

# Upgrade of XCET by BE/BI

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# Agenda

□ Overview the XCET system

□ LS2 changes

- NA type acquisition system
- Gas panel
- Controls module
- Pressure gauge
- Preliminary results

□ Conclusion

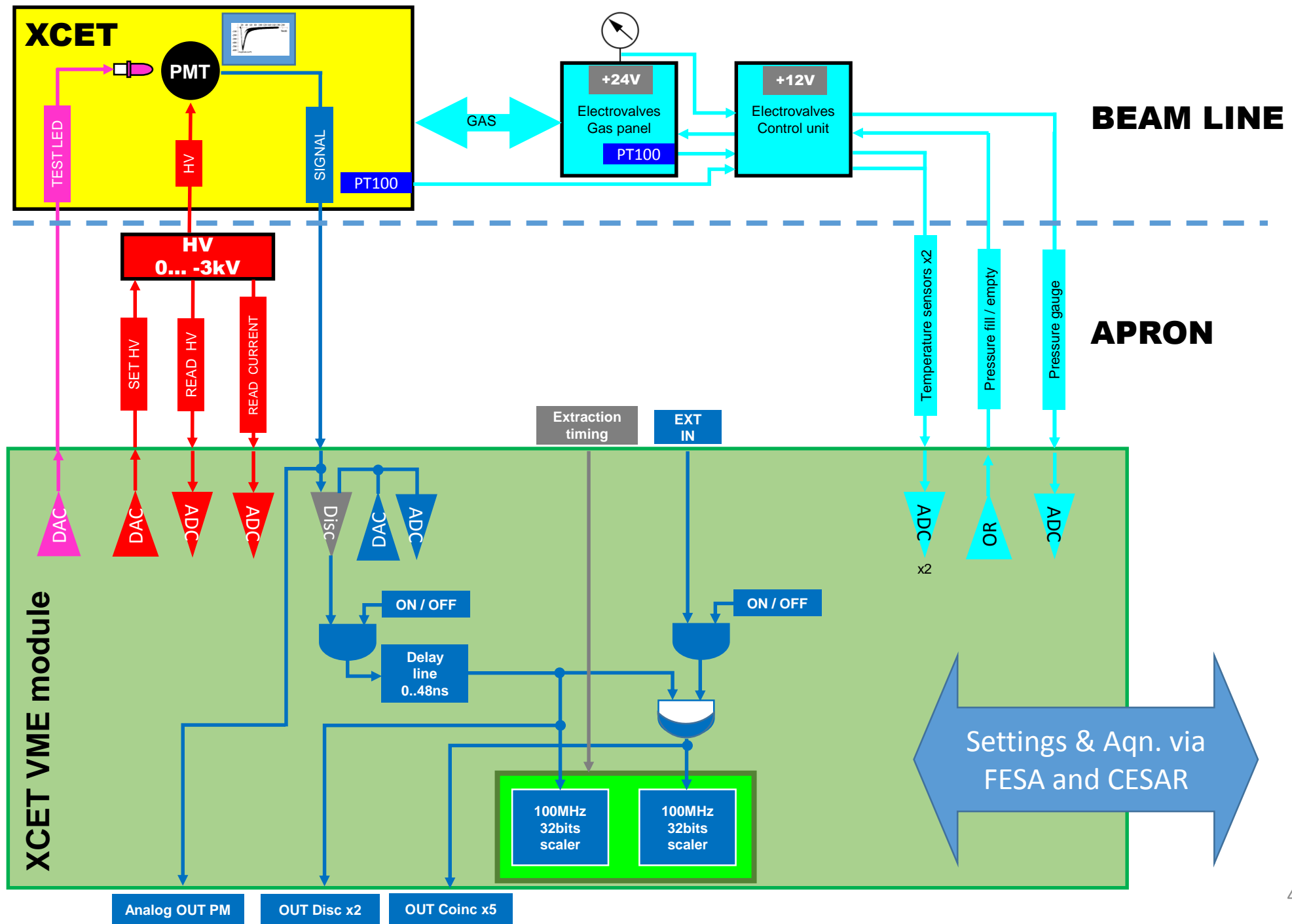
# XCET renovation in East Area

## Driven by

- New users' request for operating at 15 barg
- Use of two refrigerant gases
- Upgrade of Gas filling/exchange/controls system
- Upgrade of acquisition system: **users were left on their own!**
- Upgrade of FESA class (CERN wide)

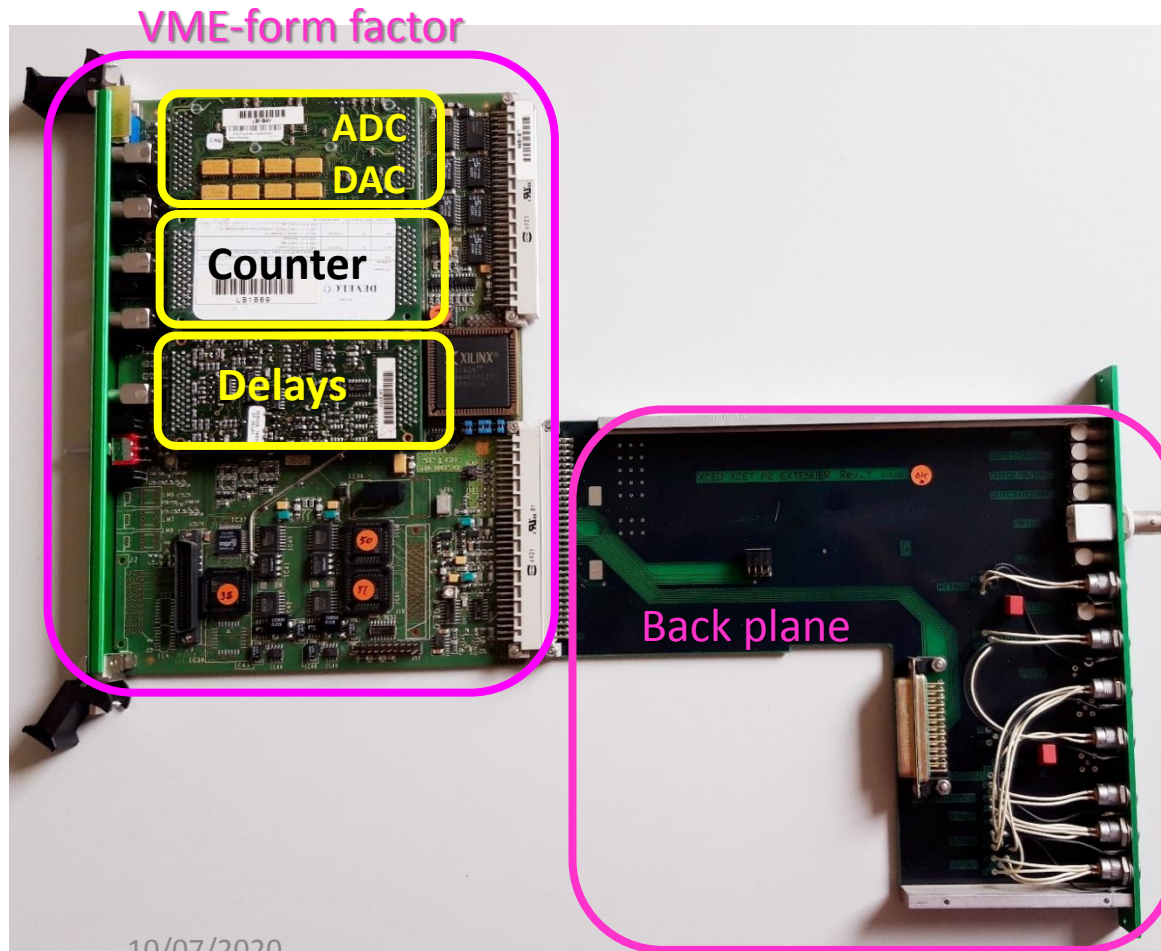


# Overview of the XCET system



# LS2 changes : NA-type Acquisition Chain

## XCET board (2006)



## FESA class

- Migration to FESA3 : common for EA and NA
- Controls of PMT settings: HV, counter, delays, discriminator
- Controls of the gas type
- Two temperature readings
- Possibility to swap between Hamilton and IFM gauge
- Input from EN/EA : enthalpy & T regulation for refrigerant gases
- Todo list
  - Optimisation of gas pressure feedback
  - GUI for pressure scans
  - CESAR: integration of 4 XCETs and tests
- Completion expected by end 2020

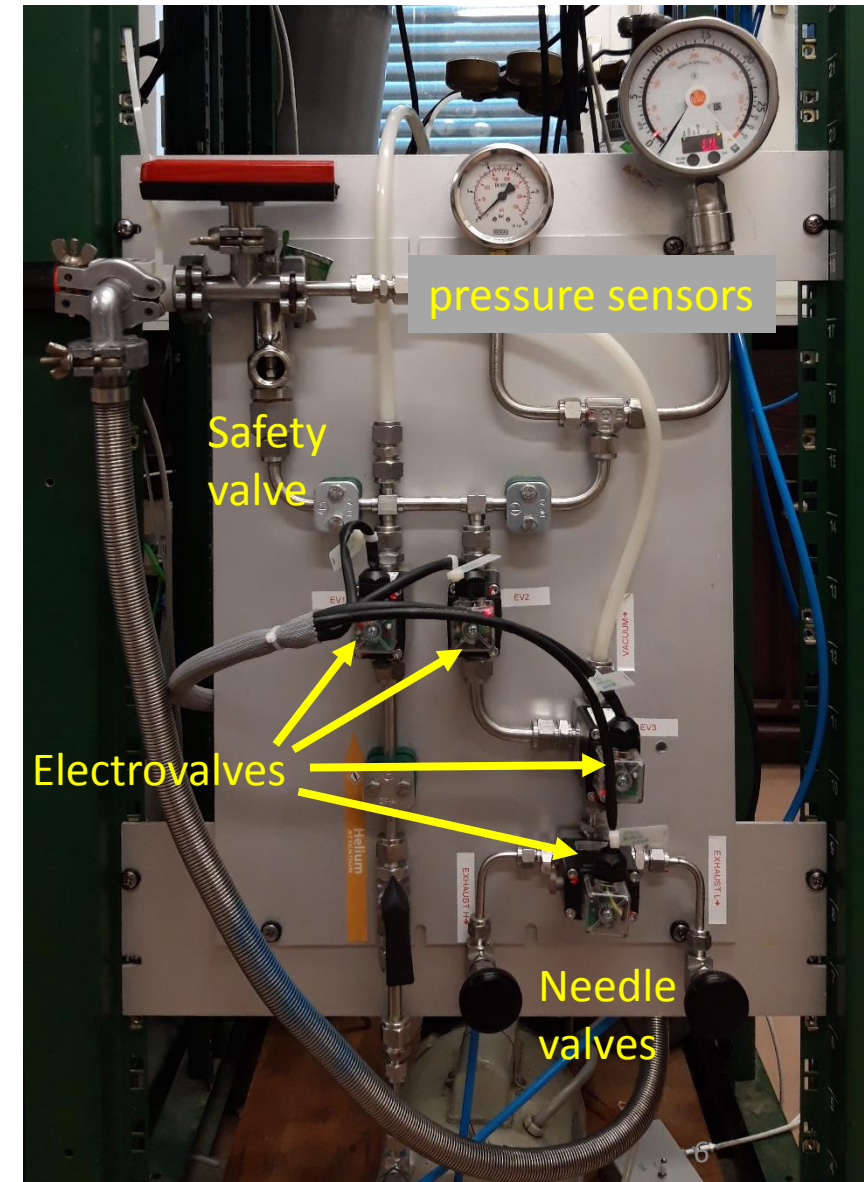
# LS2 changes : Gas panel

## FEATURES

- 24V-electrovalves : x4 (manufacturer : Burkert, DE)
- Two pressure sensors
  - Electronic for remote acquisition (manufacturer : IFM, DE)
  - Needle type sensor, for local reading
- Safety valve
- Needle valves for gas pressure limitation of upstream inlet
- Temperature sensor PT100 in a 4-wire configuration for RT meas.

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## Prototype under test



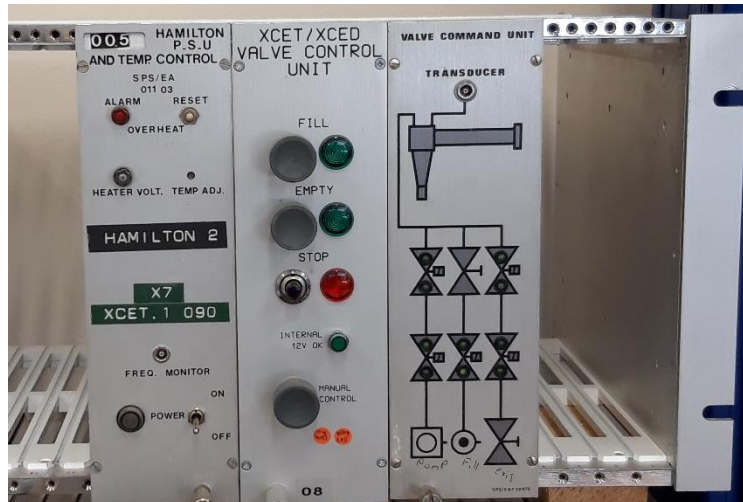


# LS2 changes : Controls module

## FEATURES

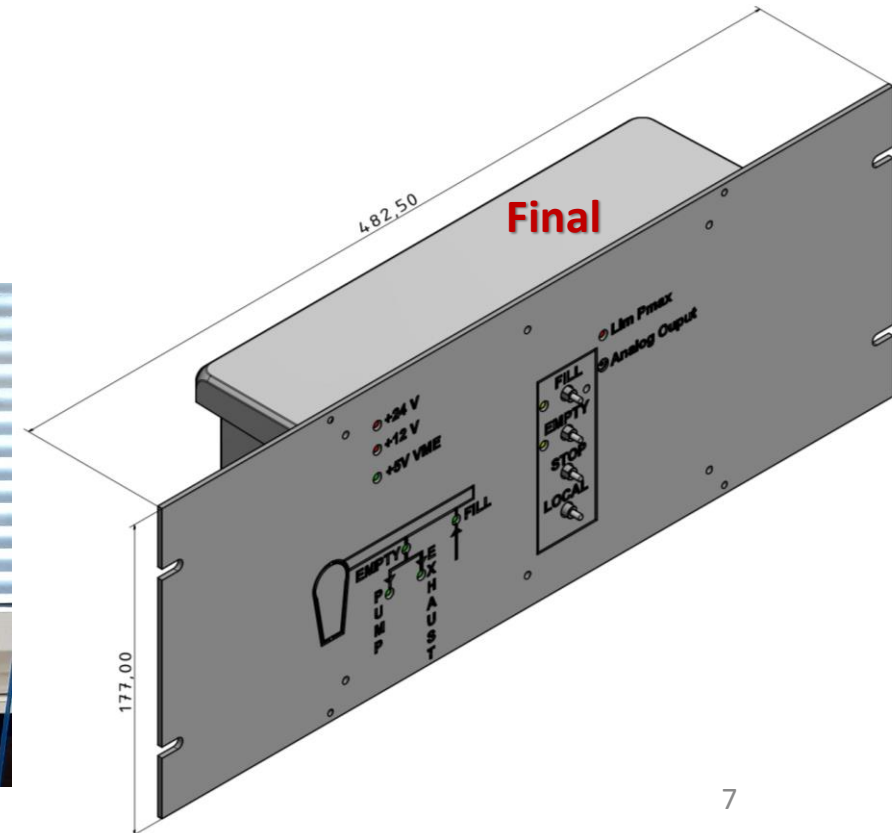
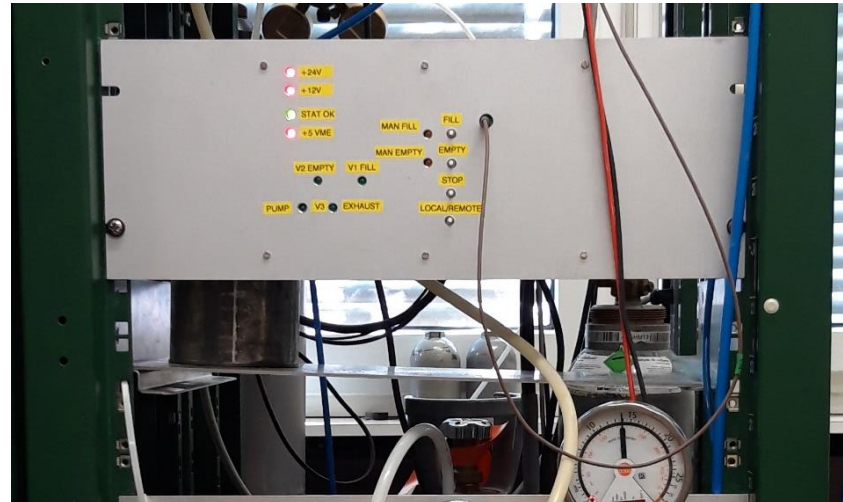
- Power supply 12-24VDC for electronics and electrovalves
- Remote or Local command: Fill/empty
- Protection against overpressure: current comparator interlock of  $P_{max}$
- Transmission of status and signals : (Remote, Pressure, Temperatures)

**Actual NA system**



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**Prototype under test**



# LS2 changes : IFM electronic pressure sensor

## PRESENT SITUATION : 44-YO HAMILTON GAUGES (adapted from old altimeter technology for aircraft)

- High precision pressure transducer which is frequency-dependent
- Absolute pressure given by 4<sup>th</sup> order polynomial degree approximation of 1/f
- Coefficients available only for He, CO<sub>2</sub> and N<sub>2</sub>. **Unknown for R218 and R134a**
- Operates at constant gauge temperature of 40°C
- Our reference Hamilton was last time calibrated in 2002
- **Discontinued** and must be replaced

## NEW PRESSURE GAUGE : IFM

- Working range : [-1, 25 barg]
- East Area P<sub>max</sub> = 15 barg
- P<sub>max</sub> *locally* settable : at P<sub>max</sub> the sensor interlocks the gas filling
- Transmission of analogue output current I<sub>IFM</sub> [4mA, 20mA] for long distance transmission
- Pressure sensitivity to temperature variation:  $\Delta P / \Delta T = \pm 3.2 \text{ mb/K}$

## MEASURED PERFORMANCES WITH N<sub>2</sub>

- On XCET board  $\Rightarrow$  10 mb resolution over full span of 16 bars (or 5 mb resolution over full span of 8 bars)
- Cross calibration with reference Hamilton gauge : frequency measured by a 6.5 digit multimeter
- Precision over 3 measurements : **10-18 mbar** for P  $\in$  [8 - 15] barg, **< 10 mbar** for P  $\in$  [0.1 - 7] barg
- Linearity :  **$\sim 1 \%$  deviation of the plot**  $I_{\text{IFM}} = f(P_{\text{Hamilton}})$  wrt linear fit





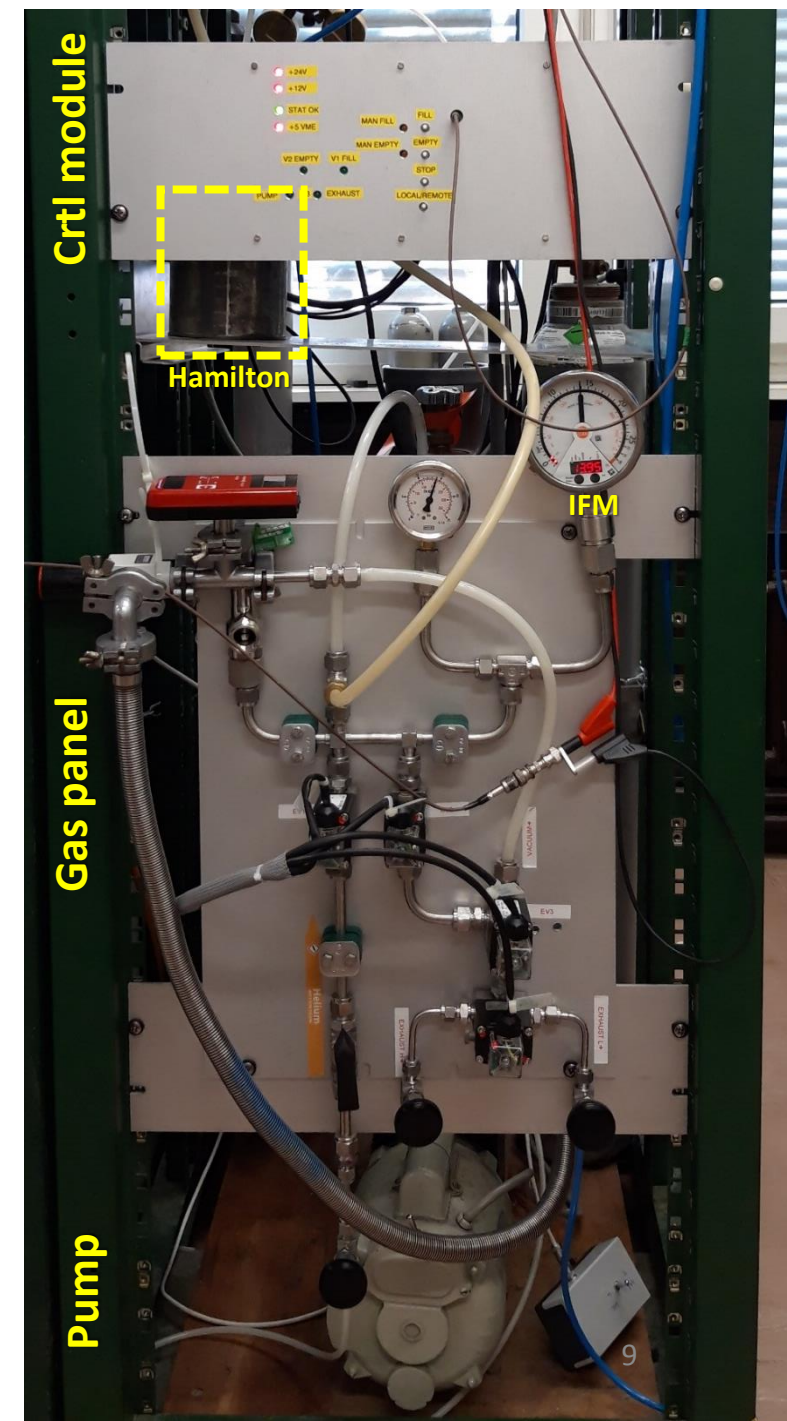
# Measured performances of the gas system

- Our dummy XCET is a 10 litre-gas bottle
- **Extreme care** put on all stainless steel pipe connections
- Only preliminary results

	XCET specs EDMS # 2114239	Tests	Medium
$P_{\max}$	15 barg	15 barg	He, CO <sub>2</sub> , N <sub>2</sub>
$P_{\min}$	< 50 mbar	1.6-2 x10 <sup>-2</sup> mbar	He, CO <sub>2</sub> , N <sub>2</sub>
Leak rate	≤ 34.10 <sup>-3</sup> mbar l/s	77 x10 <sup>-6</sup> mbar l/s	Vaccum & CO <sub>2</sub>
Precision	20 mbar	< 18 mbar	N <sub>2</sub>
Linearity	Not specified	~1 ‰	N <sub>2</sub>
Resolution	Not specified	10 mbar at full span of 16bar	
Filling speed	≤ 1 hour for 15 barg	<b>To be done with real XCET</b>	
Other gases	R218, R134a	<b>To be done</b>	

- **From EN/EA** we need a second gas panel (**electrovalve**) assembly

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# Conclusion

- ❑ Upgrade of Cerenkov detectors in East Area is progressing well on BI side
- ❑ XCETs will share common acquisition chain with North Area : electronics and controls via CESAR, FESA
- ❑ Maximum gas pressure of 15 barg
- ❑ New gas control system with low-voltage electrovalves : **ready for production**
- ❑ Electrovalves and pressure transducer give very promising results: **beyond specs.**
- ❑ To be validated with other gases and under real XCET conditions
- ❑ EDMS 2170447 will be released after validation of 2<sup>nd</sup> prototype assembly
- ❑ Cabling from T09 / T10 to APRON validated: **in EN/EL's good hands**
- ❑ No showstopper