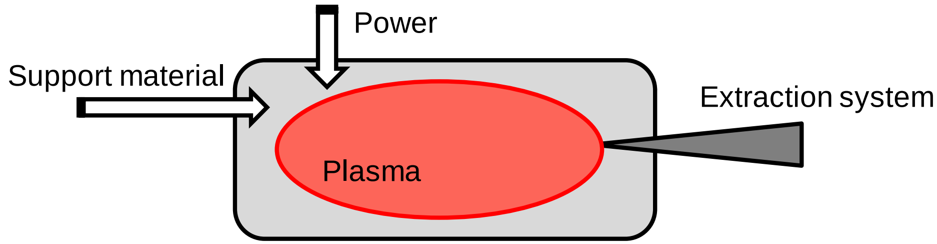
Ion Sources – Hardware and Operation

MACS Week 2010 - 2

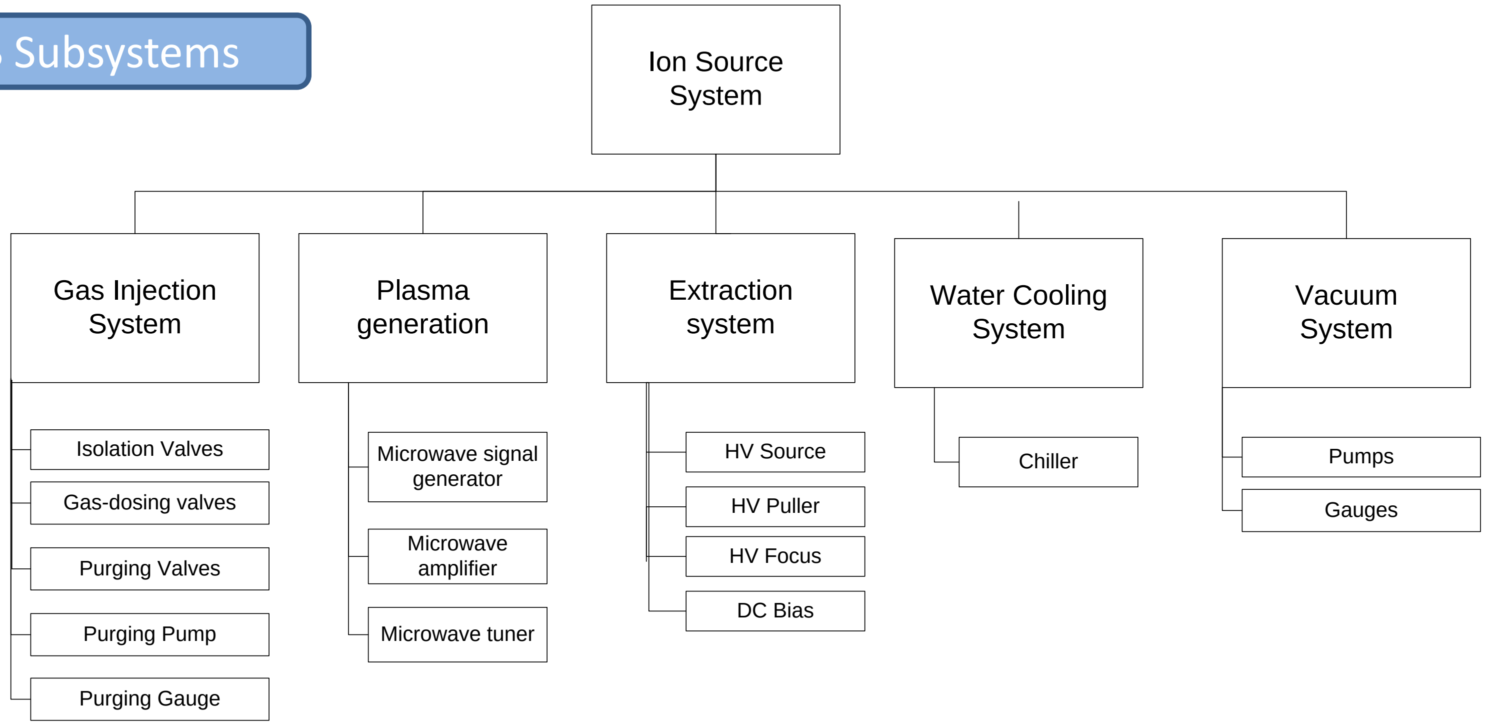
Friday 8th October 2010

Overview of an ion source

General IS model



IS Subsystems

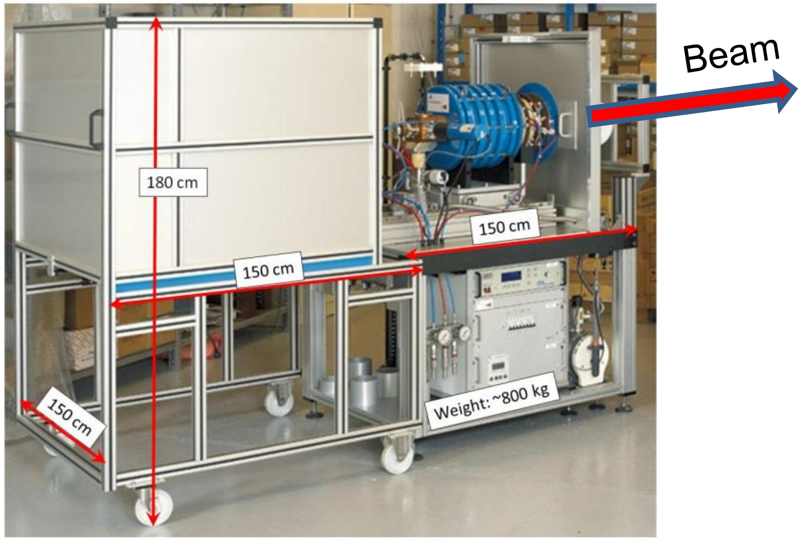


The Ion Source system

IS racks (cabinet)

Example:
Supernanogan source
(CNAO, HIT)

Ion Source Bench



- Power supplies (for the source potential, puller and focus potentials);
- HV platform, with insulation transformer and fiber optic converters;
- Control and monitoring equipment: vacuum gauge controller, command and control of the power supplies, command and control of the components of the RF system (generator, amplifier, tuner).
- The interlocking chain.

- The extraction system;
- The pumping tank;
- The source itself;
- The RF system (power supply unit, signal generator and RF amplifier);
- The gas injection circuit;
- The water cooling circuit

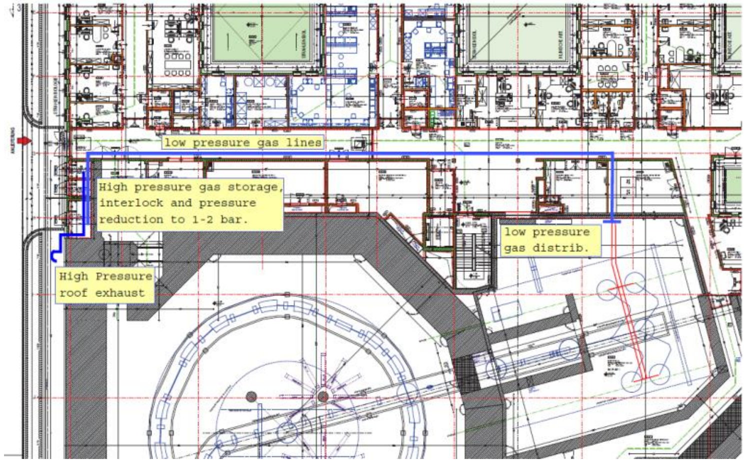
Gas injection system - overview

List of **employed gases** for the generation of different **ion beams**

Beam	Injected gas						
	CO_2	He	H_2	CH_4	N_2	O_2	Ne
C^{4+}	x	x		x			
H_3^{1+}			x				
He^{1+}		x					
N^{5+}		x			x		
O^{6+}		x				x	
Ne^{7+}		x					x

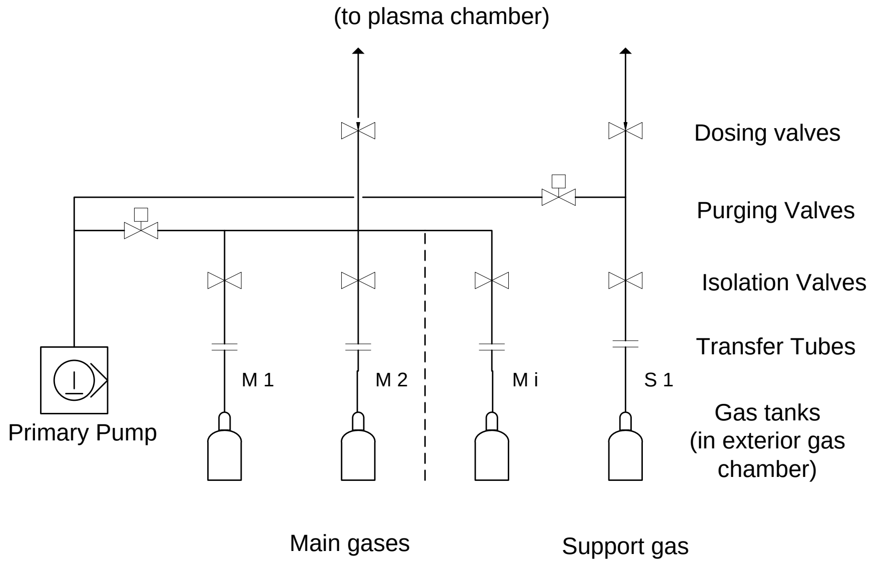
Two approaches for the global layout:

Example: Supernanogan at CNAO
(all gas system components included on each IS bench)



MedAustron: Global gas distribution
(included in the building infrastructure)

Gas injection system - hardware

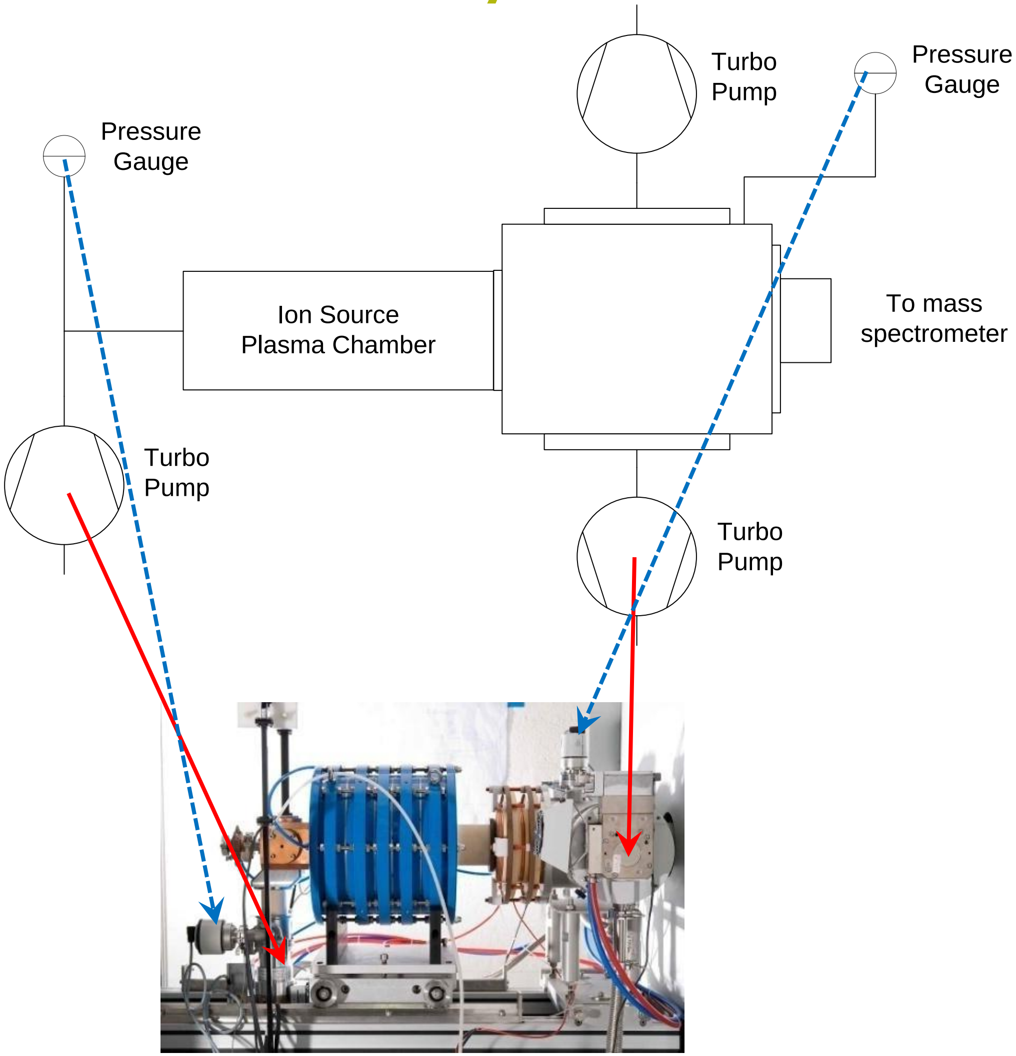


- High pressure bottles (up to 200 bars)
- High pressure to low pressure regulators (at 1-2 bars)
- Low flux electrically controlled dosing valves at CNAO; mass flow controllers at MedAustron
- Isolating gate for each gas
- Purging system with primary vacuum control
- Remote control of the panel (except for bottle replacement and low pressure regulators)

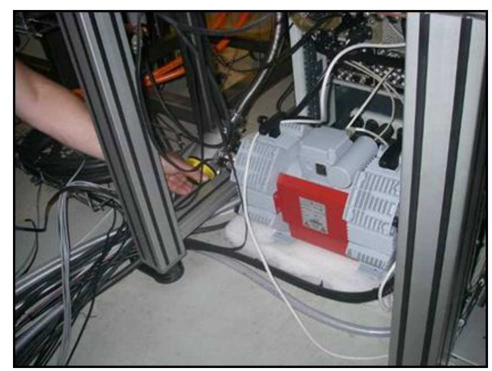
System compatible with both possible solutions:

- Global (and fixed) gas distribution – included in the building infrastructure
- Distributed (and local) gas distribution – all comprised on the IS bench

Vacuum system

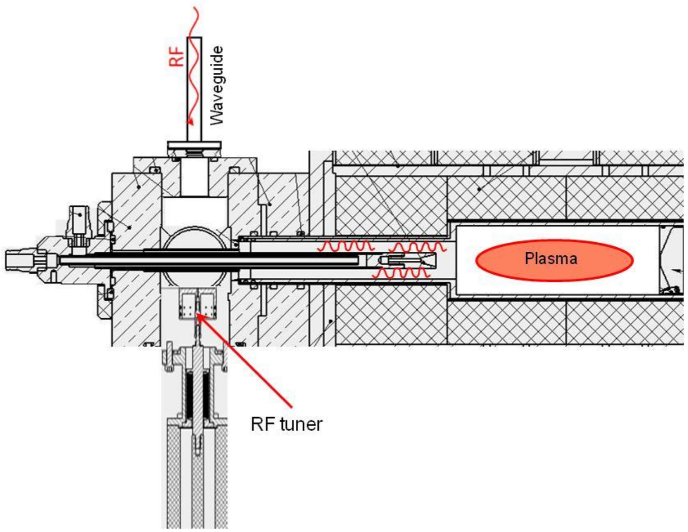


The control of the vacuum components is covered by the global vacuum control system.



Primary pump (1x)

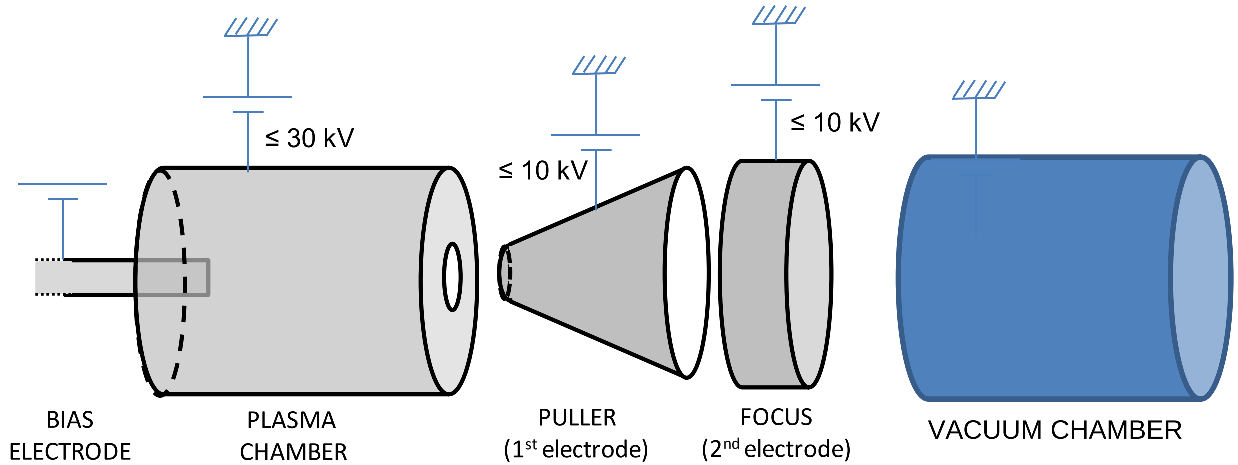
Plasma generation



DEVICE	PARAMETERS	RANGE	ACTIONS	ACQUISITION rate	Alarm
Signal generator	State	On/off	Read, write	On change	No
	Frequency	**1-22 G**Hz	Read, Write	1 Hz	No
Amplifier	State	On/off	Read, write	On change	No
	Frequency	13.75-14.5 GHz	Read, Write	10 kHz*	No
	power	0-500 W	write	-	-
	Fwd. power	0-500 W	Read	10 kHz*	No
	Refl. power	0-500 W	Read	10 kHz*	yes
Tuner	State	On/off	Read, write	On change	No
	position	**TBD** mm	Read, write	On change	No

(* Fast acquisition required for stability validation. Recording not continuous. Data treated locally)

IS Extraction system



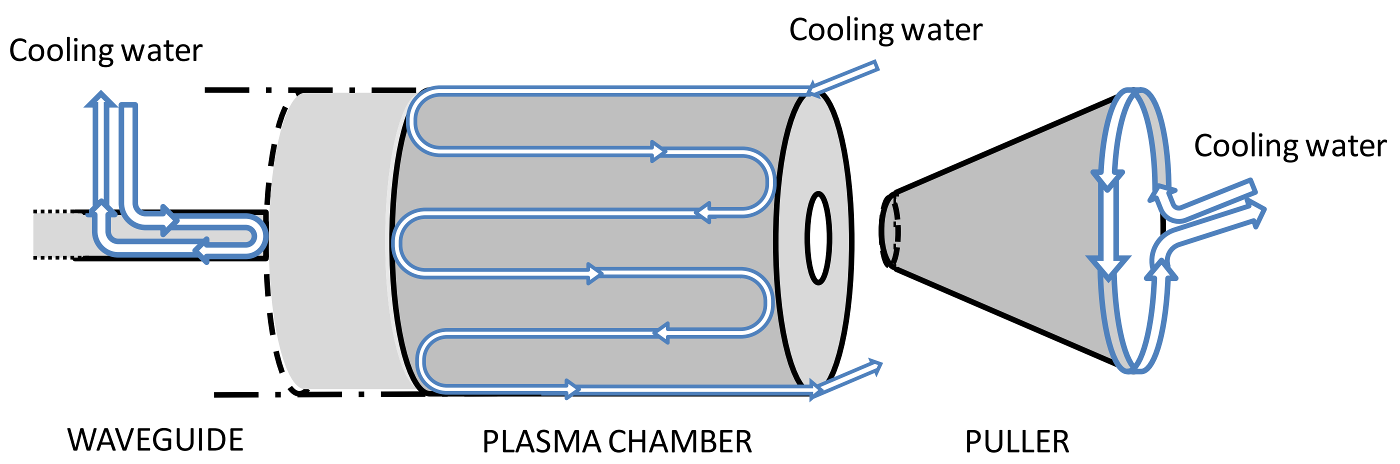
(installed in the racks close to the source)

Controlled parameters (all PS)

PARAMETERS	RANGE	ACTIONS	ACQUISITION rate	Alarm
State	On/off	Read, write	On change	No
Potential	0-30 kV	Read, write	1 Hz	No
Current	0-30 mA	Read	10 kHz*	Yes

(* Fast acquisition required for stability validation. Recording not continuous. Data treated locally)

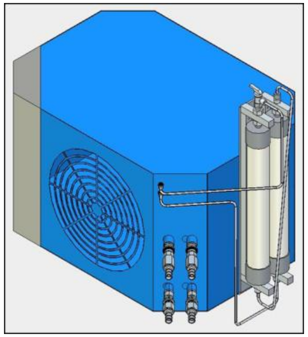
Water cooling system



To cool down:

- Plasma chamber
- DC bias
- RF injection
- Extraction system
- Extraction turbo-molecular pumps

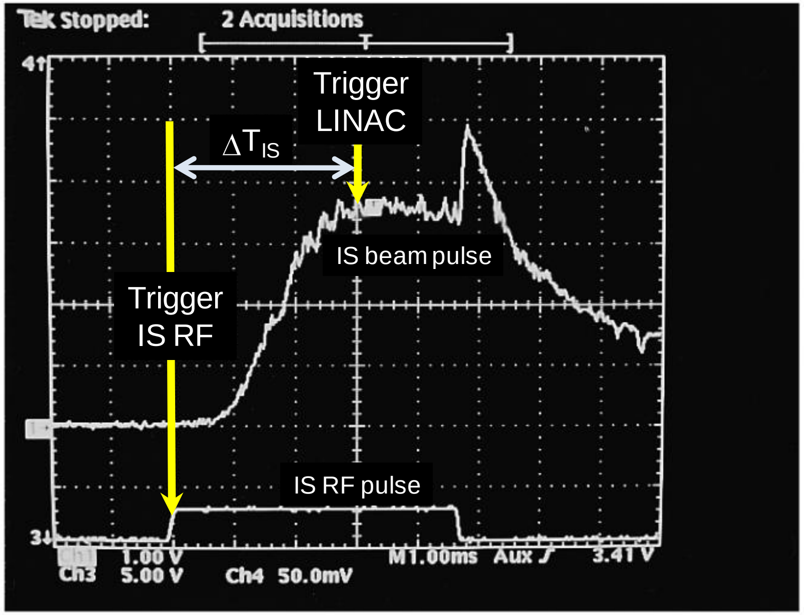
Controlled equipment



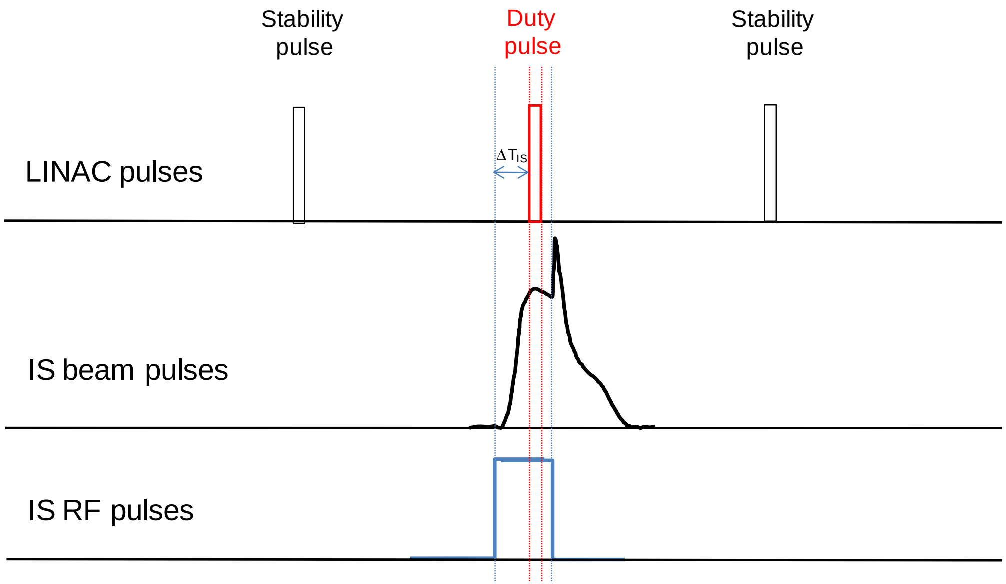
1 Chiller

- Water temp.
- Water flow

Pulsed operation

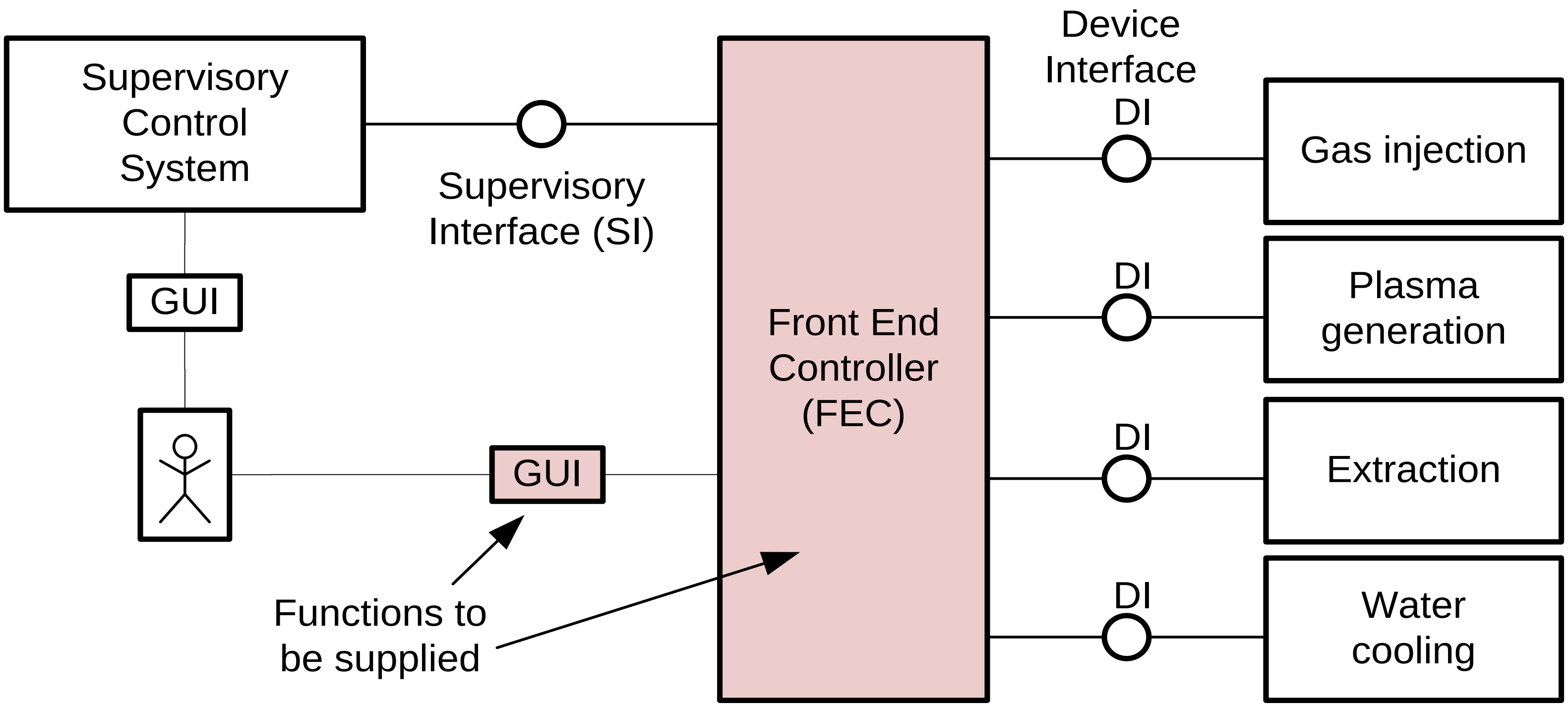


Beam pulse of C4+ from the ECR ion source (top, 100 eμA/div) and the pulsed microwave power (bottom, 900 W/div) (example from HIMAC)



Required synchronization between the RF pulses of the ion source and the LINAC pulses.

Interfaces



Supervisory Control System
Supervisory Interface (SI)
GUI
GUI
Functions to be supplied
Front End Controller (FEC)
Device Interface DI
DI
DI
DI
Gas injection
Plasma generation
Extraction
Water cooling

Status

- ➢ First version of the specification document for the IS control system → done.
- ➢ Discussions with the IS Bidders to define and assign the work packages for the control system → next ~2 weeks.
- ➢ Ion Sources contract to be placed by the end of the month (T0)
- ➢ Full hardware documentation available in T0 + 2 months.