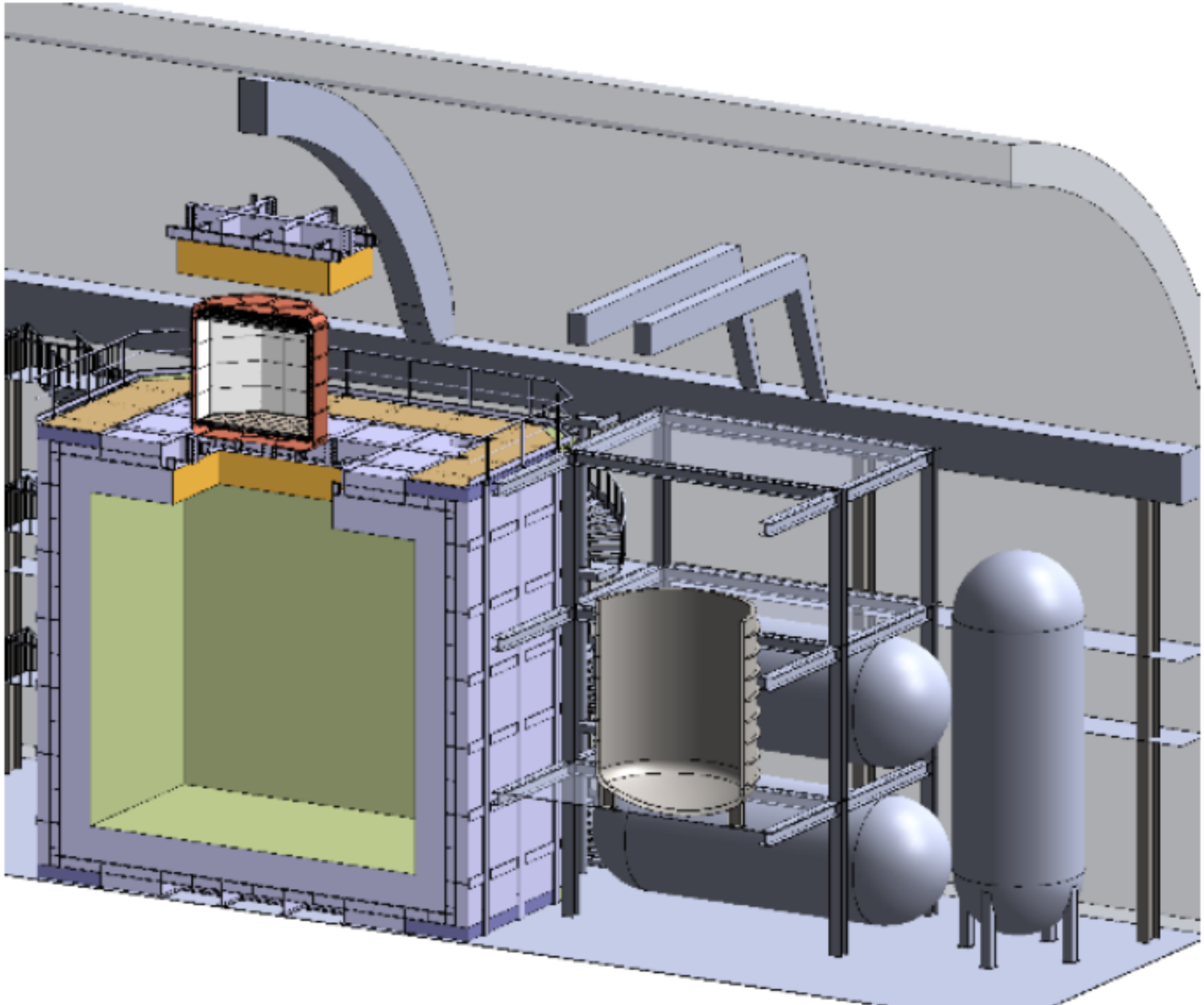
News from Dark Side 20k

(from the DS-20k collaboration meeting at CERN, 8-10 Feb. 2018)

The experiment's plans

- **Plan until fall 2017**:
  - 20-ton Underground LAr (UAr) TPC, 2-phase, in LNGS. Embedded in 7m diam. Liquid Scint active veto (Boron loaded), in 14m diam. pure water Cerenkov veto.
  - Collaboration of INFN and Princeton (NSF funds)
- **New plan, layout, goals**:
  - 20-ton UAr TPC as above. But within 6x6x6m^3 LAr cryostat, like ProtoDUNE's. Almost 400 tons. Picture
  - Advantage: 20-ton TPC easily separated with radio-pure vessel from veto volume (e.g., O_2-free Copper) .
  - Problem: LAr veto not enough to absorb/detect neutrons at req. level of < 0.1 n/exposure (!).
  - **New goal**: next step is a 300 ton detector, at SNOLAB
    - CERN (with strong Dir. of Research support)
    - SNOLAB: Art McDonald and M.Nessi came up w/ "LAr within LAr" idea



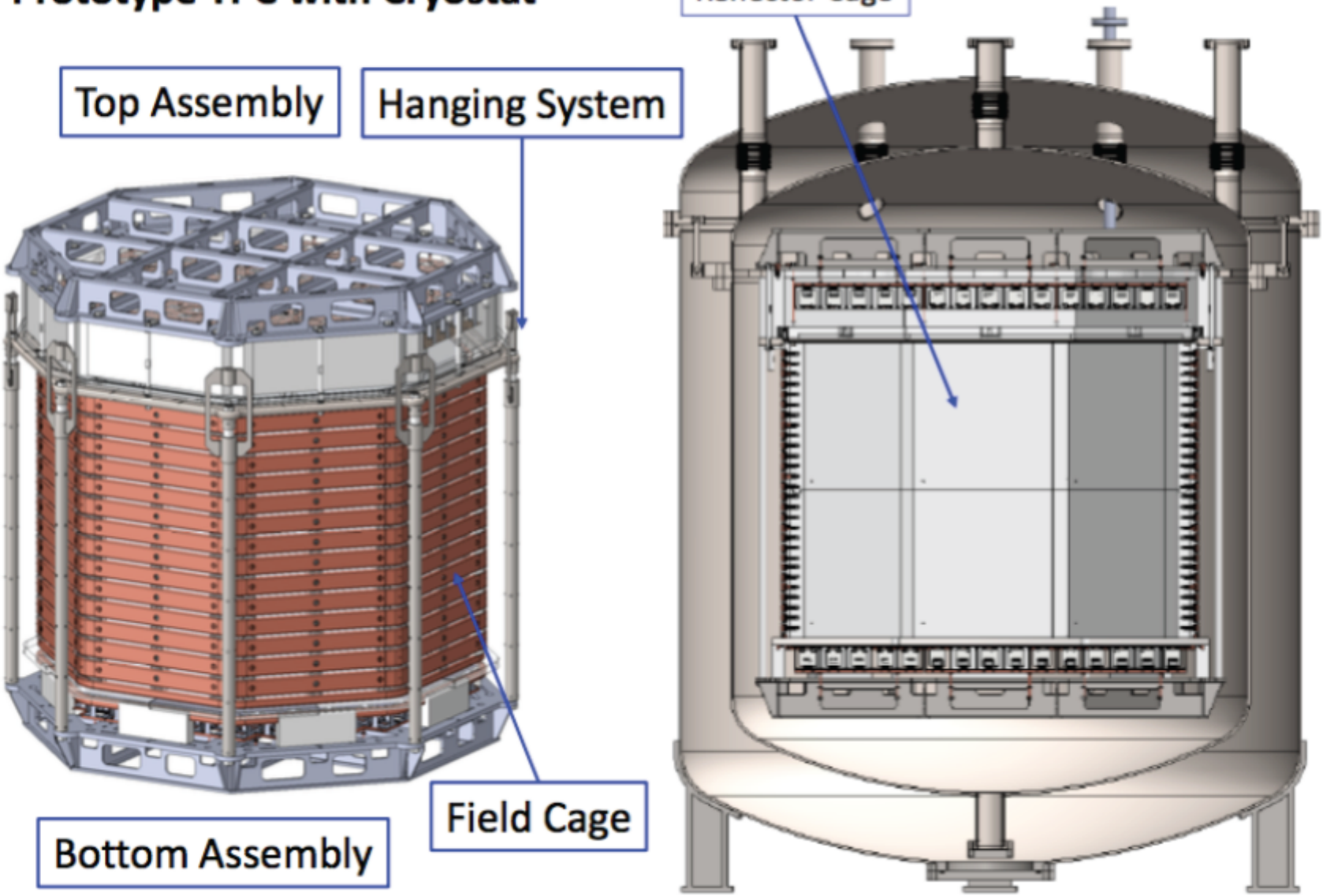
Progress since 2016 April – 1 of 2

- **1-ton prototype**: cryostat to be delivered in Apr. '18, at CERN. Construction 2018-19, operation in '19. NO PHYSICS. Verify cryogenics, TPC, signal generation & readout, DAQ. Operate until 2020. Picture
- **GOAL**: DS-20k start in 2021.
- INFN already putting resources in DS-20k despite not having approved it yet.
- INFN contracted the **LFoundry company** to produce all the FBK-developed blue-extended SiPMs for the 20k device. Picture
- SiPM prototype matrix with FEE almost ready. Picture
- UAr to be purified (but not depleted of radioactive ^{39}Ar) in 300m tall cryo tower ("Seruci-1", in Sardinia). **30m prototype built at CERN** (Mapelli). Picture

DS-Proto SS cryostat

DarkSide-20k
Prototype TPC with Cryostat

To validate the 20k Design



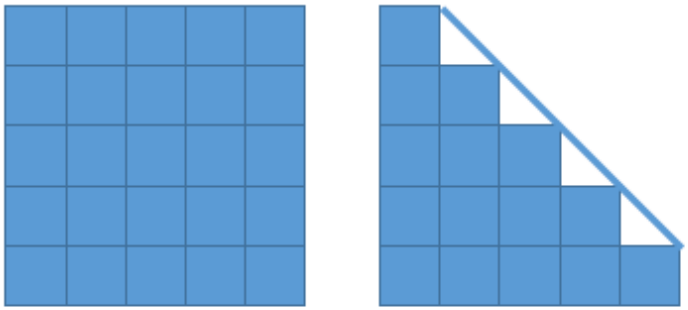
Total TPC Readout Channels of Possible Sizes

20.4 ton fiducial version (5cm cut)

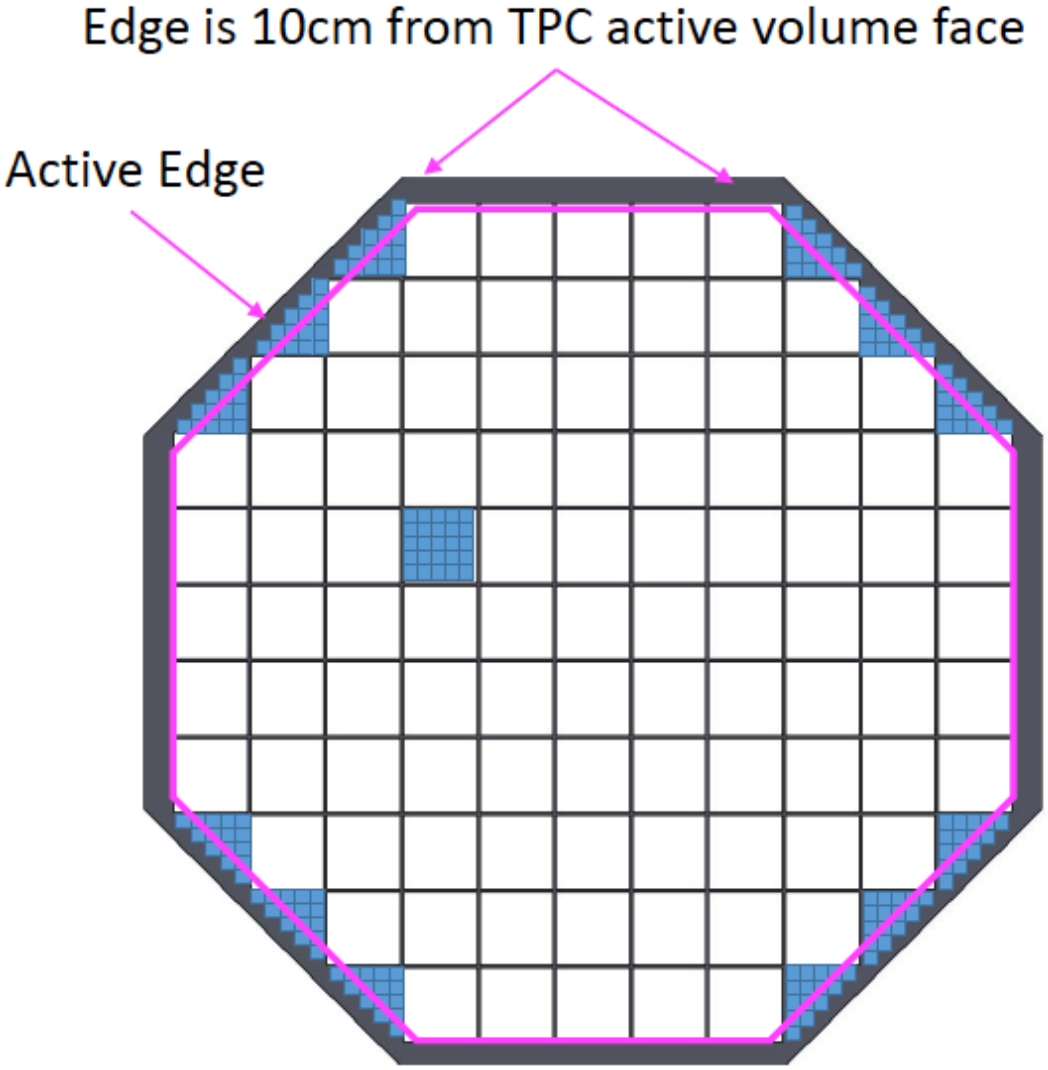
5210 = 2*(3*4*15+(3*(5+9)+11*5)*25)

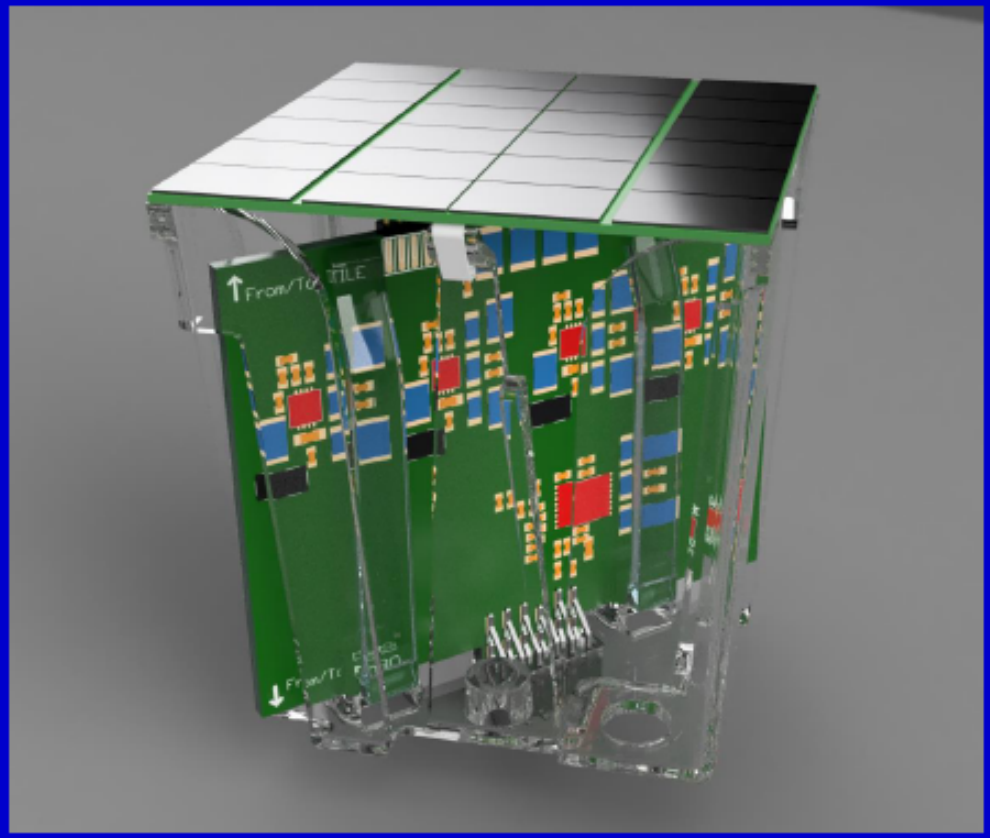
Total, active, Fiducial
33.9, 22.9, 20.4,
Total Drift length: 2.628 m

Two Types of Mother Boards



SQB **TRB**
194 **24**





The first PDM is the next milestone, presently draining most of our man-power resources

Delayed by the FBK SiPM run, expected by mid-october 2017, delivered on mid-january 2018.

On Friday, 24 November, ARIA's top and bottom modules plus one standard module were brough to Building 180 and lined up to precisely test their alignment and interconnections. (Image: Ma Brice/CERN)

Progress since 2016 April – 2 of 2

- **Comparison to LXe for DM discovery potential**: Galbiati received numbers from LZ experiment, showing expected background events for a multi-ton·yr exposure.
  Numbers are small, but they strongly reduce achievable upper limits.
  Instead,DS-20k aims for ZERO backgrounds, like DS-50.

- **Original 50kg experiment** is still running at LNGS. Expecting new result, by 20 Feb., showing sensitivity way beyond CDMS, at DM masses lower than Xe experiments, based on newly-achieved very low ionization threshold.

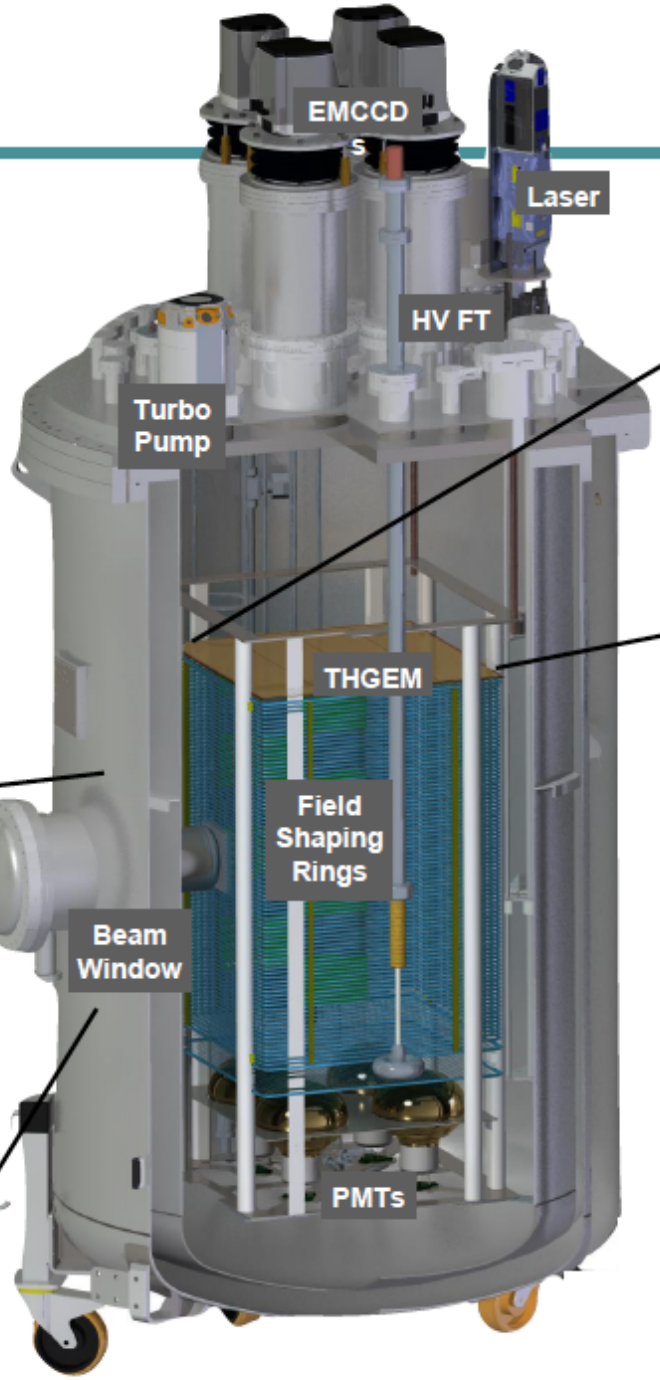
Sociology, etc

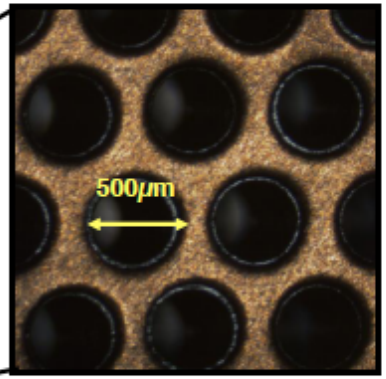
- Public statements (Galbiati):
  - collaboration now has 350 persons, but only 35-40 really working. Most groups have only 1-2 people.
  - For 300 ton plan, need more (500?). Strong recruiting effort (just got Mexico-UNAM).
  - CIEMAT group's reputation in DS-20k is good. They are now 6 (4 doctors, 2 technical).
- I had a very good impression of the collaboration's atmosphere:
  - unhurried discussion of issues, without displays of egos
  - frank acknowledgment of problems
  - much participative discussion during talks.

- Two extra talks:
  - Theorist Leszek Roszkowski: "Is WIMP hypothesis in trouble?" (NO!)
  - Consolidator grant holder Costas Mavrokoridis (Liverpool) on ARIADNE, a *photographic* 1-ton LAr detector. Pictures

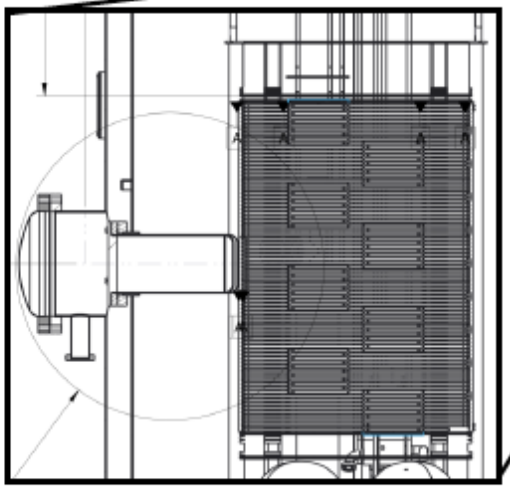
Detector Design

- 1500L Cryostat
- 53x53x80cm^3 active TPC volume
- Self contained cryogenic recirculation and purification system
- High Voltage feedthrough
- Nominal E Field 0.5kV/cm



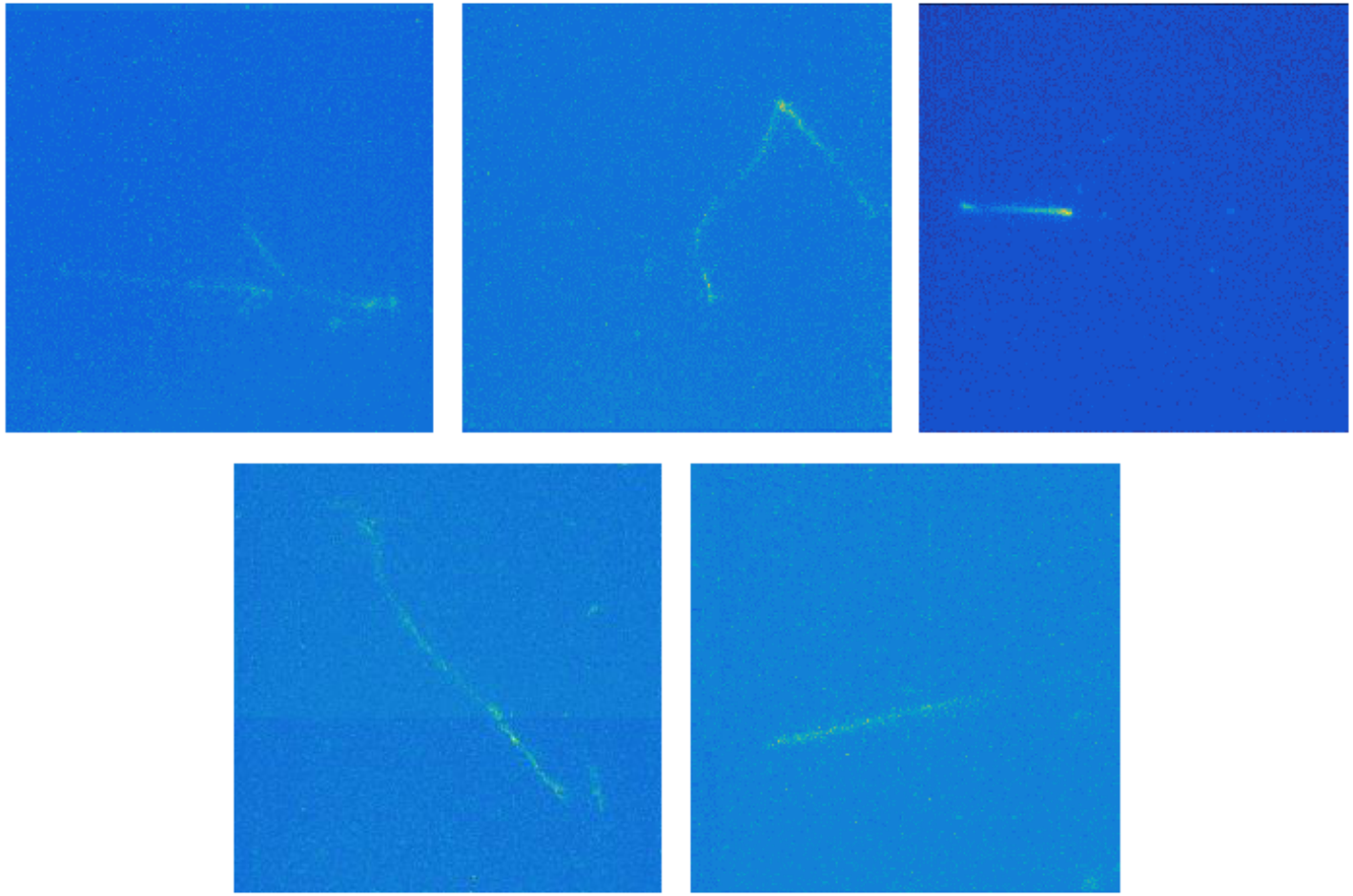


THGEM Detail


Beam Window Detail

- 4x Andor EMCCDs
- 4x 8" Hamamatsu PMTs
- 16 pad segmented THGEM
- Nd:YAG laser calibration system

Preliminary ARIADNE tracks



Preliminary cosmics 4x4 binning at low gain