

HIE-ISOLDE Users interface and beam properties for 2017

Lefteris Fadakis on behalf of BE-OP-ISO

Content

- REX/HIE-ISOLDE Users Interface
 - Vacuum system
 - Diagnostics
 - SRF
 - Equipment Array
 - Specification concerning final beam delivery checkpoint for OP
 - Establish a fast separator course for newcomers prior to each experiment
- Beam Properties
 - Energy and Energy spectrum
 - Time structure (Repetition rate, Pulse length, Slow extraction)
 - A/q
- Set Up Time
 - Provide examples varying from best to worst case.

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HIE-ISOLDE Users Interface - Vacuum system

Added labels for each experiment in the low energy panel.

Login for:

- Low energy is isoop
- Rex is rexop
- HIE is your nice login which you need to provide at least a week in advance to grand access.

The screenshot displays the REX-VACUUM control interface. At the top, there are window titles for 'unicosHMI 1: vac isl 1' and 'unicosHMI 1: vac rex 1'. The main interface shows a complex network of vacuum chambers and pumps. Key components include:

- Penning Threshold:** Indicated by a red box and arrow pointing to a gauge.
- Pirani Threshold:** Indicated by a red box and arrow pointing to a gauge.
- Valves to be closed:** A large red box contains the text: "Valves to be closed if ANY mechanical intervention takes place on experiment side." Red lightning bolts point to specific valves in the diagram.
- Pressure Gauges:** Various gauges show pressures such as 1.0×10^{-3} mBar, 5.3×10^{-8} mBar, 2.5×10^{-8} mBar, 0.0 mBar, 1.3×10^{-8} mBar, 9.9×10^{-3} mBar, 3.6×10^{-7} mBar, 3.3×10^{-7} mBar, 3.7×10^{-8} mBar, 1.9×10^{-7} mBar, 1.0×10^{-3} mBar, 3.4×10^{-7} mBar, 945 mBar, 1000 mBar, and 941 mBar.
- Control Buttons:** Numerous green buttons are visible, including 'VPG_READ', 'VPG_GPS', 'XR01', 'XR02', 'XR00', 'XR00_2', 'XR01', 'XR02', 'XR03', 'XR04', 'XR05', 'XR06', 'XR07', 'XR08', 'XR09', 'XR10', 'XR11', 'XR12', 'XR13', 'XR14', 'XR15', 'XR16', 'XR17', 'XR18', 'XR19', 'XR20', 'XR21', 'XR22', 'XR23', 'XR24', 'XR25', 'XR26', 'XR27', 'XR28', 'XR29', 'XR30', 'XR31', 'XR32', 'XR33', 'XR34', 'XR35', 'XR36', 'XR37', 'XR38', 'XR39', 'XR40', 'XR41', 'XR42', 'XR43', 'XR44', 'XR45', 'XR46', 'XR47', 'XR48', 'XR49', 'XR50', 'XR51', 'XR52', 'XR53', 'XR54', 'XR55', 'XR56', 'XR57', 'XR58', 'XR59', 'XR60', 'XR61', 'XR62', 'XR63', 'XR64', 'XR65', 'XR66', 'XR67', 'XR68', 'XR69', 'XR70', 'XR71', 'XR72', 'XR73', 'XR74', 'XR75', 'XR76', 'XR77', 'XR78', 'XR79', 'XR80', 'XR81', 'XR82', 'XR83', 'XR84', 'XR85', 'XR86', 'XR87', 'XR88', 'XR89', 'XR90', 'XR91', 'XR92', 'XR93', 'XR94', 'XR95', 'XR96', 'XR97', 'XR98', 'XR99', 'XR100', 'XR101', 'XR102', 'XR103', 'XR104', 'XR105', 'XR106', 'XR107', 'XR108', 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'XR997', 'XR998', 'XR999', 'XR1000'.

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- REX/HIE-ISOLDE Users Interface

- Vacuum system

- Diagnostics

- SRF

- Equipment Array

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- Establish a fast separator course for newcomers prior to each experiment

- Beam Properties

- Energy and Energy spectrum

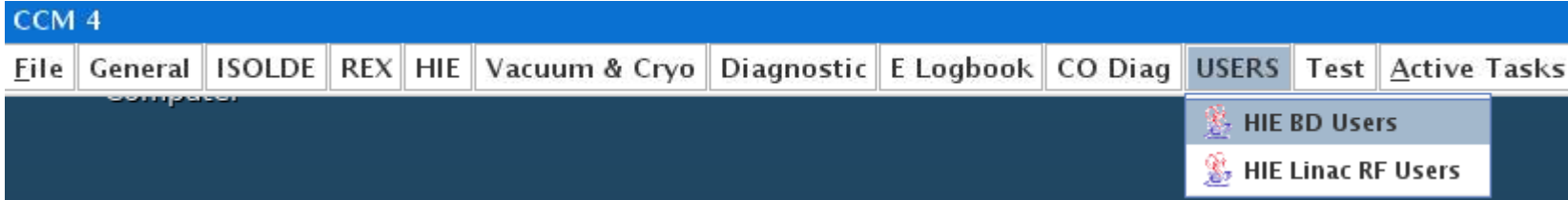
- Time structure (Repetition rate, Pulse length, Slow extraction)

- A/q

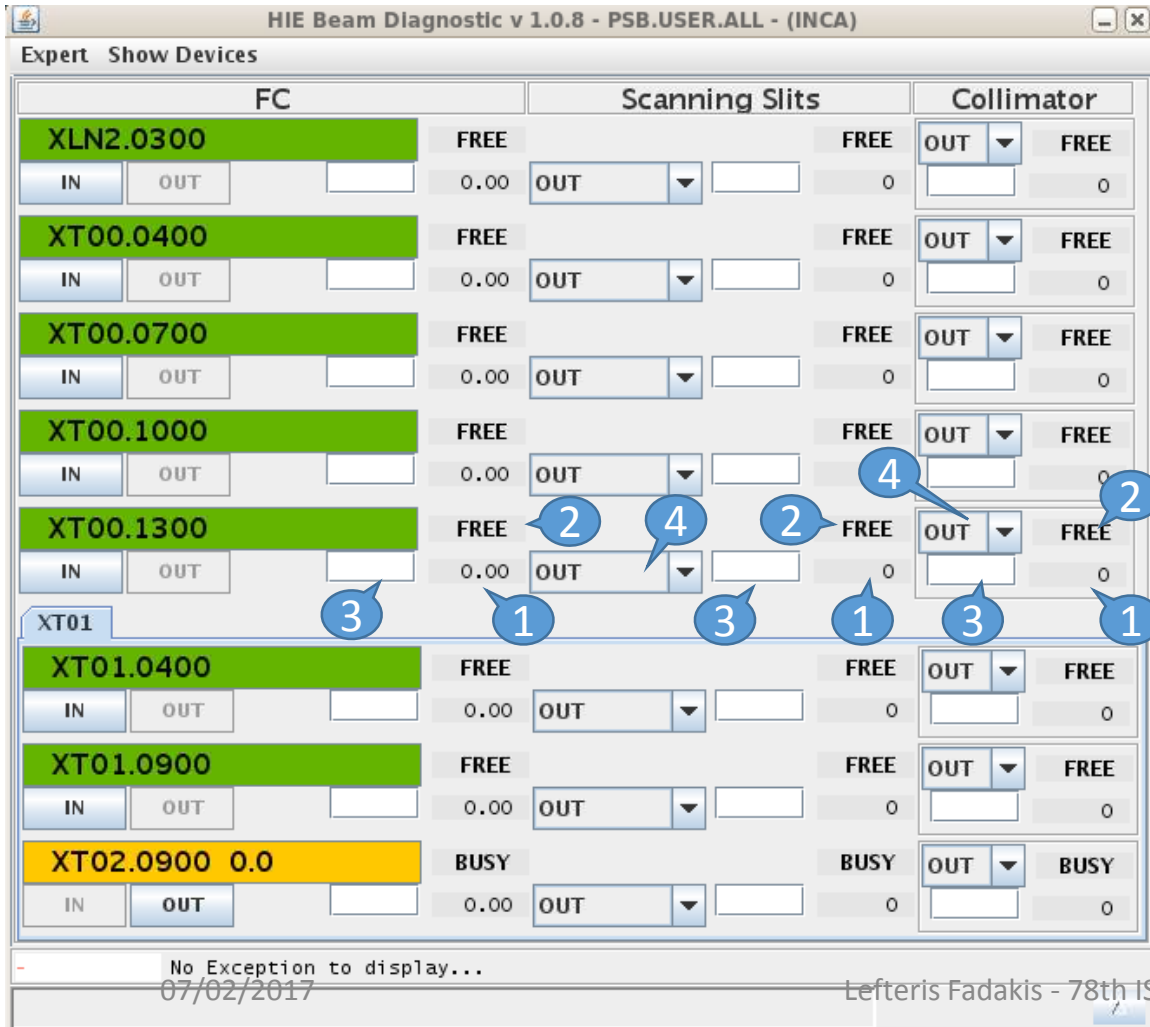
- Set Up Time

- Provide examples varying from best to worst case.

REX/HIE-ISOLDE Users Interface – Beam Diagnostics



<- Where to find it



<- GUI will evolve as the BI evolves (adding more equipment)

We will not add a bricolage/last minute solution for any FC after the last diagnostic box into the existing control system.

<- explanation of each element:

1. Current position acquisition
2. Layer availability
3. Offset movement in respect to current position
4. Go to default possible positions

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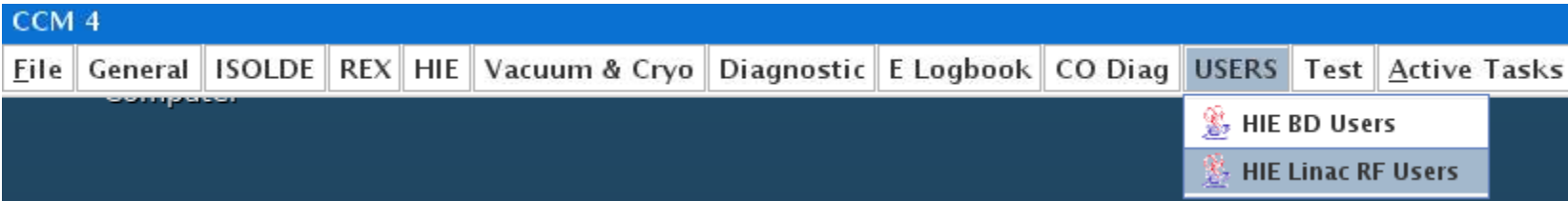
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HIE-ISOLDE Users Interface – RF Controls

<- Where to find it



User Linac RF control - Inspector 2.1.19

Linac_RF_contro...

CONTROL LINE

XLL2

CAV1	OFF	STANDBY	READY	ON
CAV2	OFF	STANDBY	READY	ON
CAV3	OFF	STANDBY	READY	ON
CAV4	OFF	STANDBY	READY	ON
CAV5	OFF	STANDBY	READY	ON

XHL1

CAV1	OFF	STANDBY	READY	ON
CAV2	OFF	STANDBY	READY	ON
CAV3	OFF	STANDBY	READY	ON
CAV4	OFF	STANDBY	READY	ON
CAV5	OFF	STANDBY	READY	ON

XHL2

CAV1	OFF	STANDBY	READY	ON
CAV2	OFF	STANDBY	READY	ON
CAV3	OFF	STANDBY	READY	ON
CAV4	OFF	STANDBY	READY	ON
CAV5	OFF	STANDBY	READY	ON

XHL3

CAV1	OFF	STANDBY	READY	ON
CAV2	OFF	STANDBY	READY	ON
CAV3	OFF	STANDBY	READY	ON
CAV4	OFF	STANDBY	READY	ON
CAV5	OFF	STANDBY	READY	ON

CONTROL LINE

	RUNNING	SETPOINT		CAV FIELD		STATUS			DETAILED STATUS
		MAG [MV/m]	PHASE [deg]	MAG [MV/m]	PHASE [deg]	LIMIT	RF SATUR	OUT FAST ILOCK	
XLL2 CAV1	!	3.279	75.0	0.004	-29.6				...
XLL2 CAV2	!	5.620	-153.0	0.005	-99.8				...
XLL2 CAV3		5.620	53.0	0.001	-165.6				...
XLL2 CAV4	!	5.156	15.0	0.005	-72.6				...
XLL2 CAV5		2.434	-81.0	0.004	-130.6				...
XHL1 CAV1		...	!	...	!				...
XHL1 CAV2	!
XHL1 CAV3		!	!		!		...
XHL1 CAV4	!	!
XHL1 CAV5	!	...	!	...	!		!		...
XHL2 CAV1		0.000	0.0	11.000	-116.7				...
XHL2 CAV2		0.000	0.0	6.000	-24.1				...
XHL2 CAV3		0.000	0.0	11.000	-143.6				...
XHL2 CAV4	!	0.000	0.0	9.000	-141.1				...
XHL2 CAV5		0.000	0.0	10.000	-49.8				...
XHL3 CAV1		0.000	0.0	7.000	-55.5				...
XHL3 CAV2	!	0.000	0.0	0.000	36.9				...
XHL3 CAV3		0.000	0.0	12.000	-103.9				...
XHL3 CAV4		0.000	0.0	4.000	12.9				...
XHL3 CAV5	!	0.000	0.0	7.000	-21.9				...

alert, SWITCH OFF CAVITY 3, inform walter.venturini@cern.ch !

07/02/2017

SOLD Collaboration Committee meeting

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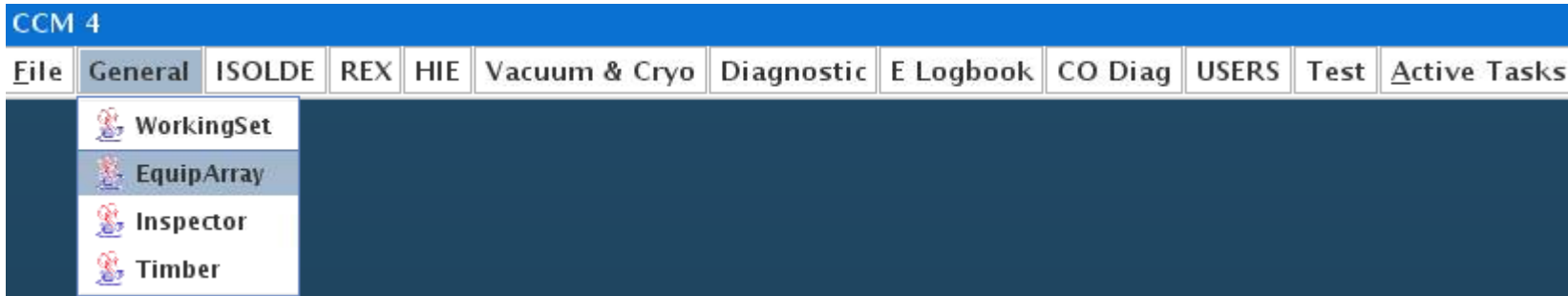
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HIE-ISOLDE Users Interface – Equipment Array



<- Where to find it

EquipArray rex - ISO.USER.ALL - (INCA)

File

RBA: no token

/acc/java/data/iso/equiparray/rex/files/Setting_2016/2016_11_13_SPEDE_132Xe32p/161118_0049_ToMinibal_132Xe32pAq4.125_4.5MeVu_68%_USERS.csv

OB Name	Buffer	CCV Value	AQN Value
XT01.RQ.0600	13.16	server is down	server is down
XT01.RQ.0700	38.54	server is down	server is down
XT01.RQ.0800	13.16	server is down	server is down
XT01.RCH.0950	0.00	server is down	server is down
XT01.RCV.0950	-6.00	server is down	server is down

REX

READ EQP TO BUFFER

WRITE BUFFER TO EQP

SCALING

From

A1 1

q1 1

E1(MeV/u) 1.00

To

A2 1

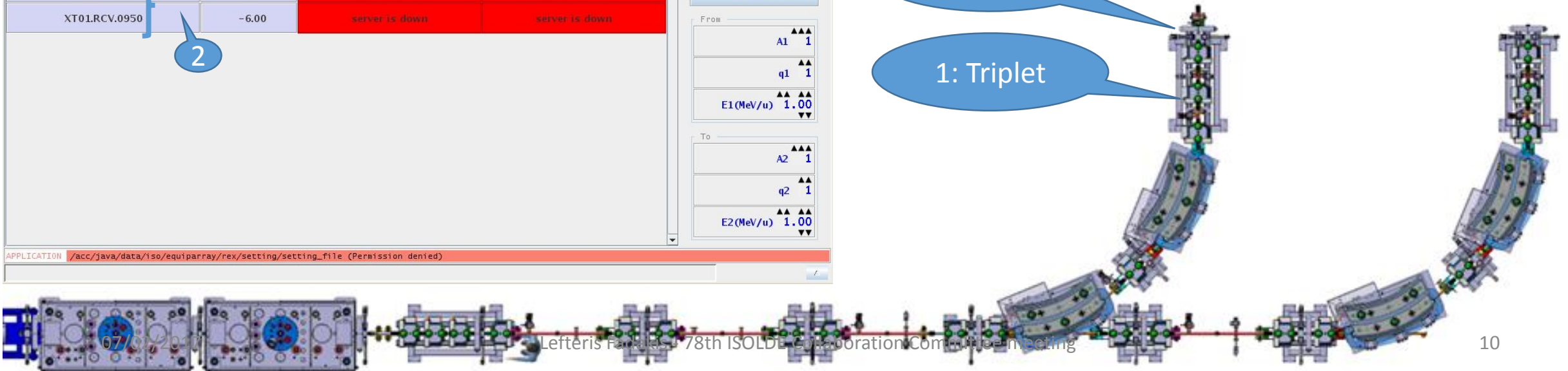
q2 1

E2(MeV/u) 1.00

APPLICATION /acc/java/data/iso/equiparray/rex/setting/setting_file (Permission denied)

2: Steerers

1: Triplet



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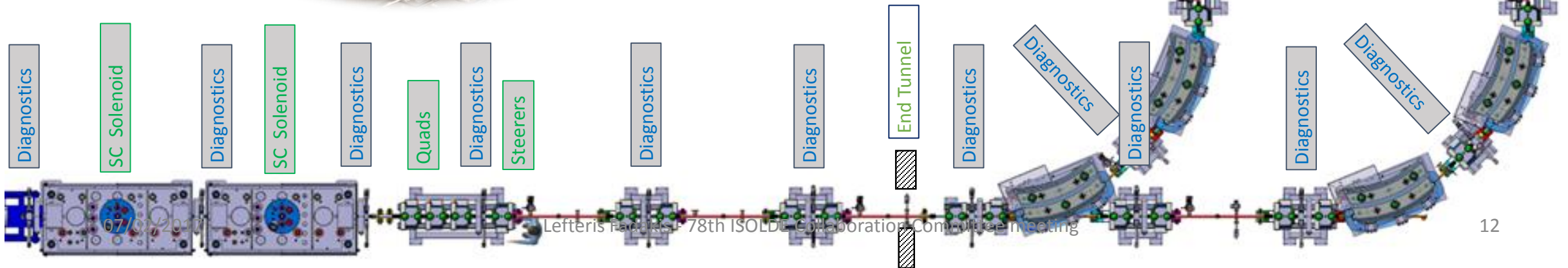
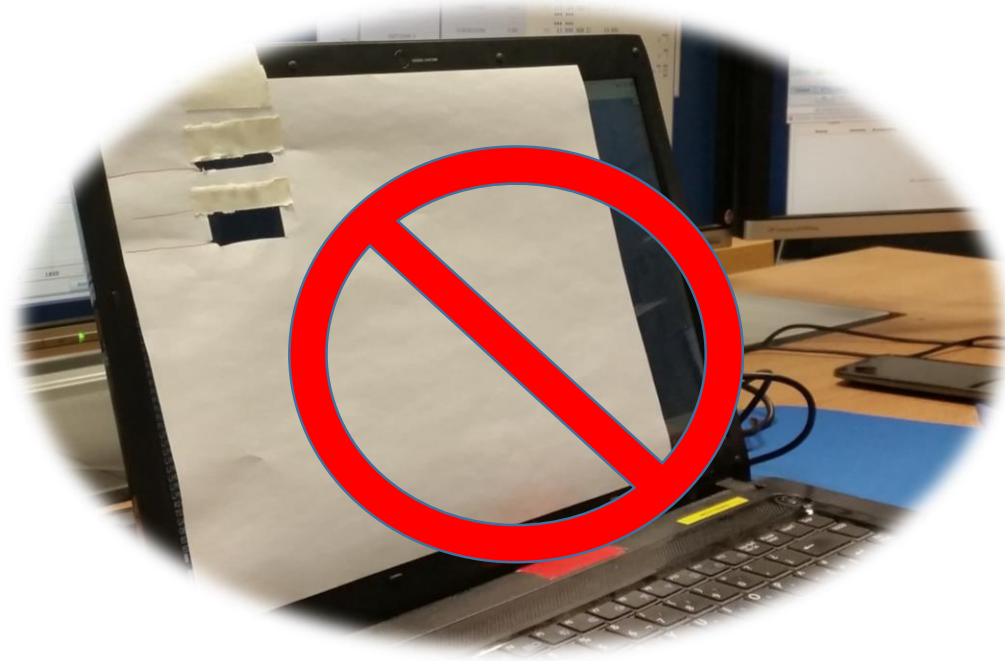
- A/q

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Final beam delivery checkpoint for OP

In 2017 OP will deliver beam as far as the faraday cup in the last diagnostics box before the experiment.
OP will not be responsible to inject beam into the users experiment.



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ISOLDE Separator course

Each year OP teaches the basics of ISOLDE to our new users.

- Beam set up, targets, beam diagnostics, call the PSB operator if there are no protons, etc
- Adding another day being considered, if people are interested in REX/HIE.



ISOLDE crush course before each experiment

In addition to the yearly separator course a crush course will be provided.

- Before each experiment we cover the basics (if needed).
 - Working sets/knobs
 - Fixed displays screens
 - Relevant applications (beam instrumentation etc)

- Verify that each users account has been granted access in the vacuum system.

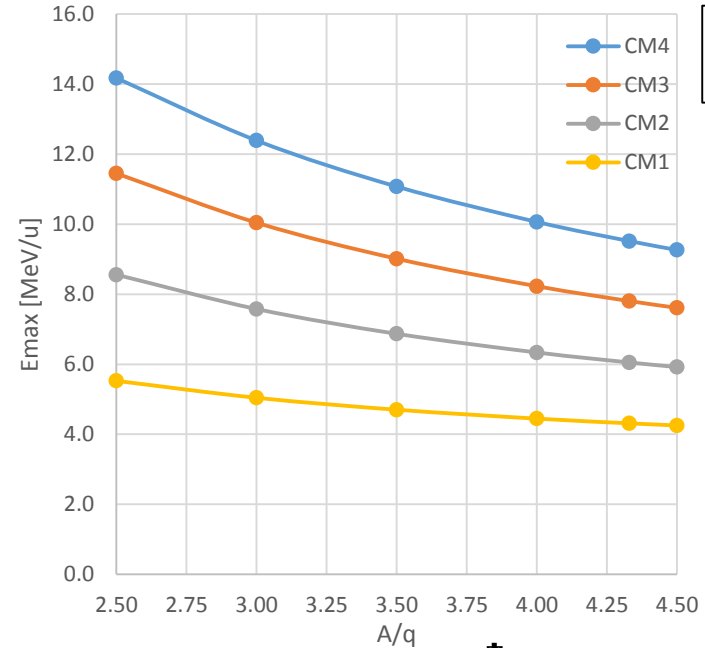
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Beam Properties for 2017: Beam Energy and Energy Spread

Expected for 2017:

- A third cryomodule is currently being installed and should be ready for the 2017 Physics campaign
- The third HEBT line (XT03) should also be ready
- Highest reachable energy of a beam with $A/q = 4.0$:
 - If average SRF gradient is 6.0 MV/m: 8.2 MeV/u
 - If average SRF gradient is 5.5 MV/m: 7.8 MeV/u
 - If average SRF gradient is 5.0 MV/m: 7.3 MeV/u

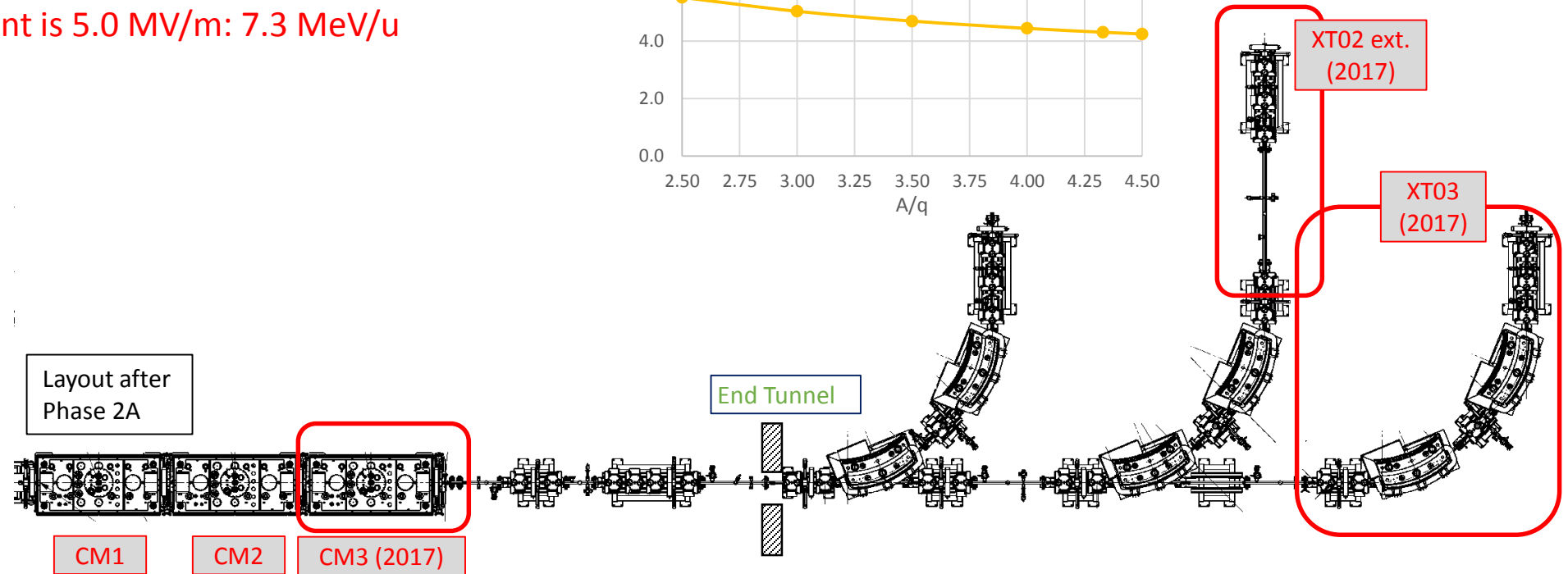


Highest beam energy (assuming all cavities at 6MV/m) for different A/q

A/q	CM1	CM2	CM3	CM4
2.5	5.5	8.6	11.4	14.2
3.0	5.0	7.6	10.0	12.4
3.5	4.7	6.9	9.0	11.1
4.0	4.4	6.3	8.2	10.1
4.3	4.3	6.1	7.8	9.5

Phase 2A of the HIE-ISOLDE project

# Cryomodules	3
# HEBT lines	3
E [MeV/u] ($A/q = 2.5$)	11.4
E [MeV/u] ($A/q = 4.3$)	7.8



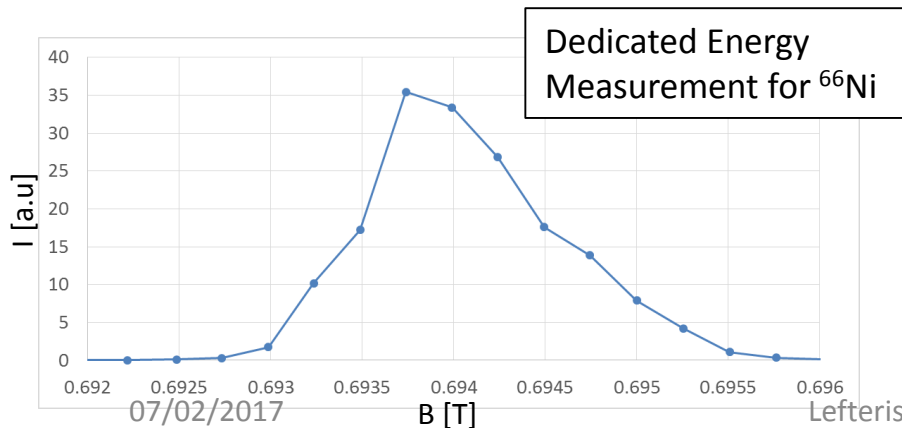
Beam Properties for 2017: Beam Energy and Energy Spread

In 2016:

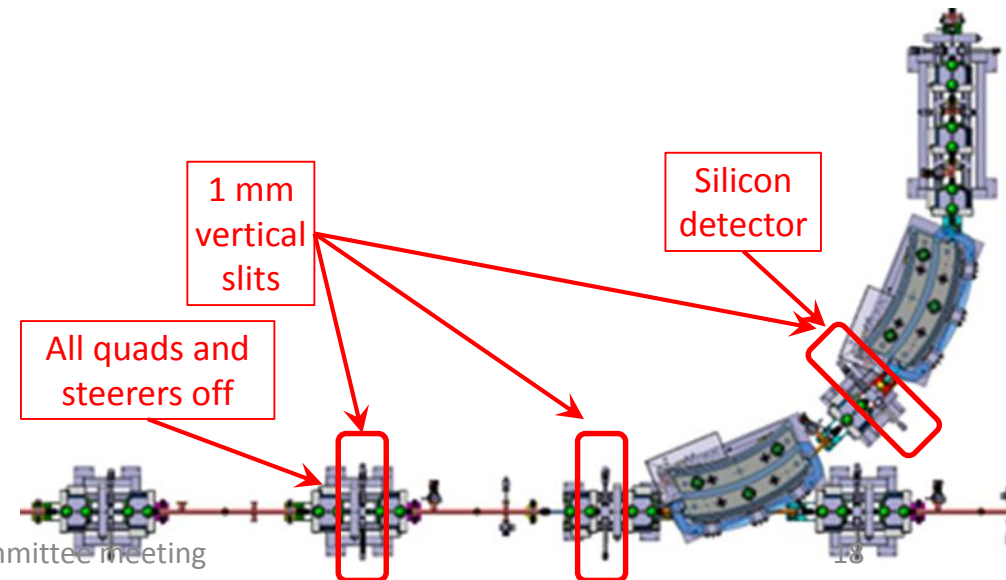
- Dedicated energy measurement (~ 4 hours were needed) using the dipole done for the last four experiments
- Due to problems with the machine (9gap amplifier for ^{110}Sn , target for ^{142}Xe), the dedicated measurements were not done in the first two experiments
- Best guess Energy is based on the settings of the dipole when beam was delivered to the users. But, it is not corrected for steerers and quads kicks

Energy and Energy Spread for experiments in 2016

	Nominal Energy [MeV/u]	Measured Energy [MeV/u]	Energy Spread HWHM [%]	Energy Best guess(1) [MeV/u]	Best guess / Measured
$^{66}\text{Ni}^{16+}$	4.5	4.47	0.2	4.46	0.998
$^9\text{Li}^{3+}$	6.9	6.72	0.5	6.74	1.003
$^{132}\text{Sn}^{31+}$	5.5	5.49	0.4	5.40	0.984
$^{78}\text{Zn}^{20+}$	4.3	4.27	0.3	4.30	1.007
$^{142}\text{Xe}^{33+}$	4.5			4.39	
$^{110}\text{Sn}^{26+}$	4.5			4.39	



- (1)
- quads and steerers ON
 - Slits retracted



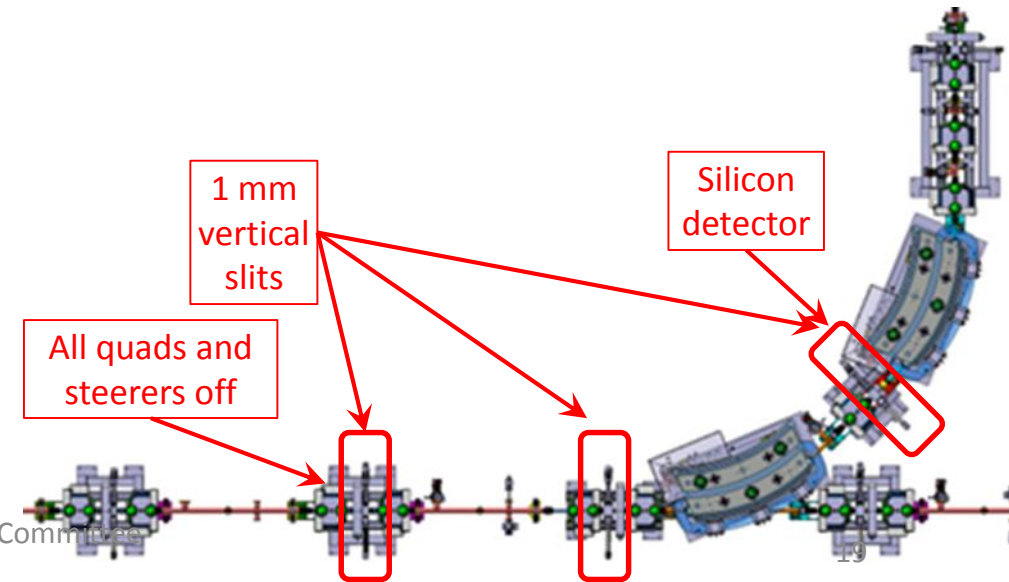
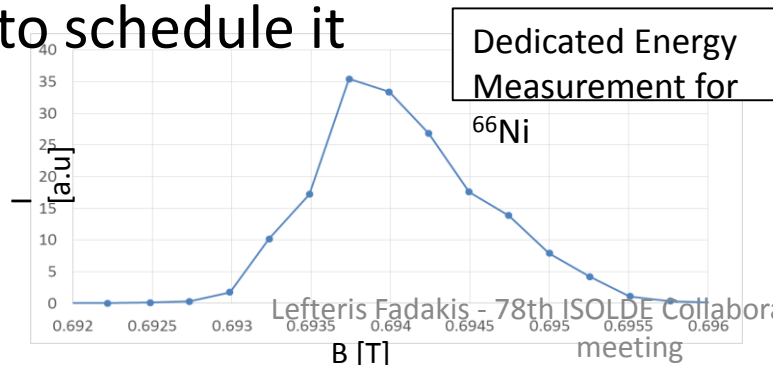
Beam Properties for 2017: Beam Energy and Energy Spread

Expected for 2017:

- A new timing class for the Si detectors (including count rates) has been developed and will be commissioned this year
- Energy measurements will be a lot faster (expected ~ 1 hour for the second half of the campaign)
- Energy spread optimization may be possible to approach the theoretical 0.25% HWHM for all experiments
- Spokesperson should decide and inform in advance if a dedicated measurement is needed
- OP will decide when to schedule it

Energy and Energy Spread for experiments in 2016

	Nominal Energy [MeV/u]	Measured Energy [MeV/u]	Energy Spread HWHM [%]	Best guess Energy [MeV/u]	Best guess / measured energy
$^{66}\text{Ni}^{16+}$	4.5	4.47	0.2	4.46	0.998
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 - A/q
- Set Up Time
 - Provide examples varying from best to worst case.

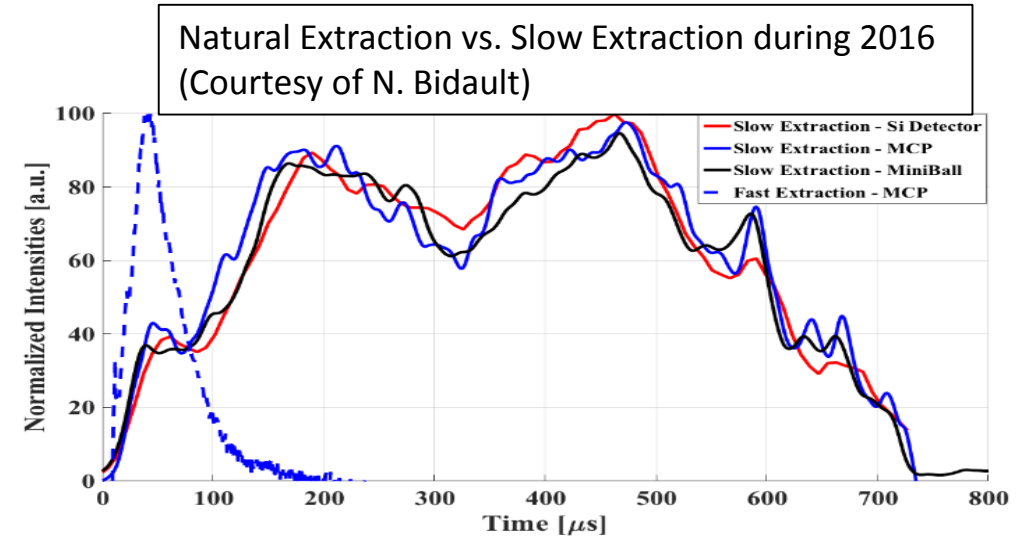
Beam Properties for 2017: Time Structure

In 2016:

- Repetition rate: up to 50 Hz
- RF Pulse length: up to 1 ms → Beam Pulse Length ~ 0.7 ms (with slow extraction)
- Average power in 9gap < 2.5 kW

Expected for 2017:

- Repetition rate: up to 50 Hz
- **RF Pulse length 2 ms → Beam Pulse Length ~ 1.7 ms**
 - Heat exchangers installed during the technical stop
 - Bertronix will be at CERN on wk. 7 and make the necessary modifications
- Average power in 9gap < 2.5 kW
- Spokesperson should inform OP if slow extraction is needed in advance (typically, a couple of hours are needed to set it up)



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Beam Properties for 2017: A/q

Before 2016:

- Nominal minimum A/q was 2.5
- Nominal maximum A/q was 4.5

Since 2016:

- Nominal minimum A/q still 2.5
- Nominal maximum **A/q changed to 4.33**
 - Several REX amplifiers not reliable at the power levels needed for beams with A/q = 4.5
- Impact of the change in specs is limited (needs to be analysed case by case):
 - Some light beams are not possible (ex: ${}^9\text{Li}^{2+}$)
 - Charge breeding efficiency for some heavy beams could become lower (by a factor 2-4)

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ISOLDE Beam Set Up Time Examples

- **Best Case #1**

Same isotope with different energies.

- If desired energies are known to OP then we can set up the machine the first time in a way that to change energy is a matter of switching off a number of cavities.

- **Best Case #2**

Different isotope but close in mass

- **Worst Case**

Completely different isotope in mass and energy

Summary

- Users should communicate to us before their experiment if they require beam energy measurement to take place.
- They should also provide a list of people to be granted access to the vacuum controls for the duration of their experiment.
- OP will not invest time in any last minute beam instrumentation solutions.
- Expected average SRF gradient for a beam with $A/q = 4.0$ to be 5.0 MV/m: 7.3 MeV/u.
- Faster energy measurement in 2017.
- RF Pulse length 2 ms \rightarrow Beam Pulse Length ~ 1.7 ms (with slow extraction)
- Nominal maximum A/q changed to 4.33.
- 46% of HIE RIB physics
- 20% of REX/HIE stable beam physics
- 40% low energy physics

Thank you

Questions?