The Gas System for the Outer Tracker of HERA−B

A clean gas system with closed loop for a large gaseous detector operating at high rates

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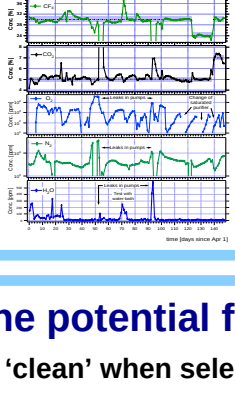
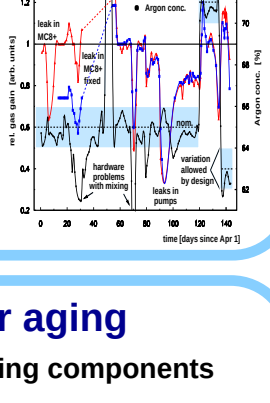
Basic Requirements

- Stable gas mix: Ar/CF_4/CO_2 (65±1) : (30±1) : (5±0.2)
- High gas flow: circulate 1 vol/h = 22 m^3/h
- Pressure regulation in 26 ch.: + 0.5 mbar vs amb. pr.
- Automated main & trace gas analysis (gas chrom.) & gas−gain monitoring for common inp. & 26 ch. outp.
- Continuous gas purification

(HERA's 96ns BX => fast drift gas => need CF_4 in gas mixture
=> high cost (70 DM/kg) => circulate gas (with 0.5−2% / h fresh gas added)
=> air & pollutants accumulate in gas => need continuous gas purification)

Performance



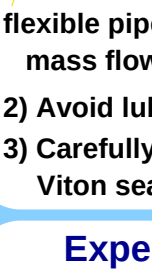


Strategies employed to minimize the potential for aging

1) Maximize the use of the few materials guaranteed to be 'clean' when selecting components

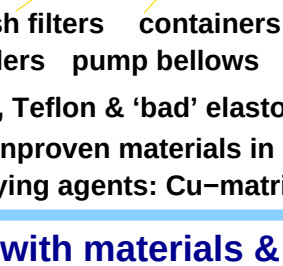
Stainless steel:

Distribution Syst.



fittings
tubing
valves

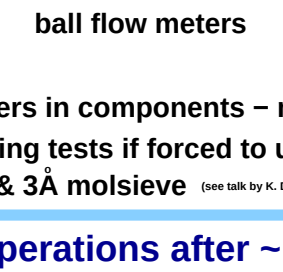
Purification System



flexible pipes mesh filters containers
mass flow controllers pump bellows

Glass:

Distribution System

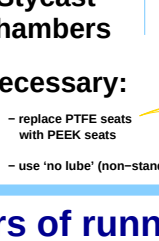


ball flow meters

Non−outgass. epoxy:

buffer barrel (2.5 bar)

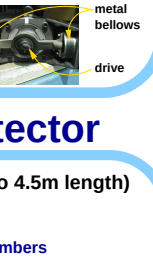
compressed gas cylinder (100 bar)



pressure regu−lator (100 bar)

using 'Stycast' as in chambers

Ex.: high−flow ball valve



2) Avoid lubrication, Teflon & 'bad' elastomers in components − modify if necessary:

3) Carefully check unproven materials in aging tests if forced to use them:
Viton seals, purifying agents: Cu−matrix & 3Å molsieve (see talk by K. Dehmelt, session 3)

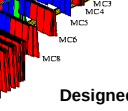
- replace PTFE seats with PEEK seats
- use 'no lube' (non−standard)

Experience with materials & operations after ~ 1.5 years of running

1) Overall success: No aging observed in the OTR detector!

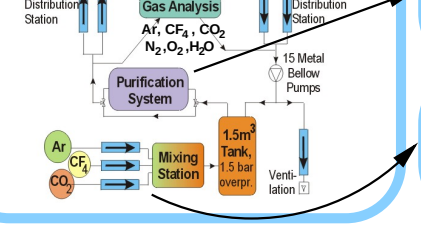
2) Some operational problems:
- Viton in MFC's appears to swell slowly (CF_4?!) making ~20% inoperable after 1 year of use

2) 50% of metal bellows pumps got leaks (mechanical problem or corrosion due to F−compounds?)

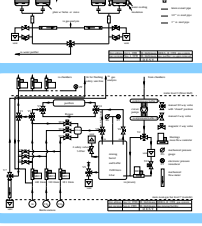


metal bellows
drive

System Overview

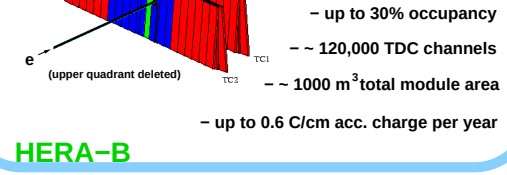


Details



Outer Tracker Detector

5 & 10 mm honeycomb drift cells (up to 4.5m length)



Designed for:
- up to 30% occupancy
- ~ 120,000 TDC channels
- ~ 1000 m^3 total module area
- up to 0.6 C/cm acc. charge per year

HERA−B

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