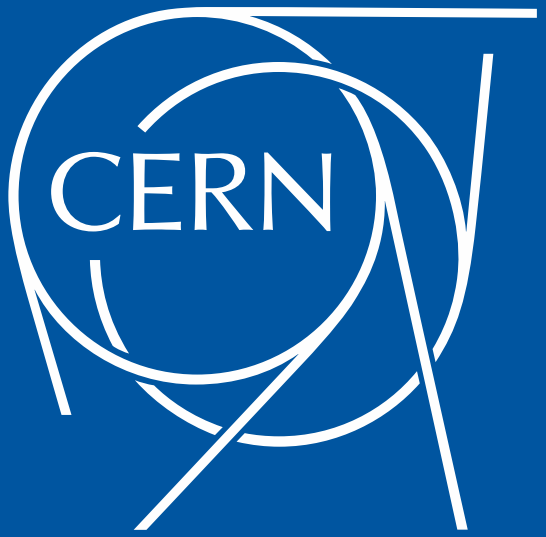

CERN

HIE-ISOLDE Report

Jose Alberto Rodriguez
on behalf of Yacine Kadi and the
HIE-ISOLDE project team

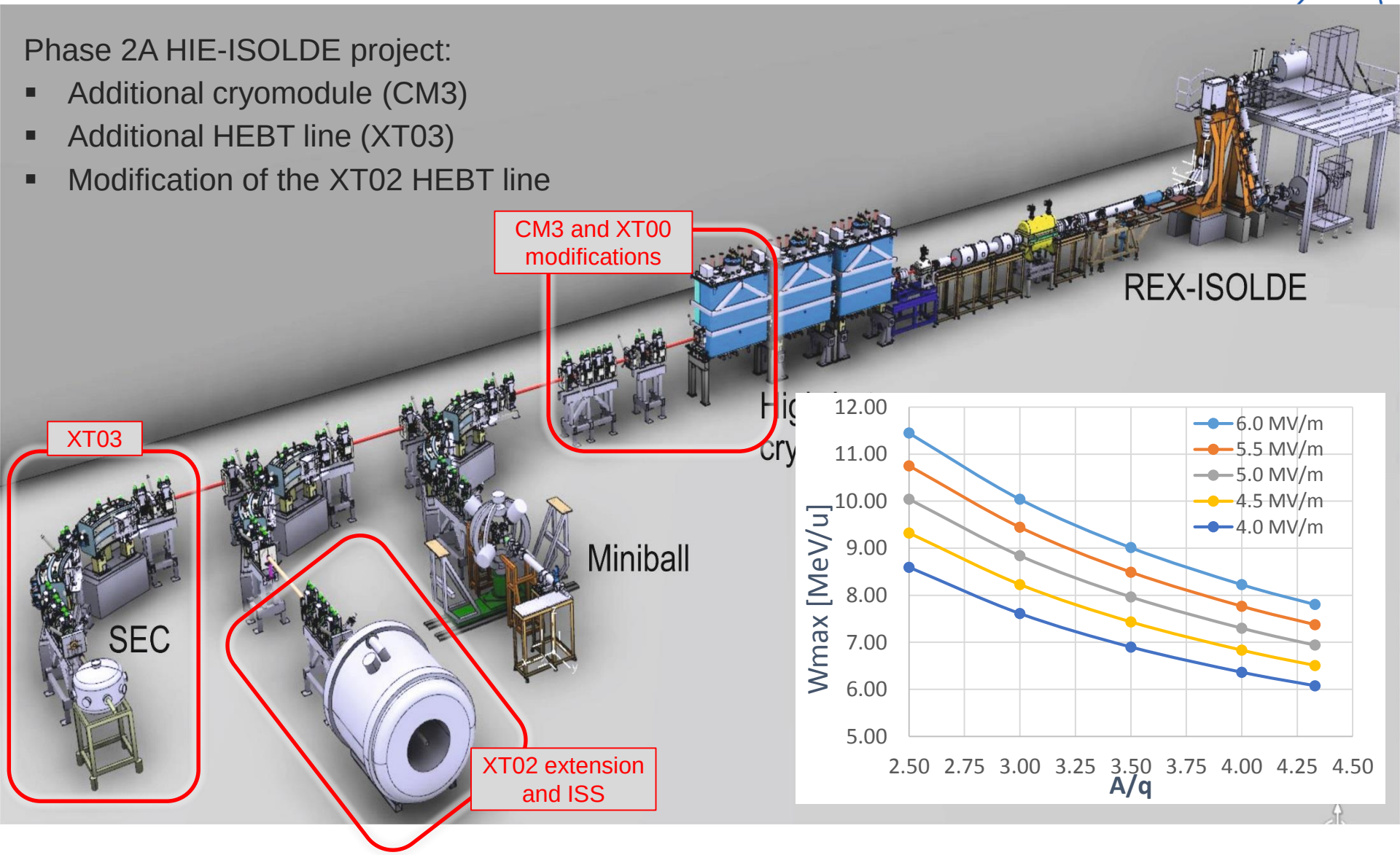
Outline:

- HIE-ISOLDE Phase 2A
- Installation
- Highlights of the Commissioning
- First Operation with Stable Beam
- Status and Schedule for Phase 2B
- Summary

HIE-ISOLDE Phase 2A:

Phase 2A HIE-ISOLDE project:

- Additional cryomodule (CM3)
- Additional HEBT line (XT03)
- Modification of the XT02 HEBT line



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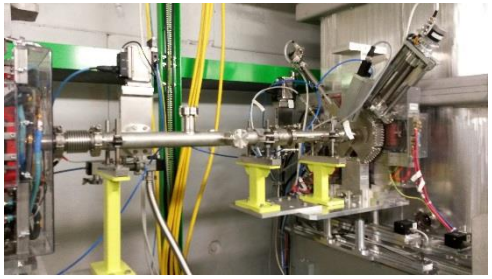
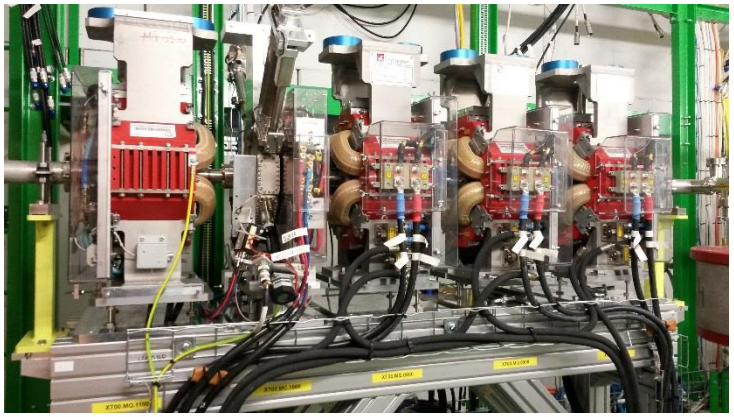
Installation: CM3 and XT00 Modification





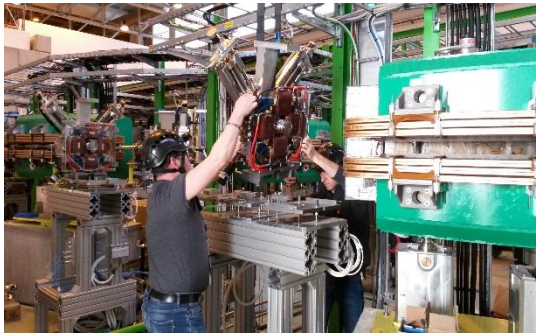


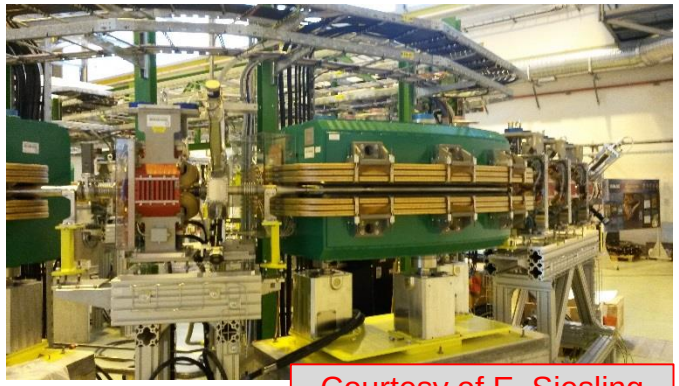


Courtesy of E. Siesling

- XLN5 intertank sector in place and vacuum closed. BCAM cameras in place
- All elements connected and aligned beginning of March
- Cryo tubing on the top-plate and outside on the tunnel roof finished. CM cabling all done

Installation: Third HEBT line (XT03)





Courtesy of E. Siesling

February – May:

- XT03 supports and tables in place and re-aligned immediately after the installation of ISS
- Installation of the dipoles followed by the Dbox units
- Quadrupole vac chambers arrived with a delay: Welding in the hall to avoid more delay
- All elements aligned
- Vacuum connections, gauges and valves in place. Sectors leak tight
- All DC, water, interlocks and instrumentation connected

Installation: ISS and XT02 Extension

Courtesy of E. Siesling

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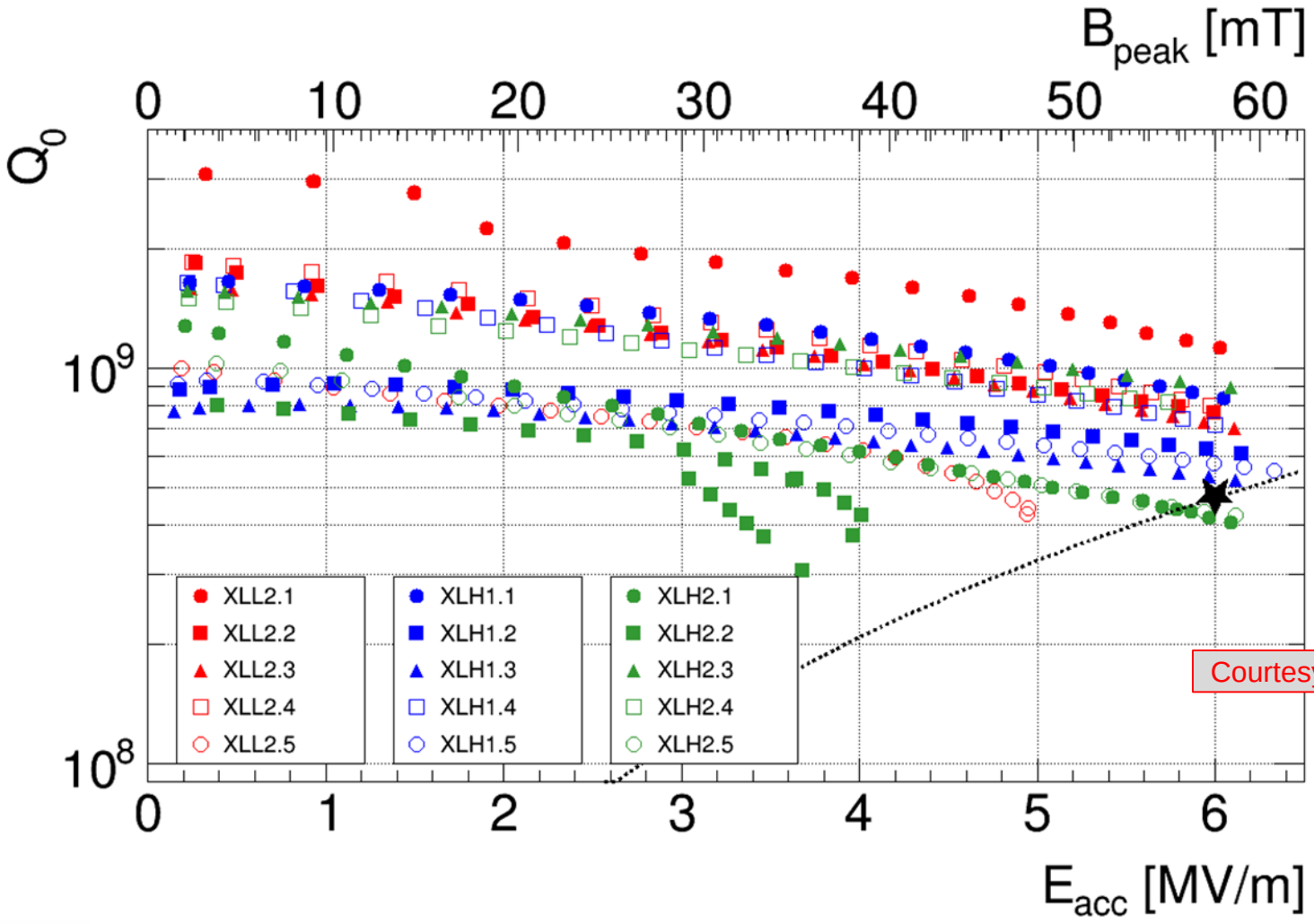
Hardware Commissioning: SRF cavities

- All cavities conditioned and RF measurements done
- Only one cavity in CM3 and one in CM1 limited by field emission at gradients lower than 6 MV/m

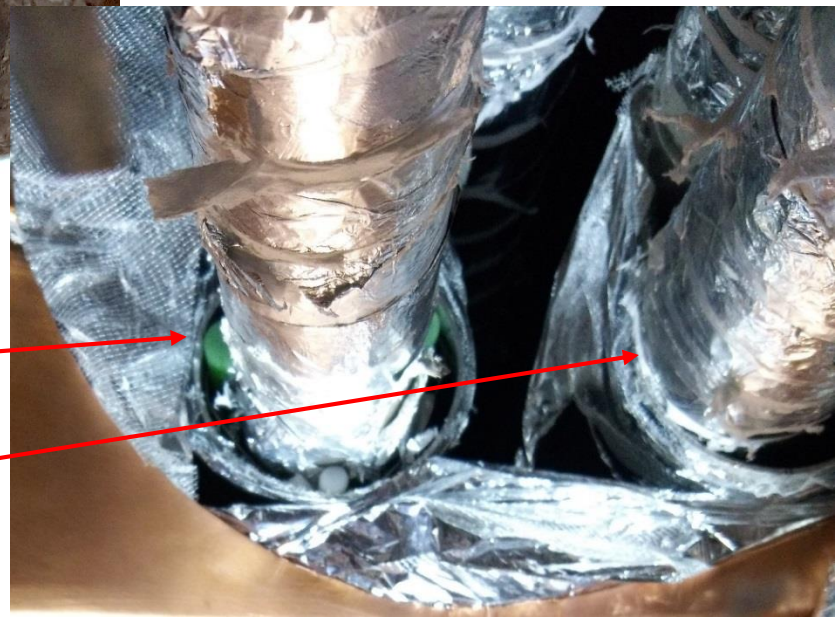


Courtesy of W. Venturini

Hardware Commissioning: Cryoline

- Thermal short in cryoline found and temporarily fixed
- Full repair planned for the 2017/18 technical stop

Courtesy of O. Pirotte



- Operation successful for LHe 4.5 K process pipe
- Not fully for GHe 4.5 K process pipe (requires too much force -> risk of breaking)

Beam Commissioning: Low Energy Tunes

- Tunes for beams with A/q = 3.5 to the end of XT01 after each REX RF structure was set-up
- Precise energy measurement using the dipole for each tune
- Transverse beam profiles at each diagnostics box measured (data not yet analysed)

RF cavity		RFQ	Buncher	IH	7GP1	7GP2	7GP3	9GP	
Energy [MeV/u]		0.29	0.3	1.185	1.53	1.88	2.23	2.82	
Transmission [%]	XSEP.FC20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	REX
	XLN2.BFC.0300	0.81	0.80	0.80	0.79	0.79	0.79	0.79	Long
	XLN3.BFC.0300	0.88	0.89	0.90	0.91	0.92	0.91	0.95	
	XLN4.BFC.0300	0.90	0.89	0.91	0.93	0.92	0.93	0.96	
	XLN5.BFC.0300	0.88	0.89	0.85	0.86	0.84	0.85	0.86	Short
	XT00.BFC.0700	0.88	0.89	0.84	0.86	0.85	0.87	0.84	
	XT00.BFC.1050	0.90	0.86	0.82	0.81	0.81	0.84	0.84	
	XT00.BFC.1300	0.81	0.80	0.81	0.81	0.80	0.81	0.80	
	XT01.BFC.0400	0.73	0.79	0.82	0.81	0.79	0.80	0.76	Long
	XT01.BFC.0900	0.81	0.80	0.81	0.81	0.80	0.80	0.78	

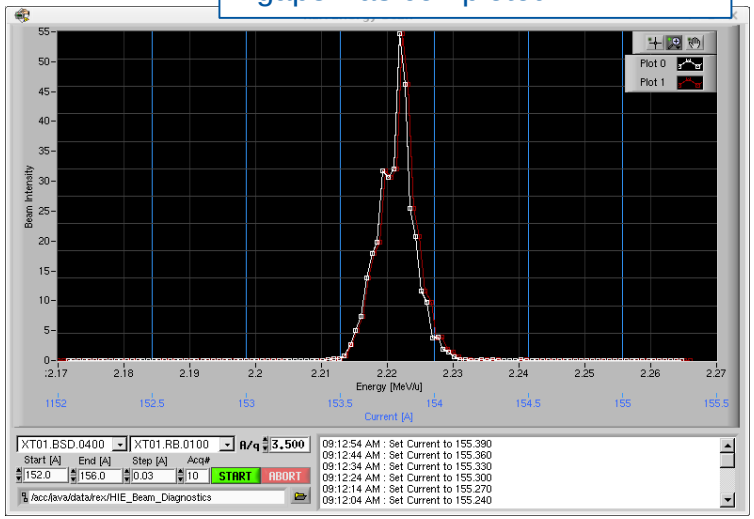
Conclusions:

- Low-energy beams can be transported without additional losses
- Beam losses in HIE-ISOLDE (ie. XLN2 to end of XT01) negligible or at the very least small
- Differences between different types of FC noticeable

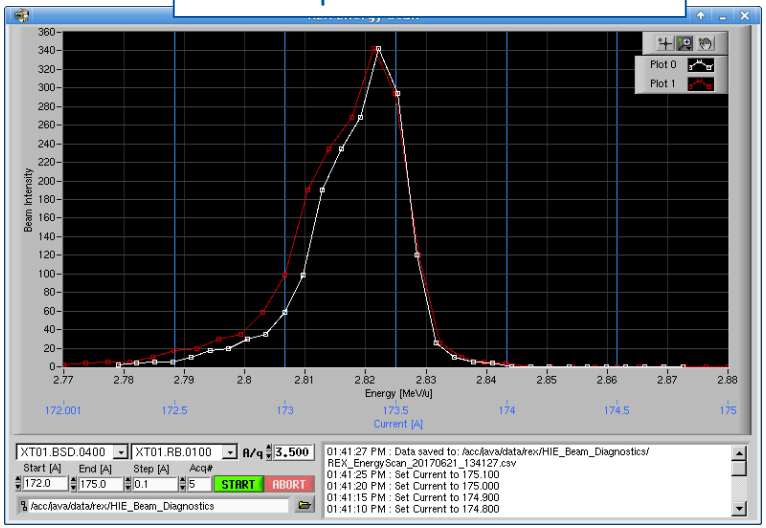
Beam Commissioning: Energy Measurement

- Energy and energy spread of the beam can be carried out using the count rate measured at the Silicon detector at XT01.0400 after the first dipole magnet

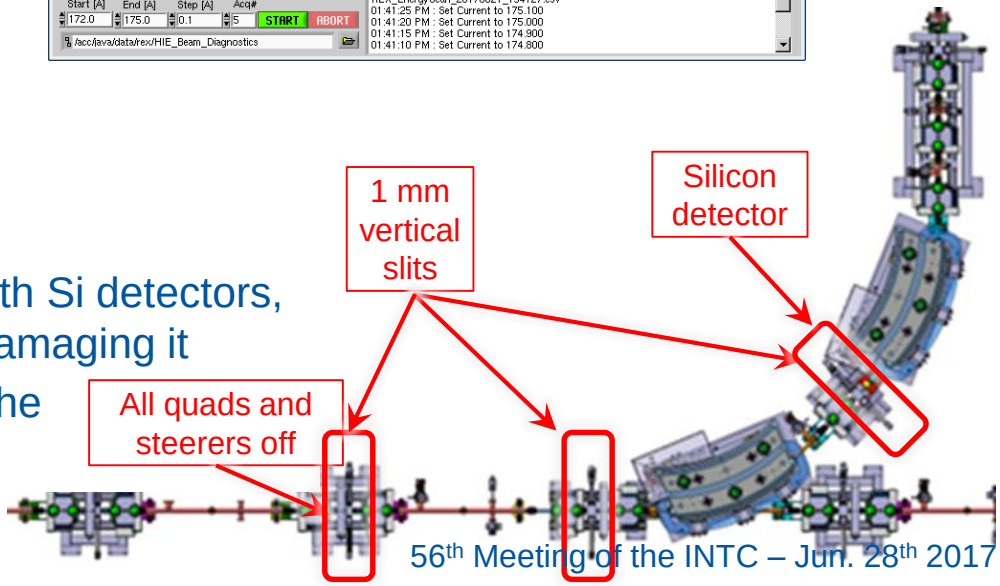
Energy Scan after set-up of 7gap3 was completed



Energy Scan after set-up of 9gap was completed



- The method works very well
  - Can be used for low-intensity beams
  - Can be completed in ~ 1 hour
  - However, as with all measurements with Si detectors, special attention is required to avoid damaging it
- We will need to consider installing them in the other two HEBT lines next year



Beam Commissioning: Remaining Activities

Week 26:

- Phasing of cavities in CM2 and CM3 with $^{14}N^{4+}$ (E_{final} = 6.5 MeV/u)
- Scaling to A/q = 3.67 and 4.0
- REX-TRAP and REX-EBIS synchronization with ^{39}K from the pilot ion source
- Scaling to A/q = 3.9

Week 27-28:

- Set-up for first RIB and Physics

Week 29:

- Scaling to A/q = 4.33

Week 30-32:

- Set-up and Physics

Week 33:

- First beam to XT03
- Commissioning of all diagnostics devices
- Commissioning of the stripping foils

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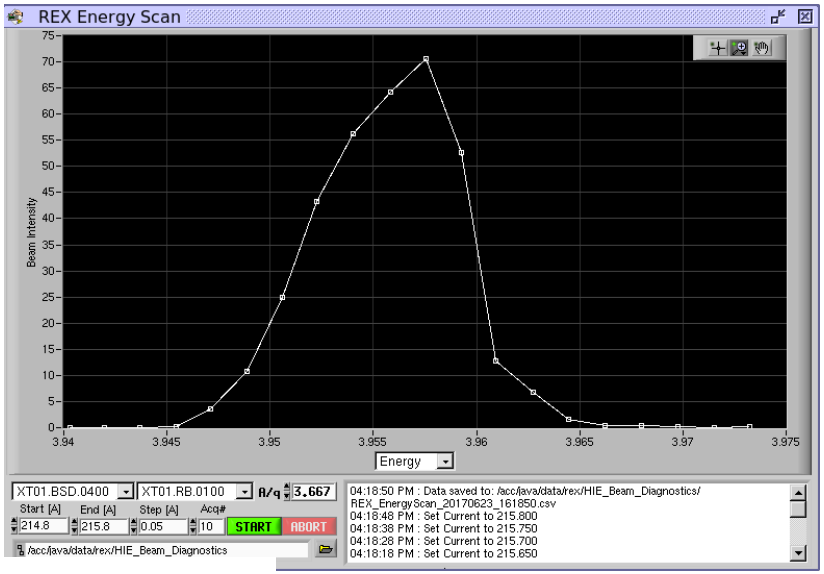
First Operation with Stable Beam:

- ^{22}Ne beam requested by Miniball users for testing and calibration last weekend

Ion	$^{22}Ne^{6+}$
A/q	3.667
HEBT	XT01
Transmission	~ 72 %
E	**3.955 MeV/u**
dE_{FWHM}	0.25 %
Length	~ 60 hours
Rep. rate	20 Hz



- Both REX and the SRF cavities quite stable (1.5 trip/shift)

RF structure	REX		HIE	
	RFQ	7GP3	SRF02	SRF04
# Trips	1	3	2	8
Downtime [mins]	15	0	10	40
Downtime [%]	0.4	0	0.3	1.1

- However, note that 40% extra power will be needed at REX for beams with A/q = 4.33 and that the gradient of the SRF cavities was not pushed to 6 MV/m

Cavity	Pf [kW]
RFQ	32.8
Buncher	1.45
IH	38.0
7GP1	51.0
7GP2	50.2
7GP3	46.2
9GP	61.5

Cavity	E [MV/m]
SRF01	4.14
SRF02	4.14
SRF03	4.14
SRF04	4.14
SRF05	3.22

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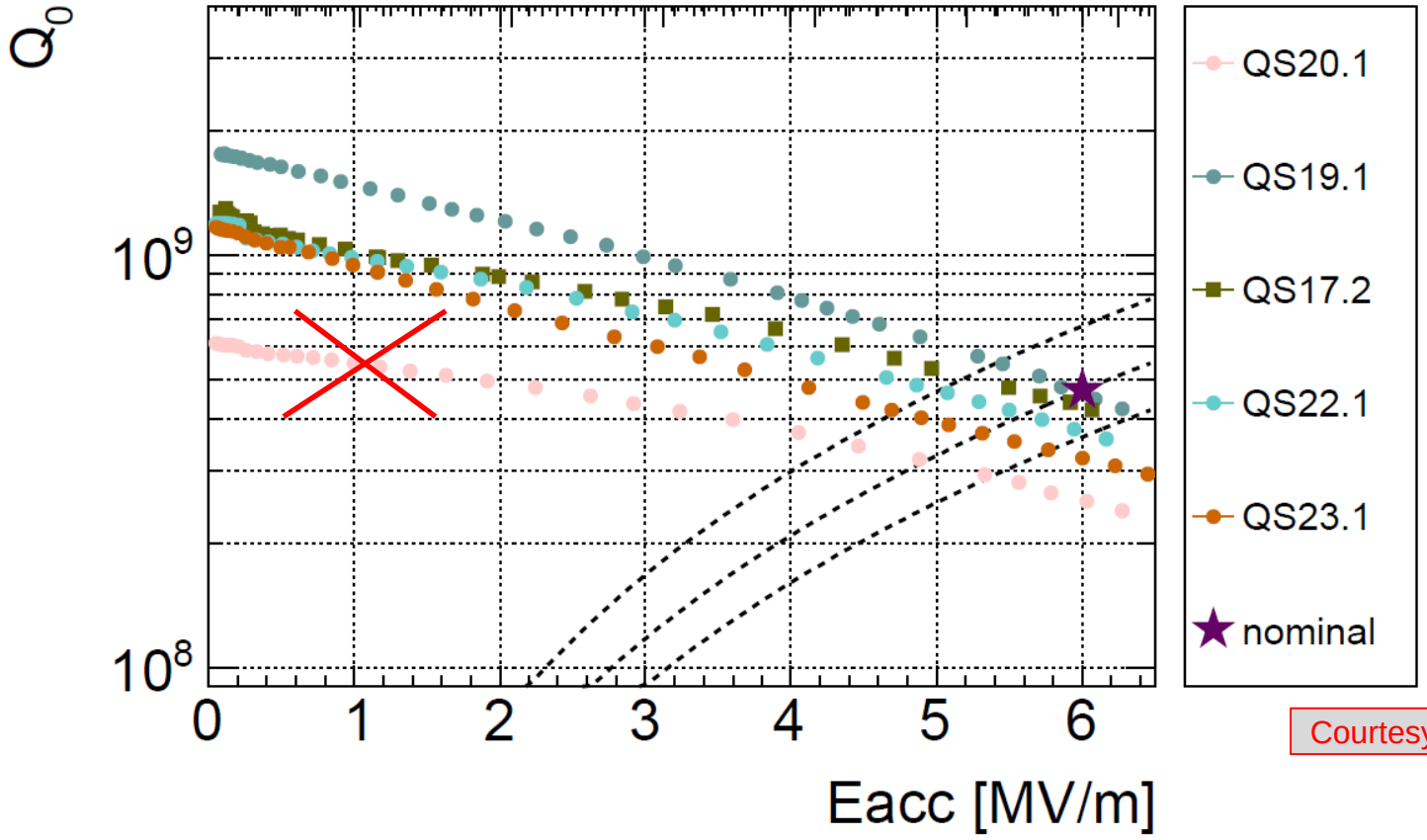
Status and Schedule for Phase 2B

Accelerating structures for CM4:

- Four cavities tested and ready for installation
- Additional cavity just coated with Niobium. Vertical RF test next week



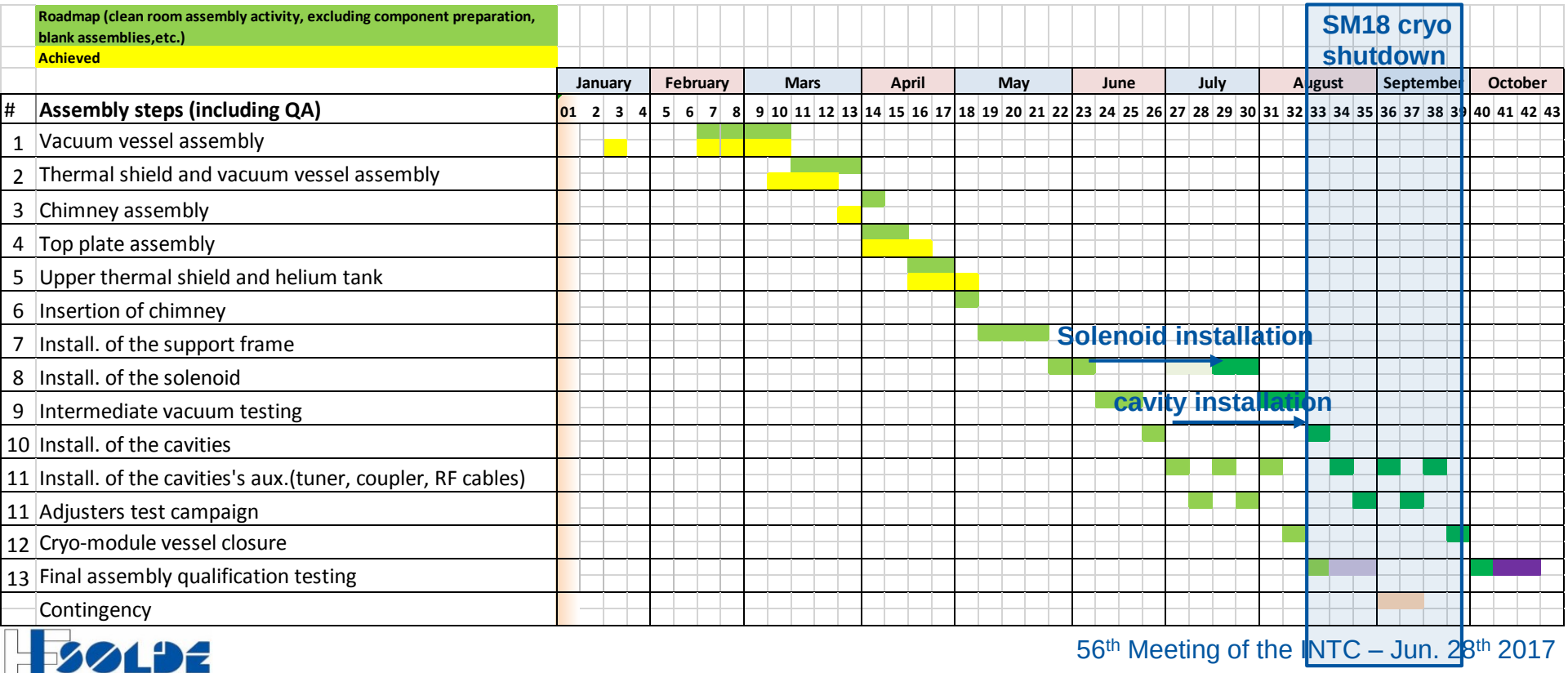
Courtesy of W. Venturini

Status and Schedule for Phase 2B

Plan for assembly of CM4:

- Same assembly team as for CM1, CM2 and CM3
- Same duration as for CM3 (27 weeks in clean room + 2 weeks qualification tests outside)
- Planning is shifted by 7 weeks to ensure the best set of active elements:
  - Solenoid #5 ready for installation in w29
  - 5 cavities ready for the installation in w33
- CM4 finished and tested at warm in w42

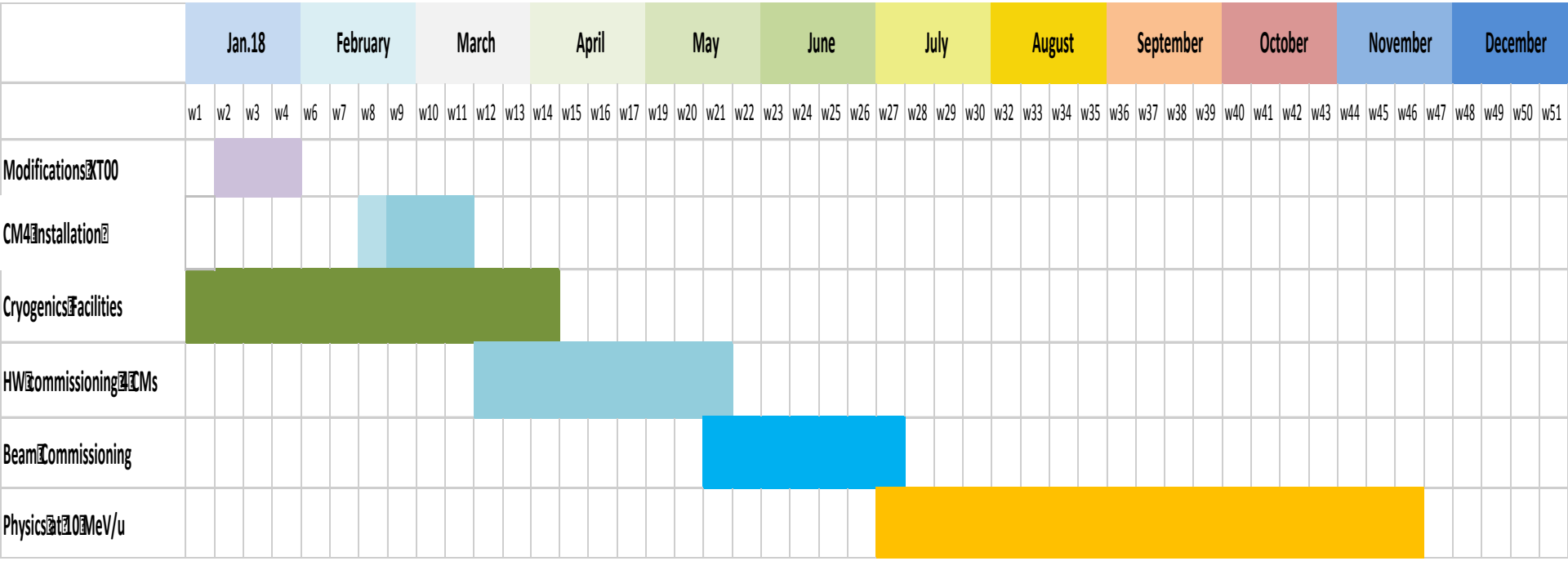
Courtesy of Y. Leclerq



Status and Schedule for Phase 2B

Plan for 2018:

- Installation of CM4 after refurbishing of cryoline starting in February
- Hardware commissioning and cryomodules cool-down starting in March
- Beam commissioning starting in May
- Physics starting in July



Courtesy of W. Venturini and Y. Kadi

Outline:

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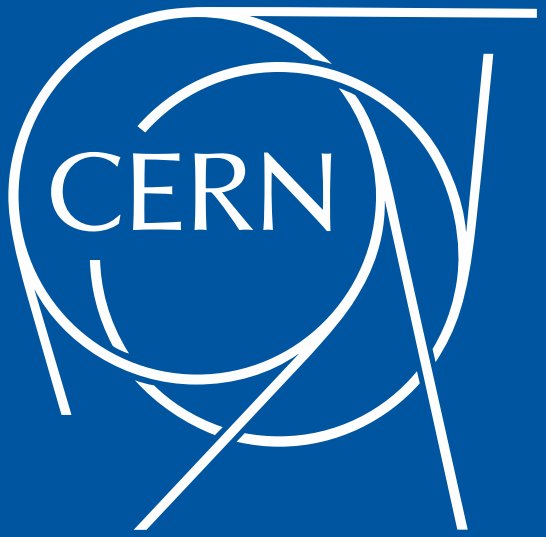
Summary:

- Installation and hardware commissioning of HIE-ISOLDE Phase 2A completed (3 cryomodules with 5 QWR each, 3 HEBTs lines)
- Hardware commissioning completed:
  - All power converters/magnets circuits tested
  - All SRF cavities conditioned and tested
  - Source of the cavity trips identified and mitigated
  - Source of thermal loss in cryoline identified and mitigated
- Beam commissioning on-going:
  - Low energy tunes to the end of XT01 prepared (80% transmission)
  - Cavities in CM1, CM2 and part of CM3 phased
  - New low and high level control software tested
  - Commissioning of XT03 on week 33
- Operations:
  - First stable beam (^{22}Ne at 4 MeV/u) delivered to the Miniball Spectrometer
- Phase 2B status and plan:
  - Four cavities ready for installation in CM4, one more will be tested on wk. 27
  - Assembly of CM4 will be completed before the end of 2017
  - Installation in tunnel in February 2018
  - Physics campaign in July 2018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