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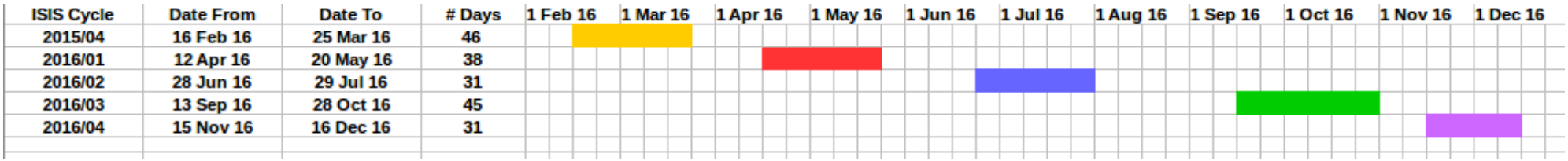
MICE Run Planning

- 2016 ISIS User Cycle Schedule
- Step IV physics program
- 2016 run plan
- Demonstration of Ionisation Cooling

2016 ISIS Run Schedule



ISIS Cycle	Date from	Date To	Length (days)
2015/04	16th Feb	25th March	46
2016/01	12th April	20th May	38
2016/02	28th June	29th July	31
2016/03	15th Sep	28th Oct	45
2016/04	15th Nov	16th Dec	31

Measurement Time Estimate

Based on October 2015 run configuration:
Decay solenoid on, SSD on, 1 V.ms beam loss setting
ISIS was running @ 700 MeV, not 800 MeV (up to a 30% drop in muon rate – not corrected for below)

Observed data rate : 31k muons per hour

Assumptions:

- Beam physics studies select 10% of this sample to generate a sample of "analyseable" muons (the fraction of muons which are selected to form a muon bunch from the full upstream sample)
- 66% duty factor (run 16 / 24 hours)
- 30% contingency

To collect a sample of 10k analysable muons would take ~ 6 hours (consistent with estimates derived from Step I analyses). This estimate embodies at least 30% contingency.

Step IV Scattering Measurements

- Scattering measurements require on the order of 1×10^5 muons per absorber per momentum point with and without SS fields
- Goal is to investigate 3 momentum points : 170 (for comparison with MUSCAT), 200 and 240 MeV/c in LiH and LH_2.
- A single scattering point will take 2 days.

Step IV Measurement Program

- A physics plan for STEP IV has been defined by the physics group

For each of three absorbers : empty, liquid hydrogen, lithium hydride and flip mode

Measurement		# Momentum settings	# Emittance Settings	# Muons / setting	Time (days)
1.	Scattering	3	1	100k	6
2.	Emittance scan	1	3	100k	6
3.	Grid scan	3	3	50k	9
4.	Reduced set	with FC in solenoid mode			7
5.	Beta studies (3 points)*	1	1	50k	3
					31

*depending on magnet configuration

2016 Data-taking

The use of different user cycles is driven by the configuration that is available

February – March : 2015/04 (46 days):

Configuration : No spectrometer solenoid fields

Calibration and alignment data

Empty and LiH absorber data. Settings to be defined by measurement co-ordinators

Run Type	Absorber	Time (days - 16 hour running)
Setup	None	2
Alignment, Physics	None	9
	LiH Install	5
Physics	LiH	12
		28 / 46 (back-loaded)

2016 Data-taking

April - May : 2016/01 (38 days) :

Configuration : SSU (ECE) + FC (+ SSD(ECE))

Magnet & channel commissioning is the priority

Beam/channel tuning

Optics verification studies

Beam-based alignment

Upstream emittance measurement

Emittance reduction measurement

Run Type	Absorber	Time (days - 16 hour running)
Setup	None	2
Commissioning	None	24
	LiH Install	5
Physics	LiH	7
		38 / 38

Beyond 2016/01

- Assuming we have SSU and SSD, the following run plan is feasible based on data rate observed in the October run with SSU on.

User Run	Date from	Date to	Run Type	Absorber	Time (days)
2016/02	28th June	29th July	Physics	None	31 / 31
			LiH installation		
2016/03	13th Sep	28th Oct	Physics	LiH	31 / 45
			LH2 installation		
2016/04	15th Nov	16th Dec	Physics	LH2	31 / 31

- Run plan depends on the status of the channel and needs to be flexible and kept under review
- Current plan can be met within the available runtime

Demonstration of Ionisation Cooling

- Running for Demonstration of Ionisation Cooling will occur mid-2018 to mid-2019.
- ISIS schedule for this period doesn't exist. Here I assume about 4 user cycles (about 140 days) @ 35 days per user cycle
- Initial assessment of muon rate for Demonstration of Ionisation Cooling phase also must take selection of muons in phase with the RF into account.
- The rate of analysable muons drops to 7% of the rate in Step IV for studies which require the muons to arrive within a 10% window around the RF peak
- Time required for 10k analysable muons : 2.2 days @ 1 V.ms beamloss, 16/24 hour running and 30% contingency

Run plan schematic

Calibration and validation

Task	RF Status	#Momentum settings	# Emittance settings	# Betatron settings	#muons / setting	Time (days)
Alignment	Off	1	1	1	10^6	15
Optics tests I	Off	9	1	1	10^4	2
Optics tests II	Off	1	1	9	10^4	2
Optics tests III	Off	1	3	1	10^5	6
RF tests	On (low)	1	1	1	10^5	2
Absorber	Off	1	1	1	10^5	2
						29

Some of this commissioning work could be done before the data taking phase.

Run plan schematic

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Core physics measurements with RF on

Task	#Momentum settings	# Emittance settings	# Betatron settings	#muons / setting	Time (days)
No absorber	1	1	1	10^5	28
Test MC predictions	1	2	1	10^5	57
$\Delta\varepsilon$ vs β_T	1	1	10	10^4	28
$\Delta\varepsilon$ vs p	10	1	1	10^4	28
					141

Total : 170 days
Measurement program is covered within contingency but tight.

Summary

- A run plan has been defined for Step IV and a framework is in place for the Demonstration of Ionisation Cooling.
- Assuming current muon rates and including a 30% contingency, calibration and validation runs and the core physics measurements can be made in the assumed run-time.
- Flexibility is essential. The run plan must react to situation on the ground.