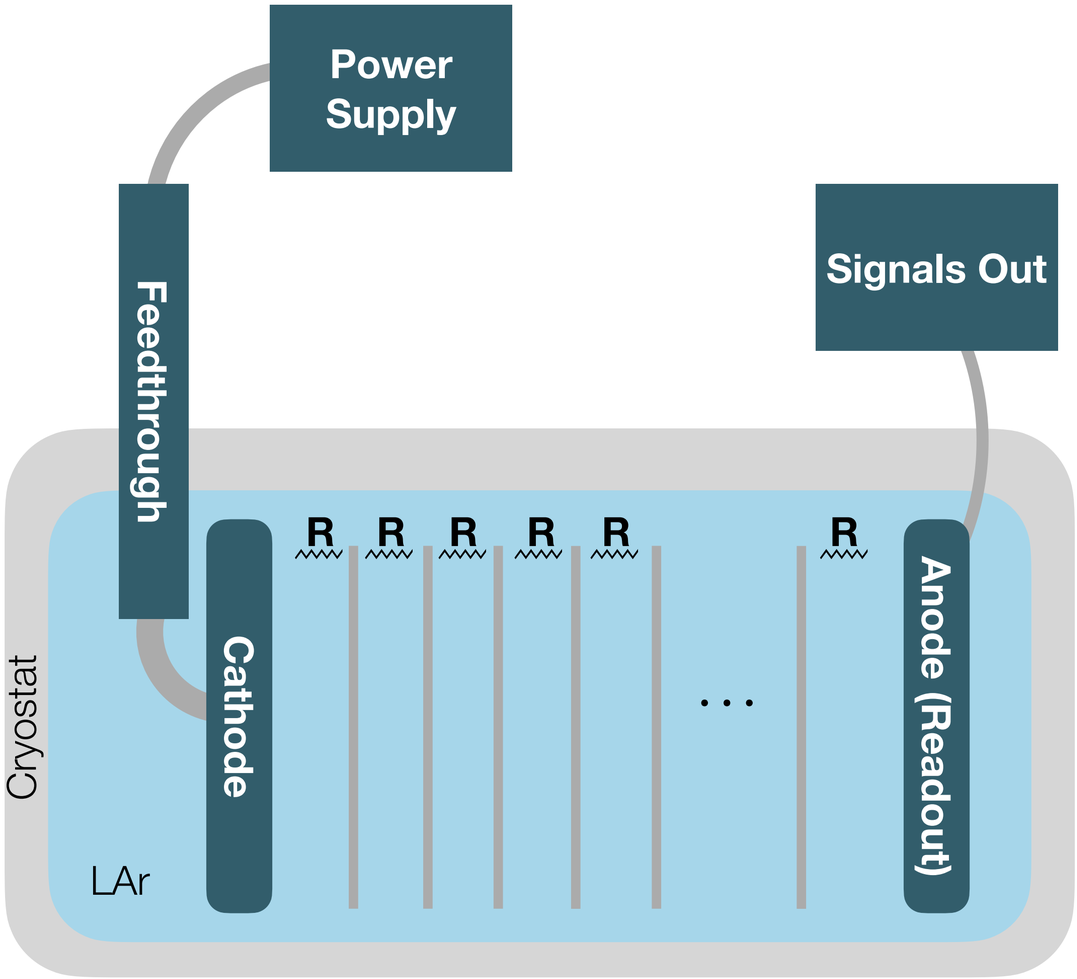
HV in LAr

Sarah Lockwitz, *FNAL*, SNOWMASS White Paper Meeting, 05/08/20

Some Context:

- HV provides the drift in noble liquid TPCs
- Typically, one aims for ~500 V/cm; ~100 kV



HV in LAr

Motivation

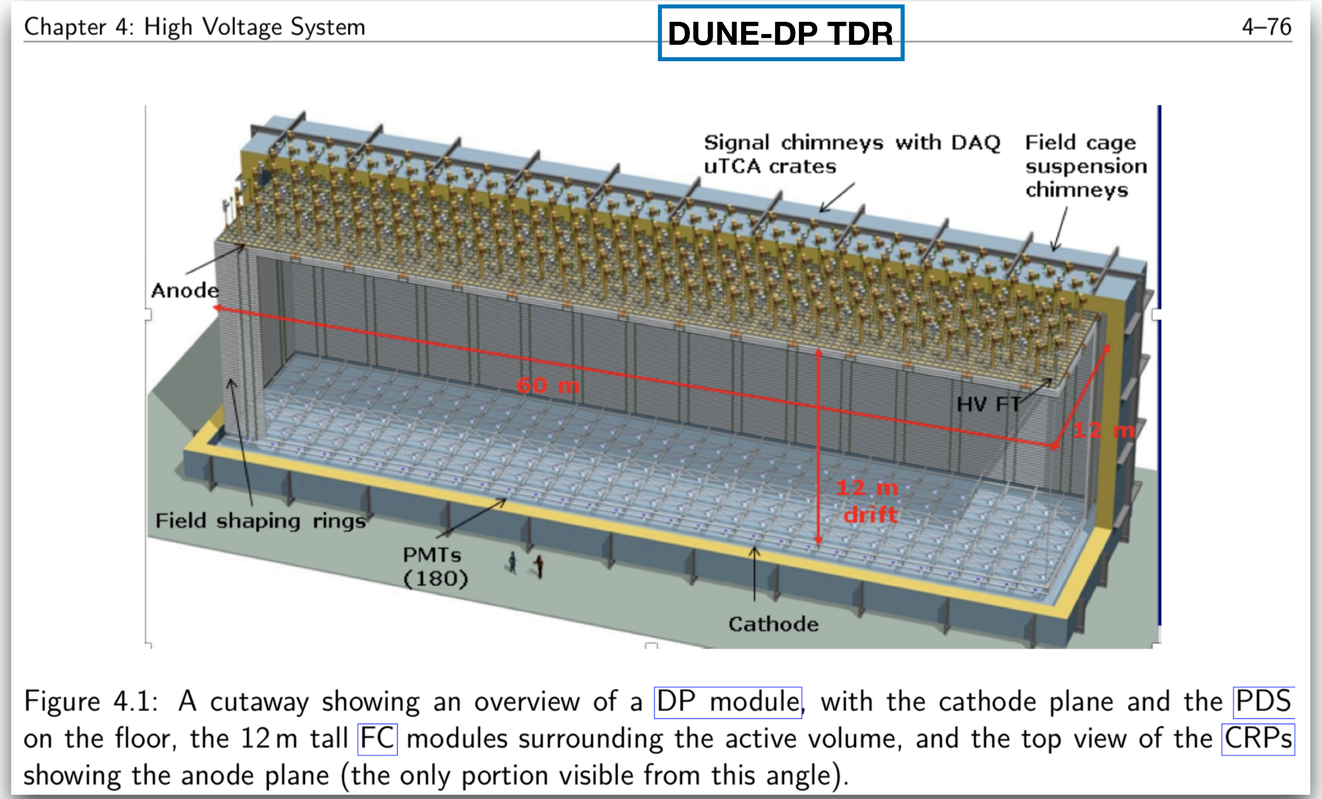
- Historically challenging
  - DM LXe have had spurious light emission
  - LAr has had various instabilities from sparks to spurious emission (irregular drift field, noise, downtime)

Experiment	Detector	Target or Maximum	Operation
ICARUS	SP Ar	75	75 (150)
MicroBooNE	SP Ar	128	70
DarkSide-50	DP Ar	60	12.7
ProtoDUNE-DP	DP Ar	300	-
ProtoDUNE-SP	SP Ar	180	180*
DUNE-SP	SP Ar	180	-
DUNE-DP	DP Ar	600	-
EXO-200	SP Xe	75	8, 12
Xenon100	DP Xe	30	16
LUX	DP Xe	up to 100	8.5
LZ	DP Xe	50	-

HV in LAr

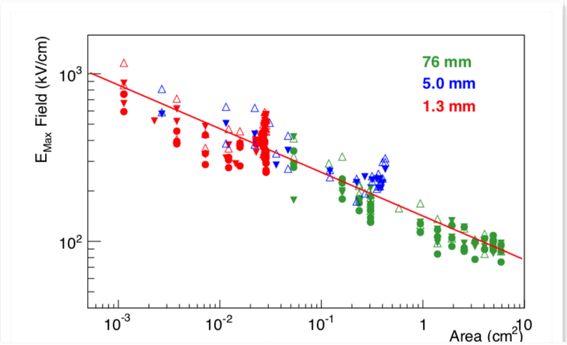
Motivation

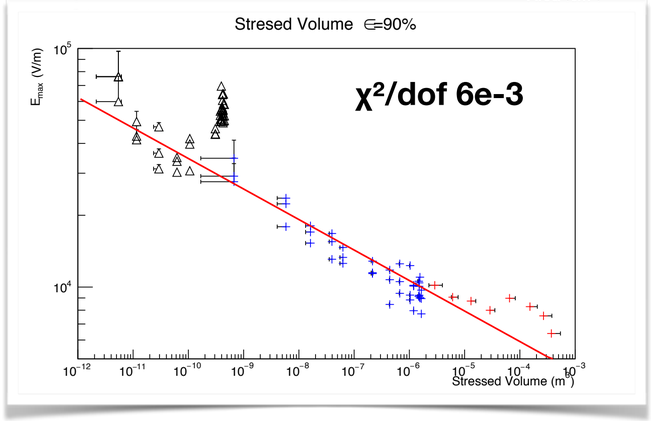
- Design systems that can run stably
  - For instance, the first module in DUNE has a target voltage of -180 kV
    - Previous systems have seen electrical instabilities of an unknown origin and mechanism at this voltage
  - Another design (dual phase) has a 12 m drift with -600 kV on the cathode
    - Significant step beyond the current experience
      - Commercial PS don't exist at this level
      - Cables, FT?
      - What is the behavior in LAr?
  - Even other design ideas for future modules find a longer drift appealing
    - Longer drift implies fewer readout channels ($) for a similar fiducial volume



HV in LAr

Status/Plans





- There is on-going testing at the PAB
  - Currently largely project-centered on DUNE components
- Would like to better understand the general/basic phenomena
  - **Conditions under which spurious emission occurs (then we can address how to remedy it)**
  - We've studied this for "sparking" before:
    - Have developed the "best" metric for predicting sparking for a given-sized object ← Develop engineering rules
    - Have created narratives for FT failure modes ← Better understanding how phenomena occur leads to better designs
  - To do this, we need reliably pure argon & **upgrade in diagnostics**
- Significantly longer drift:
  - **Basic operation**
    - Plan to get a -500 kV unit onsite to gain experience
  - **Test behavior in LAr**