First operation of GridPix in double phase Liquid Argon

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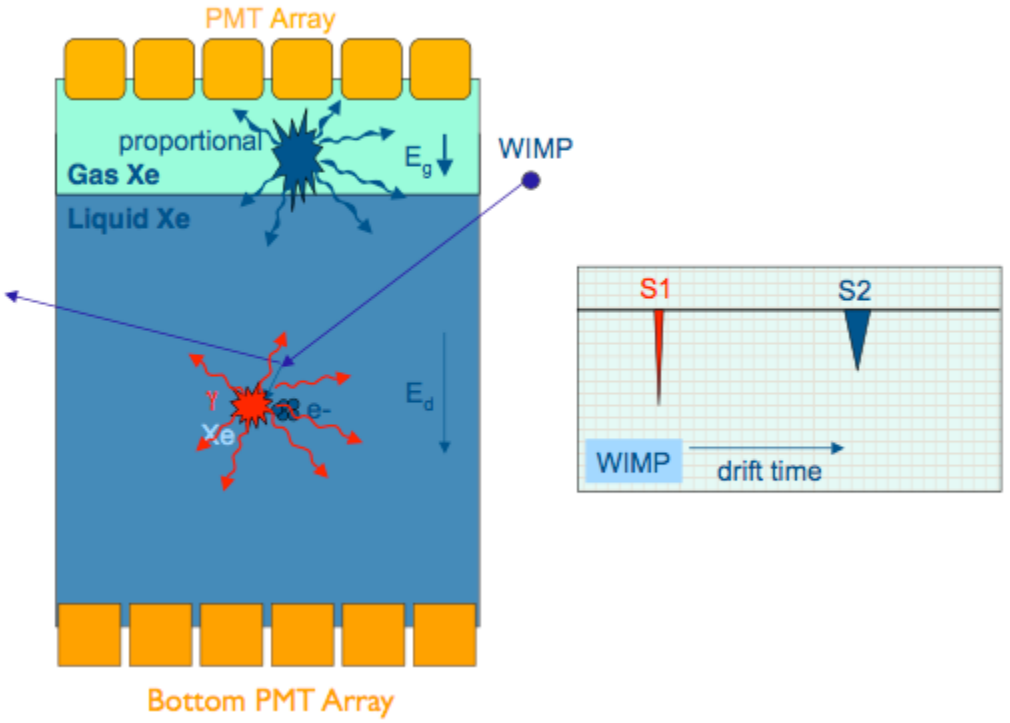
WIMP search, bi-phase Xenon

- GridPix TPC

as

WIMP / DBD

detector



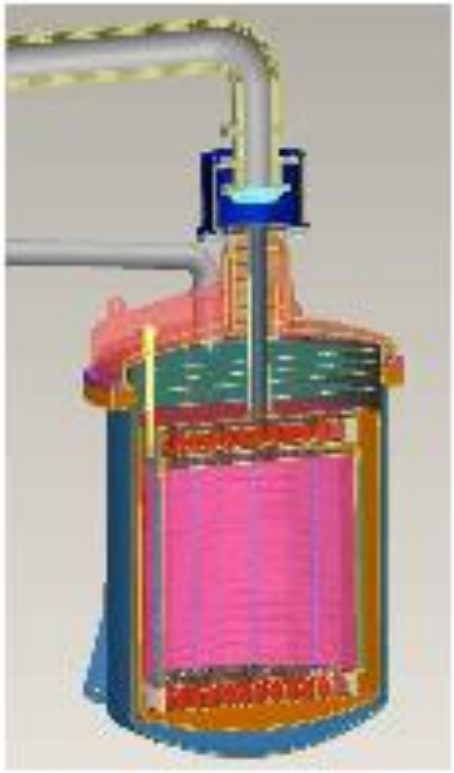
Source: Direct Searches for Dark Matter, Elena Aprile, EPS - HEP, July 21 2009, Krakow, Poland

XENON

DARWIN: European R&D project for bi-phase missing mass/energy detectors

With InGrid TPC:
- detection of single, individual electrons
    essential: granularity and the very small source capacitance at pixel input
- high (95 %) single electron efficiency
- accurate X, Y and Z (timing) precision
- potentially: (UV) photon detector

With GridPix, a detector is superimposed onto the (PM/QPID) detection system



(a)

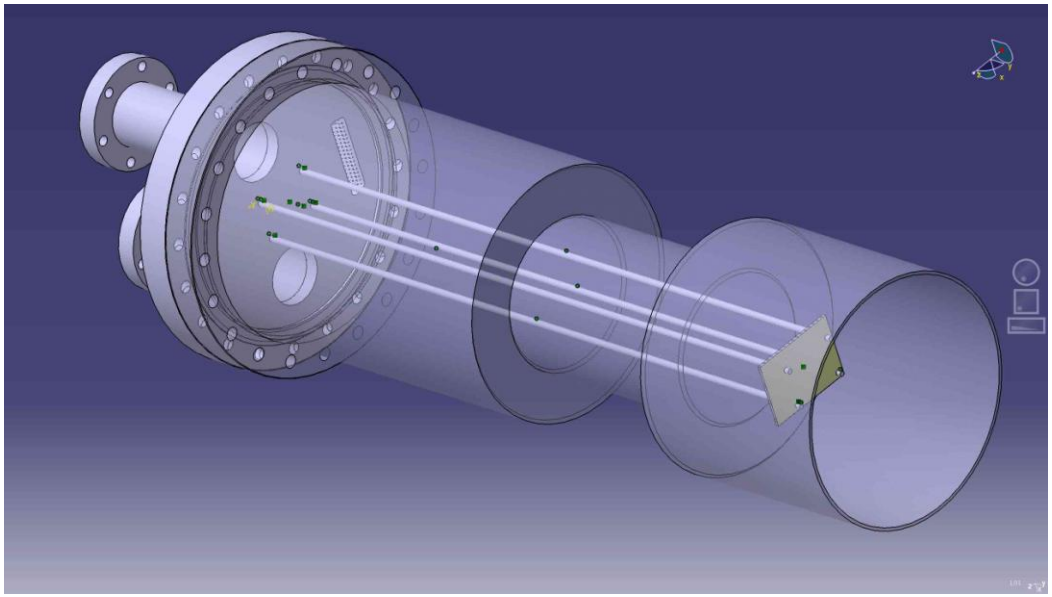
(b)

Figure 1.11: Conceptual design of XENON1T. Pictures courtesy of M.P. Decowski. Right-side drawing made by M. Doets.

Gridpix in Xenon: Test setup

- Collaboration DARWIN/XENON

  Columbia Univ., N.Y.



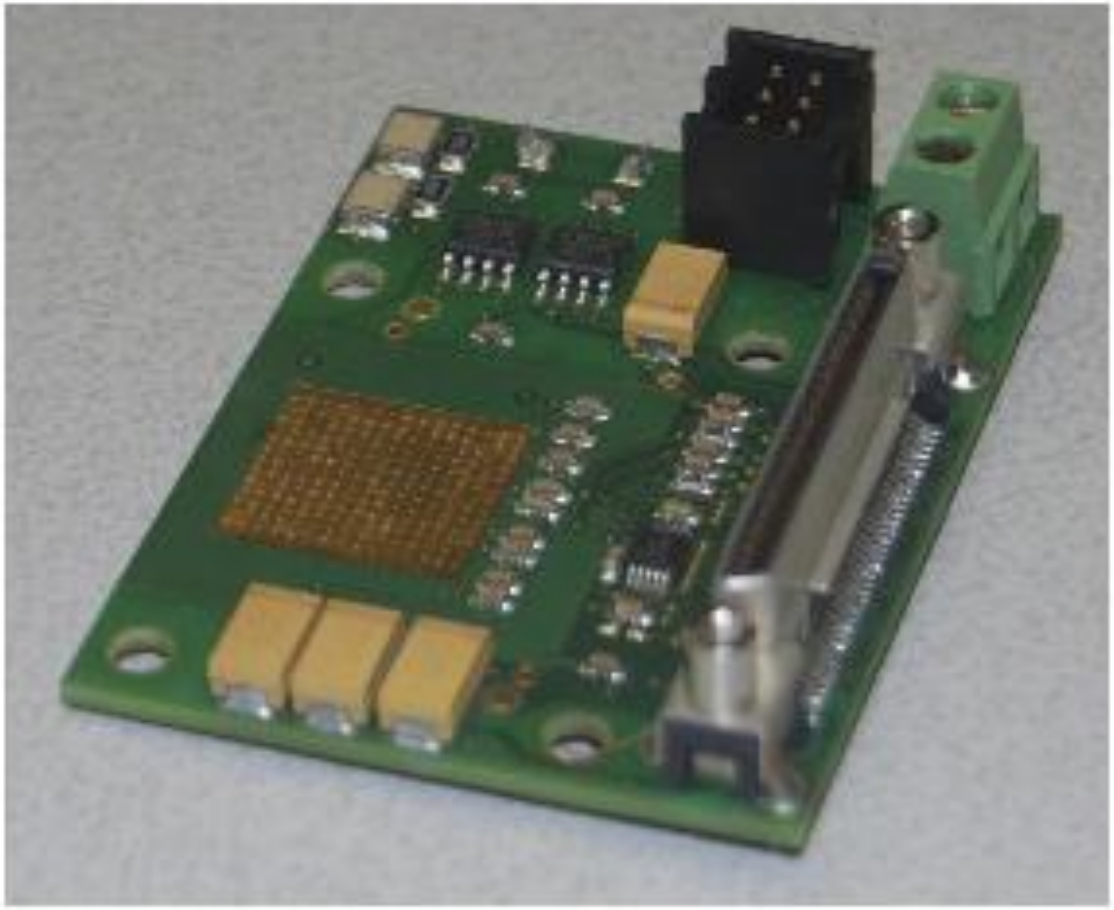
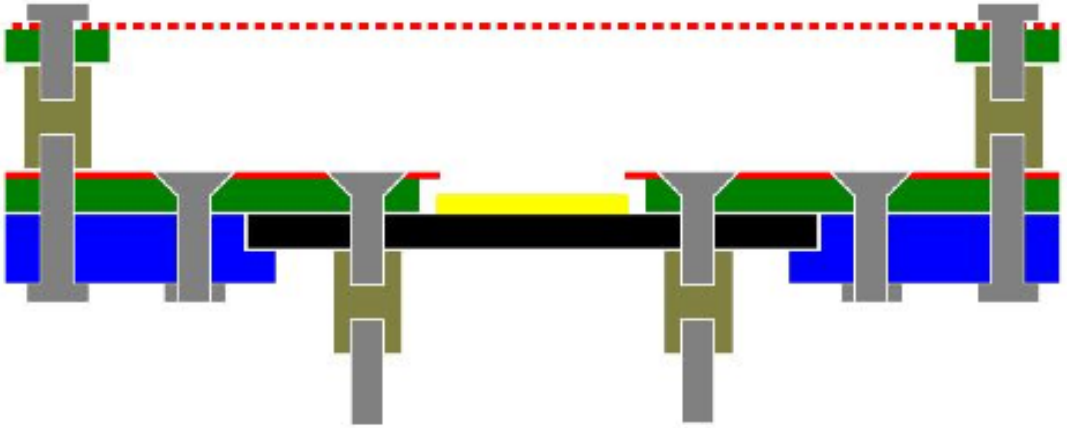


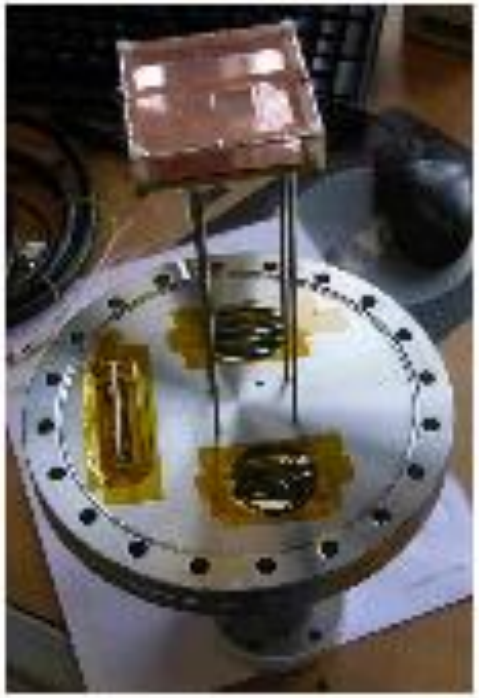
Figure 2.4: The PANalytical Chipboard. This board is used as a dummy board as it is no longer operational.

(a)

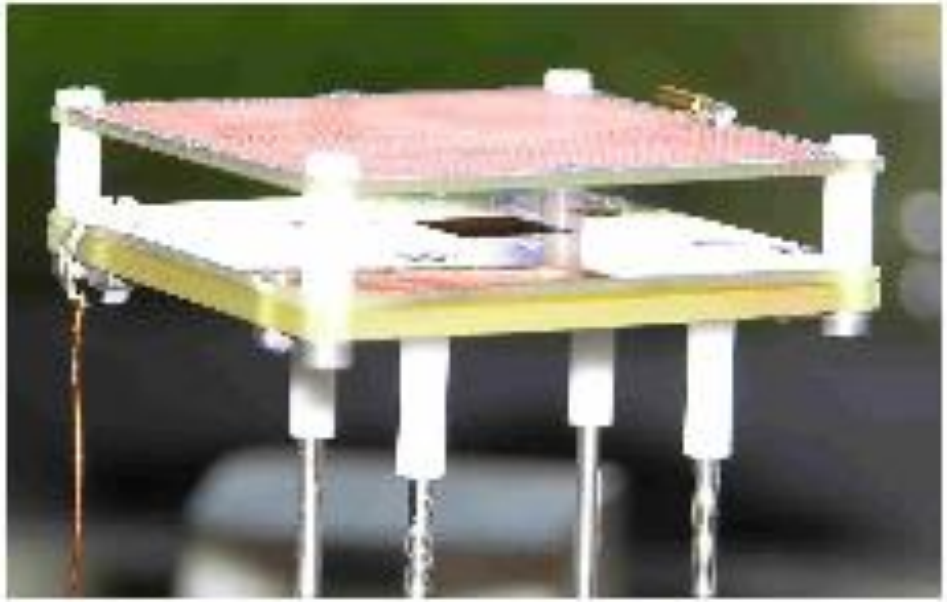
(b)

Figure 2.5: (a) VHDCI to 50 pins sub-D cable made from kapton; with the spare feedthrough on one end (b) Standard VHDCI cable with 50 pins sub-D connector being soldered to one end





(a)



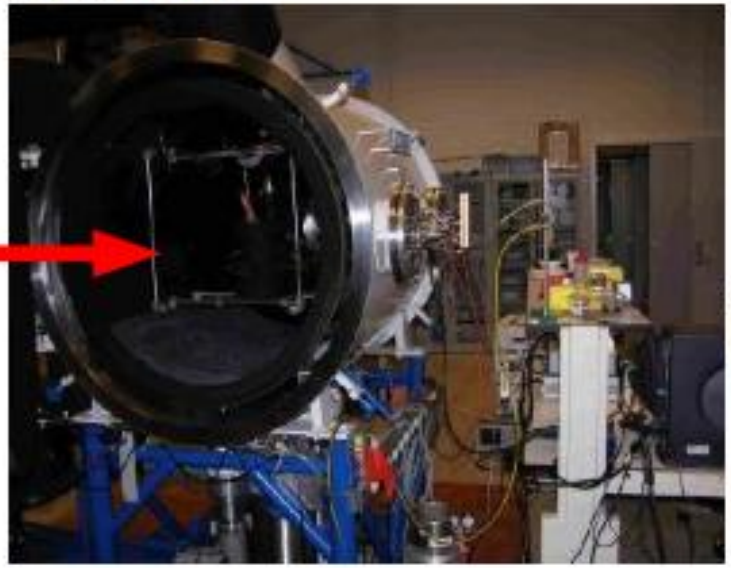
(b)

Figure 2.9: (a) The whole assembly, suspended from rods, upside down. (b) A closer view of the PCB assembly. Wires for high voltage feeds are connected on the guard and the cathode. High voltage for the grid is supplied through a connection on the PCB.

Meeting the challenge

Experiments in vacuum cryo-chamber

- Dutch National Laboratory for Aerospace
- Gridpix operational at least down to -73°C in Ar/iC_4H_{10} 90/10 mixture and -50°C in pure Ar gas
- Master thesis of M. van Dijk
- Abort tests due to vacuum breakdown



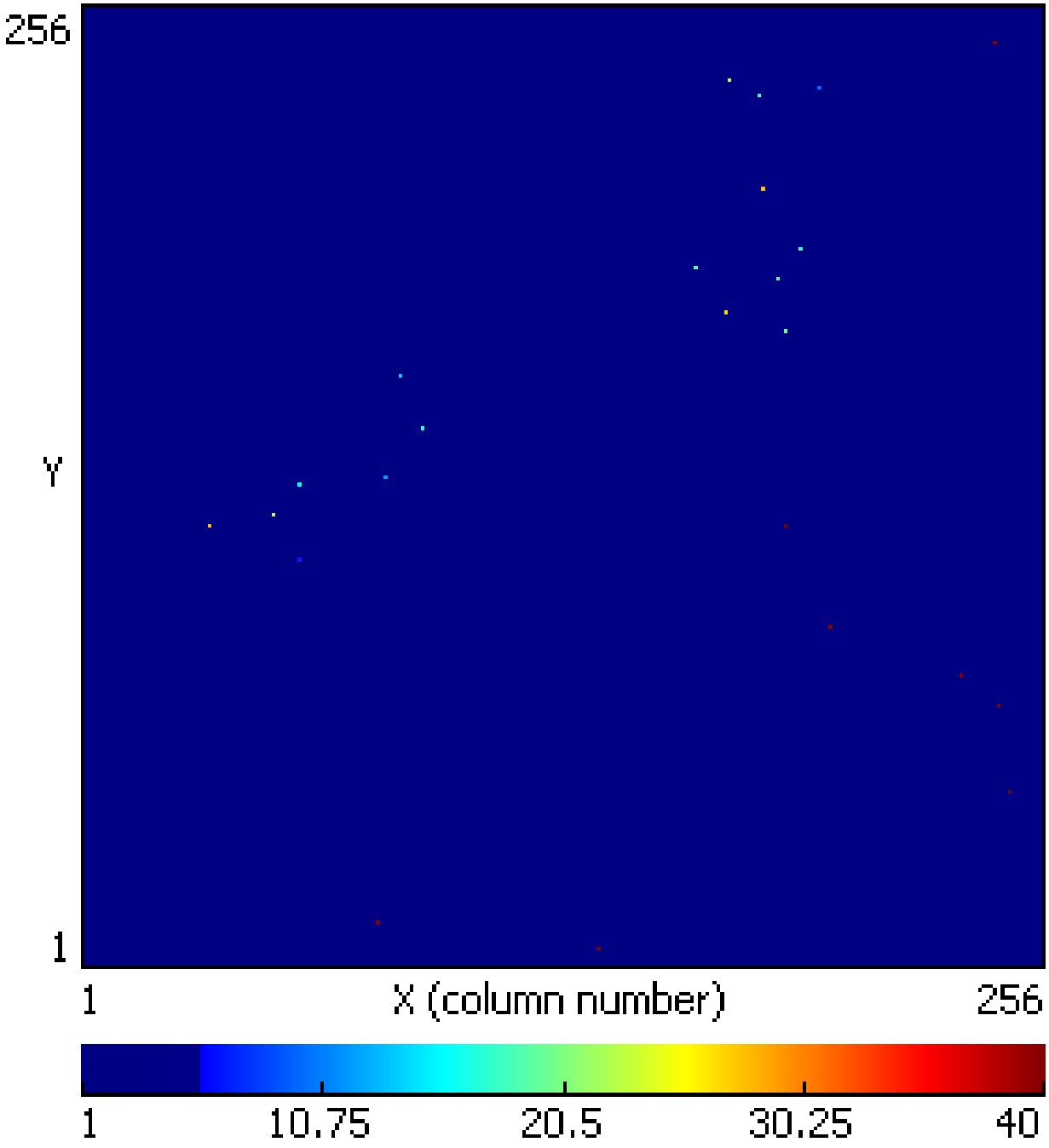
M. van Dijk

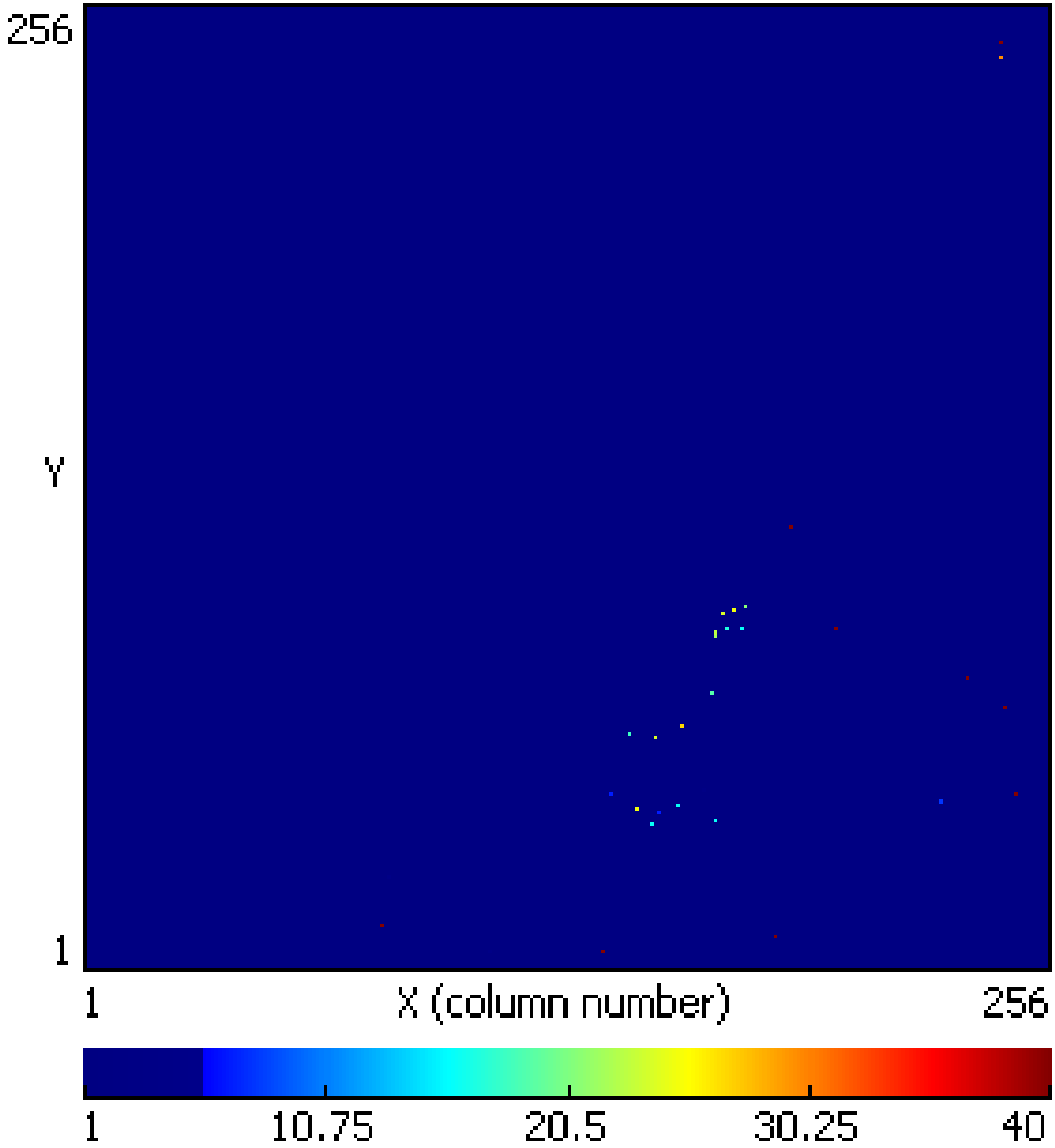
(a) (b)

Figure 2.11: (a) The exterior of the NLR cryostat at NLR. (b) The interior of the NLR cryostat at NLR.

55Fe in pure argon,
HVgrid = 350 V
P = 1 bar
T = -70 C
at NLR cryostat

gain: ~ 200 !

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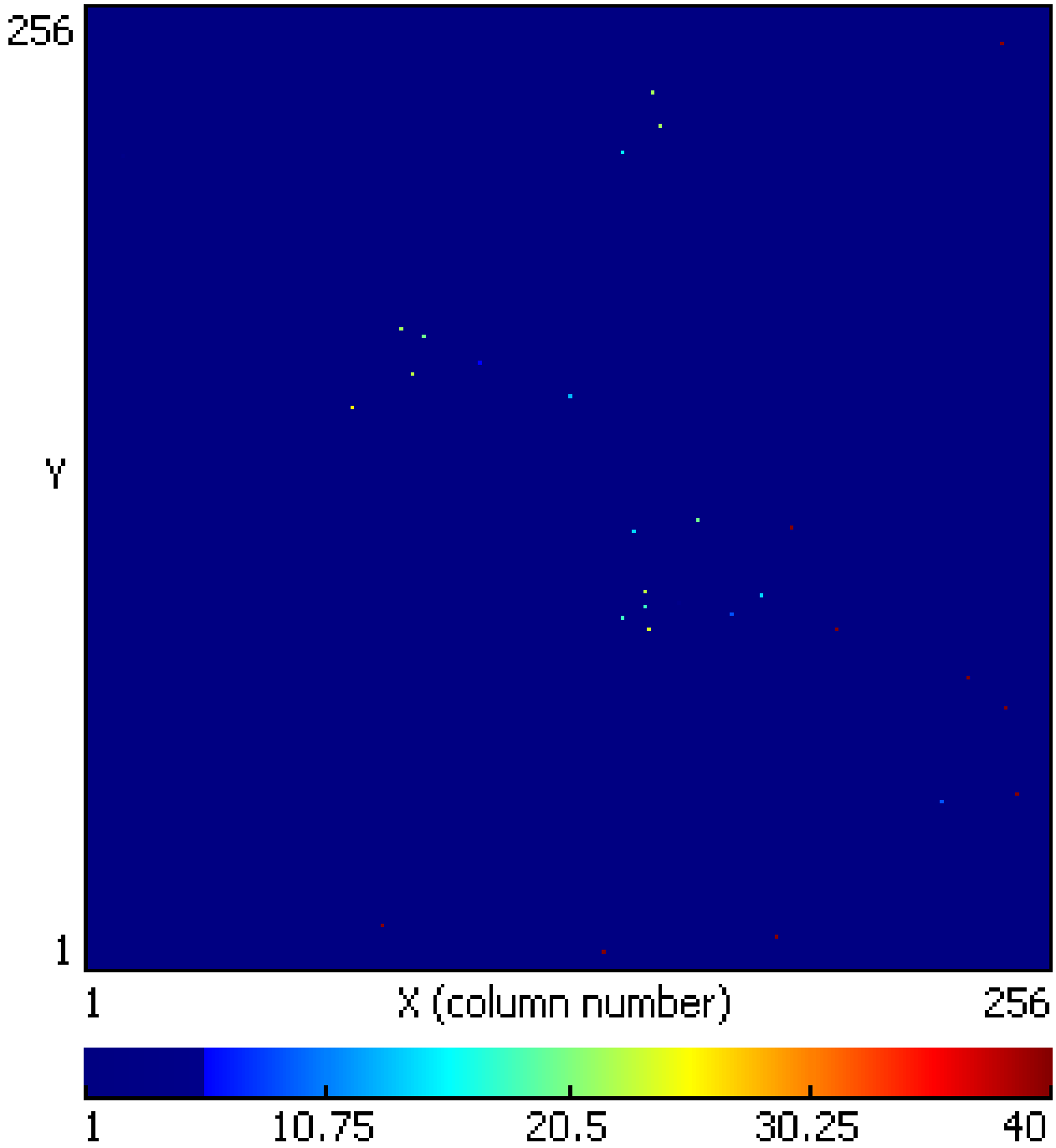
Y
1
1
X (column number)
256
1
10.75
20.5
30.25
40


256
Y
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X (column number)
256
1
10.75
20.5
30.25
40

- TimePix chip: proved to work at – 100 C
    - confirmed – 83 C in our work
    - Would TimePix work at -160 C (LAr temperature?)

- Gas gain in pure Ar, pure Xe: measured G = ~ 200. Purity?

- Special pixel chip (TPX-?) may have noise < 20 e-

- Discharge stability: influence protection layer? UV photon propagation?

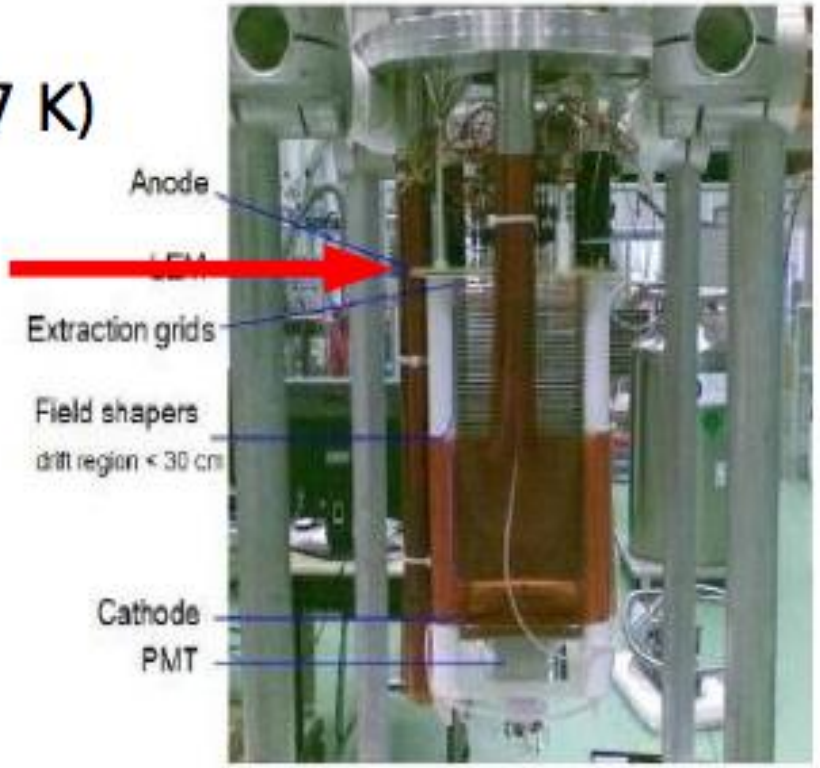
- Required HV: 350 V. Steep gain/HV relation. Pure Ar proportinal wire tube: 600 V!

- Max reachable gain (@NTP) with Micromegas versus single GEM

Upcoming work

New collaboration with Rubbia group at CERN

- Use LAr test cyrostat of the ArDM experiment to reach temperatures T = -186°C (87 K)
- Construct support structure for Gridpix detector to be mounted inside the cryostat
- Preliminary tests to check suitability of detector's electronical components



ArDM collaboration

Expanding GridPix?

- Photoelectric effect
- Future possibility:

  CsI layer on grid