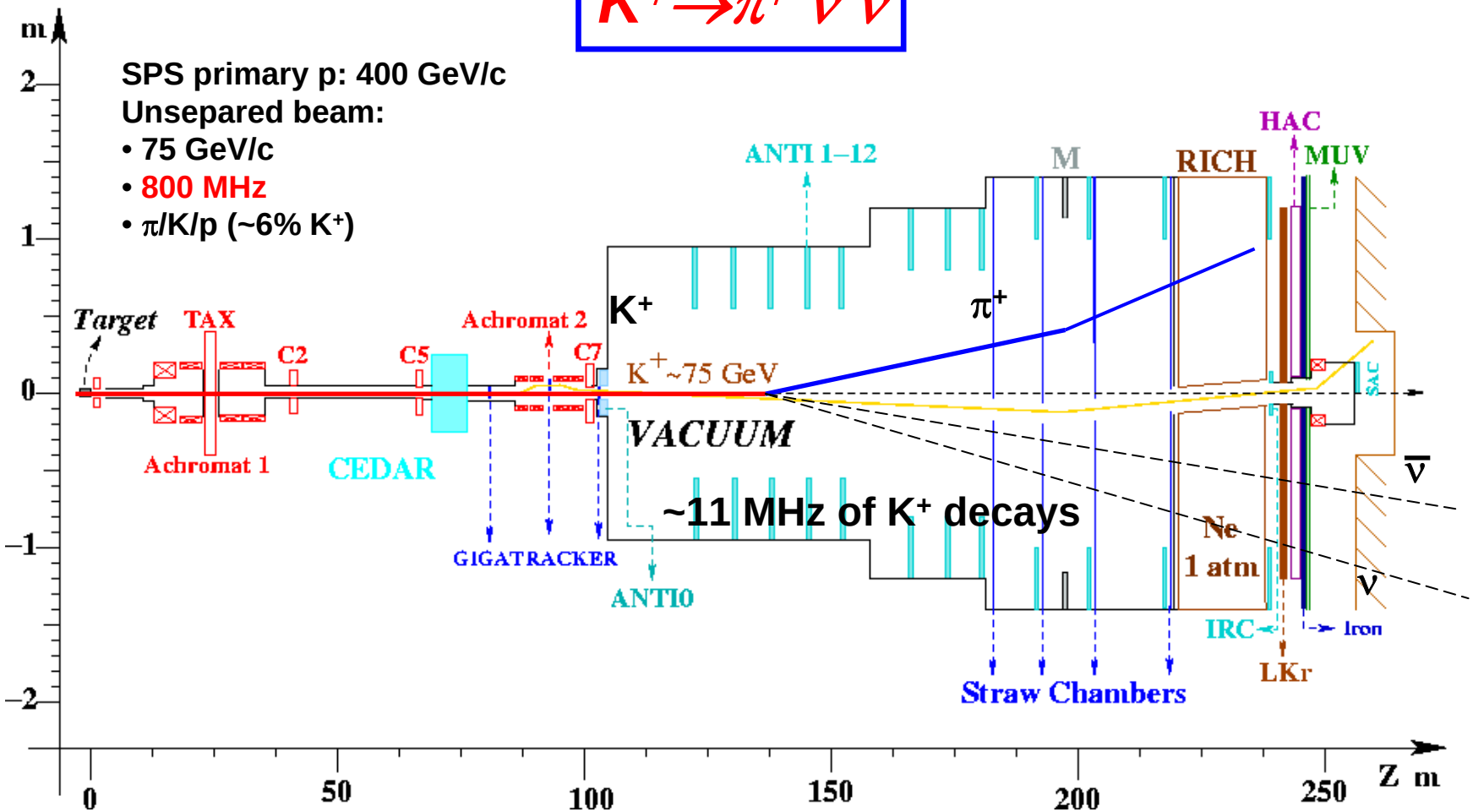
Fermilab Physics Workshop Discussion Session: Next Generation $K^+ \to \pi^+ \nu\nu$ Experiments

P-326 Detector Layout

$$K^+ \rightarrow \pi^+ \nu \bar{\nu}$$

SPS primary p: 400 GeV/c
Unsepared beam:
- 75 GeV/c
- 800 MHz
- π/K/p (~6% K^+)

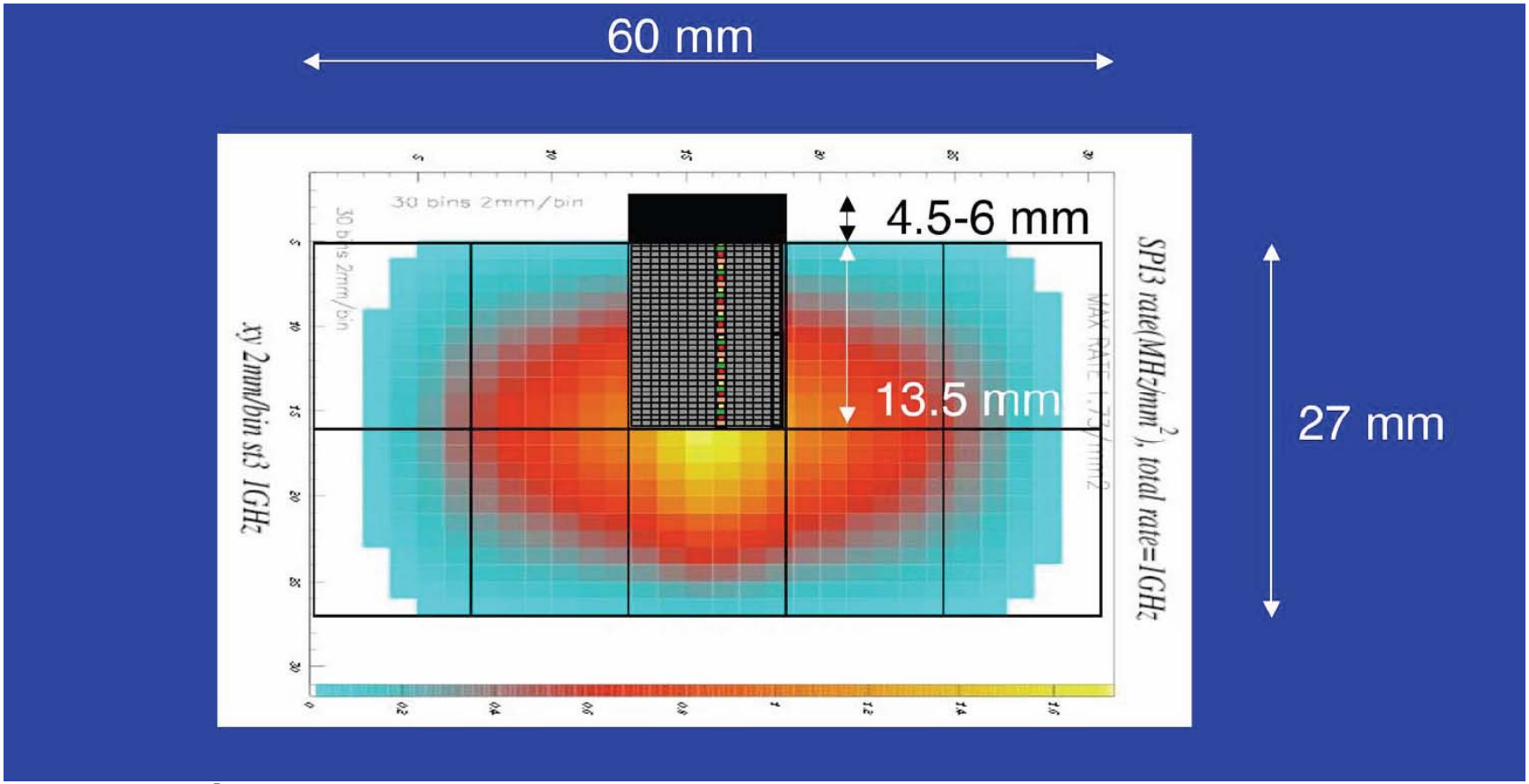


~11 MHz of K^+ decays

Towards O(1000) $K^+ \to \pi^+ \nu \nu$

- <u>Assume</u> that NA62 succeeds to perform full tracking at ~1 GHz rate in an unseparated hadronic beam
- To be competitive the next in-flight experiment should either:
  - Operate at better duty cycles (e.g. 1 instead of 0.3) and higher rate
  - Operate at kaon rates of ~ 1 GHz (separated beam)
- Ultra-light mass, fast tracking is, in my opinion, the main issue to address the class O(1000) in-flight $K^+ \to \pi^+ \nu\nu$ experiments
- Ways to handle higher rates in a continuous beams:
  - Improve time coincidence between pion and kaon to avoid combinatorial backgrounds
  - Improve overall angular resolution for both kaon and beam trackers
  - Evaluate possibility of ultra-light, large-surface micro-pattern gaseous detectors
  - Large area thin solid-state trackers

Gigatracker (Silicon μ–pixel)



Requirements:

Time resolution: 200 ps / station

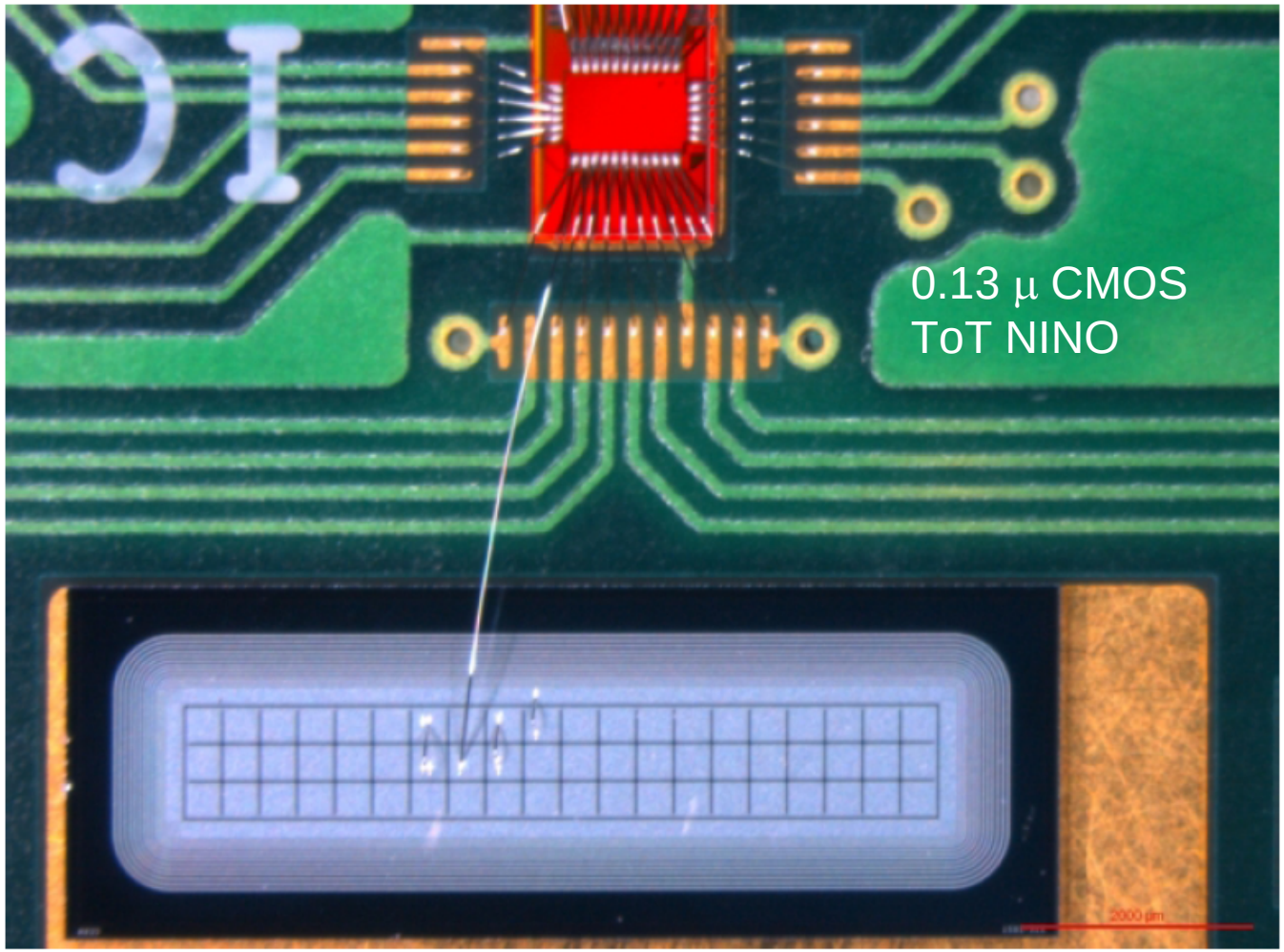
Material Budget: < 0.5 % X_0 / station

Driven by the experience with the thin hybrids of the ALICE SPD

IRST Diode with NINO chip

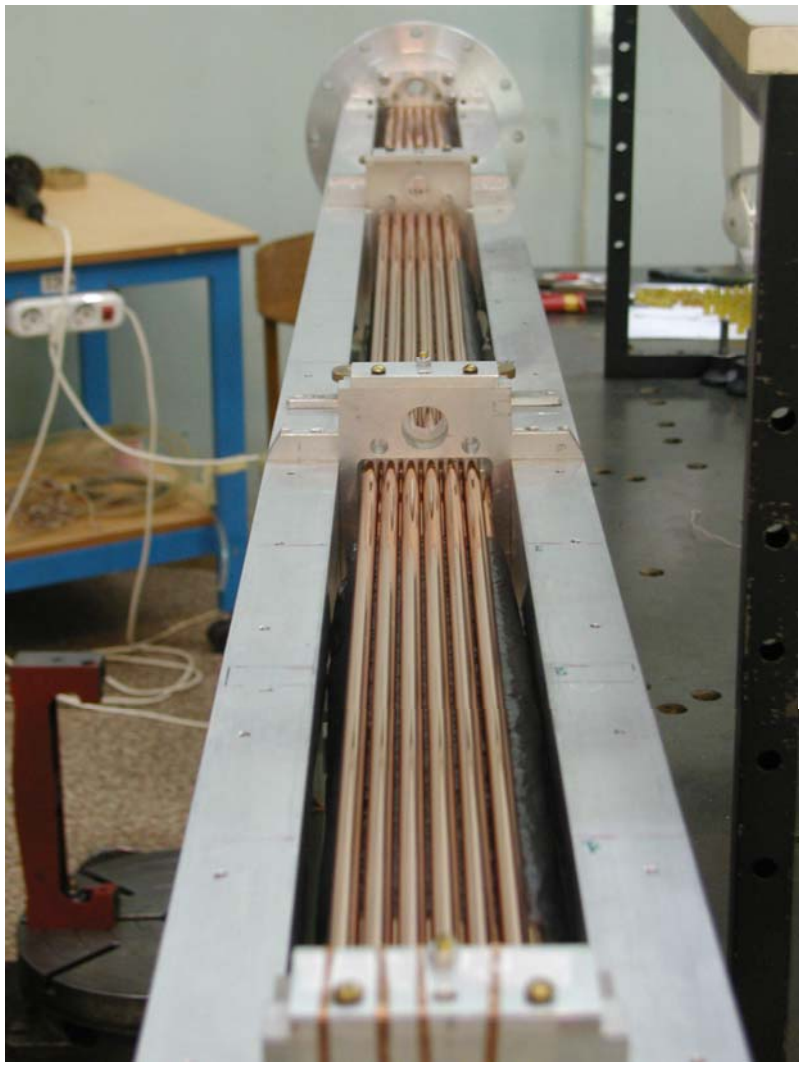
Electrical tests looks promising

Next step:
~8 x 8 matrix
Bump-bonded to R/O chip for Beam Test



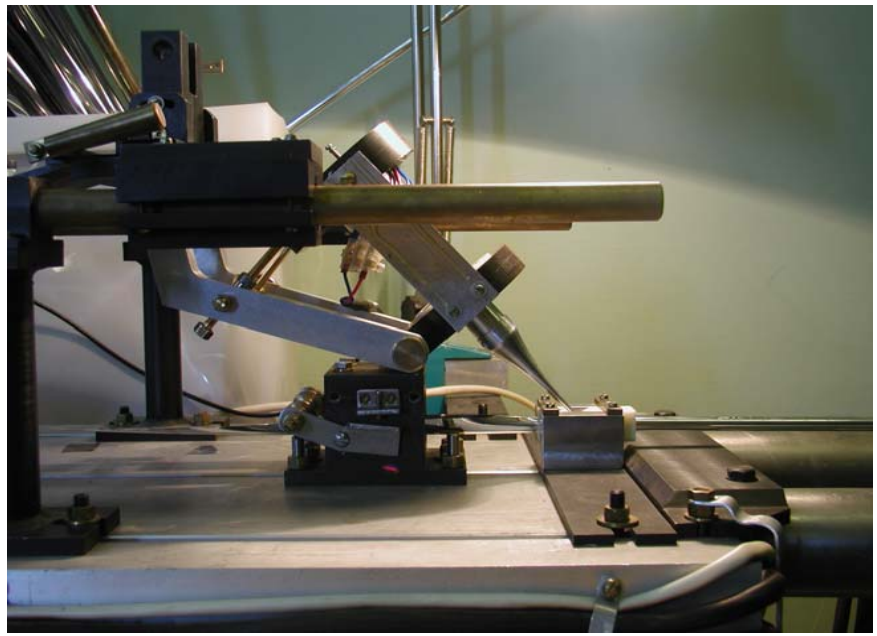
Fadmar Osmić – P326 GTK Meeting, September 10, 2007 -7-

STRAW Prototype

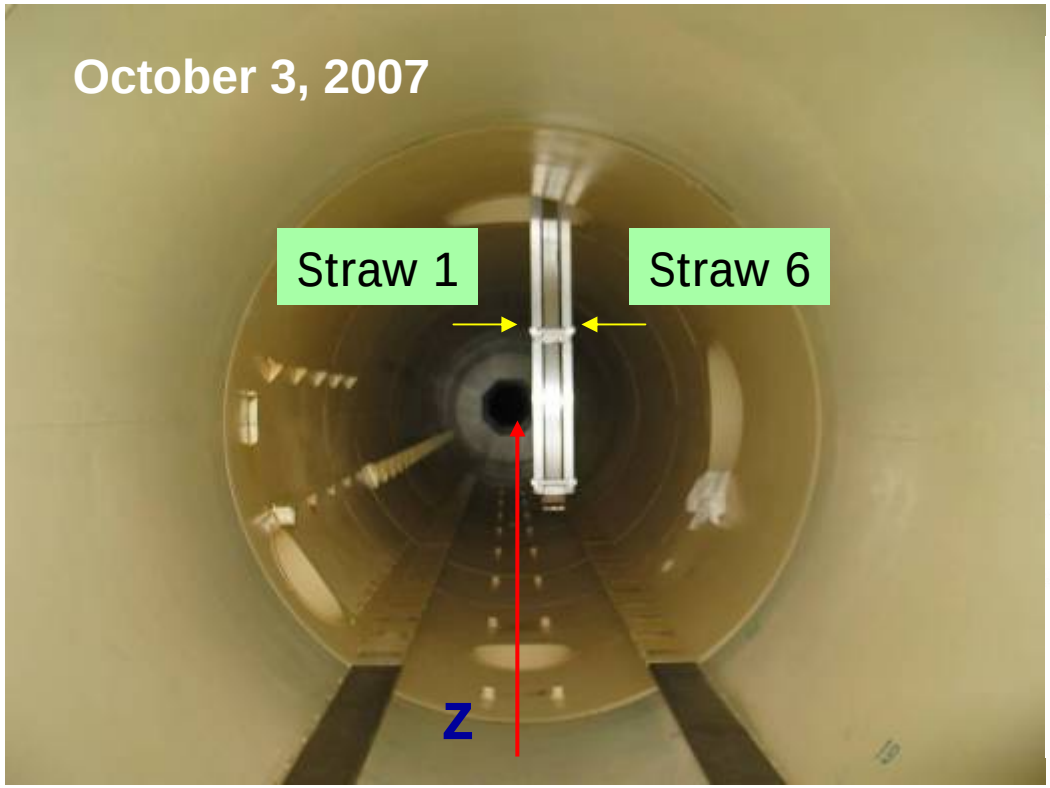


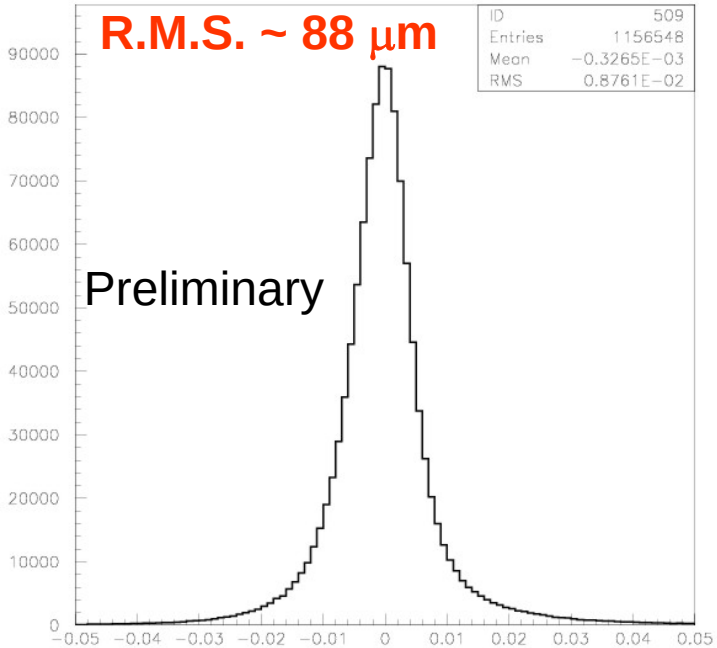
Ultrasound Welded mylar (linear weld, no glue!)

- **36 Al**
- **12 (Cu+Au) mylar straws**



Straw Prototype inside the Vacuum Tube





- **Data were collected with hadron, muon and kaon decays**
- **The test in the actual vacuum tank enables one to address realistic issues**

Other Issues

- **Photon Vetoes**
  - Coverage
  - Speed
  - Resolution (calorimetry)
- **Particle Identification**
  - Material Budget
  - High-rate Photo-detectors
  - Resolution
- **Trigger and DAQ**
  - Flexibility
  - Trigger-less capability
  - Zero suppression or data compression

Synergies to be found

- Development cost for state-of-the-art detectors and electronics are pricing out (Cost/channel) small and medium scale experiments of high physics impact
- Conversely, decade-long lead times between large projects could result on slower progress on R&D for lack of physics experiments where the new technologies could be tested on a shorter time scale