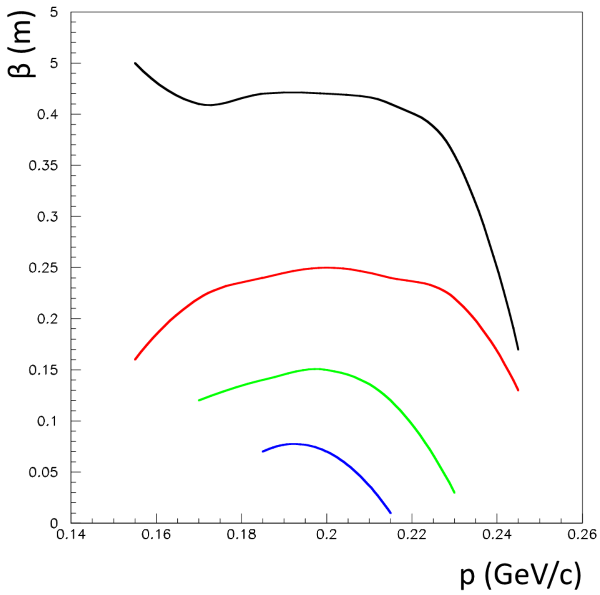


Figure 3. Momentum acceptance of MICE Step IV for various values of beta function at the symmetry plane. Becomes narrower for smaller values of beta.

After the tests described above we can move on to collecting data and comparing it to the simulation results for various settings with no material in the channel:

- reference momenta of 240, 200, and 140 MeV/c;
- β at the symmetry plane of 42, 25,15, and 7 cm;

- emittance of 10, 6, and 3 mm rad;
- magnetic field flip at the symmetry plane vs. no flip. Non-flip configurations are used for smaller values of β and larger momenta to circumvent possible coil current limitations.

The suggested list of settings to study is summarized in Table 1, column "empty channel". Estimates for time required to perform certain operations are summarized in Table 2. Note that these estimates are guesses, and as such have large error bars.

Table 1. Step IV configuration with different absorbers, cooling channel and beam line settings.

Parameters				Step IV Configurations						
Field flip	Beta [cm]	Momentum [MeV/c]	Emittance [mm rad]	Empty channel	Liquid Hydrogen	LiH disk	Al disk	PE disk	LiH 90° wedge	LiH 45° wedge
Yes	42	240	10		+	+	+		+	+
Yes	42	240	6	+	+	+	+	+	+	+
Yes	42	240	3		+	+		+	+	+
Yes	42	200	10	+	+	+	+		+	+
Yes	42	200	6	+	+	+	+	+	+	+
Yes	42	200	3	+	+	+		+	+	+
Yes	42	140	10		+	+	+		+	+
Yes	42	140	6	+	+	+	+	+	+	+
Yes	42	140	3		+	+		+	+	+
Yes	25	240	10		+	+			+	+
Yes	25	240	6	+	+	+			+	+
Yes	25	240	3		+	+			+	+
Yes	25	200	10		+	+	+	+	+	+
Yes	25	200	6	+	+	+	+	+	+	+
Yes	25	200	3		+	+	+	+	+	+
Yes	25	140	10		+	+			+	+
Yes	25	140	6	+	+	+			+	+
Yes	25	140	3		+	+			+	+
Yes	15	140	10		+	+			+	+
Yes	15	140	6	+	+	+			+	+
Yes	15	140	3		+	+			+	+
Yes	7	140	10		+	+			+	+
Yes	7	140	6	+	+	+			+	+
Yes	7	140	3		+	+			+	+
No	15	240	10		+	+				
No	15	240	6	+	+	+				
No	15	240	3		+	+				
No	15	200	10		+	+				
No	15	200	6	+	+	+				
No	15	200	3		+	+				
No	7	240	10		+	+				
No	7	240	6	+	+	+				
No	7	240	3		+	+				
No	7	200	10		+	+				
No	7	200	6	+	+	+				
No	7	200	3		+	+				
				14	36	36	9	9	24	24
									Total:	152

Table 2. Estimates for time required to perform certain operations.

Change flip/non-flip magnet configuration (run down magnets, swap cables, check, run up)	~1 day
Change momentum and beta function of the cooling channel (retune focusing coils, matching coils, possibly spectrometer solenoids)	~0.5 day
Change beam momentum and emittance (magnet retuning, change diffuser setting)	~1 hr
Collect 100k of useful muons	~2 hrs
Replace one absorber with another	~8 days
All empty channel configurations (14)	~10 days
All liquid Hydrogen absorber (or LiH flat absorber) configurations (36)	~18 days
Additional flat absorber materials (Al, PE) (9+9+absorber change)	~16 days
All 90° (or 45°) wedge absorber configurations (24)	~12 days

Thus, calibration tests with the empty channel will take two to three weeks, and reference data taking will take another 10 days. Overall, MICE Step IV with no material in the cooling channel will require a dedicated ISIS run (if there are no delays with hardware that could be Feb 2013).

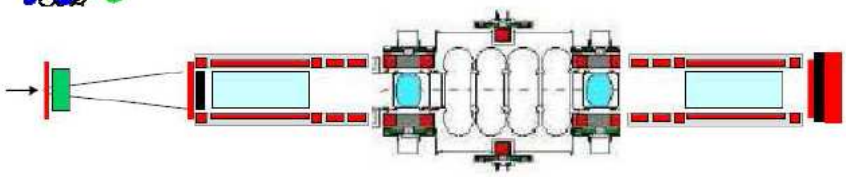
Liquid Hydrogen absorber will most likely be the first demonstration of muon cooling in MICE (there is still some flexibility in whether liquid Hydrogen or LiH disk is studied first). Liquid Hydrogen absorber is one of the two baseline configurations; hence, it would be useful to study a variety of the cooling channel and the beam line parameters (3 emittances, 3 momenta, 4 values of β and 1 change of flip/non-flip setting). Assuming 18 days for data taking and along with installation and testing with the empty absorber that will make another dedicated ISIS run (May 2013).

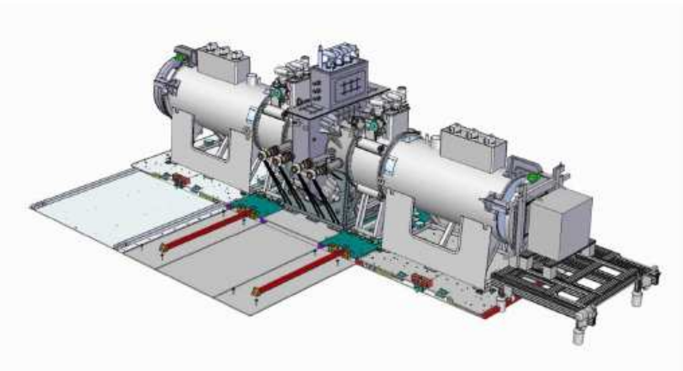
Taking data with LiH flat absorber is estimated at 18 days, the fact that the change of absorber takes approximately 8 days leaves about 4 days during the run to start collecting data with one of the extra materials (Al or PE). This can be continued during the next ISIS run, along with the study of the remaining material, installation and initial testing of the 90° LiH wedge absorber (July and October 2013).

During the next ISIS run the study of both the full 90° LiH wedge and the 45° half wedge will be complete (November 2013).

Step VI schedule (Alan Bross and Andy Nichols)

STEP V (aspirational)





Subsystem	Date
Step IV data-taking complete	Q1 2013
Absorber Focus Coil #2	Q4 2011
LH2 system B	Q1 2013
RF Amplifiers	Q3 2013
RF Infrastructure	Q3 2013
Successful test of first CC coil	Q4 2011
RFCC #1	Q1 2013
AFC Moving platform #2	Q4 2012
RFCC Moving platform #1	Q4 2012
ISIS Long shutdown start	Aug 2014
ISIS Long shutdown end	Feb 2015

Step V ready... Q2, 2014

Figure 4 to be changed MICE Step V "aspirational" top level schedule (17 June 2011). Color code of individual items : in red the key schedule drivers. In orange, the high risk items. In green, the items that are considered complete.

Brief Narrative on specific parts of the project

Infrastructure and Safety (Andy Nichols)

In general, most of the infrastructure in the MICE hall is complete, in that it is now a properly equipped experimental facility. Specifically for MICE Step IV, custom steel floor plates have been delivered, which will be bolted down during the August shutdown, and the moving platforms to support the AFC will be delivered in November 2011.

Some reasonably significant modifications to the South mezzanine will be required to accommodate both the EMR (Electron-Muon Ranger) and the RFCC, both of which have 'grown' somewhat since the original plans were made. However, this problem is well understood technically and will not hold up the schedule.

The general electrical work is the responsibility of the Daresbury Electrical and Controls Group, who now have a regular presence in the MICE hall. Recent activities have included network socket installation, cable trunking installation and provision of an earthing bus-bar.