IRFU Saclay plans for the HK project

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for the Saclay T2K team

EU-HyperK
CERN
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Outline
- The Saclay group
- Saclay contribution to T2K
- Envisaged contribution to HK

The T2K group

- Alain Delbart – Denis Calvet
- Sara Bolognesi
- Sandrine Emery
- Edoardo Mazzucato
- Georges Vasseur
- Marco Zito
- + a new PhD student (fall 2014)

SEDI

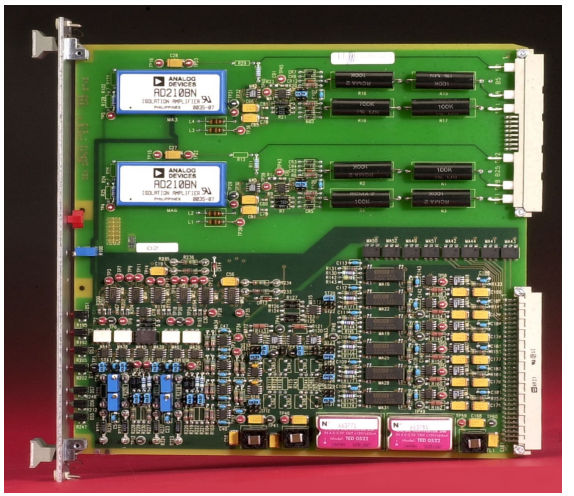
SPP

Saclay contribution to T2K

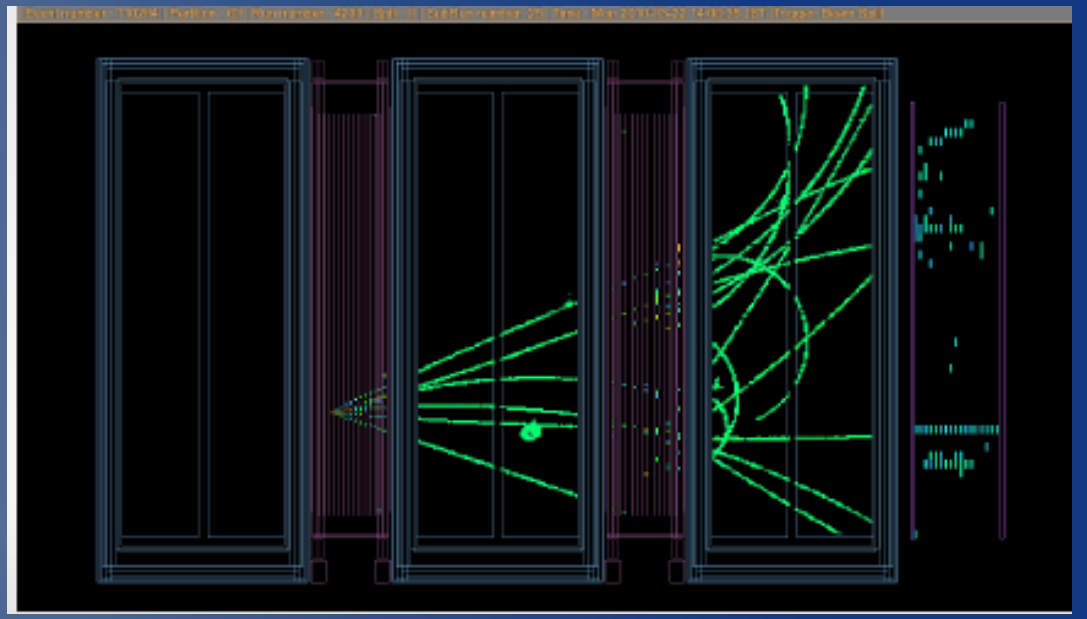
- Quench protection system for beam line magnets
- ND280 TPC design
- TPC Micromegas (72 modules, ~9m²)
- TPC Front end electronics (120 k channels)
- TPC simulation and reconstruction
- Analysis of near detector neutrino interactions

Magnet Safety System

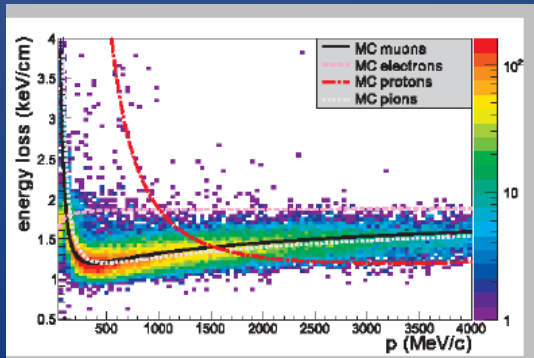
- Magnet Safety System: protection of the 34 superconducting Magnets of the T2K beam line
- Quench detection
- Realised by: Irfu/SIS



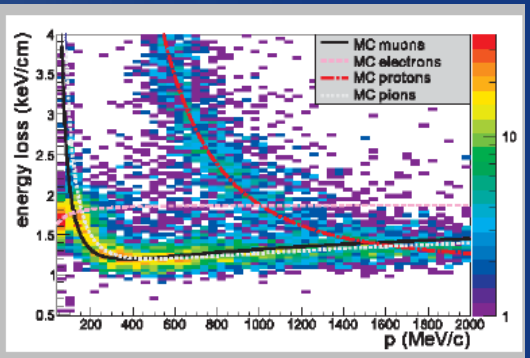
T2K: the first large Micromegas TPC



Three large TPC built for the T2K near detector
First large TPC with MPGD
~9m**2 instrumented with MicroMegas
Saclay built also full FE electronics
A key detector for the study of neutrino oscillations

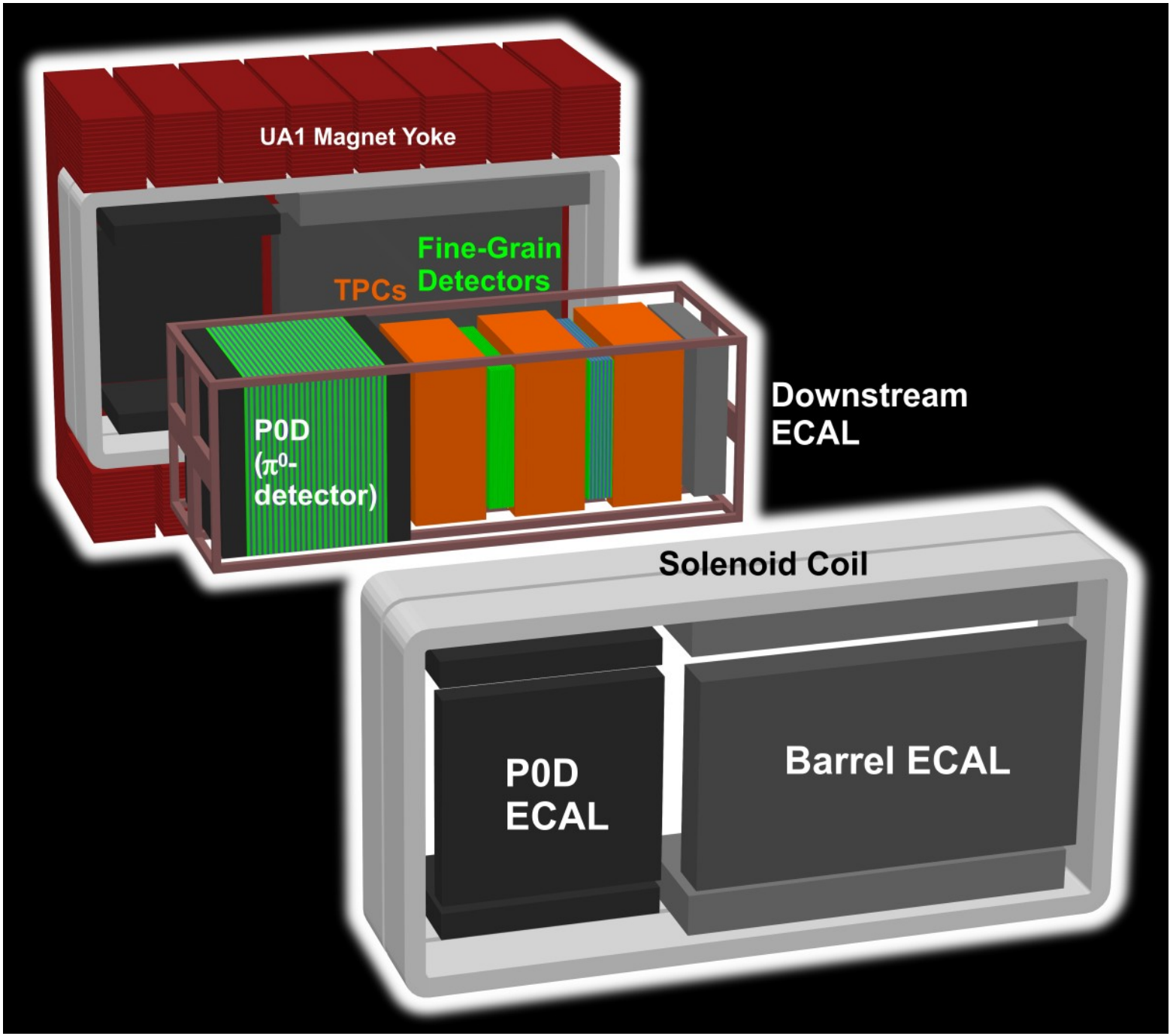


Negative tracks: μ^-, e^-

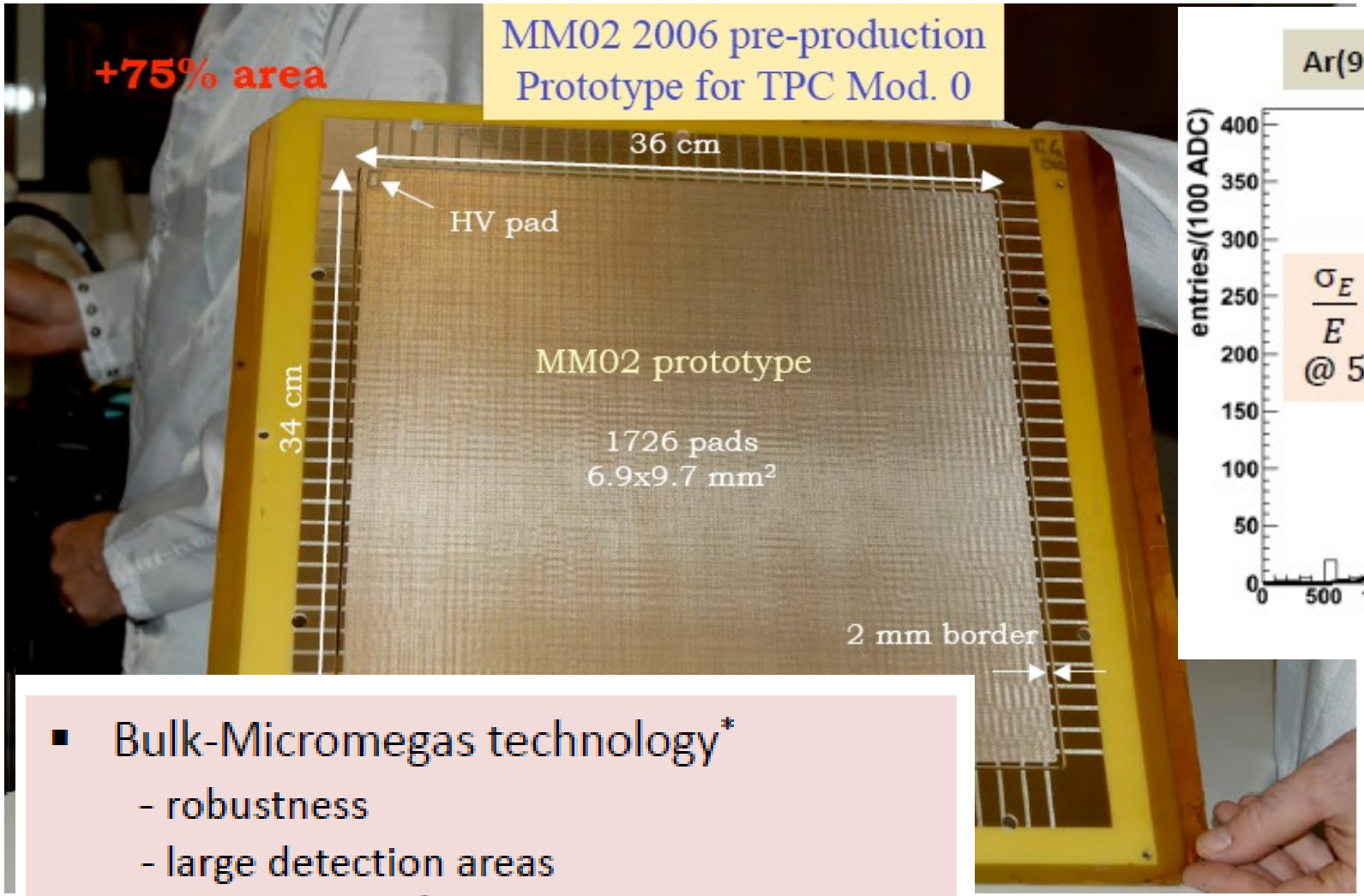


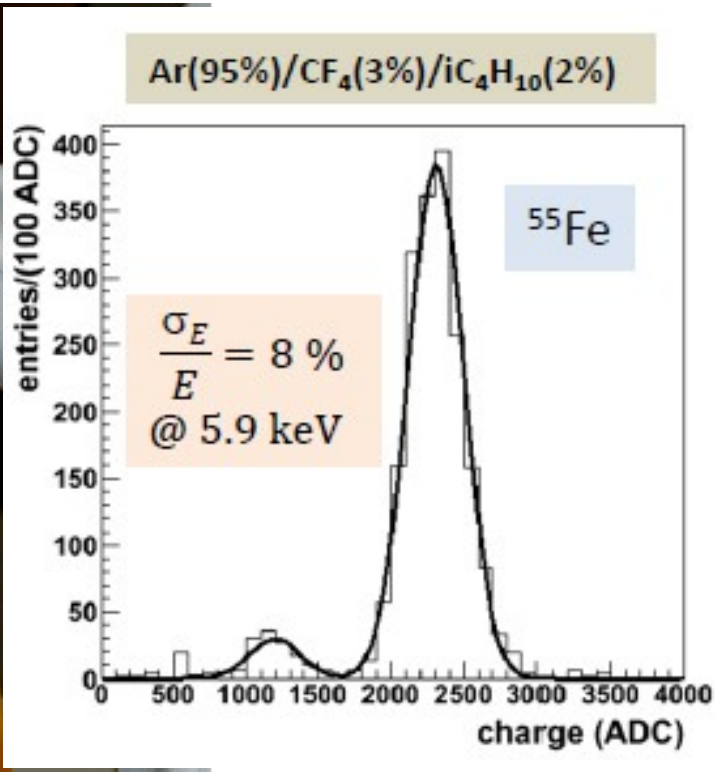
Positive tracks: p, π^+, e^+

The T2K near detector



The T2K Micromegas





- Bulk-Micromegas technology*
  - robustness
  - large detection areas

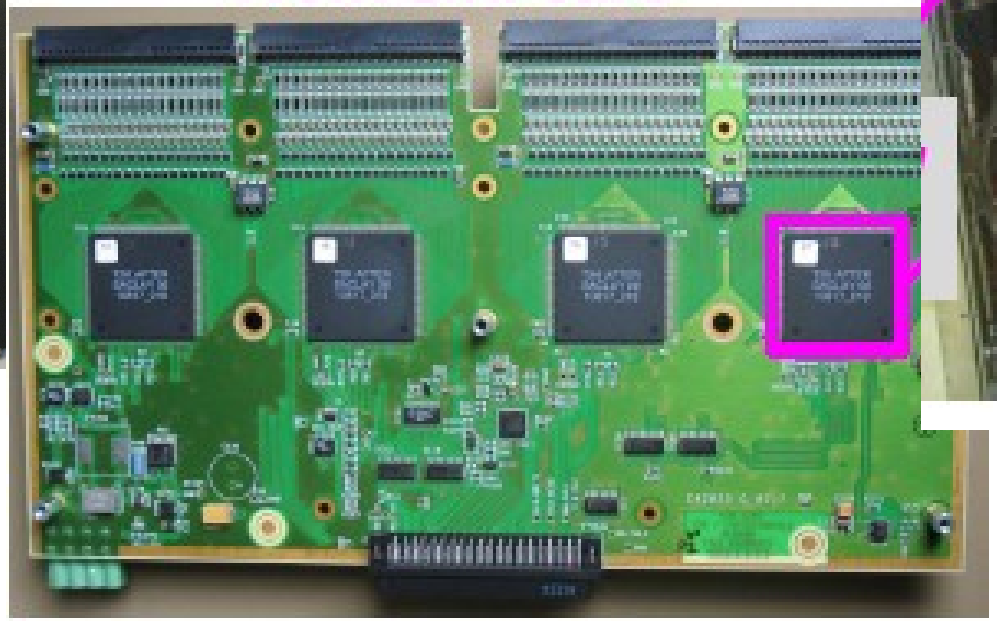
Nucl. Instr. Meth., A560, 405 (2006)

- 128 µm amplification gap
- 1726 active pads (~7 mm²) / module
- 72 modules (36 × 35 cm²) for 3 TPCS

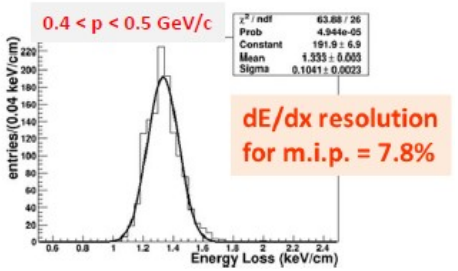
The TPC front-end electronics

- 124,416 electronic channels for 3 TPCs
- Front End Electronics (FEE) based on asic AFTER:
  - 72 channels × 511 analog memory cells (SCA)
  - programmable gain : 120 - 600 fC,
  - peaking time : 0.1 - 2 µs (200 ns)
  - sampling frequency up to 100MHz (25 MHz)
- 6 Front End Cards (FEC) + 1 Front End Mezzanine (FEM) per module
- FEM : data collection, zero suppression, slow-control …
- Data from 72 modules collected by 18 Data Concentrator Cards (DCC) and sent to DAQ system.

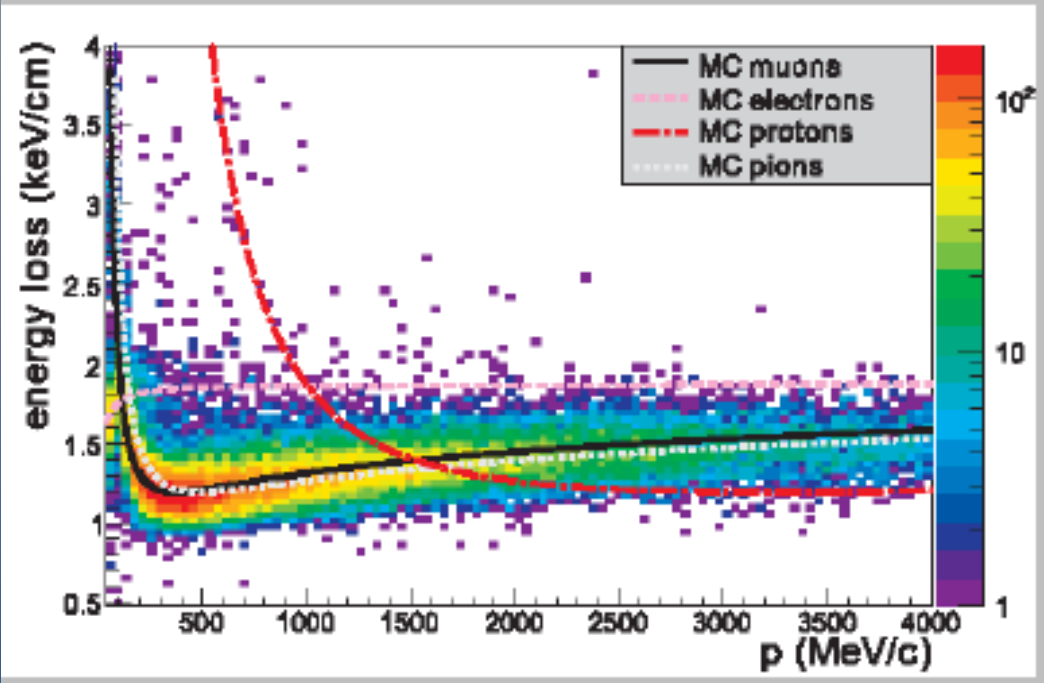
Front End Card



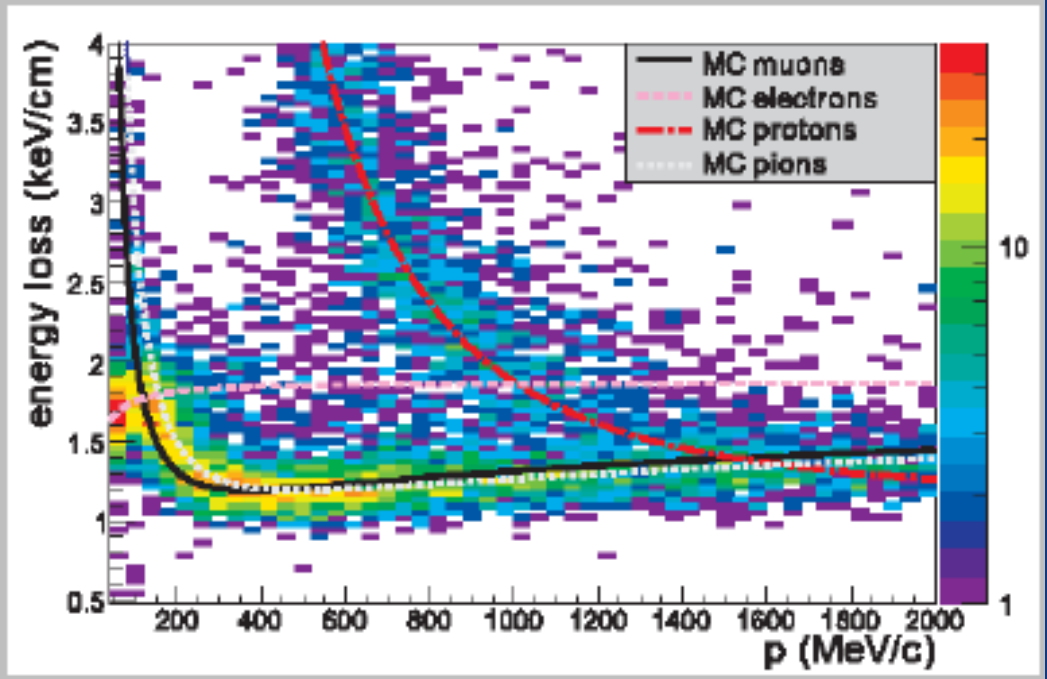
Particle Identification: dE/dx



Through-going muons and neutrino interactions in ND280



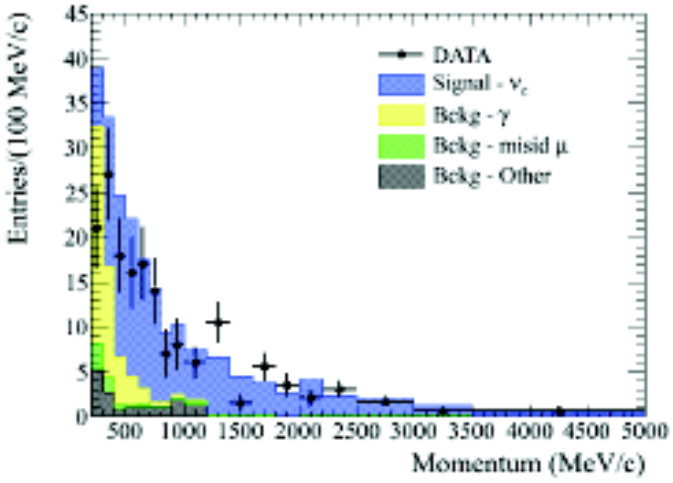
Negative tracks: μ^-, e^-



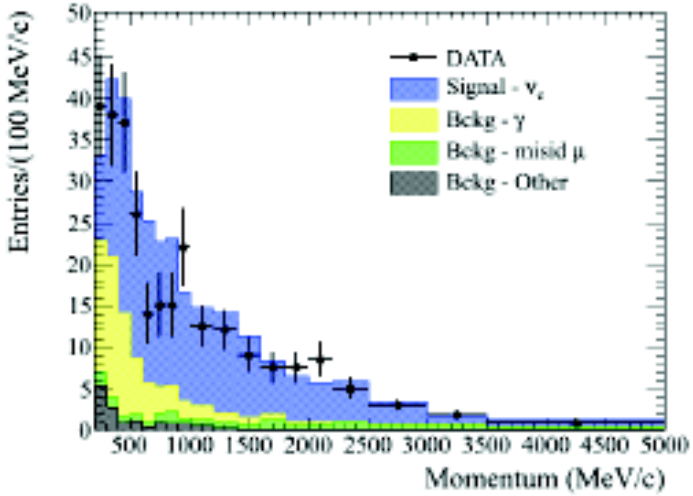
Positive tracks: p, π^+, e^+

Measurement of intrinsic ν_e

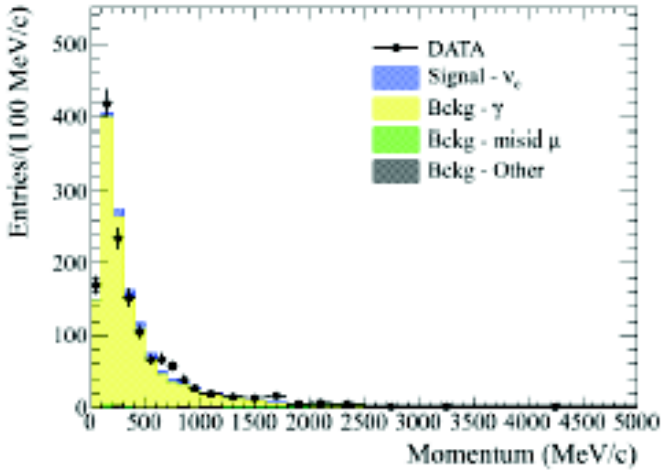
CC0π



CC1π⁺ + CCother



Gamma sideband

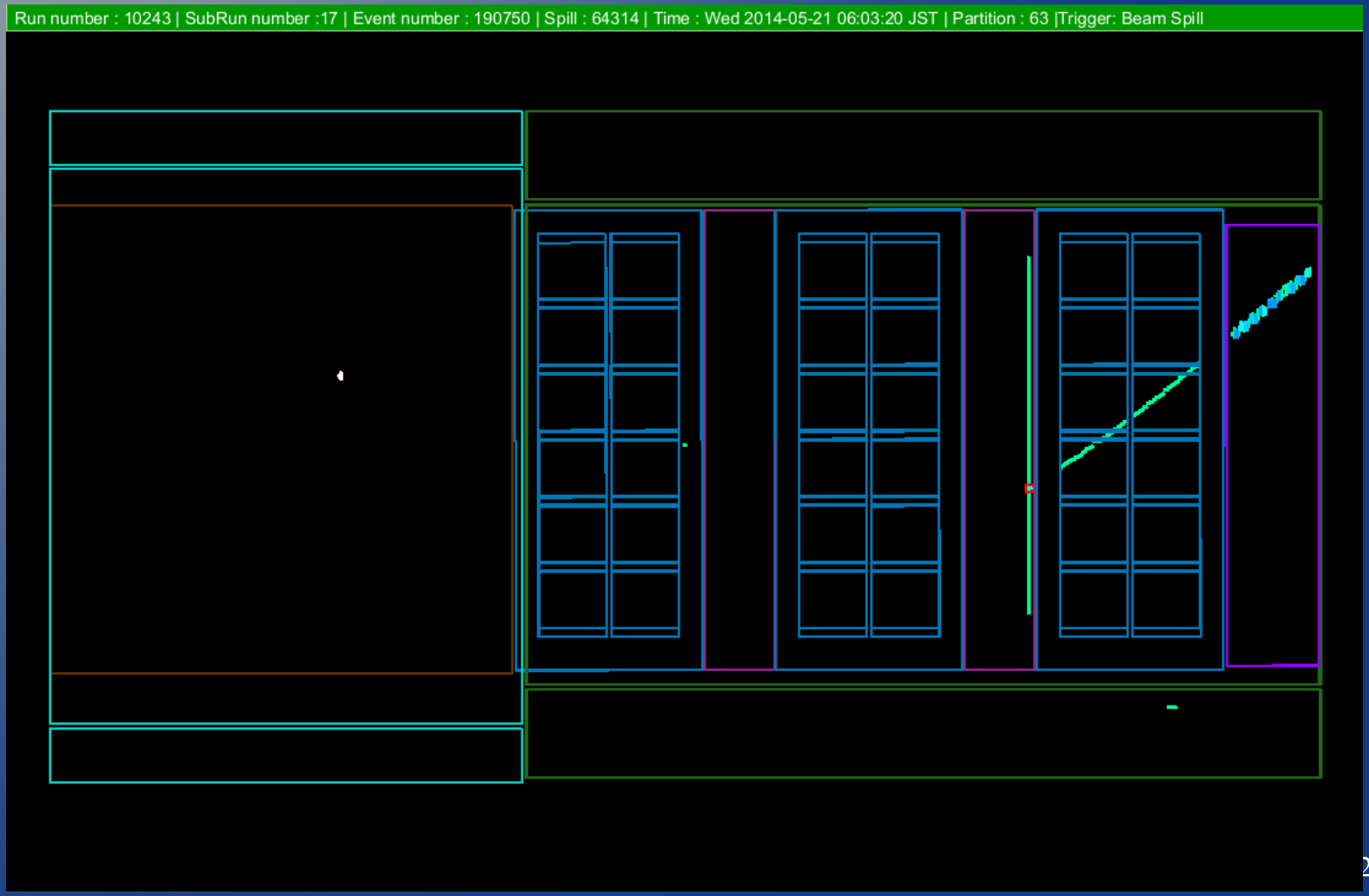


$$\frac{\text{measured } \nu_e \text{ flux}}{\text{predicted } \nu_e \text{ flux}} = 1.06 \pm 0.06(\text{stat}) \pm 0.08(\text{syst})$$

Envisaged contribution to HK

- Possible contribution to the beam line: Saclay has a strong accelerator division. To be further explored in conjunction with the neutrino beam group
- Development of the near detector for HK, especially a new TPC, including using Saclay detector and electronics infrastructures
- Contribution to HK software and analysis

First antinu candidate in T2K ND



Near detector

- The HK near detector will benefit from T2K experience and setup
- The two main paths are an ambitious upgrade (high pressure TPC-see Morgan talk) or a reoptimization of the target-TPC configuration
- The Saclay group plans to contribute to these studies in collaboration with other groups through simulation studies and R&D on MicroPatternGasDetectors