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# Liquid argon R&D achievements and status of MicroBooNE

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**10.07.2014, Sinergia Swiss neutrino strategy meeting**

# Breakdowns in LAr

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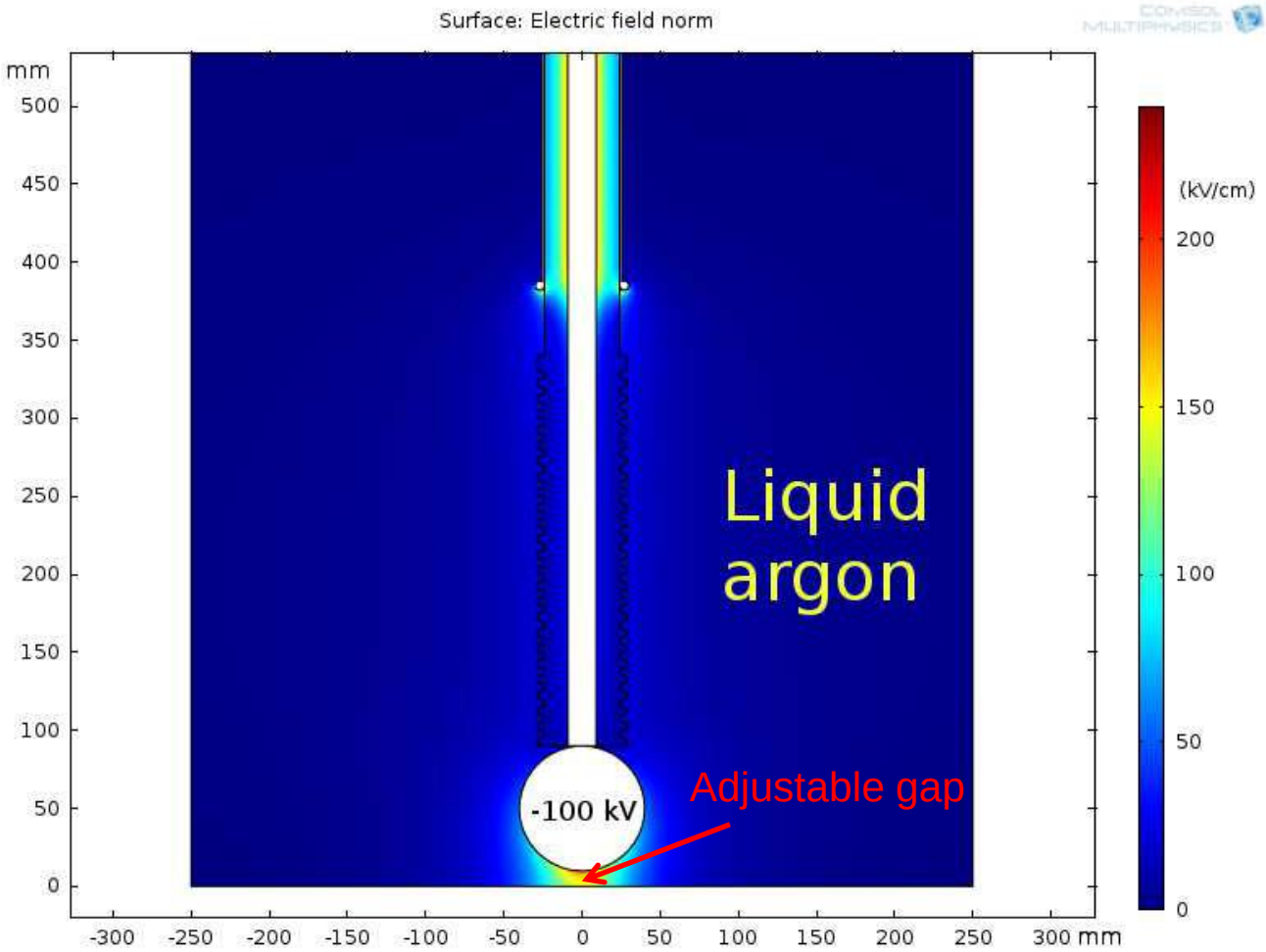

# Breakdowns in LAr

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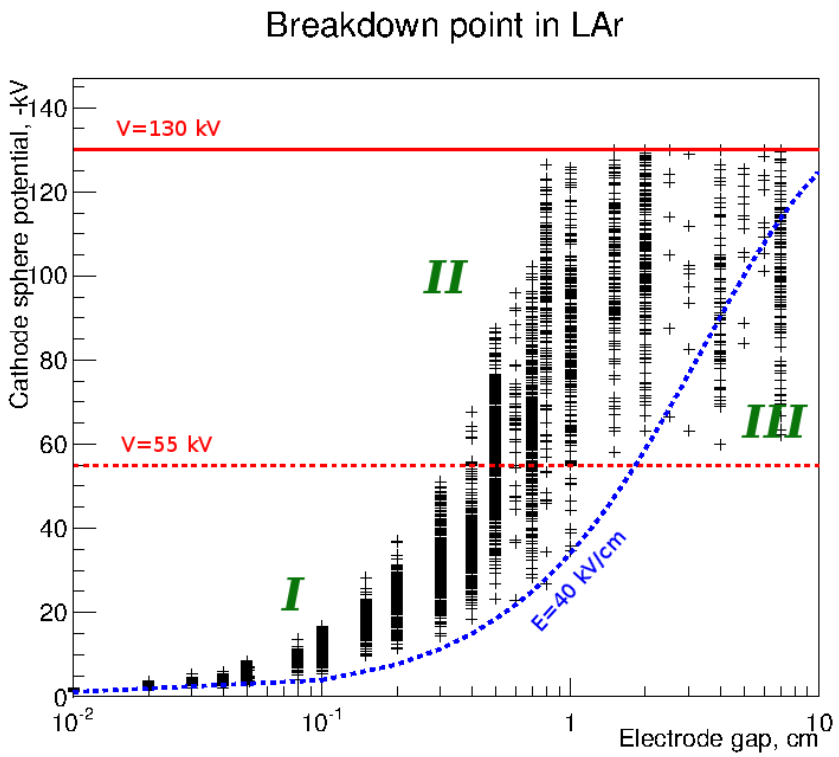
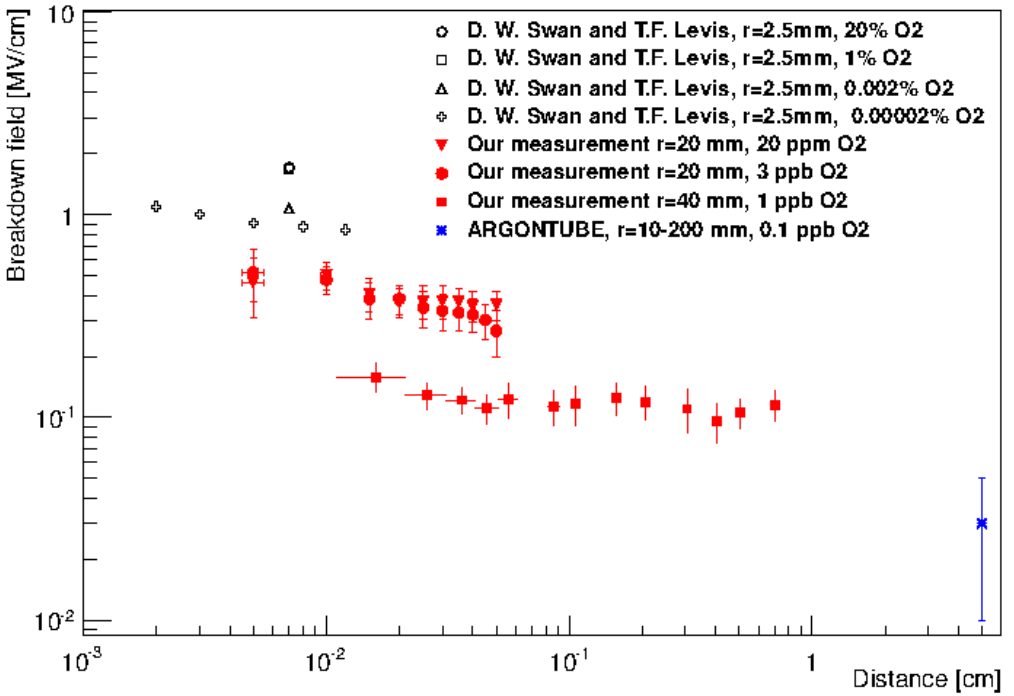
> Breakdowns in LAr occur already at fields of **40 kV/cm** for $O_2$-equivalent impurity level of **1 ppb**




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

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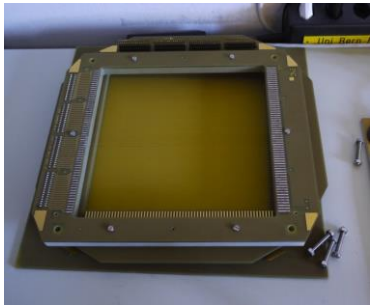
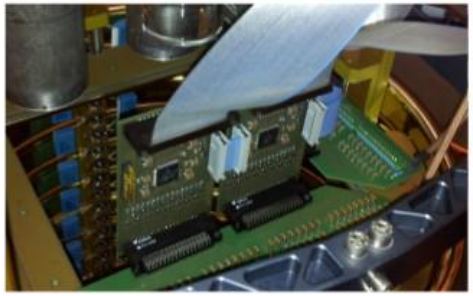
- Charge readout: Two plane readout
- Frontend: LARASIC4 by Brookhaven National Laboratories (2011 J.Phys.: conf. Ser. 308 012021)
- Same gain and signal rise time at room temperature and in LAr
- Less noise in cold
- A large step forward for LArTPCs

**Readout wires**
20 x 20 cm, 64 x 64 wires



**Frontend**
2 LARASIC4, i.e. 32 CH per host PCB.
$G_{max}$ = 25mV/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

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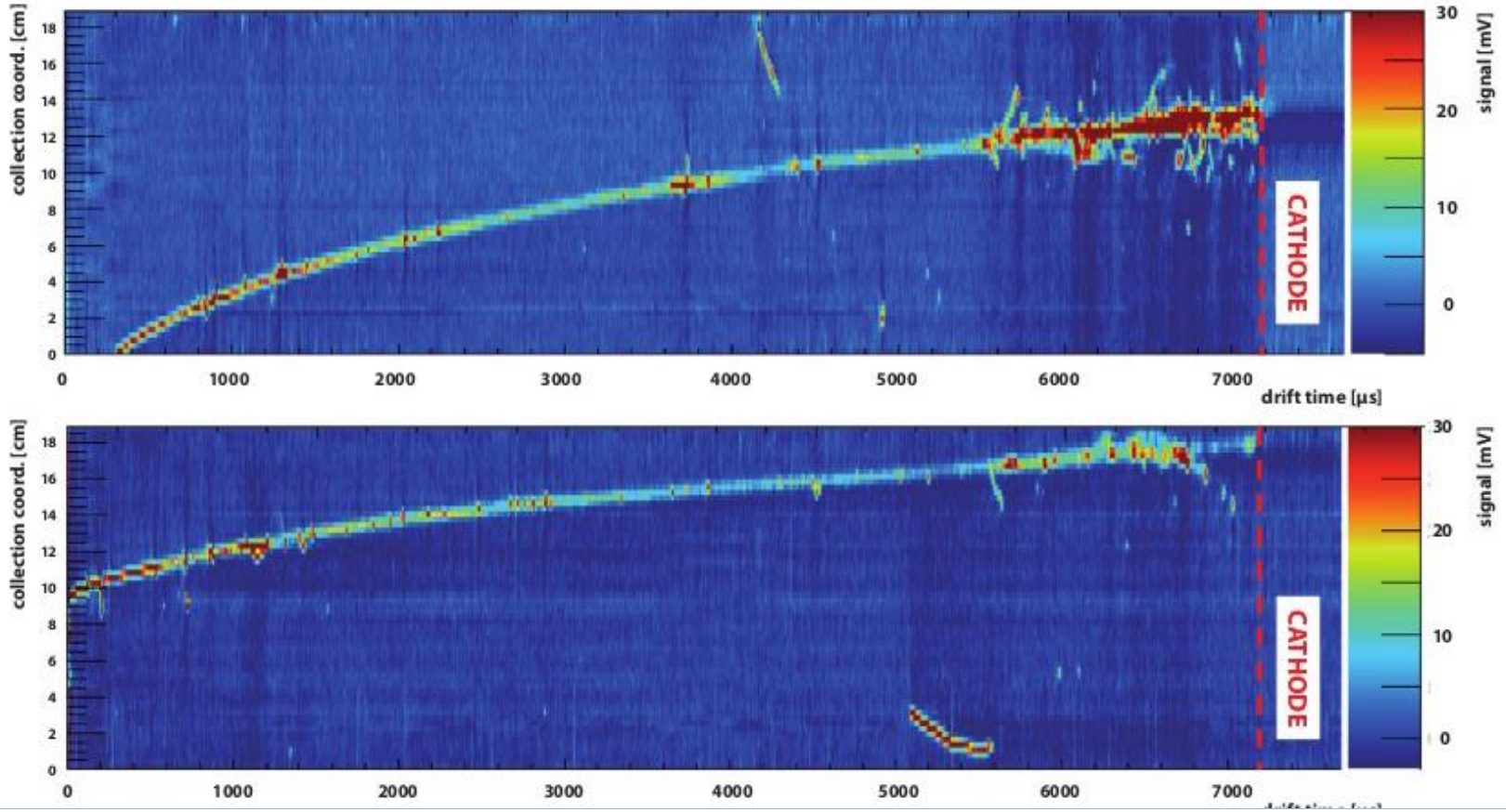
- For MIP S/N ≈ 16, ENC ≈ 525 $e^-$
- 5 m drift events clearly visible



# Field correction test in ARGONTUBE

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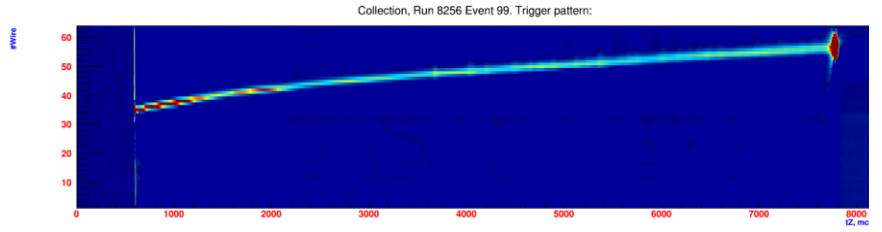
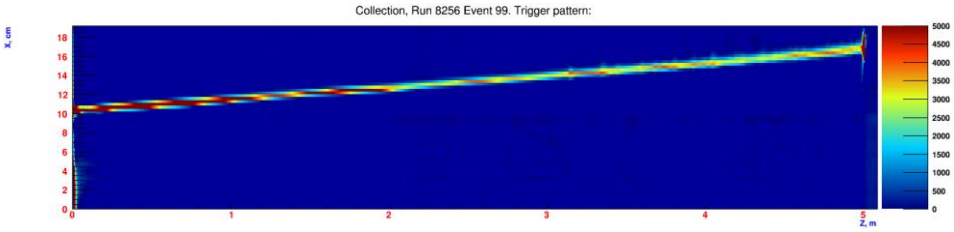
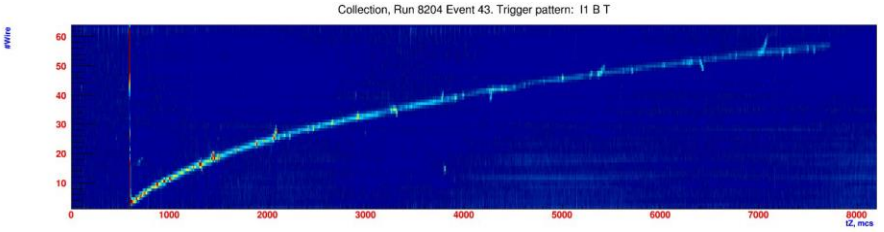
- Field distortions occur due to Greinacher undercharge and argon ion space charge
- Space charge production rate $7 \times 10^{-11}$ $Cs^{-1}$ for ARGONTUBE (active mass 280 kg)
- Ion drift velocity of the order of cm/s
- Use the straight UV laser track to correct the field
- Apply correction to particle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

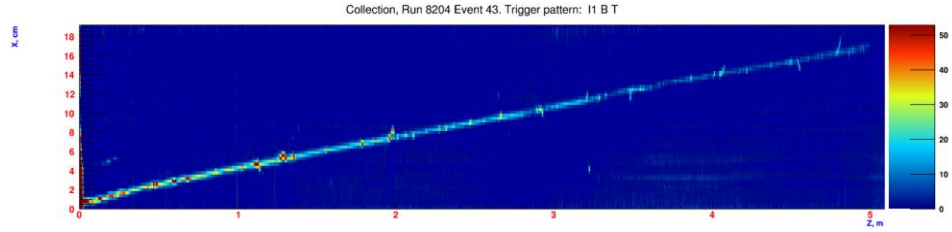



Before correction




After correction



# MicroBooNE location



# MicroBooNE detector

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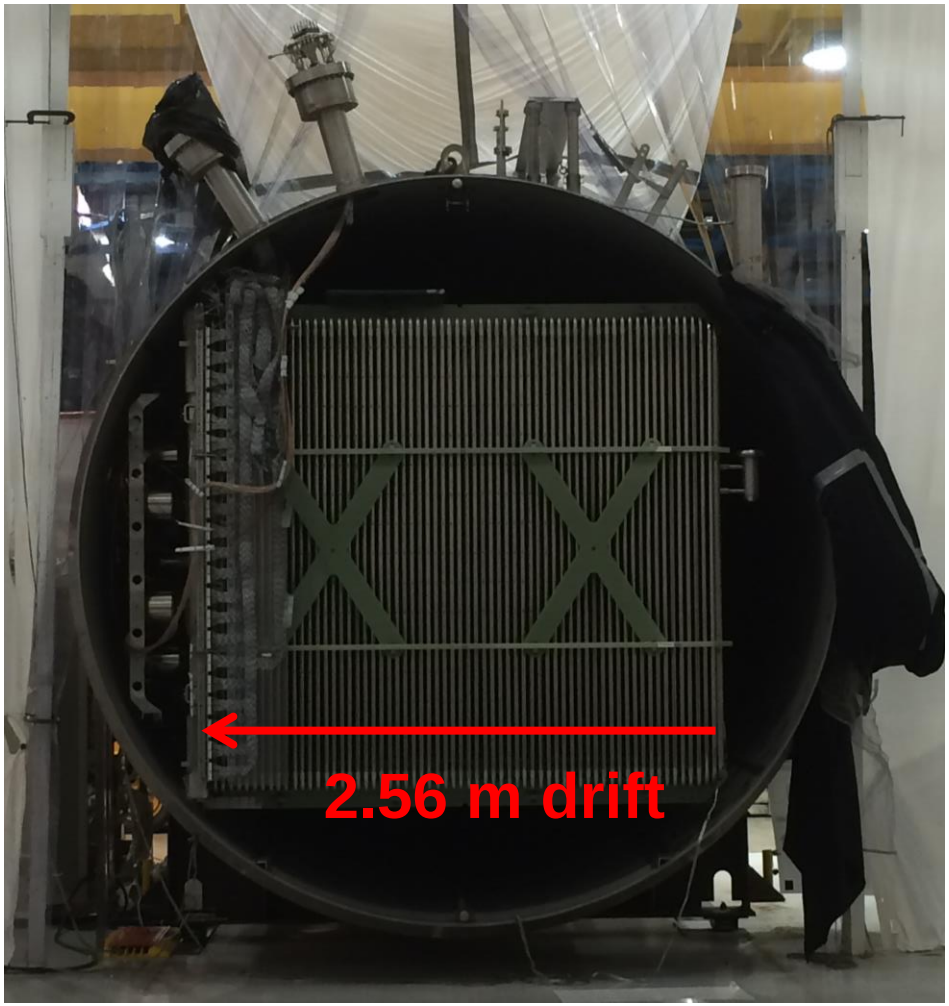
- Foam insulated vessel holds 170 t LAr
- 60 t fiducial mass
- Fill without evacuating
- Drift field of 500 V/cm
- Frontend electronics in LAr
- 3 readout wire planes and a total of 8256 channels
- Light detection: 32 8” PMTs
- Operated on surface



# Moving the MicroBooNE detector



# UV laser calibration system for μBooNE

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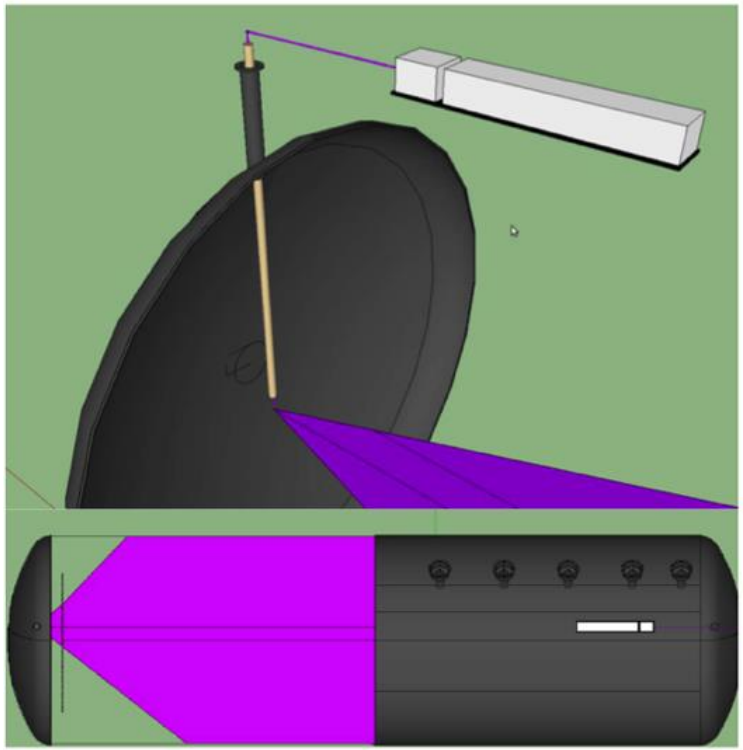

Movable mirror in LAr


# UV laser calibration system for μBooNE

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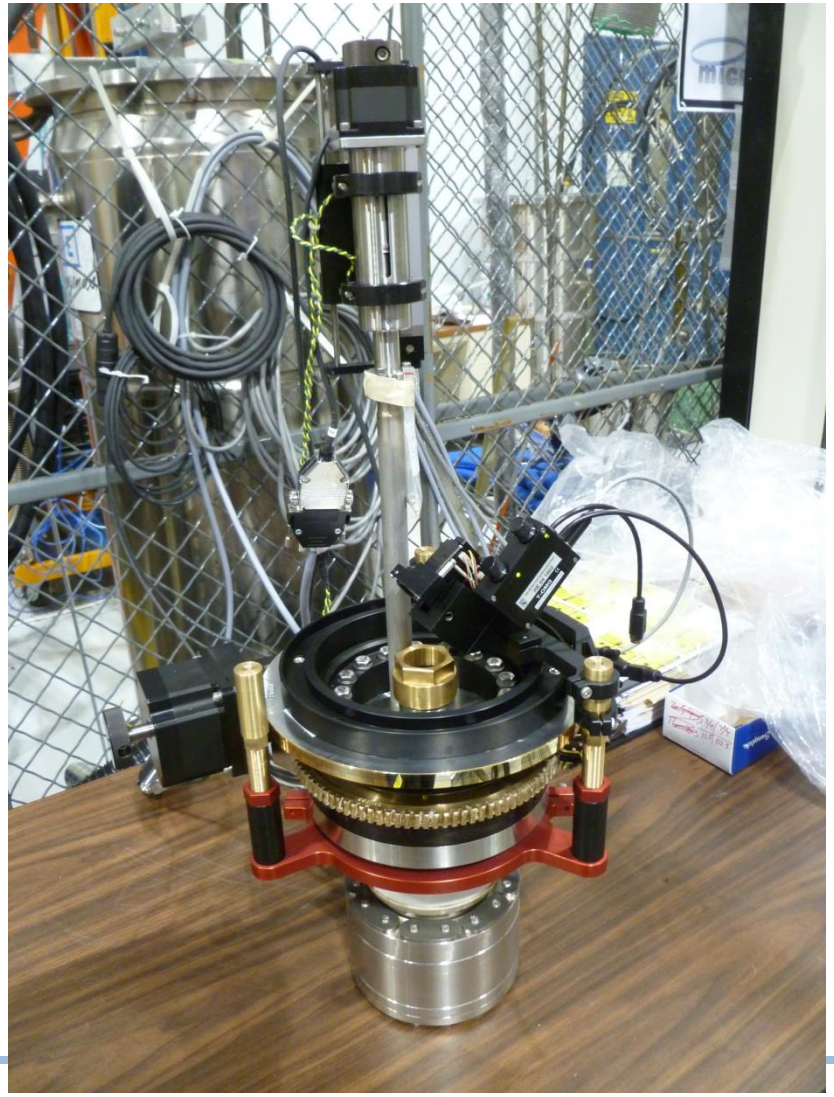

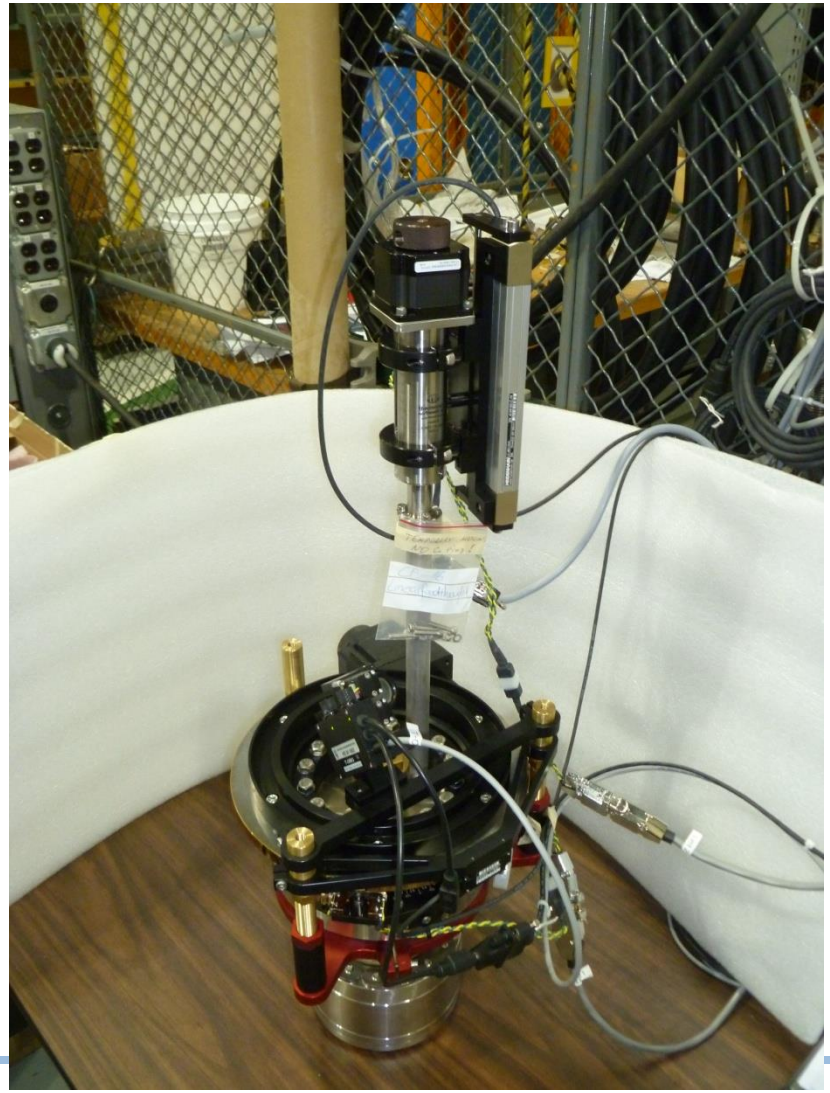

# Test of UV laser calibration system for μBooNE

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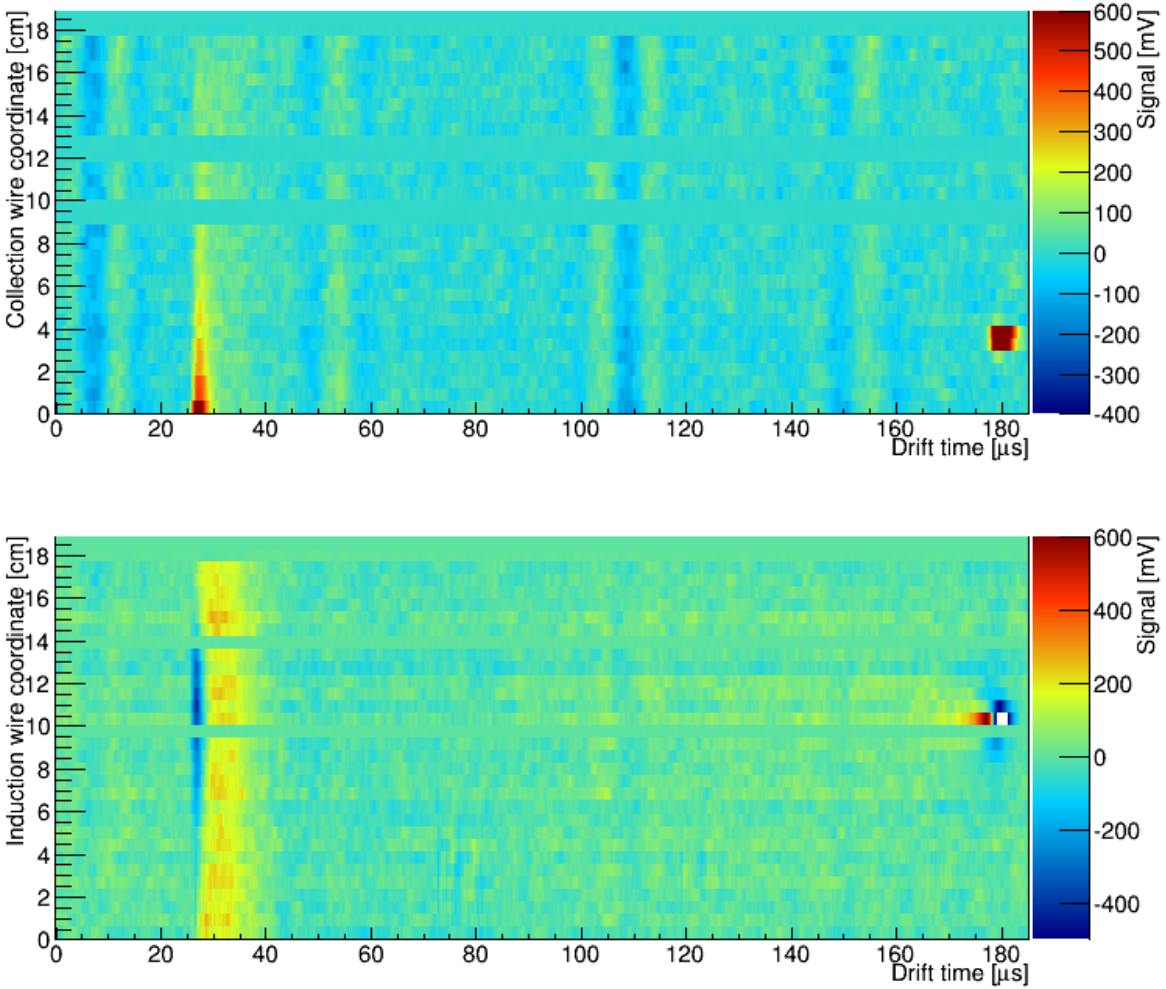

# LAr1-ND extension to MicroBooNE

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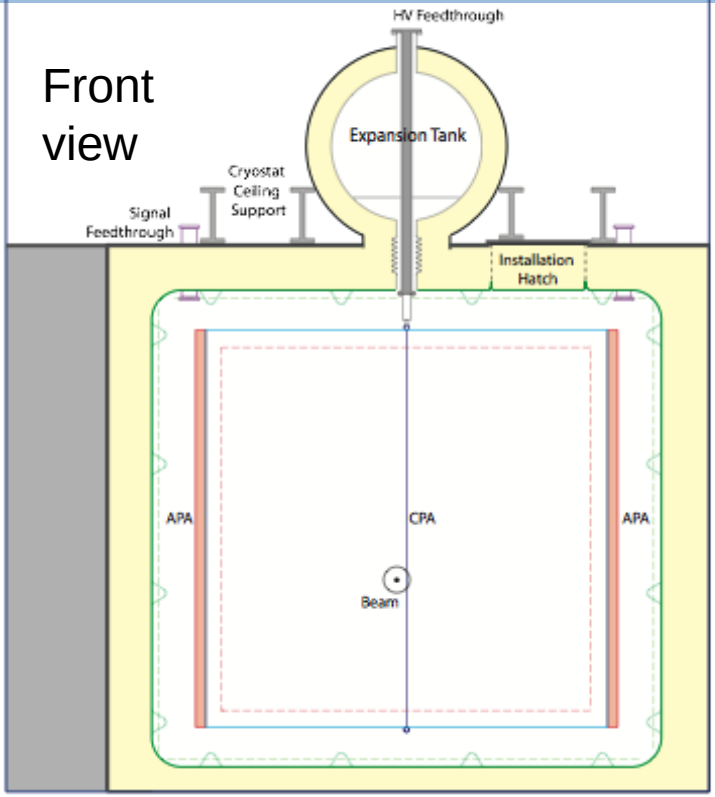
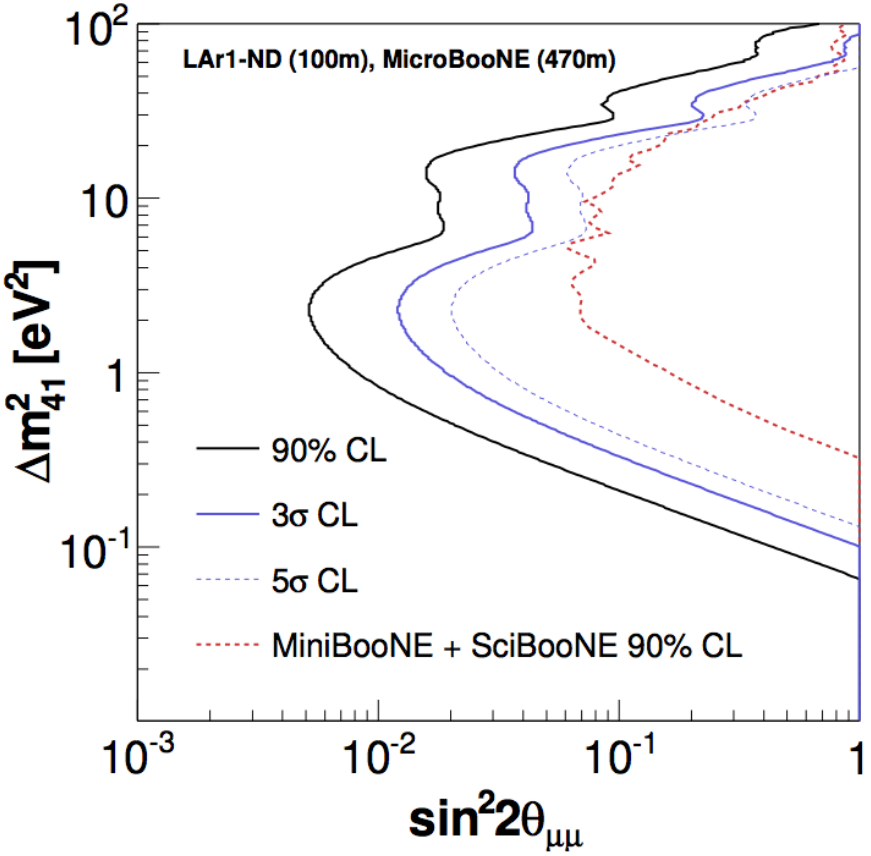


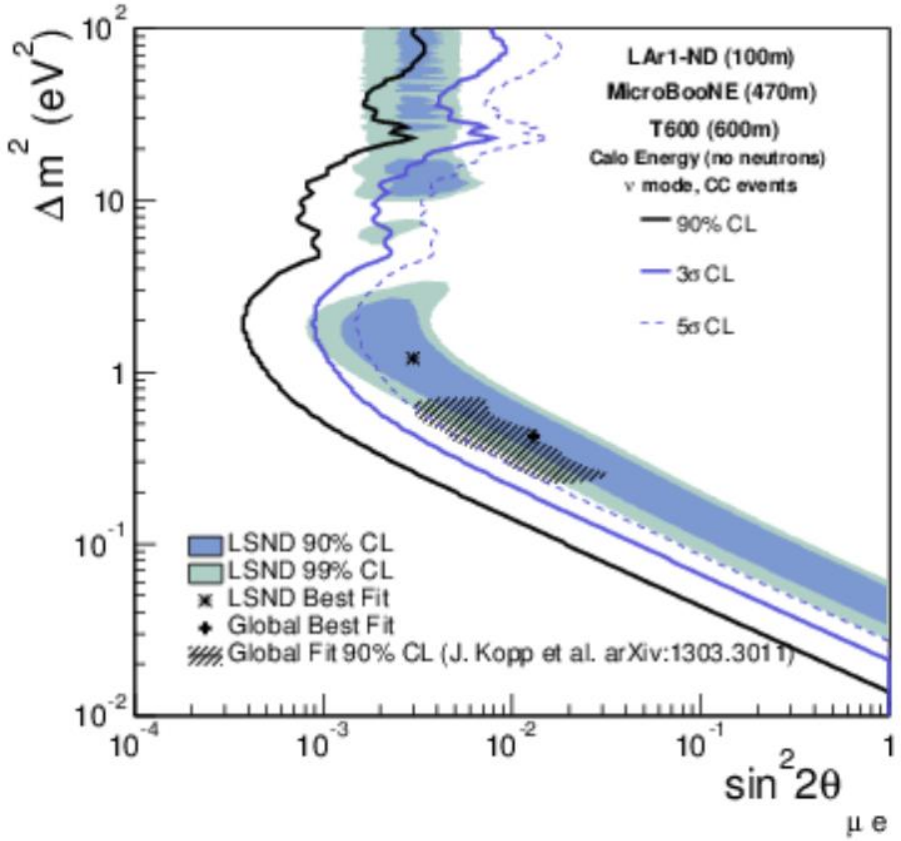

4.4 m (beam direction) x
4.1 m (wide) x
4.8 m (tall)
= 150 t LAr (82 t active)

- 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

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- 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 ≈ 16, ENC ≈ 525$e^-$
  - 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!

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