# HP Gas TPC test bench @ FNAL

Guillermo Fernandez Moroni

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## Reference design: ALICE TPC @ CERN

- They've been running:
  - Good reconstruction in a high multiplicity environment.
  - True 3D track system (pad plane readout).
  - High resolution pad channel.
  - Running at 1 atm
- General:
  - Readout area=~32m^2
  - All available in 1 year.
  - 557k pad channels
  - Pad sizes:4x7,6x10,6x15mm
  - Cost of readout chambers only materials ~2MU\$S (but for US accounting (incl. labor) multiply by ~3x)



The ALICE TPC, a large 3-dimensional tracking device with fast readout for ultra-high multiplicity events, NIMA

#### ALICE readout chambers



Characterization of a fully equipped ALICE TPC Readout Chamber, M.L. Knichel







From prototype to series productioin, H. Stelzer et al

#### Inner Readout Chamber (IROC) @ FNAL





Pad size IROC: 4x7.5 mm<sup>2</sup> OROC:4x10, 4x15 mm<sup>2</sup>

#### **Test Bench goals**

- Chamber have been operated at 1 atm in ALICE and have not been tested at higher pressures, but there is no reason to think they will no work at higher pressure.
- Run from 1 to ~10 atm pressure and
- Different gas mixtures

#### Detector performance:

- Gain
- Uniformity
- Stability
- Energy resolution
- Ion feedback

Gas properties: (Aachen University interest)

- Transversal and longitudinal diffusion
- Drift velocity
- <u>Test stand for electronics</u>
- Possibility for light detectors

#### Vessel for HP

- Tested to run at 150 psi (10 atm)
- Allows for single pad readout
- Vacuum cleaning system



### TPC





#### Field cage

ALICE:

• Used to test all ROC IROC Field cage. Top view

#### FNAL



- Field cage under construction
  - Following ALICE test bench design
  - $\circ$  Active volume ~0.025m^3 = 25L.
  - Ok for test at 1 and 10 atm.
  - It is attached to IROC chamber
  - The whole detector can be moved to different vessel
  - Open field cage for light detectors

#### Field cage simulation (Garfield++)

#### Potential Contours (V)





#### Field cage simulation (Garfield++)



#### Pad Readout

- Gain measurements using 55Fe at the HV plane
  - Multiple pads readout (picoammeter)
  - Single pad readout (charge amp for each channel)



#### Single pad measurements readout using Lariat electronics



#### Single pad readout test using lariat electronics

• IROC pad capacitance



- Liquid argon: ArgonCube pad capacitance 5pF (Igor Kreslo et al, >2015)
- Test of pad planes in liquid using Lariat electronics

• Lariat noise vs Temperature

Collection RMS vs. Temperature Green=Bottom, Blue=Middle, Red=Top



- 500 channels
- 25mV/fC max preamp gain
- MIP particle -> 180 ADC counts
- 0.5mV/ADC count
- ADC speed 60 MHz

#### Gas system

- Final design
- Same system for 1 to 10 atm (150psi)
- A few components already have been installed
- Remaining components already ordered to vendor. Most of the components will be delivered in 4 weeks. Some special components in 7 weeks.
- Major construction work startigt in 4 weeks.



#### Conclusions and Time table

- Major components of the gas system, detector and electronics already at Fermilab.
- Available liquid argon electronics at Fermilab will work well for the Gas tests.
- We now have a final design of the gas system and the we have placed the order for the final components.
- Time table:

