

ОТДЕЛ ТРЕКОВЫХ ДЕТЕКТОРОВ ОФВЭ ПИЯФ

А.Г.Крившич

26 декабря 2006 г.

Состав отдела

Научных сотрудников	- 4 чел.
Ведущих инженеров	- 2 чел.
Старших инженеров	- 1 чел.
Рабочих	- 5 чел.
Студентов	- 1 чел.
Аспирантов	- 1 чел.

Основные направления работы ОТД в 2006 г.

1. Проект TOTEM.

2. Исследование процессов развития старения и стриммерных разрядов в детекторах частиц, работающих в пучках высокой интенсивности.

3. Детектор тепловых нейтронов

4. Эксперимент В. В. Сумачева.

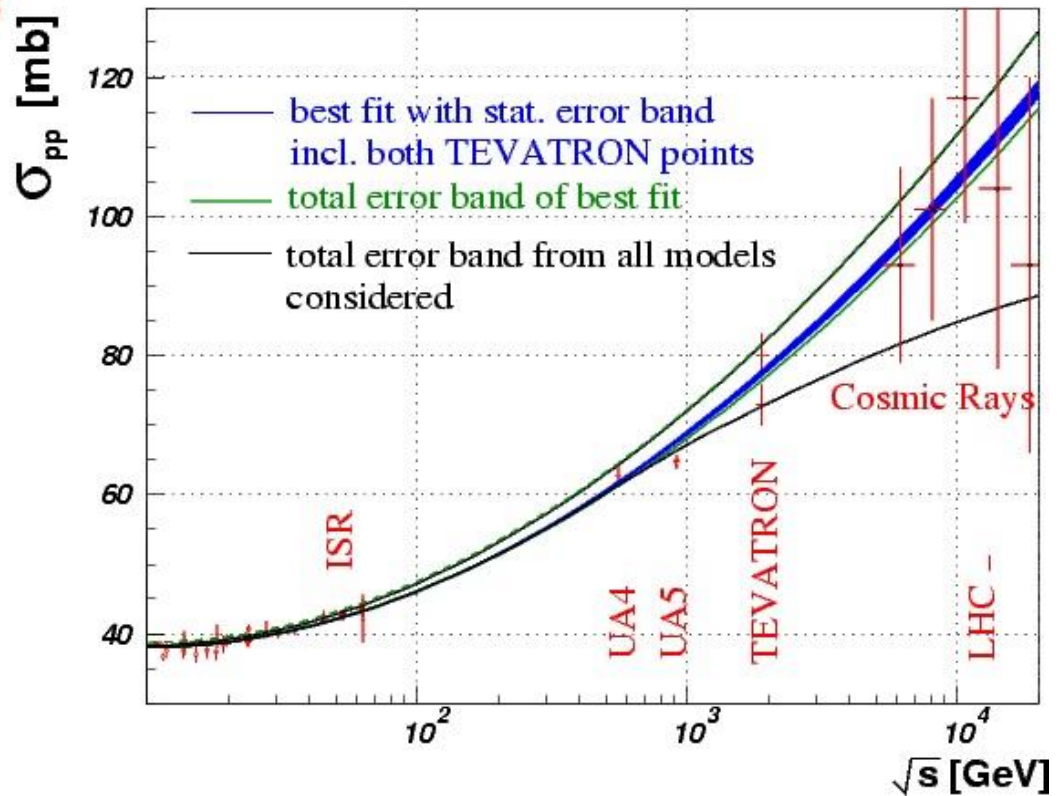


TOTEM

1. Measurement of the total pp cross-section.
2. Study of elastic proton scattering over a wide range in momentum transfer up to $(-t) \gg 10\text{GeV}^2$
3. Measurement of the inelastic pp interaction in the forward region.



TOTEM Physics: Total p-p Cross-Section



- Current models predictions: 90-130 mb
- Aim of TOTEM: **~1%** accuracy

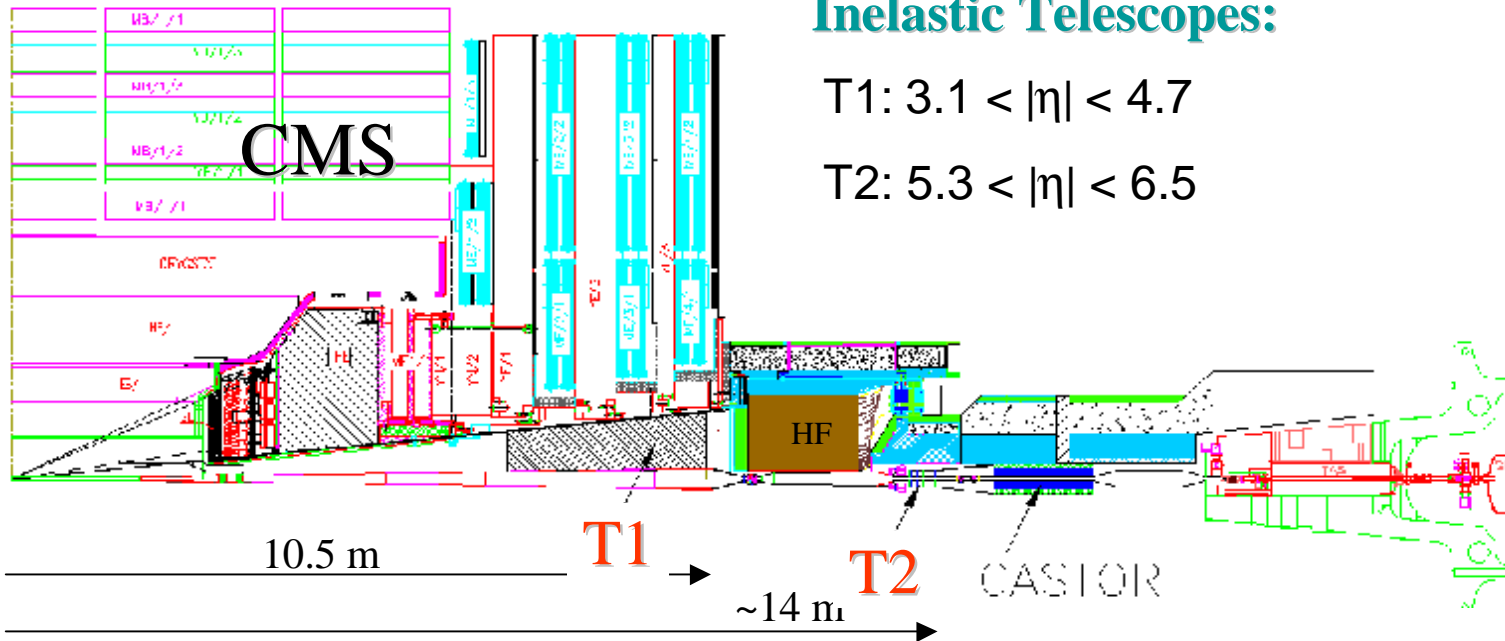
Prediction for LHC

$$S_{tot} = 111.5 \pm 1.2 \begin{matrix} +4.1 \\ -2.1 \end{matrix} \text{ mb}$$

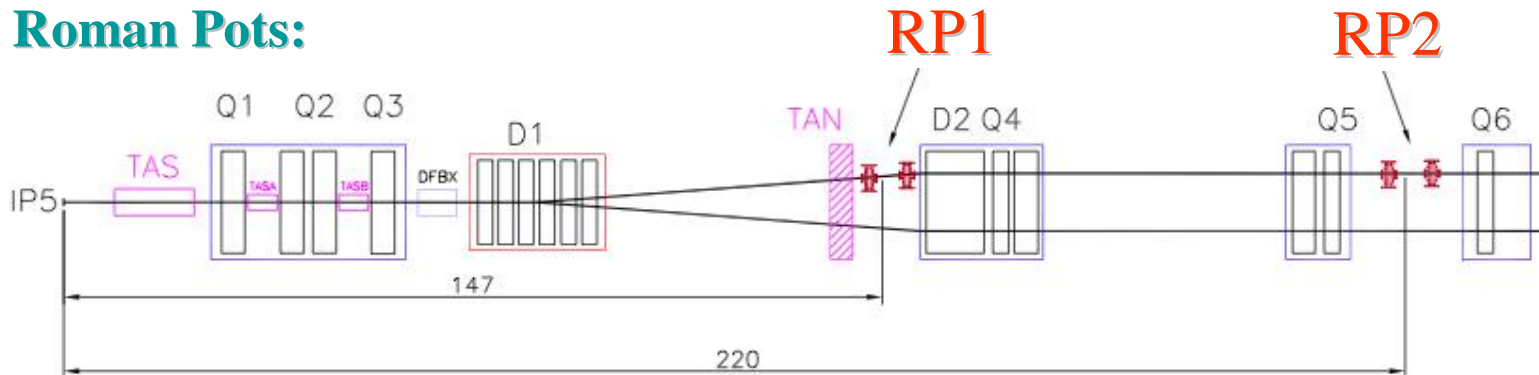
$$\left. \begin{aligned}
 LS_{tot}^2 &= \frac{16p}{1+r^2} \times \frac{dN}{dt} \Big|_{t=0} \\
 LS_{tot} &= N_{elastic} + N_{inelastic}
 \end{aligned} \right\} \begin{array}{c} \text{Optical} \\ \text{Theorem} \\ \longrightarrow \end{array} \boxed{S_{tot} = \frac{16p}{1+r^2} \times \frac{(dN/dt)|_{t=0}}{N_{el} + N_{inel}}}$$



The TOTEM Detectors



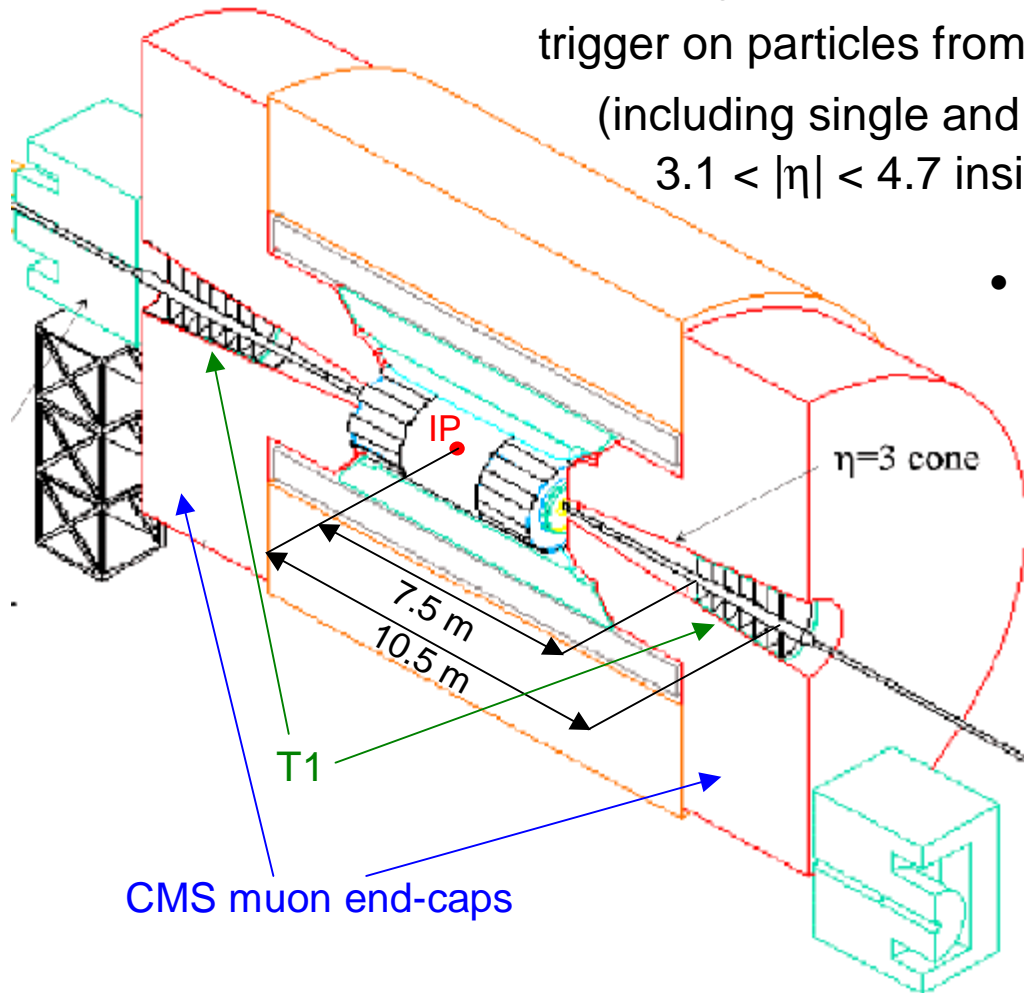
Roman Pots:





The T1 Telescope

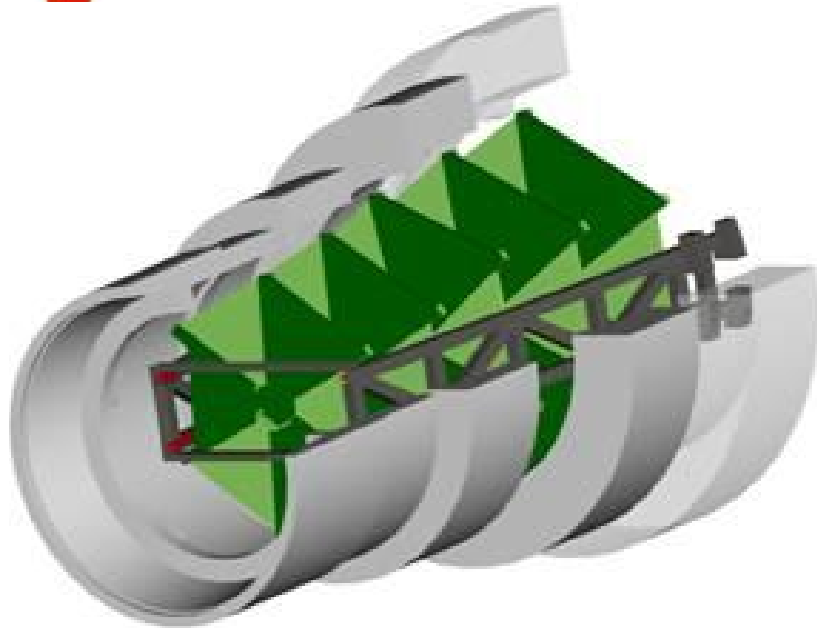
- Primary goal:
trigger on particles from primary pp interactions
(including single and double diffractive events) in the region
 $3.1 < |\eta| < 4.7$ inside CMS muon end-caps.



- Characteristics (up to $L = 10^{31} \text{ cm}^{-2}\text{s}^{-1}$):
 - Large geometrical (η - ϕ) acceptance
 - Close to full efficiency
 - Trigger capabilities
 - Bunch crossing determination (only for $t \approx 75 \text{ ns}$)
 - Machine background rejection due to good position resolution allowing vertex reconstruction
 - Radiation tests (to be done) up to few C/wire
- Detector design similar to CMS CSC muon chambers

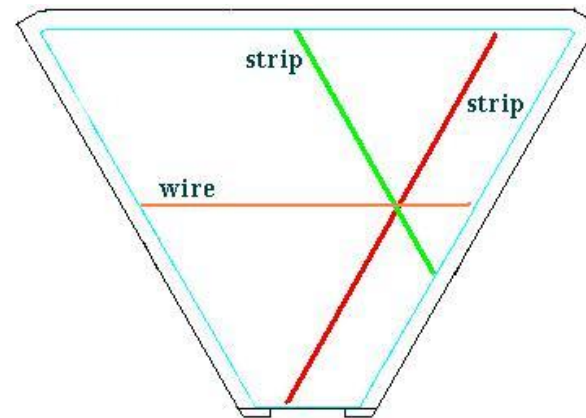


General Structure and Chamber Design



- Each plane made up of 6 independent trapezoidal CSC:
 - overlapping edges to have complete azimuthal coverage;
 - planes slightly rotated with respect to each other

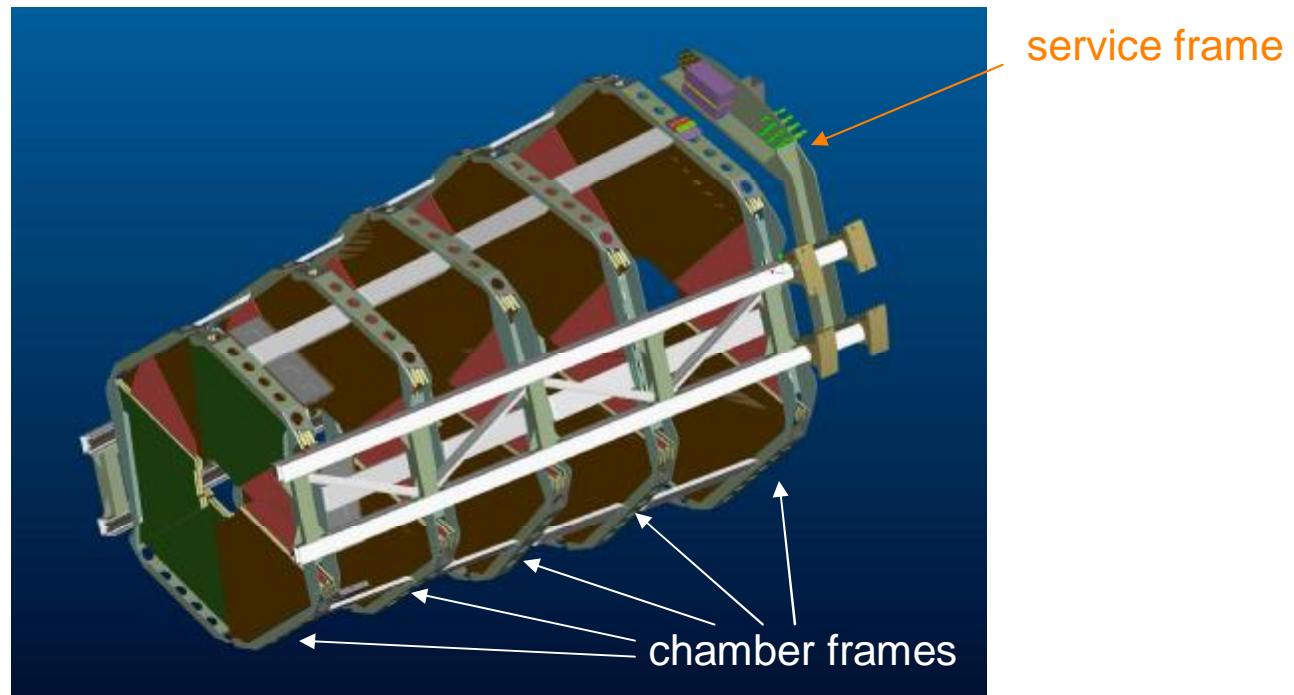
- Two symmetric arms, each with five planes of multi-wire proportional chambers with cathode strip read-out (CSC)
 - split in two half-arms, independently sliding on the support structure



Total number of wires per half-arm: ~ 2500

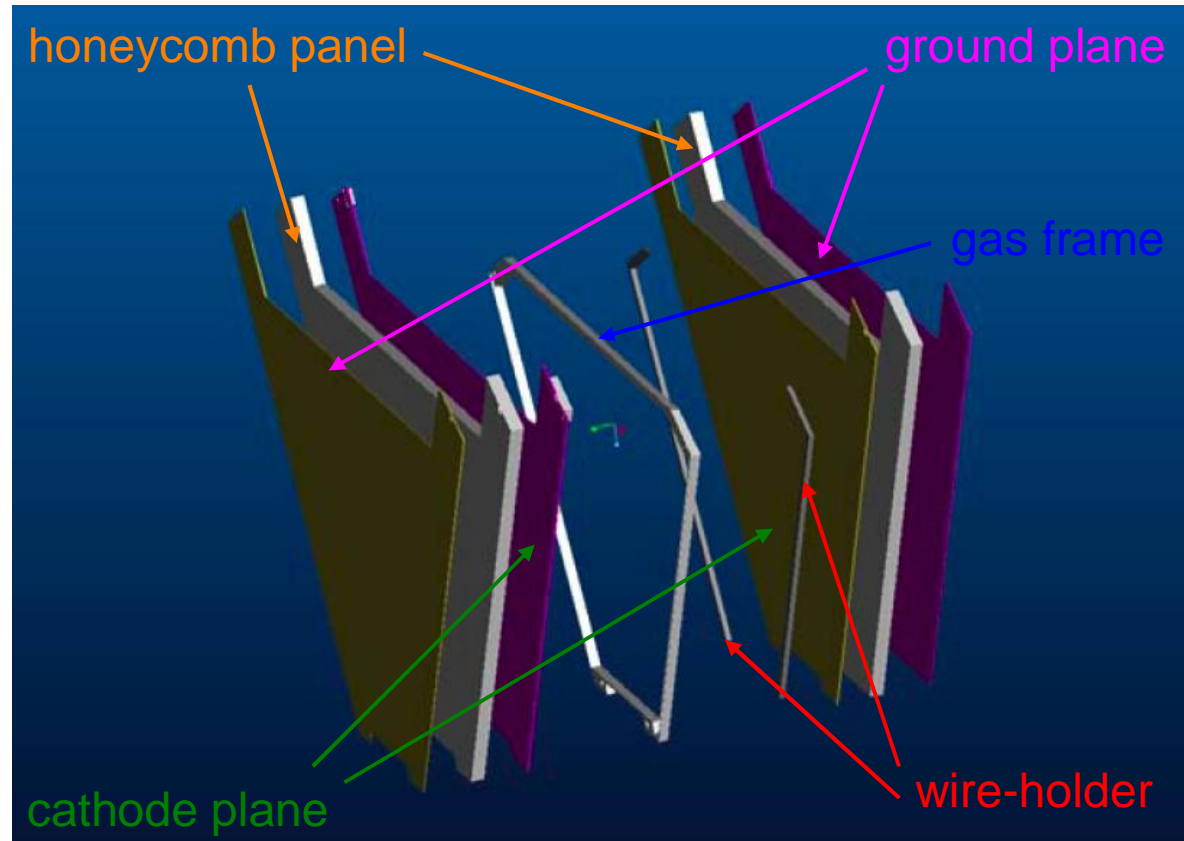
Total number of strips (both views) per half-arm: ~ 4050

Production status: support structure



- Both trusses ready in Genova
 - Now undergoing small upgrades to try and improve stiffness
- All chamber frames in production
 - 5th layer frame slightly modified in order to solve interference problem with beam pipe support

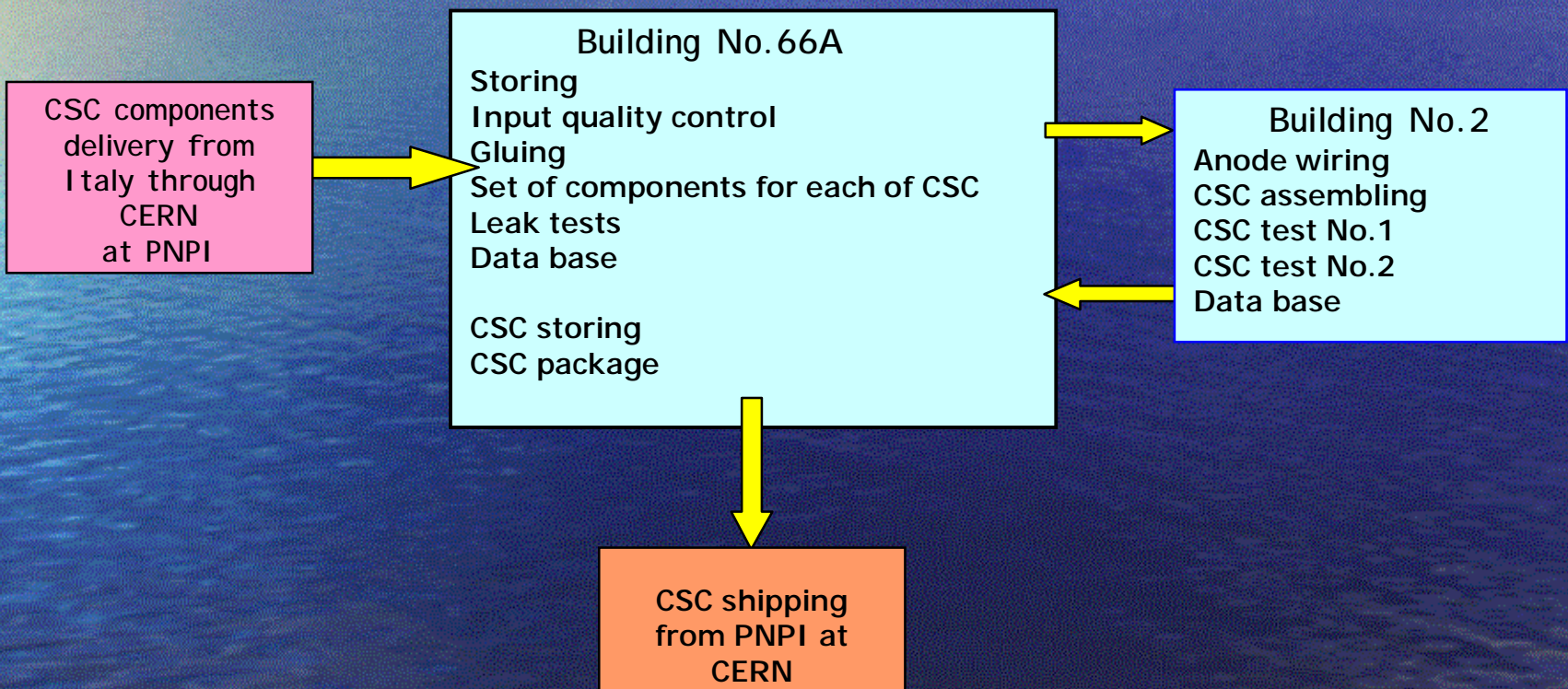
Production status: chamber components



○ Ready:

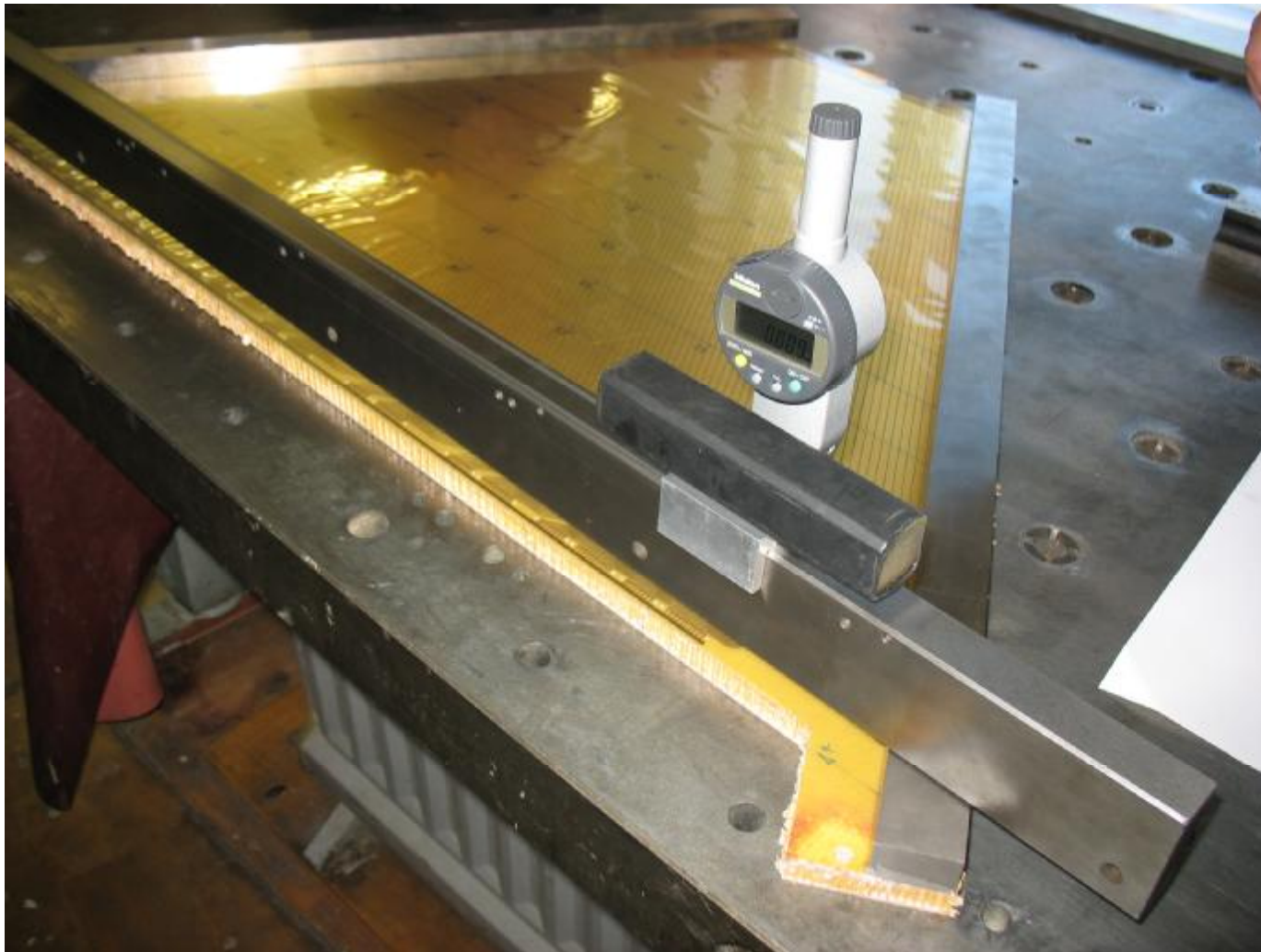
- all components for type 1P, 5P (but 5P will be re-produced);
- cathode planes, wire-holders, gas frames for type 1G, 5G, 5P new production;
- PCB layout for all cathode planes and wire-holders

General technology chain of the TOTEM CSC manufacturing at PNPI



Chamber production at PNPI

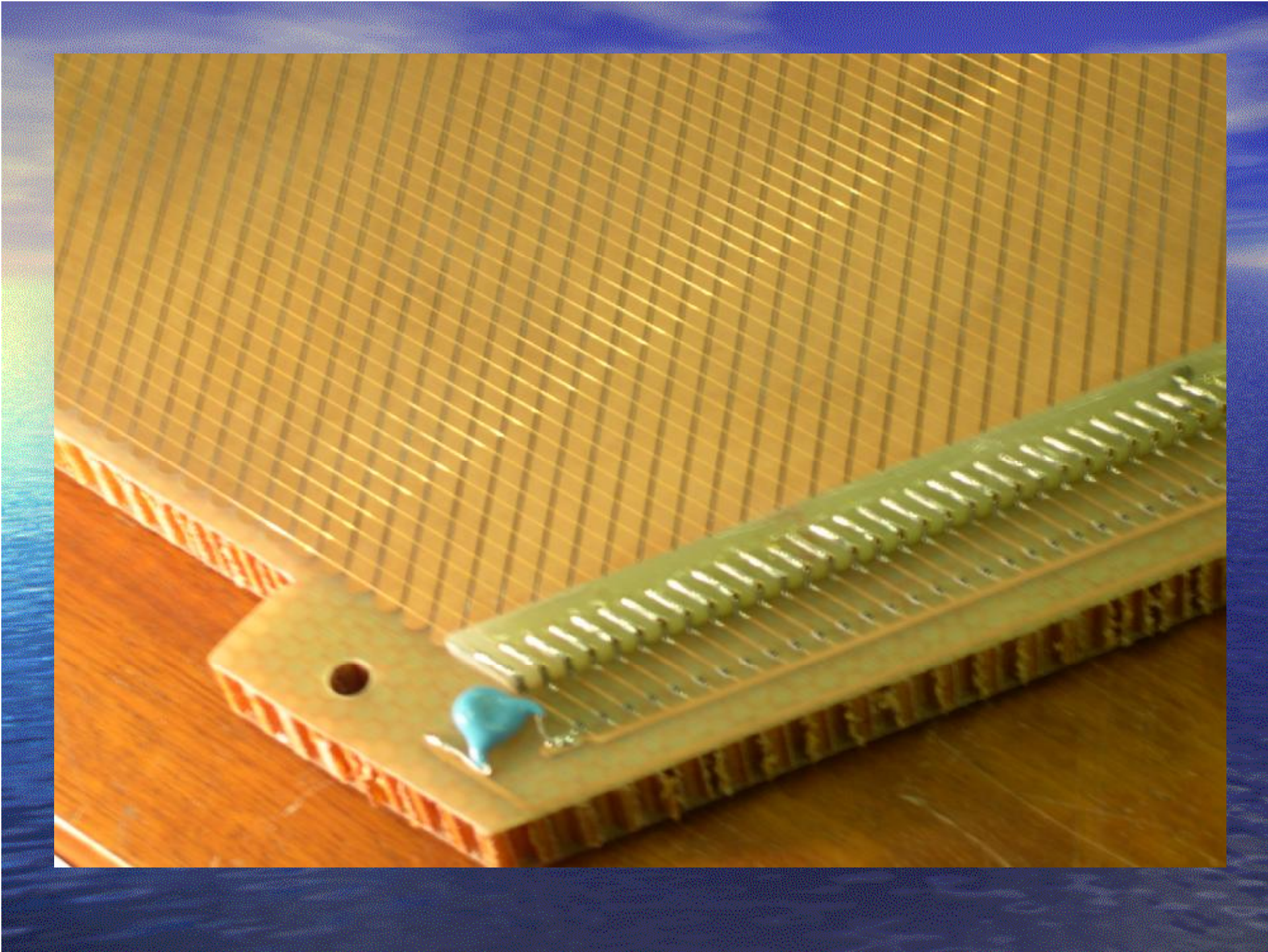
Measurement of cathode planarity



Chamber production at PNPI

Wiring





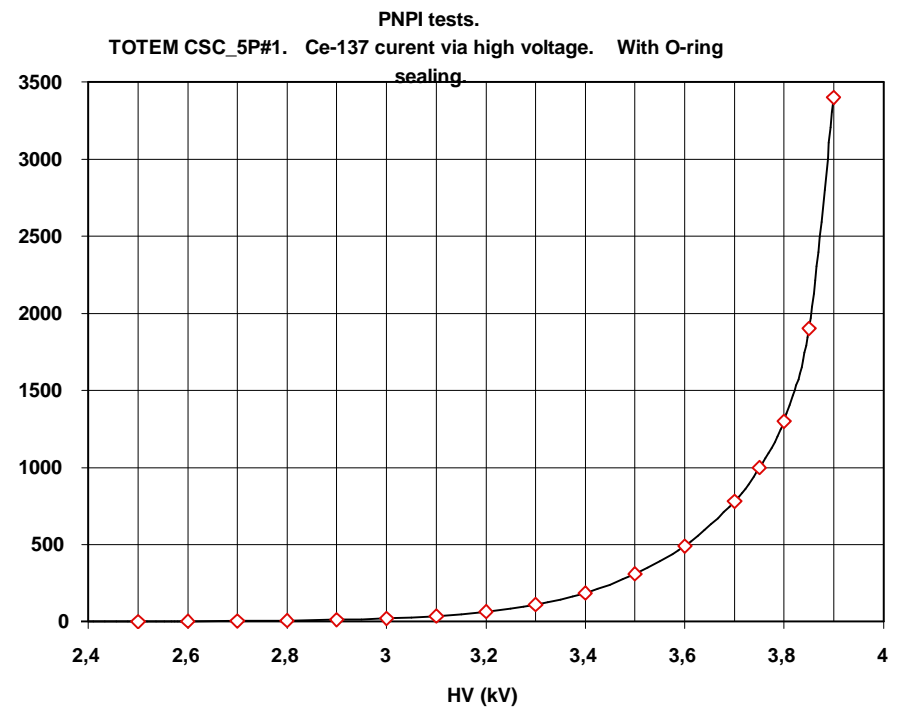
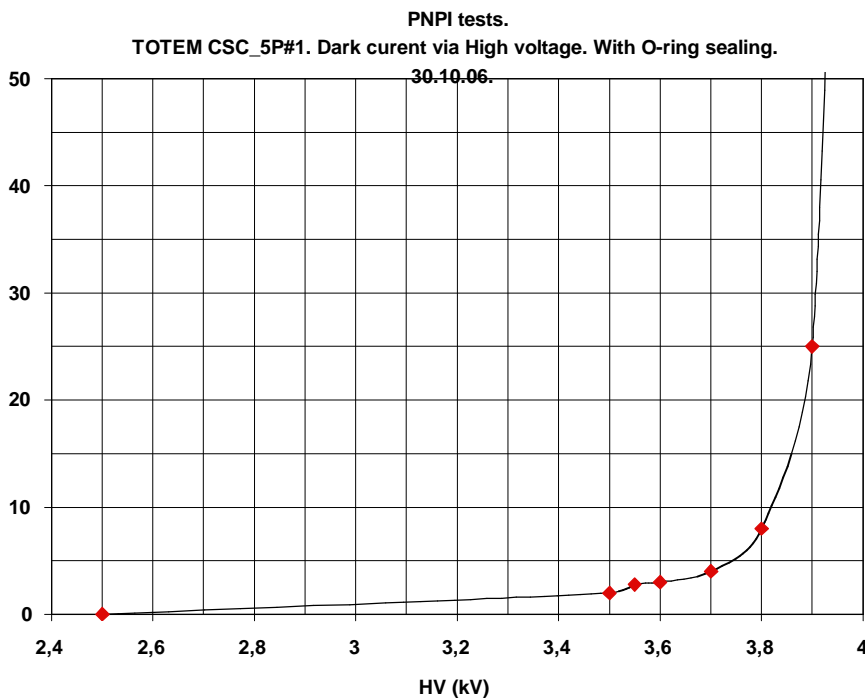
Chamber production at PNPI

Test set-up with temporary sealed chamber

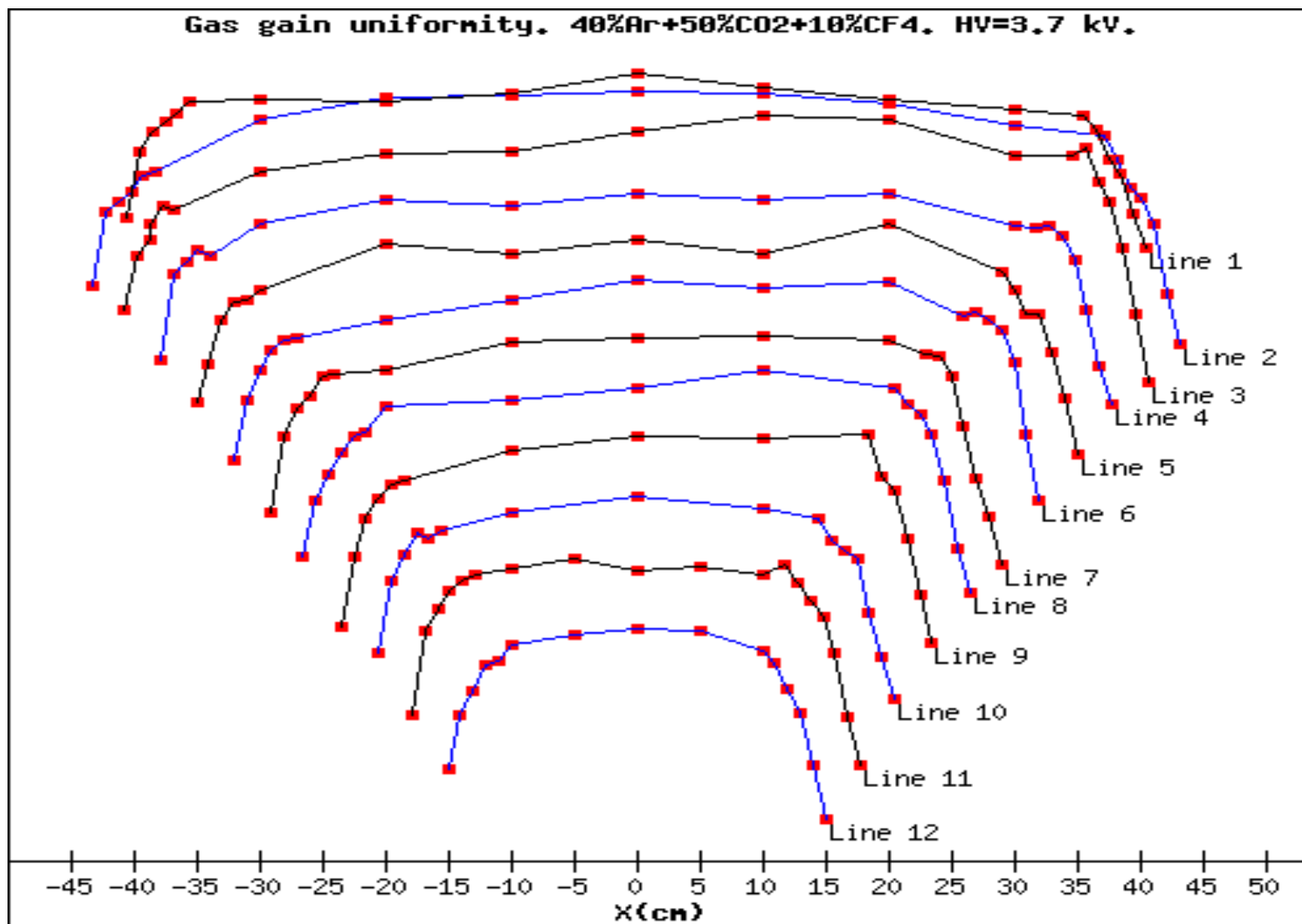


CSC characterization at PNPI

1. Very low dark current (few nA) at “usual” HV values, raise starting from HV= (3.8 - 3.9) kV;
2. After irradiation with strong ^{137}Ce source (about 15 mA), current returns to previous values \Rightarrow no self-sustained discharge;
3. **G**ain uniformity within $\pm 15\%$ throughout whole chamber

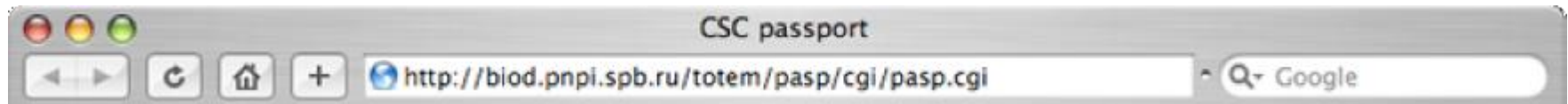


CSC gas gain uniformity



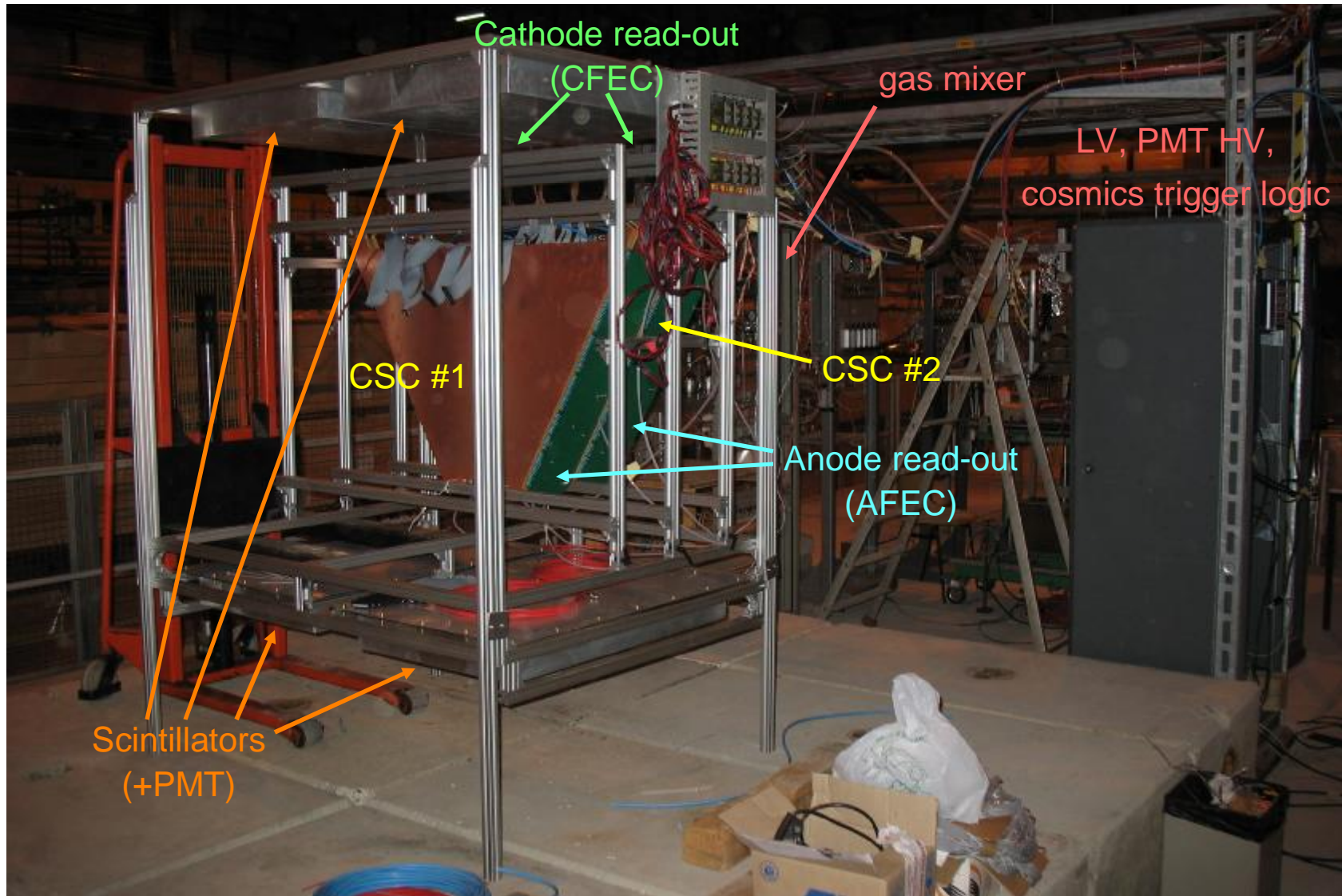
Production database

- All results of quality controls and measurements for each chamber are stored in a database. Data will be made available through a web interface: [example page](#) (in the works)



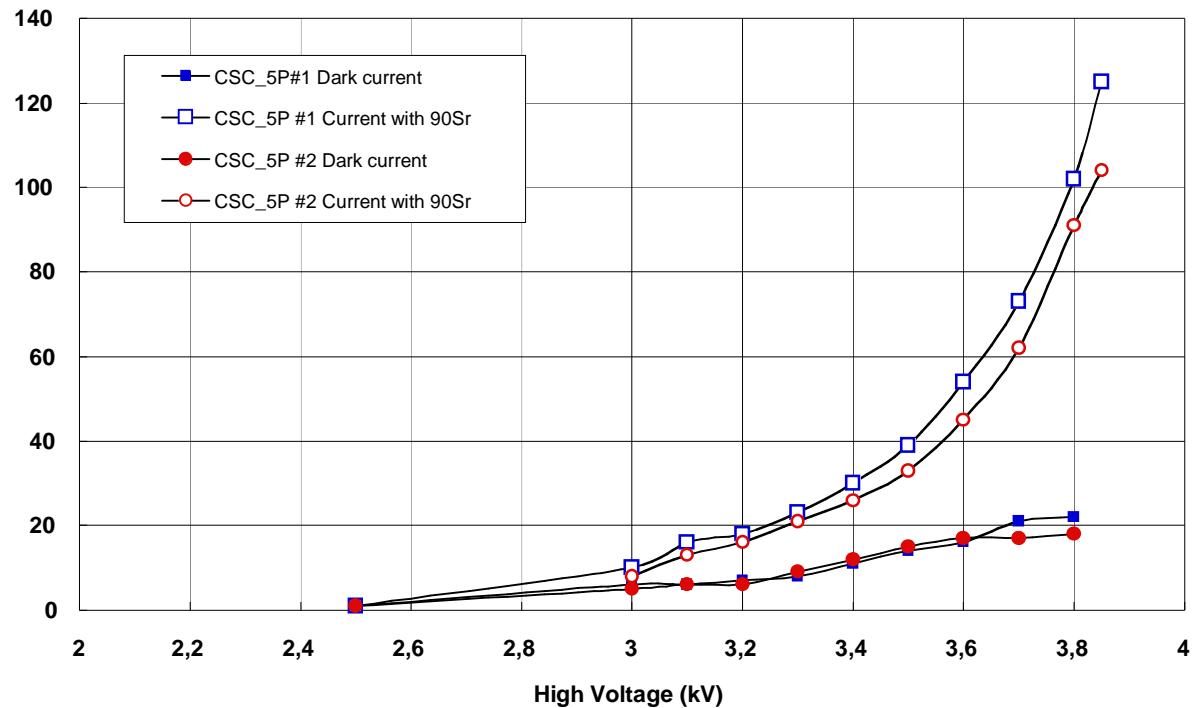
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Wire Panel ID:	001
Gas Panel ID:	001

Test beam set-up at CERN



Dark current measurements at CERN

Current vs. High Voltage for CSC_5P #1 and CSC_5P #2 (with/without of 90Sr)
20.11.2006



○ At high voltage values both chambers could clearly “see” the beam

Production status: CSC components

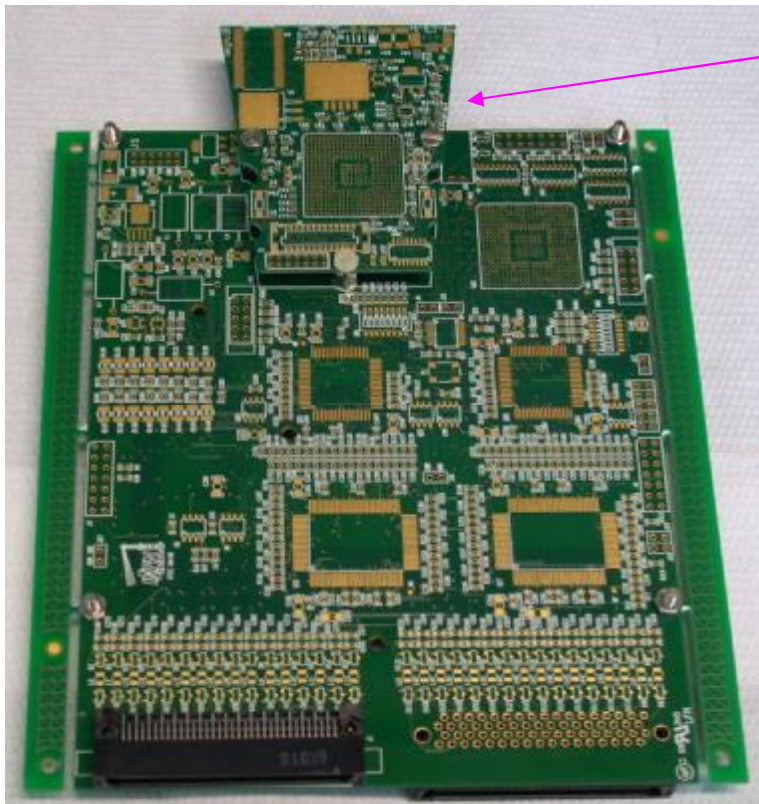
Tentative schedule for component readiness

CSC type	Wire-holder	Cathode panel	Gas frame
1P	ready	ready	ready
1G	ready	31/1/07	ready
2P	31/1/07	15/2 - 15/4/07	31/1/07
2G	31/1/07	15/2 - 15/4/07	31/1/07
3P	31/1/07	15/2 - 15/4/07	31/1/07
3G	31/1/07	15/2 - 15/4/07	31/1/07
4P	31/1/07	15/2 - 15/4/07	31/1/07
4G	31/1/07	15/2 - 15/4/07	31/1/07
5P (new)	31/1/07	31/1/07	ready
5G	ready	31/1/07	ready

- All material for 1/4 telescope: 15/3/07
- All CSC for 1/4 telescope assembled: 30/4/07 (proposal under discussion)

Production status: read-out electronics

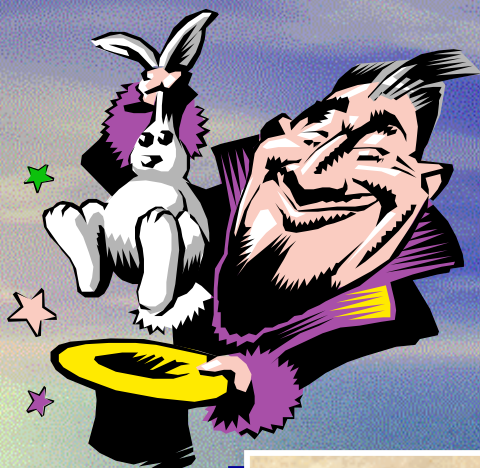
64-channel CFEC
(CMS digitization)



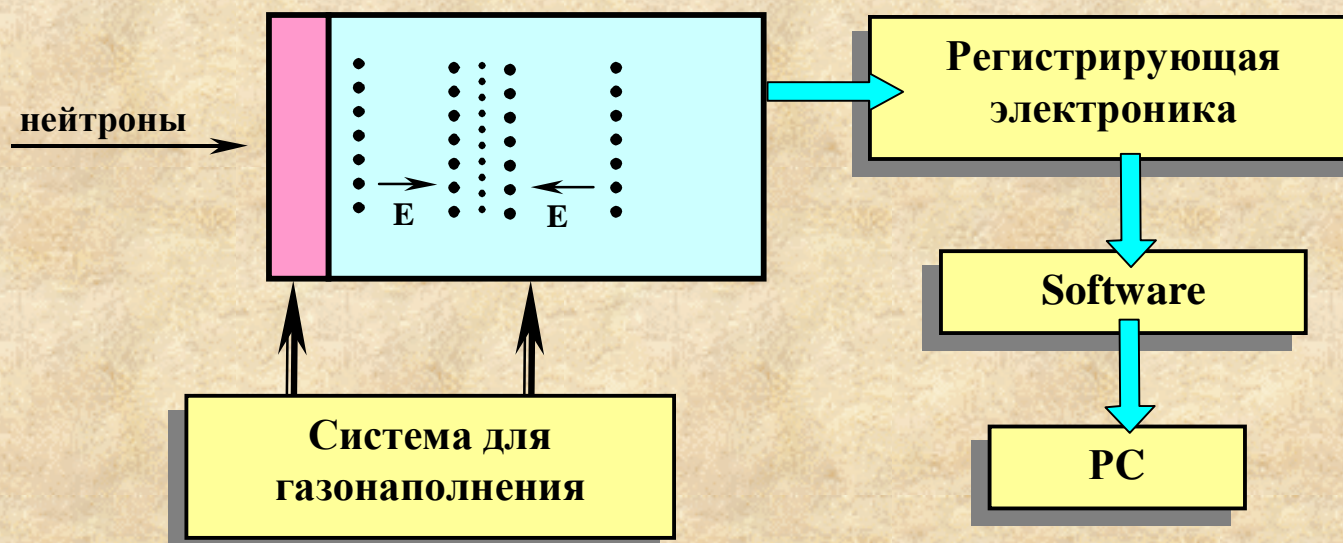
VFAT simulator

128-channel CFEC
(analog VFAT)



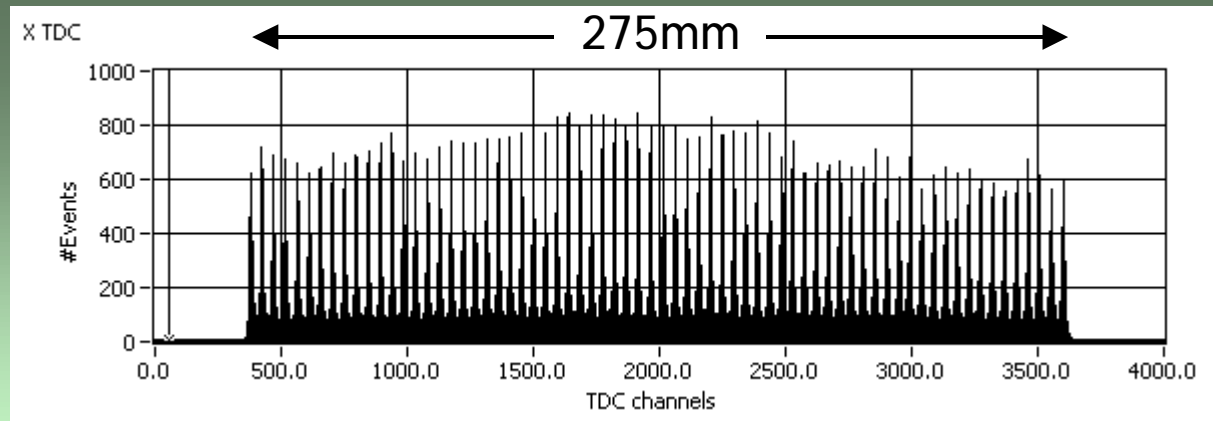


Нейтронный детектор.



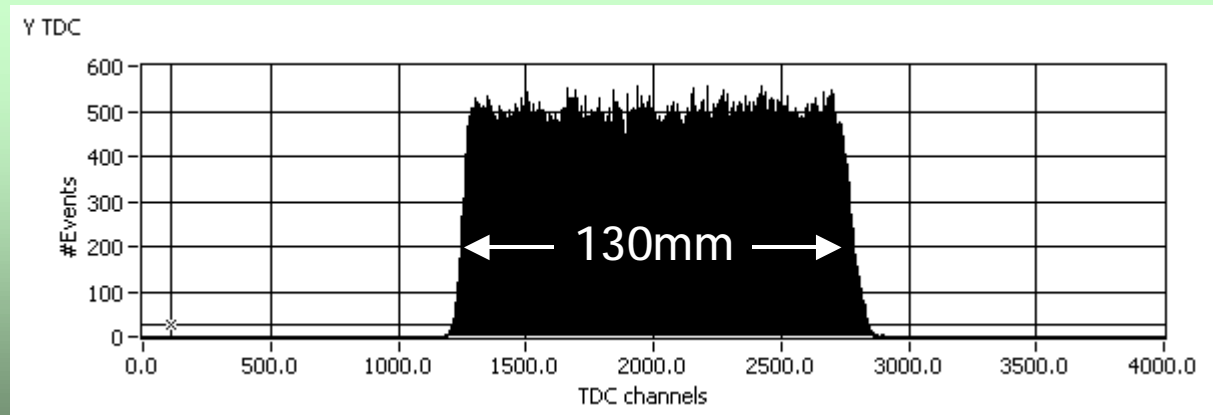
Position accuracy

Position error: $\pm 0.45\text{mm}$



Uniform illumination spectrum in the coarse resolution axis (X) obtained by neutron background

Differential nonlinearity for this figure is within $\pm 7\%$



Uniform illumination spectrum in the fine resolution axis (Y)

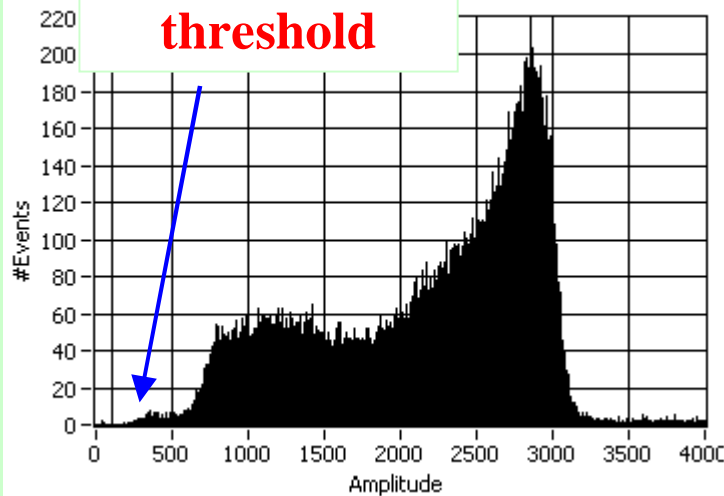
Thermal neutron spectra

${}^3\text{He} + n \rightarrow \text{p} + \text{T} + 764 \text{ keV}$

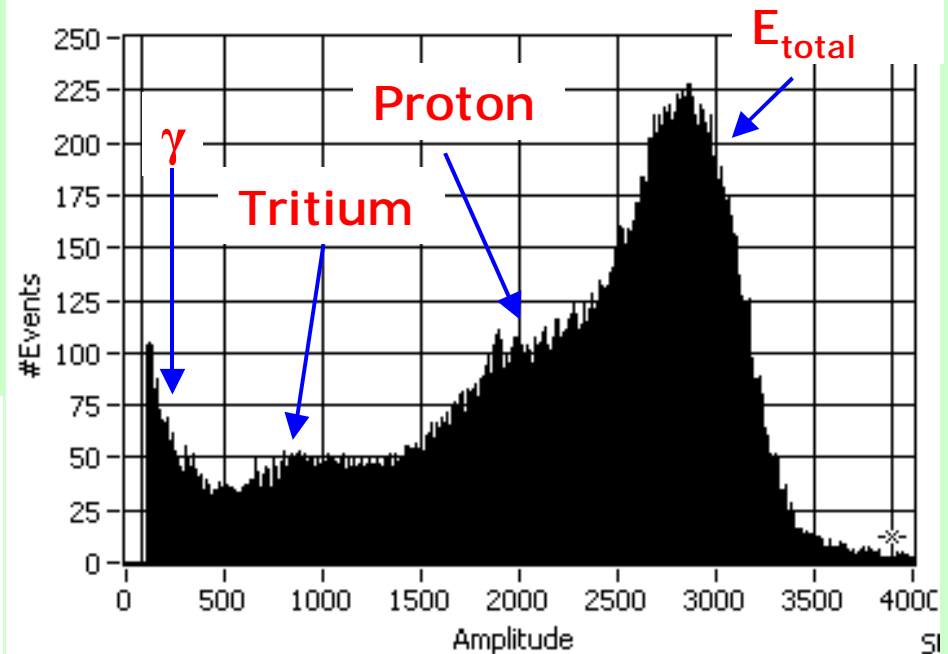
$E_p = 573 \text{ keV} (3/4 E_{\text{total}})$

$E_T = 191 \text{ keV} (1/4 E_{\text{total}})$

γ cuted off by
preamplifier
threshold

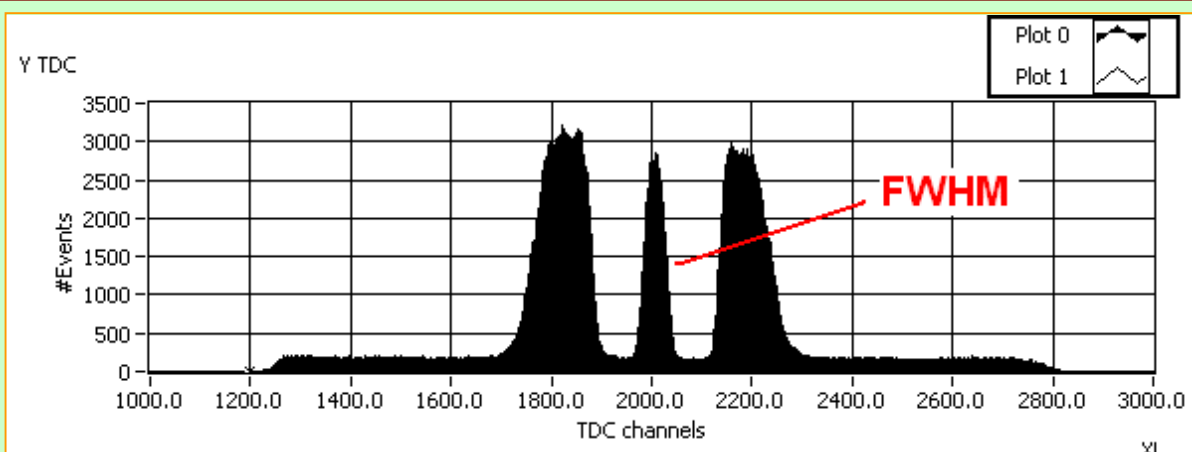


Thermal neutron energy spectra obtained in the proportional neutron counter (HV=-2250V)



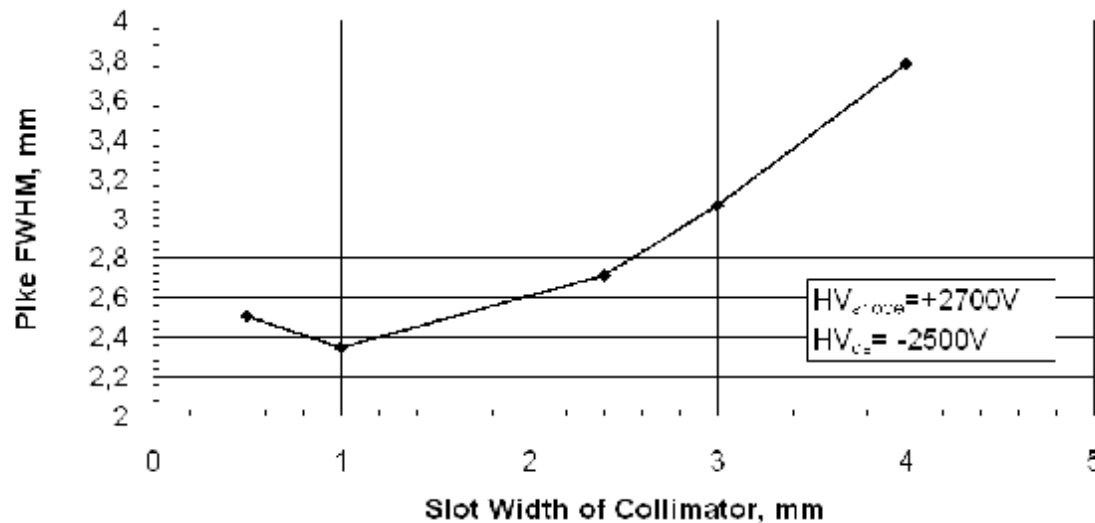
Thermal neutron energy spectra obtained in the ND (HVanode=2800V, HVds=-2500V)

Position resolution measurement (one point)



The pike in the fine resolution axis obtained by narrow (4mm) thermal neutron beam.

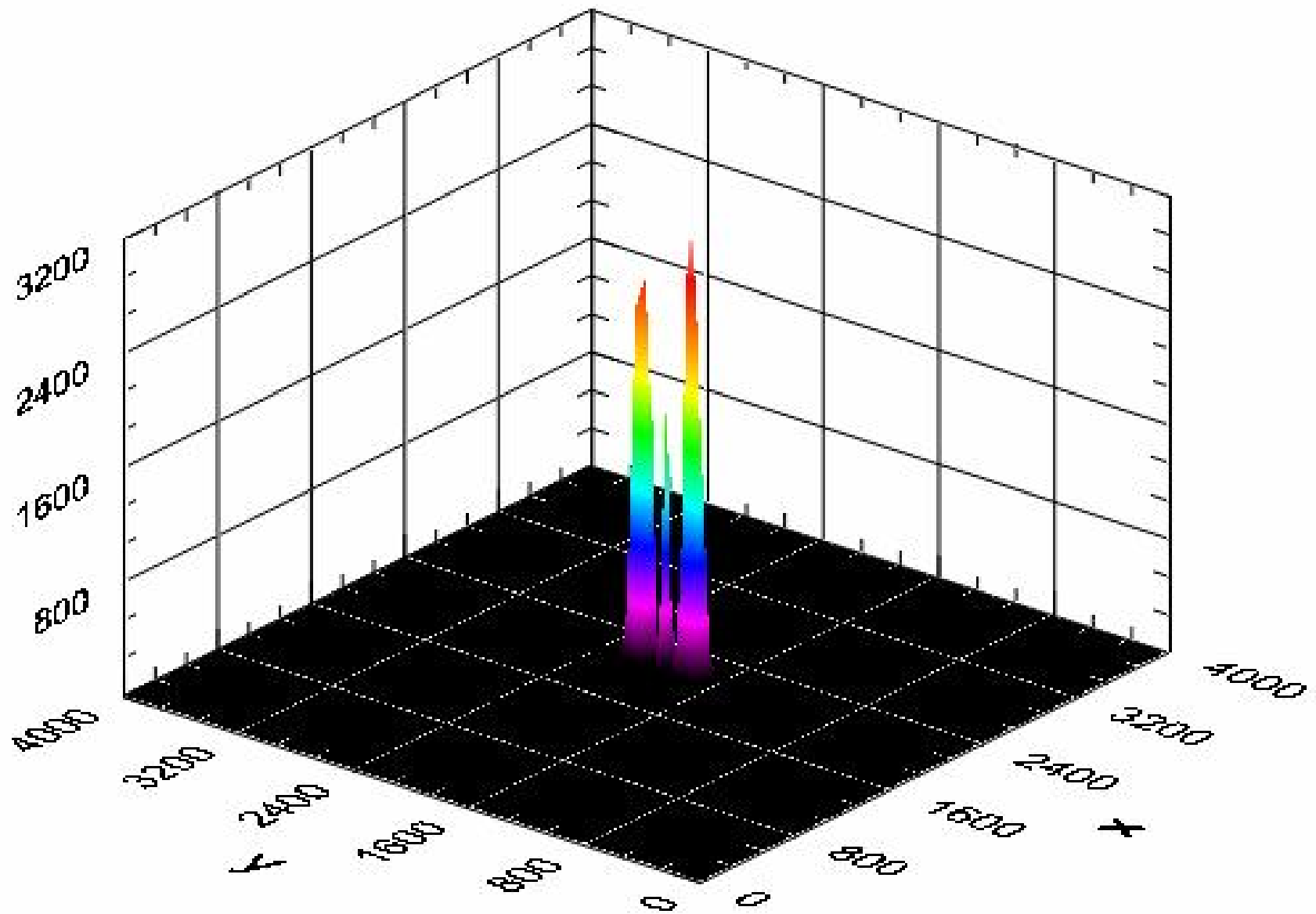
Neutron detector position resolution
(in the fine resolution axis)



The neutron pike width stay constant after 2.4mm-collimator.

So,

FWHM is about 2.5mm



Эксперимент «Эпикур» (В. В. Сумачев)

1. Сделана часть трековой системы на базе ПК с шагом 1мм и апертурой 200*200мм.
2. ПК успешно прошли испытания на пучке ИТЭФ.

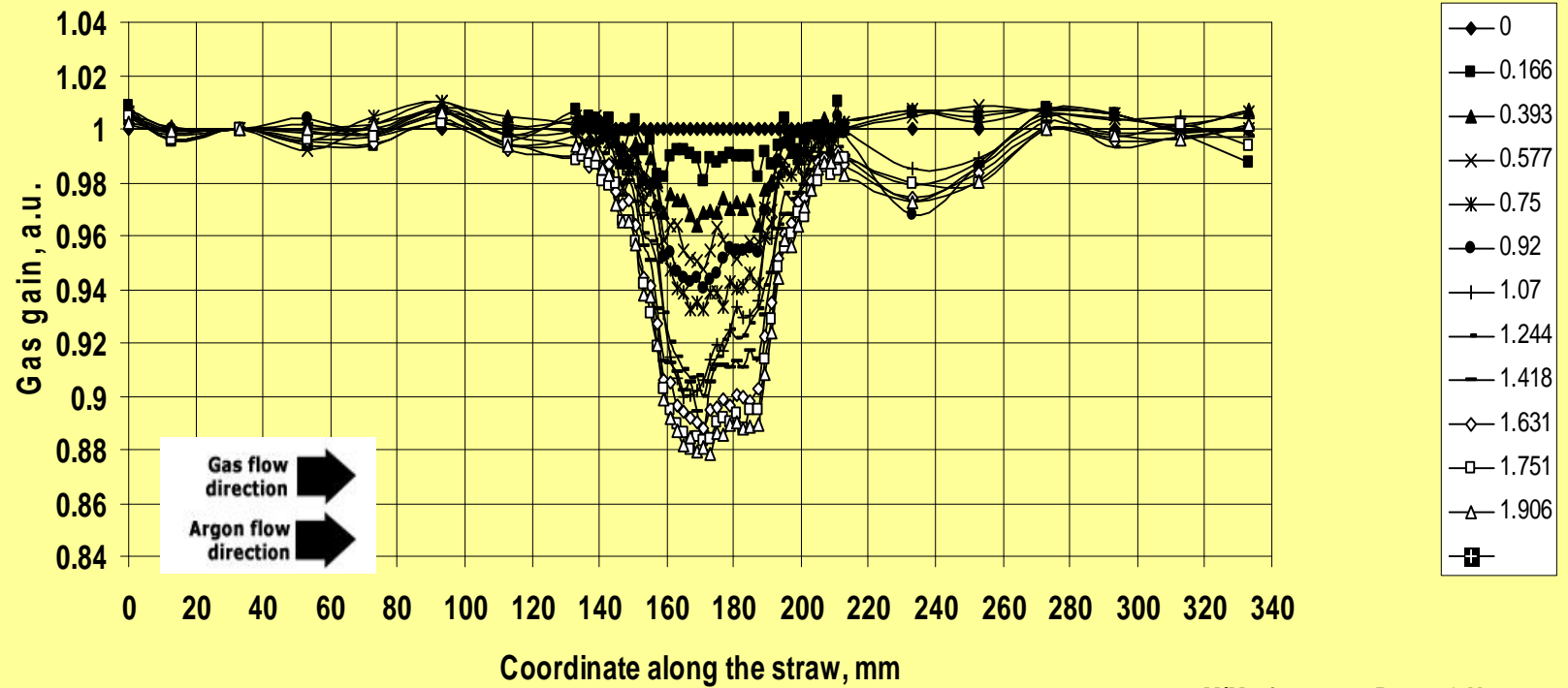
The background of the slide is a photograph of a sunset over the ocean. The sky is a deep blue with wispy white clouds, and the sun is low on the horizon, creating a bright orange and yellow glow. The water in the foreground is dark blue with gentle ripples. A large, bright yellow rectangular box is centered on the slide, containing the title text in red.

**Старение детекторов частиц
в интенсивных
радиационных полях**

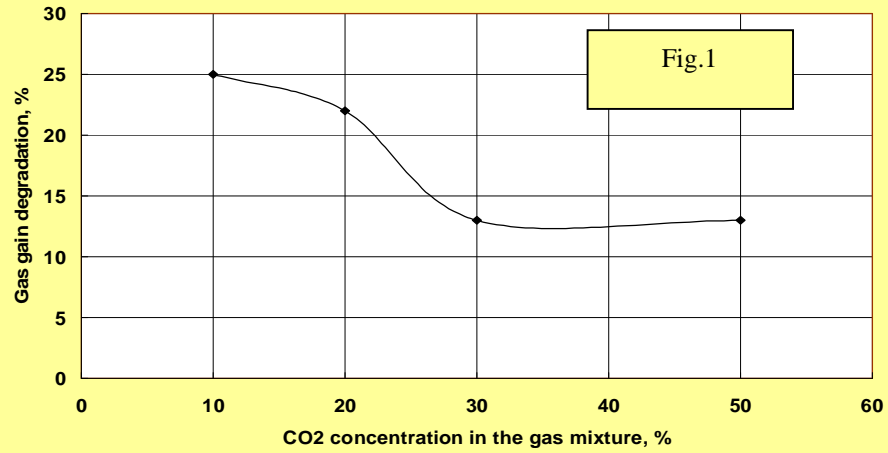
Task 34. Relative gas gain distribution along the straw for different accumulated dose.

Ar+20% CO₂+10% CF₄, Wire diameter - 35mcm, FWHM=34mm, Right straw, HV=1687 V

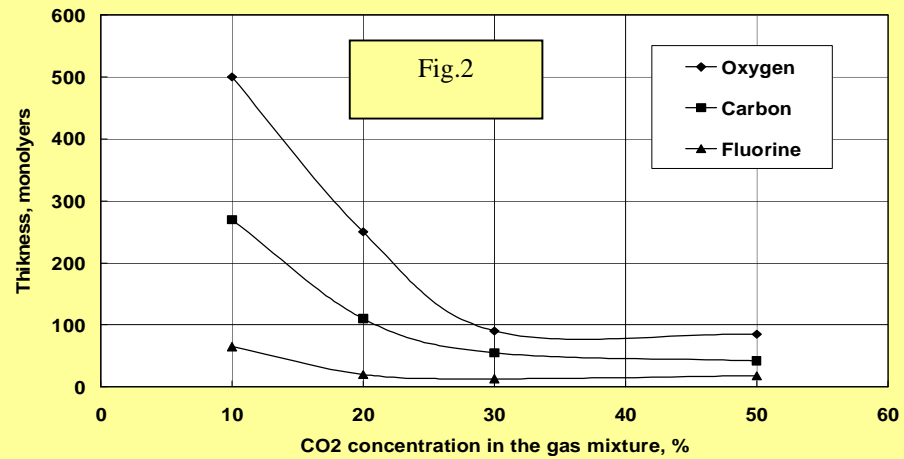
14.12.05 - 27.12.05



Gas gain degradation after the charge accumulation of 1.7 C/cm for different concentration of CO₂ in the gas mixture Ar+CO₂+10%CF₄. Gas gain is 100000.



Element's amount accumulated by anode wire after the charge accumulation of 1.7 C/cm for different concentration of CO₂ in the gas mixture Ar+CO₂+10%CF₄. Gas gain is 100000.





ОФВЭ, С Новым 2007 годом.

**43 лет – это время
МОЛОДОСТИ И СИЛЫ.**

