

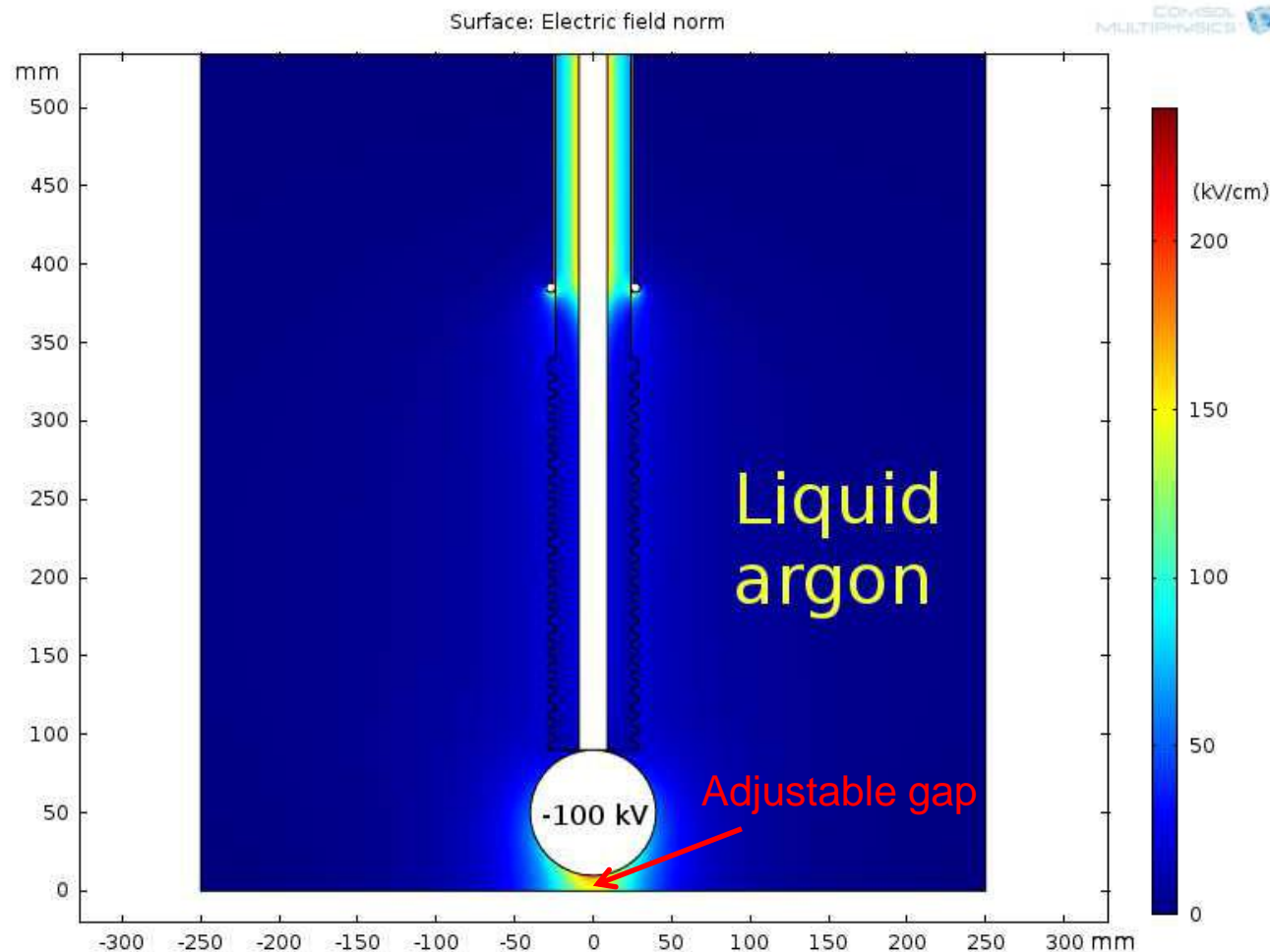
Liquid argon R&D achievements and status of MicroBooNE

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10.07.2014, Sinergia Swiss neutrino strategy meeting

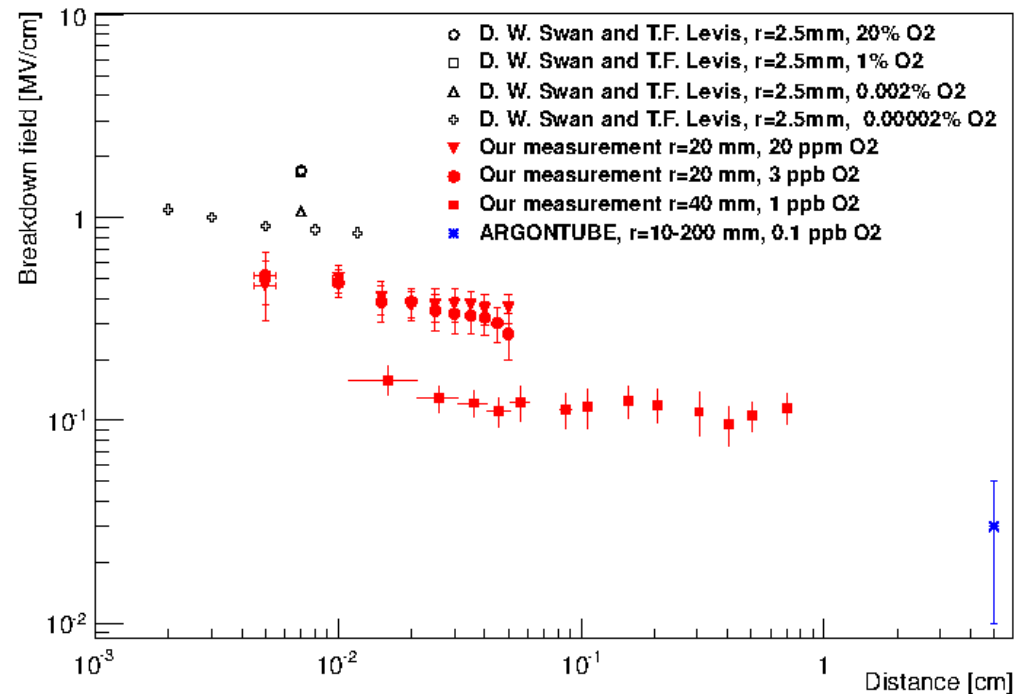
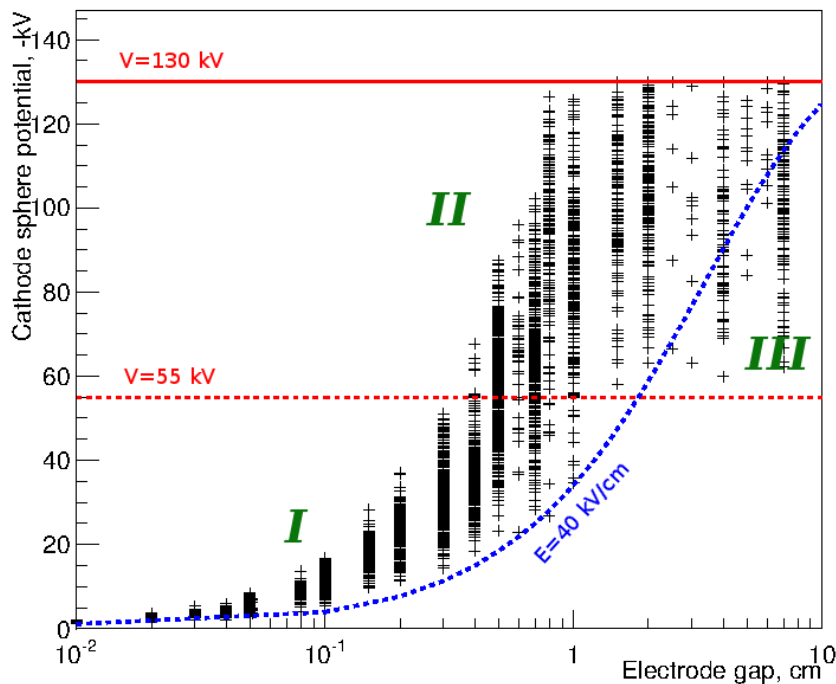
Breakdowns in LAr



Breakdowns in LAr

- > Breakdowns in LAr occur already at fields of **40 kV/cm** for O₂-equivalent impurity level of **1 ppb**

Breakdown point in LAr



2014 JINST 9 P04006

Breakdowns in LAr

- > 450 μm natural polyisoprene (latex) cover on cathode
- > Breakdown at **412 kV/cm**
- > A factor **10** higher than before



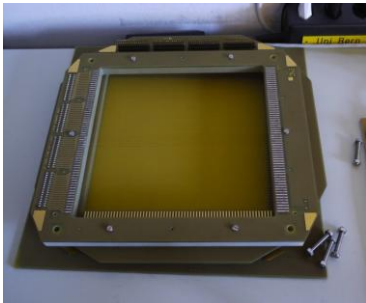
arXiv:1406.3929, accepted by JINST

Cold electronics test in ARGONTUBE

- > Charge readout: Two plane readout
- > Frontend: LARASIC4 by Brookhaven National Laboratories (2011 J.Phys.: conf. Ser. 308 012021)
- > Same gain and signal rise time at room temperature and in LAr
- > Less noise in cold
- > A large step forward for LArTPCs

Readout wires

20 x 20 cm, 64 x 64 wires



Frontend

2 LARASIC4, i.e. 32 CH per host PCB.
 $G_{\max} = 25\text{mV/fC}$ resp. 120mV/nA .



Buffer Amplifiers

64 CH, $G=1$.
Impedance matching.



DAQ

CAEN V1724 ADCs,
up to 100 MS/s.

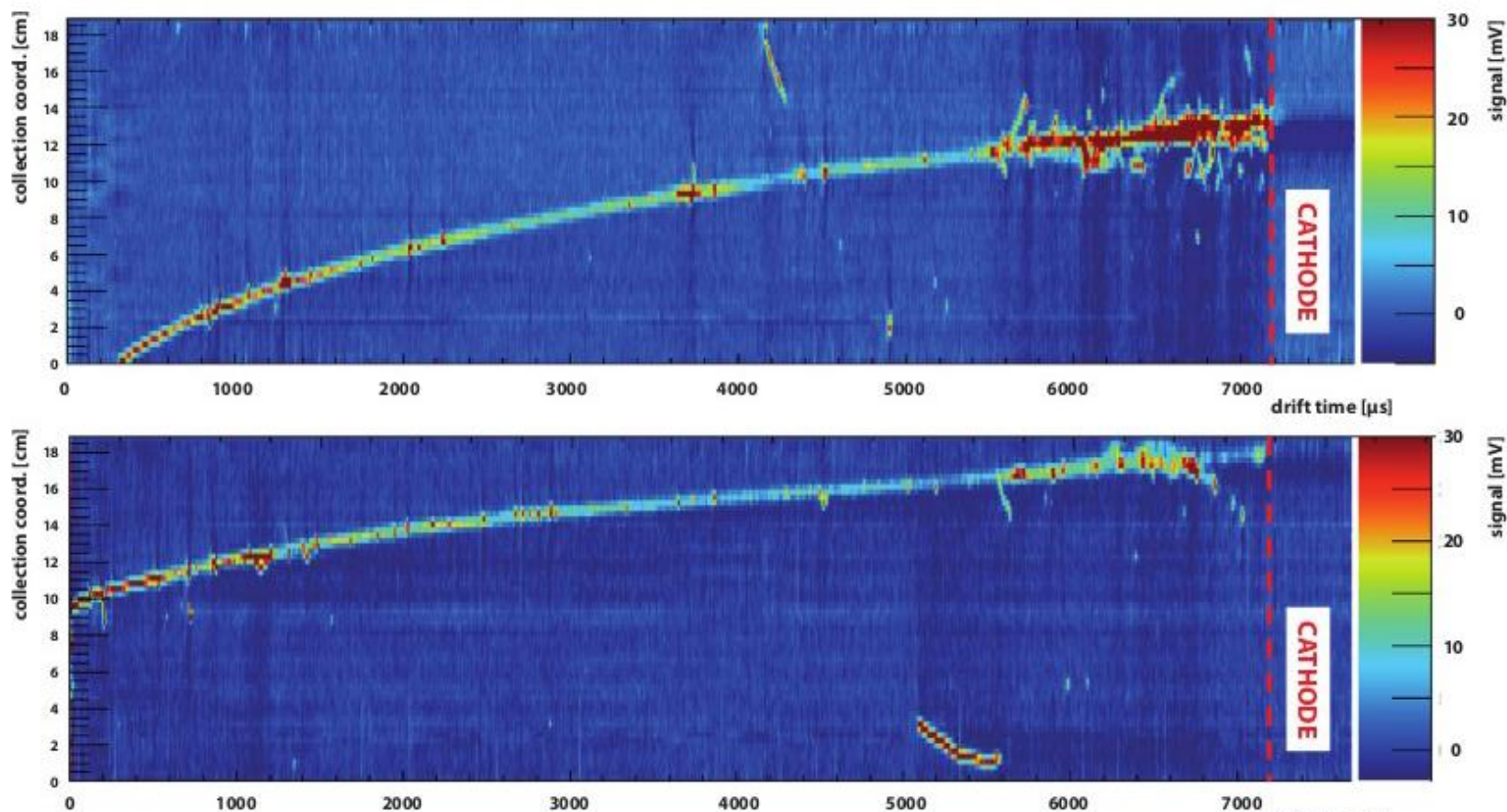


Cold part

Warm part

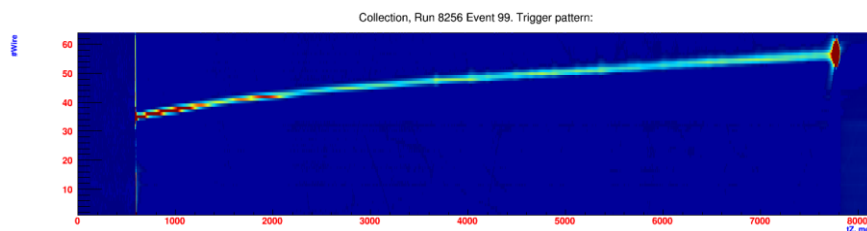
Cold electronics test in ARGONTUBE

- > For MIP S/N ≈ 16 , ENC ≈ 525 e⁻
- > 5 m drift events clearly visible

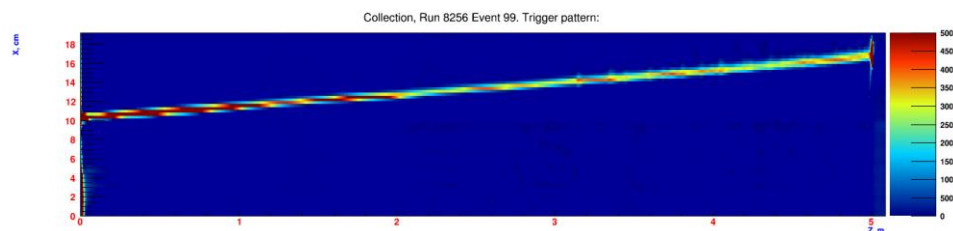


Field correction test in ARGONTUBE

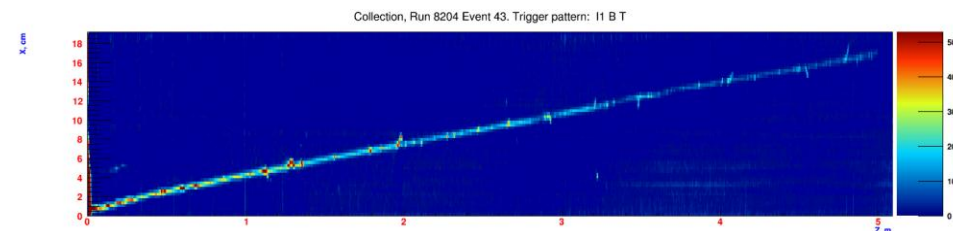
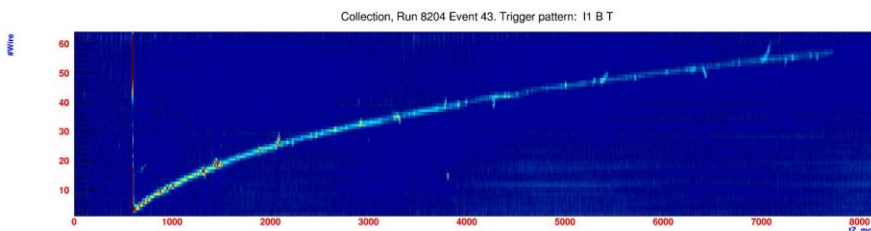
- > Field distortions occur due to Greinacher undercharge and argon ion space charge
- > Space charge production rate $7 \times 10^{-11} \text{ Cs}^{-1}$ for ARGONTUBE (active mass 280 kg)
- > Ion drift velocity of the order of cm/s
- > Use the straight UV laser track to correct the field
- > Apply correction to particle tracks



Before correction



After correction

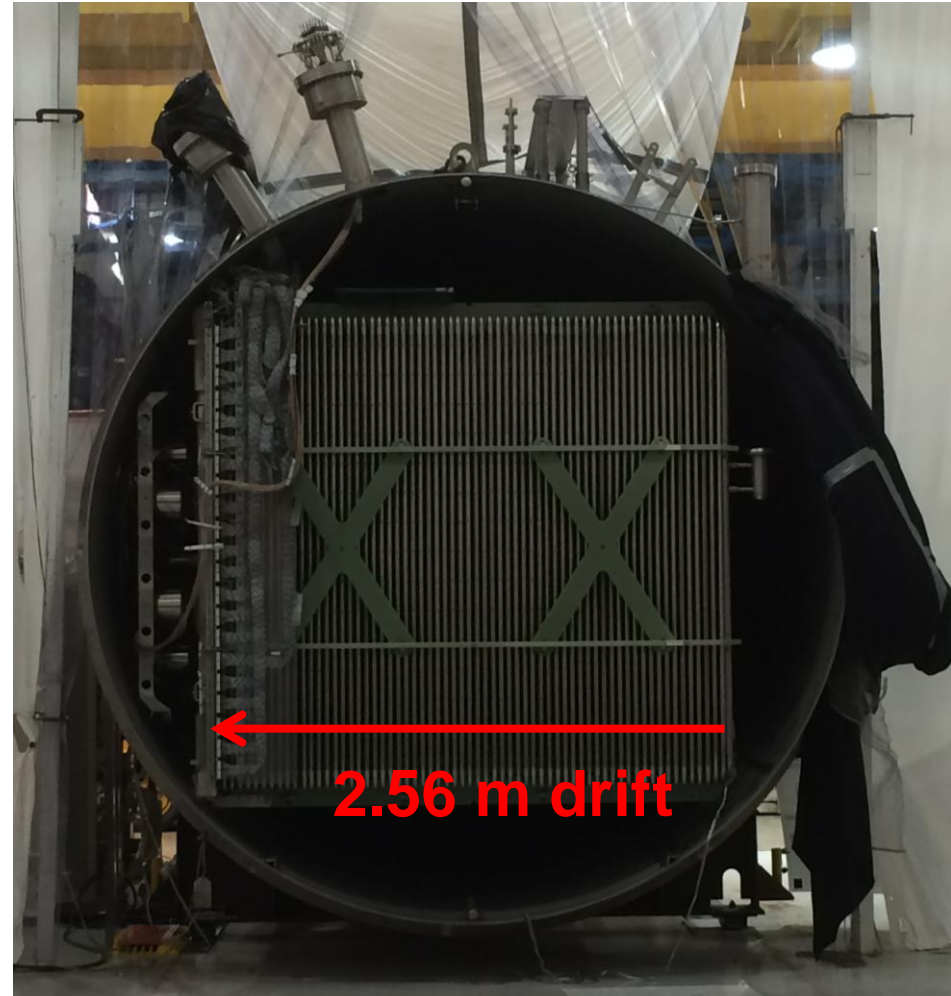


MicroBooNE location



MicroBooNE detector

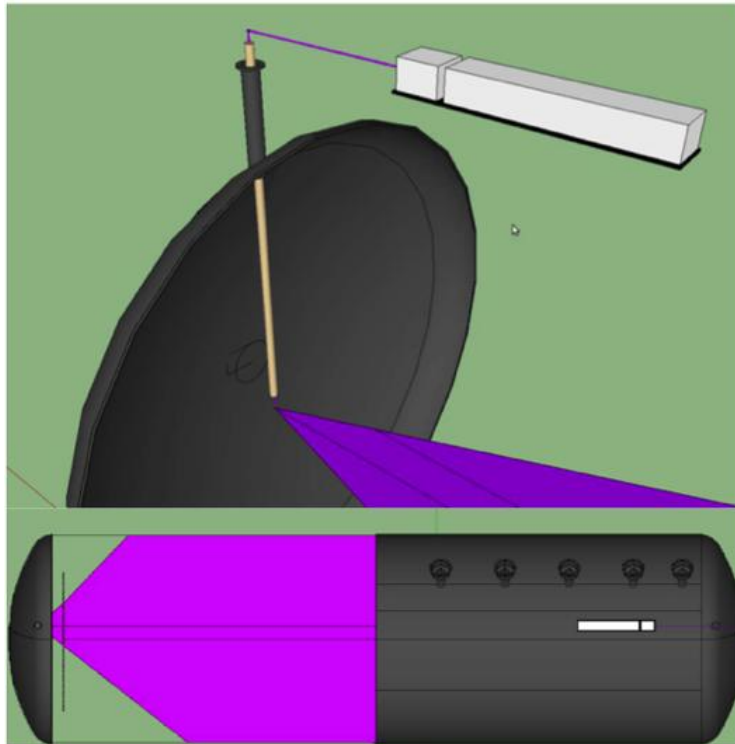
- > Foam insulated vessel holds 170 t LAr
- > 60 t fiducial mass
- > Fill without evacuating
- > Drift field of 500 V/cm
- > Frontend electronics in LAr
- > 3 readout wire planes and a total of 8256 channels
- > Light detection: 32 8" PMTs
- > Operated on surface



Moving the MicroBooNE detector



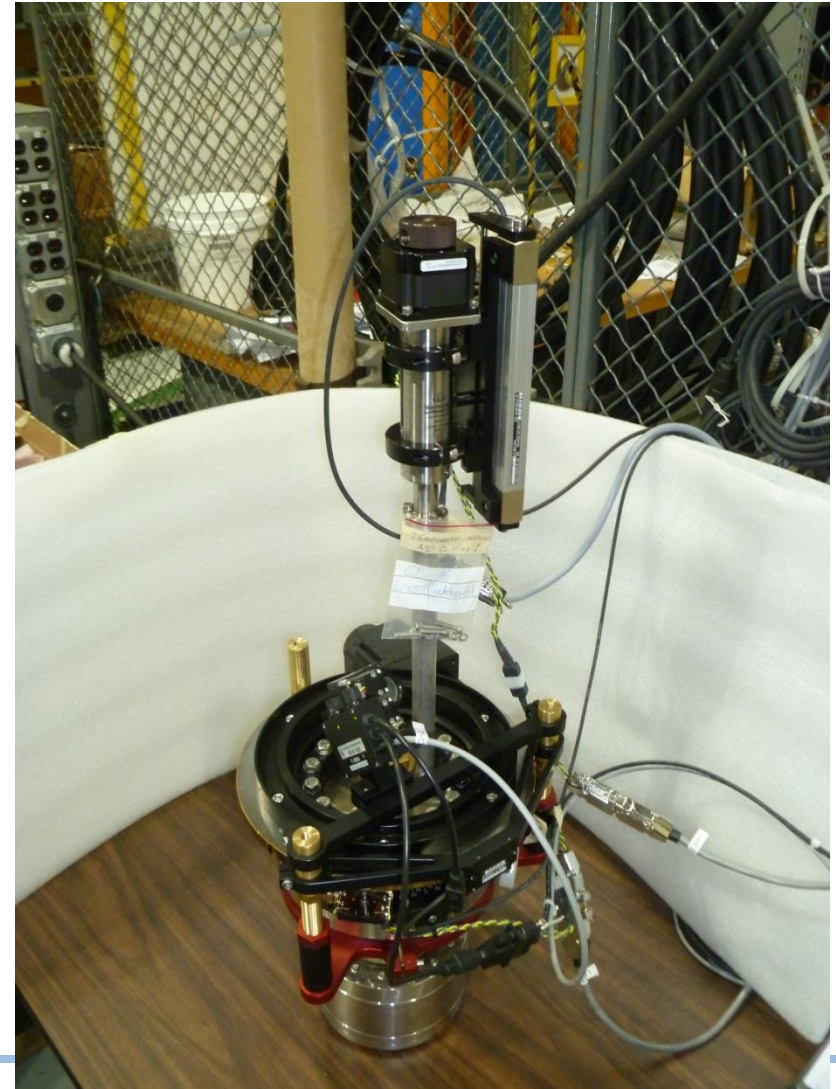
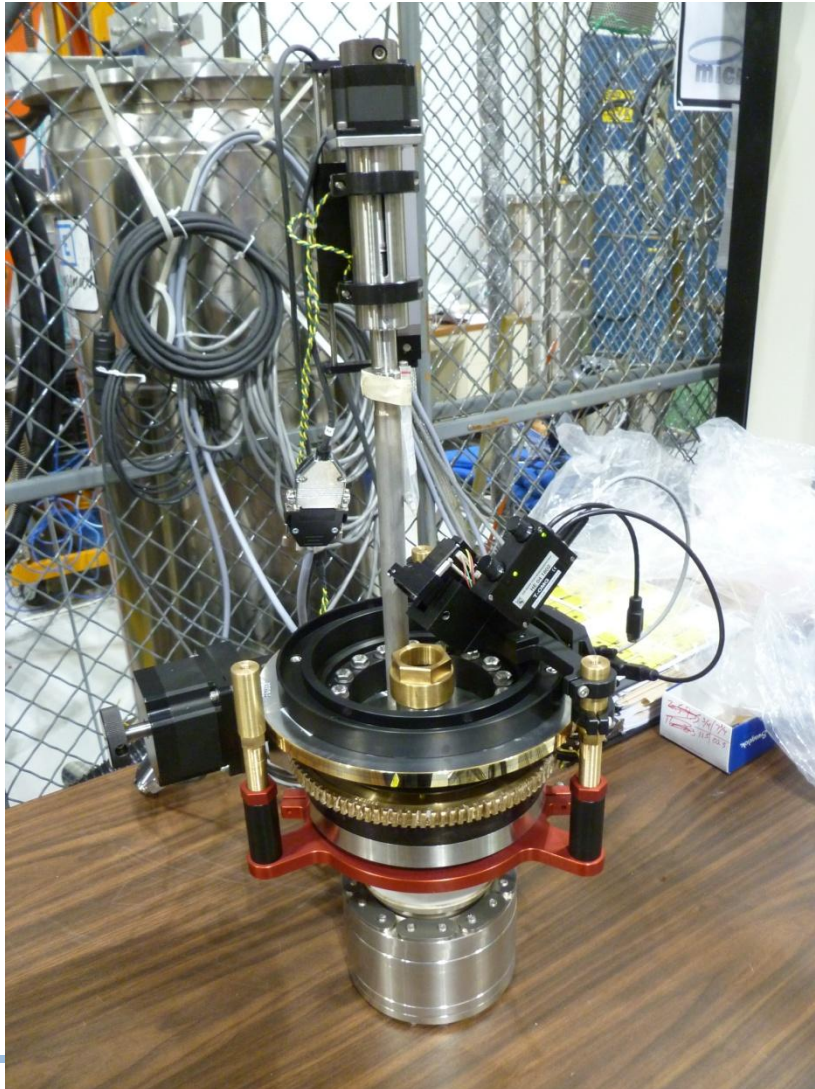
UV laser calibration system for μ BooNE



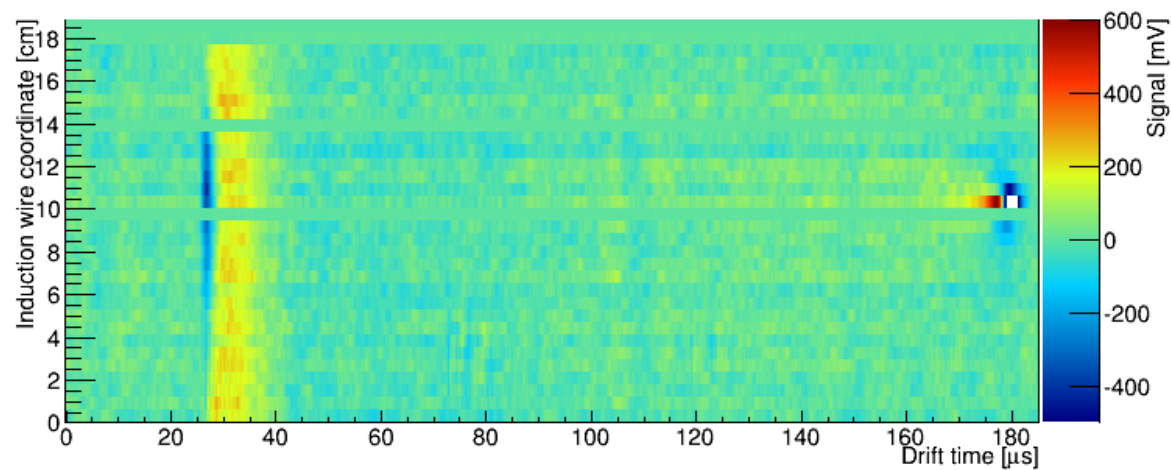
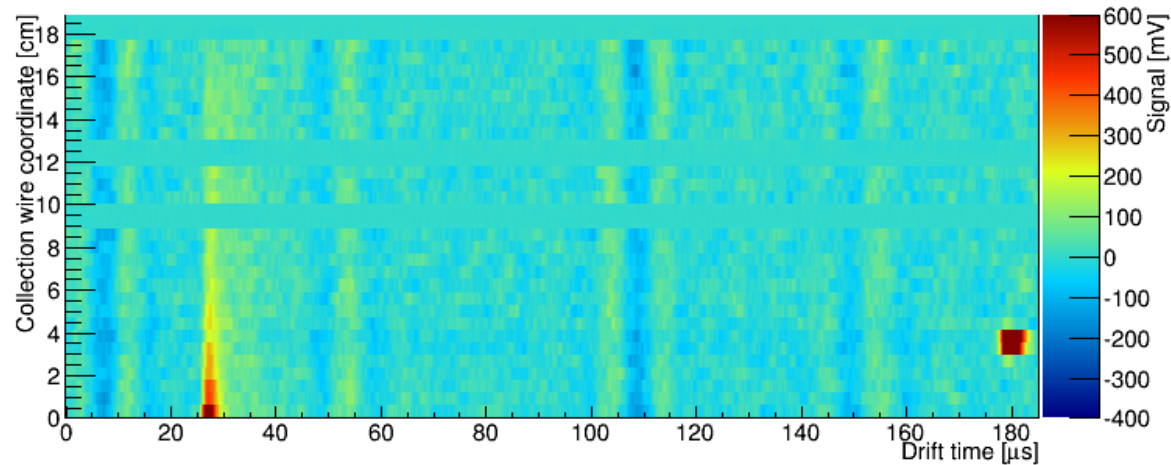
Movable mirror in LAr



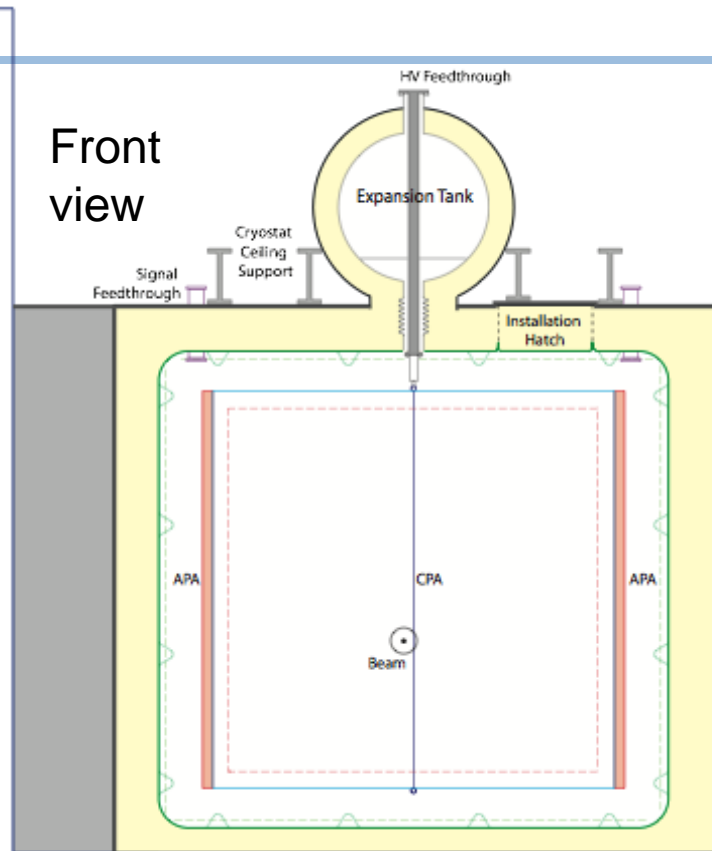
UV laser calibration system for μ BooNE



Test of UV laser calibration system for μ BooNE



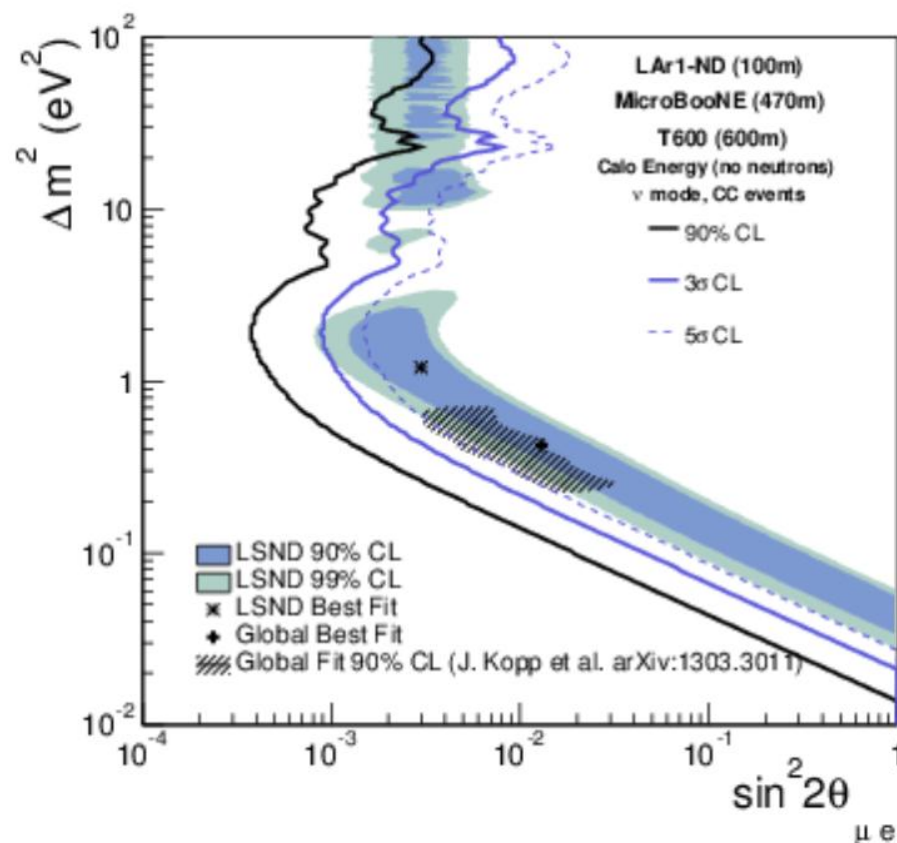
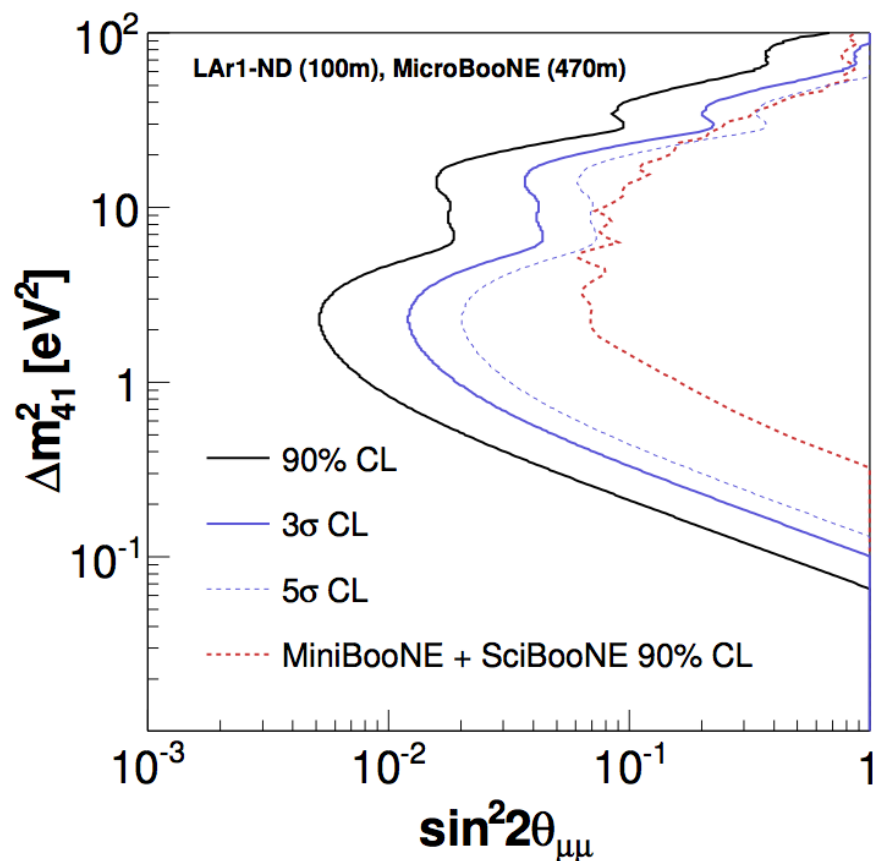
LAr1-ND extension to MicroBooNE



4.4 m (beam direction) x
4.1 m (wide) x
4.8 m (tall)
= 150 t LAr (82 t active)

- > Near detector with about 100 m baseline
- > Membrane cryostat
- > Bulk of the cryostat surface is wetted with liquid (i.e. signal feedthrough immersed in liquid, to limit outgassing from signal cables)
- > Single cathode plane, two readout anode plane assemblies
- > Collaboration:
 - 3 US National Labs
 - 6 US Institutions
 - CERN
 - 1 Swiss Institution (BERN)
 - 5 UK institutions

Sensitivity to oscillations



Summary

- > HV test showed a breakdown field of 40 kV/cm at 1 ppb impurity level
- > Breakdown field can be increased by a factor of 10 by coating the cathode with latex
- > Cold frontend electronics were tested in ARGONTUBE
 - Signal to noise $S/N \approx 16$, $ENC \approx 525e^-$
 - Clear tracks of 5 m drift were seen
- > Also a field calibration was performed using UV laser tracks
- > The MicroBooNE detector was moved 3 weeks ago and start operation at the end of this year
- > Bern is participating with a UV laser calibration system
- > LAr1-ND is planed to be an near detector for MicroBooNE

Thank you for your attention!

