**First Operation of a Ton Scale Dual Phase Liquid Argon TPC**

**Laura Zambelli** (LAPP, CNRS/IN2P3, USMB)

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### 3D Imaging of a Ton Scale Dual Phase Liquid Argon TPC

- **Drifting** \([0.5 \text{ kV/cm}]\) towards the anode, **extracted** \([2 \text{ kV/cm}]\) in the gas layer, **amplified** \([33 \text{ kV/cm}]\) in the LEMs and **induced** \([5 \text{ kV/cm}]\) to a 2D collection readout with equal charge sharing.

**Advantages w.r.t single phase design:** accessible electronics, better granularity, very large S/N ratio, longer drift, fewer channels.

**Challenges:** stability of the LAr level, GAr thermodynamics, operation of a large area of amplification and readout plane.

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### Cryogenics Stability

- Cryo-camera installed for visual feedback during filling and commissioning.
- GAr temperature and pressure constantly monitored and were very stable over time.
- In the vapour phase, a gradient of \(2 \text{ K/cm}\) is observed.

**Liquid argon level** is measured by 8 level meters installed around the CRP.
- The position of the CRP can be adjusted to the liquid with 3 ropes.
- The LAr level can be monitored at the LEM level by measuring the LEM-Grid capacitance.

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### Data Collected

- Cosmic runs with two trigger configurations (external scintillator planes, PMT)
- Total of \(~500 k\) events recorded in more than 100 different HV settings

**1st evidence of \(e^-\) extraction into the gas phase from light signal:**

**Interactions and showers:**

**Corresponding waveforms of the through going track:**

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### Electronics

- **FE cards plugged inside independent and sealed chimneys**
- **17 problematic channels out of 1260**
- **Stable noise at the level of 1500 e^-**

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### Charge Readout Plane

- **100 µm stainless steel wires**
- **3.125 mm spacing**

**A drift field of 2 kV/cm is required to minimize the slow extraction component**

**The effective gain is:**

**Pedestal RMS [ADC]:**

- **~20 [nominal]**
- **~3 [best run]**

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### Light Signal

**S1 signal** provides the \(t_1\) and can serve as internal trigger

**S2 signal** depends on the HV settings

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### Very HV

- **Field cage made of 20 shaping rings of stainless steel.**
- **For a drift field of 0.5 kV/cm, a custom-made HV feedthrough polarizes the cathode at \(-56kV\); it was successfully tested at \(-300 kV\).**

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### The Dual Phase Technology

**3D imaging from electrons drifting** \([0.5 \text{ kV/cm}]\) towards the anode, **extracted** \([2 \text{ kV/cm}]\) in the gas layer, **amplified** \([33 \text{ kV/cm}]\) in the LEMs and **induced** \([5 \text{ kV/cm}]\) to a 2D collection readout with equal charge sharing.

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