High Pressure Gas Monitor Chamber

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Calibrating a TPC





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Integrating a Monitoring Chamber into your Experiment

Doing the calibration twice

- Monitoring chamber and detector are usually operating under different ambient conditions
- Only needs T and p for continuous transfer of calibration data





Mini TPC: Gas Monitoring Chamber



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Not only Calibrating, also Monitoring

- Malfunction of isobutane supply at gassystem of T2K's near detector
- First seen in supply line, later also in return line







Atmospheric Pressure GMCs for T2K's Near Detector



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GMCs for T2K's Near Detector

- GMC crate
 - 2 Gas Monitoring Chambers
 - Pressure sensors
 - Temperature sensors
 - Preamps
- (VME) DAQ and HV crate
 - FADC
 - Trigger Board
 - SiPM power supply
 - Anode & cathode power supply
 - Computer / Crate Controller











High Pressure GMC



1: cathode, 2: gas gap spacer, 3: Sr⁹⁰ capsules, 4: HV resistor, 5: razor, 6: cage feet, adjustable, 7: scint. fibres, 8: trigger electronics







High Pressure GMC









High Pressure GMC



- Pressure up to 10 bar
- PFA lined pipe as vessel
 - electrical isolation
 - rated to 25 bar
 - flanges to 40 bar
- Basket (euro-pallet size) with electronics and sensors
- Additional DAQ crate

Safety concern: High Voltage with Radioactiv sources













HV safety of radioactive sources

Sources close to very high voltages and exposed to pressurized gas



Simulation of potential at far source holder





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Electron Drift at High Pressures

- Gas density affects drift chamber properties
 - reduces gain at constant voltage
 - shifts drift velocity curve
 - shifts and scales diffusion







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Drift Velocity Measurement with P10 (90 % Ar : 10% CH4)

Working Point Considerations



- RWTH Aachen University ٠
- Université de Genève ٠
- Lancaster University •
- Imperial College London •
- Royal Holloway University London •
- University College London •
- University of Warwick •









High Pressure TPC R&D

T10 Beamline at CERN's PS

- During Aug/Sep 2018
- Low momentum beam
 - < 800 MeV/c momentum
 - Used moderator blocks
- Test of optical high-pressure TPC in beam
- HP GMC installed in the gas
 flow for reference









Filled gases at the test beam had all less than 2% quencher added. The HPGMC could not be operated with such gases.





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Lessons learned from HPTPC testbeam

cathode



Low quencher gas mixtures let through too much (VUV) light.

Try to make everything more transparent.

Also try to measure diffusion with multi wire anode

anode









- High Pressure Monitor Chamber available
- Operated at CERN test beam
- Will be improved to cope with lowquencher gas mixtures
- Will be extended to measure also gain and diffusion
- Device to measure drift gas properties in unexplored pressure regime
- Check of Garfield/Maxwell simulations









Thank you!

