TinyTPC and Photosensitive Dopants

LArTPCs detect charge and light from particle interactions to study neutrinos indirectly. TinyTPC, a compact LArTPC with a pixelated readout system (LArPix), aims to improve energy measurements for low-energy events by enhancing ionization charge collection. It will explore the effects of photosensitive dopants and xenon in liquid argon. Isobutylene, with ionization energy near argon’s scintillation energy, efficiently converts scintillation light into a detectable ionization signal.

Diagnosing High Voltage Breakdown

- **Previous Limitation**: Could only achieve up to 3.5kV due to electrical breakdowns, aimed for 5kV.
- **Debugging Process**: We conducted tests using a small dewar filled with liquid argon and nitrogen. This involved:
  1. Testing different ground configurations
  2. Monitoring the TPC resistance

Clustering Muons vs Source Data

1) I used a density based clustering algorithm (DBSCAN) to initially sort possible muon tracks from small radioactive interaction events and noise
   - Leapfrog logic to be computationally cheap

2) I used random sample consensus (RANSAC) as an iterative line fitting algorithm to find cleanest tracks that were most likely to be from a muon

3) Muon tracks are further sorted by ones that are known to pass through the anode of the TPC, in order to determine the drift time

This plot shows roughly a 5% charge gain using 4ppm of isobutylene
- Charge gain effects decrease with distance from the anode as a lot of impurities were introduced upon injecting the isobutylene
- Electron lifetime was much lower with 4.0ppm of isobutylene vs none

Next Steps

Current Run:
- We’ve added xenon to the LAr to test if it still shows enhanced charge effects and produces light

Future Runs:
- Test with a new high-voltage flange at 5 kV.
- Use a new filter for injection to achieve higher purity after injecting isobutylene

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