

ArgonCube 2x2: status and plans

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ArCube collaboration meeting

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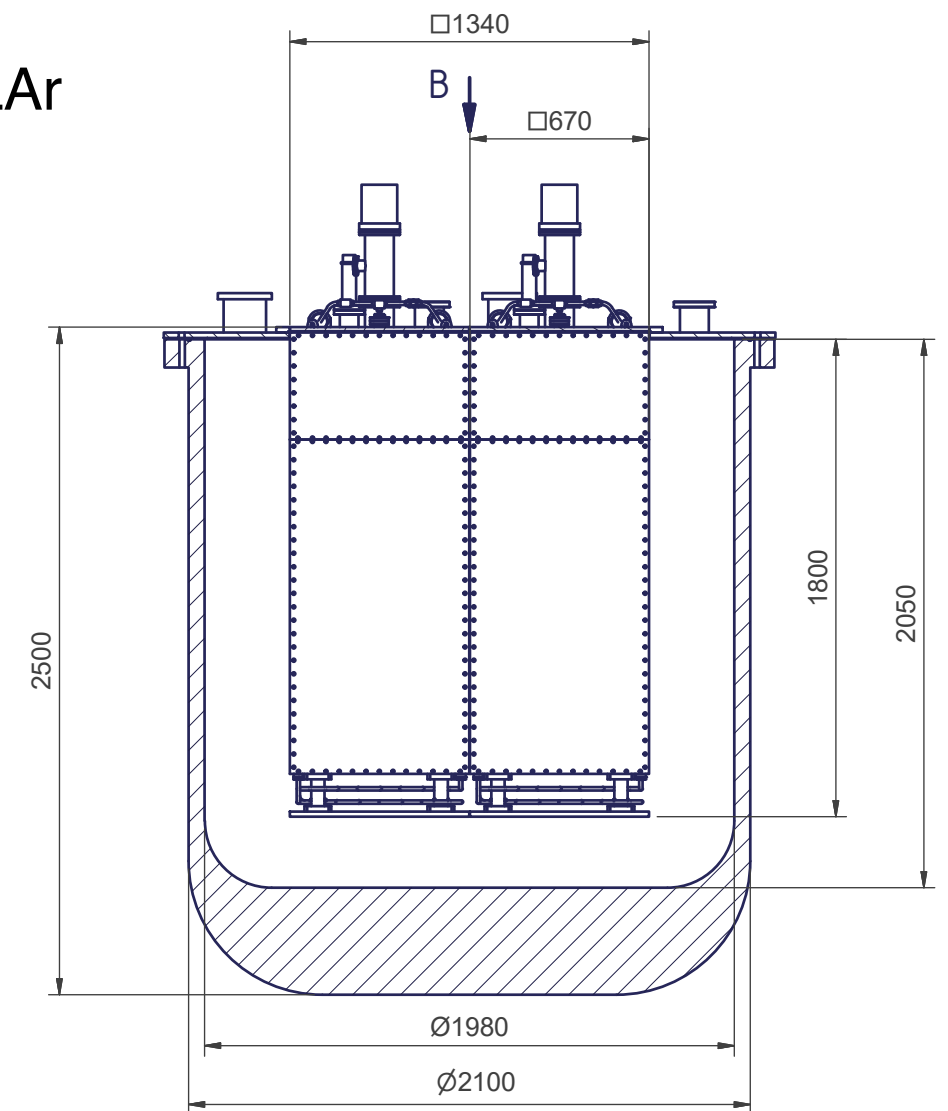
LHEP infrastructure

Laboratory:

- LN₂ dewar: 5000 l
- LAr dewar: 5000 l

2x2 cryostat:

- Total cryostat volume ~ 6300 l
- Active volume (4 modules, 8 TPCs) ~ 1440 l = 2 t of LAr



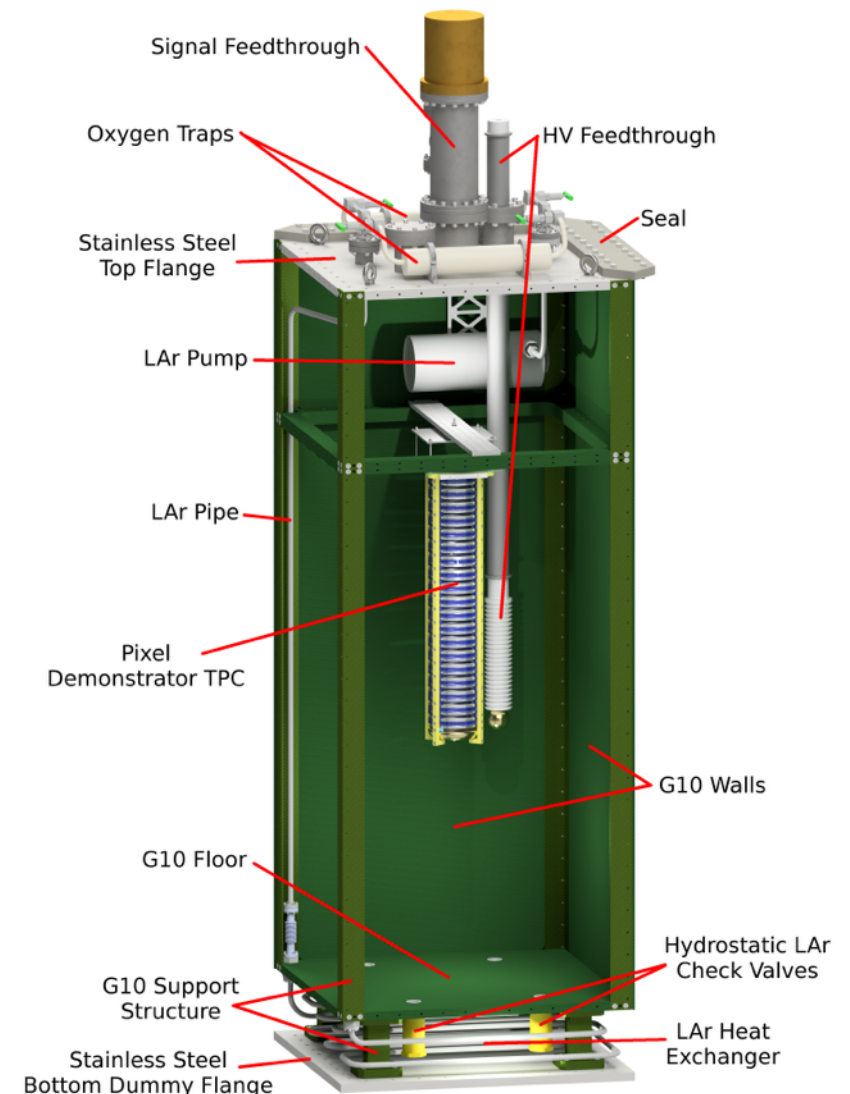
Purity test with the ArgonCube prototype

Goals:

- prove that the LAr inside the module can be purified enough after “hot” extraction and re-insertion into the bath
- validation of the cryogenic system

Prototype for DUNE-ND:

- Dimensions (67x67x181) cm³
- G10 wall material
- Internal LAr separated by the bath and continuously purified in liquid phase
- LAr in the bath is potentially highly contaminated by electronegative impurities
- Testing with cosmic muons

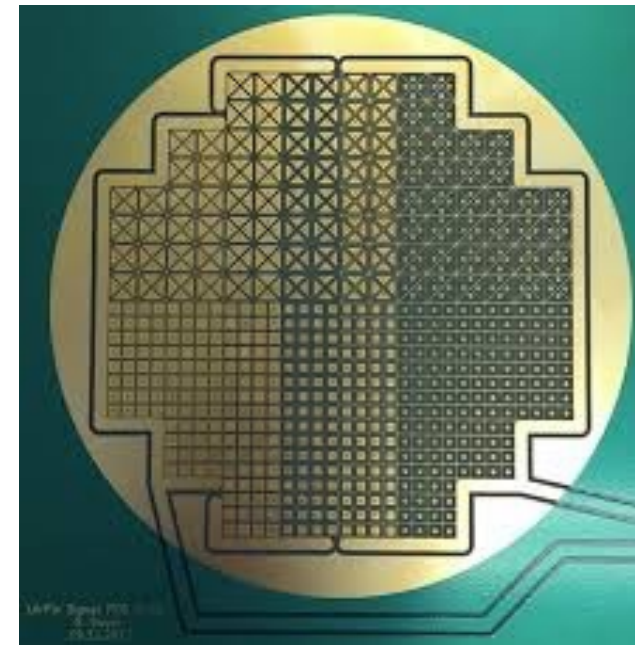


Purity test with the ArgonCube prototype

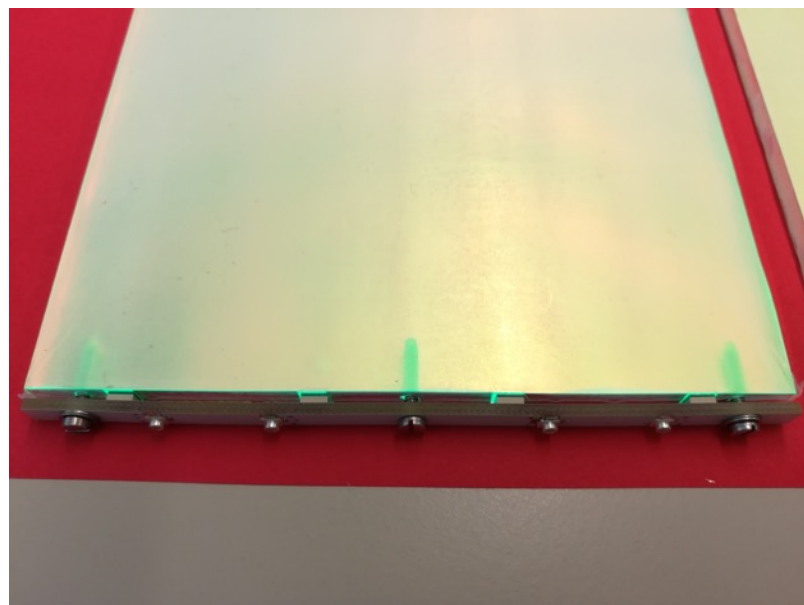
TPC instrumentation:

- Charge detection:
 - LArPix (see [talk from Dan](#))
- Light detection:
 - ArCLight: characterisation studies ongoing (see [talk from Igor](#))
 - Light Collection Module (LCM): scintillation fibres (see [talk from Alexandr](#))

LArPix



ArCLight



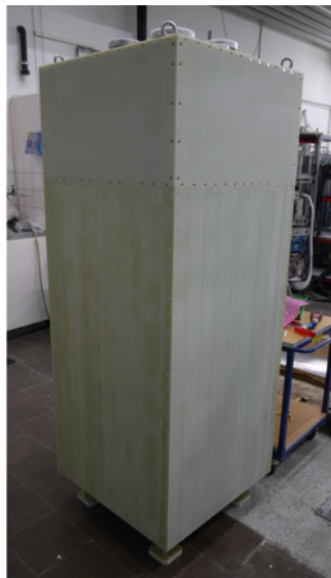
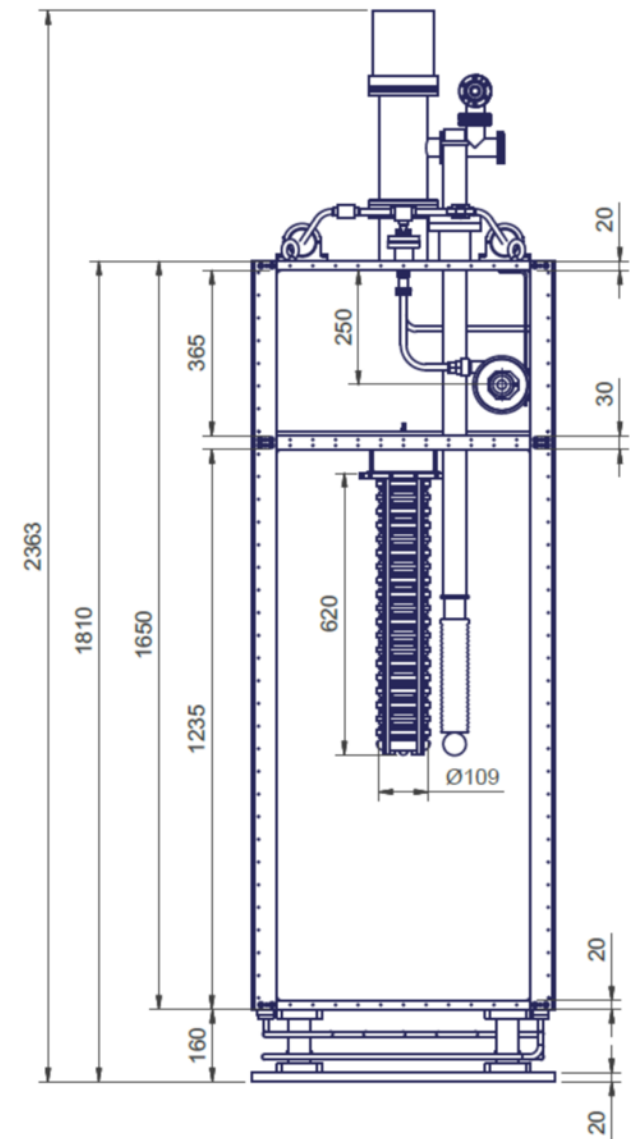
LCM



Purity test with the ArgonCube prototype

What is ready:

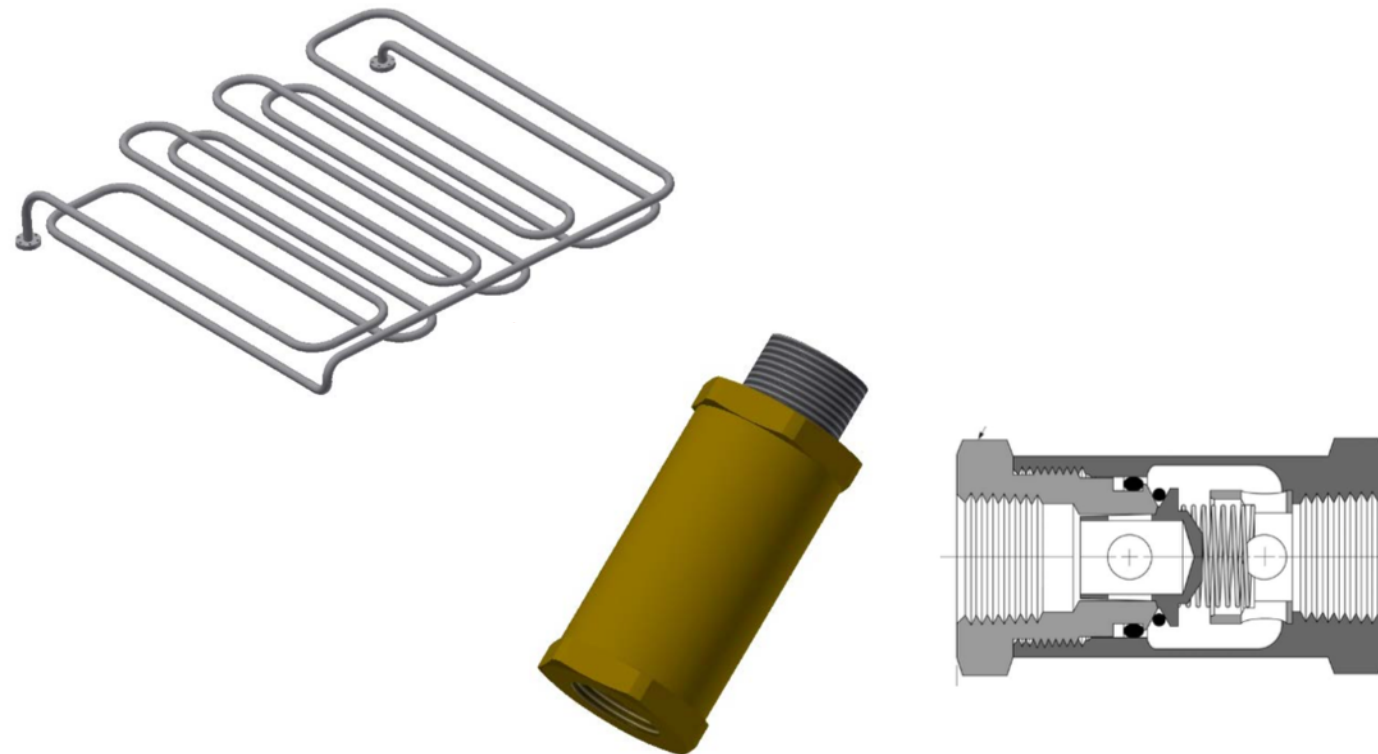
- Top flange with all the feedthroughs
- G10 structure: L-shaped pillars, middle frame, lateral big and small panels, floor, supports and G10 made screws
- Bottom dummy flange
- HV feedthrough
- Demonstrator TPC
- Electronic feedthrough (readout)
- Cryogenic recirculation pump
- LAr oxygen filters (2x)



Purity test with the ArgonCube prototype

Under design/purchase:

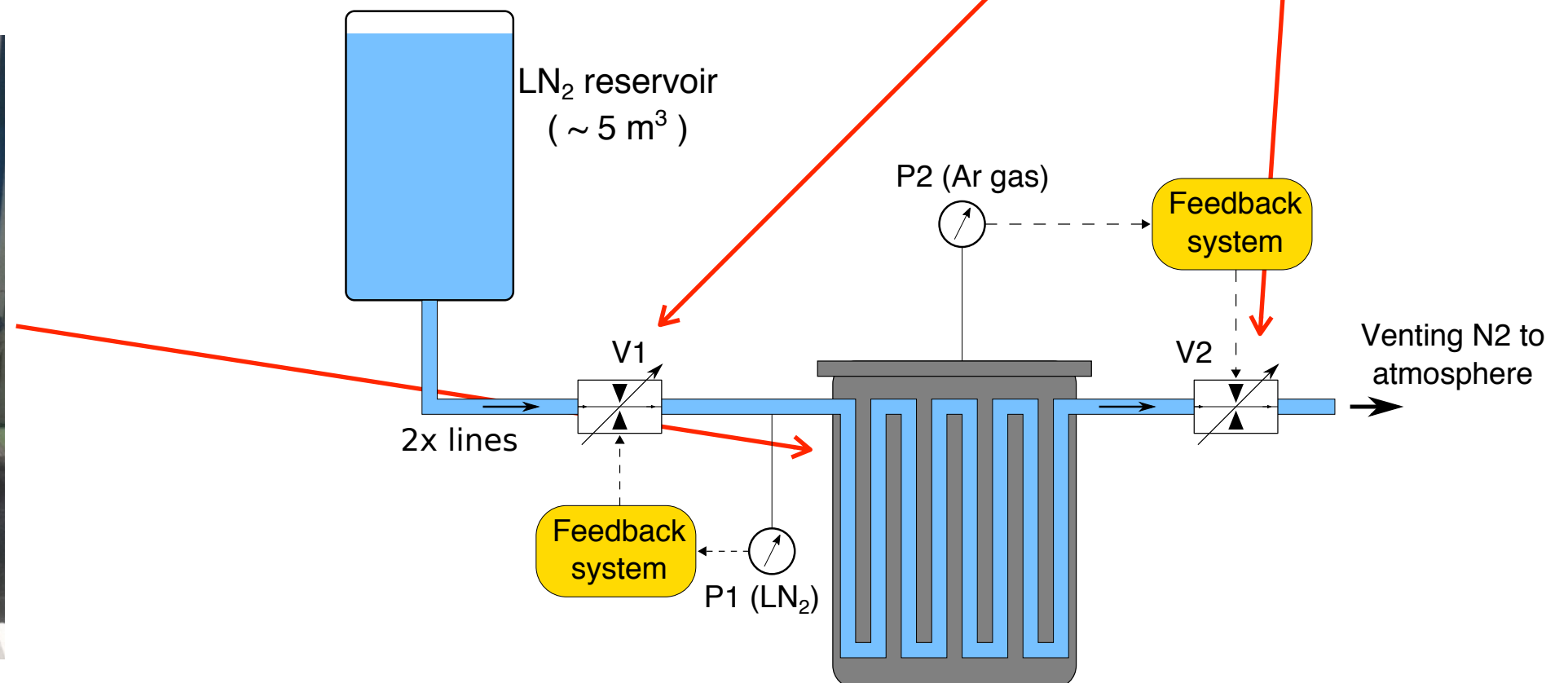
- LAr internal pipes: end of June
- Heat exchanger is being designed: ready in August
- Check valves to fill and empty the module (~ 15 mbars overpressure): expected in August
- Pressure equalisation system (gas phase) between modules and cryostat: pipe outside the flanges with bidirectional valves



Purity test with the ArgonCube prototype

Cryogenic system:

- Working point: 85 K at 1.05 bar and above the Ar triple point (83.8 K)
- Required cooling power:
 - For module insertion: $\sim 2 \text{ kW} = 38 \text{ l/hr}$ of LN_2 (from CERN)
 - Consumption during operations: $\sim 80 \text{ W} = 1.4 \text{ l/hr}$
- 4x LN_2 control valves (30 kEUR): purchased, delivered in 16 - 20 weeks
- Pressure sensors for cooling feedback



Purity test with the ArgonCube prototype

Monitor, control and alarm system:

- Liquid phase differential pressure between module and cryostat liquid phase
- Gas phase differential pressure between module and cryostat
- Recirculation flow: might influence the former parameters
- Pressure monitoring and stabilisation through feedback system (PID) for LN₂ flow regulation
- Level meters: inside the module and in the cryostat

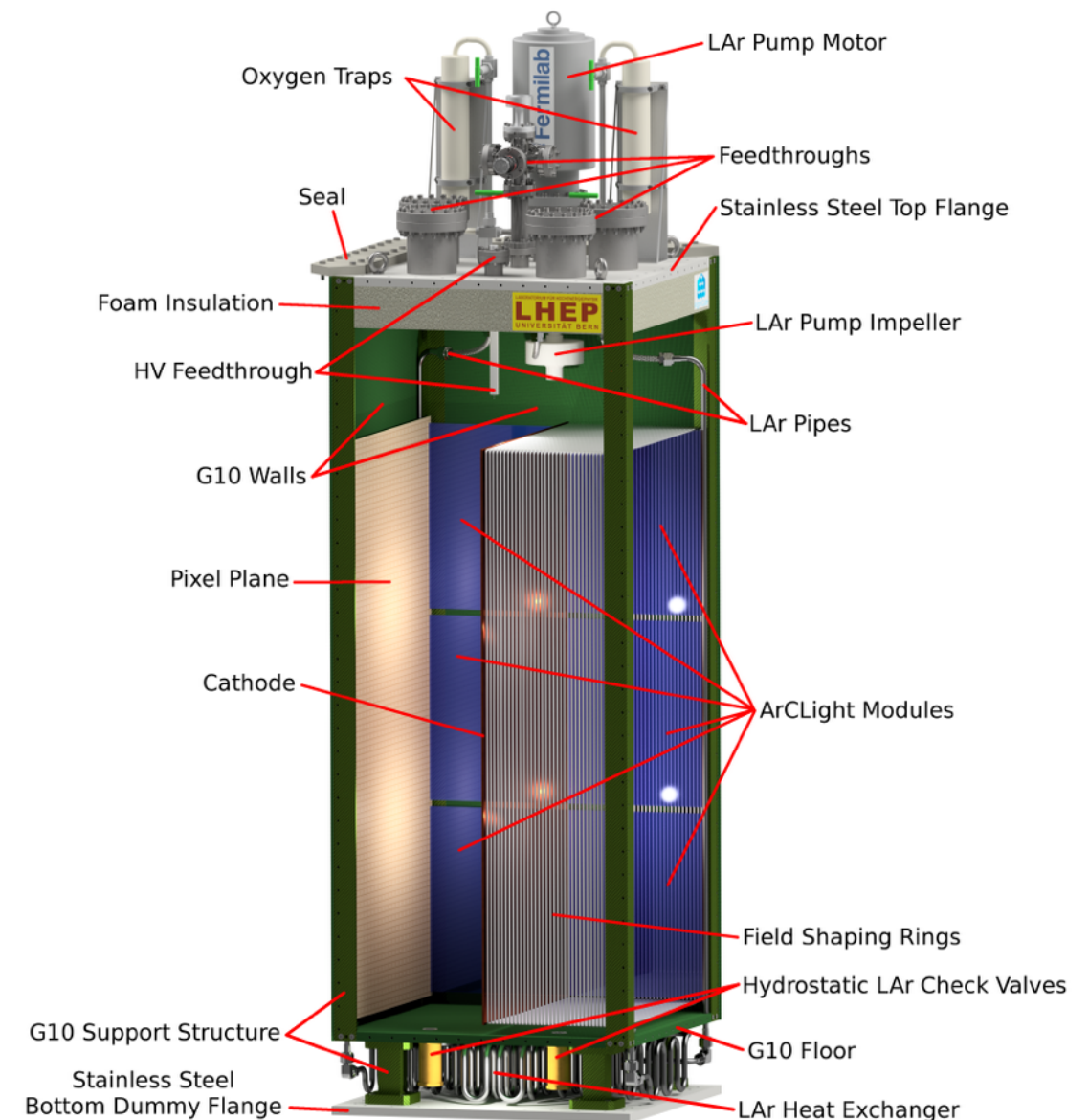
Fully instrumented module

ArgonCube final module:

- Minor modifications to the cryogenic setup
- LAr recirculation based on prior tests

Resistive shell:

- Maximum electron drift length: ~ 33 cm
- Maximise active volume
 - Option 1: resistive foil (see [talk of Roman](#))
 - Option 2: conductive tracks on G10 walls

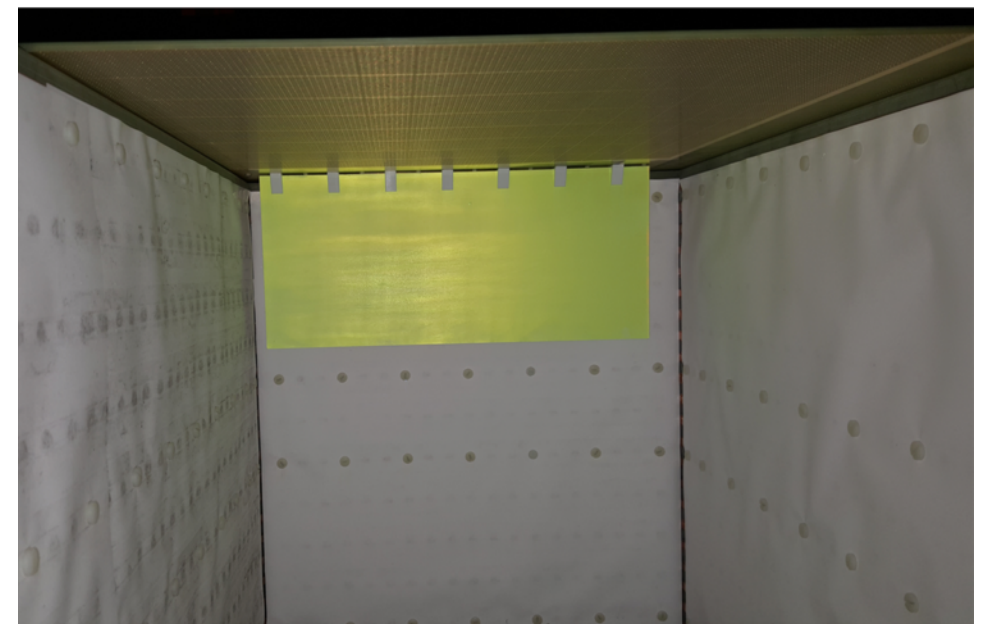


Only for illustration.
Not actual design.
The module is sealed
on all the sides.

Fully instrumented module

TPC instrumentation:

- Charge detection: pixelated anode (PixLAr)
 - Electronics for readout: see talk from Dan
 - About 50 x 120 cm² with 3 mm pitch: $\sim 10^5$ readout channels (see [talk from Camilla](#))
- Light detection:
 - ArCLight readout already in place (see [talk from Roman](#))
 - Total 6 ArCLight units (30 x 40 cm²) for a single ArCube module. Dimensions to be optimised for ND(see [talk from Patrick](#))
 - Total 24 LCM units (30 x 10 cm²)



Fully instrumented module

- High voltage for cathode plane:
 - required about 33 kV for operation at 1 kV/cm
 - G10 laminated with resistive layer
- Recirculation pump from FNAL for 300 lpm
- Purification filters already designed and optimised
- Full instrumented module ready at about the end of 2018
- In 2019 the 2x2 ArgonCube setup will be deployed at FNAL and exposed to neutrino beam