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# PK3201_001_00 SYSTEM DESCRIPTION

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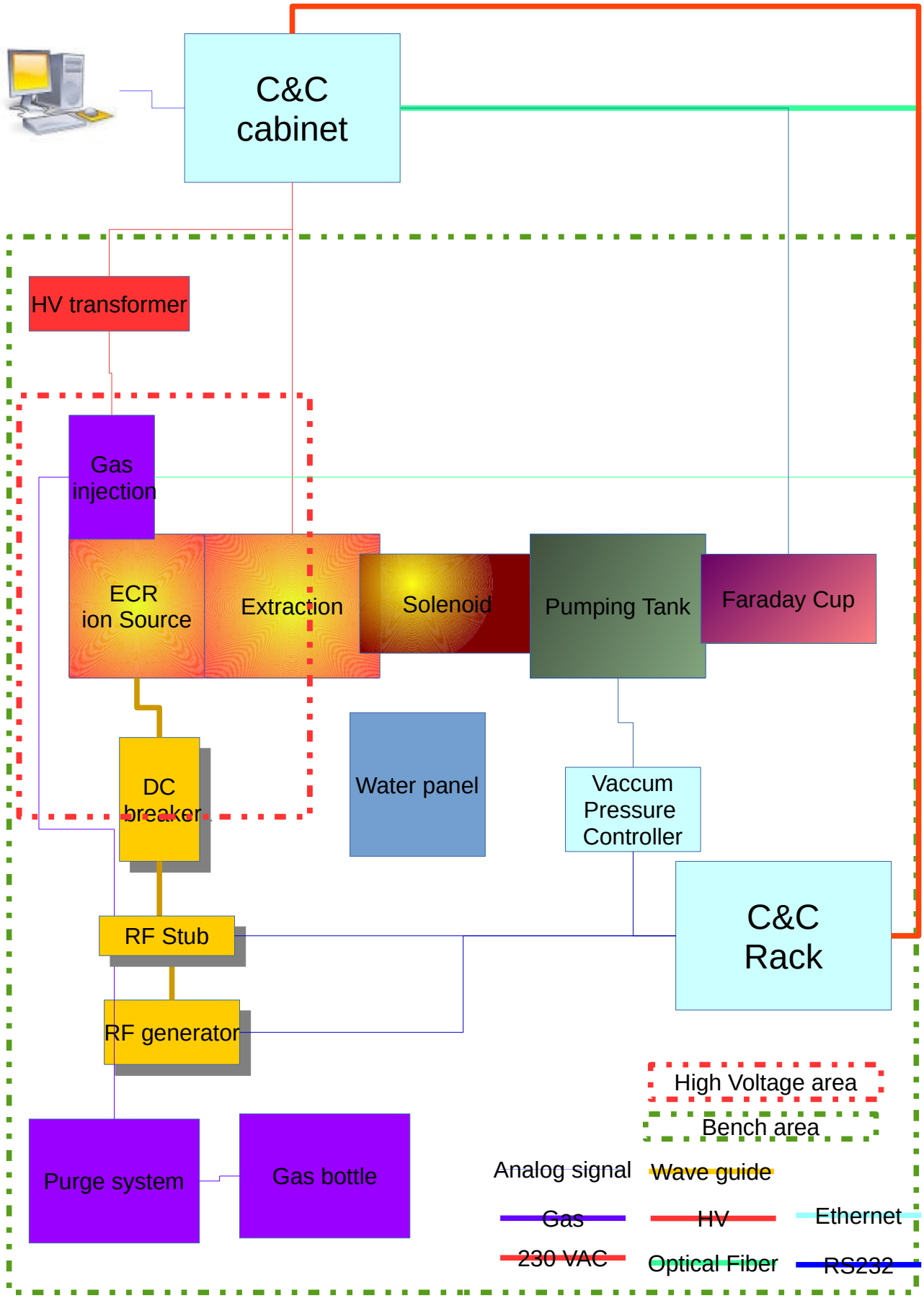
# 1. OVERVIEW

*Figure 1: Bench overview*

*Figure 2: Control cabinet overview*

## 1.1. BLOC SYSTEM DESCRIPTION




Main signals connections

## 1.2. SUB-SYSTEMS POSITION

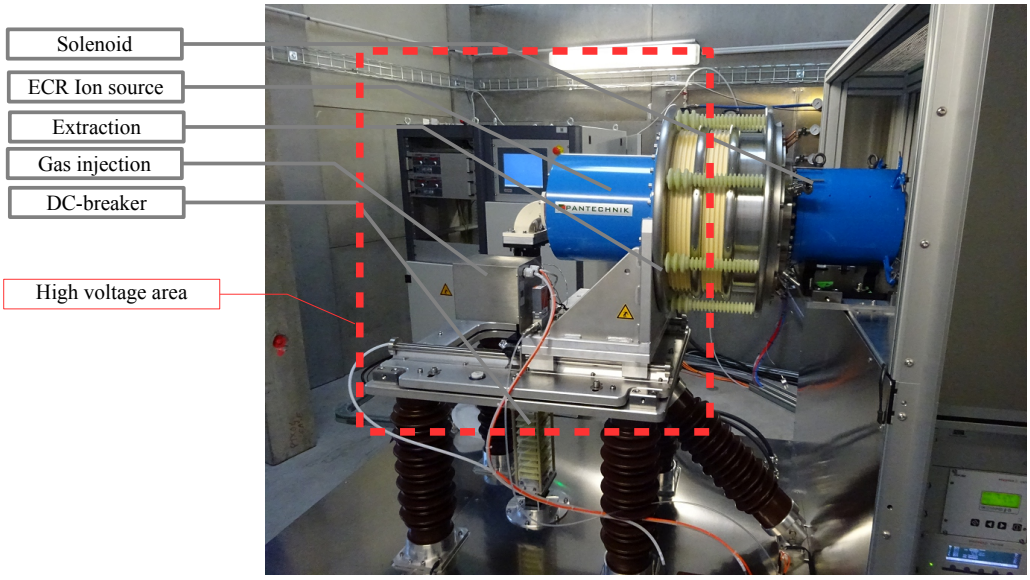



*Figure 3: High voltage area*

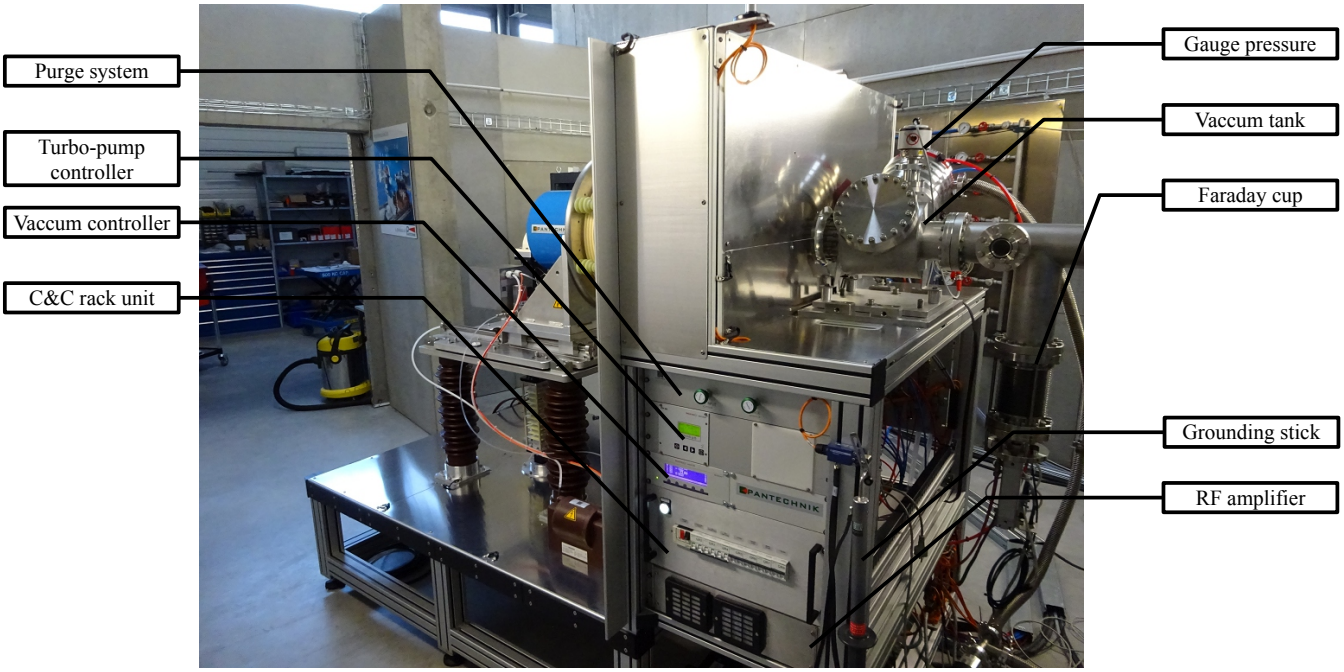



*Figure 4: Bench right side*

*Figure 5: Bench left side*

# 2. SUB-SYSTEMS

## 2.1. SECURITY SYSTEM

### 2.1.1. INTERLOCK DESCRIPTION

Safeties interlocking is implemented to preserve the equipements and the operators.

The main interlocks are High voltage security to avoid sparks and RF interlock to avoid Micro-wave radiation and over heating.

These interlock are implemented through several security components:

- Water cooling (flow meter and thermal switches).
- Door locks.
- Grounding components.
- Vacuum threshold.
- Operator validation.

### 2.1.2. WARNING LAMP

The Warning lamp indicates 3 states corresponding to the follows:

*Figure 1: Warning lamp*

- Green light: System in safe mode, released at ground, access allowed for the operator.
- Orange light: RF interlock validated, ready for microwave generation.
- Red light: HV interlock validated, bench access locked and ungrounded, ready for high voltage.

### 2.1.3. RF & HV PROTECTION

- HV INTERLOCK : The High Voltage interlock is needed to apply the voltage on the elements.

  The necessaries inputs are:

  - Ion source bench closed.
  - Cabinet HV door closed.
  - External interlock OK (dry contact closed).
  - Grounding stick on position.
  - Grounding system latched (HV relays disconnected from the ground).
  - TPG256 relay C OK (vacuum below $1.10^{-4}$ mbars on the Tank gauge).
  - HV interlock validated on the GUI.

- RF INTERLOCK : The Radio Frequency interlock is needed to start the microwave amplifier and apply current on the solenoid.

  The necessaries inputs are:

  - HV interlock OK.
  - All water flow meters and thermal switches OK.
  - TPG256 relays A and B OK ( Vacumm values between $6.10^{-7}$ mbars and $1.10^{-4}$ mbars).
  - RF interlock validated on the GUI.

## 2.2. WATER PANEL SYSTEM

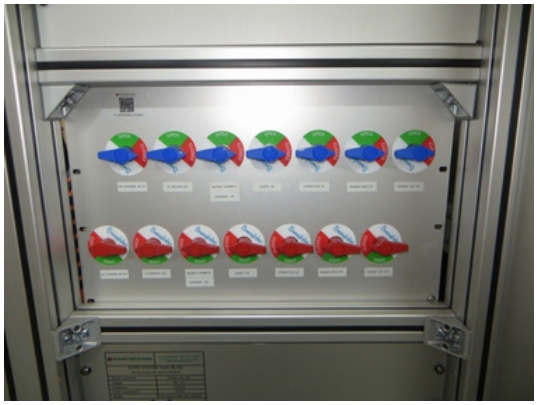


*Figure 6: Water panel front side*

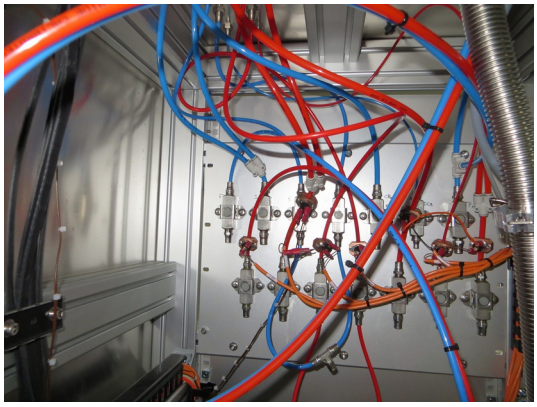


*Figure 7: Water panel rear side*

The water panel permits to close a water circuit. A thermal switch (45°C) is connected on the outlet of each circuit (except the solenoid which is placed directly on the coils).

| Component cooled | Recommended pressure | Minimum flow rate |
|---|---|---|
| Plasma Chamber | Max 5 bars, Delta P : 3 bars | > 4l/min |
| Extraction system | | |
| Diaphragms 1 & Solenoid Chamber | | |
| Faraday cup & Diaphragms 3 | | |
| Turbo Mollecular Pump & Diaphragms 2 | | |
| DC breaker | Max 5 bars, Delta P : 3 bars | > 1l/min |
| Solenoid Coils | Max 15 bars, Delta P : 10 bars | > 4l/min |

## 2.3. VACUUM SYSTEM

### 2.3.1. VACUUM PUMP

The bench is equipped with a turbo mollecular pump (700l/min) connected to a primary scroll pump.

A Leybold SecuVAC and a manual valve are connected between the Primary pump and the turbo pump.

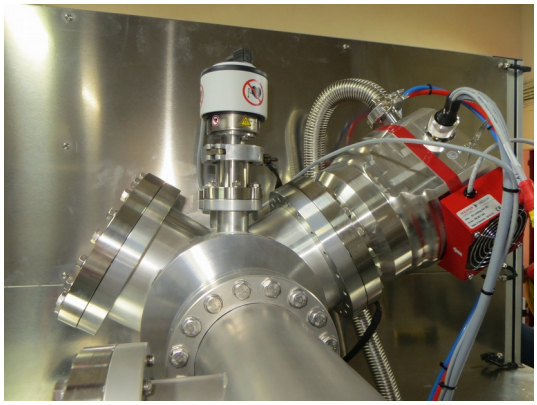


*Figure 8: Turbo mollecular Pump 550l/min*

*Figure 9: Triscroll primary pump + SecuVac valve + manual valve*

## 2.3.2. VACCUM CONTROLLER

A vacuum controller TPG256 monitors all the gauge connected on the Ion source bench.

| Sensors # | Sensor name | Assigned relay & Threshold | Function |
|---|---|---|---|
| Sensor 1 | TANK | A ($6.10^{-7}$mbars)<br>B ($1.10^{-4}$ mbars)<br>C ($1.10^{-4}$ mbars) | Vacuum in the pumping tank |
| Sensor 2 | PRIM | D ($5.10^{-1}$mbars) | Primary vacuum |
| Sensor 3 | PURG | E ($1.10^{-1}$mbars) | Vacuum in the gas panel |
| Sensor 4 | Not Connected - SPARE | | |
| Sensor 5 | | | |
| Sensor 6 | | | |

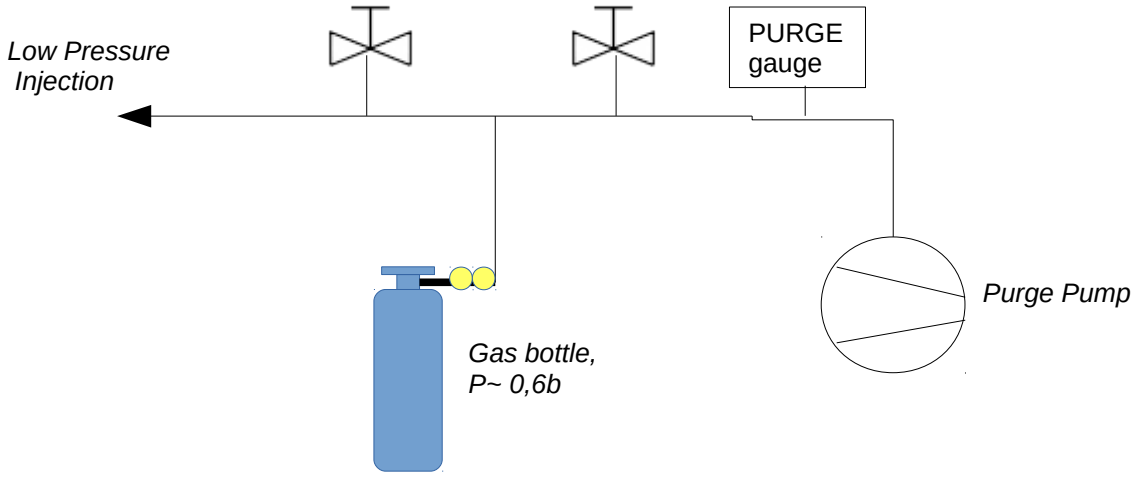
*Figure 10: Gauge controller TPG256*

*Remarks : At the start up of the Controller the Full range gauge (Tank gauge) must be switched manually on the front panel.*

## 2.4. GAS SYSTEM

### 2.4.1. HIGH PRESSURE GAS INJECTION & PURGE SYSTEM

The High pressure side of the Gas system is the follow:




**WARNING : Remind to close the bottle before start a purging procedure**

*Figure 11: Gas panel front side*

*Figure 12: Gas panel rear side*

*Figure 13: Purging pump*

### 2.4.2. LOW PRESSURE GAS INJECTION

The gaz tube coming from the gas panel is connected to the Massflow Controller who regulate the flow rate up to 4sccm.

The principle of the low pressure gas injection is small electrical box supplied in 230VAC by a High voltage transformer. The remote control is done by a optic fiber connected to a RS232 converter located in the signal rack. Refer to the manual **PK15-0107-DT09 "Gas panel 1N_GASLP_V03"** for more informations.

The HV transformer is disconnected from the 230VAC supply if the shielding cage is open.

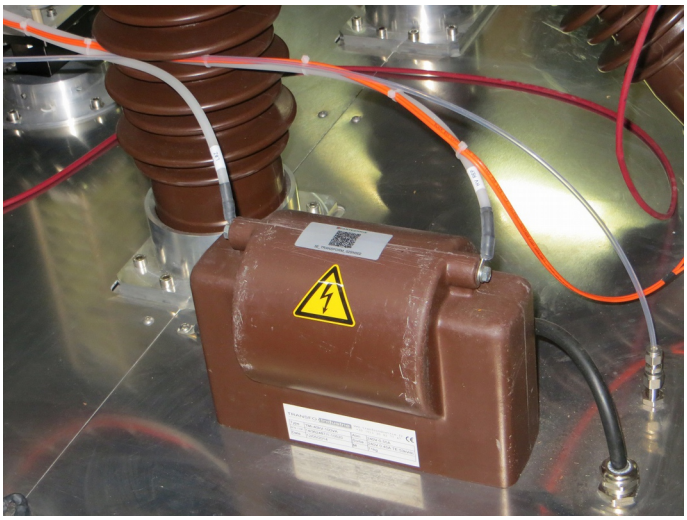


*Figure 14: HV transformer*

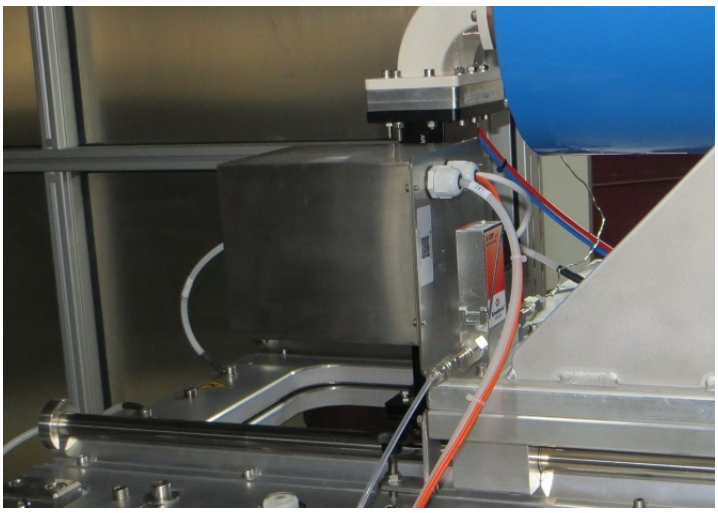


*Figure 15: Low pressure gas injection*

## 2.5. RF SYSTEM

The RF system 1R_RFSYSTEM_V03 is designed for a Sihli2 ECR ion source. The system is composed of :

- An RF amplifier @ 2.45GHz (1,2kW)
- An RF Isolator with a water cooling load
- An RF stub for matching the RF impedance inside the Waveguide
- A DC breaker (1R_DCBREAKER_V04) for isolation between High Voltage and the ground.
- A waveguide path.

The RF system is described in the following documents :

- **PK15-01-07-DT03 : « 1R_RFSYSTEM_V03 Technical documentation »**
- **PK13-0107-DT12 : « DC Breaker 1R_DCBREAKER_V04 Technical document »**

## 2.6. OPTICAL & BEAM DEVICES

### 2.6.1. ECR ION SOURCE

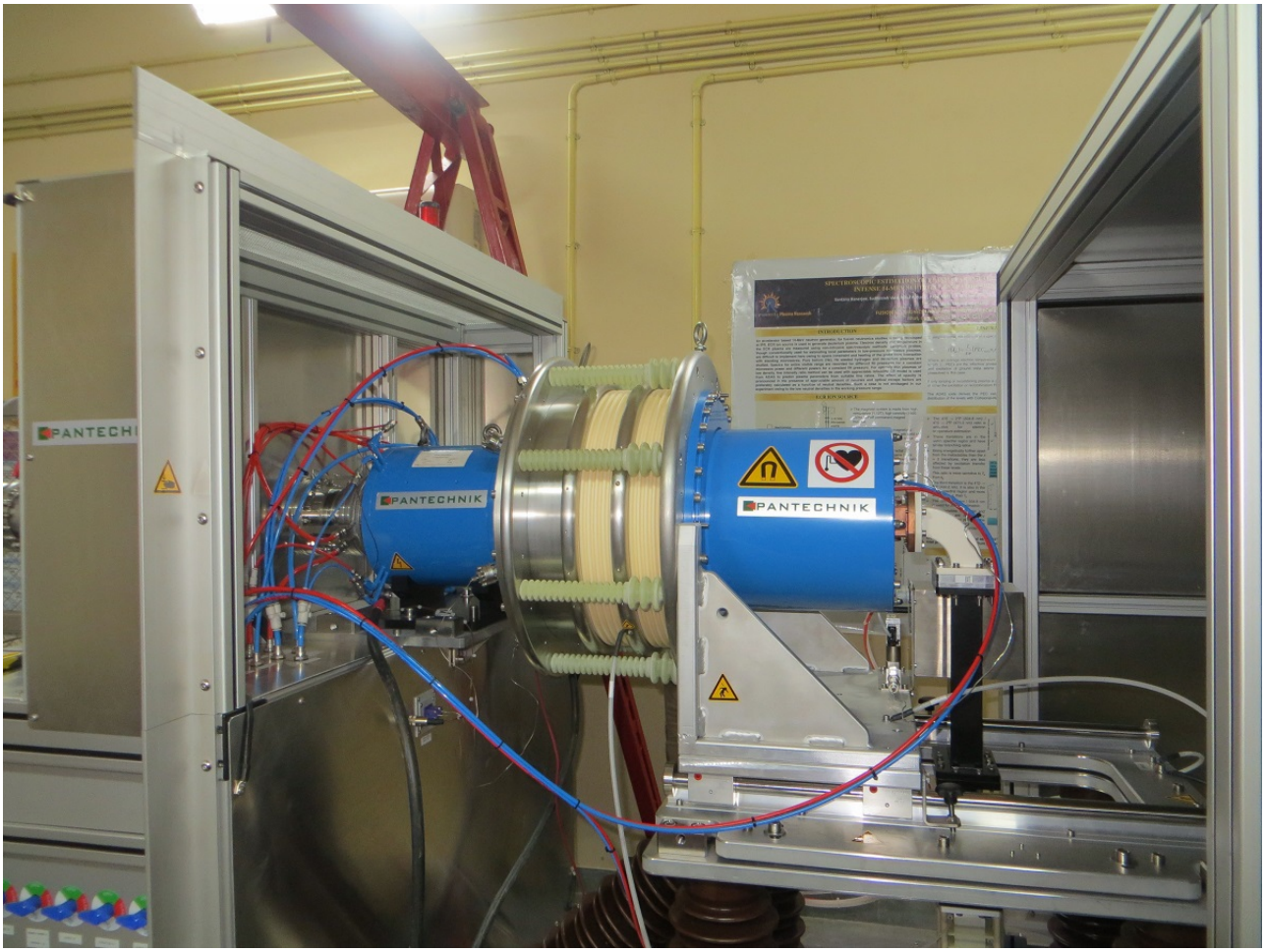



*Figure 16: ECR Ion Source SILHI*

The ECR ion source SHILI® is fully described in the document : **PK15-0107-DT02 " 0S_SILHI_V01 ECR Ion source user's manual"**

## 2.6.2. EXTRACTION

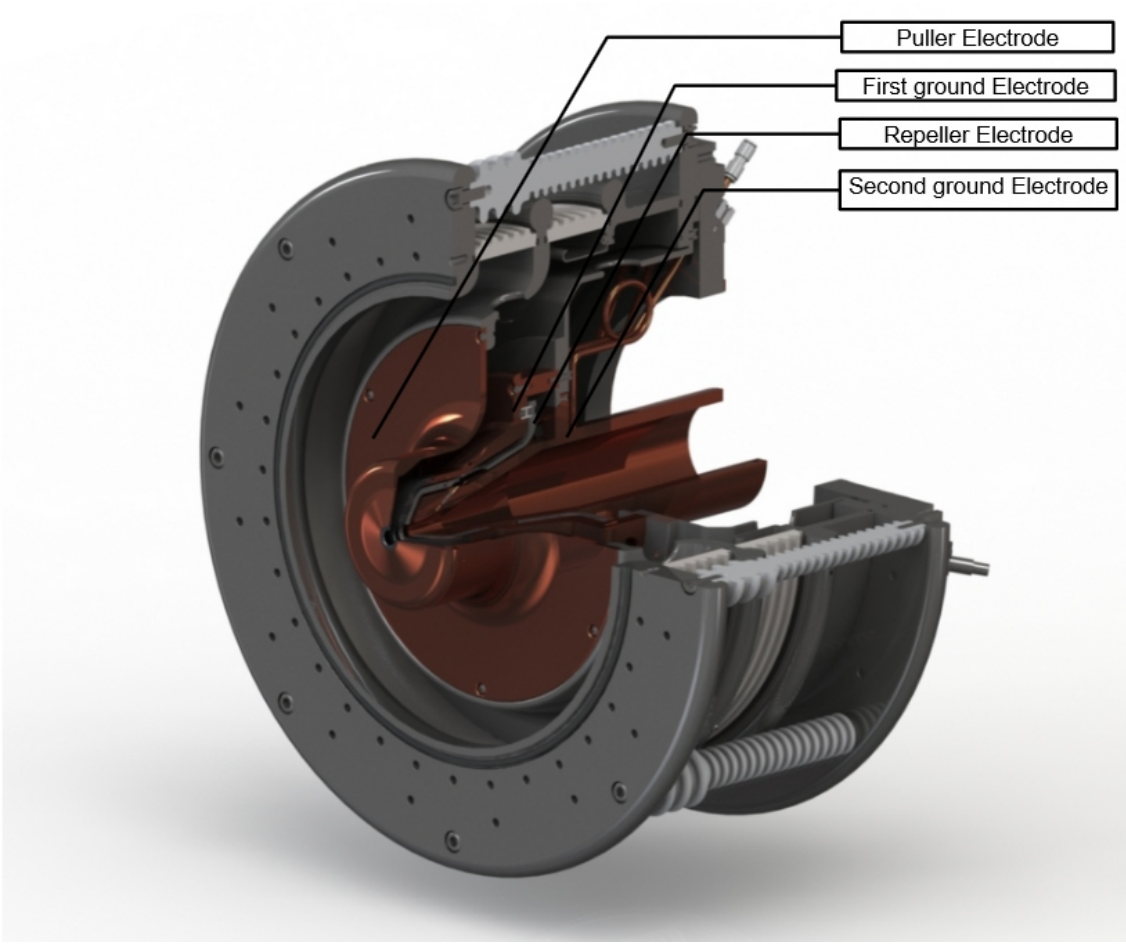



*Figure 17: Extraction view*

The extraction system consists of multielectrode assembly:

- Puller electrode: up to +30kV
- 1st Ground electrode
- Repeller electrode: up to +5kV
- 2nd ground electrode

The electrodes are isolated by ceramic insulators.

The ground electrodes are water cooled.

## 2.6.3. SOLENOID

*Figure 18: Solenoid magnet*

The solenoid permit the focalisation of the ion beam.

It is supplied by two TDK 10V-240A power supplies connected in serial.

One of the power supplies is locally set to ~ 45A, the second one is adjustable from 0 to 200A.

The solenoid chamber and the coils are water cooled.

Refer to the document **PK15-0107-DT06 “ 0O_SOLENOID_V01 Datasheet” for more informations.**

## 2.7. C&C SYSTEM

### 2.7.1. C&C CABINET

The Command & Control Cabinet is designed to operate equipment relative to the ECR source SILHI and relative to beam transport and measurements.

As well as the power supply for the source potential and focus potential, the C&C cabinet provides all the necessary signals to control the ion source, and a Water-cooled Faraday Cup.

It is mainly based on I/O Crio modules that provide analogue and digital signals for the control and monitoring of all the parameters.

For the safety use of the ion source, the use of the RF power and of all the supply is protected by interlocking chains.

The Command & Control cabinet is fully described in the document : **PK15-0107-DT07 " 1E_C&C_V04 Description"**

## 2.7.2. C&C RACK

The extension rack is designed to supply 230Vac and operate equipment relative to the ECR source SILHI bench.

*Figure 19: Extension rack front side*

Refer to document **PK15-0107-DT08 " 1E_C&C-RACK_V01 technical documentation"** for more informations.

## 2.8. DIAGNOSTIC SYSTEM

### 2.8.1. FARADAY CUP

*Figure 20: Faraday cup*

The faraday cup is remote controlled.

A fixed electron repeller power supply is connected (-770Vdc). The HV interlock must be enable.

The farady cup is water cooled and is protected by a diaphragms.

The Faraday cup is fully described in the document: **PK15-0107-DT05 “ 1D_FARADAY_V05 datasheet »**