

# Beam monitoring @ CNAO with PEPITES

Presented by M. Vanstalle

---

M. Verderi, C. Thiebaux

M. Donetti, L. Lanzavecchia, A. Mereghetti, M. Pullia, C. Viviani

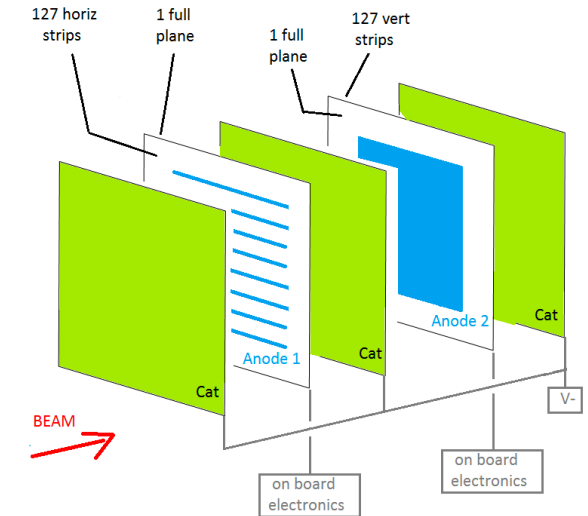


# Current monitoring system @ CNAO

Centro Nazionale di Adroterapia Oncologica

- ▶ Scintillating fibers Harp monitors in the extraction line with different electronics (CCD, photodiodes)
  - \* Radiation damage + electronic obsolescence  $\Rightarrow$  Necessary to change/upgrade the fibers
  - \* For now plan to be replaced with GIM (for Gas intensity Monitor)
- ▶ GIM: Segmented ionizing chamber
  - \* GIM thick in longitudinal direction ( $\sim 6$  mm Water-Equivalent-Thickness)  $\Rightarrow$  highly disturbed the beam
  - \* GIM can only be used during commissioning  $\neq$  during treatment!

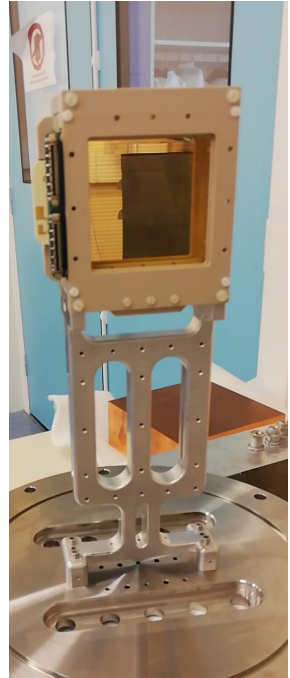
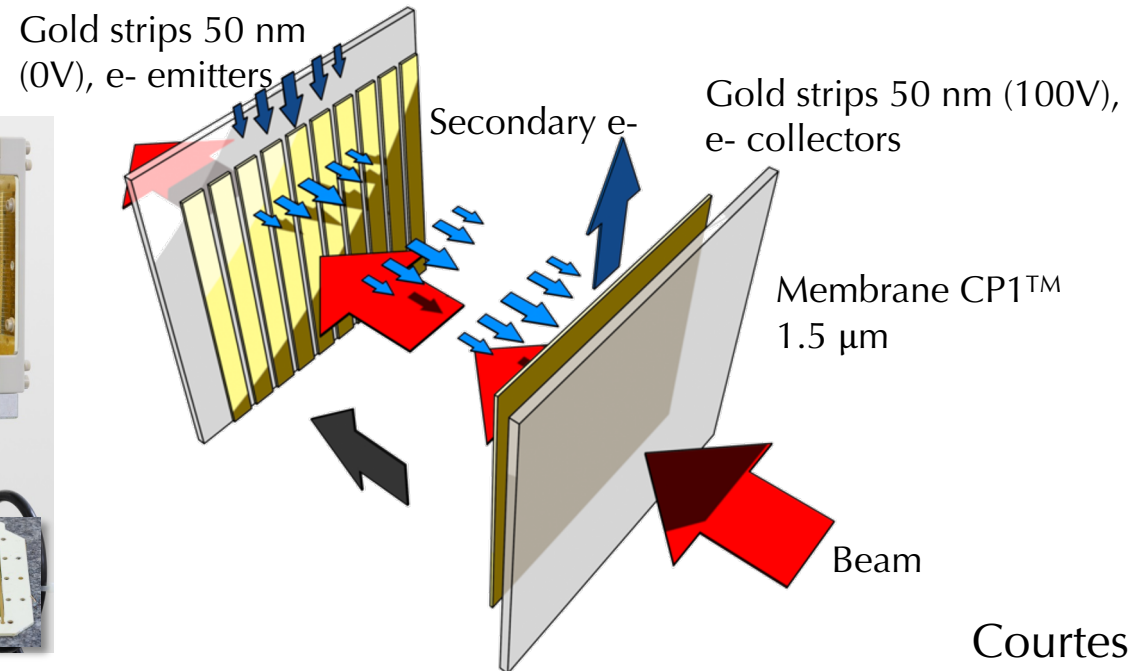
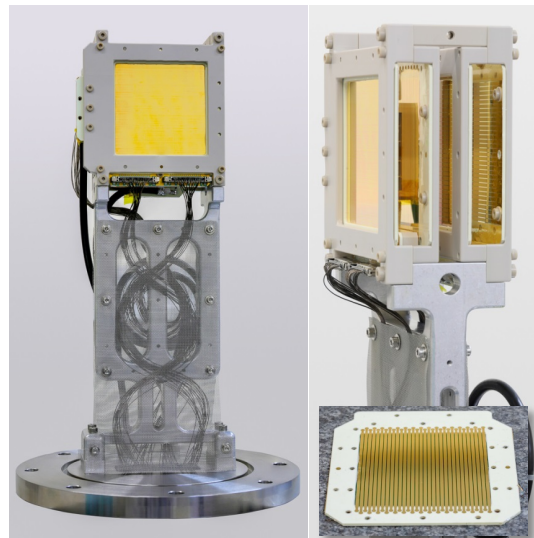
➔ Necessity of beam monitoring system with low WET, radiation resistant, capable of measuring clinical current ( $\sim$  nA) and beam profile



# The PEPITES system

## ▶ PEPITES (Profileur à Electrons secondaires pour Ions Thérapeutiques)

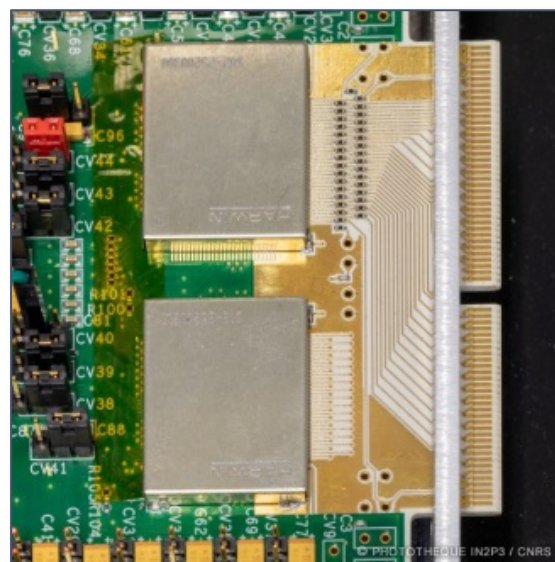
- \* Secondary electrons emitter, thickness <math>< 10 \mu\text{m}</math> WET
- \* Monitoring of charge particle beam, 1 pA-20 nA
- \* Installed on ARRONAX
- \* Good candidate for beam monitoring in **FLASH therapy** (>5 Gy in 100 ms)! ( $2^{\text{dary}}$  electrons extremely linear up to A currents!!)



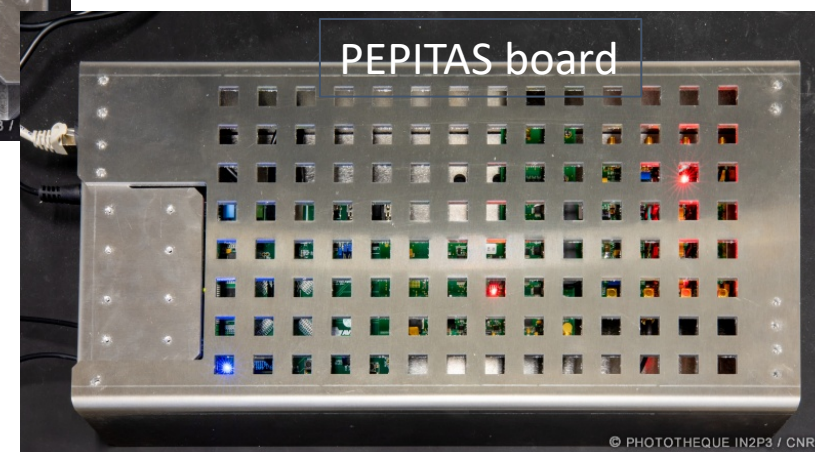
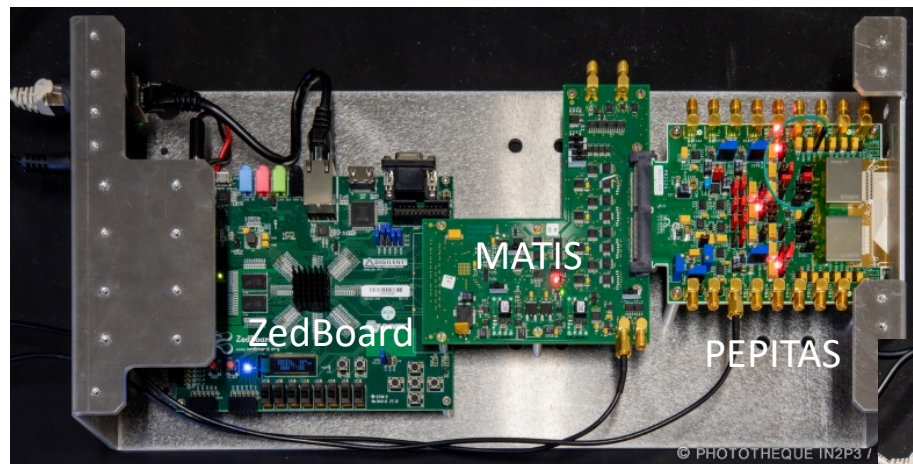
Courtesy of M. Verderi

# The PEPITES system - electronics

- ▶ ASIC PEPITA + board + firmware developed by CEA/DEDIP



ASICS PEPITA



Courtesy of M. Verderi

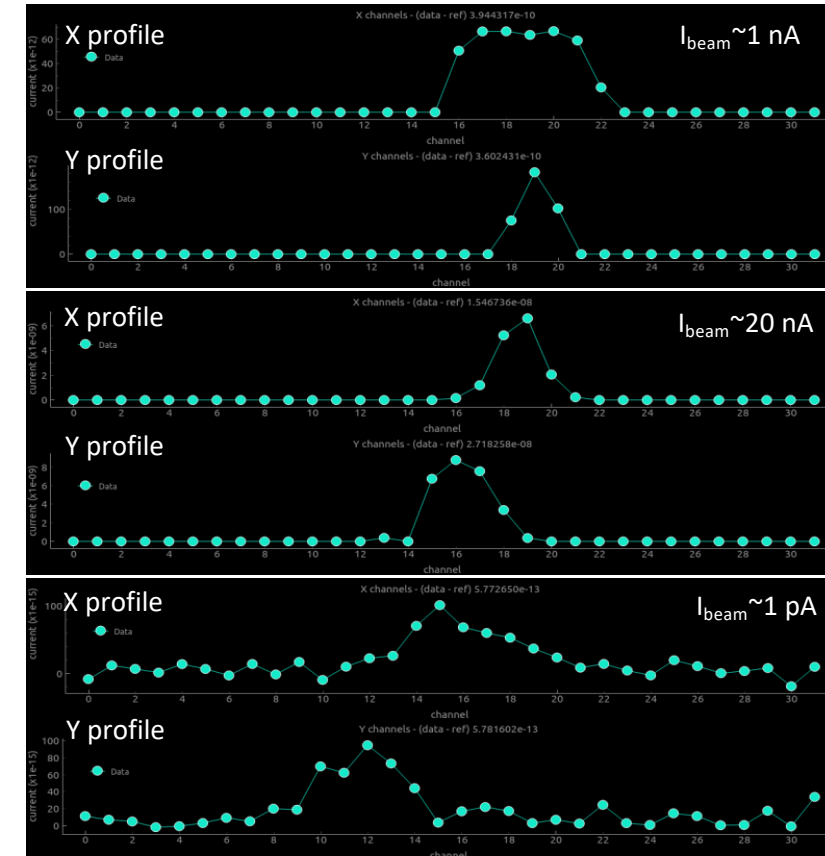
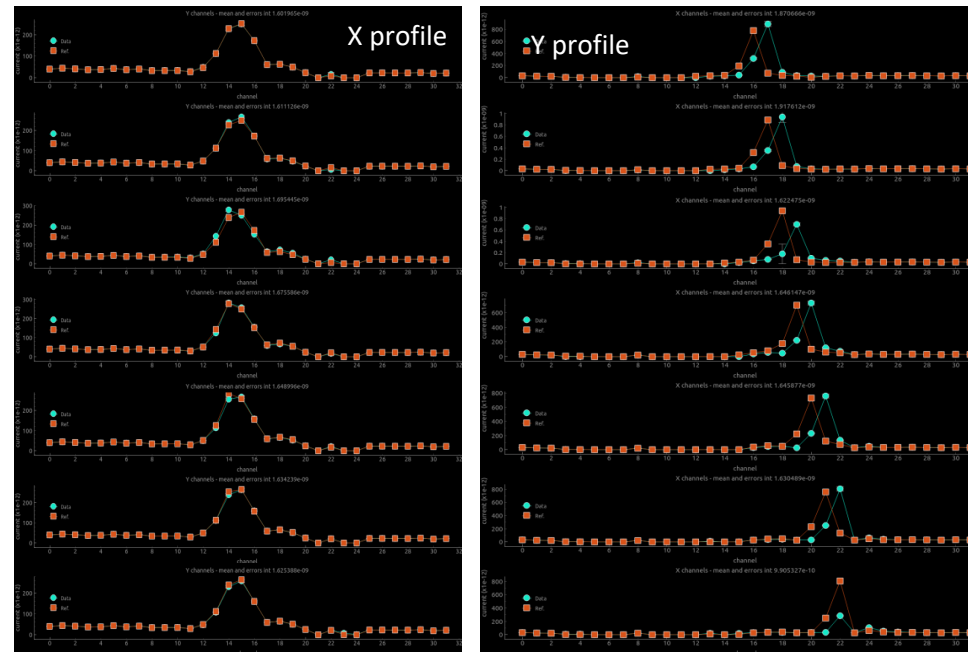


# The PEPITES system – some results on



► Preliminary results on ARRONAX, with 68 MeV proton beams

Y profile scan (step=strip length),  $I_{\text{beam}} \sim 500 \text{ pA}$



NB: @ CNAO

- \* Max p current ~ 2 nA
- \* Max <sup>12</sup>C current ~ 0.4 nA

Courtesy of M. Verderi

- ▶ Collaborative project over PEPITES foreseen over at least 3 years
- ▶ Several beam shifts available during the project
- ▶ First step (end of 2022):
  - \* Test of the “nomad” system in experimental room with p,  $^{12}\text{C}$  with all energies available (60-250 MeV for p, 120-400 MeV/u for  $^{12}\text{C}$ )
  - \* Check if PEPITES does not disturb the beam





## ► Second step (2023):

- \* Design of a system adapted to the beam pipe of the experimental room
- \* Possible evolution: reduction of material budget (if beam too much disturbed on ~ 6m of distance)
- \* Three tasks:
  - ❖ Design (L. Lanzavecchia)
  - ❖ Simulations (A. Mereghetti), in collaboration with in2p3 (?)
  - ❖ Integration in CNAO control system (C. Viviani)

## ► Third step (2024):

- \* Production of the devices and installation in experimental room
- \* Development of the DAQ system

## ► Fourth step (2025): Final test of PEPITES @CNAO

- \* Beam test (M. Donetti)
- \* Data analysis (C. Viviani)
- \* Potential future development or use on clinical beam lines (M. Pullia)



# Thank you for your attention

---

▶ On CNAO side:

\* M. Donetti, L. Lanzavecchia, A. Mereghetti, M. Pullia, C. Viviani



▶ On In2p3 side:

\* M. Verderi, C. Thiebaut

