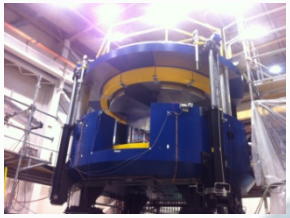
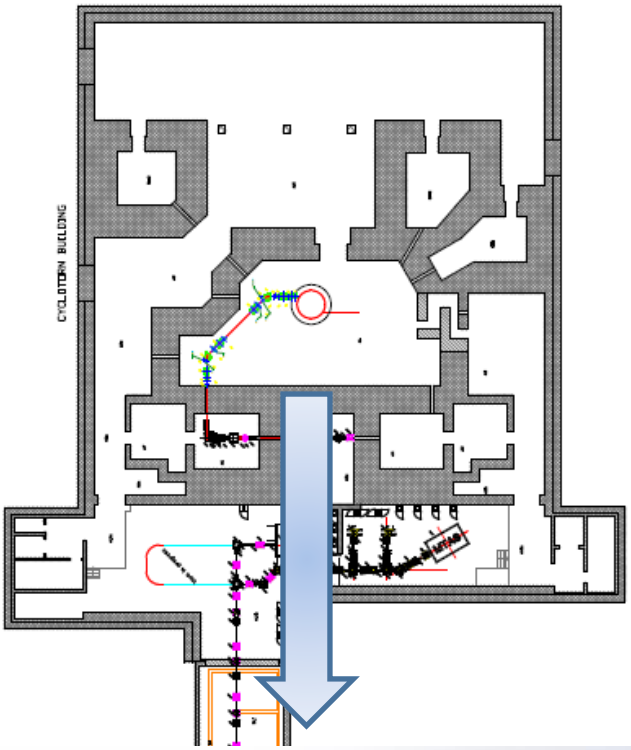
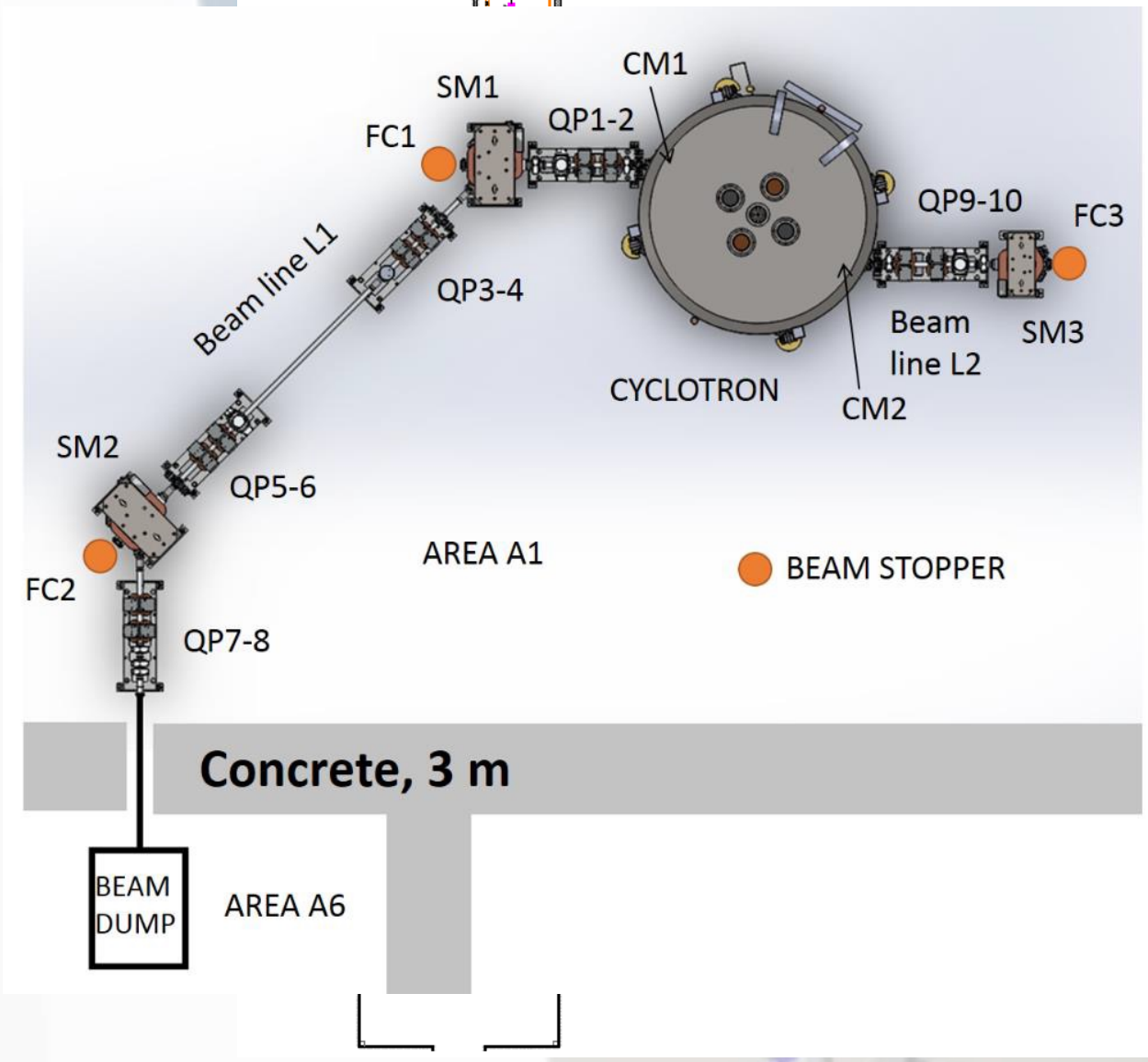
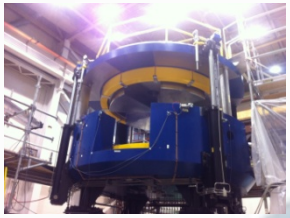
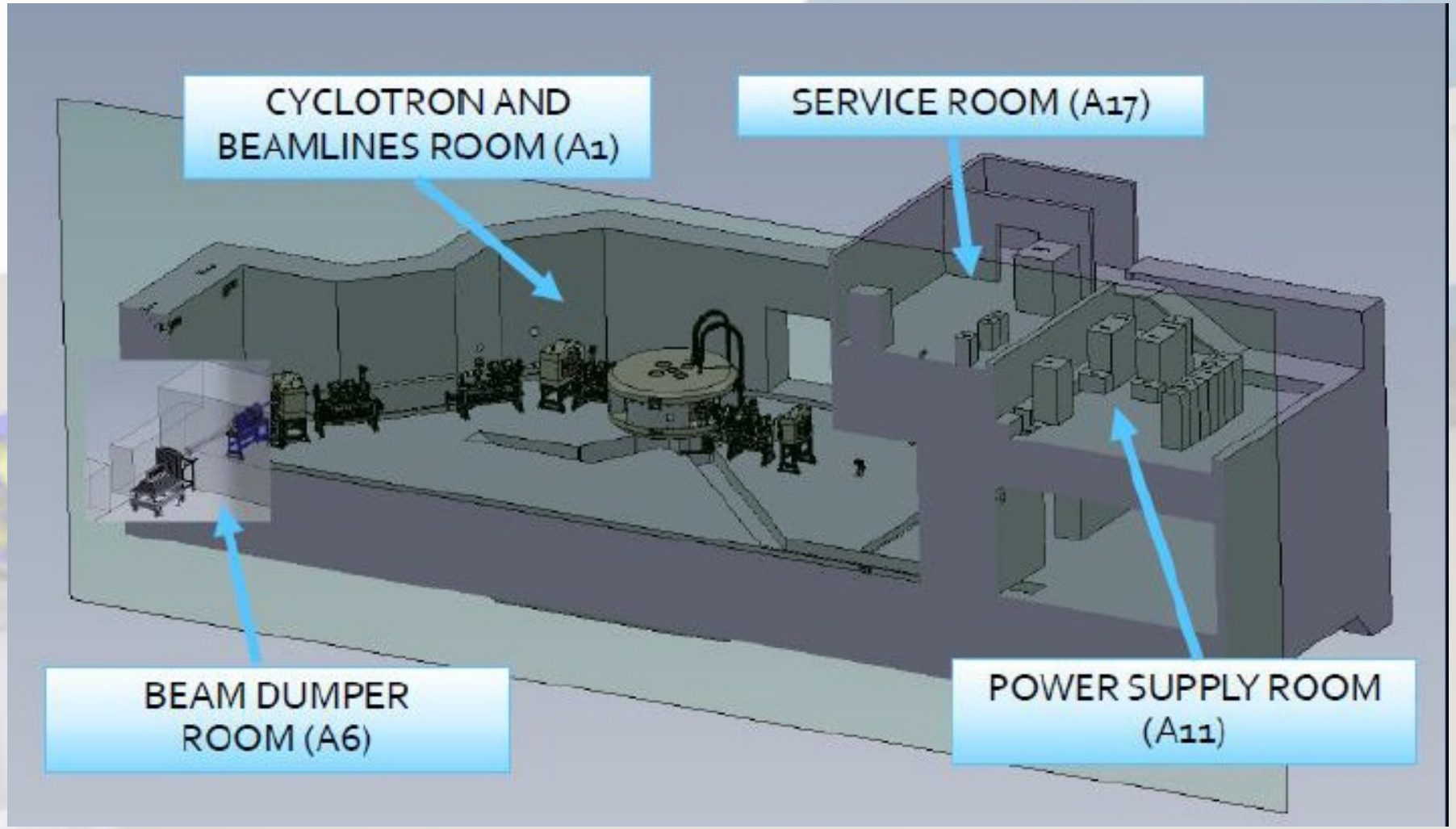


Status of the SPES Cyclotron, commissioning and capabilities report


CYCLOTRON BUILDING


SM1
CM1
FC1
QP1-2
QP9-10
FC3
Beam line L1
QP3-4
Beam
line L2
SM3
CYCLOTRON
CM2
SM2
QP5-6
AREA A1
BEAM STOPPER
FC2
QP7-8
Concrete, 3 m
BEAM
DUMP
AREA A6




CYCLOTRON AND BEAMLINES ROOM (A1)
SERVICE ROOM (A17)
BEAM DUMPER ROOM (A6)
POWER SUPPLY ROOM (A11)

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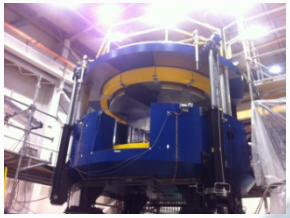

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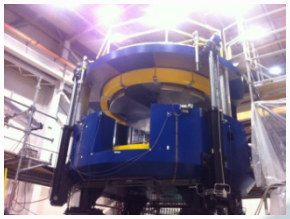
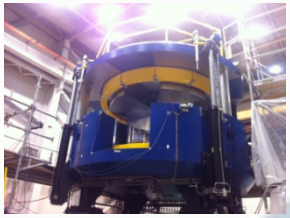
exotic beams for science

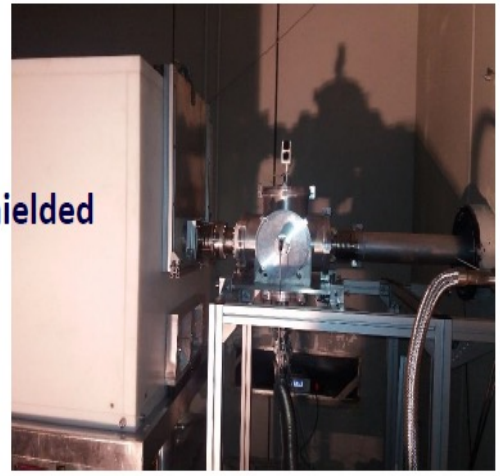


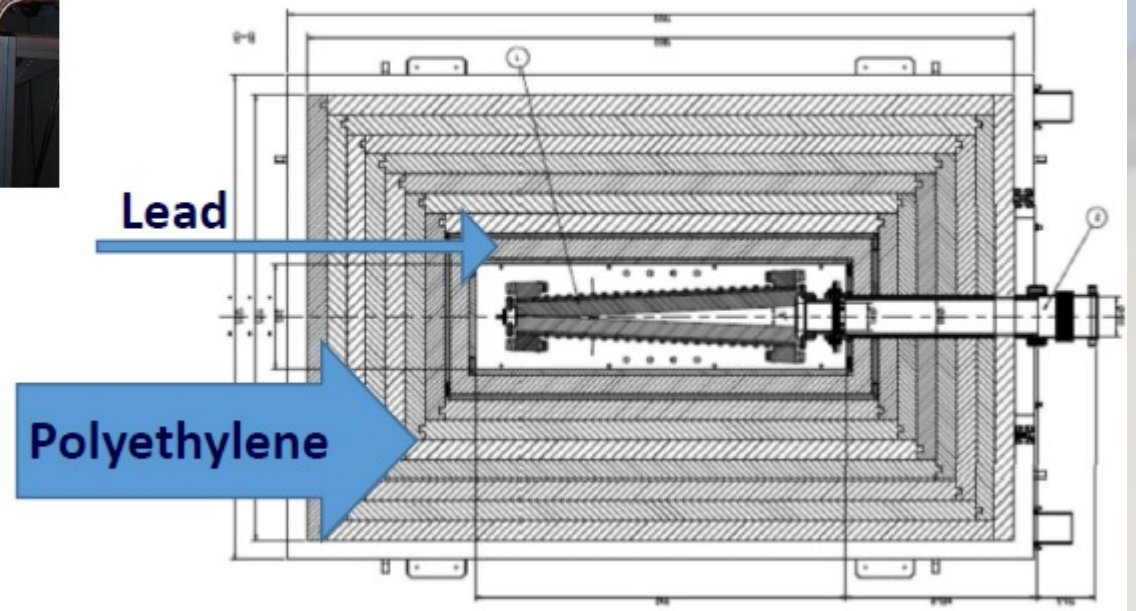
CYCLOTRON MAIN SPECIFICATIONS

- Proton energy variable in the range 35-70 MeV
- Total current outside the cyclotron, two extraction lines ≥700 µA (~ 4.2*1015 p/s)
- Operation vacuum (beam on) ≤ 2·10-5 Pa
- Momentum spread Δp/p of the extracted beam < ± 0.2%
- Beam spot size on the target Φ=40 mm (area 1260 mm2)
- Beam time structure CW
- Beam intensity stability on target for proton beam
  - o Fast (time scale µs) ± 10%
  - o Medium (time scale s) ± 1%
  - o Slow (time scale hour) ± 1%
- Emergency switch-off time < 50 µsec
- Machine reliability >95% of planned operation time
- Planned operation time ≥ 7500 h/Year
- Beam current losses:
  - ○ Injection line ≤ 1%
  - ○ Central Region ≤ 90 %
  - ○ Acceleration ≤ 5%
  - ○ Extraction ≤ 1%
  - ○ Transport line ≤1%



Beam Dumper shielded by polyethylene





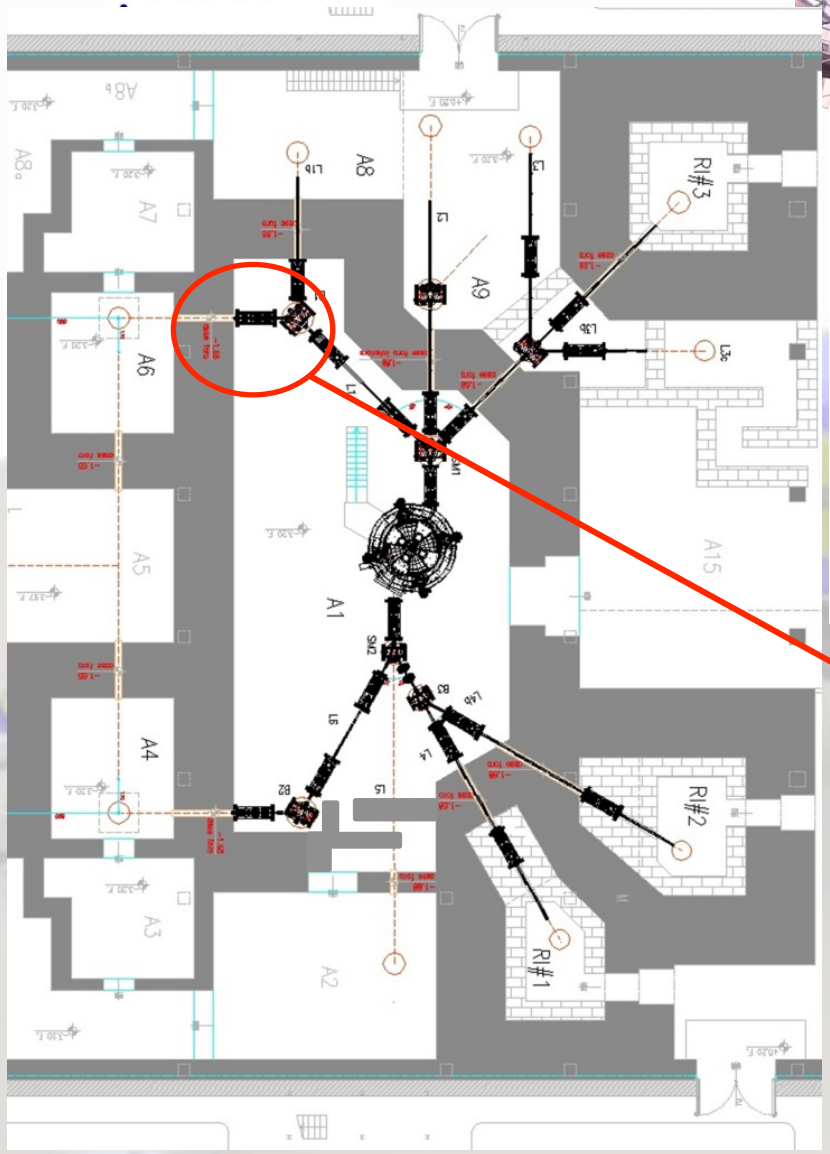
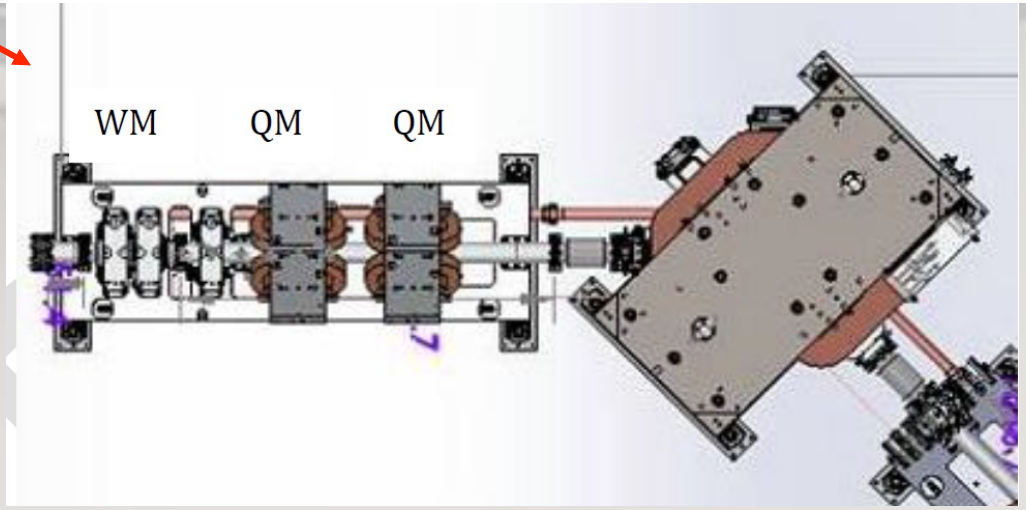


Table 1. Proton beam requirements at different target stations in SPES building.

Area	A4	A6	A9	RI#1	RI#2	RI#3	L3c
Purpose	ISOL target	ISOL target	Neutrons generator targets	Radio isotopes (RI) production	RI production	RI R&D	RI R&D
Energy	40 MeV	40 MeV	30–70 MeV	35–70 MeV	35–70 MeV	35–70 MeV	35–70 MeV
Current	200 μA	200 μA	50 μA	500 μA	500 μA	300 μA	<1 μA

Table 1 shows the beam requirements for each experimental hall expected to be operating in SPES building.



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Design Note DN700_39_004 Rev 3

2D Beam Current Profile with Wobbling Magnet

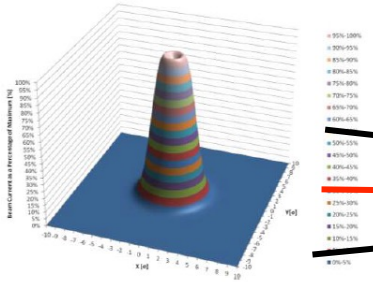


FIGURE 1: 2D BEAM CURRENT PROFILE USING A WOBBLING MAGNET AND MAXIMIZING AREA WITHIN 5% CURRENT DENSITY UNIFORMITY

2D Beam Current Density Profile Cross Section

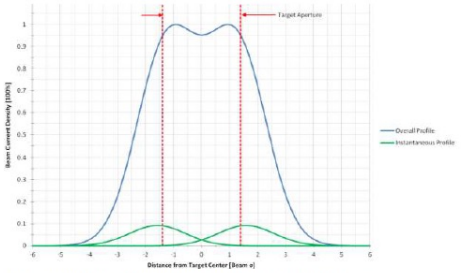
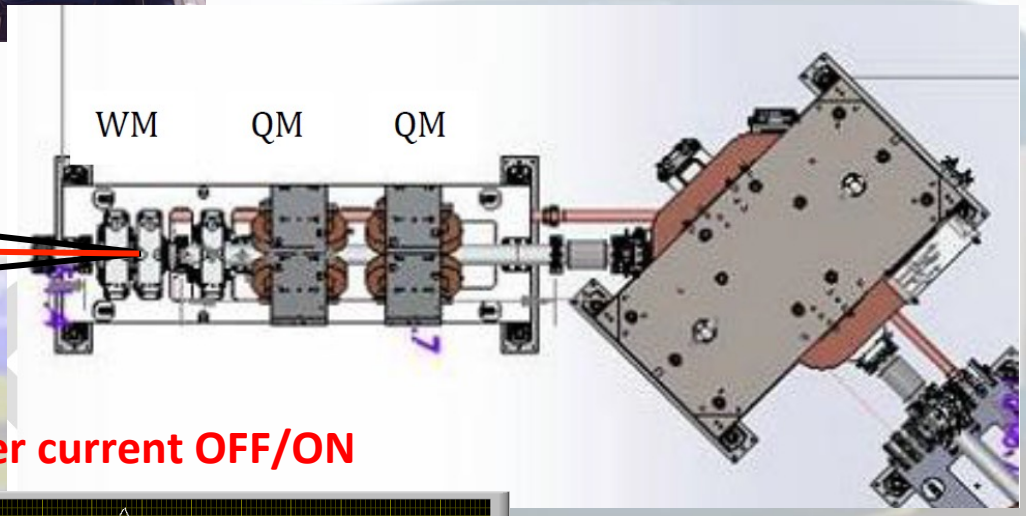
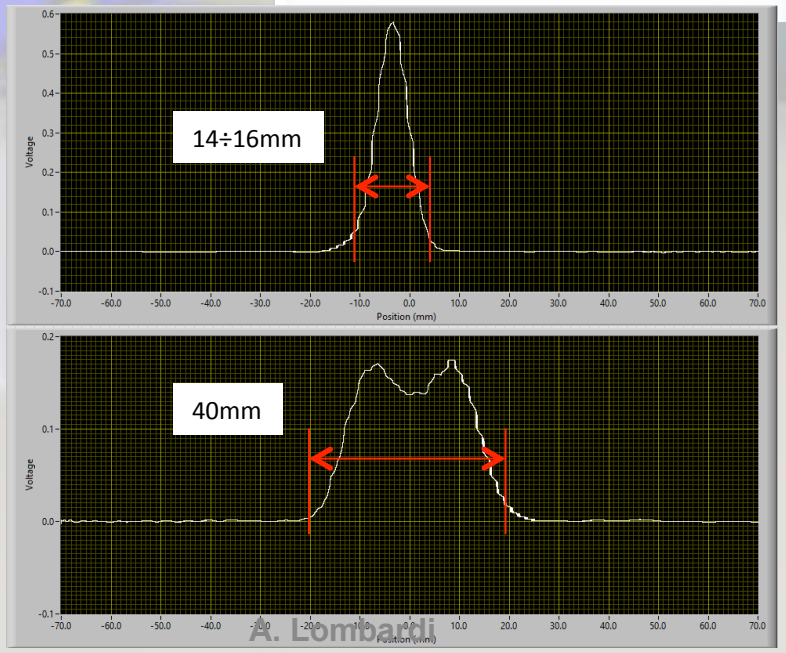


FIGURE 2: CROSS SECTION OF BEAM CURRENT DENSITY USING A WOBBLING MAGNET

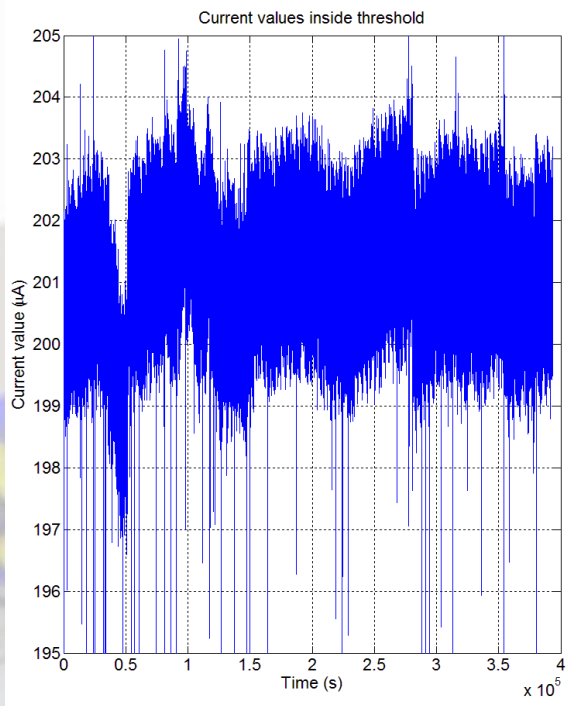


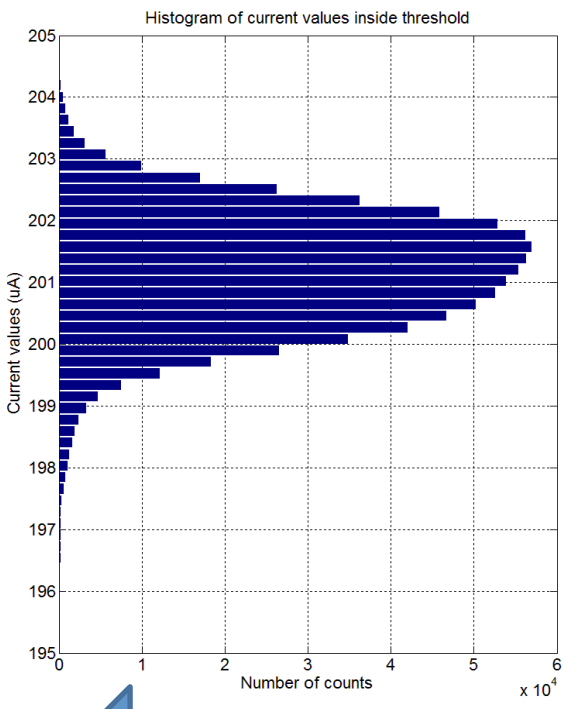
Wobbler current OFF/ON



SAT endurance test

Raw data (trips removed)

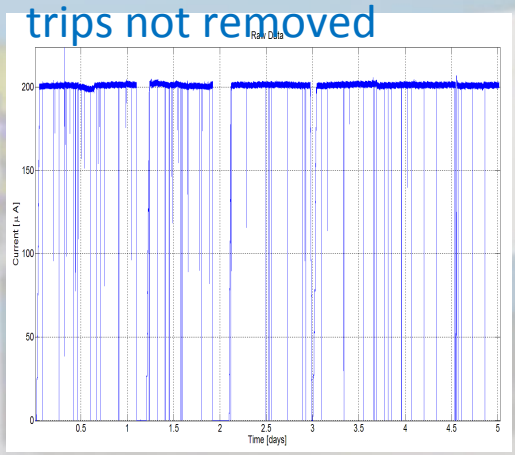




The average value of current is: 201.18 μA
with standard deviation of: 0.97 μA

Trips removed

Raw data, trips not removed



Total acquisition time: 5.0 days.
The total down time is: 9.1 % of total time.
The total up time is: 4.55 days of 5.0 days.
The total up time is: 90.9 % of total time.
Of the total 108 trips, **72 are RF sparks.**

ISIS CA Trend

17:30 19/06 start test

12:00 21/06
loss of comm in MPS

8:30 23/06 restart test

16:20 20/06
srs failure

17:30 20/06
RF spark
manual restart

00:30 22/06
Stripper change

11:17 22/06
HV IS extractor cable
failure + intervention
on IS

12:44 24/06
srs failure

11:05 25/06
srs failure

6:50 26/06
HV power supply
IS failure

220
200
180
160
140
120
100
80
60
40
20
0

2:00:00 AM 6/20/2017
2:00:00 AM 6/21/2017
2:00:00 AM 6/22/2017
2:00:00 AM 6/23/2017
2:00:00 AM 6/24/2017
2:00:00 AM 6/25/2017
2:00:00 AM 6/26/2017

Ready

3:42:37 PM

ISIS CA Ruler Control

	Name	Y value	X value/time stamp
1	TG1C3	115.6	6/26/2017 3:37:53 PM
2			

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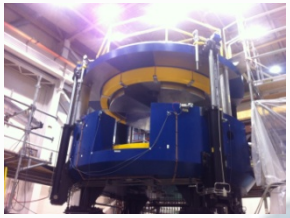

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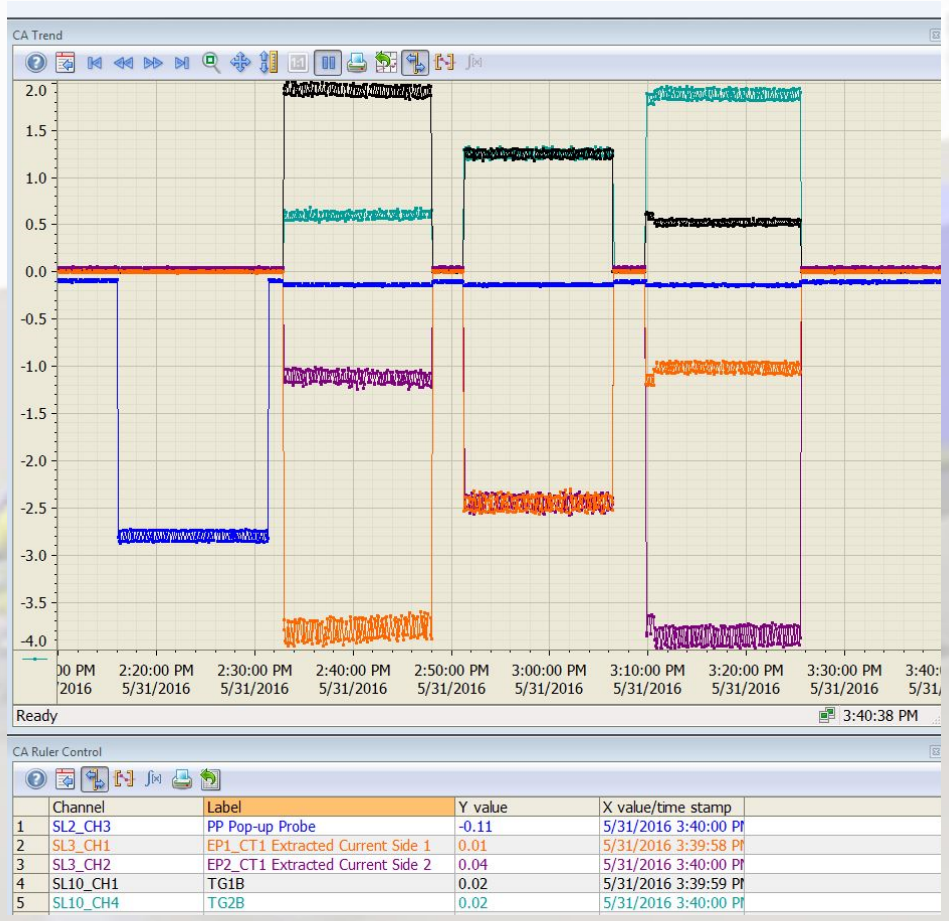
May 2016



CA Ruler Control

	Channel	Label	Y value	X value/time stamp
1	SL2_CH3	PP Pop-up Probe	-0.11	5/31/2016 3:40:00 PM
2	SL3_CH1	EP1_CT1 Extracted Current Side 1	0.01	5/31/2016 3:39:58 PM
3	SL3_CH2	EP2_CT1 Extracted Current Side 2	0.04	5/31/2016 3:40:00 PM
4	SL10_CH1	TG1B	0.02	5/31/2016 3:39:59 PM
5	SL10_CH4	TG2B	0.02	5/31/2016 3:40:00 PM

September 2016

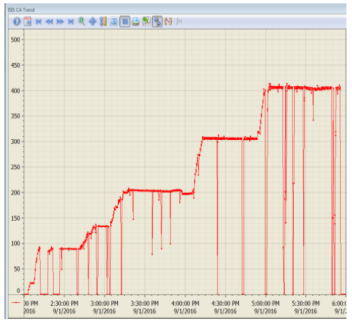


Figure 7: Beam current on target ramp-up (μA), versus time.

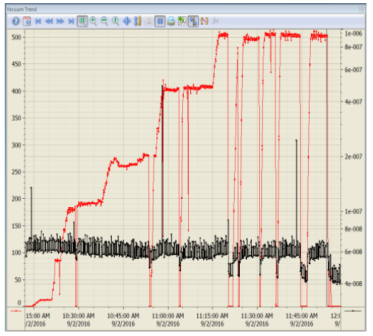
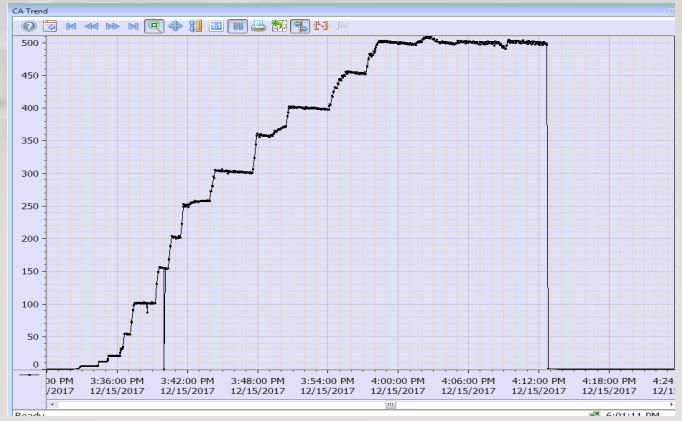
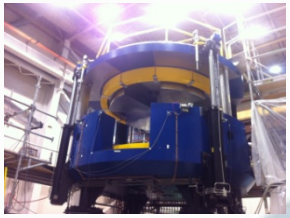


Figure 8: Vacuum and beam current (μA) versus time.

December 2017

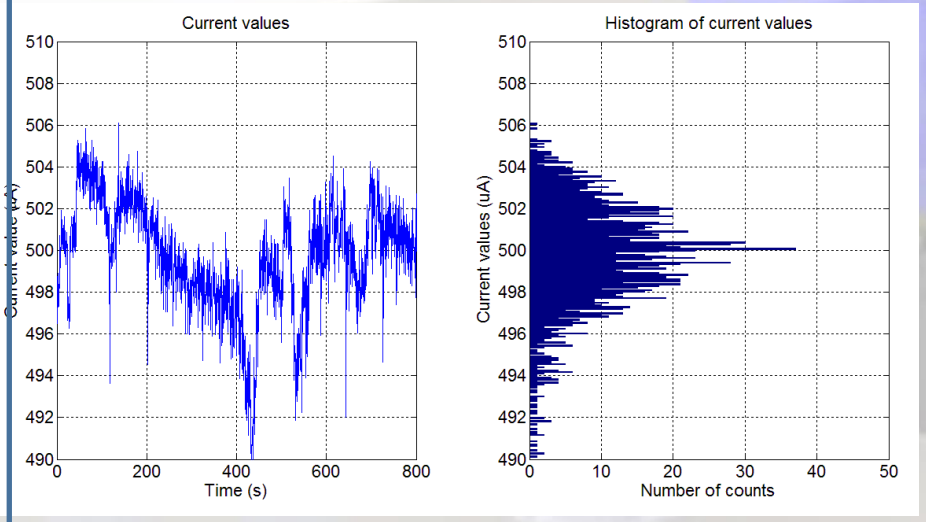




500 μA: two runs in two different days

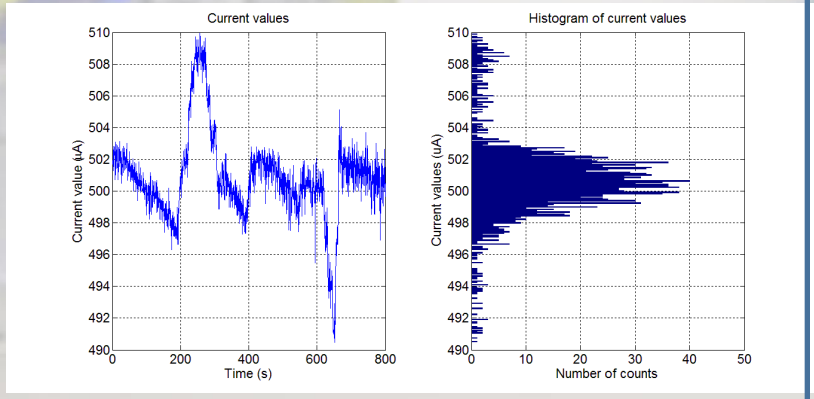
Each run around 15 minutes

14th Dec. 2017



The average value of current is: 499.7 μA
with standard deviation of: 2.6 μA

15th Dec. 2017



The average value of current is: 500.8 μA
with standard deviation of: 2.7 μA

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- Infr n
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- Cycl
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