HIE-ISOLDE Project Status Report

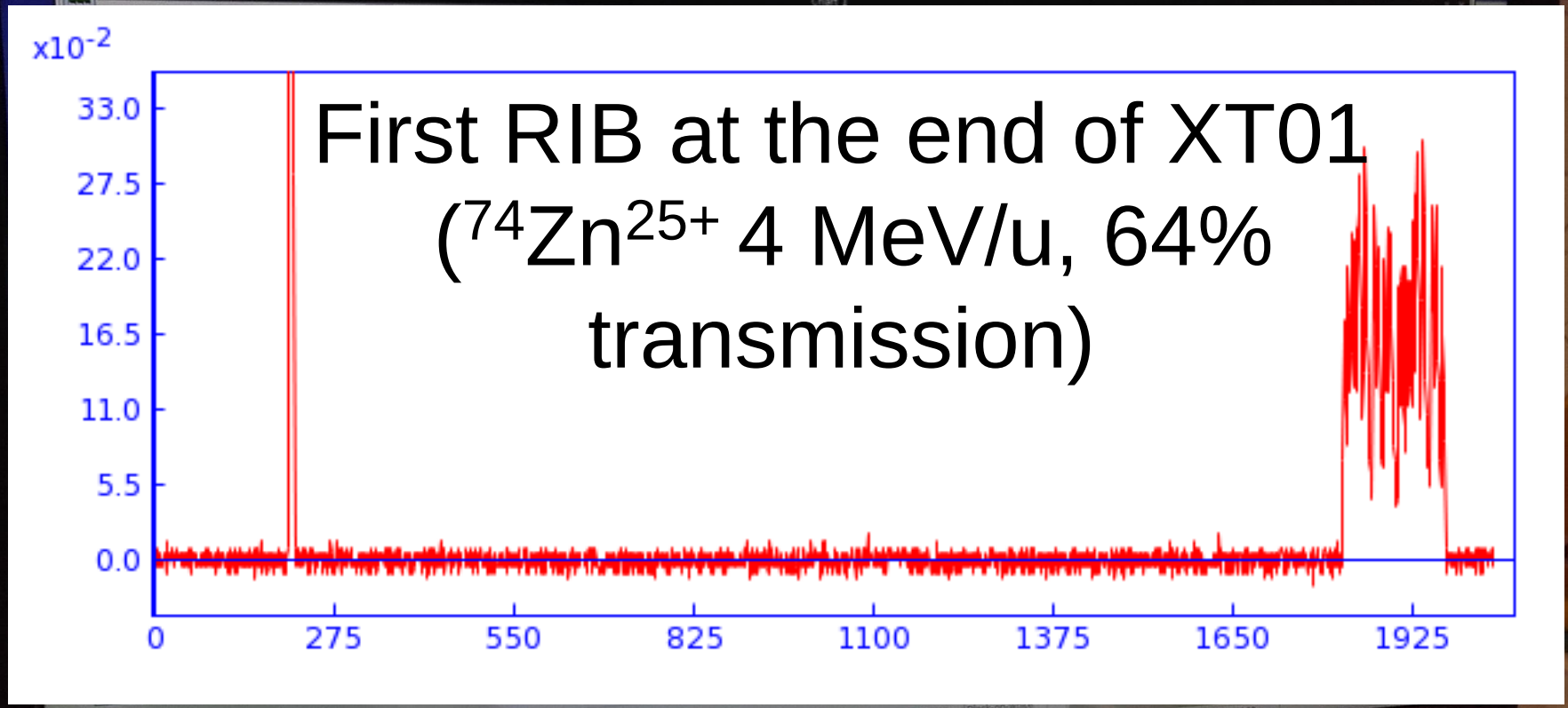
51st ISOLDE & nTOF Technical Committee meeting
November 11th 2015

Y. Kadi
On behalf of the HIE-ISOLDE Project Team

OUTLINE

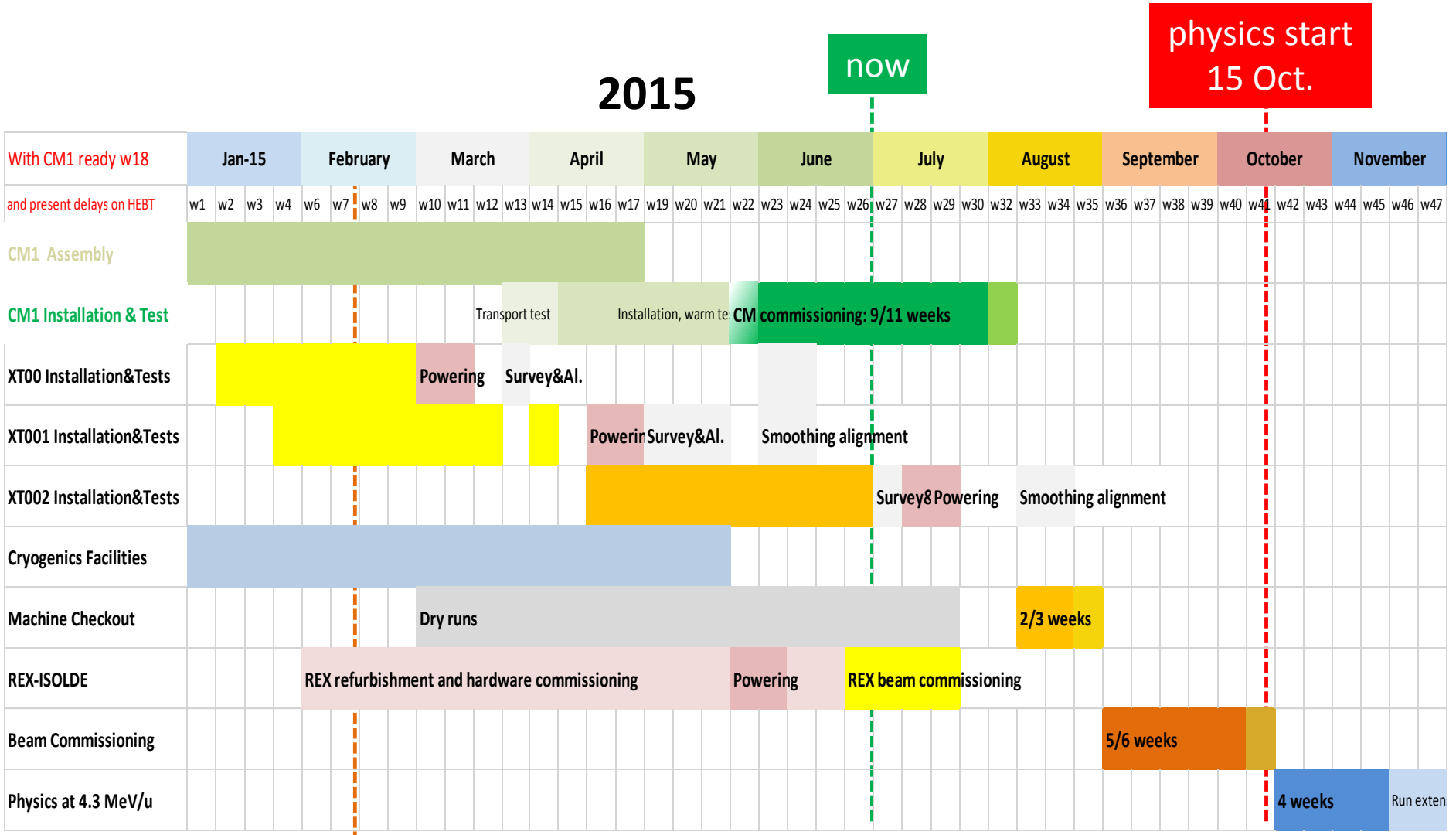
- Main Highlights
- Status of the Machine
  - ✓ REX+SC Linac+HEBT commissioning
  - ✓ Pending issues
  - ✓ CM2 assembly
- End-of-year shut-down works
- Schedule 2016-2018
  - ✓Physics @ 5.5 MeV/u
  - ✓Physics @ 10 MeV/u
- Conclusions

@ 17:00 !



First RIB at the end of XT01
($^{74}Zn^{25+}$ 4 MeV/u, 64% transmission)

HIE ISOLDE roadmap in 2015

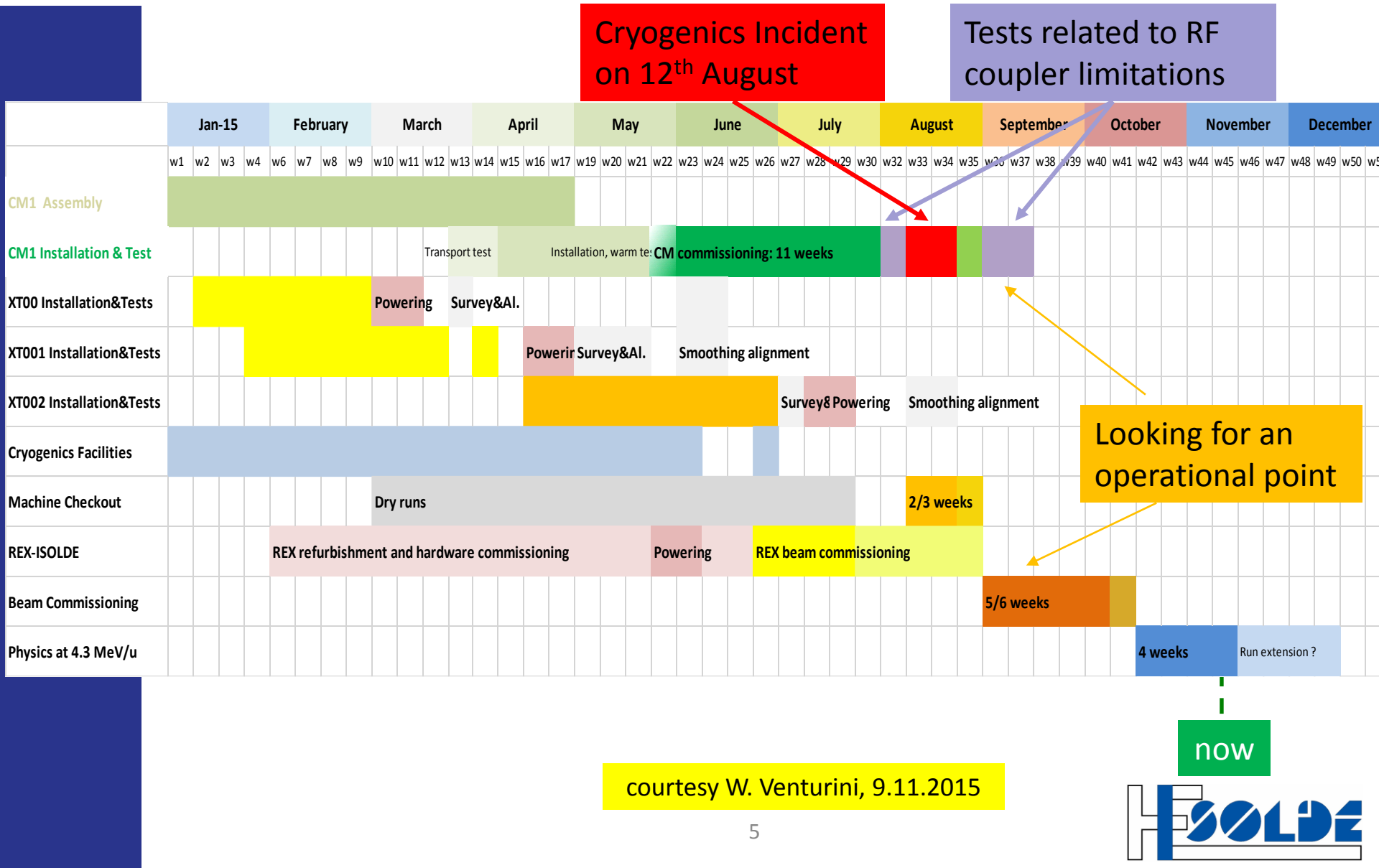


HW tests starting 19 Feb.

Several mitigation measures to catch up with earlier delays possible (first already adopted: no cold test of CM1 in SM18).

courtesy W. Venturini, 30.6.2015

HIE ISOLDE roadmap 2015



courtesy W. Venturini, 9.11.2015

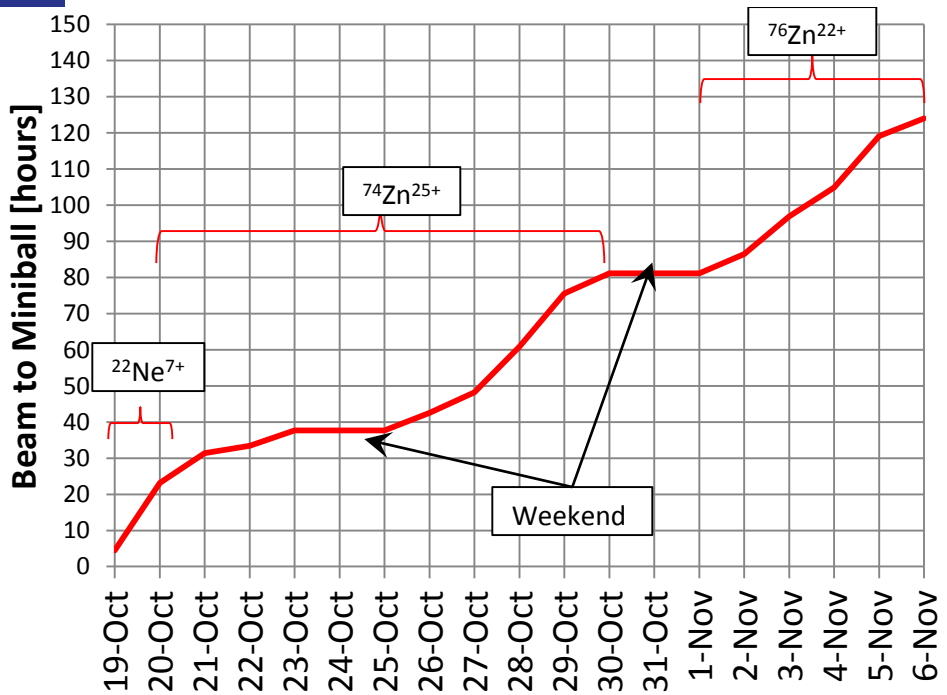
Commissioning with beam

- **Stage 1: REX diagnostics box: w25-w26**
  - ✓ Commissioning with beam started on June 16th
- **Stage 2: First HIE-ISOLDE diagnostics box: w27-w33**
- **Stage 3: Commissioning and phasing of RF Structures in REX:**
  - ✓ Cavities and their amplifiers were commissioned after they were turned on by the RF team
  - ✓ Many of the problems listed in previous slides were discovered at this time
  - ✓ Finally, operational settings (phases and amplitudes) for all RF cavities were determined
- **Stage 4: Commissioning the High Energy Beam Transfer (HEBT) line w33-w38**
- **Stage 5: Acceleration with SRF cavities: w40-w43**
  - ✓ First attempt to accelerate beam on wk. 40
  - ✓ Lots of work to reduce the amount of power needed to reach the necessary gradient and to increase their stability during wk. 40-41
  - ✓ All cavities phased for $^{12}C^{4+}$ with a final energy of 4 MeV/u on wk. 42
  - ✓ $^{12}C^{4}$ beam with 4 MeV/u transported to the end of XT01 on wk. 43

courtesy W. Venturini, 9.11.2015

Operations: Beam to Miniball

- Three different ions delivered to Miniball (one stable and two RIBs)
- Two different energies per nucleon
- SRF limited to running ~ 6 hours per working day due to heating problem in couplers



Week 43	Mon - 19-Oct	$^{22}Ne^{7+}$ - 2.85 MeV/u
	Tue - 20-Oct	
	Wed - 21-Oct	
	Thu - 22-Oct	$^{74}Zn^{25+}$ - 4.0 MeV/u
	Fri - 23-Oct	
Week 44	Mon - 26-Oct	
	Tue - 27-Oct	$^{74}Zn^{25+}$ - 4.0 MeV/u
	Wed - 28-Oct	$^{74}Zn^{25+}$ - 2.85 MeV/u
	Thu - 29-Oct	
	Fri - 30-Oct	
Week 45	Mon - 02-Nov	
	Tue - 03-Nov	$^{76}Zn^{22+}$ - 4.0 MeV/u
	Wed - 04-Nov	$^{76}Zn^{22+}$ - 2.85 MeV/u
	Thu - 05-Nov	
	Fri - 06-Nov	

Ion	Energy [MeV/u]	Ibeam [1E6 pps]	time [hours]
$^{22}Ne^{7+}$	2.85		31.4
$^{74}Zn^{25+}$	2.85	1-2	15.5
$^{74}Zn^{25+}$	4	1-2	34.3
$^{76}Zn^{22+}$	2.85	0.5-1	26.7
$^{76}Zn^{22+}$	4	0.5-1	16.2
Total			124.0

Jose Alberto Rodriguez, BE-OP-PSB (x167538)

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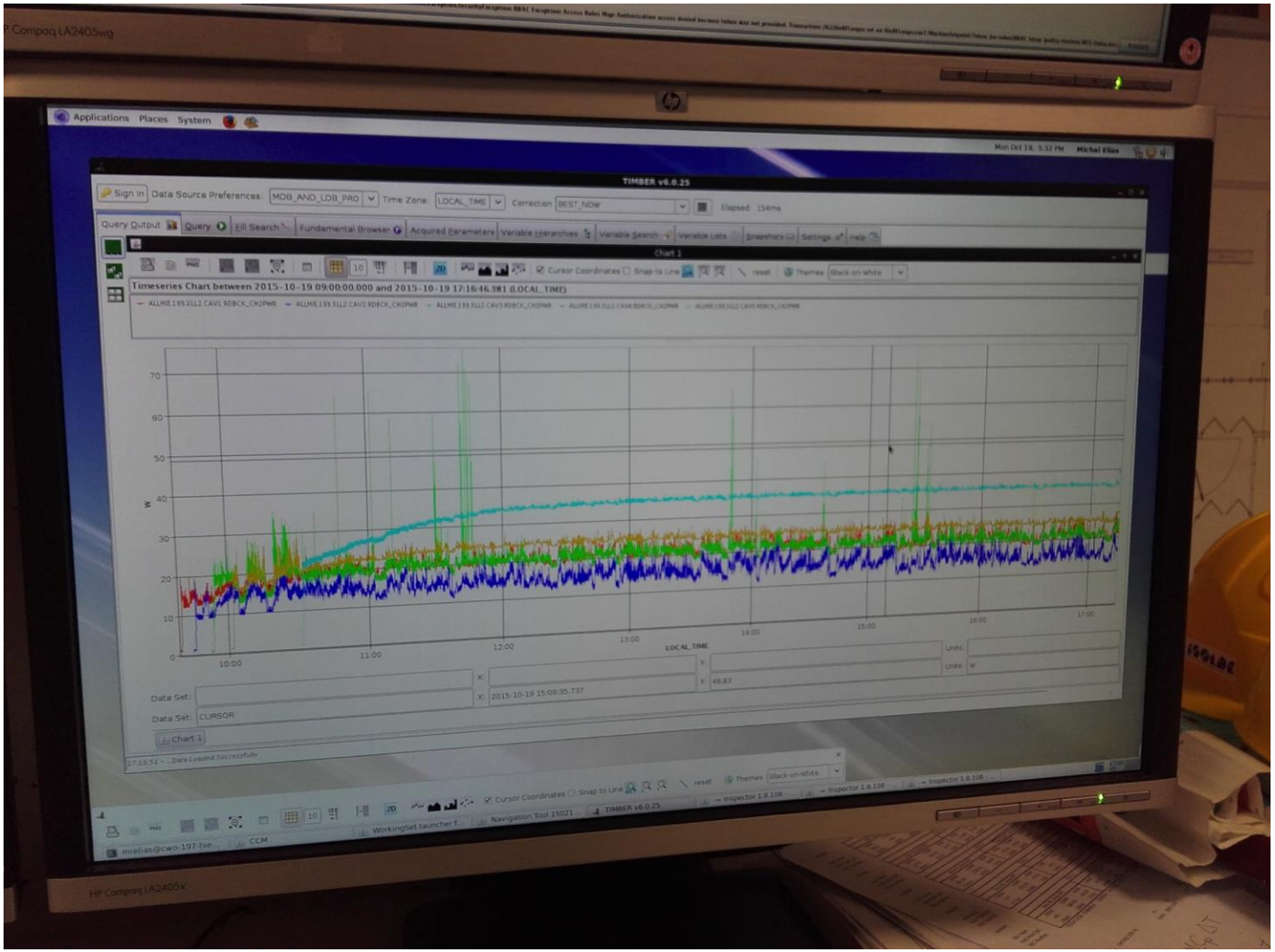
RF Coupler Issue



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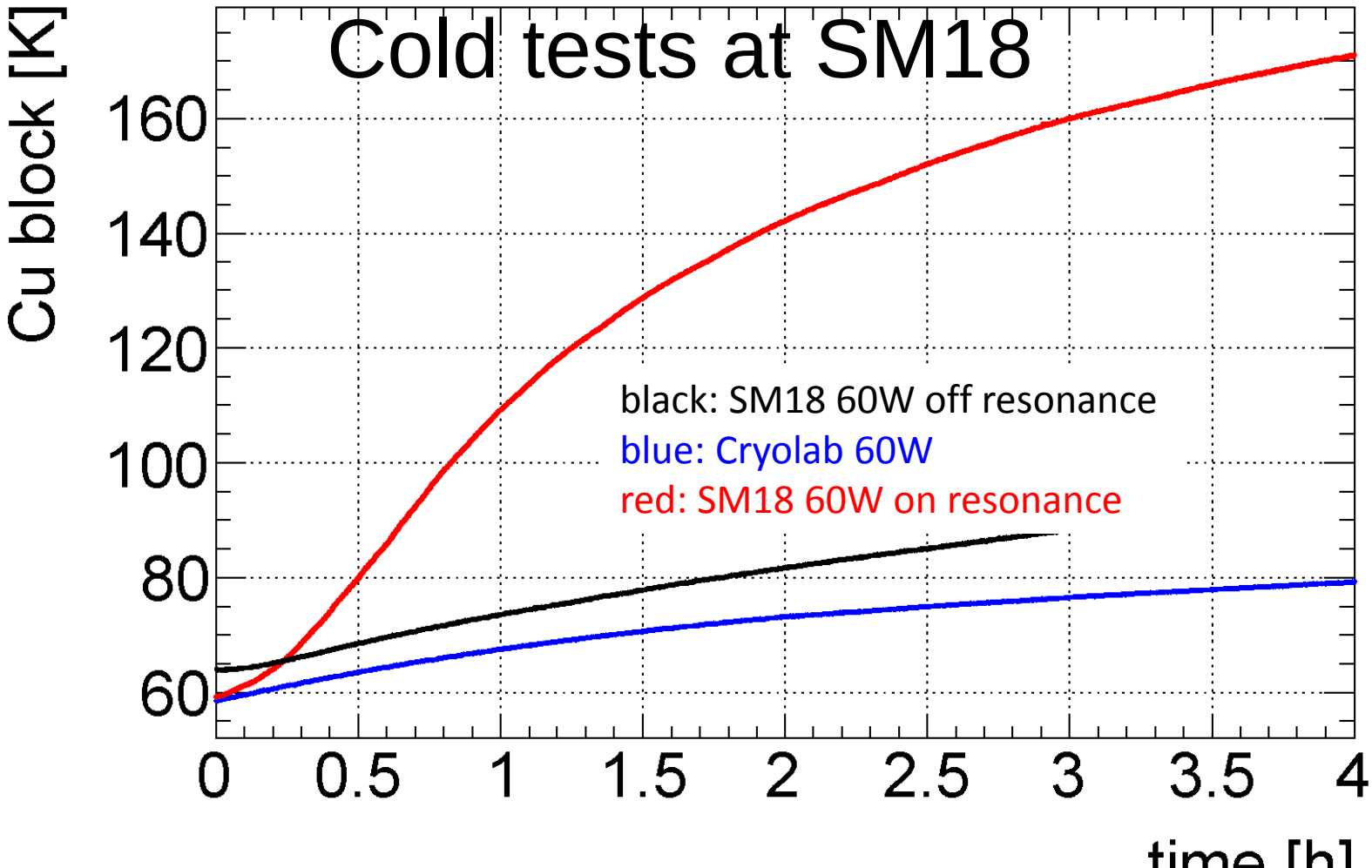

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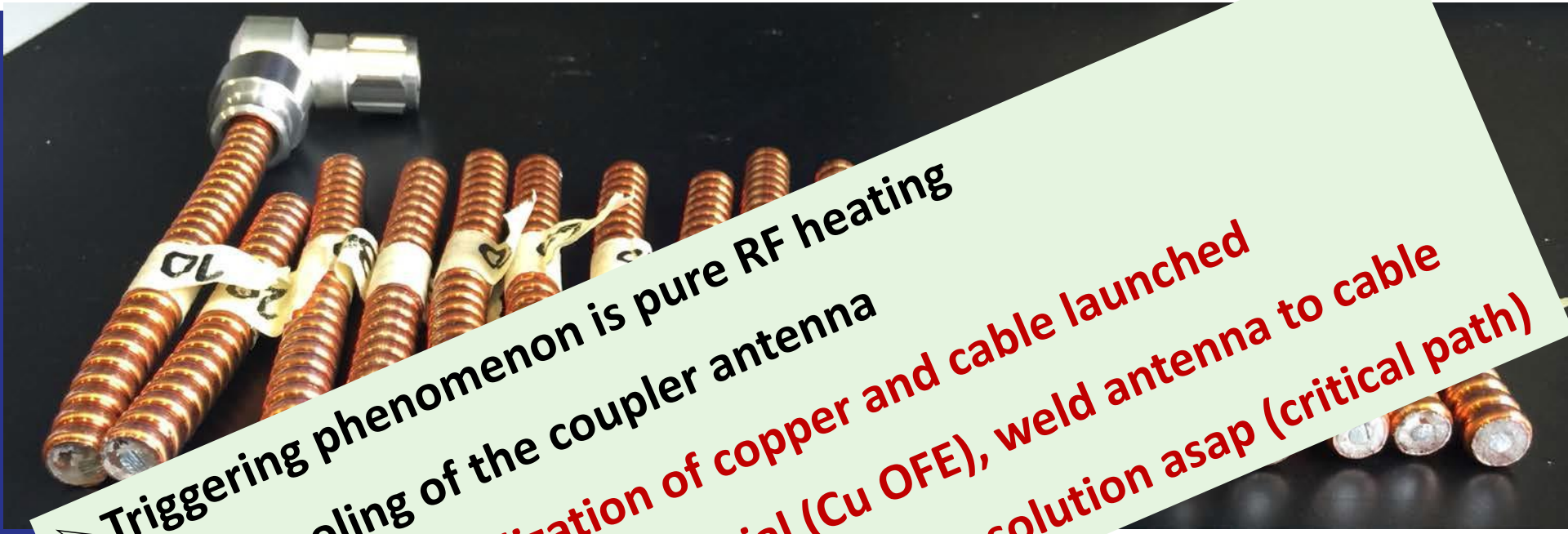


- Triggering phenomenon is pure RF heating
- Key is cooling of the coupler antenna

⇒ New thermalization of copper and cable launched

⇒ Change antenna material (Cu OFE), weld antenna to cable

⇒ Crash program: need to test new solution asap (critical path)

courtesy Y. Leclercq, 9.11.2015

CM2 assembly

Roadmap (clean room assembly activity, excluding component preparation, blank assemblies,etc.)
In progress
Achieved

		June				July					August				September					October				November		
#	Assembly steps (including QA)	w21	w22	w23	w24	w25	w26	w27	w28	w29	w30	w31	w32	w33	w34	w35	w36	w37	w38	w39	w40	w41	w42	w43	w44	w45	w46	w47
8	Install. of the solenoid																											
9	Intermediate vacuum testing *(newly added)*																											
10	Install. of the cavities																											
11	Install. of the cavities's aux.(tuner, coupler, RF cables)																											
12	Cryo-module vessel closure																											
13	Final assembly qualification testing																											

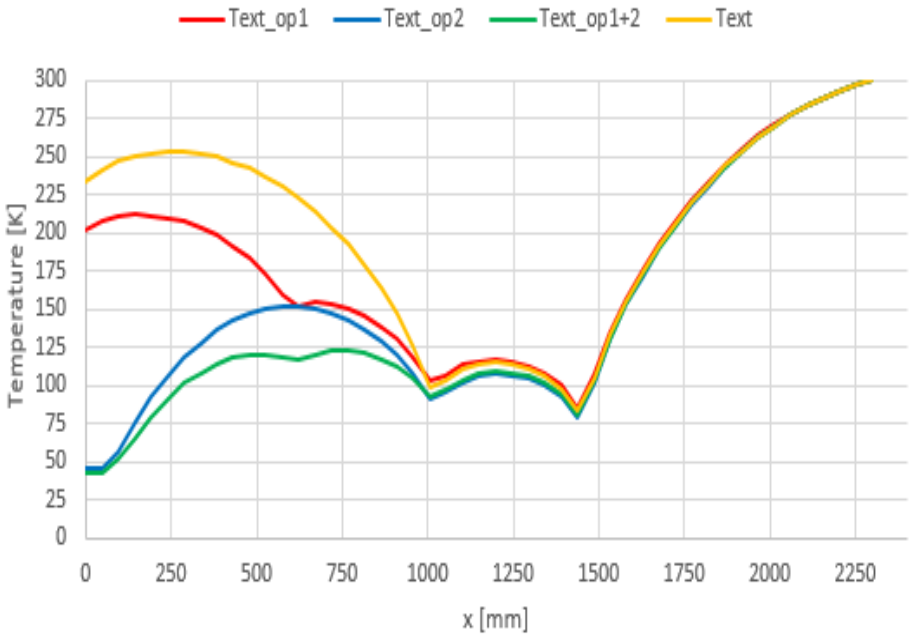
Solenoid assembly into the supporting frame

Dummy cavity assembly

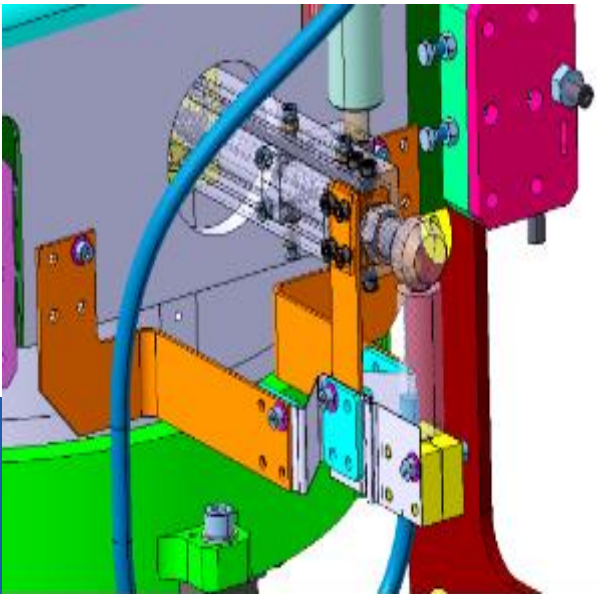
Intermediate vacuum testing

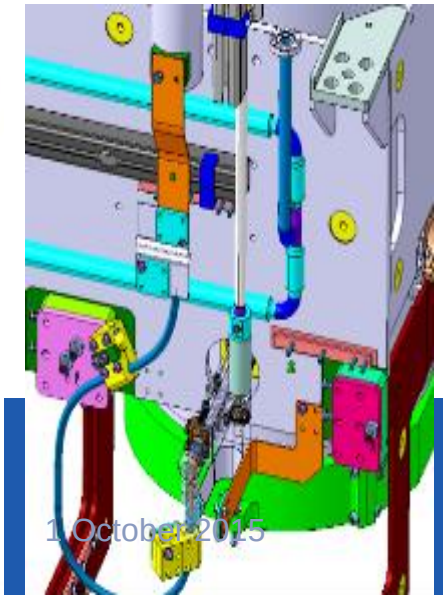
Next step: Cavities assembly

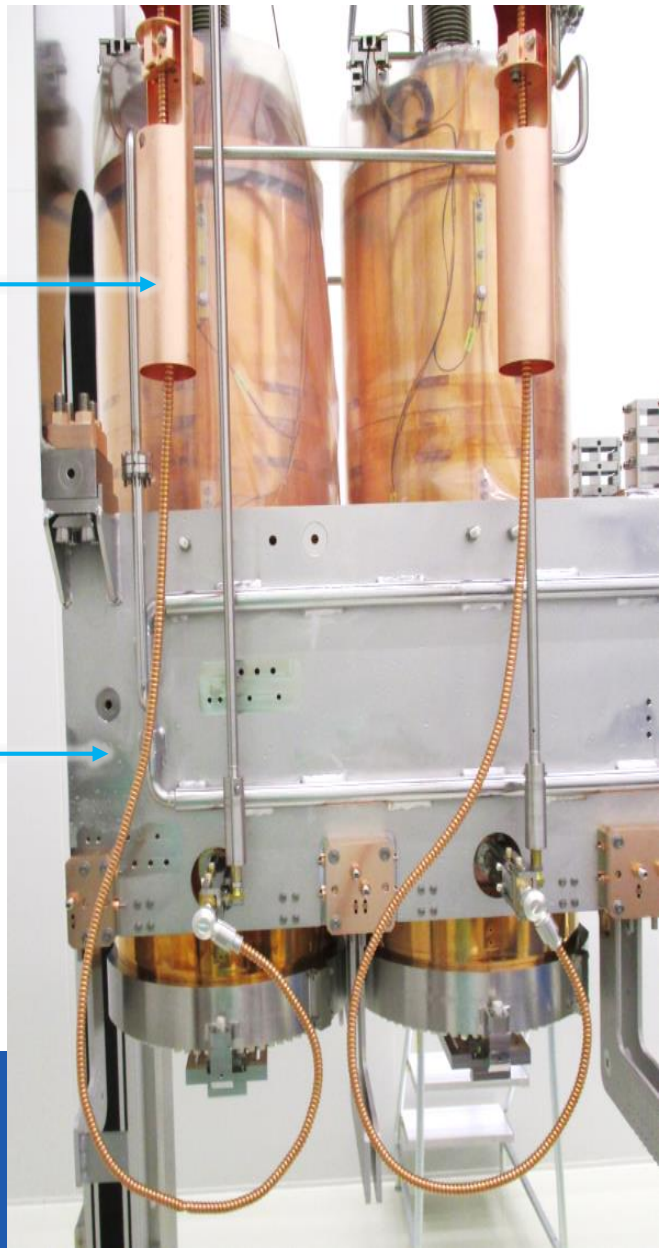
RF coupler thermalizations: conceptual design



Courtesy :
Julien Dequaire,
Luca Valdarno







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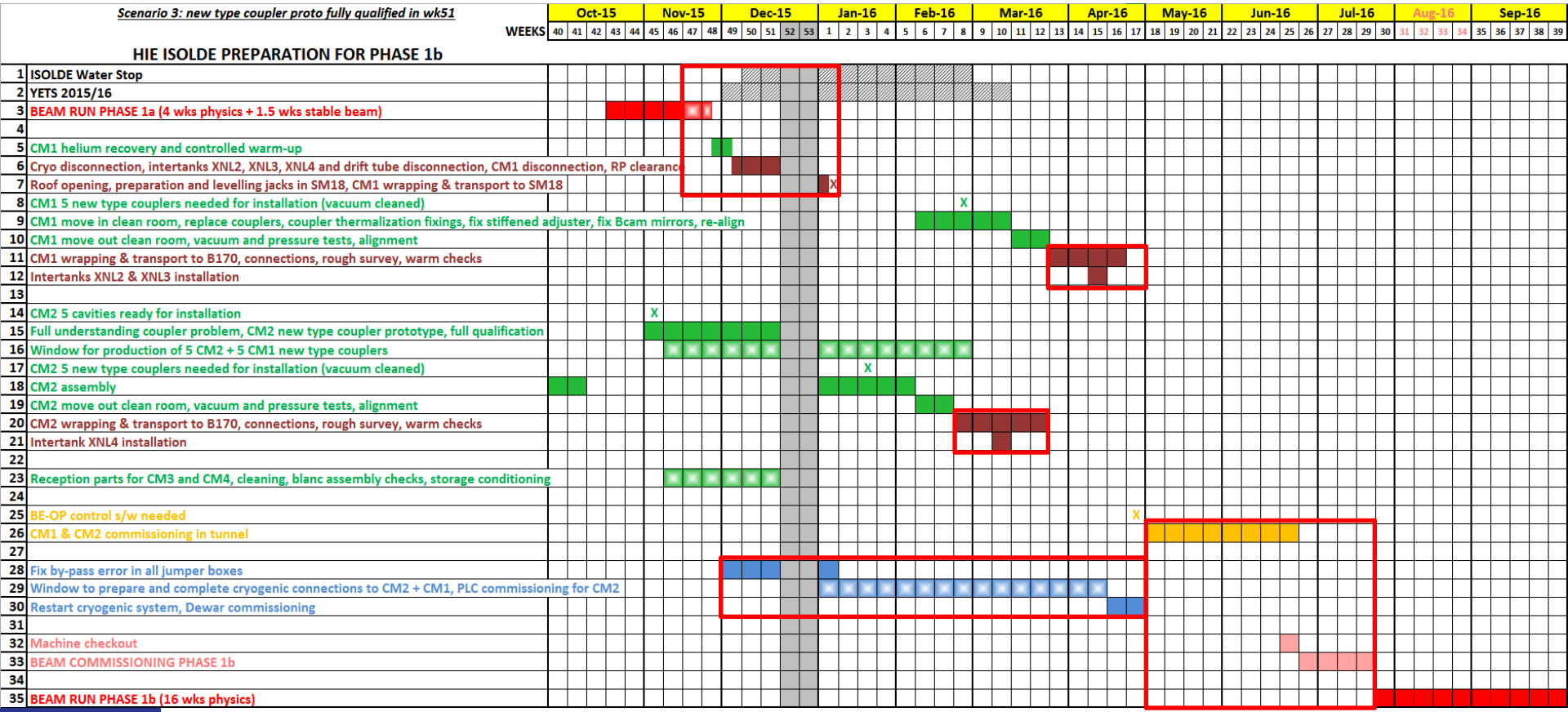
Main installation & startup tasks



- Removal CM1: End-of-year 2015
- Installation CM2: end Feb – end March 2016
- Re-installation CM1: end March – end April 2016
- Cryo modifs & maintenance: Dec 2015 – end April 2016
- HW & Beam commissioning CM1 & 2: May – end July 2016

Physics start
end July 2016 (16 wks)

courtesy E. Siesling, 9.11.2015

End-of-year & removal CM1

Scenario 3: new type coupler proto fully qualified in wk51

HIE ISOLDE PREPARATION FOR PHASE 1b

		Oct-15					Nov-15				Dec-15					Jan-16				Feb-16				Mar-16					Apr-16			
	WEEKS	40	41	42	43	44	45	46	47	48	49	50	51	52	53	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	ISOLDE Water Stop																															
2	YETS 2015/16																															
3	BEAM RUN PHASE 1a (4 wks physics + 1.5 wks stable beam)																															
4																																
5	CM1 helium recovery and controlled warm-up																															
6	Cryo disconnection, intertanks XNL2, XNL3, XNL4 and drift tube disconnection, CM1 disconnection, RP clearance																															
7	Roof opening, preparation and levelling jacks in SM18, CM1 wrapping & transport to SM18															X																
28	Fix by-pass error in all jumper boxes																															
29	Window to prepare and complete cryogenic connections to CM2 + CM1, PLC commissioning for CM2																															
30	Restart cryogenic system, Dewar commissioning																															

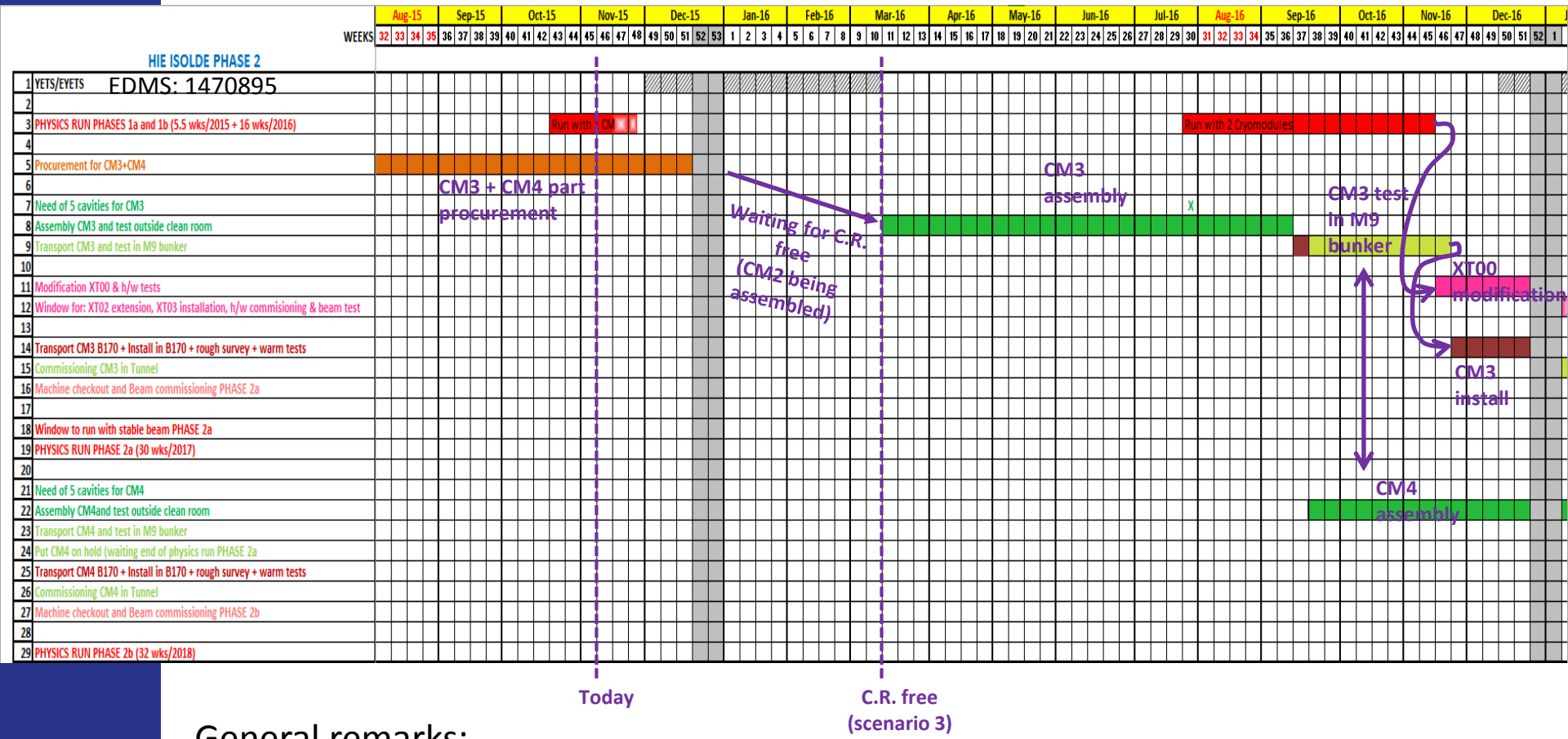
<u>End-of-year work: wk48 – wk1</u>

Users: Stable beam until 25 Nov
(1 1/2wks after p-stop)
Warm up CM1: Starts 25 Nov
(constraints: cryo modif work & water stop)

- 1 day heating elements commissioning
- 6 days controlled warming up

Cryo jumper boxes modification wk49 – wk1
(constraints: availability due to YETS)
Dismounting all services wk49 – wk51
Transport CM1 to SM18 wk1

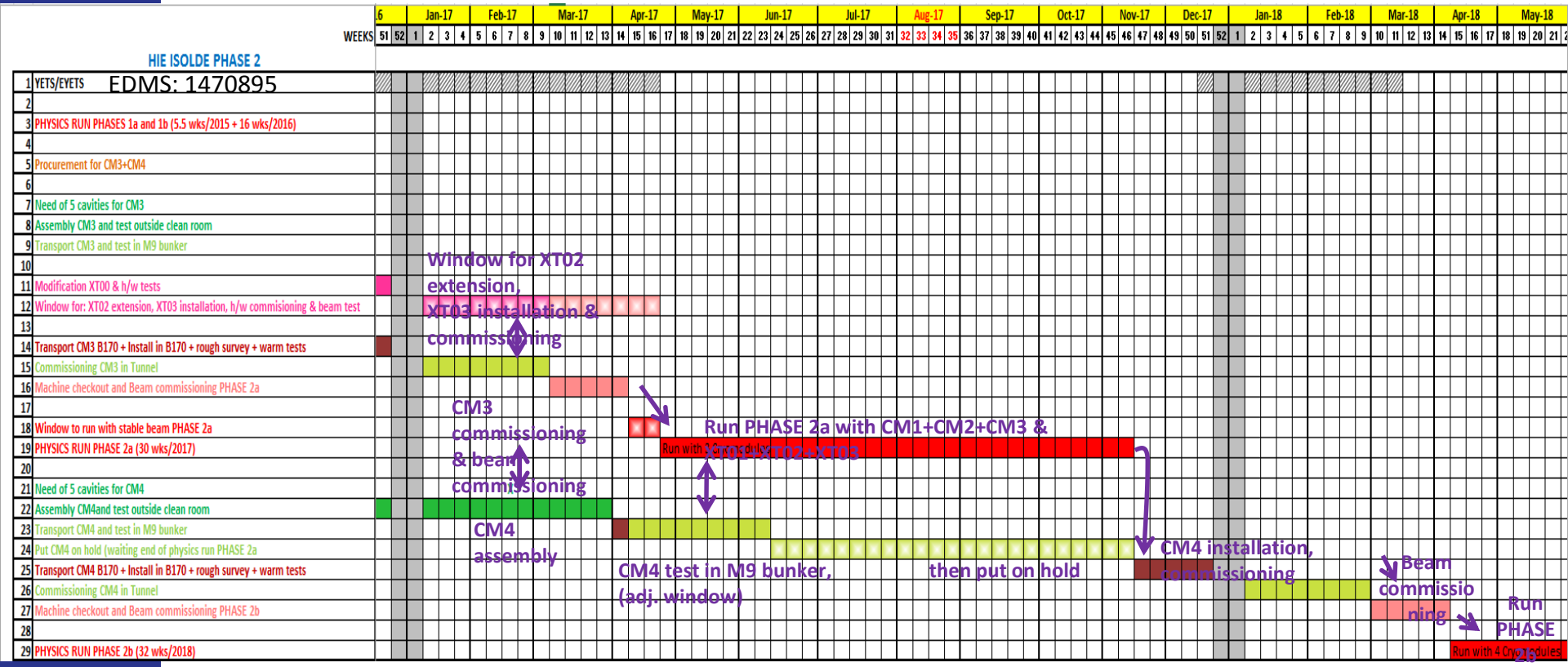
Forecast for HIE-ISOLDE Phase 2 (years 2015- 2016)



General remarks:

- Test in M9 bunker are foreseen for CM3 and CM4 while the HIE-ISOLDE facility is in operation
- XT00 modification for PHASE 2

Forecast for HIE-ISOLDE Phase 2 (years 2017- 2018)



General remarks:

- PHASE 2 run is could be split into PHASE 2a (2017) and PHASE 2b (2018)
- beam optics with 3 CMs to be checked

Conclusions

The 2015 Hardware Commissioning campaign achieved its goals:

- Envelopes for OP defined
- Software & Controls operational
- Weaknesses and limits identified and investigated

CM design choices validated:

- Cavity cleanliness preserved during assembly
- Heat loads according to specs.
- Alignment specifications fulfilled

SC cavities field measurements confirmed with beam

RF input lines/coupler problem identified, being addressed

Physics run started on 19th October, on schedule

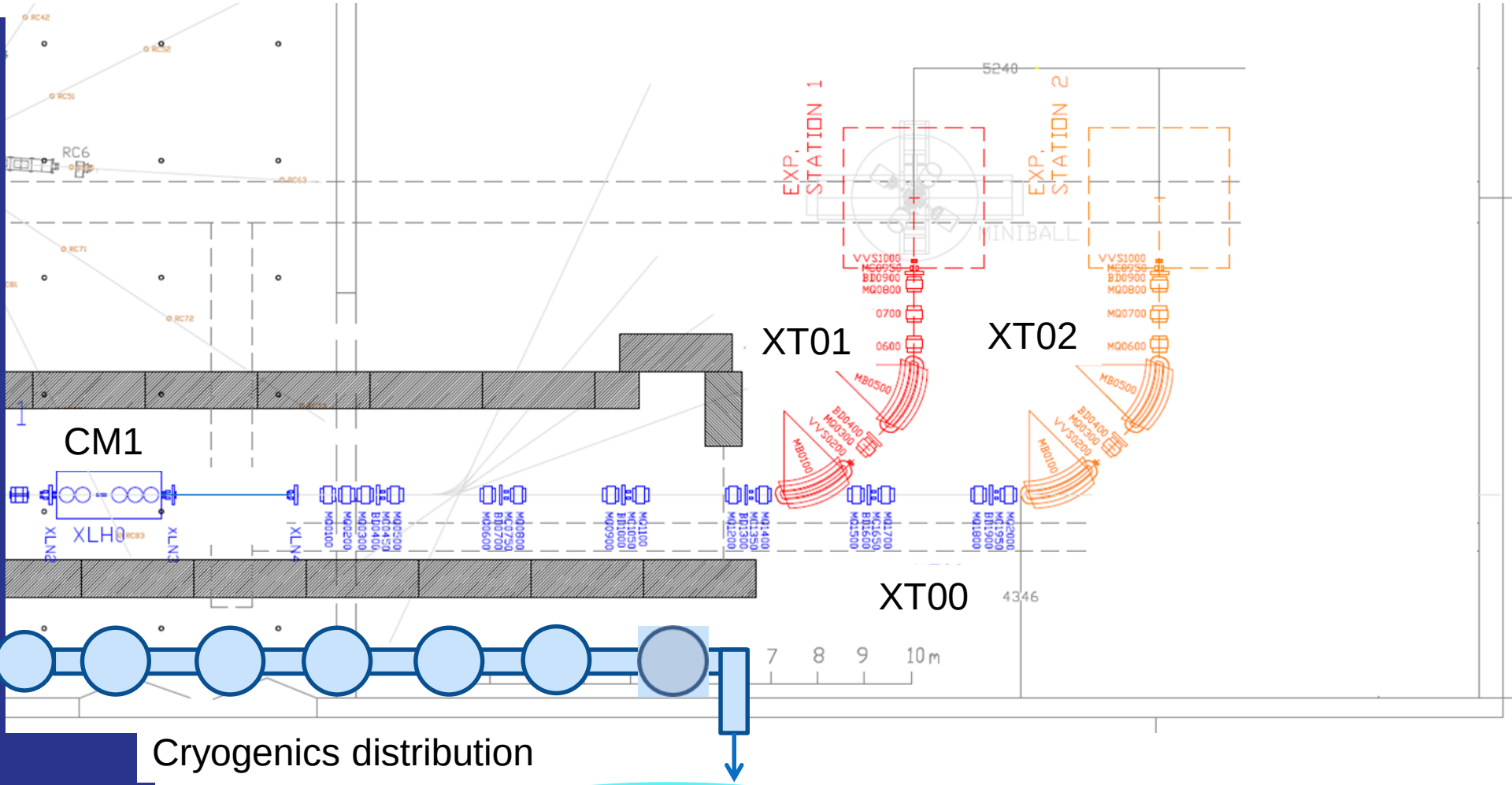
Beam Commissioning was limited to the strict minimum: to be revised for 2016!

Preliminary planning leading into 2016-2018 physics run is available

Acknowledgments

Thank you for your attention

Components to be commissioned



Cryogenics distribution

Cryogenics facilities

Commissioning with beam

Even though a basic program of commissioning with beam has been completed, there are still many tests and measurements that need to be conducted:

- Beam to XT02 (tentatively on week 47)
- New RF amplifier for 9gap structure (tentatively early 2016)
- Characterize the behavior of REX's amplifiers at a higher peak and average power
- Understand limits in machine scalability (A/Q and energy)
- Understand sources of beam losses and improve beam transmission
- Systematic checks with beam of polarities of all optics magnetic elements
- Complete the final implementation and commission the field regulation of the power converters for the dipole magnets
- Systematic commissioning of all the devices in the beam diagnostics boxes
- Individual calibration of each Faraday cup
- TOF sytem
- Finalize and commission the beam diagnostics high level control application
- Complete the cross-calibration of SRF cavities, Si detectors and the dipole magnets. Determine error bars in beam energy measurements
- Systematic measurements of beam properties (e.g. emittance, Courant-Snyder parameters…)
- Benchmarking optics model and implement modifications if necessary

CM2 cavities status (2015)

Production process	QS2		QS7	QS5	QS8	QS 9	QS1 0	QS1 1	QS1 2	QS1 3	QS1 4
	2.2	2.3	7.2	5.2	8.1	9.1	10.1	11.1	12.1	13.1	14.1
Substrate reception	x	x	x	x	x	x	x	x	x	WE34	WE34
Frequency pre-tuning	x	NP	x	x	x	x	x	NP	WE36		
Annealing	NP	NP	NP	NP	x	x	NP	NP	WE40		
Surface treatment	x	x	x	x	x	x	WE35	NP	WE41		
Nb coating	x	x	x	x	x	Cut & inspection at CERN	WE36	Process stopped due to substrate non-conformity	WE42		
RF vertical test at 4.5K	x	WE36	x	x	x		WE40		WE45		
Storage /on hold			Stored	Stored	Stored						
Nb stripping	x										

NP: Not performed.

Walter7, Slide 11

3D view of HELIOS on XT02