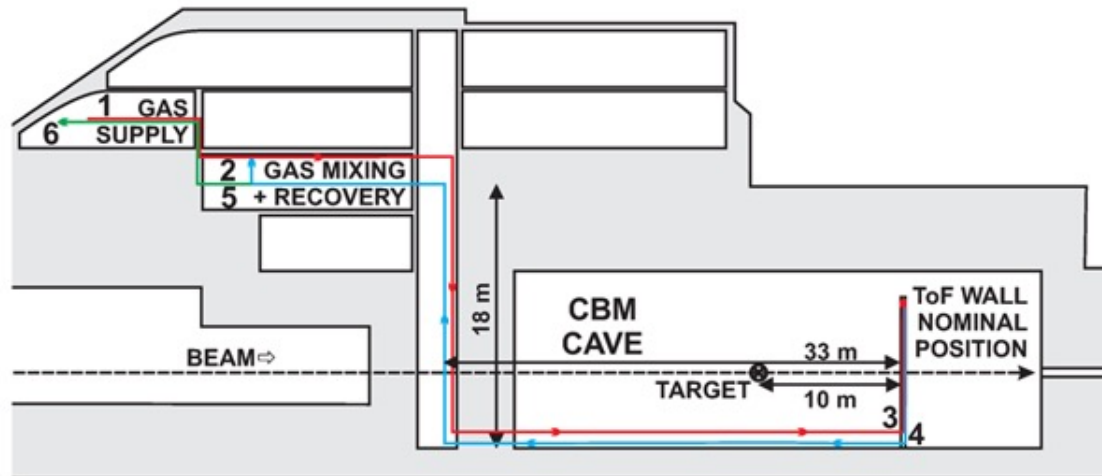


# RICH

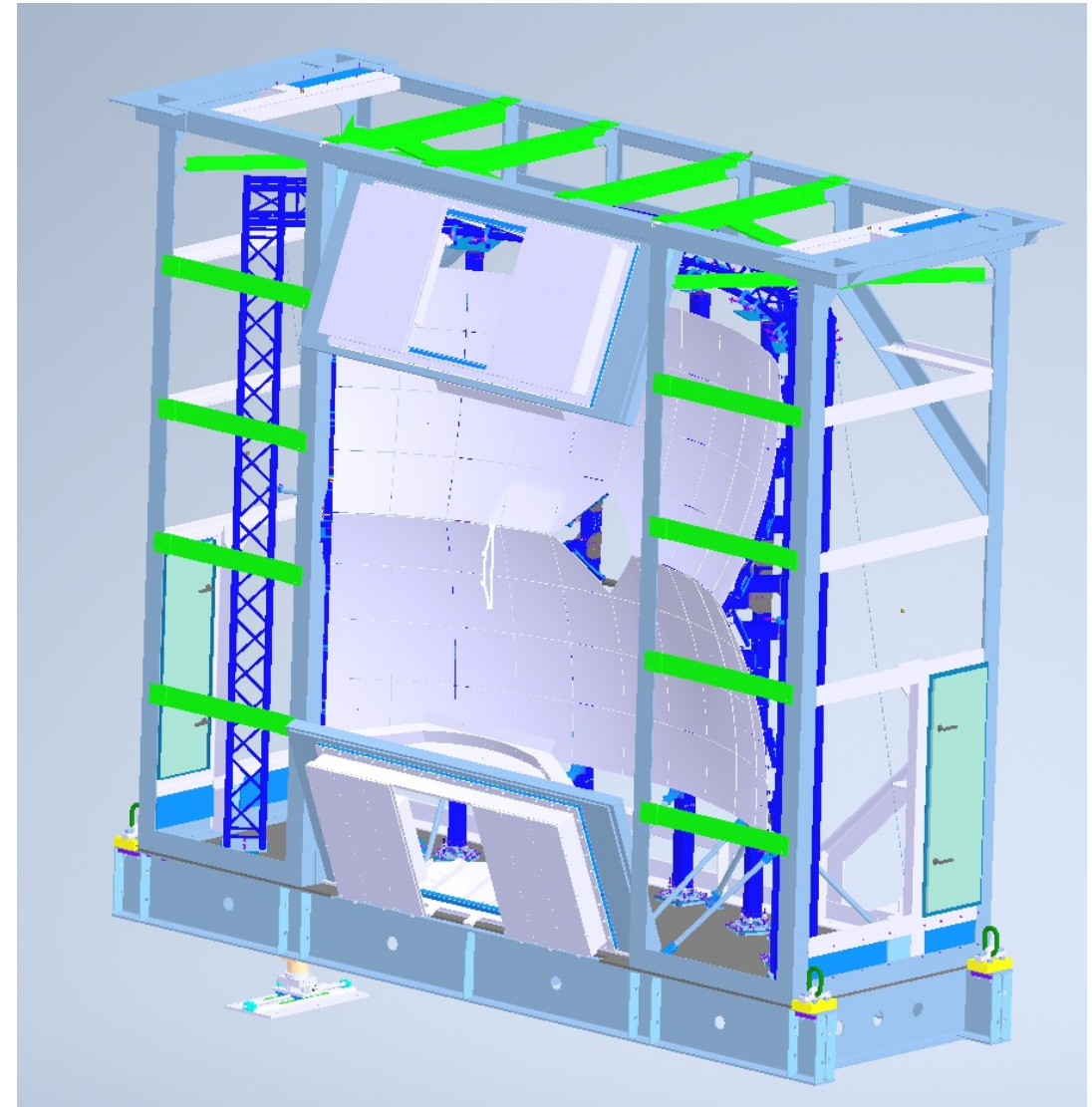
# Reduced gas system

Luca Ahrens

- $H \times W \times D = 5200 \times 6000 \times 2000$  (in mm)
- Radiator volume of about  $60 \text{ m}^3$
- Radiator gas  $\text{CO}_2$  at 2 mbar overpressure
- $\text{N}_2$  for purging and during muon setup
- $n_{\text{CO}_2} = 1.00045$  @  $T = 0^\circ\text{C}$ , 1 atm
- $\gamma_{\text{th}} = 33.3$  with  $p_{\text{th},\pi} = 4.65 \text{ GeV}/c$



M. Kis



- Maintain a constant overpressure of 2 mbar within the detector.

- Provide pure CO<sub>2</sub> to the detector and control the gas quality.

- Maintain a constant overpressure of 2 mbar within the detector.

- Regulate the flow rate through the detector
- Controlling the system with a PLC
- Writing the data of all sensors in a common interface
- Testing detector purging flow rate
- Optimizing the flow rate through all critical devices
- Simulate the height difference of E30 and E10
- Test gas tightness of the RICH gas vessel

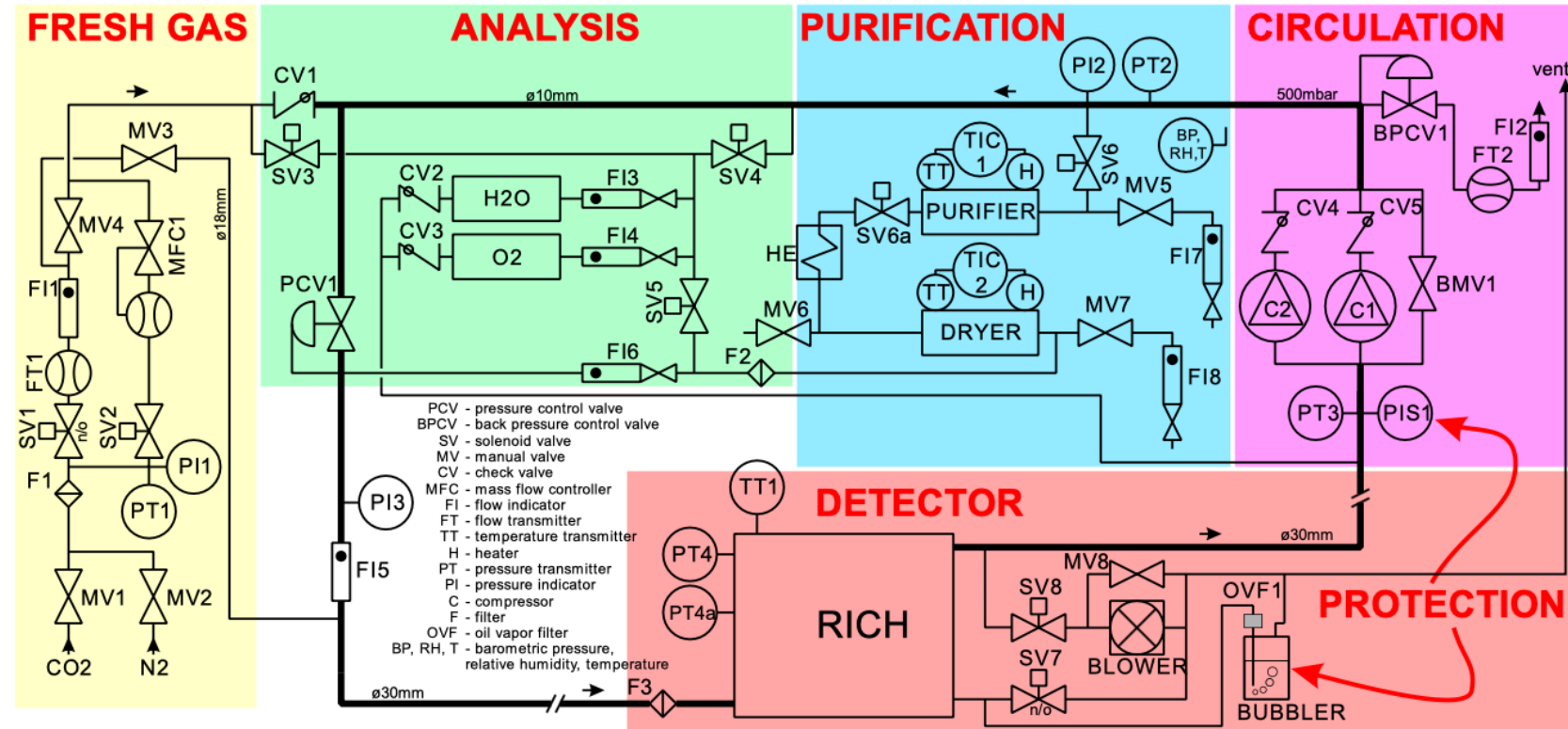
- Provide pure CO<sub>2</sub> to the detector and control the gas quality.

- Need to find established purifier and dryer that match safety standards
- Find and test a reliable gas monitoring system for the detectors gas content
- Include it into the existing gas system

# FDR version of the system

- Possibility to analyze fresh, purified and circulating gas
- Takes into account pressure drop at pipelines
- Blower and bubbler allow sharp barometric pressure changes
- $\text{H}_2\text{O}$  and  $\text{O}_2$  analyzers work fine

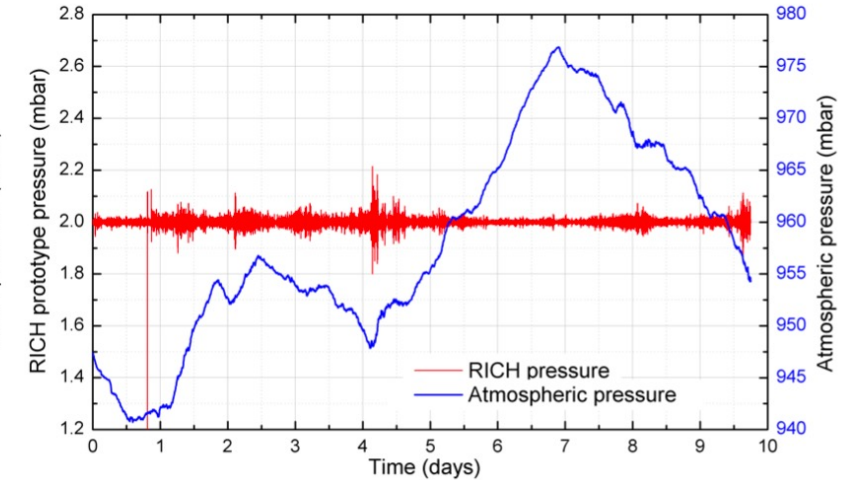
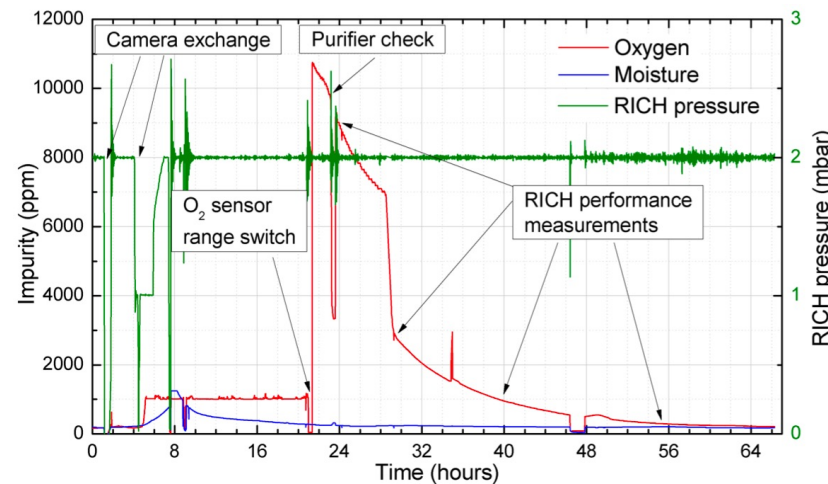
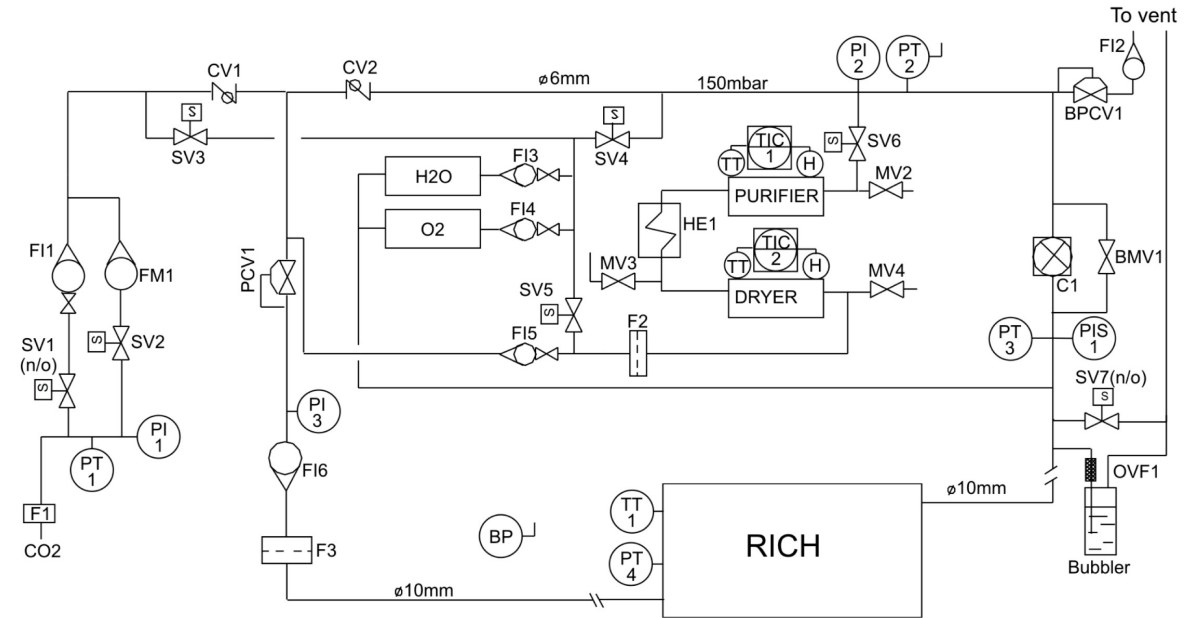
- Design of purifier and dryer needs changes



- Designed by PNPI

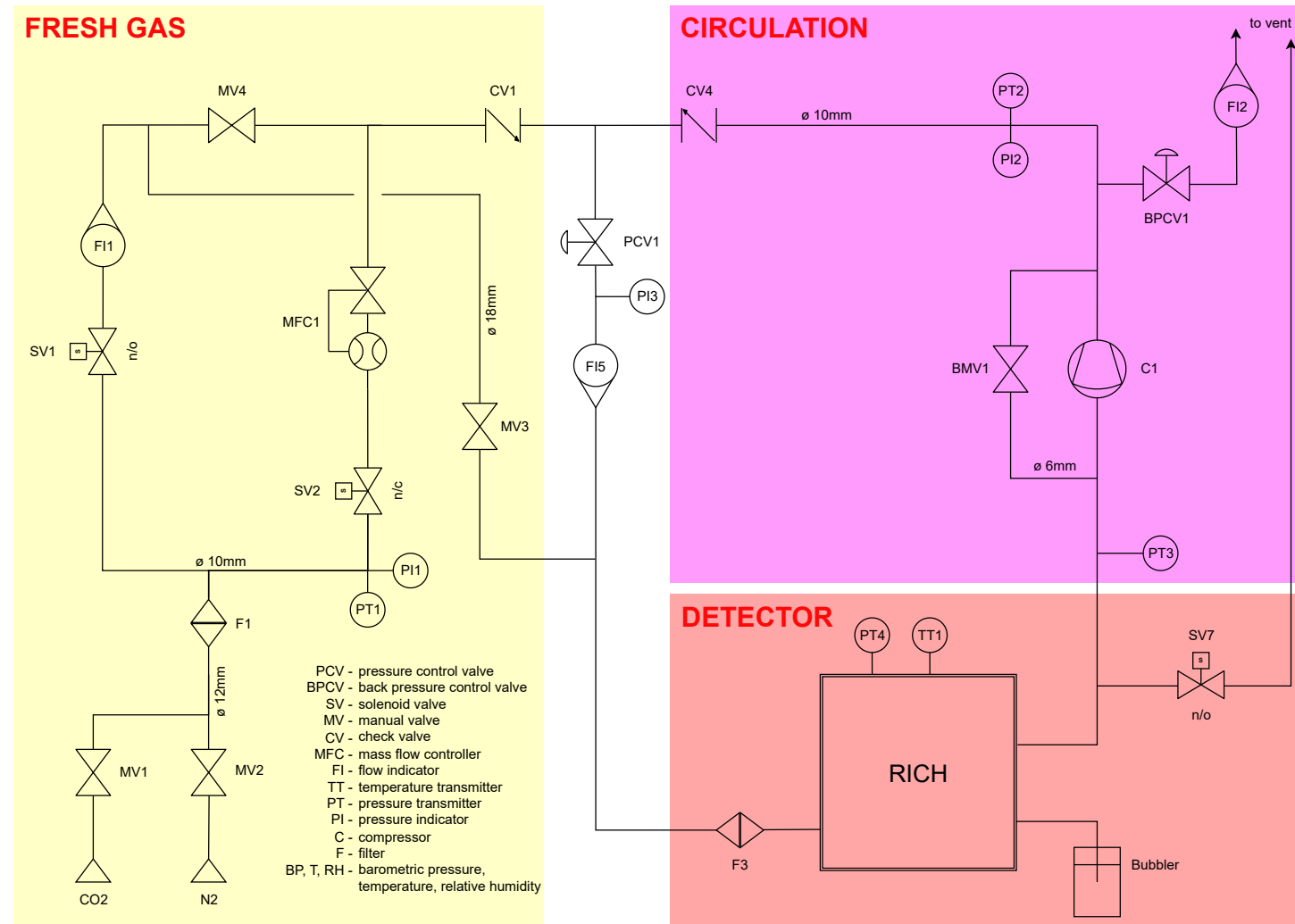
# Old prototype system

- First prototype was tested at CERN in 2011/2012
- Differential pressure was stabilized at 2 mbar
- Oxygen and moisture under control



RICH TDR Jun13

- System can be expanded to add:
  1. Analysis unit
  2. Purification unit
  3. Blower and second compressor
- Recirculating flow rate: up to 40 slpm
- Purging flow rate: 100 slpm or higher
- Fresh gas flow rate: up to 40 slpm
- Differential pressure: 2 mbar
- Pressure stability:  $\pm 0.1$  mbar



slpm – standard liter per minute



# New prototype system



Front



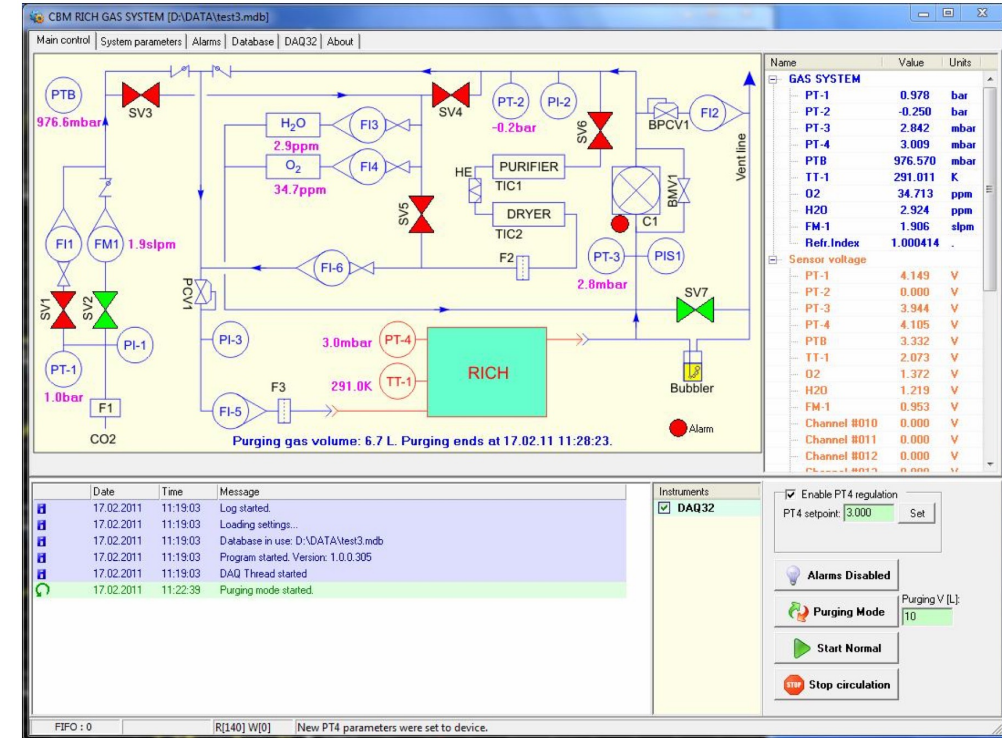
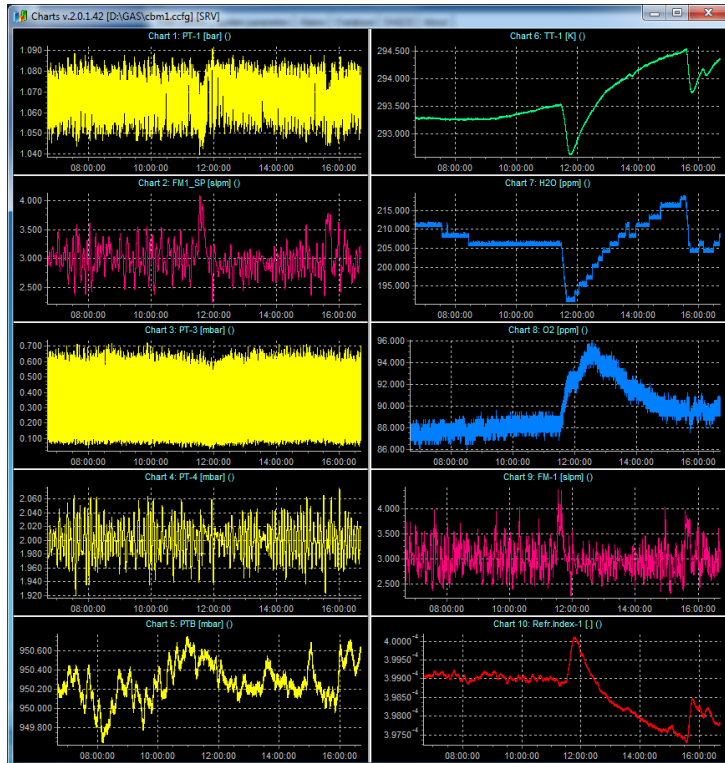
Side



Back

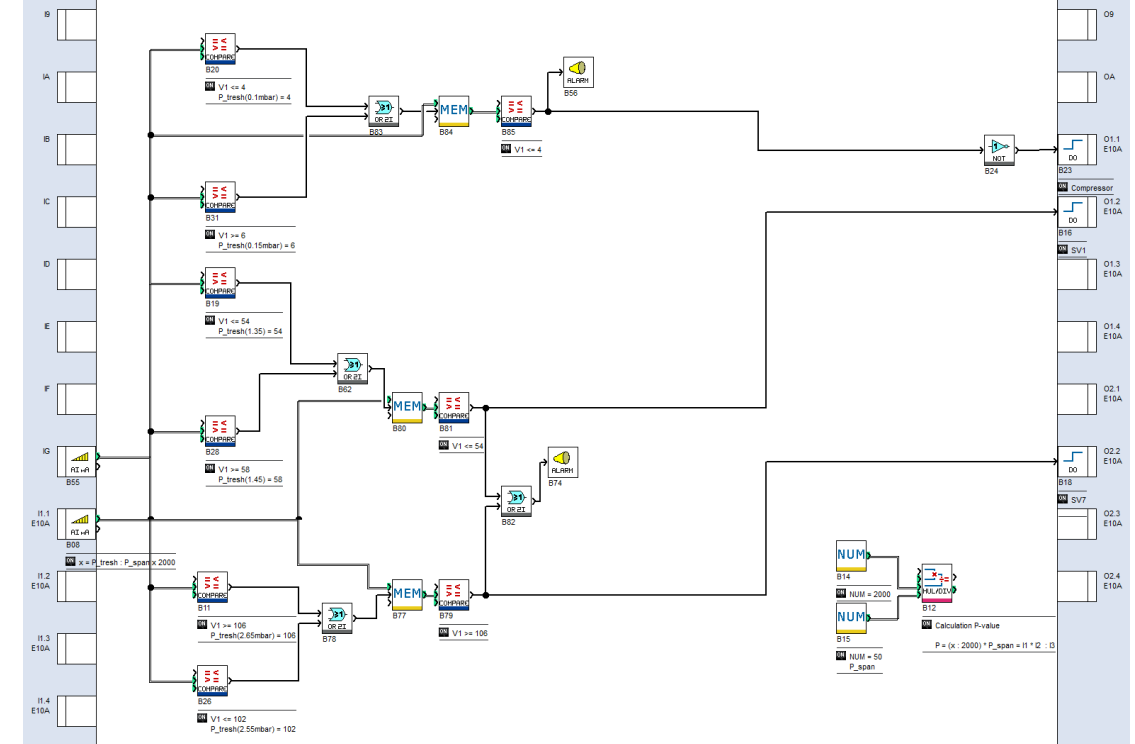


- Previously controlled by a gas system software
- Switching to a Programmable Logic Controller
- Different protocols for operating, flushing and maintenance mode



- Alarm settings control the valves and compressor
- Final version will also allow the analysis of the gas and initiate purification, if needed
- Data of sensors need to be written and stored in common format

- PLC by Crouzet (EM4 B26 Ethernet)
- Same PLC as the TRD group
- With expansion modules up to 46 I/Os
- Is programmed by the free Crouzet Soft (Function Block Diagram)

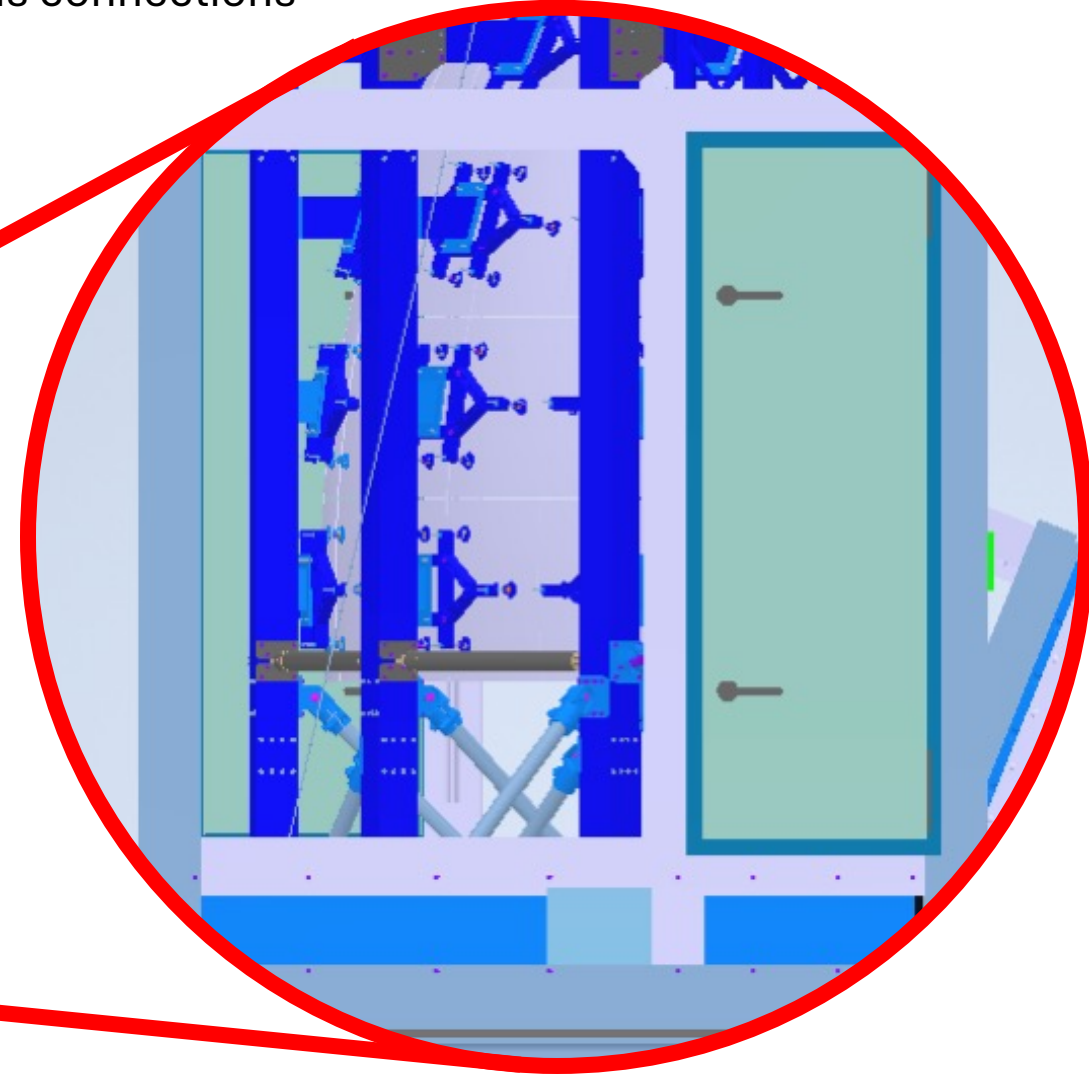
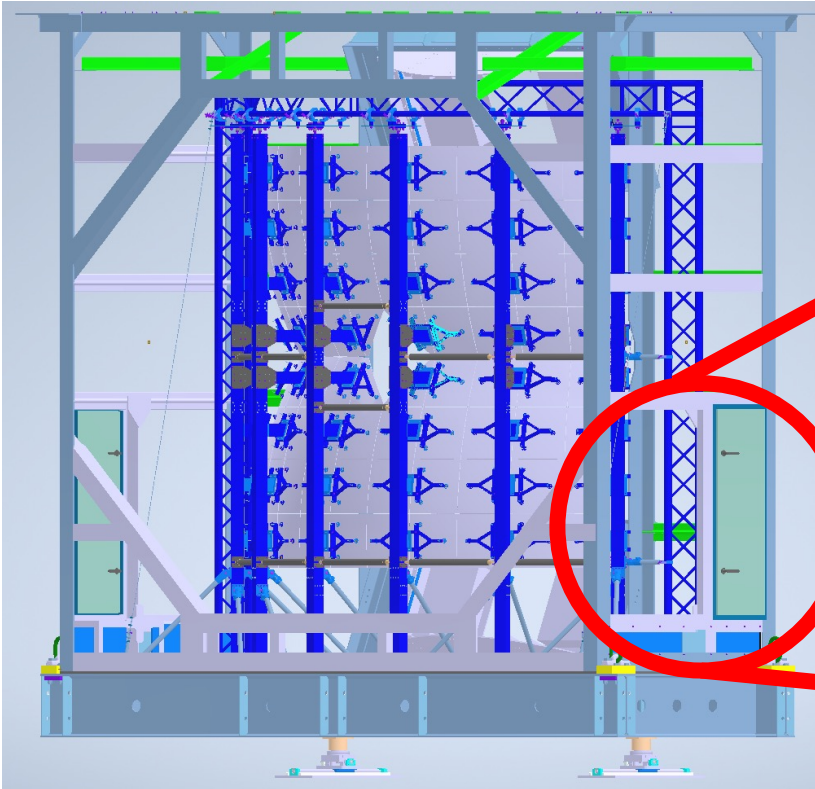


- Currently working on the alarm settings and writing data
- For RICH gas system PLC size is sufficient



# Prototype box

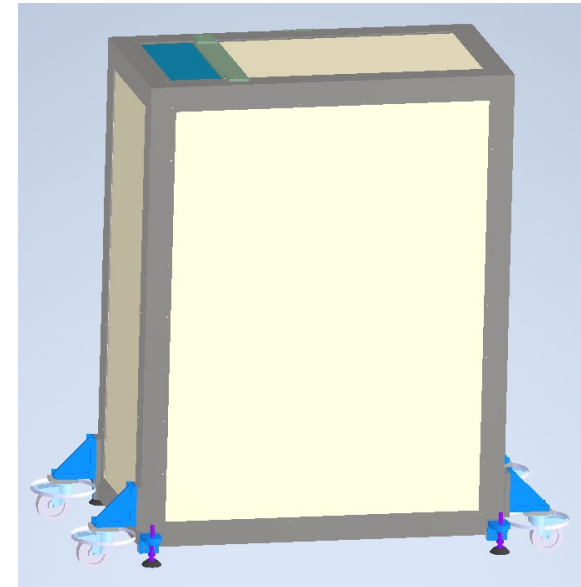
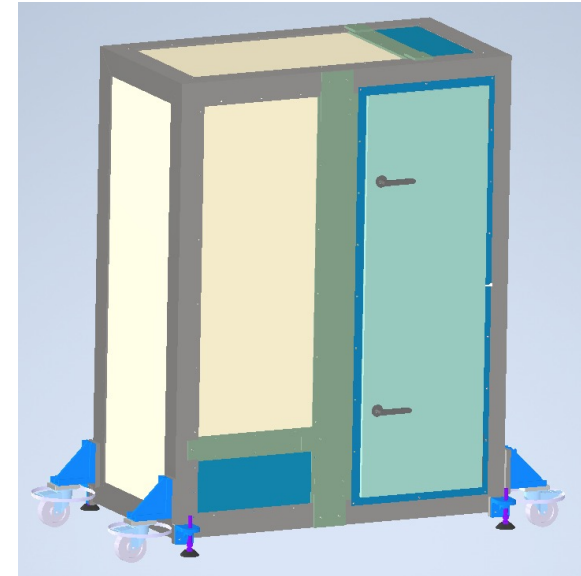
- Building a prototype box to test:
  - Bonding and screwing of the plates to the profiles
  - Size and positioning of the gas connections
  - Gas and light tightness
  - Testing gas system



- Includes biggest plate, door and gas connection plates in original size
- Door is from TROX
- Profiles are in final design
- H x W x D = 1850 x 1450 x 750 (in mm)
- Volume of about 2000 liters
- It is rollable and fits through all doors



Many thanks to M. Völlinger and T. Wasem





- Assembly of the gas system in progress, will finish within next months
- Test box is already ordered
- Program for controller needs to be finished
- Run the gas system
- Measure for gas and light tightness of box
- Find and integrate optimal purifier and dryer
- Talk to expert (Chilo Garabatos)
- Optimize everything for the final design
- **RICH – Reduced gas system**



# RICH

# Reduced gas system

Luca Ahrens

Thank you for your attention