



Experimental study of breakdown electric fields in liquid argon

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- Study of breakdown electric field in liquid argon as a function of argon electronegative contamination level, cathode-anode distance and electrode size.
- Motivation: dielectric strength of liquid argon not precisely determined, yet its value is crucial for the design of the next generation liquid argon neutrino and dark matter detectors.
- An electrode sphere-plate geometry was implemented using spheres with diameters of 1.3 mm, 5.0 mm, and 76 mm.
- The cathode-anode distance was varied from 0.1 mm to 25 mm.
- Each set of measurements was repeated at different liquid argon contamination levels, ranging from 1.5 parts-per-million of O₂ equivalent to less than 100 parts-per-trillion.

Breakdown test setup

Feedthrough

Delivers up to -150 kV to the probes

Translator

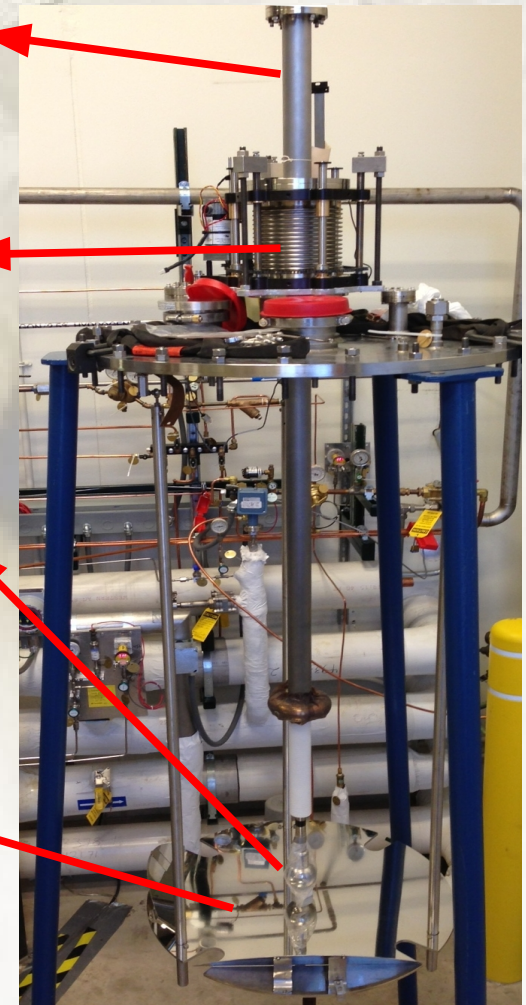
Regulates cathode-anode distance

Cathode

Three swappable spherical probes of different diameter

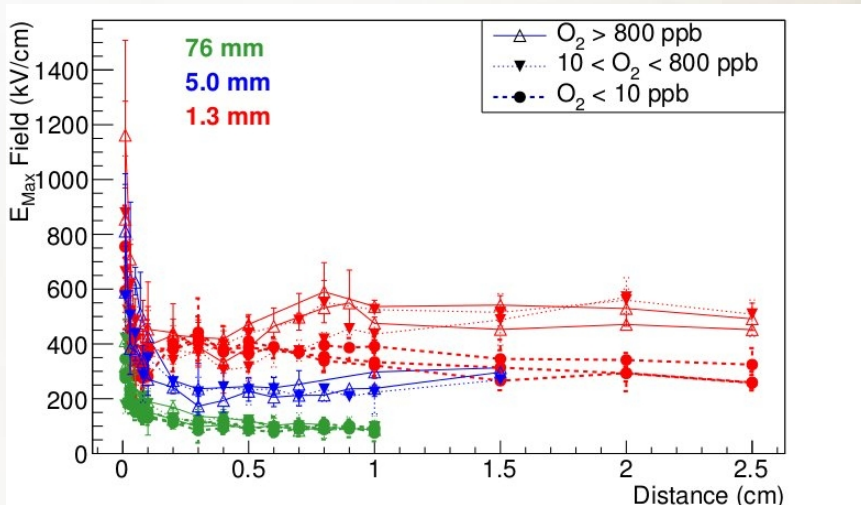
Anode

74 cm diameter grounded plate



(some of the) Results

Average breakdown E-field



- ✓ A dependence of the breakdown E-field on liquid argon electronegative contamination level is mostly evident with the 1.3 mm probe. Similar dependence is not clearly visible for the other probes.
- ✓ A stronger dependence of the E field on the probe size becomes evident when comparing these results with studies present in literature, conducted at a variety of argon contamination levels and electrode sizes (*relative plot present in the poster*).

- ✓ Defining stressed cathode area as the area of the probe with E-field above 80% of the max E-field, a clear dependence of the breakdown E-field on the stressed area is observed for all the probes.
- ✓ This is the first time such dependence is shown for liquid argon.
- ✓ The observed geometric effects are of critical importance in the design of LArTPC detectors for future neutrino experiments, where drift distances on the scale of meters are required.

E-field vs stressed cathode area

