

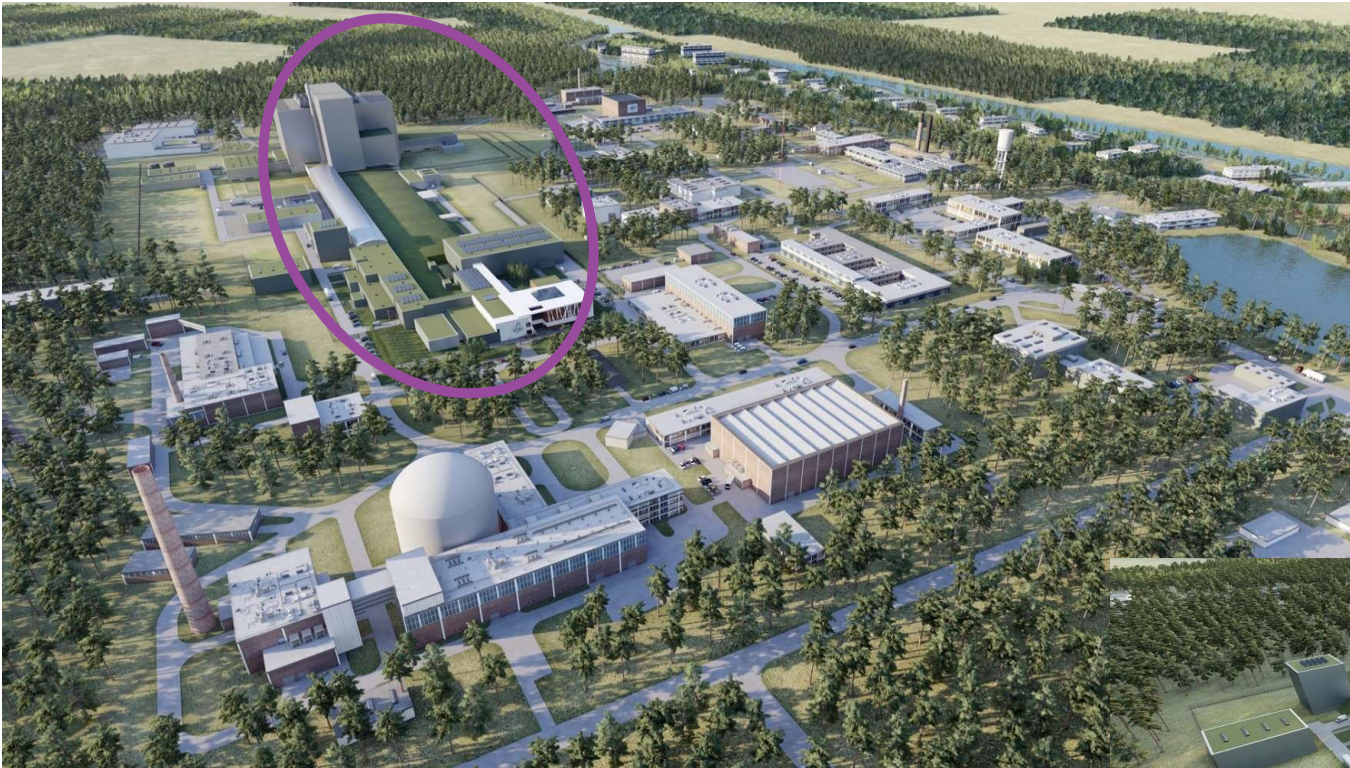
**sck cen**

Belgian Nuclear Research Centre

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## **MYRRHA-MINERVA linac status and commissioning**

# Towards MYRRHA ADS

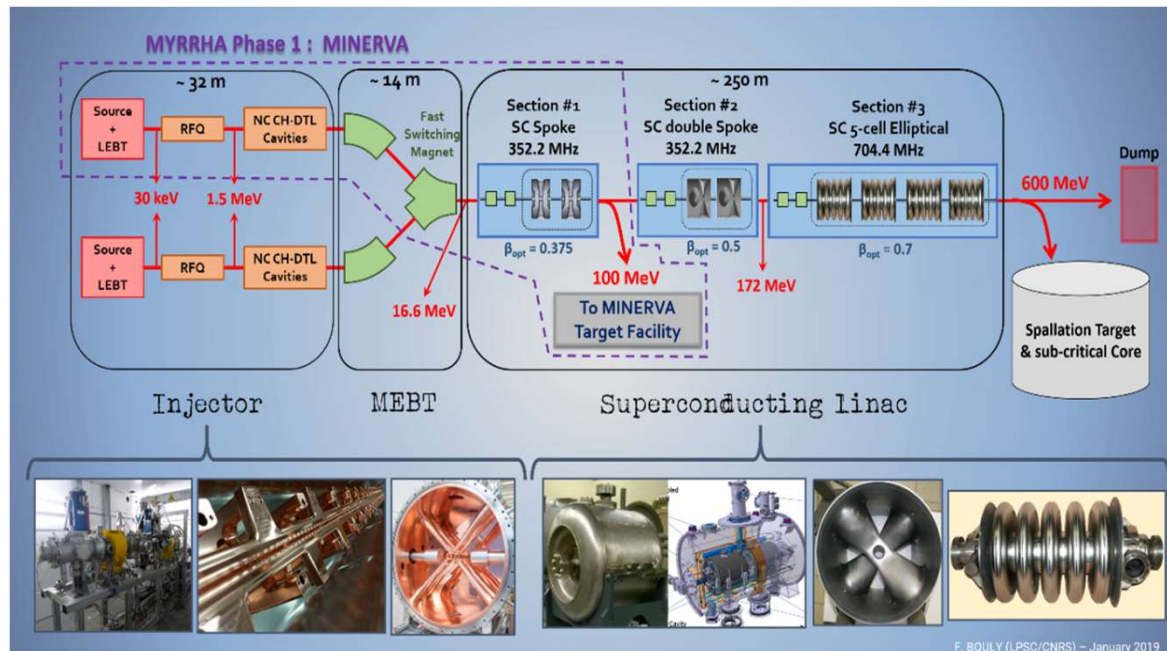


- **MYRRHA Phase 1 Implementation**
  - Also referred to as MINERVA





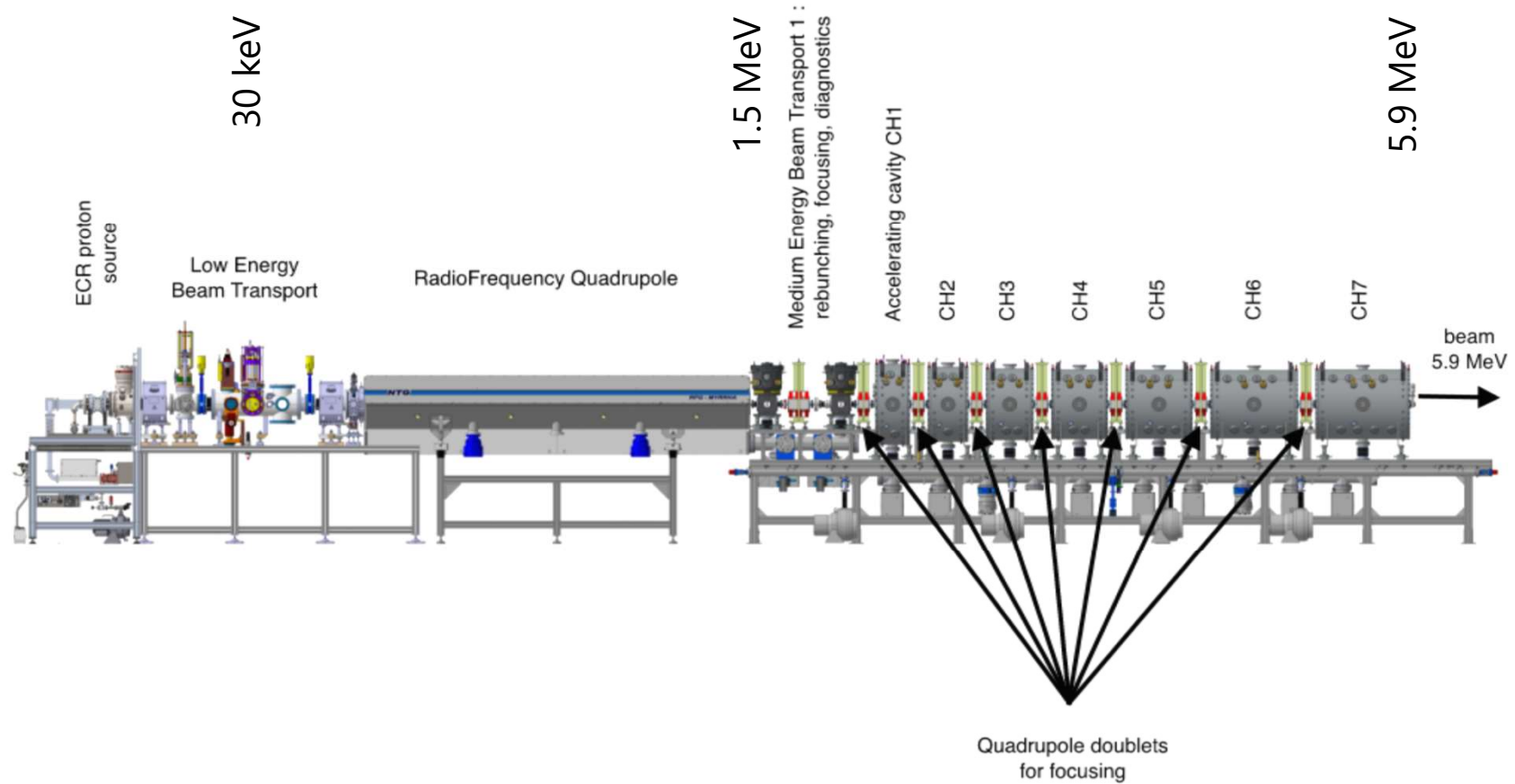
# MYRRHA versus MINERVA LINAC



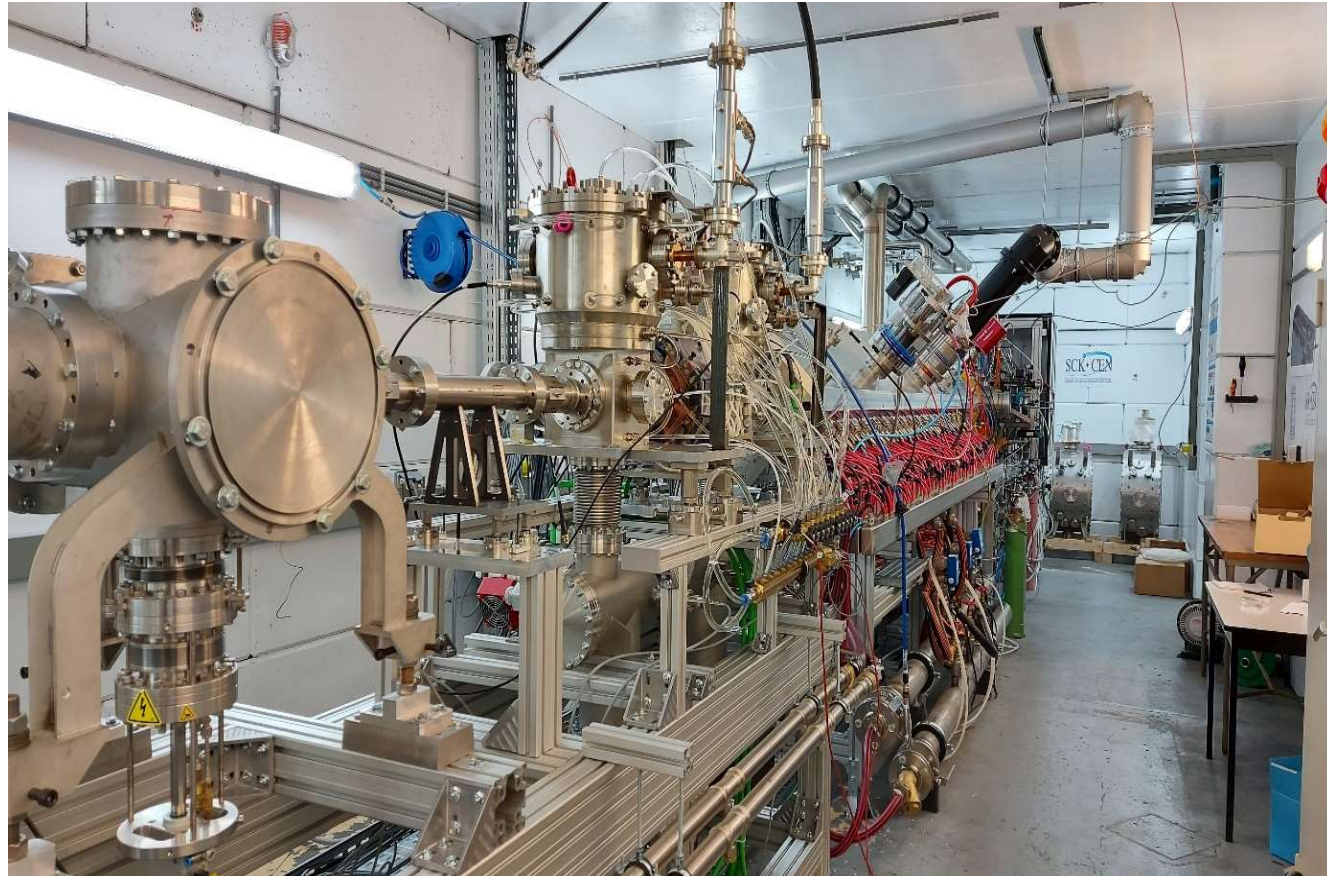
- beam particle : protons
- beam energy : 600 / 100 MeV
- beam intensity : 4 mA
- beam delivery : 2.4 / 0.4 MW CW (with regular holes)
- beam MTBF : 250 hours, a failure = a beam trip > 3 s

**Key : Reliability**

# Integrated prototyping : Injector test platform

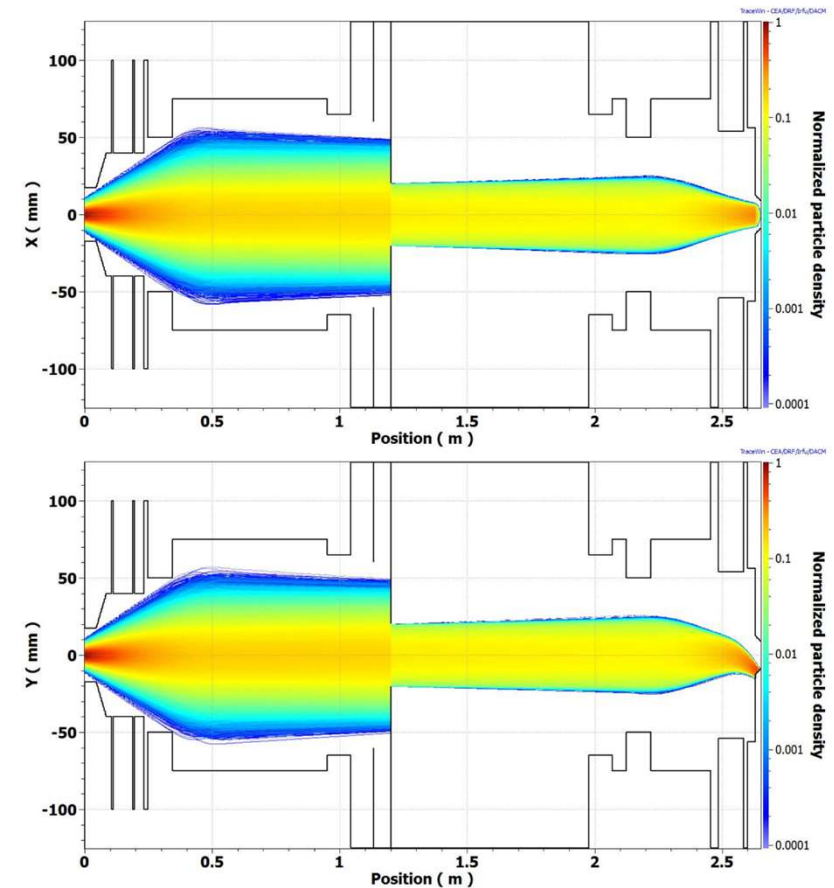
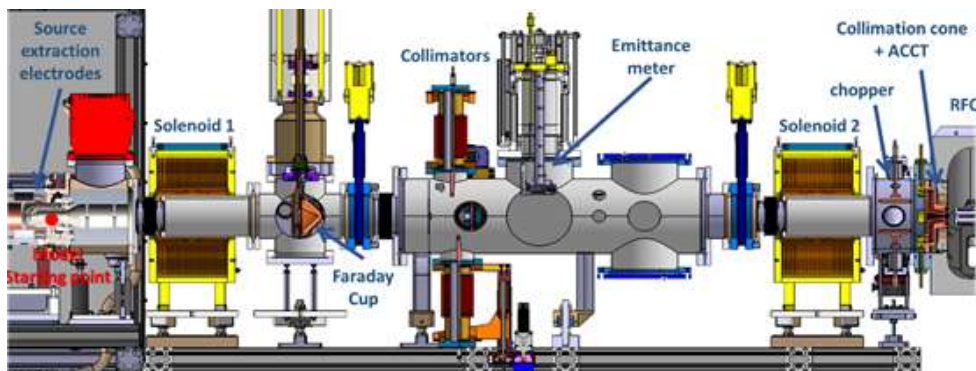


# Injector installation today



# Source & LEBT commissioning

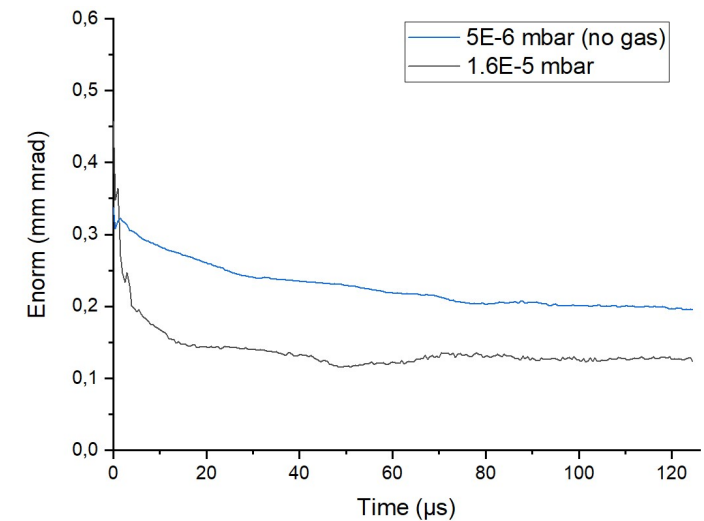
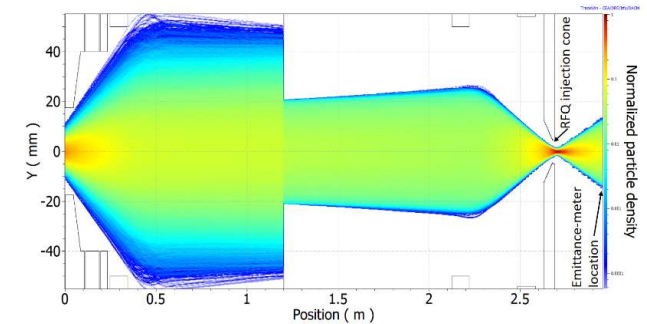
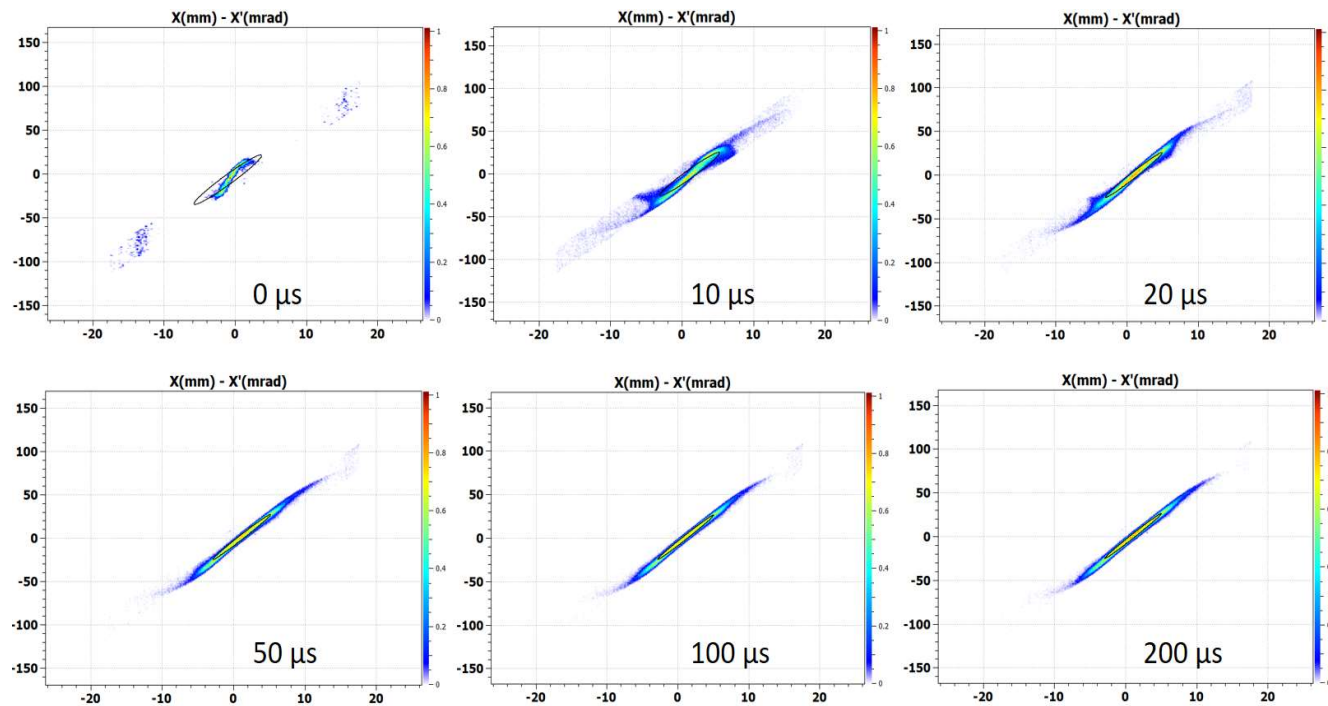
- Beam transmission
- Beam stability
- Beam matching
- Space charge compensation studies





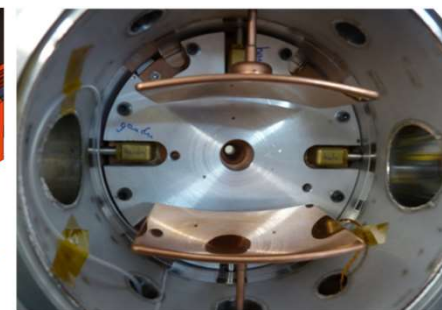
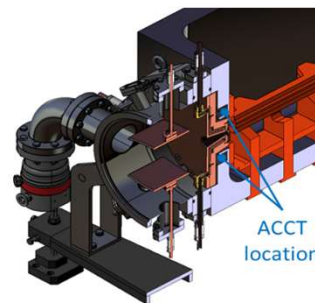
# LEBT commissioning : RFQ beam matching and SCC transients

- Transverse emittance measurements with Allison scanners



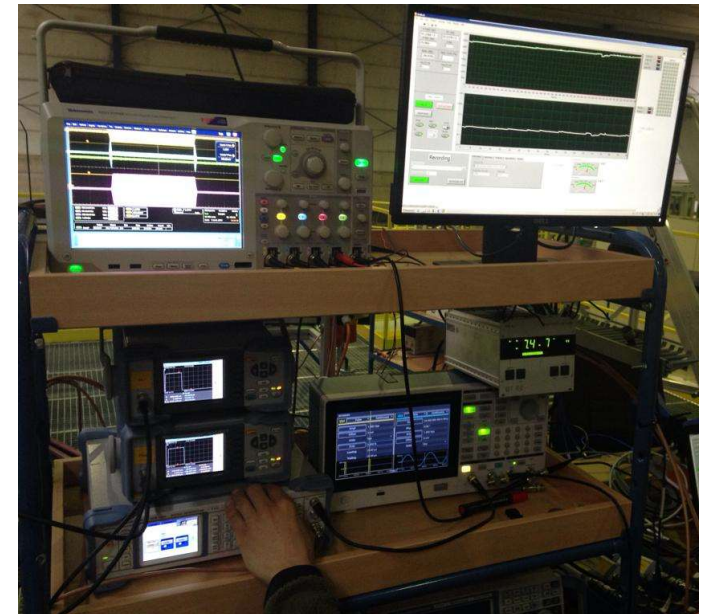
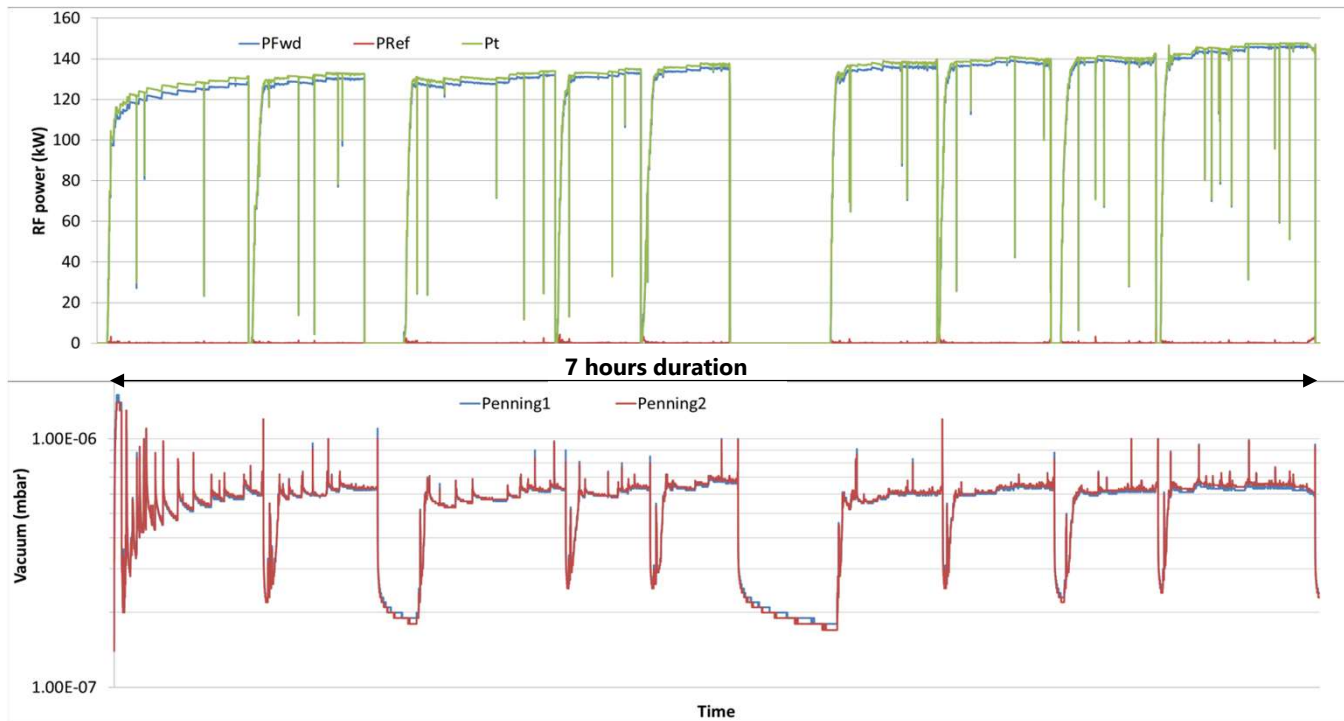
# MYRRHA's RFQ

Parameter	Unit	Value
RFQ type	---	4-Rod RFQ
Frequency	MHz	176.1
$E_{in}$	keV	30
$E_{out}$	MeV	1.5
Length	m	4
Beam current	mA	5
Voltage	kV	44
$R_p$	k $\Omega$ m	73
Power losses	kW	106
Specific power loss	kW/m	26.5
Kilpatrick factor	---	1.05
$m_{max}$	---	2.2
$a_{min}$	cm	0.31
Cell number	---	244
Transmission	%	98.6
$\epsilon_{out,rms,100\%,N}(x)$	$\pi$ mm mrad	0.21
$\epsilon_{out,rms,100\%,N}(y)$	$\pi$ mm mrad	0.21
$\epsilon_{out,rms,100\%,N}(z)$	keV deg	0.41

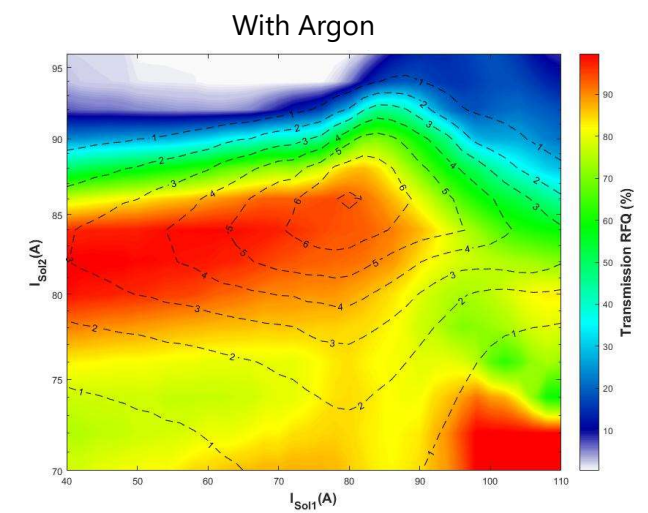
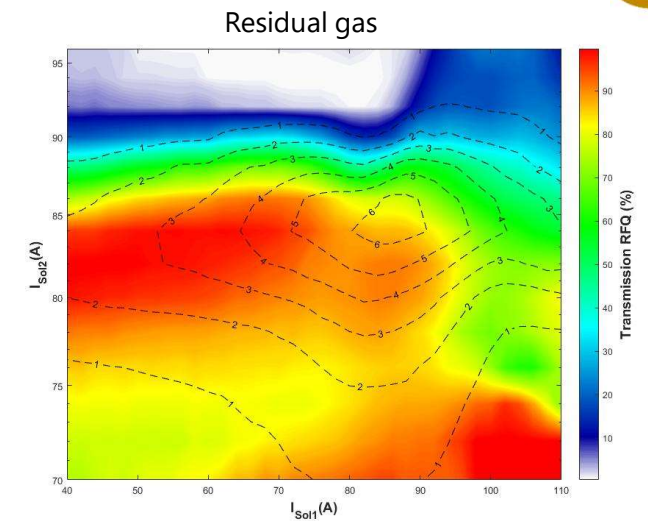
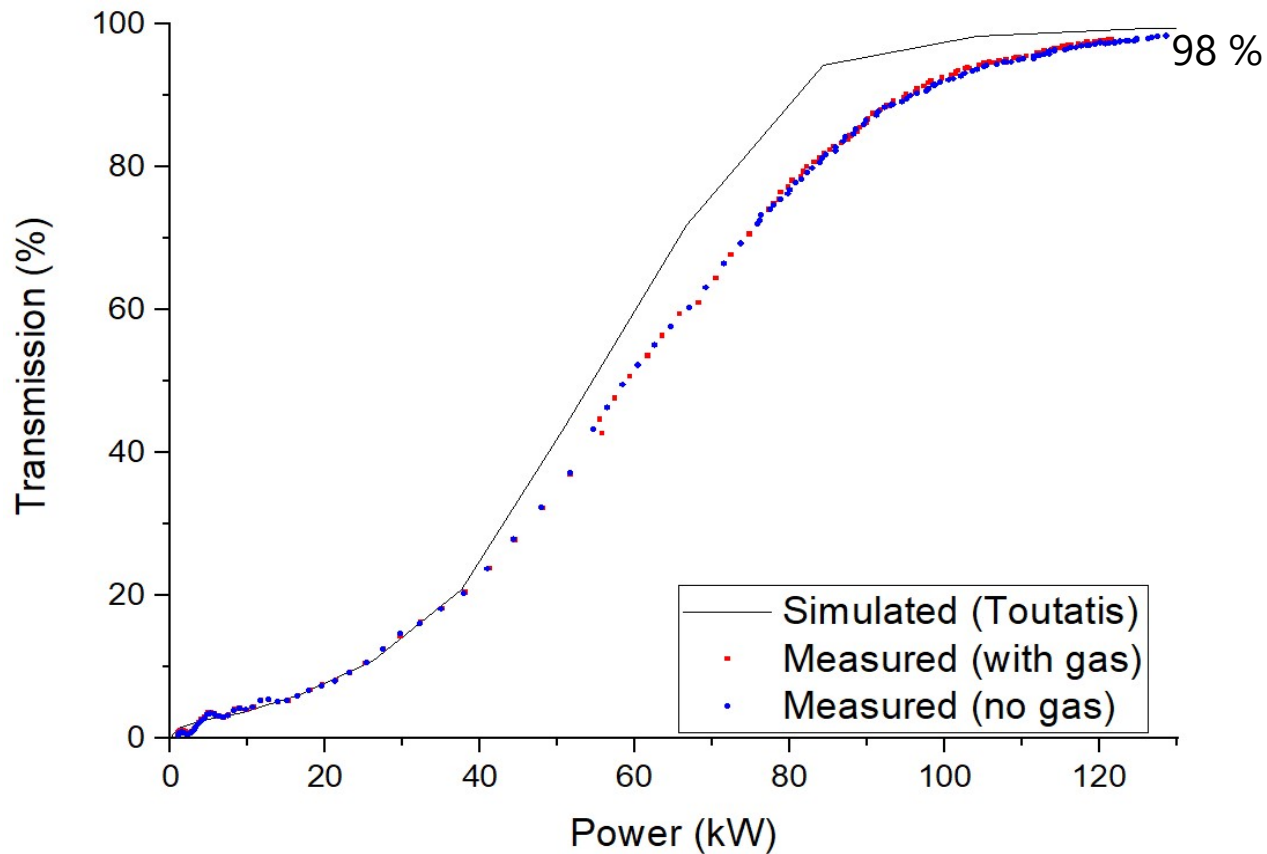




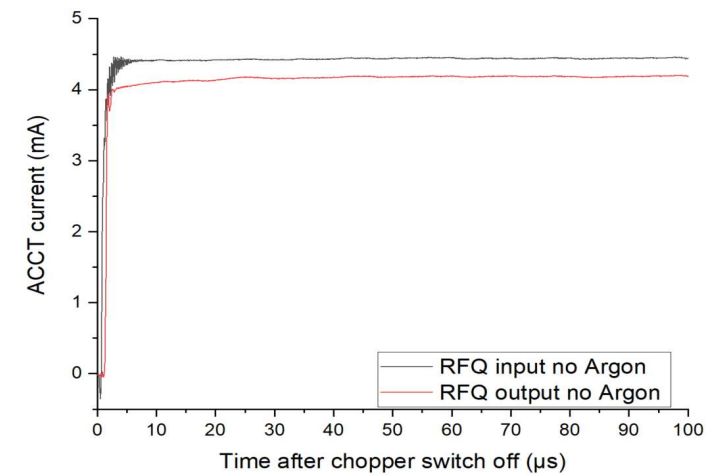
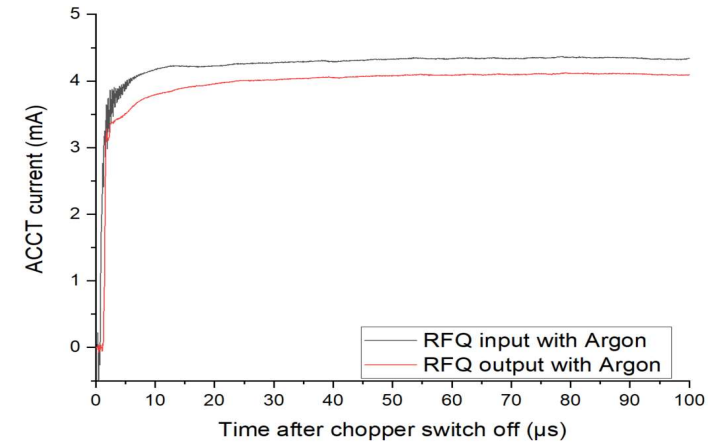
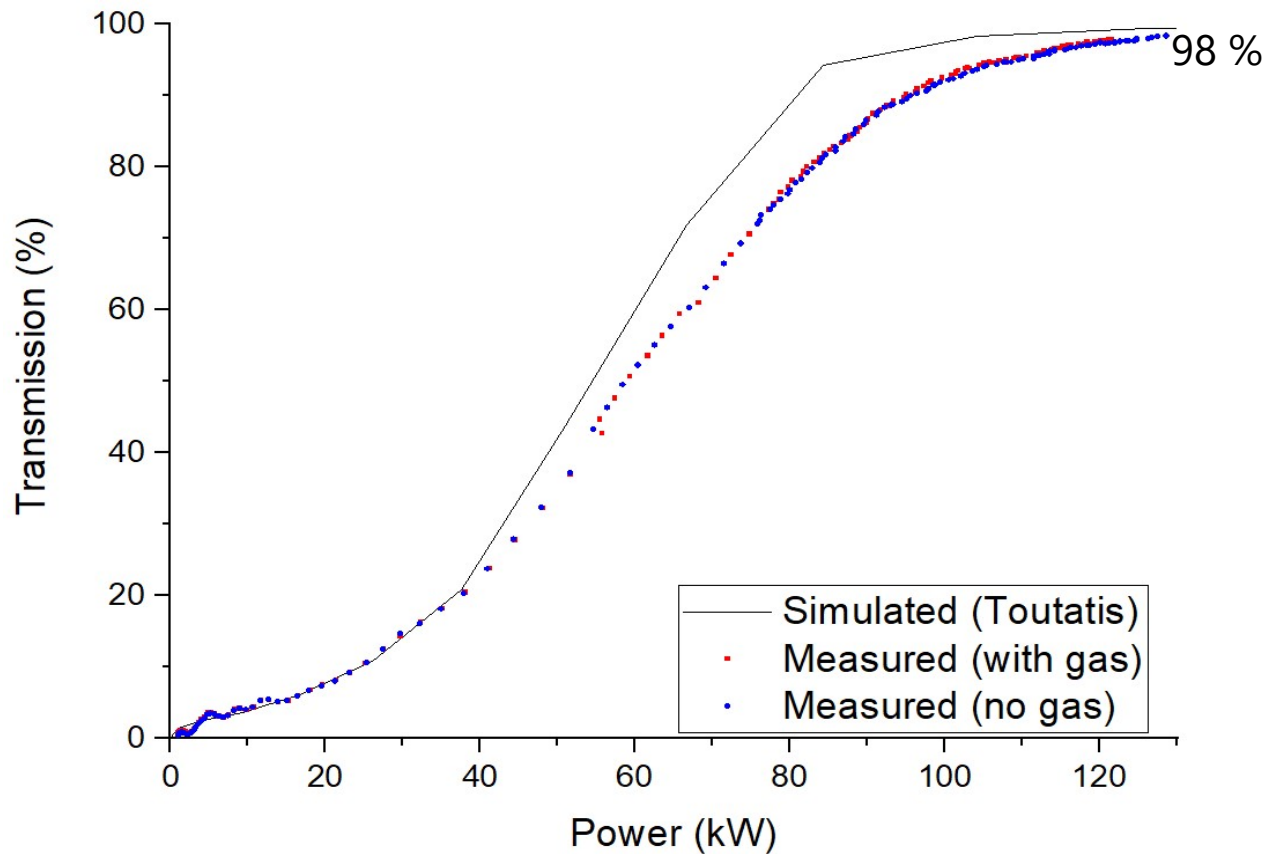
# RFQ conditioning at a glance



# RFQ transmission measurement



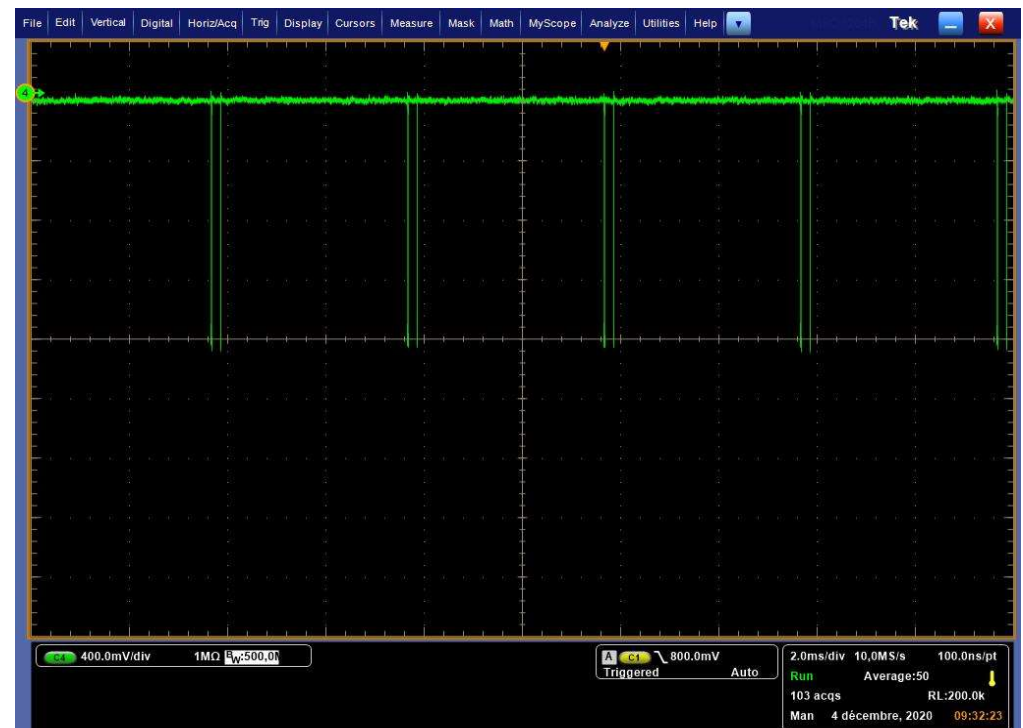
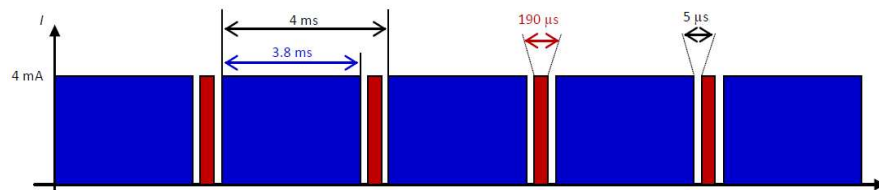
# RFQ transmission measurement: current rise time





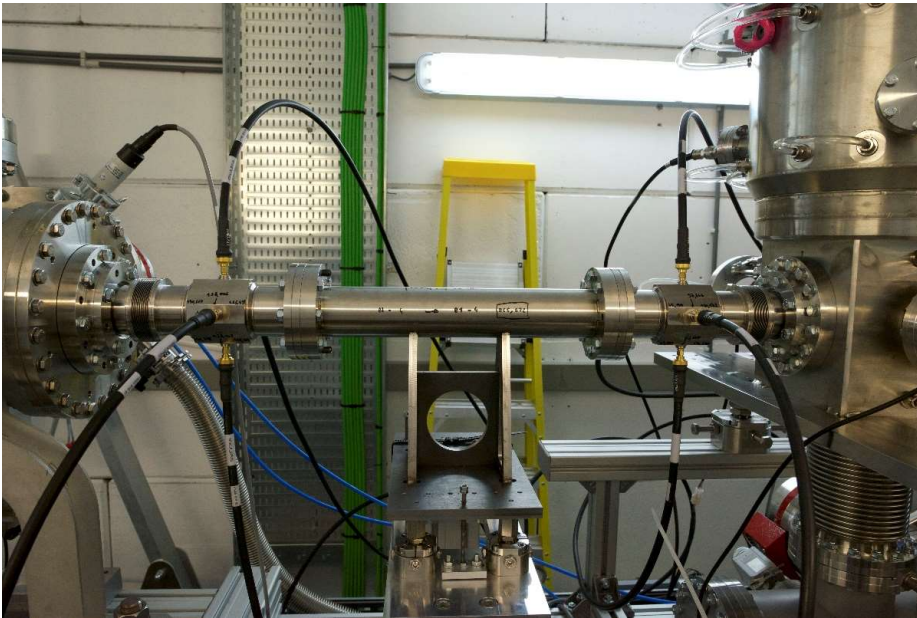
# RFQ full power beam commissioning

- MYRRHA beam structure :
  - 3.8 ms pulses for reactor
  - short pulses for ISOL

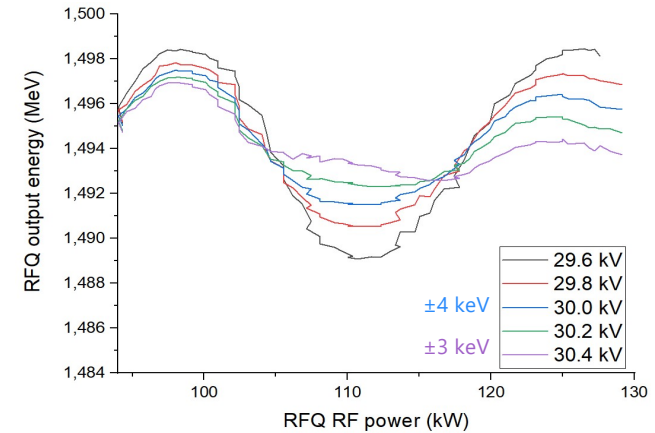


# RFQ energy measurement by ToF

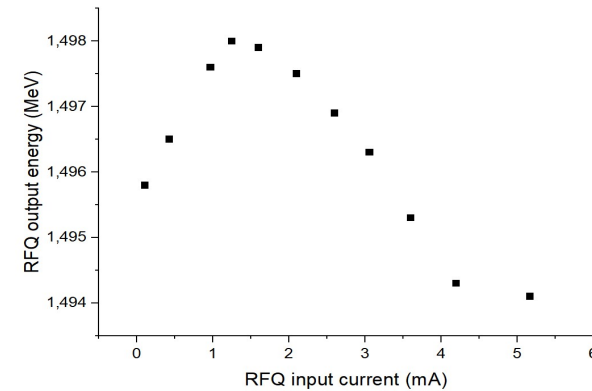
- Measurement setup



- Energy wrt RFQ input energy



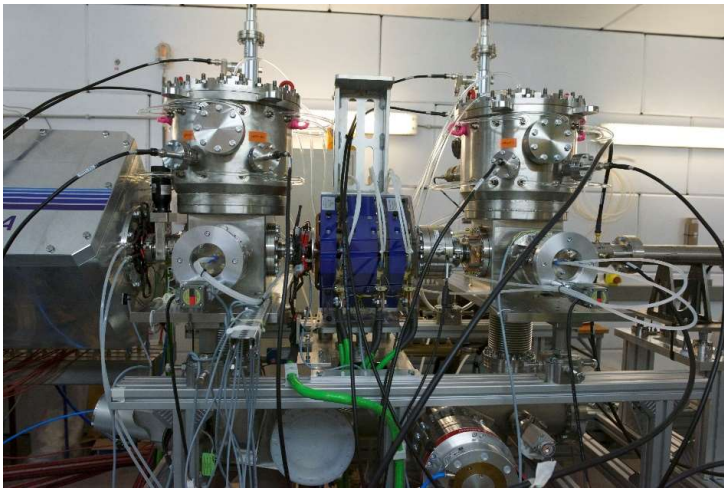
- Energy wrt beam current



➤ **Nominal energy :  $1.494 \pm 0.003$  MeV**

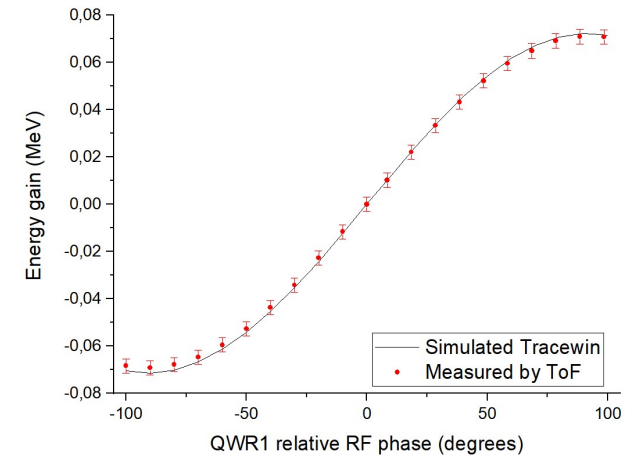
# MEBT1 beam commissioning

- MEBT1 : 2 quarter wave resonators for bunching + quadrupole triplet

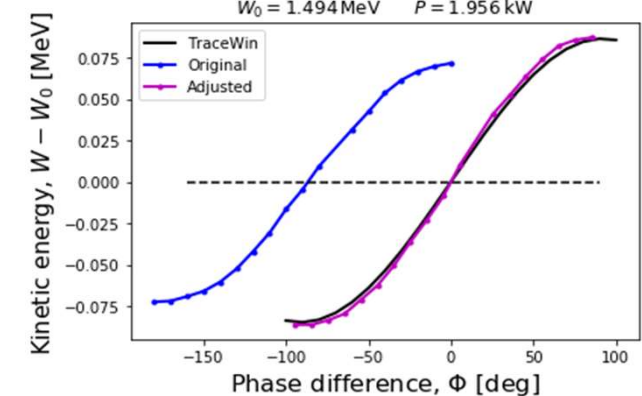


- RF phase and amplitude tuning

QWR1



QWR2



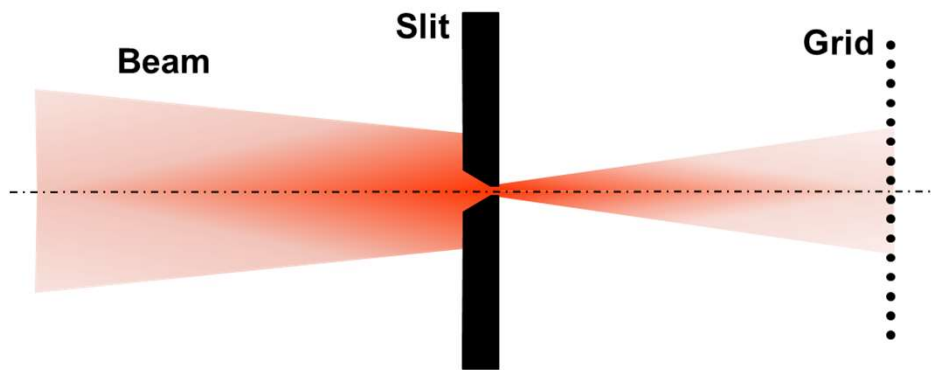
➤ Both QWR successfully tuned by ToF



# Future activities: EMI and BSM integration

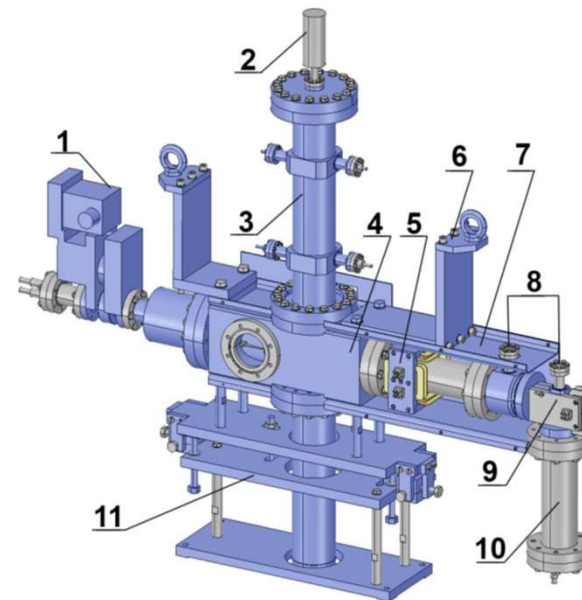
- EMI = Transverse emittance

(delivery expected in the coming months from ESS Bilbao)



- BSM = Bunch shape monitor

(delivery expected in December from INR Russia)



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