IFJ PAN FCAL Activities

Status Report

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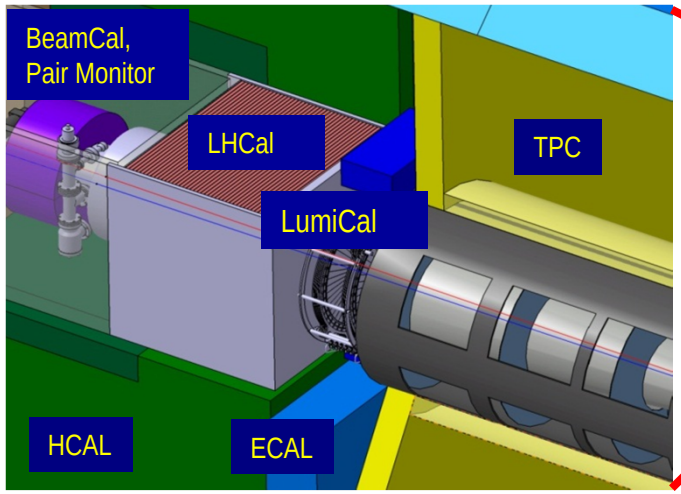
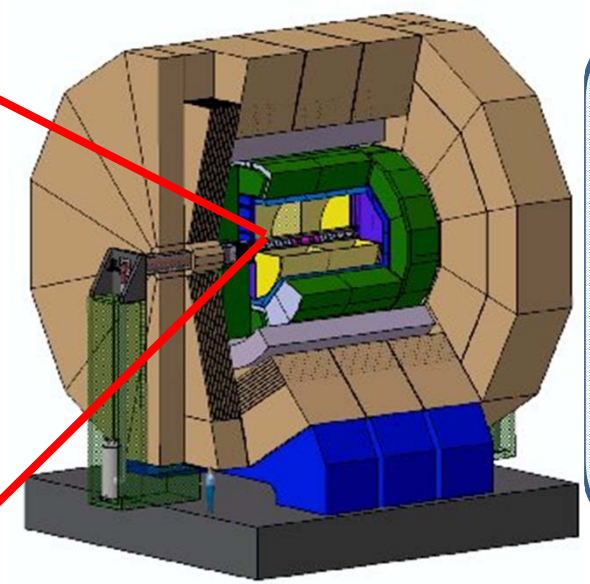


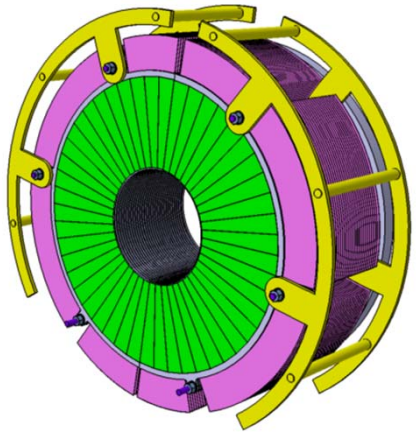


- LumiCal Sensors, mechanics, MDI
- LumiCal alignment
- DAQ
- MC Simulations
- Physics studies

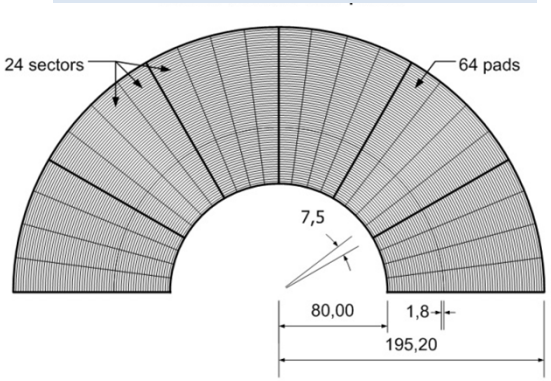
LumiCal Sensors

The design of the silicon sensors for LumiCal (then produced by Hamamatsu).

LumiCal Final prototype

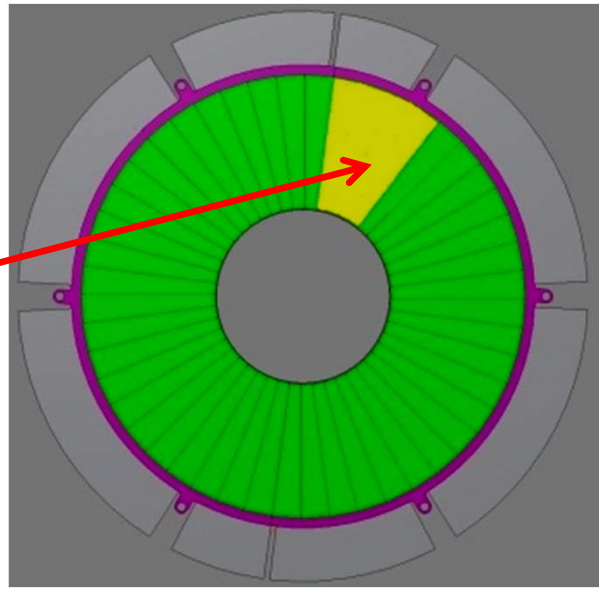


Silicon sensors half plane



The four sectors (30^0 in azimuthal angle) were used in beam test measurements (financial resources → 4π coverage).

The Kapton foil fan-out was made to connect sensors with readout electronics (FPGA + thinner fan-out ?)

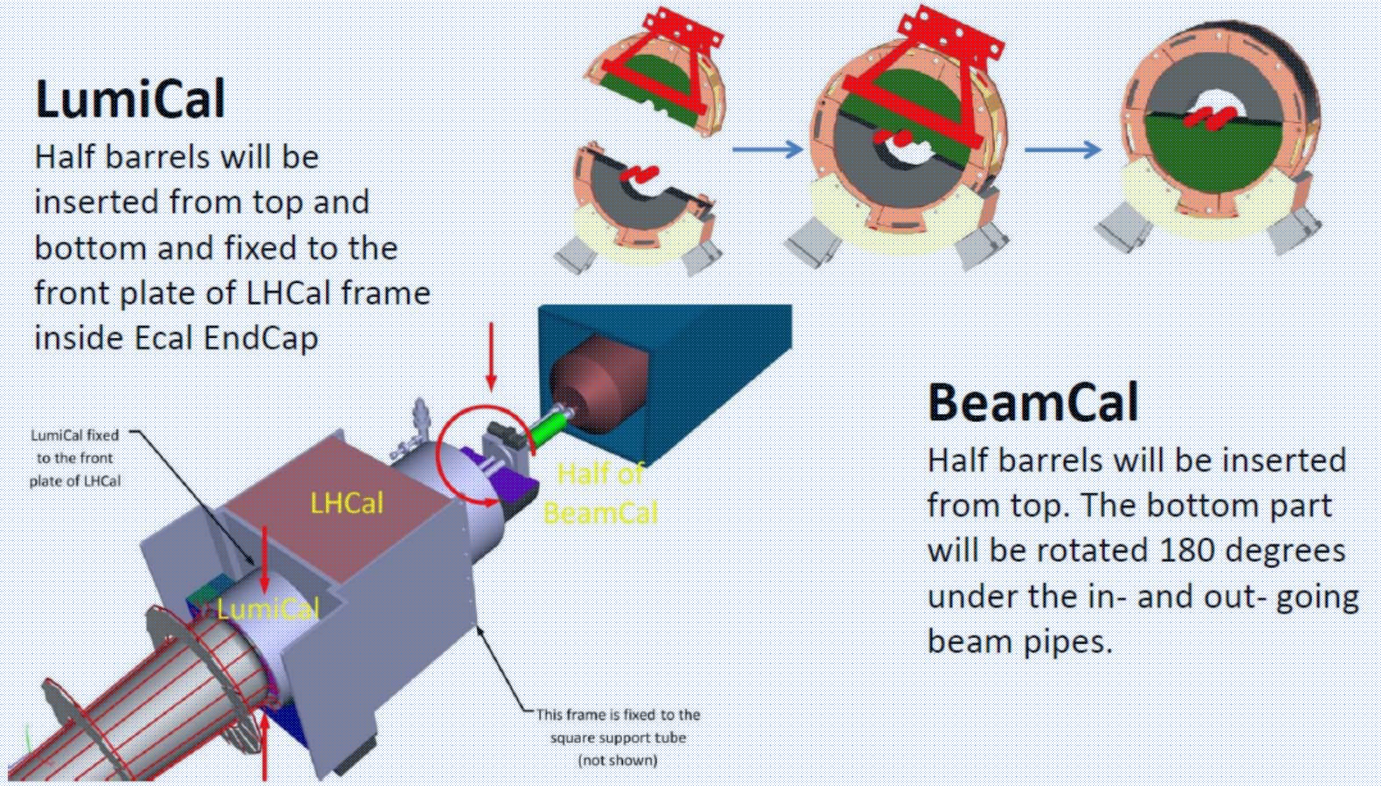


LumiCal Mechanics and MDI

(De-)assembling of LumiCal and BeamCal; routing of cables etc.

LumiCal

Half barrels will be inserted from top and bottom and fixed to the front plate of LHCal frame inside Ecal EndCap



BeamCal

Half barrels will be inserted from top. The bottom part will be rotated 180 degrees under the in- and out- going beam pipes.

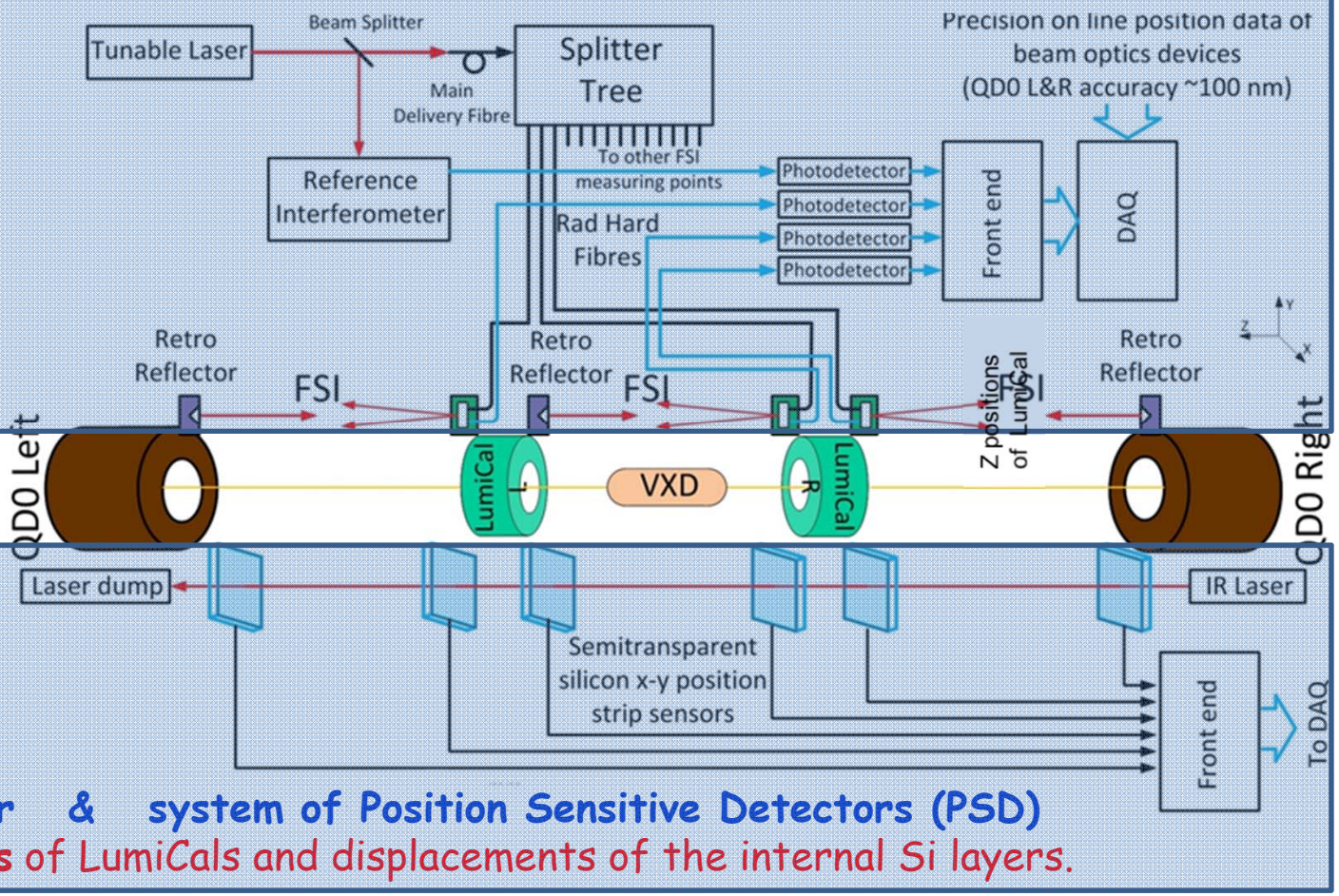
Potential participation of engineer(s) from the Cracow University of Technology

LumiCal Laser Alignment

The required precision: $\Delta x,\ \Delta y \approx 500\ \mu m$ $\Delta z \approx 100\ \mu m$, internal Si layers $\approx 10\ \mu m$

The Laser Alignment System (LAS) under development; encompasses two components:

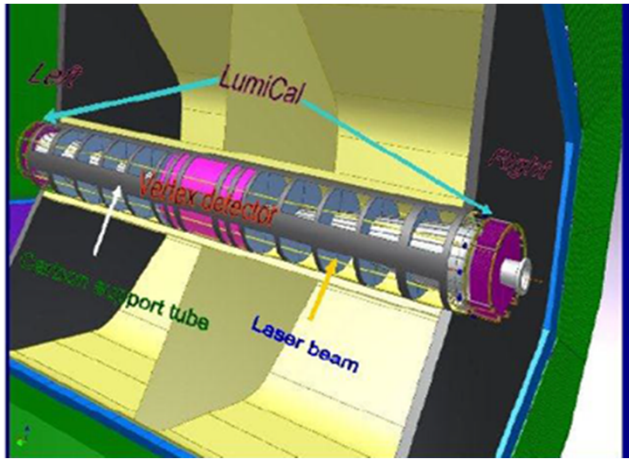
- **Frequency Scanning Interferometry (FSI) system**
  → the **absolute distance** between both LumiCals by measurement of interferometer optical path differences using tunable lasers and counting fringes.

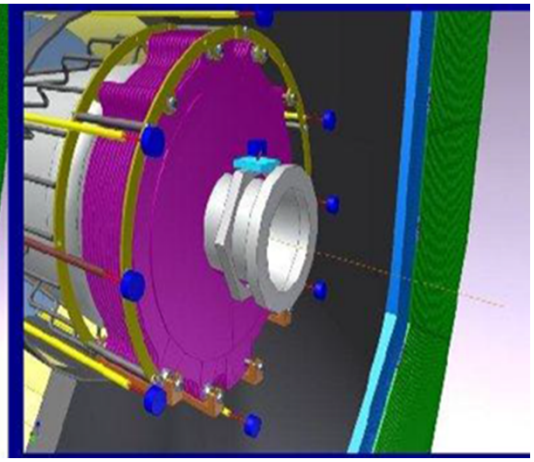


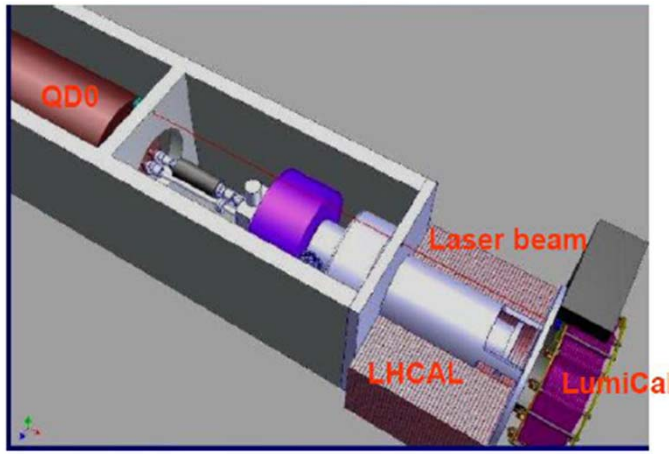
- **Infra Red (IR) laser & system of Position Sensitive Detectors (PSD)**
  → **relative positions** of LumiCals and displacements of the internal Si layers.

LumiCal Laser Alignment

- **Infra Red (IR) laser & system of Position Sensitive Detectors (PSD)**
  - ➔ relative positions of LumiCals and displacements of the internal Si layers.

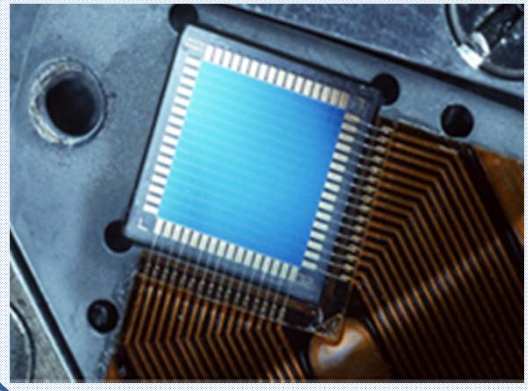


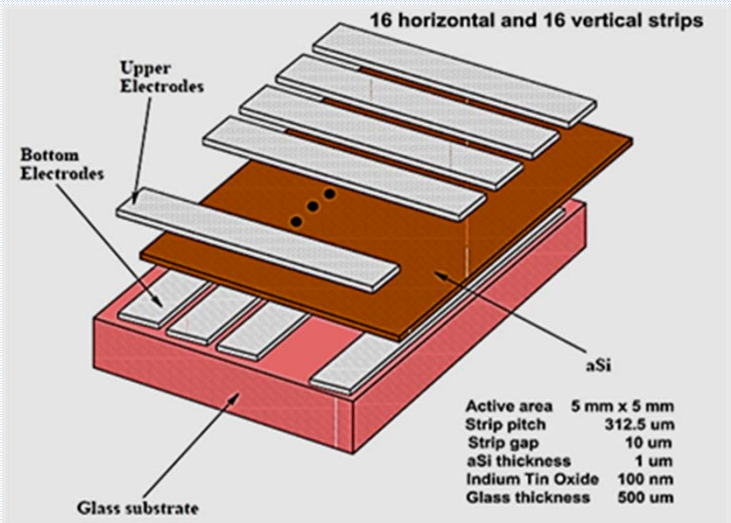




Good reference points:
- QD0 magnet,
- Beam Position Monitors,
- The beam pipe.

PSDs:

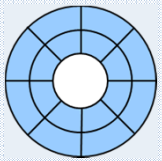




Laser Beam Position Determination

Possible deformations
(inner layers of Si sensors):

- gravitational sagitta,
- temperature,
- …

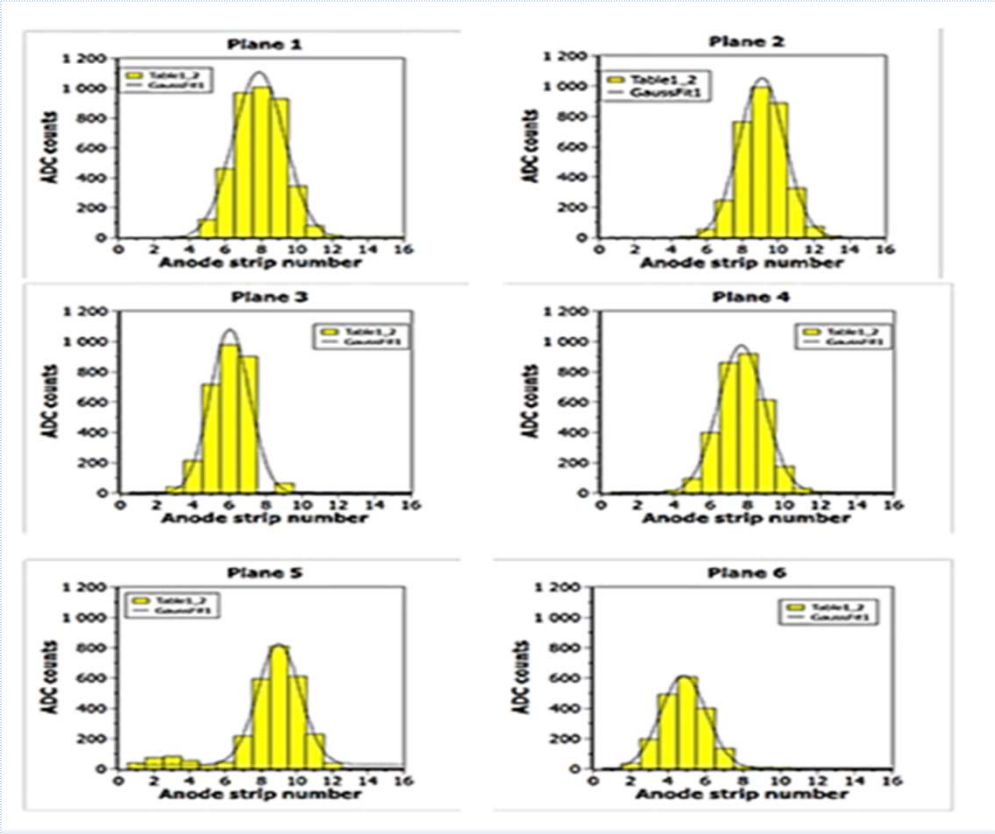

normal


X,Y deformation


Z deformation

Light transmission:
exceeding 85%
for λ > 780 nm

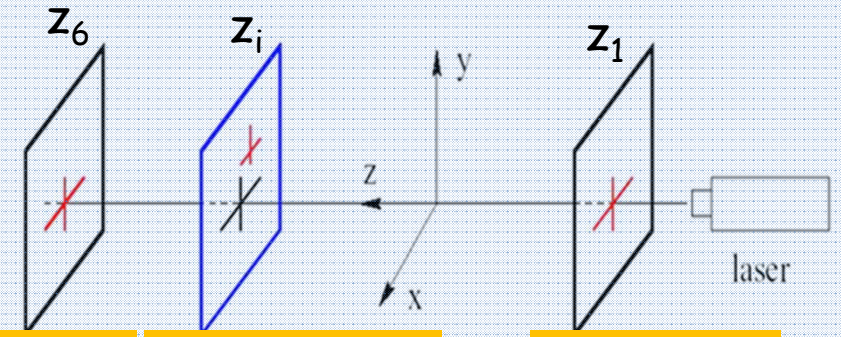
Beam profile signals from the X-strips of the PSBs along the moving beam.



The available aperture for the laser beam: 5 x 5 mm^2 /sensor.

The mean positions $\bar{x}$ obtained from a Gaussian fit to the observed signals → next page.

Laser Beam Position Determination



ref_plane_6 | plane_i: sensor 3 and 4 | ref_plane_1

The mean position of sensors 1 and 6, $(\bar{x}_1, \bar{y}_1)$ and $(\bar{x}_6, \bar{y}_6)$ define the reference straight line.

The expected position of the beam at sensor plane **i** :

$$\Delta x_i = \bar{x}_1 \frac{z_6 - z_i}{z_6 - z_1} + \bar{x}_6 \frac{z_i - z_1}{z_6 - z_1}$$

$$\Delta y_i = \bar{y}_1 \frac{z_6 - z_i}{z_6 - z_1} + \bar{y}_6 \frac{z_i - z_1}{z_6 - z_1}$$

Residuals:

$$Rx_i = \Delta x_i - \bar{x}_i$$

$$Ry_i = \Delta y_i - \bar{y}_i$$

The accuracy of the beam position: $\leq 20\mu$m using layout with 6 semi-transparent sensors

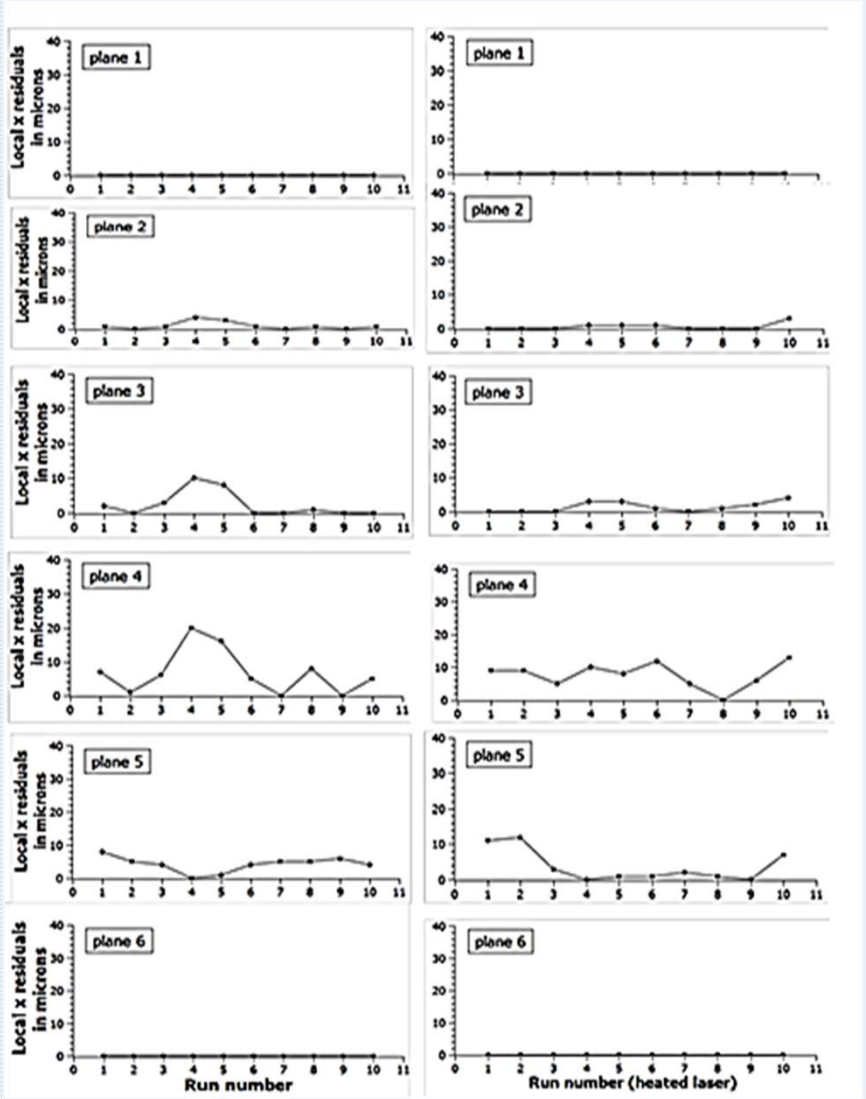
Laser Beam Position Determination

Fluctuations grow up with the distance along the laser beam.

Possible explanations:

- laser instability with an increase of beam diameter,
- noise of the sensors.

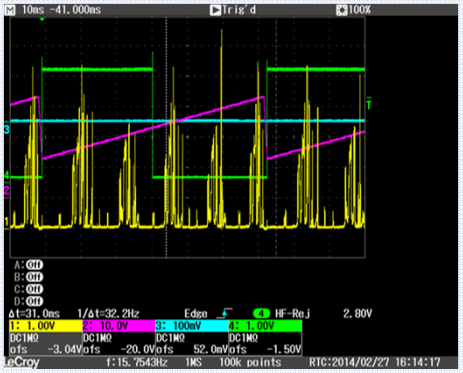
Data taken after few hours of laser's operation operation show smaller fluctuations
(right column plots).



LumiCal Laser Alignment

- **Frequency Scanning Interferometry (FSI) system**
  - ➔ the **absolute** distance between both LumiCals by measurement of interferometer optical path differences using tunable lasers and counting fringes.

Signals observed from a simple laser diode:



The main optical elements for FSI prototype were collected and assembled.

The tests indicated errorneous behavior of the tunable laser.

The latter sent to the manufacturer for inspection (duration of six weeks).

Futher problems after laser's „repair":

- for some output power sets the laser works in dual-mode instead of a single one;
- during the tuning of wavelengths the transitions from single- to dual-mode happen „at random".

LumiCal Laser Alignment

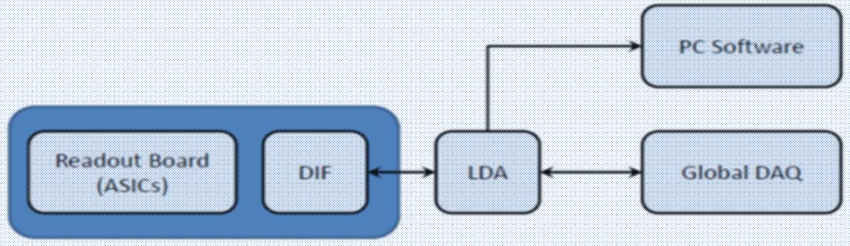
The IR & PSD system is essentially fully operational.

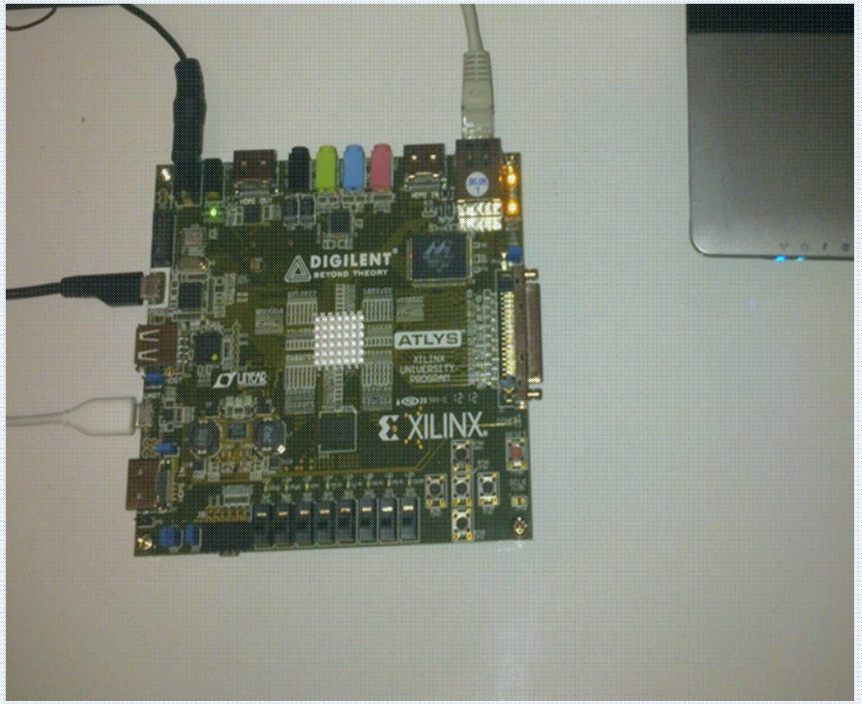
The FSI suffers from:

- ✓ Laser malfunctions.
- ✓ Lack of manpower.
- ✓ Shortage of financing (AIDA2 resources, polish grant ?).

Data Acquisition

Work on preliminary concept
for DIF (Detector Interface) module
as an interface between
local DAQ (sensors readout)
and common DAQ
e.g CALICE DAQ2 system.

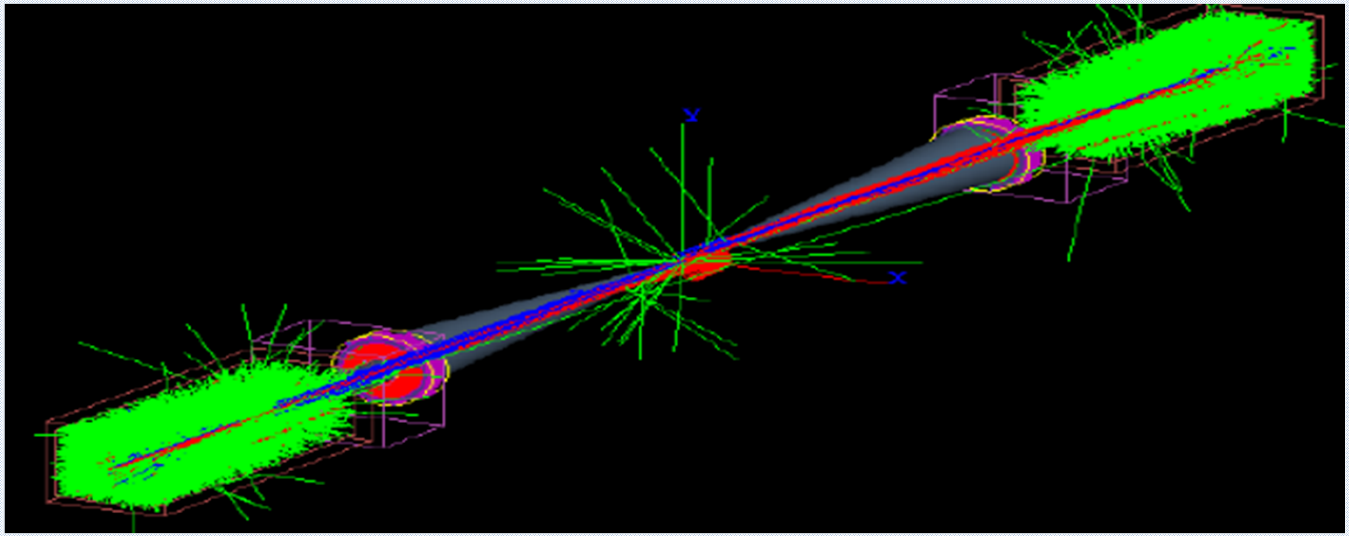




Financial resources uncertain (AIDA2 ?)

Monte Carlo Simulations

- Optimization of the LumiCal geometry.
- Studies of reconstruction of electromagnetic clusters.
- Simulations of test beam results.



- Struggle to the final algorithm of cluster reconstruction.
- Transition MOCCA → DD4hep.

Physics Studies

- Studies of gamma-gamma interactions, in particular aimed at the measurement of the photon structure function
  (both ILC/CLIC; natural activity harnessing all forward calorimeters).
- Physics background studies.
- New processes…

Summary

- The IFJ PAN group is currently in the transitional period…

- In particular we hope
  to reinvigorate involvments,
  strengthen in manpower
  and possibly also
  extend our activities to CLIC issues.