# NEWS from the TPC

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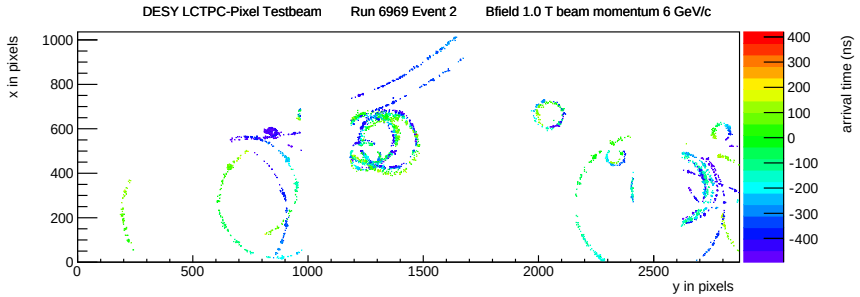
Prepared for the TC meeting and updated

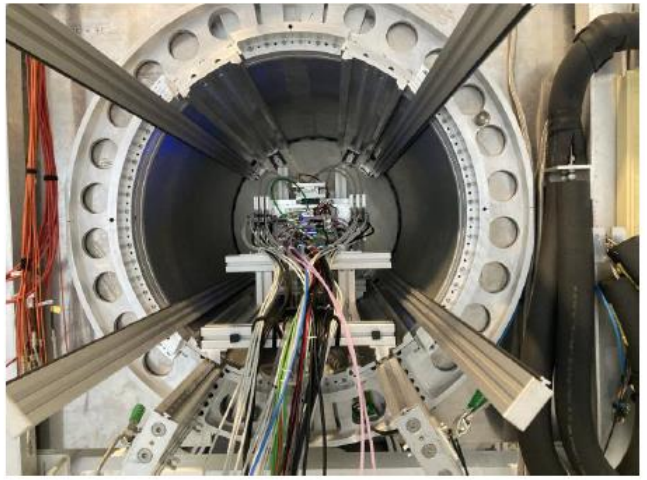
**Where we are** :

Almost 2 decades of R&D carried out by institutions in Asia, the Americas and Europe:
- all options for the gas-amplification technology tested:
GEM, MicroMegas with resistive anode and GridPix were selected,
- the best drift gas was selected.
- CMOS pixel readout technology demonstrated and being developed
- dE/dx resolution confirmed
- design of a gating device successful and usability demonstrated (but needs to be engineered)

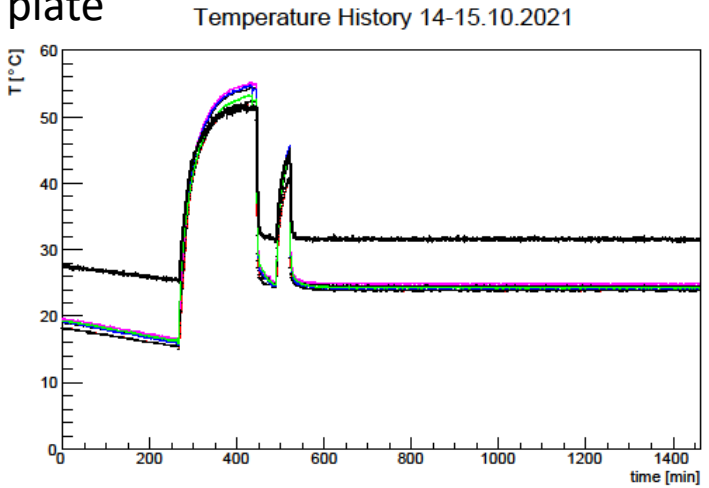
## TPC activities since June 2021:

- Bonn-Nikhef beam test of a GridPix 8-quad module in DESY in June with a silicon telescope

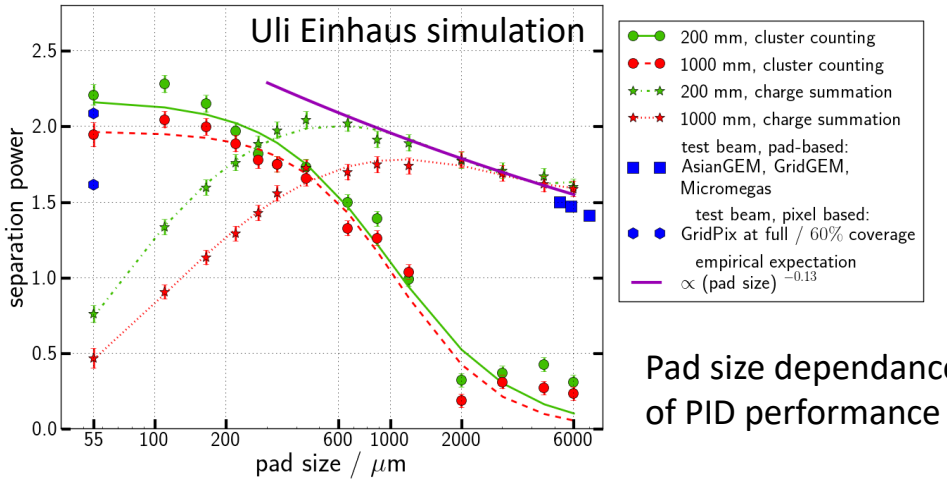


Saclay successful 2-phase CO2 cooling test of a Micromegas module at DESY mid-October with a 3D-printed cooling plate




Preparation of a new stripped foil for the Large-Prototype field cage (DESY, CERN)




Pad size dependance of PID performance

Presentations in conferences and various meetings:


ILCX in October :

- Yumi Aoki : Study of spatial resolution in the time direction for ILC-TPC (followed by discussions in LCTPC on shaping impact on the z resolution)
- Paul Colas : Test of a 3D-printed cooling plate for a TPC using 2-phase CO2
- Peter Kluit : Towards a Pixel TPC

CEPC meeting in November

- Peter Kluit 'Pixel TPC technology'
- Huirong Qi

Snowmass white paper (Alain Bellerive)

2021 IEEE NSS MIC RTSD conference in October
Maxim Titov, Huirong Qi
2022 February: Vienna instrumentation Conference. Jochen Kaminski

LCTPC speaker's bureau re-activated (chair : Maxim Titov)

3 theses defended :

- Uli Einhaus (DESY) on «High Granularity dE/dx PID from Hardware to Physics »
- Kees Ligtenberg (Nikhef) on pixel TPC
- Paul Malek (DESY) on GEM TPC analysis
- Yumi Aoki (KEK) on z resolution and gating GEM (March 2022)

Collaboration meeting 3 half days in January 2022 by zoom. Topics : R&D, Common module in view of Technology choice (not discussed), strategy -> enlarge scope beyond ILC.

**Difficulties to face** :
Front-end electronics development. Low-consumption and/or power pulsing, ‘real estate’ improvement needed.
NIKHEF situation is difficult: 1 PhD student has finished and management decided to end gaseous (TPC) R&D. The detectors, DAQ and setup were moved to Bonn and the laser setup to Nijmegen.

In general it is difficult to have ILC R&D recognized and funded. Attempts to find synergies with T2K/ND280 upgrade, Alice upgrade, CEPC, EIC (But ATHENA project turned down)

**Solutions coming :**
Two presentations on electronics in the LCTPC collaboration meeting (Beijing Saclay Sao Polo) :
WASA in Tshinghua, SALSA, 65 nm (following SAMPA, 130 nm) in Saclay - São Paulo
Geovane Grossi Araujo da Souza (São Paulo and Prag) presented a new hybrid card with the SAMPA chip at RD51 in February.

# Strategy issues

ILD presently discussing strategy for the future.

Given that the ILC in Japan - which was so far the main option – will be, at least, delayed, it looks reasonable to consider other options : FCC, CEPC, CLIC 380 GeV.

Main differences with ILC are :

- The beam time stucture does no allow power pulsing -> strong constraint on electronics.
- For the circular colliders, at the Z the (irreducible) primary ionization is already too large to avoid track distortion from space charge.

If one is to propose to adapt the TPC design to other colliders, one has to make the following studies for each of them:

- Study the machine background (with a B=2T field for circular colliders)
- Perform R&D for ion backflow suppression (still, the primary ionization at Z is limiting)

An important ingredient in the final choices will be the sustainability (maximize plug-to-beam efficiency), low-consumption electronics for the detector. ILC has assets there.