Test-beam results for BeamCal and LumiCal sensor planes

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outline

Several issues :

1. Show the recent upgrade at TAU.
2. Some new results from sensor characterization measurements.
3. Next test beam at CERN.

Tel-Aviv Silicon Lab Upgrade

- In the last year the Tel-Aviv particles detector laboratory underwent an upgrade.

- The silicon / LumiCal part had a major infrastructure upgrade.

- **Full sensor board assembly is now possible at TAU.**

- Room area was doubled on the expense of a student room.

- A clean chamber, based on "tent" in the room with over-pressure, from steady flow.

  - Size 8.5 square meters.
 - ISO class 7 (10k level).

Tel-Aviv Silicon Lab Upgrade

- We deployed the K&S semi-automatic bonding machine, received from DESY.

- Clean room is also containing a work place for sensors, and the probe-station.

- In addition, 2 sensor response stand are in construction.

  - Radioactive sources: Fe55, Sr90, Ru106.

 - Laser source of the order of 1 micron resolution.

Laser test stand.

- Designed for the MIMOSA sensors in-pixel test, and also for LumiCal sensors.

- Based on Nikon modular industrial microscope (could be the wrong choice …).

- 3 wave lengths, 635 (for alignment), 980 and 1064 nm.

- All are fiber coupled laser diode with output power of ~ mW from QPhotonics.

- With ILX LDC-3724C Controller.



Plane for Laser test stand
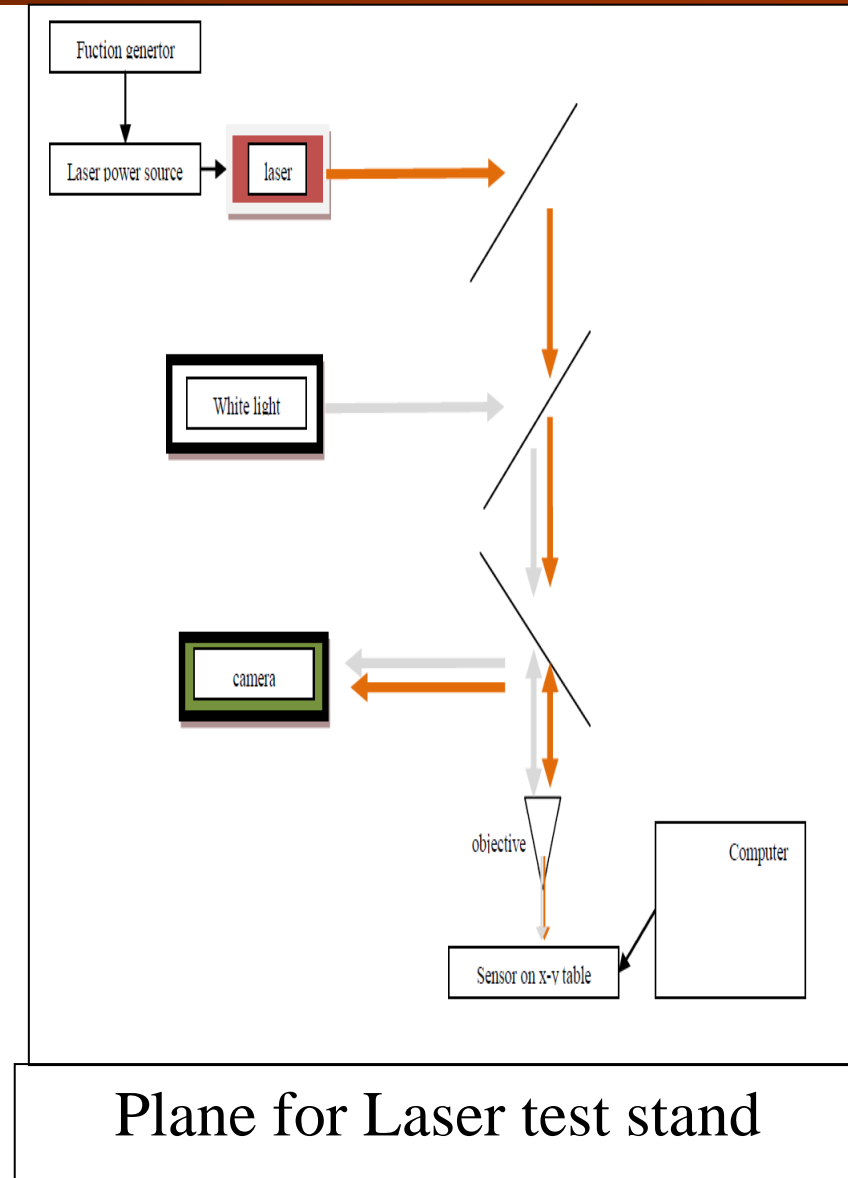
LumiCal sensor prototype

- Each layer has 48 sectors in the azimuth direction, and 64 pads (rings) in the radial one.

- A silicon-sensor prototype was produced by Hamamatsu from 320 μm thick 6" wafer, high resistivity n-type silicon

- The sensor prototype has 4 sectors (30° azimuthally) and 3 guard rings.

- Total of 256 pads.

64 Pads
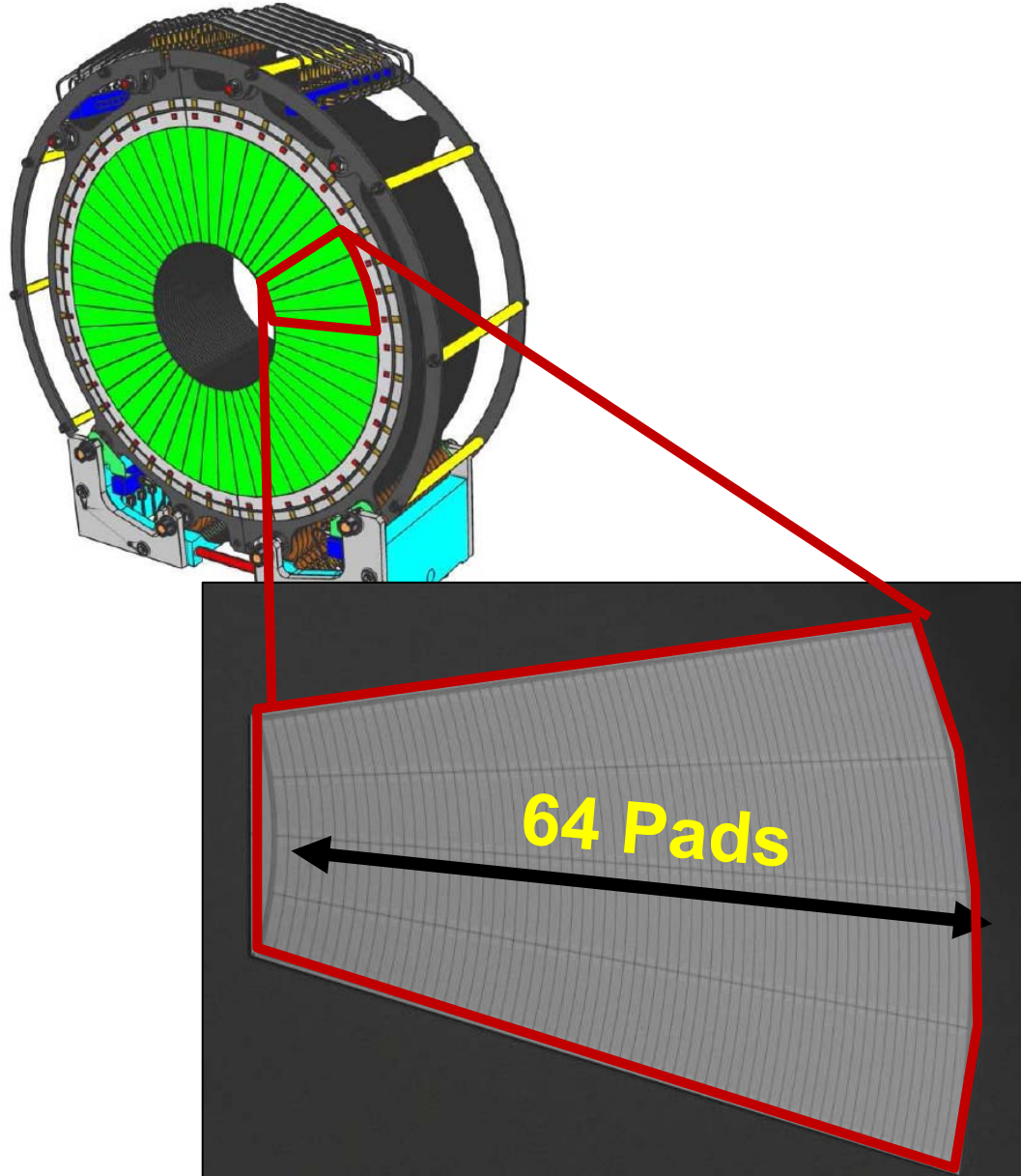
LumiCal sensor characteristics

- During the last year, a new extensive test was started for the LumiCal silicon sensors.

- The test included the current and capacitance as a function of voltage measurements.

- Current measurements have the structure of a reverse diode and a strong dependence on temperature.

- From capacitance measurements the depletion voltage and sensor uniformity can be extracted.

- Since almost 2 sensors were measured, by Sasha and Oron, the behavior of the tail can by seen.
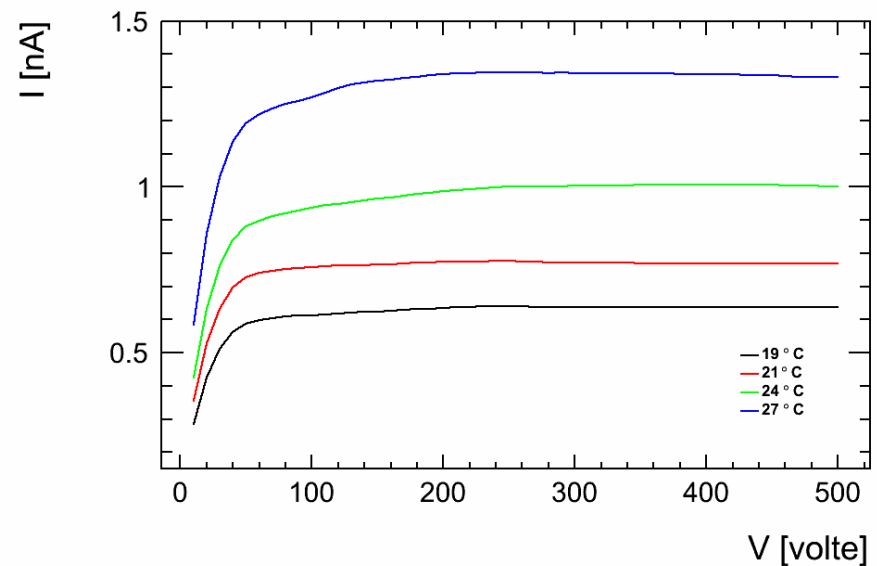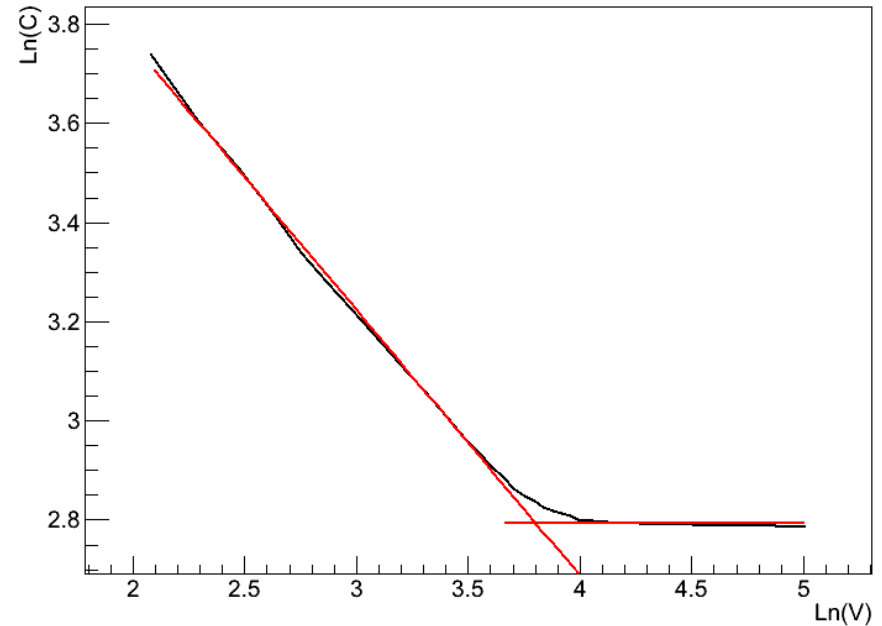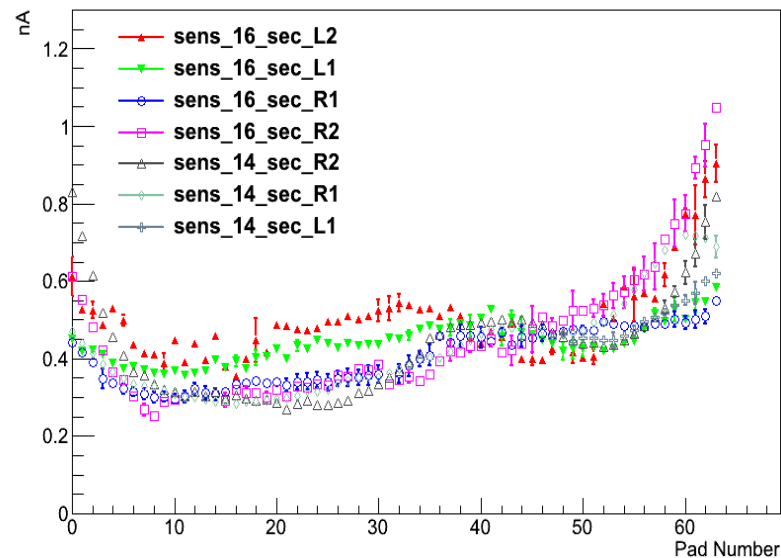
LumiCal sensor characteristics

From the measured characteristics we can extract information on the quality and uniformity of the sensor tile.
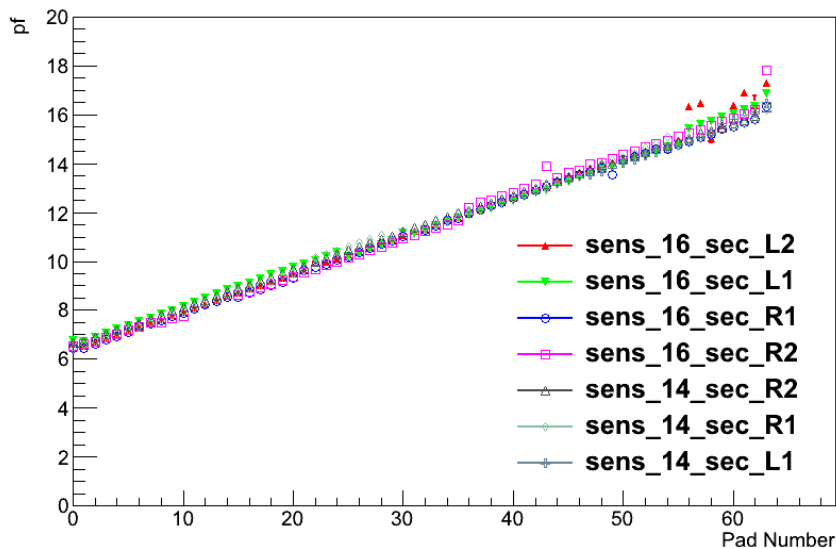The IV measurement displays the height of the dark current.
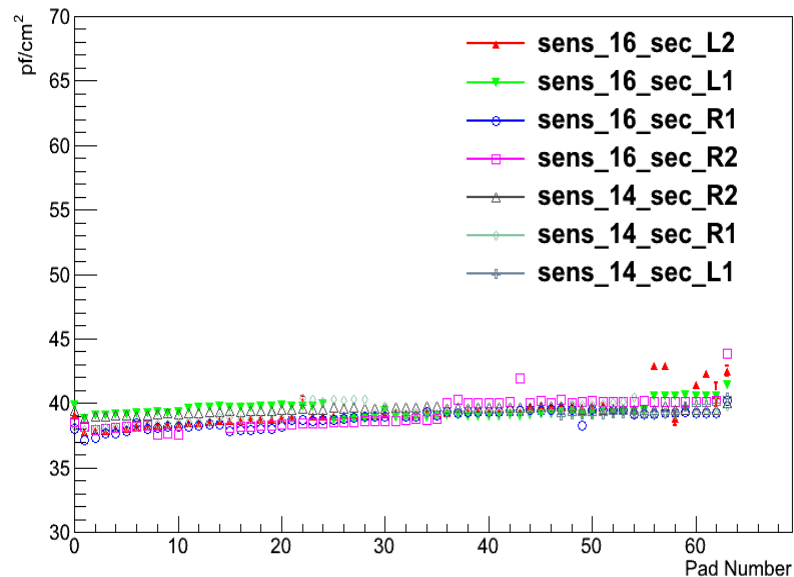And CV measurement indicates on the Geometric capacitance
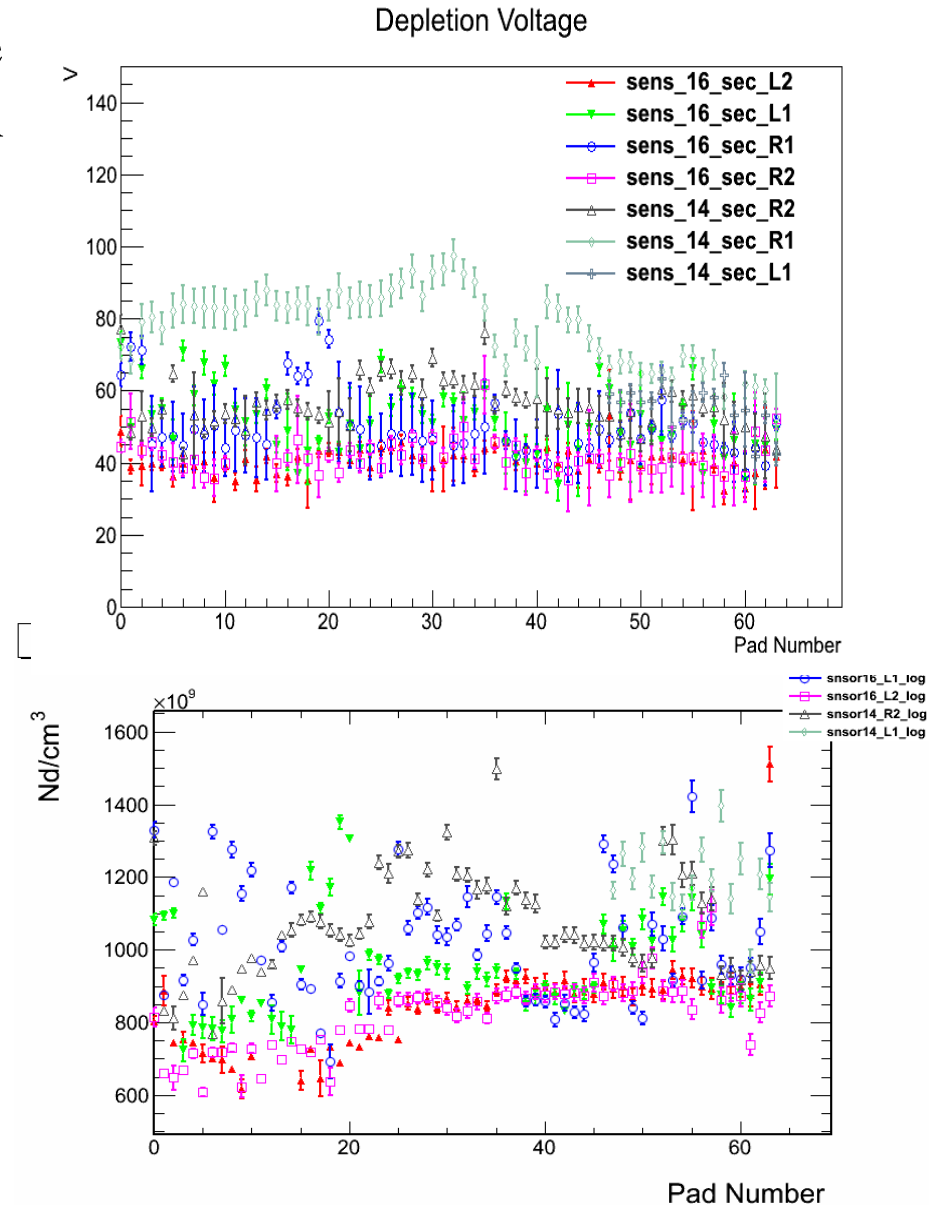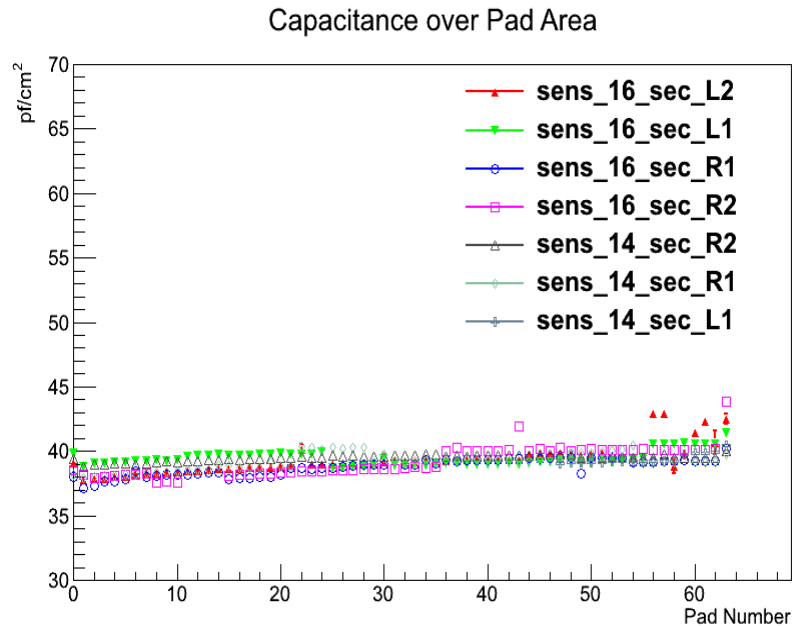

Current

Capacitance

Capacitance over Pad Area

LumiCal

CV measurement allows to extract the depletion voltage and the resistivity in a particular pad.
The result of around 40 pf / cm^2 is equivalent to a depletion layer thickness of the order of 265 μm.
All results are in agreement with earlier measurements.

Depletion Voltage

Capacitance over Pad Area

Next Beam test

- Next beam test will be in beam T9 at the PS accelerator at CERN.

- Test objective is to use the flexible (but rigid) calorimeter structure for measurement of E.M shower development in LumiCal and BeamCal.

- Use the AIDA/EUDAT beam telescope for tracking.

- Mechanical structure need to be placed after telescope.


Beam direction
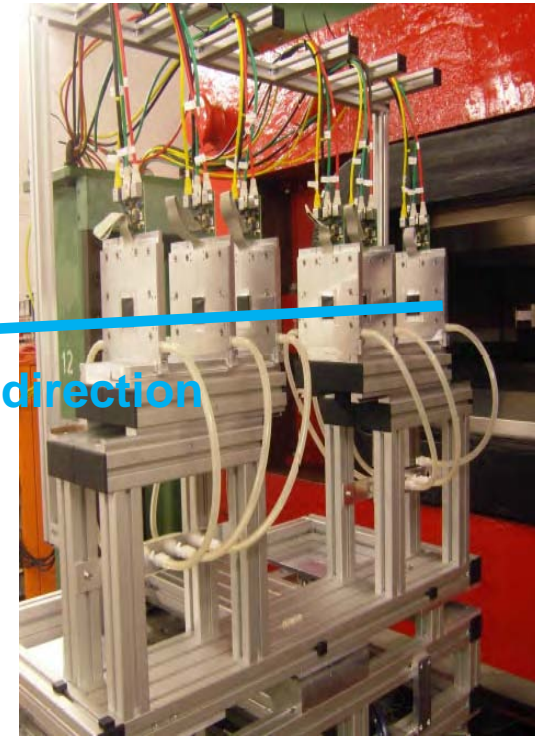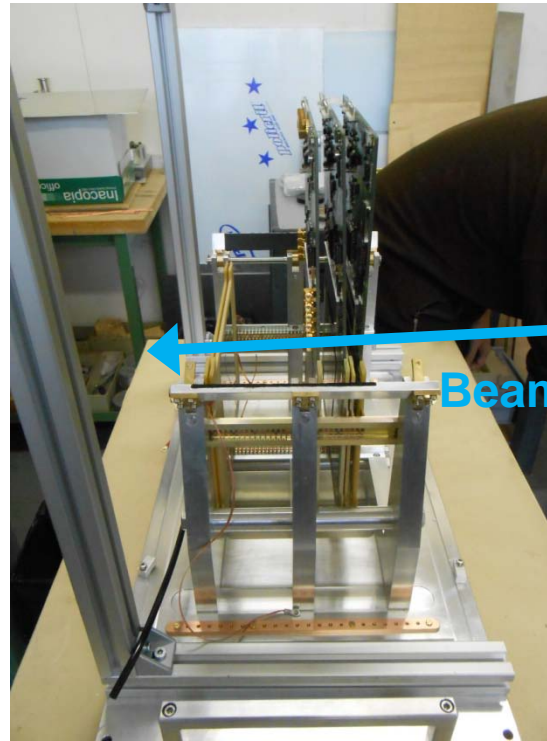
Next Beam test

- T9 is a secondary beam line produced from a 24 GeV/c primary proton beam

- T9 beam momentum range is 0.5 - 15 GeV/c and has a momentum resolution of just over 0.5%.

- Positive or negative particles.

- mixed beam : pions, (anti)-protons, e+ or e- , kaons and muons.

- electrons fraction can be as high as 80% at 0.5 GeV/c but drops to ~5% at 5 GeV/c, for the electron-enriched target.

- Beam is delivered uniformly over a burst of 0.4 seconds (Spill) 1-2 times every 15 sec, with 1-10^6 particle.

- Instruments : Scintillator, Delay Wire Chamber, Cherenkov counter, beam telescope and some more.

Next Beam test

- Expected rate : 100 triggers/minute -

    1 measurement (50k triggers) = 8 hours.

    taking into account only electrons will reduce rate.

- In the energy of 4.5 GeV, peak position is layer 5-7.

- We can use only 4 sensors in different ordering.

- Either a single ordering (2,4,6,8) or we can change the ordering (1,2,3,4 – 4,5,6,7 - 7,8,9,10), difference in statistics.

- Hadrons and muons can be used for alignment.
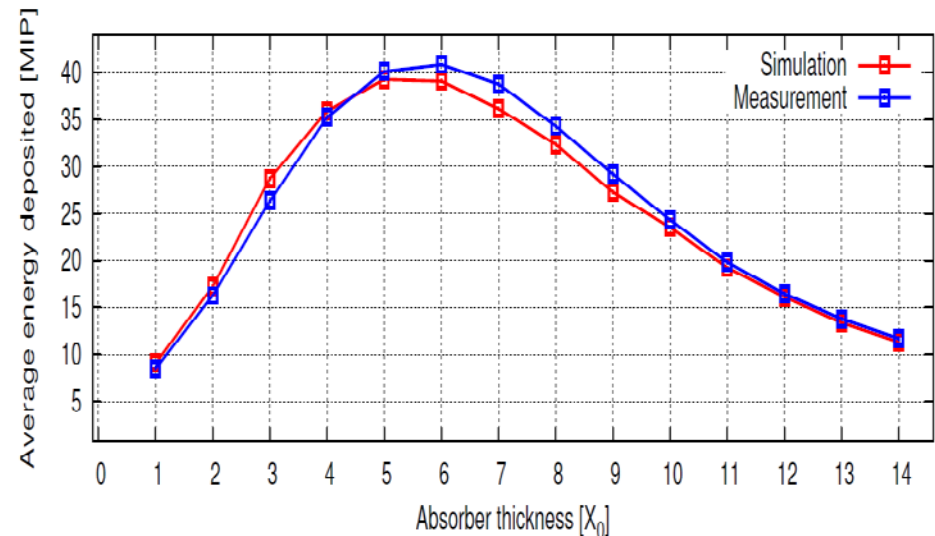
Summary

- We showed the recent upgrade of the TAU silicon / LumiCal lab.

- We now have the capability of full sensor board assembly.

- New laser test stand with μm resolution is under development.

- Some new results of full sensor tails were shown.

- Next test beam is different from what we got used to at DESY.

Thank you!