

# The Usage of N-Perflourcarbons as RICH Radiators

# The specifications

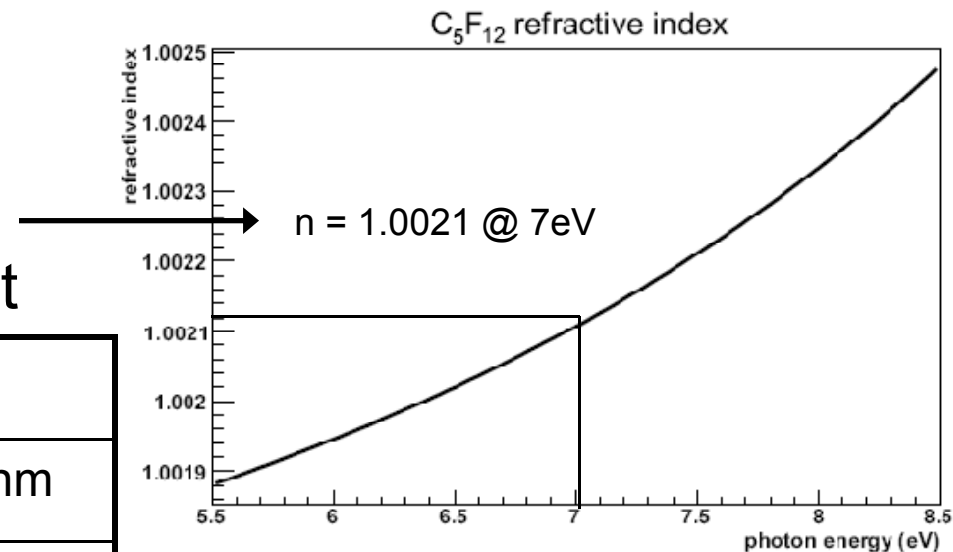
- Little chromatic dispersion
- Refractive index sufficient  $O(1.001)$
- Good UV transmittance (Csl)
- Long radiation length
- Non flammable
- Easy to use

➤ N-perflourcarbons fulfill these specs

# Refractive index

- Refractive index can be tuned by choosing the appropriate Perflourcarbon
- Very moderate chromatic dispersion, at

Gas	$dn/dE$ [ $eV^{-1}$ ]	@
$CF_4$	$5.3 \times 10^{-6}$ *	180 nm
$C_4F_{10}$	15	180 nm
$C_5F_{12}$	21	180 nm
$C_6F_{14}$ Fluid!	2800	180nm

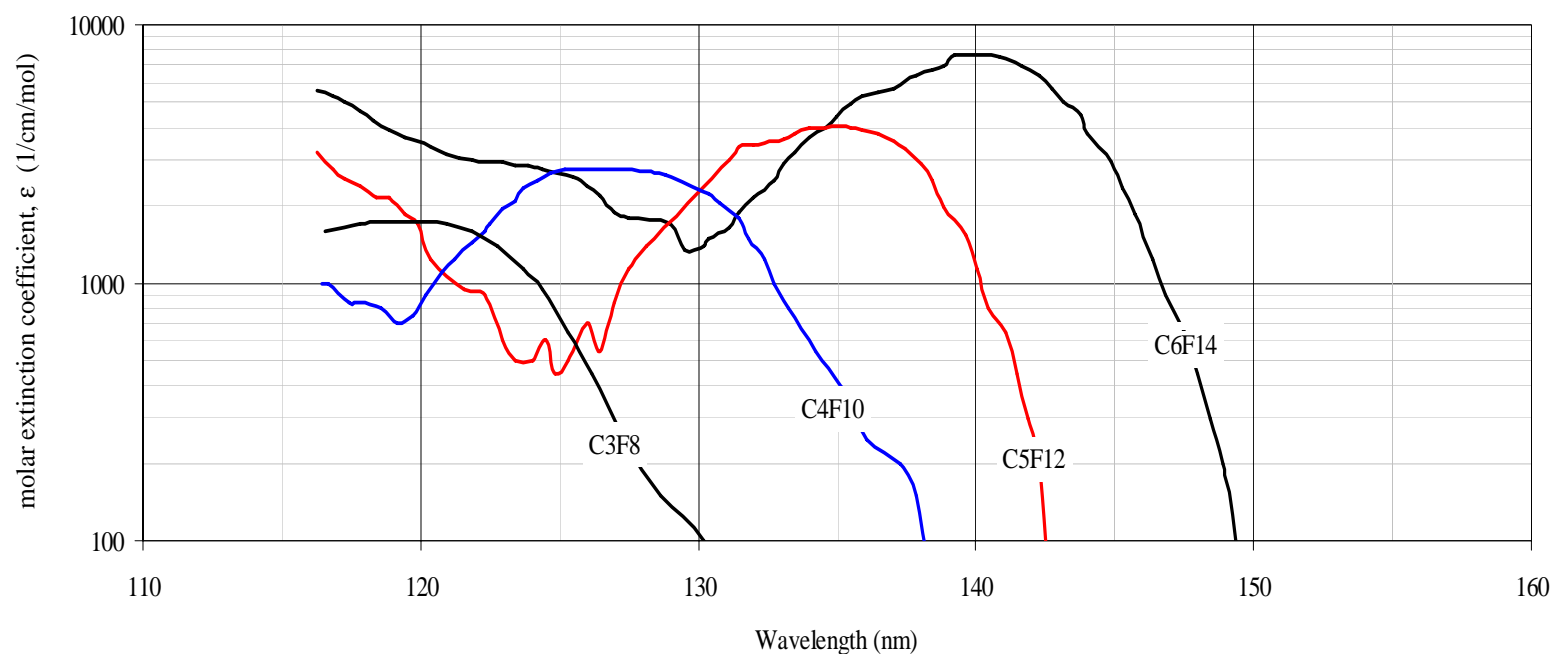


FROM: Gas Cherenkov detectors for high momentum charged particle identification in ALICE  
G. Volpe et. altera

\*Dissertation von Peter Fauland  
Universitat Bielefeld

# Transparency

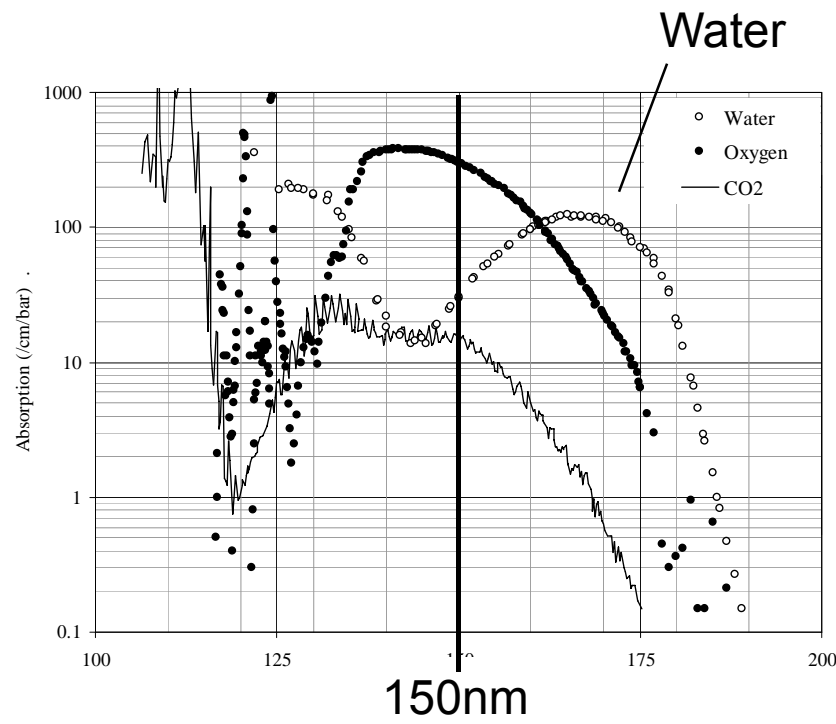
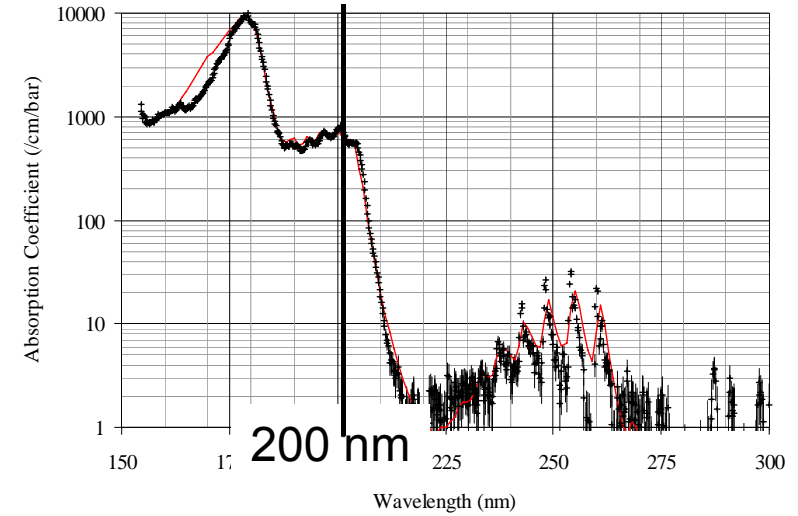
- Good transparency for clean  $C_nF_m$
- Extinction in far UV ok for light gas as  $C_3F_8$ 
  - Photon detector should be sensitive above 180nm



Chemical Physics Letters, volume 3, number 8, 1969, 649-651

# Watch contaminations

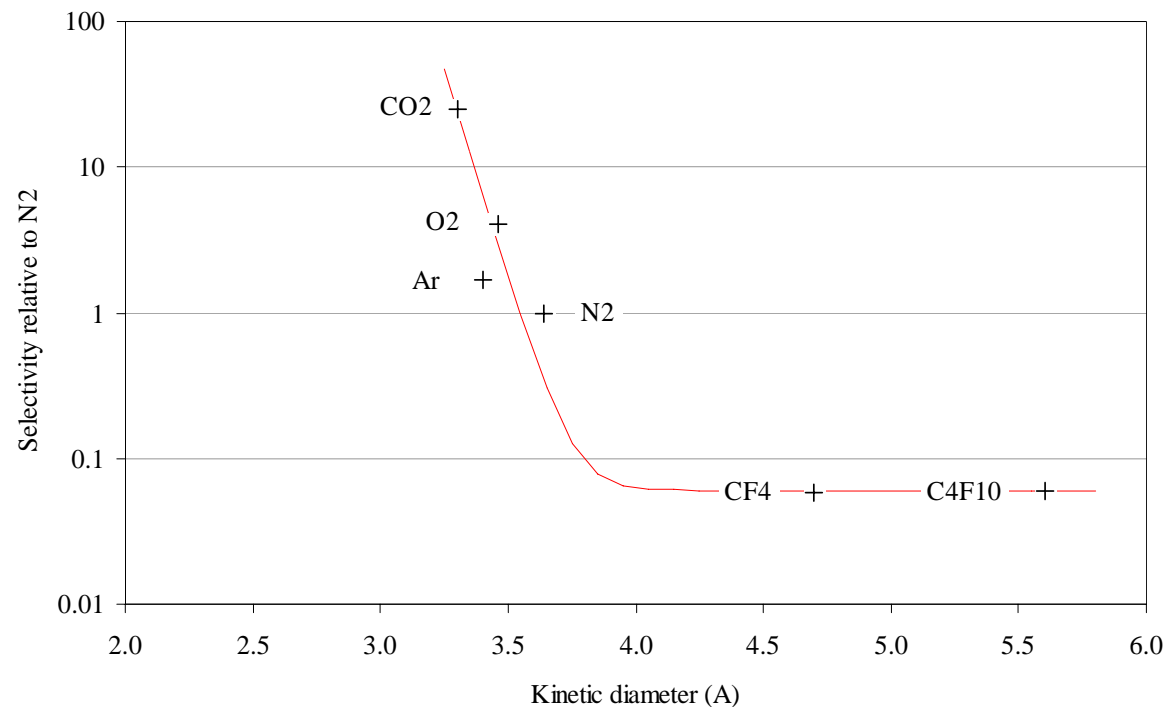
- Benzene kills transparency



- Water and Oxygen should be kept low

# Membrane cleaning

- Membranes allow selection of kinetic diameter
- $\text{CF}_4$  and  $\text{C}_4\text{F}_{10}$  can be well separated from Oxygen, Argon and Nitrogen



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# $C_4F_{10}$ recovery

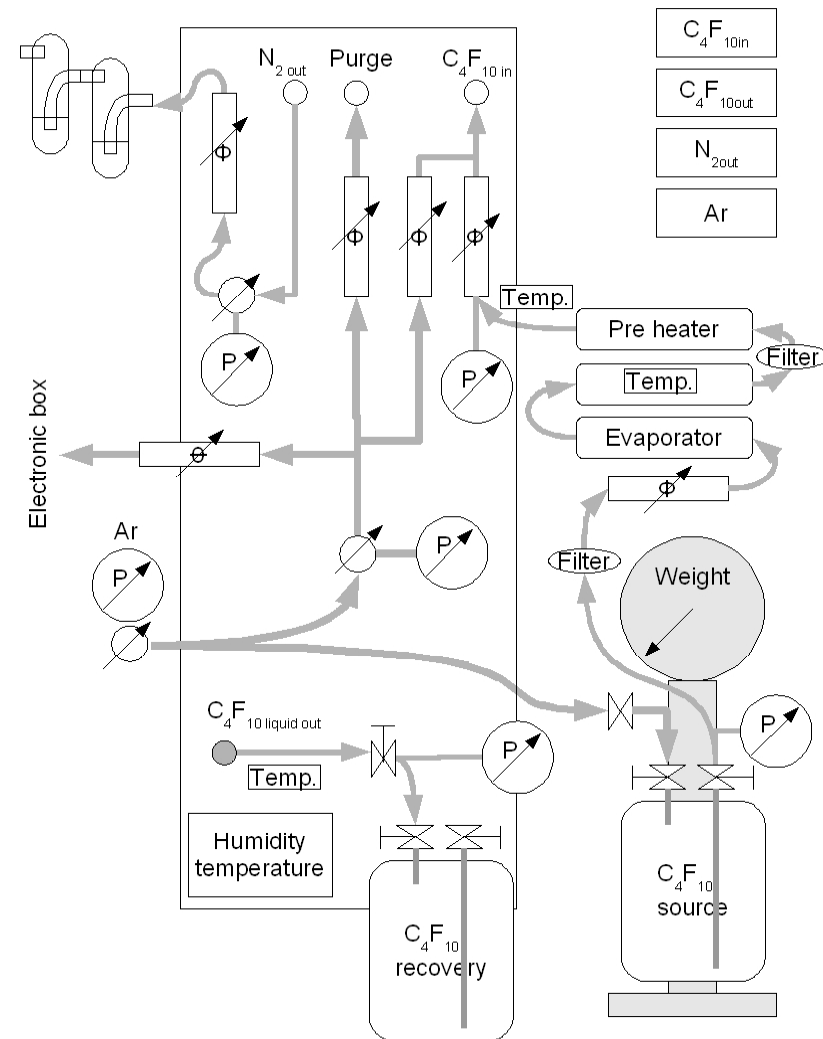
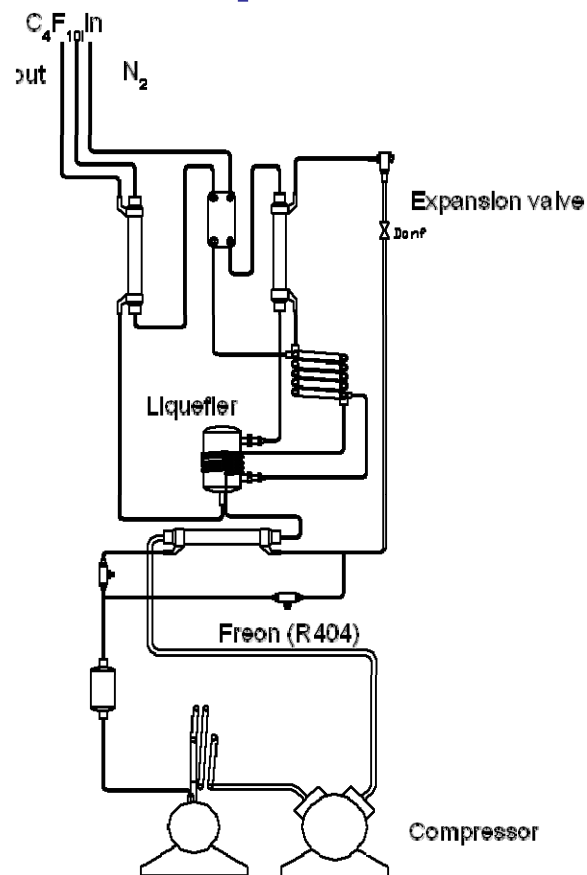
- $C_4F_{10}$  is a good Čerenkov radiator
- Widely used: Compass, Delphi, Hera-B, Hermes, LHCb
- Expensive gas: must be recovered before opening detector
- Example: LHCb Rich1

# LHCb RICH1 $C_4F_{10}$ recovery

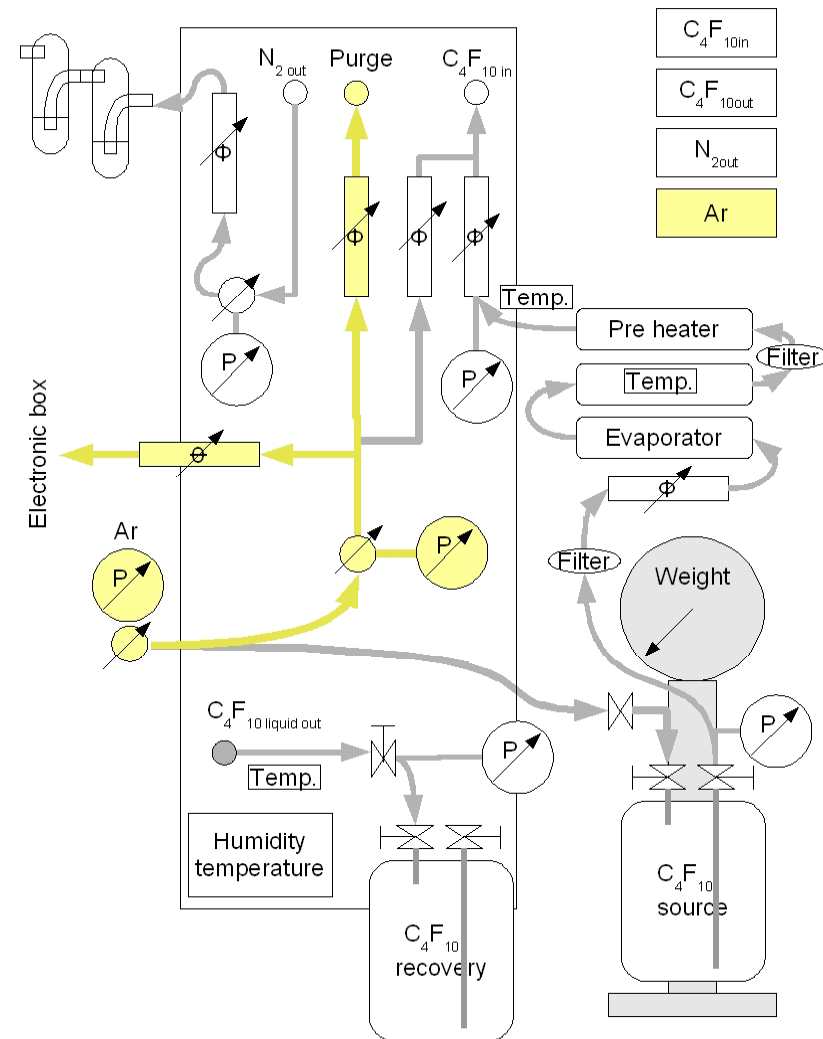
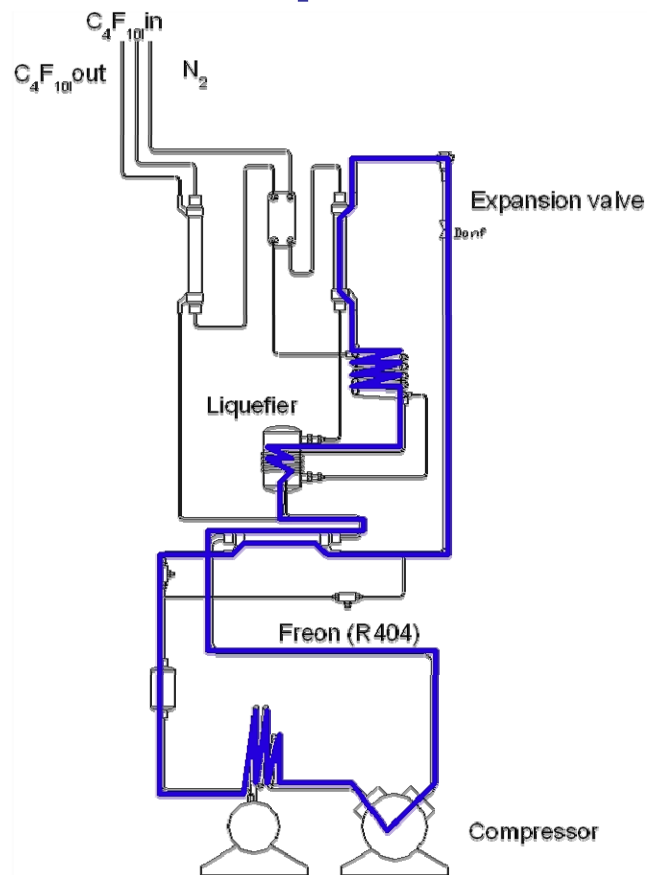
- Twofold membrane filters
  - Eliminates light gases
  - Exit can be used for recovery or direct recycling
- Fridge
  - Separates  $C_4F_{10}$  from Argon, Nitrogen etc.
  - Outputs liquid  $C_4F_{10}$  to container



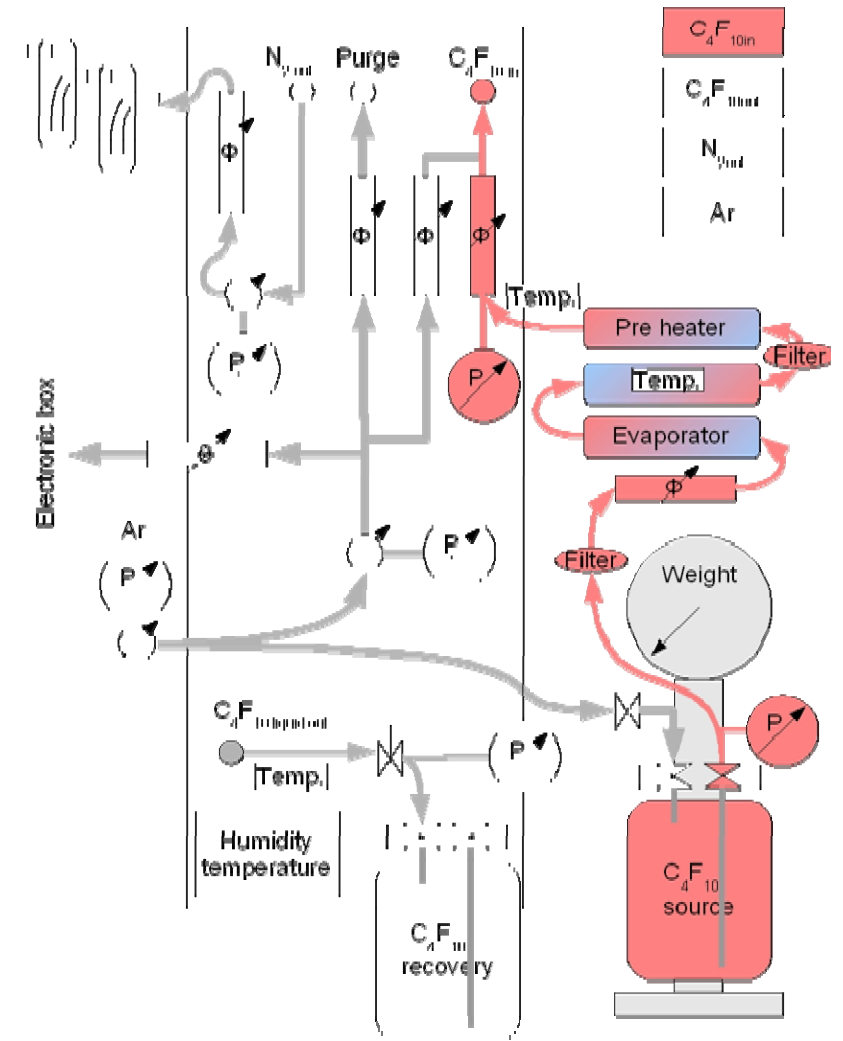
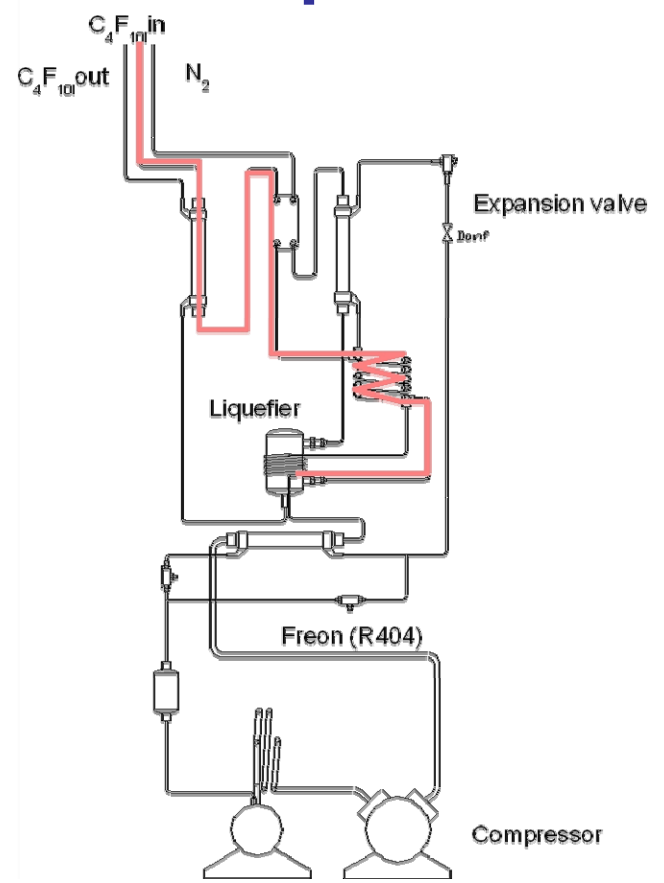
# The test setup



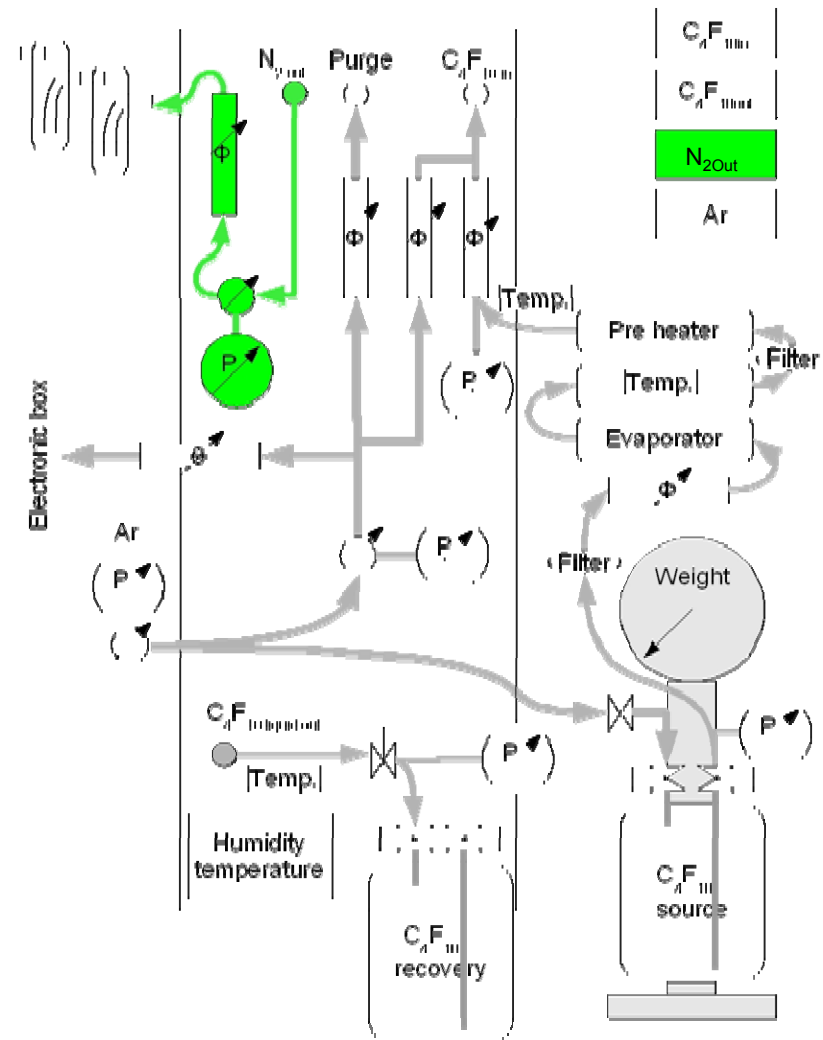
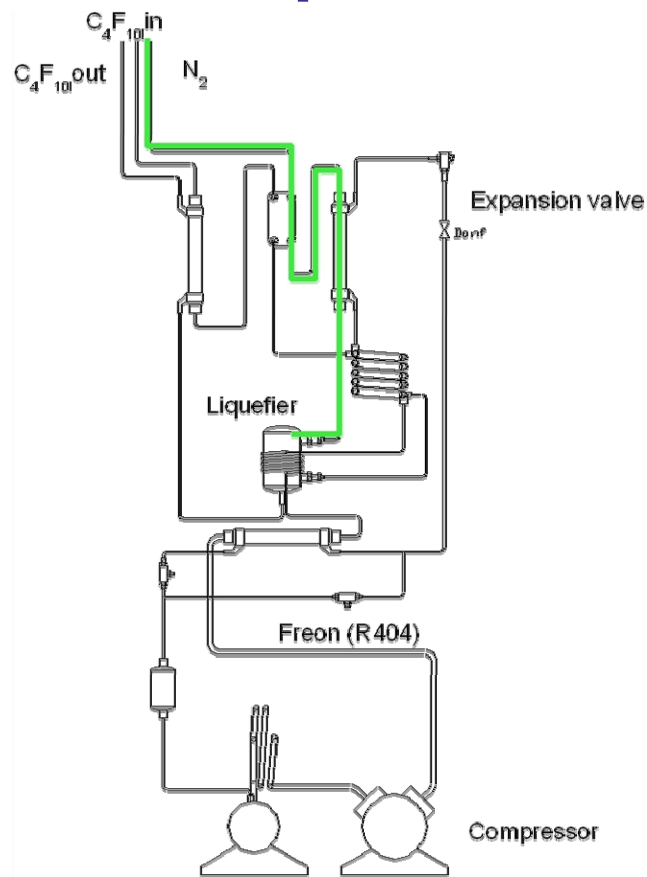
# The test setup



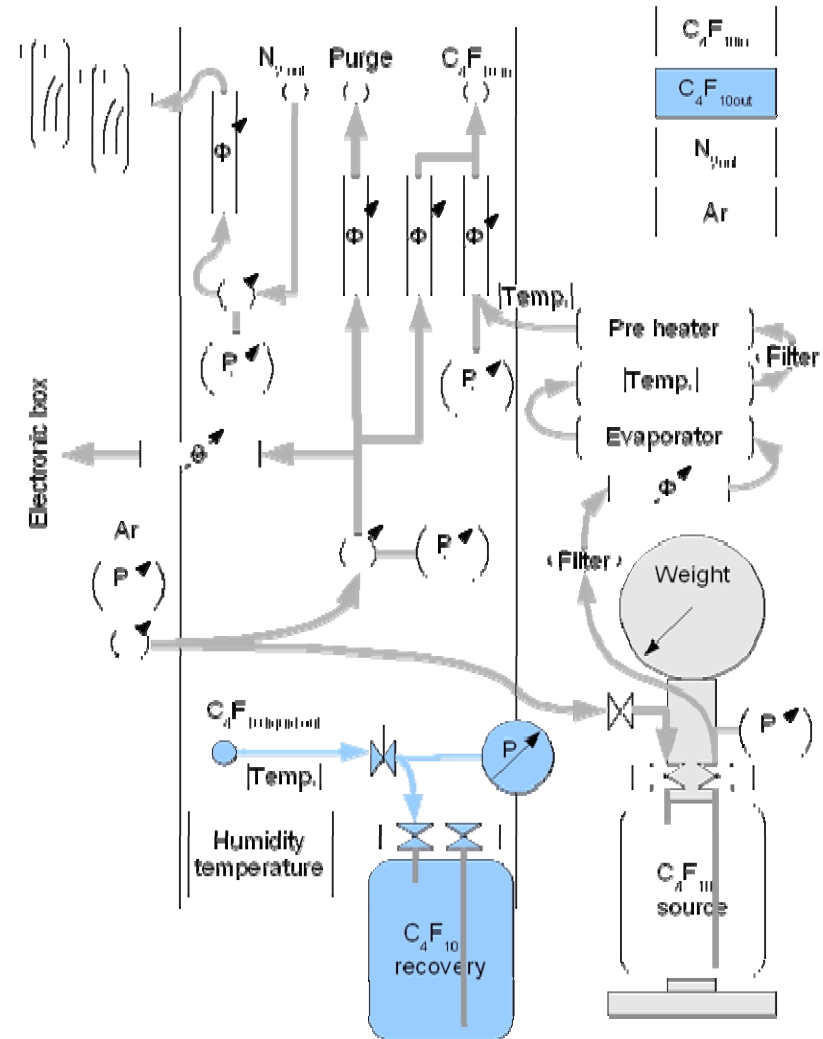
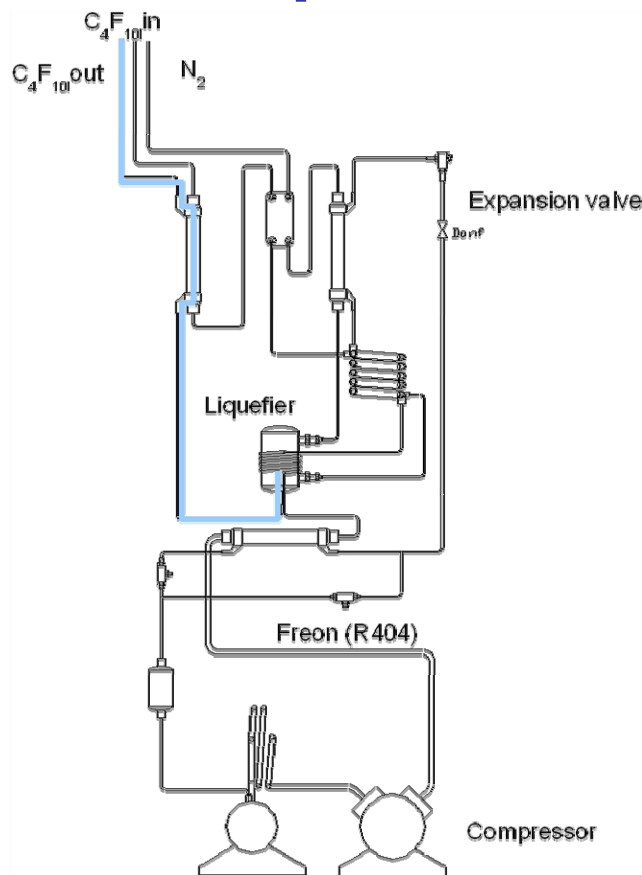
# The test setup



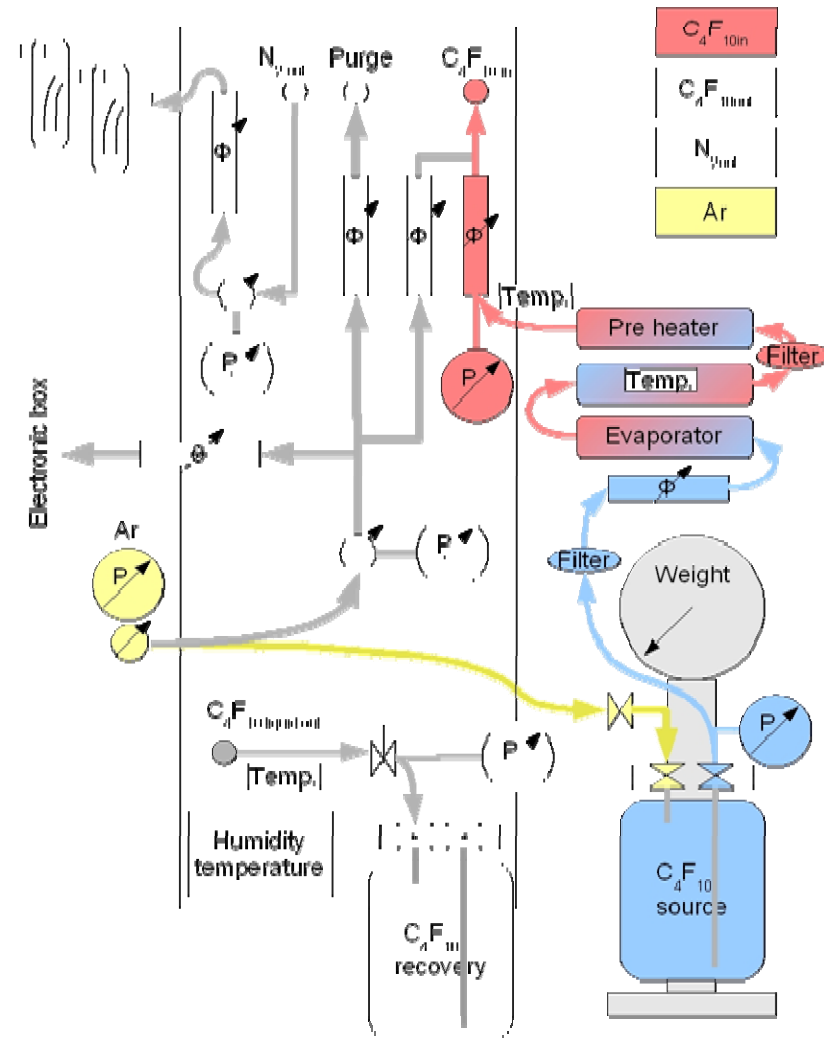
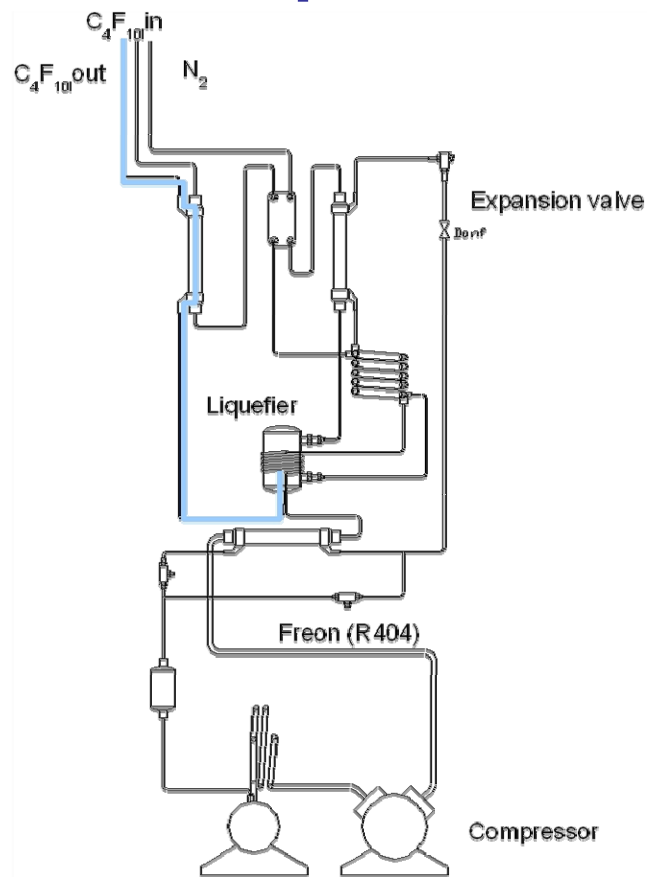
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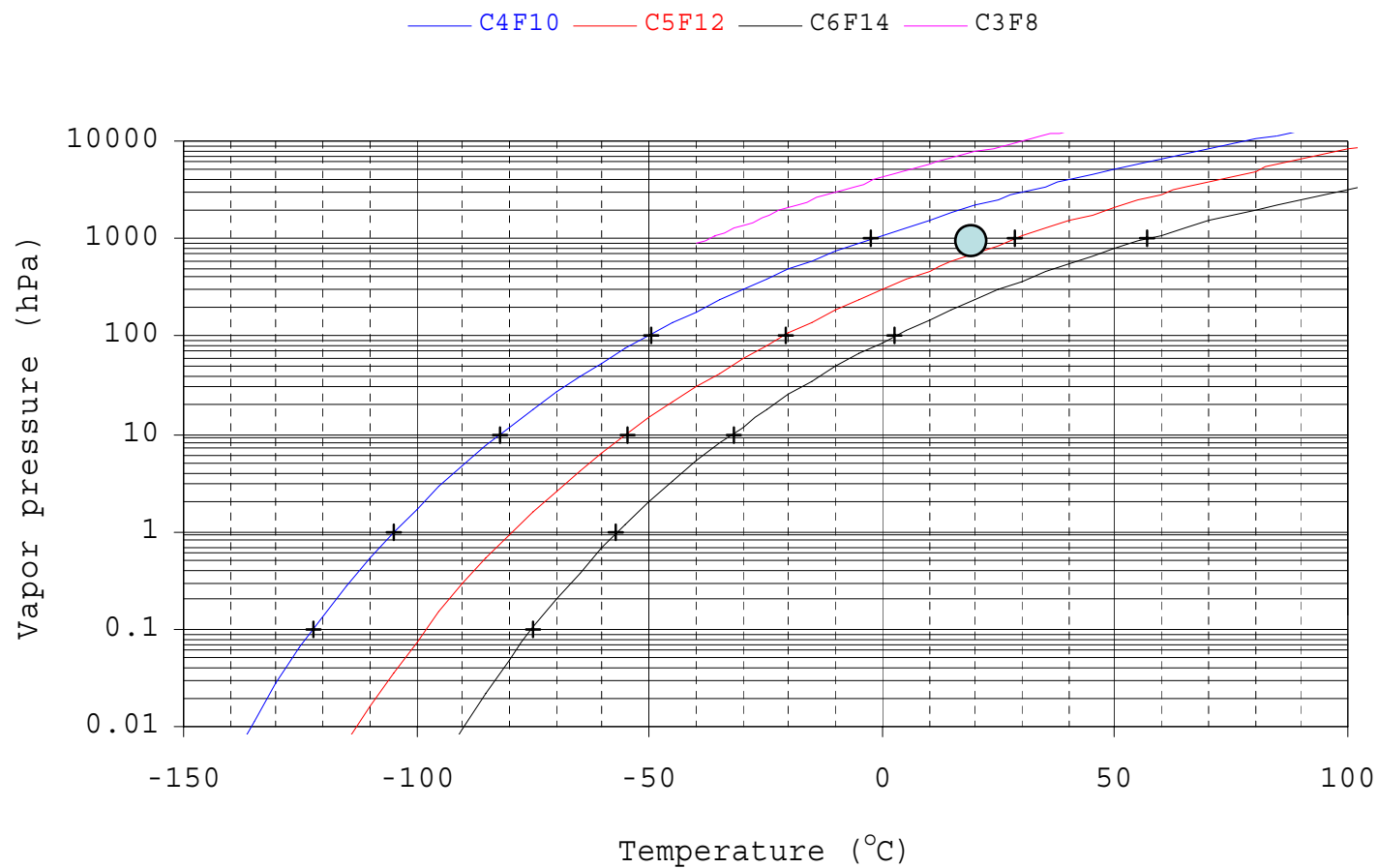
# The test setup



# The test setup



# Vapor pressure of $C_nF_m$

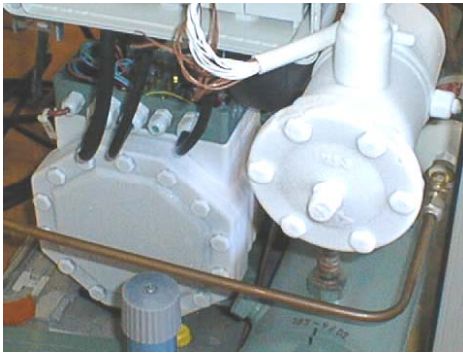


# Tests

- 20 recovery test with C<sub>4</sub>F<sub>10</sub>
- 13 runs with evaporation in source bottle
- 7 runs with external evaporation







# Obstacles

- Mixture of different  $C_nF_m$ , O(5%) non  $C_4F_{10}$
- Ice built up in compressor electronic box
- Up to 6.6 kg can stay in recovery rack
- Corrosion of 63 l bottles in lab
  - Liquid extraction line in bottle not gas tight
- $C_4F_{10}$  condensates at 1.2 bar overpressure
  - Compression must go along with heating




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• Liquid loss at >200l/h waste gas flow

# Summary of recovery tests

- System works stable
- Efficiency in first 5 tests 81.5% av.
- Efficiency in next 15 tests 90.4% av.
- External evaporator works reliably
- 24 h for 4 m<sup>3</sup> of LHCb RICH1 @ max. flow
- Next steps
  - Installation of recovery system
  - commissioning



# Backup Slides