

MICE magnetic measurements
Sequence of events and
MICE hall movements

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revision from 13 December 2012
revision 30 January 2013





Motivations for magnetic measurements

0. Precision In order to understand the cooling measurements (and the multiple scattering and energy loss measurements) specially in case of discrepancy between the predictions and the experimental results the magnetic field required precision is of the order of a few gauss.

1. Focus coils: magnetic measurements of focus coils are aimed at the determination of the intrinsic properties of the magnets such as alignment and symmetry of the coils, possible difference in expectations between flip and non flip mode due to different forces, etc... the magnets in R9 serve as reference in an environment which is reasonably iron-free. The measurements in the hall in situ (with the exact same sequences of points) serve to measure the field and its stray field as well as probe the understanding of magnetic masses in the hall.

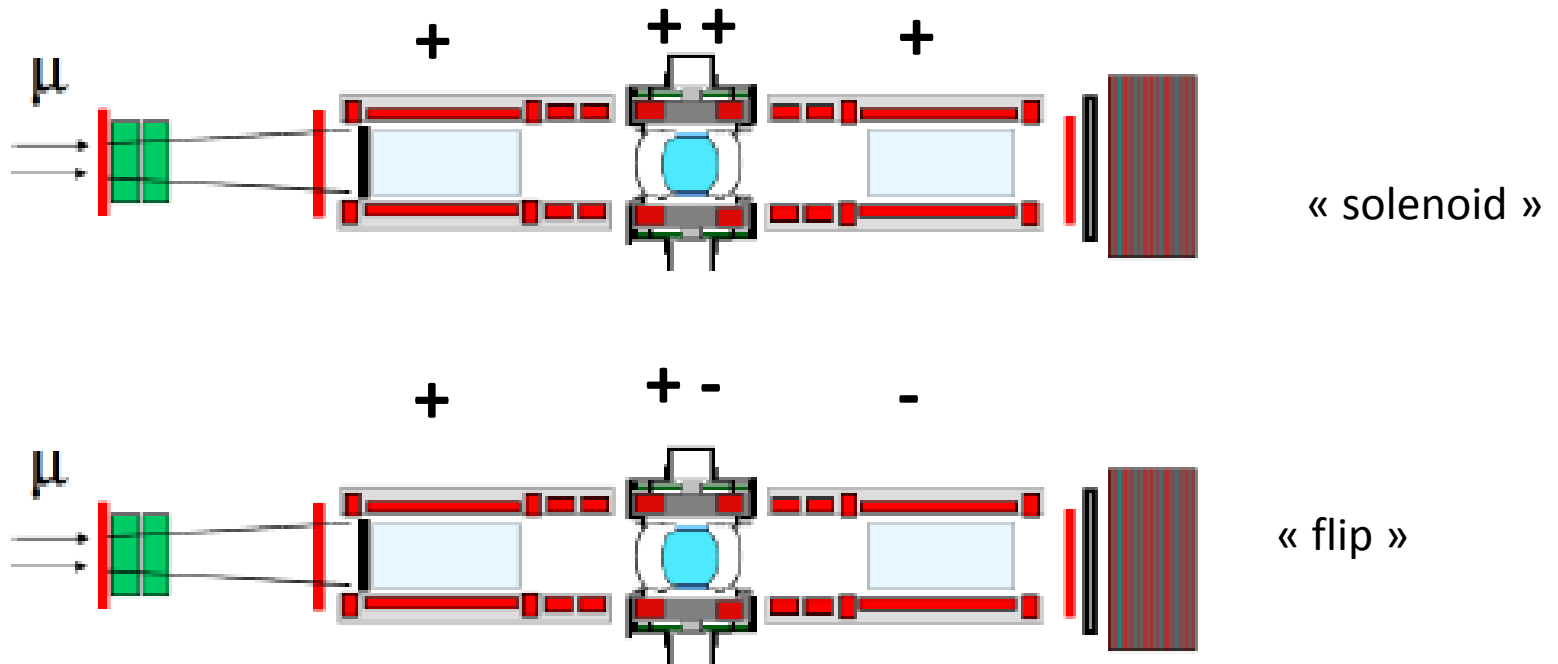
2. Spectrometer solenoids

These magnets are part both of the measurement and of the cooling channel (matching coils) The magnetic measurements serve two purposes: 1) to allow precise reconstruction of particle momentum in the tracker, and 2) as above, to allow precise understanding of the particle transport for the cooling and absorber properties measurements. It is important that the measurements take place with the magnetic environment (Virostek Plates etc...) and preferably in the MICE hall (distortions due to magnetic masses)



Polarities

We expect to run step IV with two polarities



Is there a motivation to run the - - - and - -+ + settings?

NB the other MICE focus coils will also run in -+ mode.

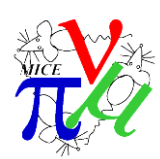
focus coil run at settings corresponding to different momenta e.g. $P= 240$ 200 and 140 (3 settings = 3×2.5 hours of measurement = 1 day)

spectrometer solenoids things are less well defined. suggestion:

1. fix the field once and for all in the 'tracker' part to the nominal 200 MeV/c setting.
2. then vary the matching coils according to e.g configurations of MICE proposal p 41
 - some work to do:
 - add solenoid mode
 - review match coils settings for 140 MeV/c settings and full field in solenoid.

Table 3.3: Current densities for different beta examples (for historical reasons the coil dimensions and currents differ slightly in these optical calculations from those given in Section 4)

	p (MeV/c)	β_L (cm)	B_{sol} (T)	Δ (%)	Focusing (A/mm ²)	Coupling (A/mm ²)	Match 1 (A/mm ²)	Match 2 (A/mm ²)	End 1 (A/mm ²)	Sol. (A/mm ²)	End 2 (A/mm ²)
1a	200	42	4	12	117.8	90	65.0	97.2	100	80.9	128.9
1b	240	42	4	11	141.3	108	74.3	103.6	97.9	80.9	128.9
2	200	25.4	4	12	139.7	79.3	66.7	74.4	104.4	80.9	128.9
3	175	16.7	3.5	14	136.2	58.9	53.1	47.8	97.2	70.8	112.8
4	150	10.5	3	13	128.7	37.5	40.9	14.0	89.7	60.7	96.7
5	140	5.7	2.8	10	137.2	0	20.8	-18.9	91.8	56.7	90.2



Practical Sequences

1. FC magnet is measured in R9 February 2013
2. FC magnet is measured in situ, i.e. in its step IV position (March 2013)
then placed in park position
3. SS1 +SS2 magnets are measured in situ, i.e. in its step IV position (fall 2013)

Constraints and limitations

-- Due to the size of the magnetic measurement device

only one magnet can be 'in situ' at one given time

new feature: it is possible to measure SS1 and SS2 in the same sequence i.e. with both in situ

-- it is expected to take a few days to install the magnetic measurement kit and

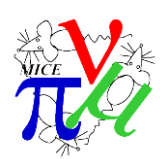
Another 'few days' to perform the measurements and dismount.

For now count three weeks for AFC (flip and non-flip modes)

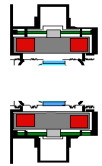
and

two or three weeks for the two solenoids (this includes a polarity flip for SS2)





1. FC magnet is measured in R9 in February 2013



Sequence 1 FC

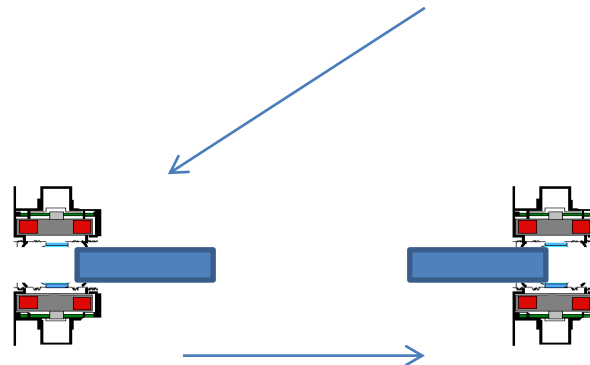
Measurement device 1 for FC

- Allow 7 days for 1-A and 1-B
- day 1 preparations
- day 2 fine setting, survey (<math><150\mu\text{m}</math>)
- 1st measurements and check
- day 3 measurements 1-A
- day 4 move to 1B and survey
- day 5 measurements
- day 6+7: reserve
- a few days for polarity change
- 5 days for 1-C and 1D
- ➔ **3 weeks**



Sequence 1 -A:
empty FC,
Flip mode +-
upstream

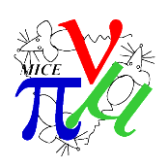
Sequence 1 -B:
empty FC,
Flip mode+-
downstream



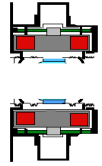
Sequence 1 -C:
empty FC,
Sol mode++
downstream

Sequence 1 -D:
empty FC,
Sol mode ++
upstream





2. FC magnet is measured in R5.2 March-April 2013

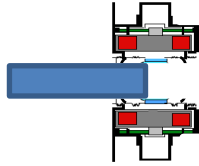


Sequence 2 FC

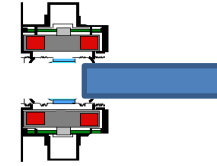


Measurement device 1 for FCs

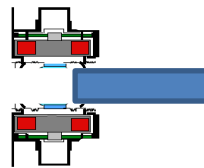
Allow 6 days for 1-A and 1-B
a few days for polarity change
5 days for 1-C and 1D
= 3 weeks



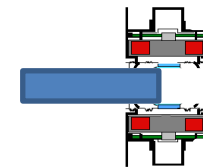
Sequence 2 -A:
empty FC,
Flip mode +-
upstream



Sequence 2 -B:
empty FC,
Flip mode+-
downstream

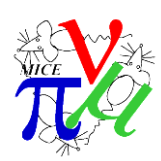


Sequence 2 -C:
empty FC,
Sol mode++
downstream

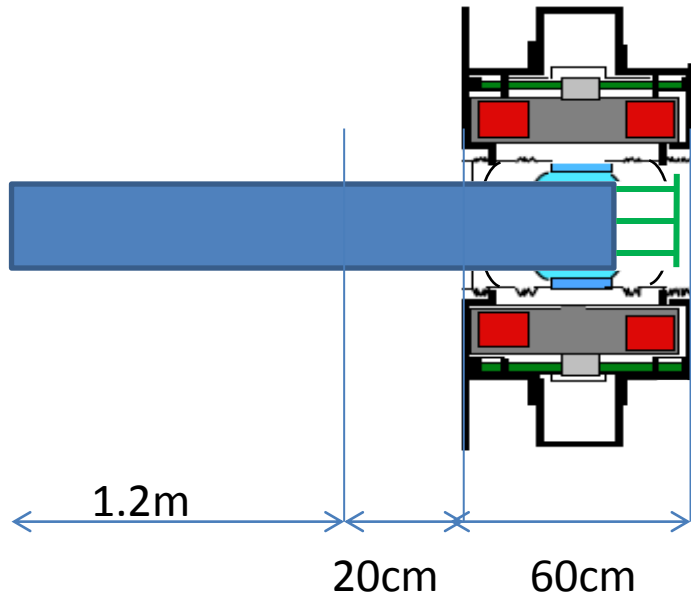


Sequence 2 -D:
empty FC,
Sol mode ++
upstream





Measuring mesh: AFC scan settings



assume 10 seconds per point

scan steps:

1. within the magnet and in near stray field regions (80cm):

16 phi steps, every 2cm in z → 640 points **time = 1.8rs**

2. in outer field region (120cm)

16 phi steps, every 5 cm in z → 384 points **time = 1.1hr**

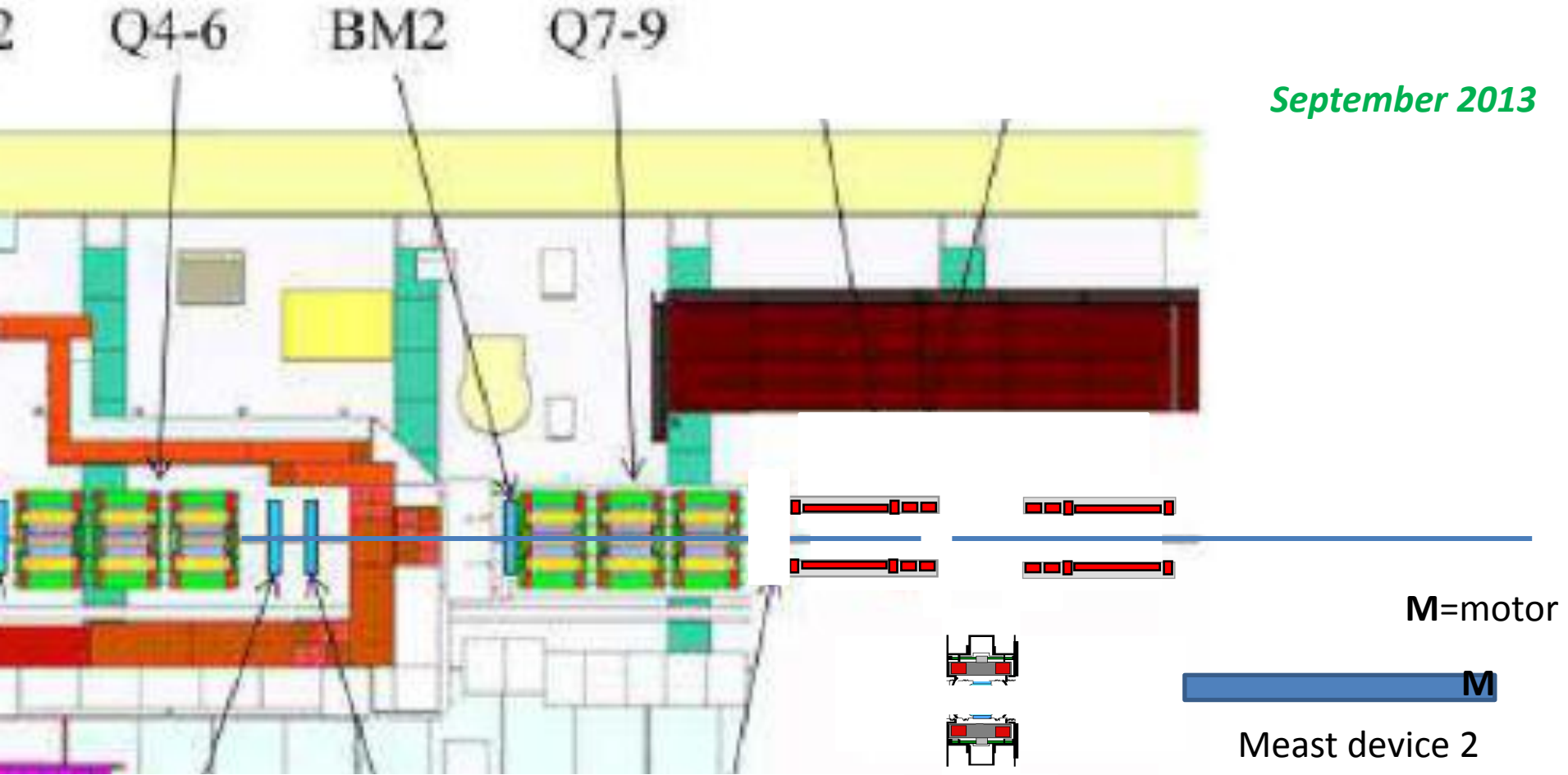
magnet settings 1/3 2/3 and full field

total measuring time = 9hrs

for simplicity in analysis all settings will be measured with the same measuring mesh



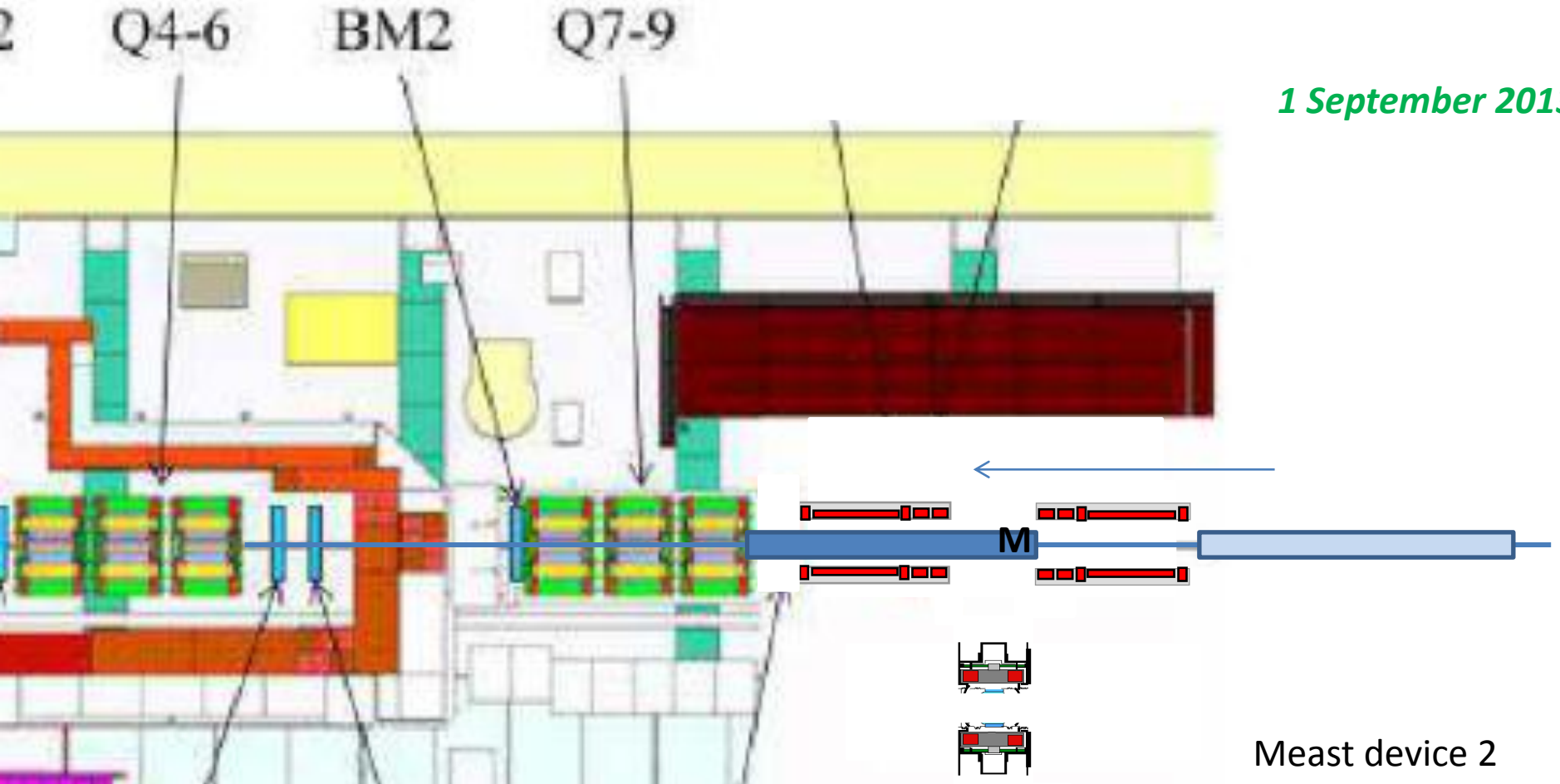
September 2013



Sequence 3 in the MICE hall : spectrometer solenoids

- AFC in park position install SS1 and SS2
- in beam position, power up
- with Virostek-plates (no TOF1/2, EMR etc..)
- pump cool and train magnets in parallel
- Alan Grant investigating this possibility

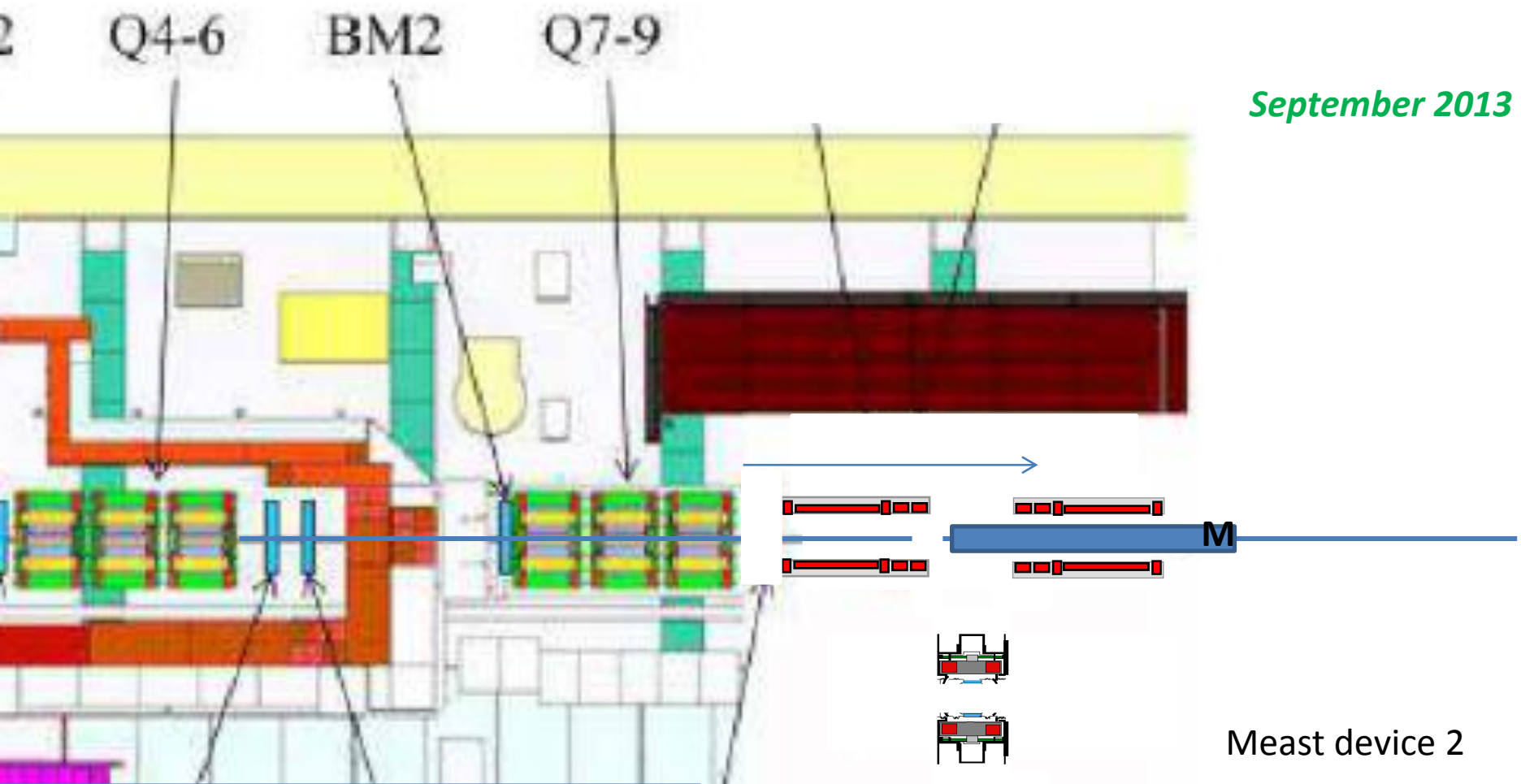
1 September 2013



w 5 days for 3-A
1 preparations
2 fine setting, survey <math><150\mu\text{m}</math>
3+4 measurements and check
5 reserve
week

Sequence 3.A
measure SS1 in polarity +

September 2013



w 5 days for 3-B
(1 fine setting, survey <150μm)
2+3 measurements 3-B
4 reserve
w days (?) for polarity change and ramp-up
n 2 days measurements 3-C
t weeks (but could well be 1 week)

Finish sequence 3-A in stray field region
Sequence 3-B
measure SS2 in polarity +
sequence 3-C
measure SS2 in polarity -