Preparation for RFQ Conditioning

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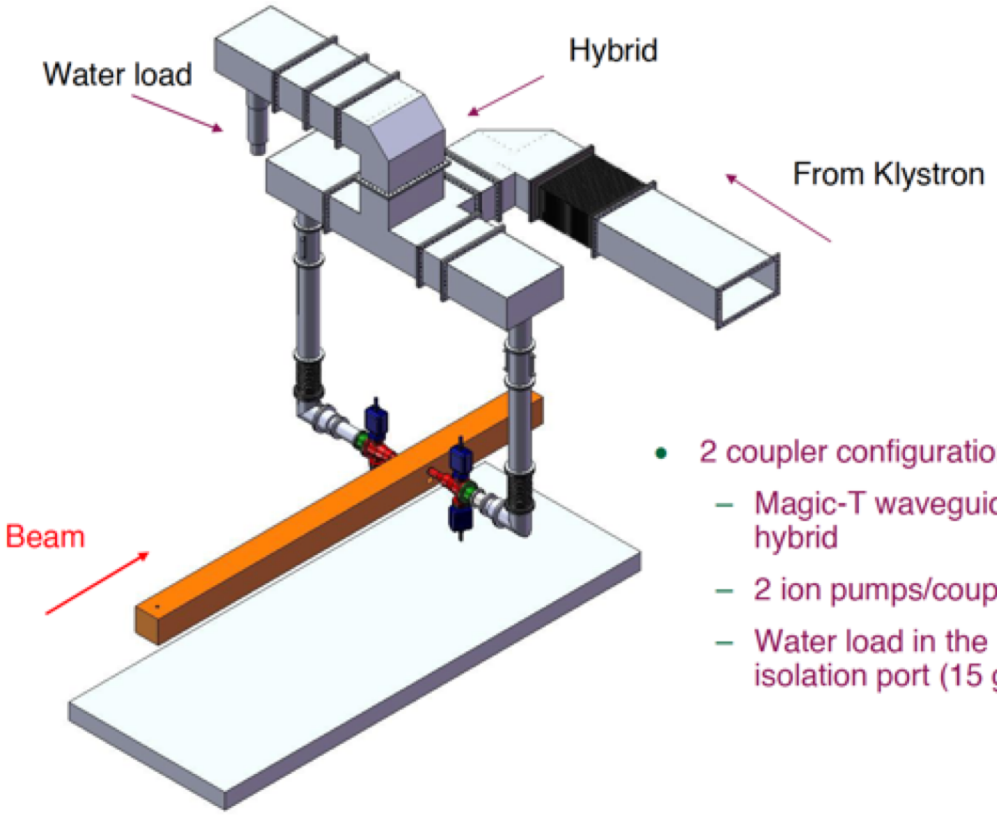
Experience from SNS

Two Coupler Configuration



- 2 coupler configuration
  - Magic-T waveguide hybrid
  - 2 ion pumps/coupler
  - Water load in the isolation port (15 gpm)

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for

Experience from SNS

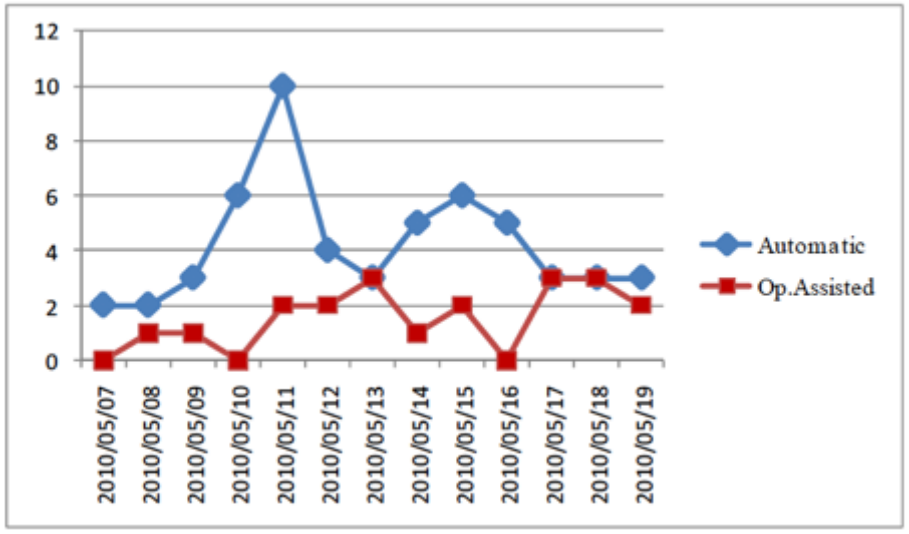
EUROPEAN SPALLATION SOURCE

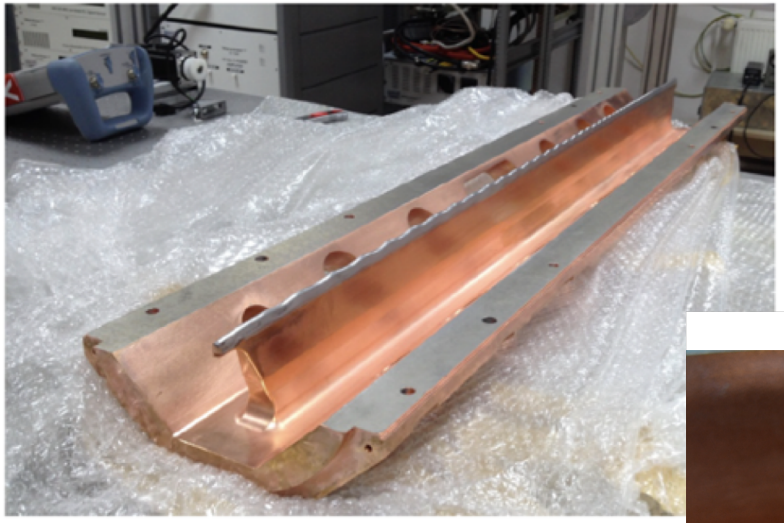
Summary

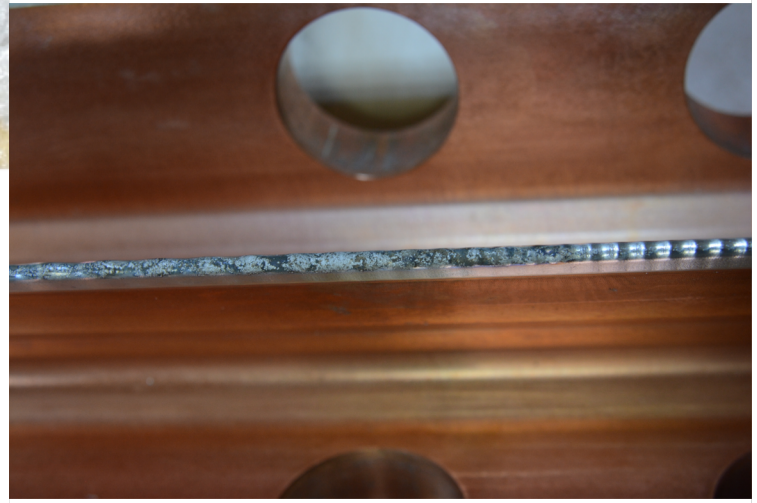
- New coupling system for the RFQ was important for the full beam power operation
- 2 coupler coupling system developed for the existing RFQ cavity
- 3 couplers procured and RF (50%) conditioned at RFTF in 2007
- New coupler design employs the ceramic window used in 805 MHz SNS/SRF cavity couplers
- New couplers installation completed as planned during the 2/4 – 3/23, 2008 shutdown period
  - Removal of old system 2/04 - 10 '08
  - Installation waveguides, couplers, supports 2/11 - 19 '08
  - Tuning & phase matching 2/20 - 28 '08
  - Full RF testing/conditioning 2/29 – 3/14 '08
- Coupling system has been fully conditioned on RFQ cavity at full power and duty cycle: ~ 900 kW, 1msec, 60 Hz
- H^- beam transmission through the RFQ has been tested and verified by accepting and measuring the beam at the MEBT beam stop
- 3 more spare couplers purchased and readied for RF conditioning

Experience from JPARC&CSNS

	Event	RF/beam widths (us)	I-Peak (mA)	Pwr@ MLF (kW)	Condition or Cont. op. days
Sept. 2008	Trip rate increase	200/100	5		very poor
Nov.	Improvement: interlock,conditioning, etc.				
Dec.	MR study and MLF user program after conditioning	155/100	5	20	poor
Jan. – Feb. 2009	Conditioning and operation user program was cancelled	155/100	5	20	poor
Mar.	Vacuum system improvement: ion pumps, diagnostics				
June	MLF user program	155/100	5	20	2
Jul.-Sept.	Vacuum improvement: Cryo. Pumps. baking, oil-free pumps				
Nov. - Jan.	MLF user program	255/200	15	120	2 to 3
Dec.	MLF high power demonstration (1hour)	555/500	15	300	
Jan. 2010	Demonstration of continuous operation for 6 days	255-555 /200-500	15	120	6
Feb. - Mar.	MR and HD/NU study, beam delivery	555/200 -500	15	can-celled	7 to
Arp.- May	MLF, MR(NU) beam delivery	555/200 -500	15	120	13(m







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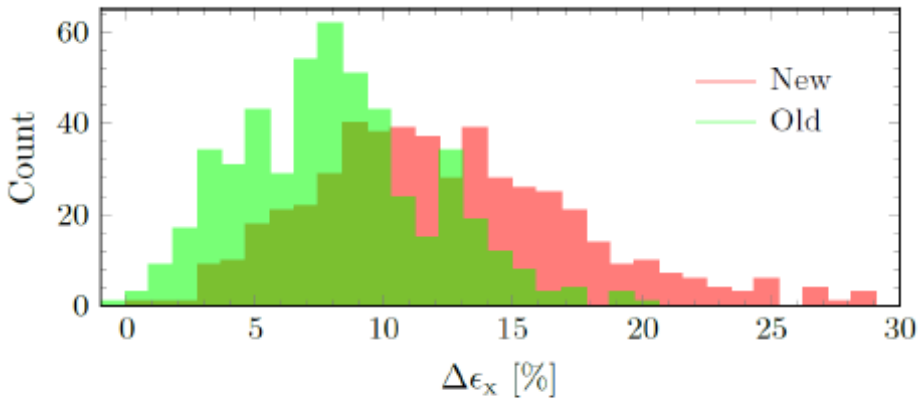
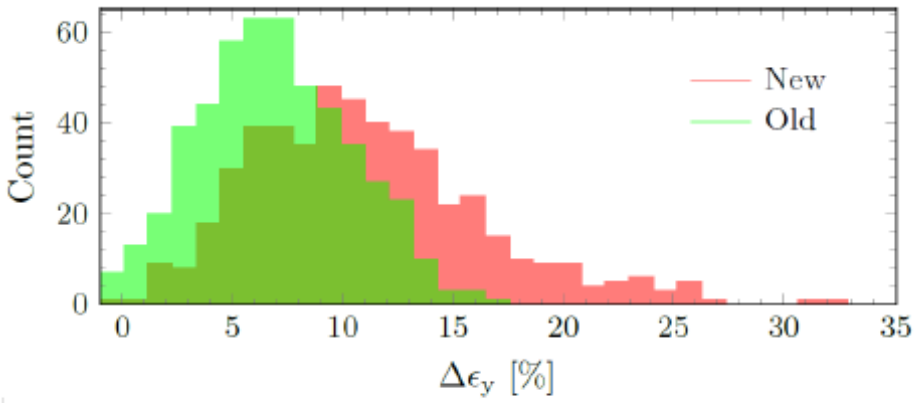
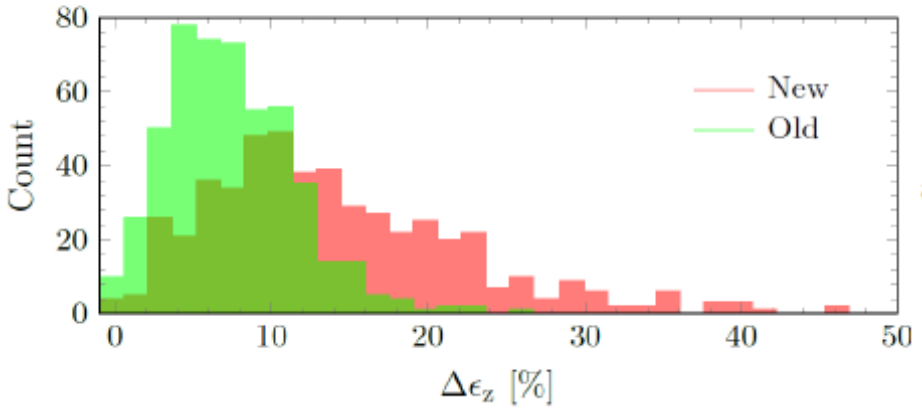
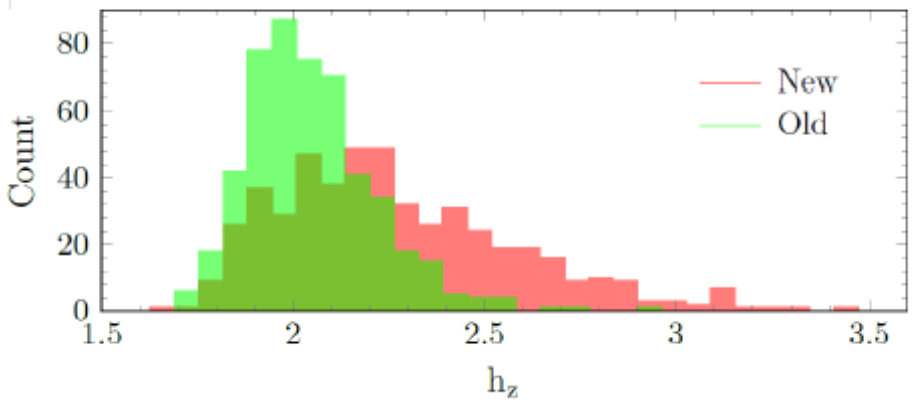
How 1% Field Flatness Affects/DTL Simulation



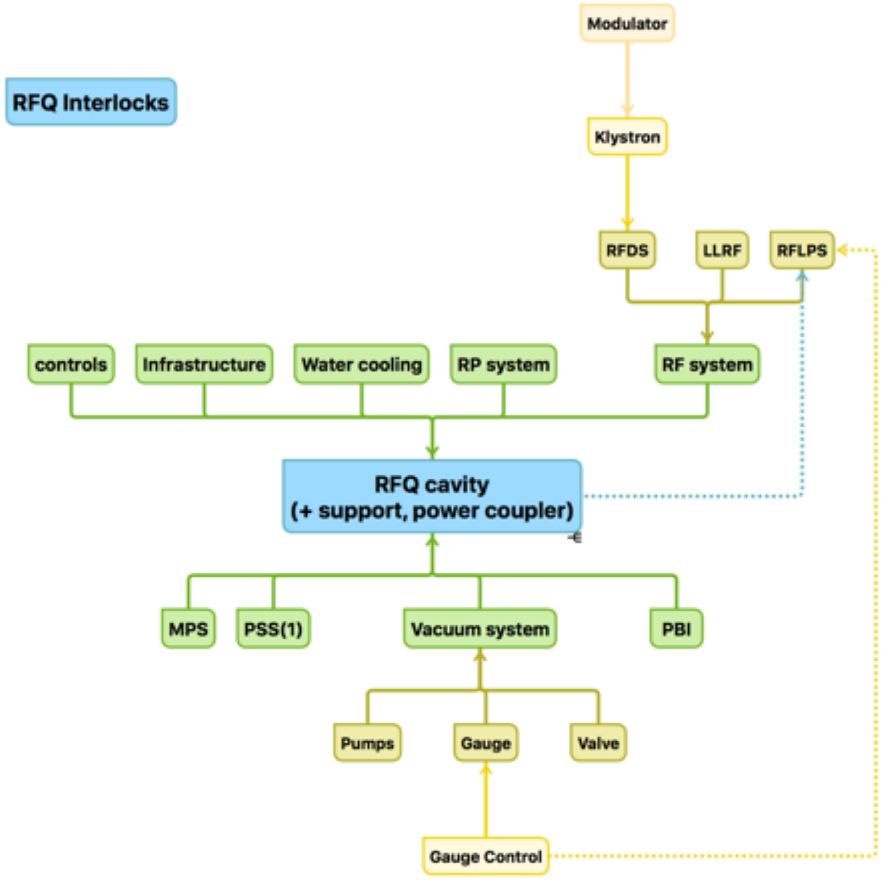






Interlocks

- 16 more cables need to be added(RFQ+DTL)
- for RFQ, 70% fast interlocks with problem(hardware or cables are missing)
- To be checked
  - racks, power, slow interlocks…
  - Interfaces with RF/Vacuum/Water



Tools

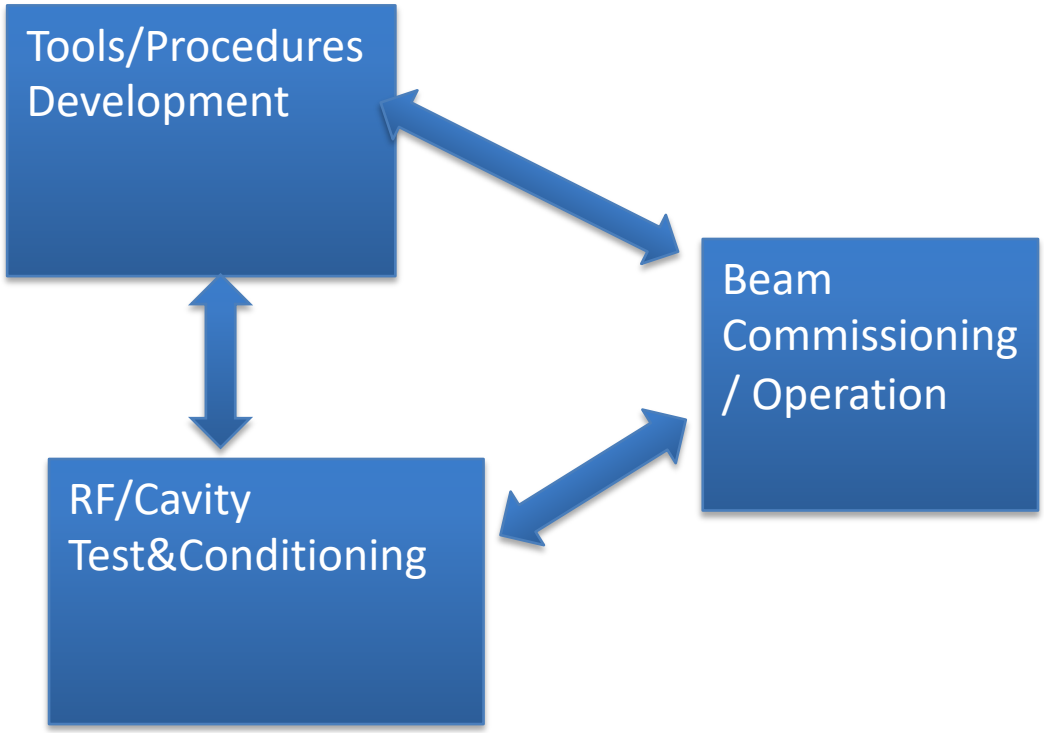
https://confluence.esss.lu.se/display/LG/RFQ+Test+Plan

	(h)	(Names)	
e.g. Magnet Polarity Check; Cooling Interlock Test; RF Conditioning, etc.	*hours*	*e.g. E. Trachanas (WP3), T. Fay (ICS), other WP support*	*e.g. Cables & connectors installed, tested and connected to the equipment; Activity A is complete before activity B can start.*
Prepare racks for Power Up	16 h	Emmanouil (WP3), T. Fay (ICS), P. Van Velze (ICS)	cables pulled and terminated by Infra or WP3/ICS, racks installed, PDU installed, Conventional Power provided (expected end of Feb 2020), Electrical Schematics
Connect cables and connectors to components	16 h	Emmanouil (WP3), T. Fay (ICS), P. Van Velze (ICS)	Cables pulled and terminated by Infra or WP3/ICS, Labelling of devices, As-built Electrical Schematics
RFQ Conditioning Application testing	120 h	Emmanouil (WP3), T. Fay (ICS)	local tests, integrated tests and deployment of App at TS2 (24 h just for RFQ)
Pick-up calibration application		D. Noll (WP3), T. Fay (ICS)	
Calibration of 22 pick up RF cables and Cavity Field Validation	8 h	CEA, D. Noll (WP3), T. Fay (ICS), R. Zeng (WP3)	LLRF System + Controls Calibration procedure OPI available to carry out calibration and results can be archived to database
Validation of Fast Interlock: Arc detector	8 h	ICS, RF	RF LPS System + Control Available
Validation of Fast Interlock: Vacuum	8 h	ICS, Vacuum	RF LPS System + Control Available
Validation of Fast Interlock: Electron-current	8 h	ICS, RF	RF LPS System + Control Available
Validation of Slow Interlock: Temperature, water flow	4 h	T. Fay (ICS), WP3	RF LPS System + Control Available
Validation of Temperature stability without RF	4 h	T. Fay (ICS), WP3	Temperature stability controlled by water skid are within ±0.1 degC, Maximum temperature range are ??
Frequency detuning measurement with RF	16 h	T. Fay (ICS), WP3, LLRF	LLRF System + Controls Available.
Frequency tracking in open loop (low power RF)	16 h	T. Fay (ICS), WP3, LLRF	LLRF System + Controls Available.
Frequency tracking in closed loop (low power RF)	16 h	T. Fay (ICS), WP3, LLRF	LLRF System + Controls Available.
RFQ warm up and automation (high power RF)	8 h	T. Fay (ICS), WP3, LLRF	High Level IOC to automate procedure.
RFQ RF conditioning	240 h	T. Fay (ICS), WP3, RF	High Level IOC to automate RF conditioning
Post conditioning. Sort out data, analyse the results and identify potential issues	40 h	WP3, RF	To be completed prior to the next phase (beam commissioning). Preparation for operations.
"Long" run test at Emax	24 h continuous	WP3, LLRF	RFQ running at maximum gradient for minimum? Hours in open loop. And minimum? hours in closed loop. Will need 3 shifts!

Procedures

What Expects in Theory

More Practical Mode



Thank you