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Cooperation between
IFIC (Valencia) and CU (Prague)

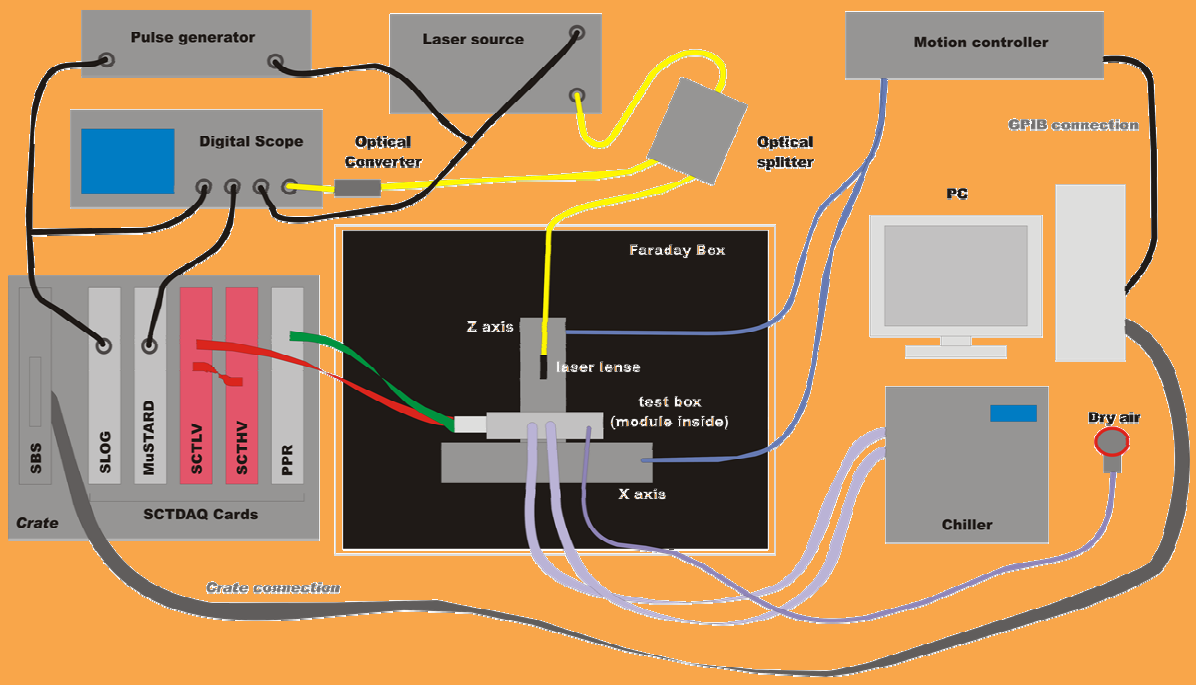
http://ific.uv.es/sct/lasertest

Cluster Meeting - April 5, 2005

Status

- Stable mechanical setup
- Laser detection only on one side (metal backside of detectors is no transparent to light)
- Automatic focus algorithm with precision 40 μm in *z* and 4 μm in *x*
- Automatic algorithms to test:
  - All channels *(for production and QA)*
  - Channels from the *mask file* *(checking response and noise)*
  - Bond mixing *(for production and QA)*
  - Channels from a *custom file* *(optional)*
  - Punchthrough channels test with gain confirmation
- No crosstalk observed inside chip
- Pulse shape reconstruction done
- Possibility to test modules up to 4º C in hyb. (-20º C in chiller) with dry air or nitrogen
- Automatic logbook generated and saved with all important information

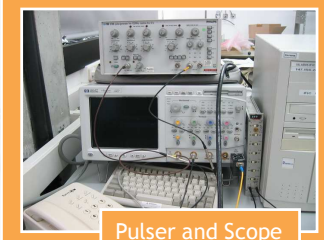
Setup



Setup

LaserTest lab.

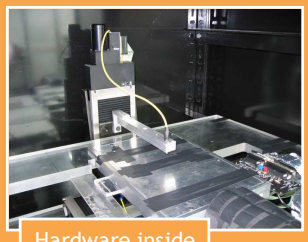
Laser source



Pulser and Scope

Laser parameters

Wavelength of light:	1060 nm
Laser energy of photon:	1.170 eV



Hardware inside the black box

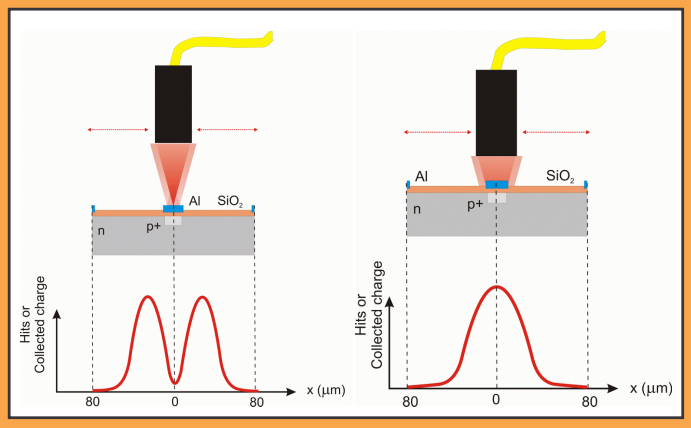
Optical converter

Pure Silicon properties

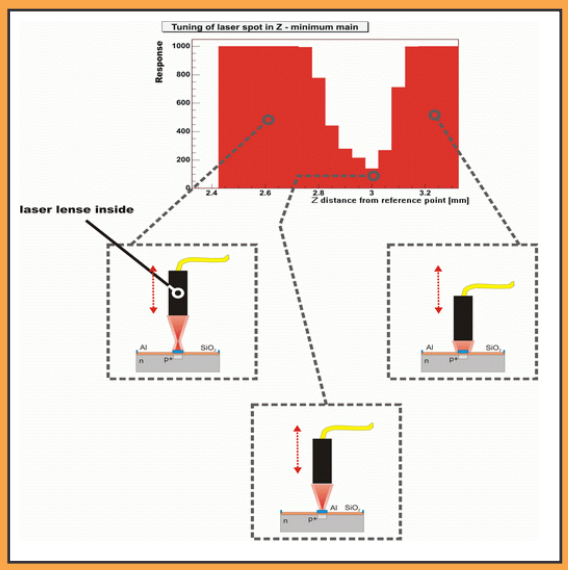
Real part of dielectric const.:	12.65
Imag. part of dielectric const.:	0.00075
Index of refraction:	3.557
Imag. part of index of refr.:	0
Absorption coefficient:	12.07 cm^{-1}

Focus Algorithm

Main conclusion: The alg. is based on light reflection on strip metal material (Al).



Focusing in *x (perpendicular to strips)*



Simple Requirements: Strip number (strip to focus) as input

Focusing in *z (up and down)*

Focus Algorithm

Method

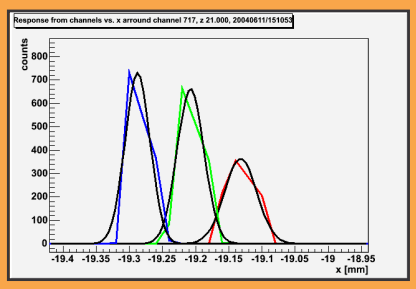
- Independent of starting point

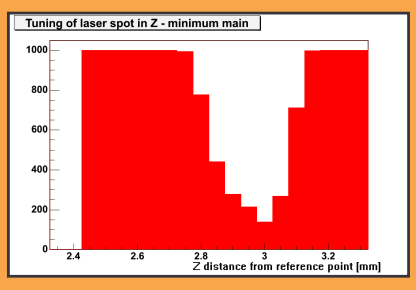
- *Based on TriggerBurst Scans: it finds channel position in x and z using the reflection over the aluminium and calculates strip width (pitch)*

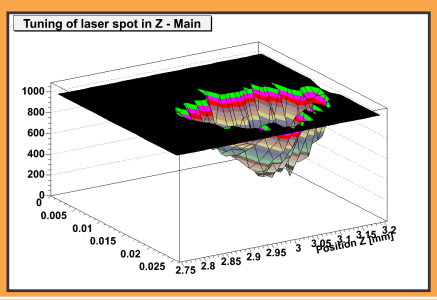
- *Dynamic threshold selection based on strip output*

- *In each Z and X distance, we acquire Trigger Burst and Median Charge data*

- *Finally, we found the minimum point in a 3D plot*



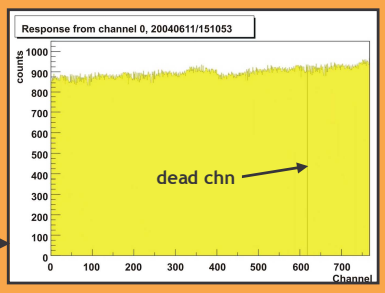




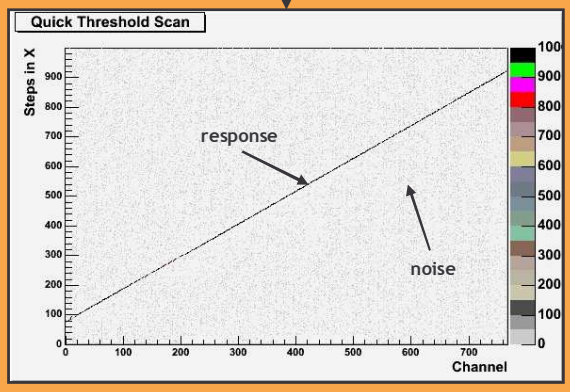
Fine 2D scan in range 360 x 20 mm to find focus point

QA Tests (I)

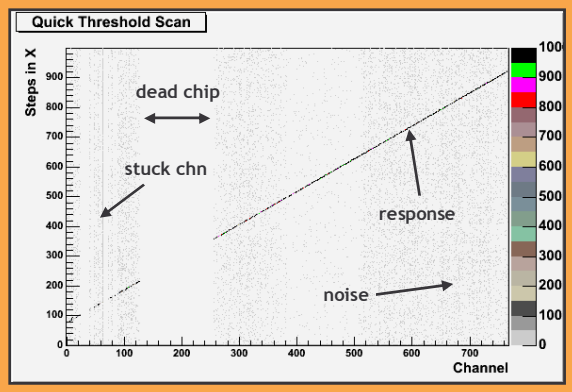
BOND & CHANNEL TEST: Test for checking the response of all channels using laser beam. Results are ready in ~30 min per detector (full channel test), this is 2 hours per module (with 4 detectors).



Production module (back)



Production module (front)

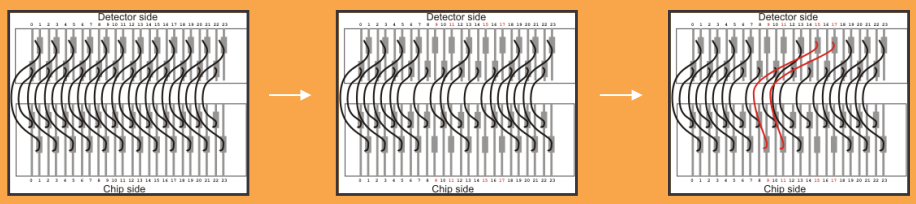


Prequalification module

QA Tests (II)

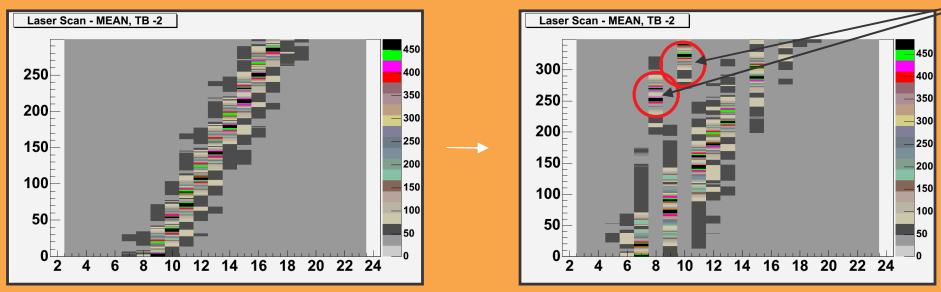
We re-bond some bonds to different positions to look dependence of chip channel stability base of neighbored high powered channel.

The channels are detected in unexpected positions. We can calculate the bond mixing with precision. *This is a good test to check the bonds.*



In the results, you can see the differencies...

Channels re-bonded

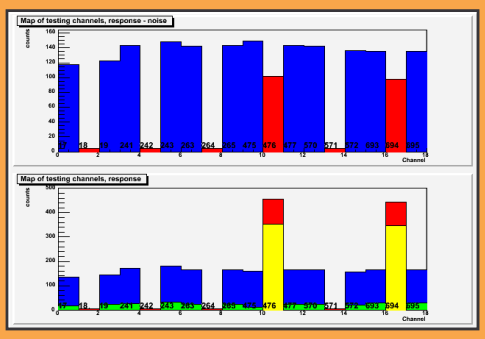


After

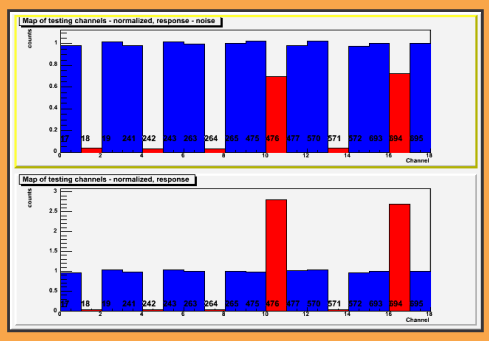
Before

QA Tests (III)

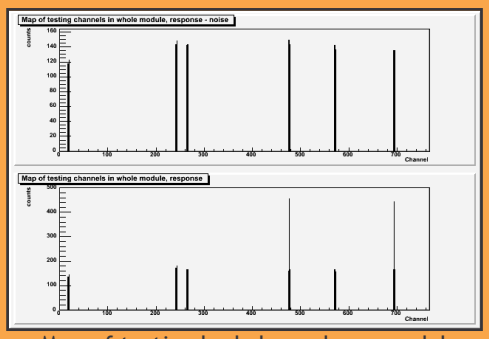
BAD CHANNEL TEST: This test is for checking of response from bad channels based on *mask file* and compare it with neighbours channels



Testing channels (red) with their neighbours (blue). up: response – noise, bottom: response from channels and noise (yellow/green)



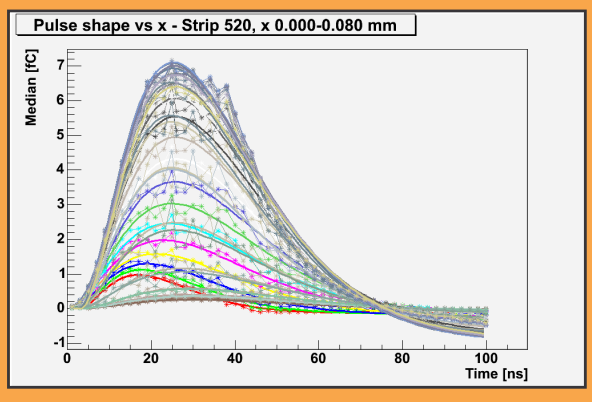
Testing channels normalized to 1 using their neighbours: average of them was the reference value. Two channels shows some response but in very high level – un-trimm channels

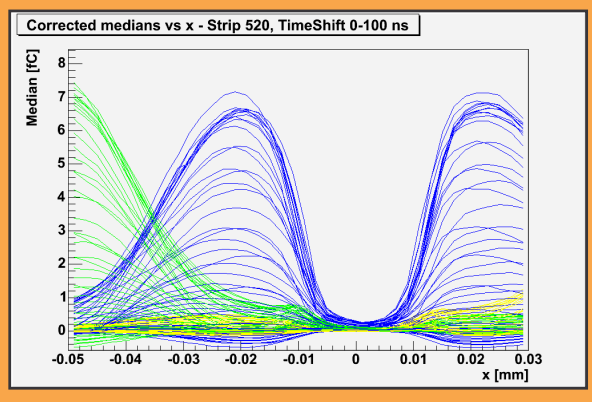


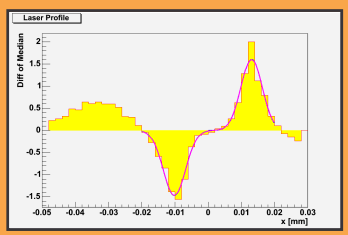
Map of testing bad channels on module

Pulse Shape Reconstruction

Pulse shape reconstruction vs. interstrip position of laser spot was done (Hamamatsu module type).

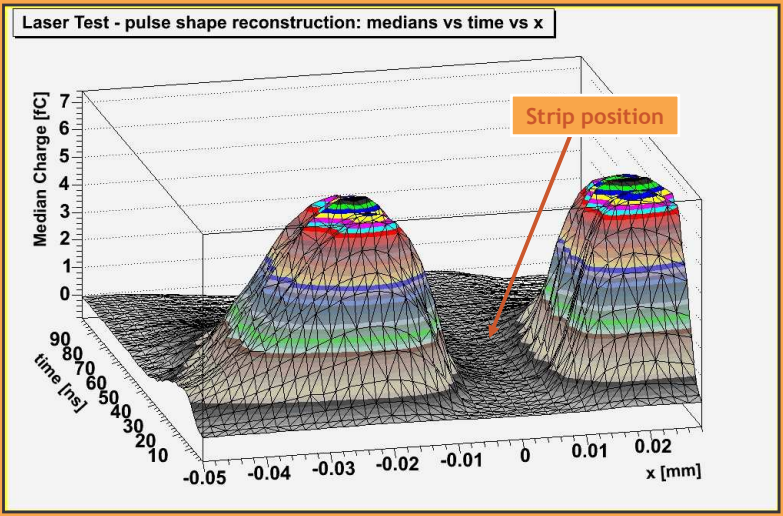


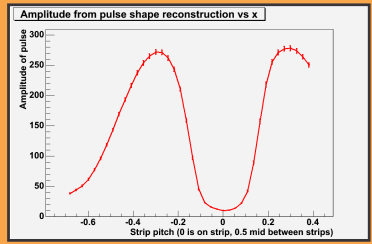


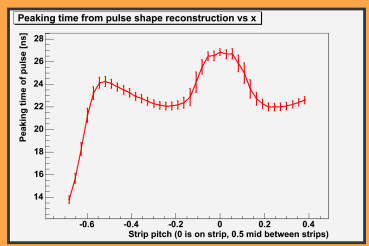


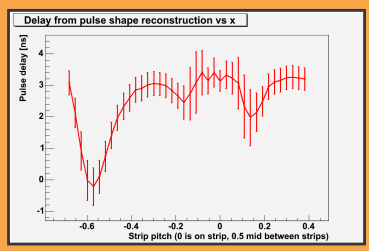
Also quality of laser spot was measured using fit of edges over metal strip: sigma (3.3 +- 1.3) µm, strip width = (23.3 +- 1.4) µm

Pulse Shape Reconstruction





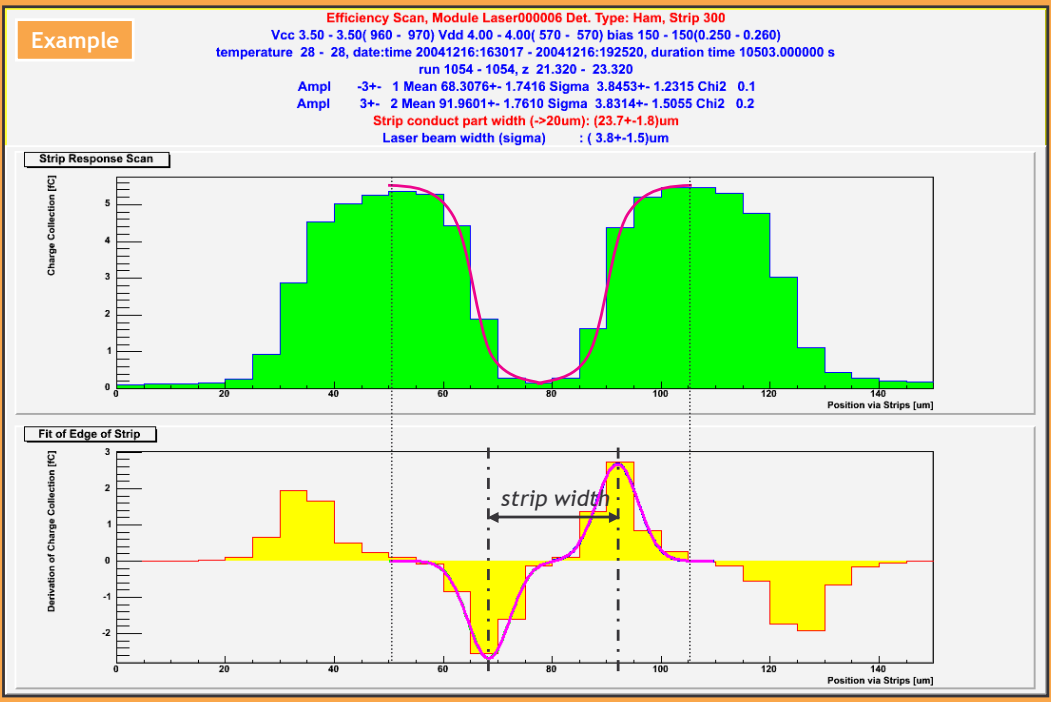




3D reconstructed pulse. On point 0 (in x) practically whole light beam is reflected out, so this is the position of the strip.

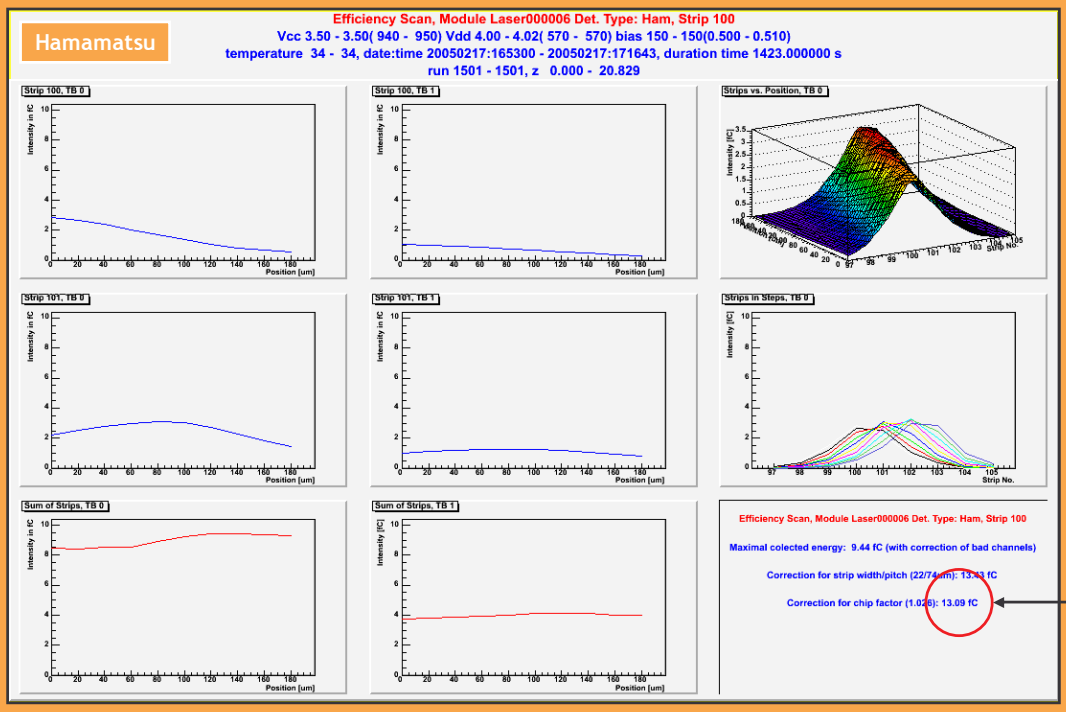
Strip Width

Pitch Ham: (23.9 +- 0.4) µm
Pitch CiS: (18.2 +- 0.9) µm



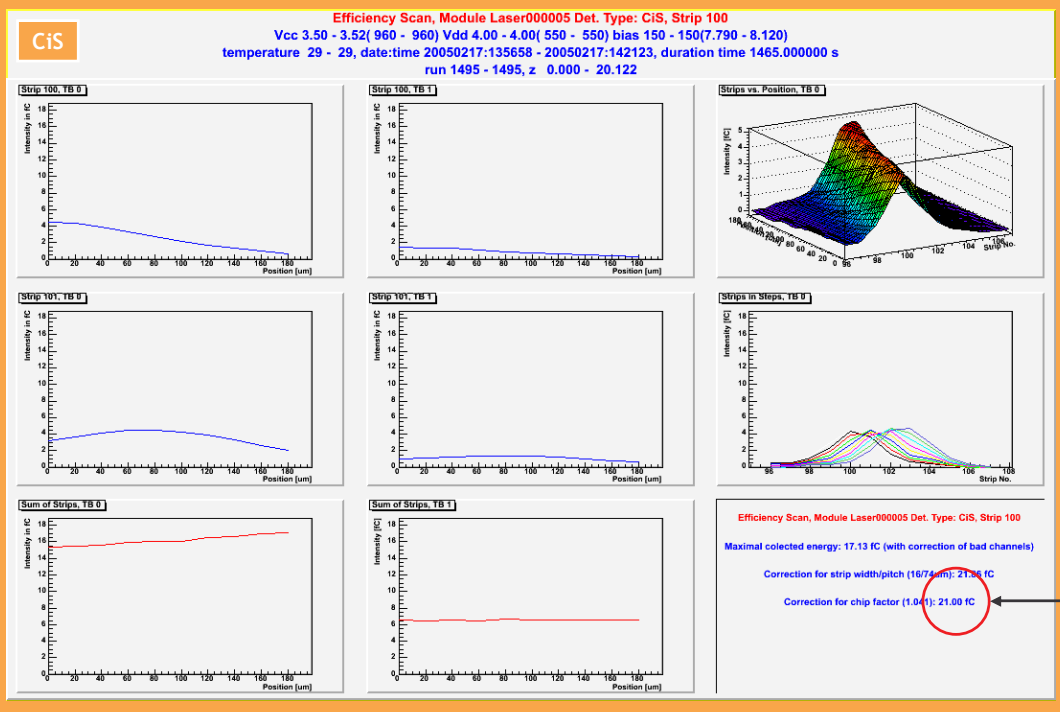
Hamamatsu Vs CiS

Collected charge: 13.09 fC



Hamamatsu Vs CiS

Collected charge: 21.00 fC



Hamamatsu Vs CiS

Previous status:
- Not well known optical properties of sensors (detectors)
- No comparation between Hama and CiS was done (no testbeams, no beta tests, etc)

First LaserTest results: Ratio CiS/Hama **~1.6**

So, to know where was the problem, we had to:

1 - Repeat LaserTest measurements under many differents conditions:
  * Temperature dependencies
  * Bias dependencies
  * Detector type dependencies (W21,W22,etc)
  * Humidity dependencies

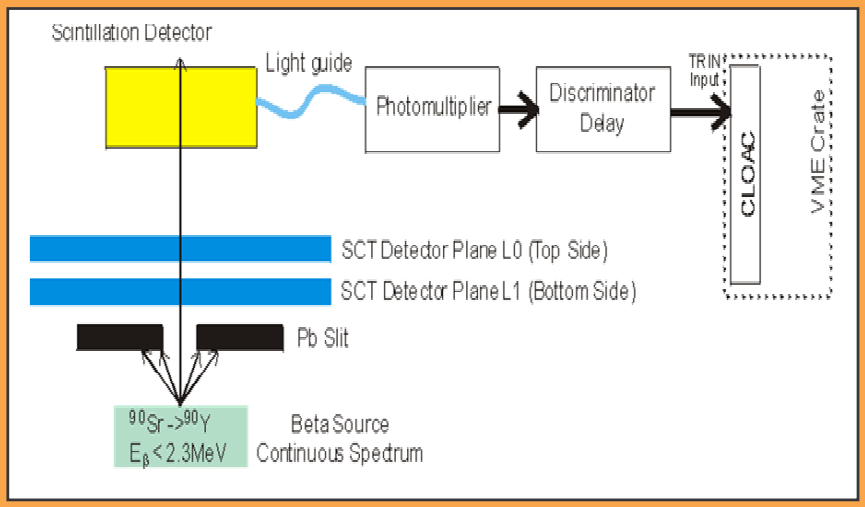
→ Ratio ~1.513
CiS/Hama

2 - Comparing results with a charged particle beam: **BetaTest**

3 - Measure the reflectivity of the sensors

Beta tests

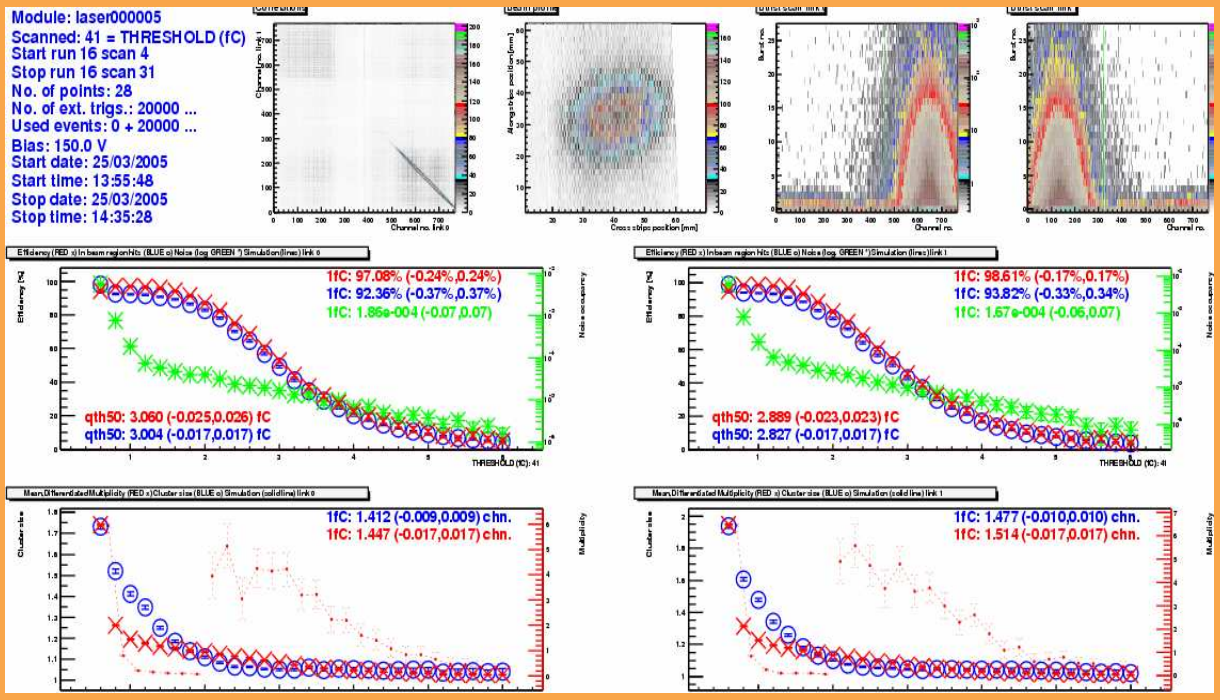
We tested both modules (Hama and CiS) to be sure if the problem was an optical problem or a sensor problem.



Thanks to the PRAGUE group

Beta tests

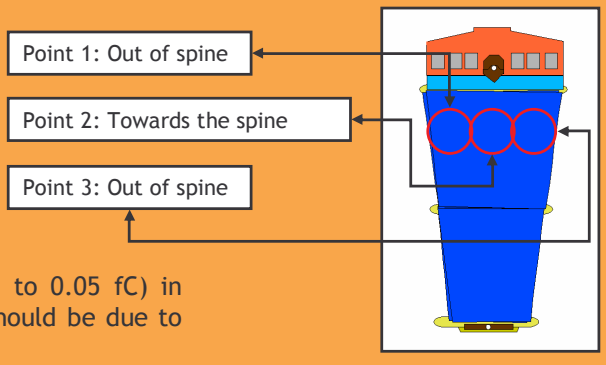
Example



Beta tests

Hamamatsu			CiS		
Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
3.00 fC	2.91 fC	3.00 fC	3.02 fC	2.88 fC	3.05 fC

NOTE: This values are not corrected by the calibration factors of each chip, but $C_{CiS} > C_{Hama}$, so they have very good agreement



This shows the perfect agreement (up to 0.05 fC) in both cases, so the ratio we observed should be due to optical properties

Reflectivity

Preliminary results:

Reflectivity coeficient is higher in Hamamatsu than in CiS. We measured them last week so **we are working in exact numbers**, but…

here is the explanation we were looking for!

System used: