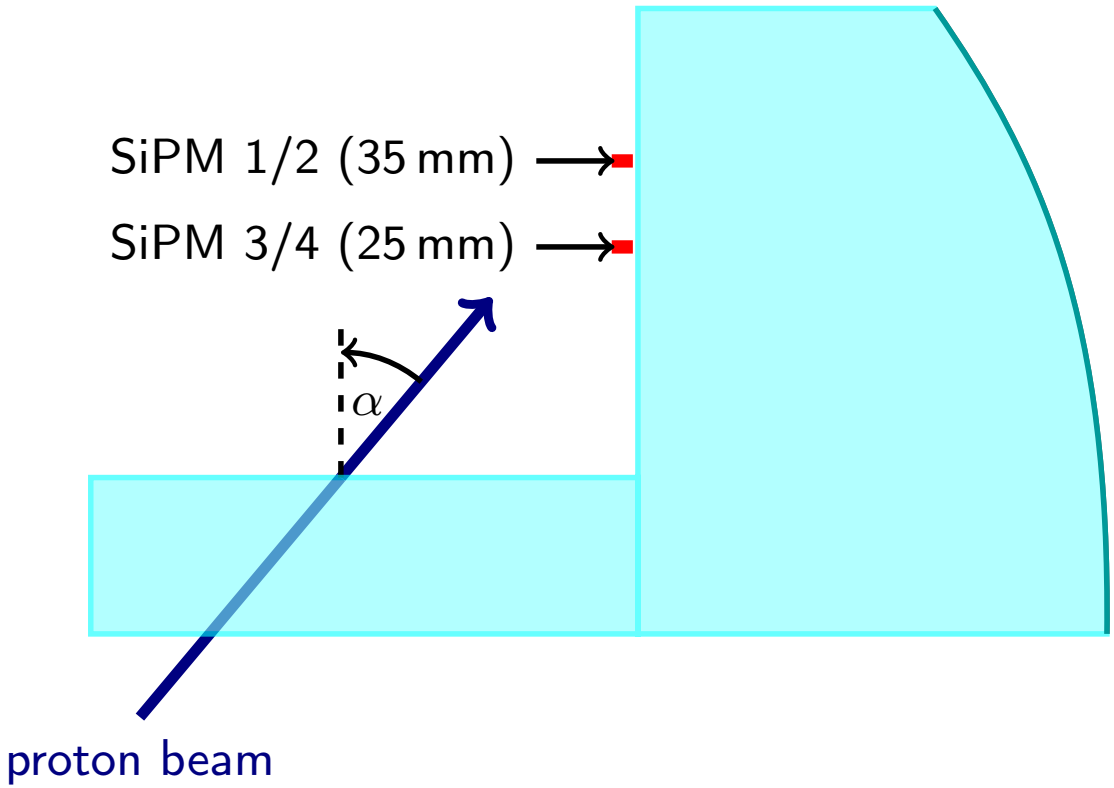
Test of the focusing TOP design using G-APDs at the Jülich test beam

Peter Koch *on behalf of the Gießen group*

Justus-Liebig-Universität Gießen, Germany

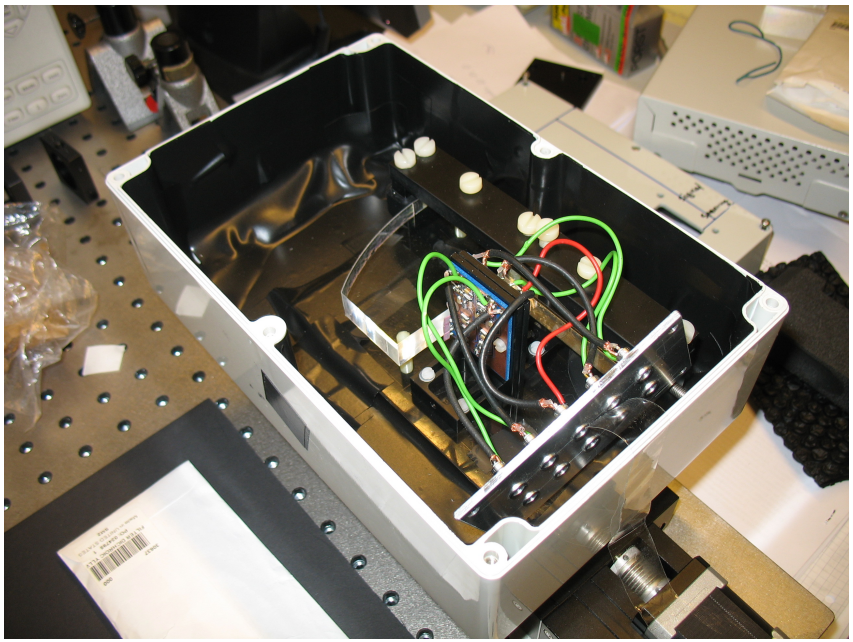
PANDA Collaboration Meeting, March 2010

Prototype for test beam at COSY

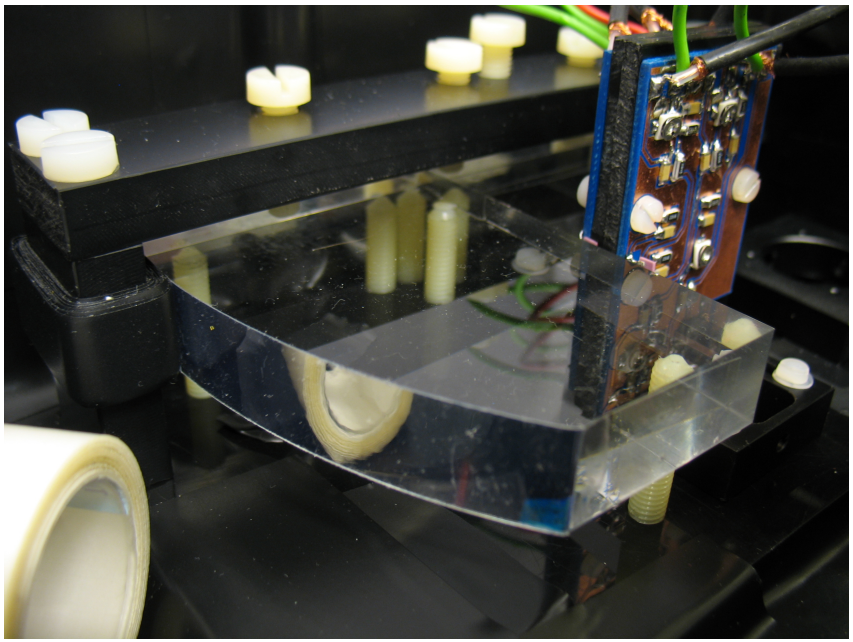


- Radiator bar (instead of disc): acrylic glass, $70\,\text{mm} \times 20\,\text{mm} \times 15\,\text{mm}$
- Focusing element: acrylic glass
- Mirror: VM2000 reflective foil
- Photo sensors: 4 SiPMs (G-APDs) from Moscow Engineering Physics Institute (MEPhI)

Light guide in lab

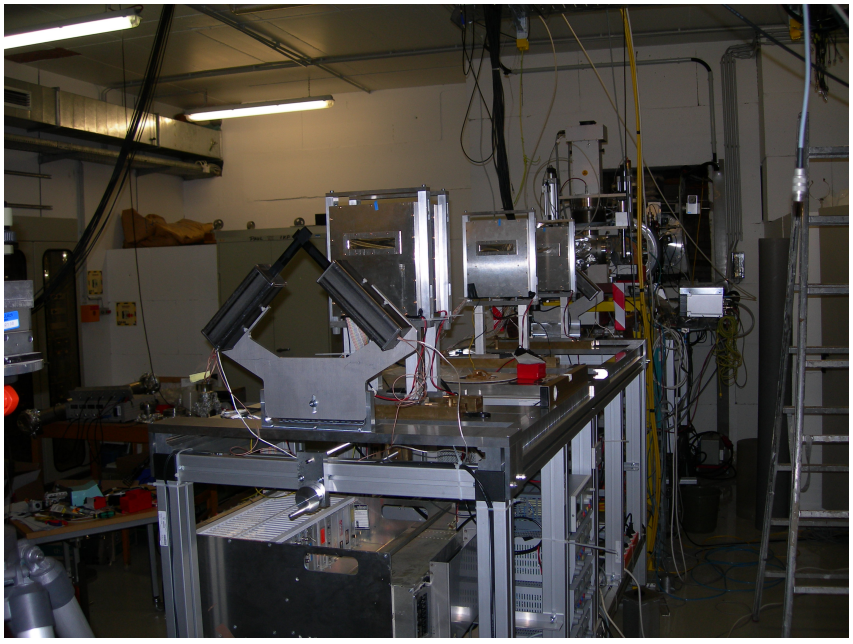


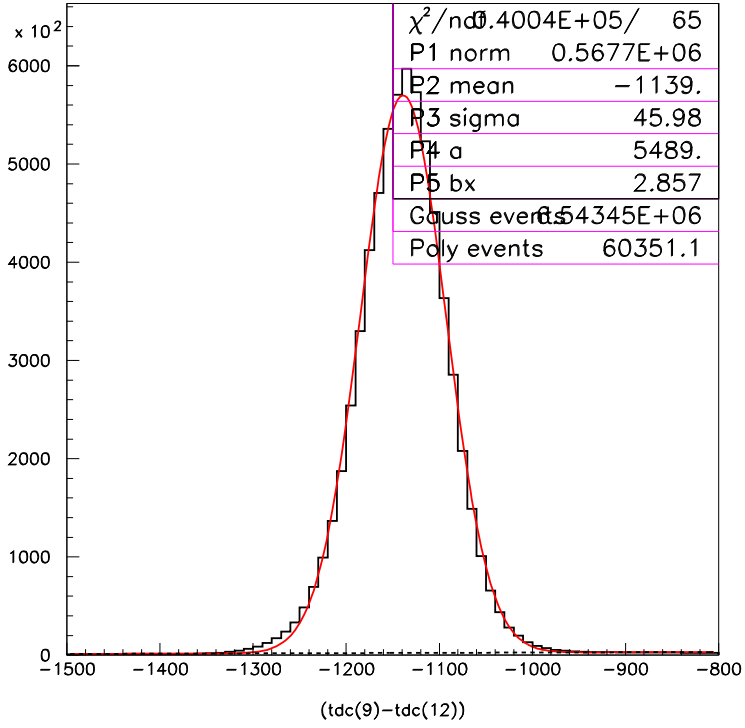
The light guide inside its box.



Curved surface with VM2000 mirror foil.

Trigger system



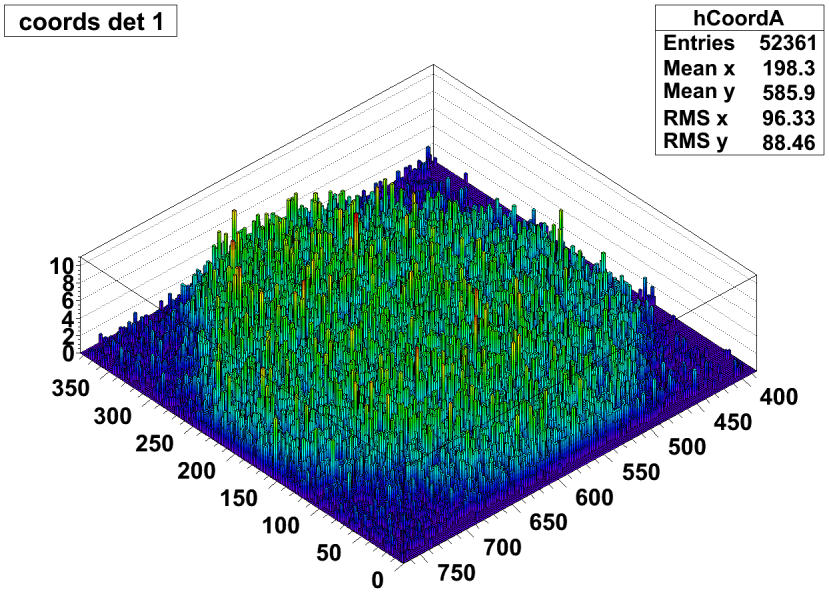


4 silicon strip detectors (tracking)
4 scintillators (trigger)

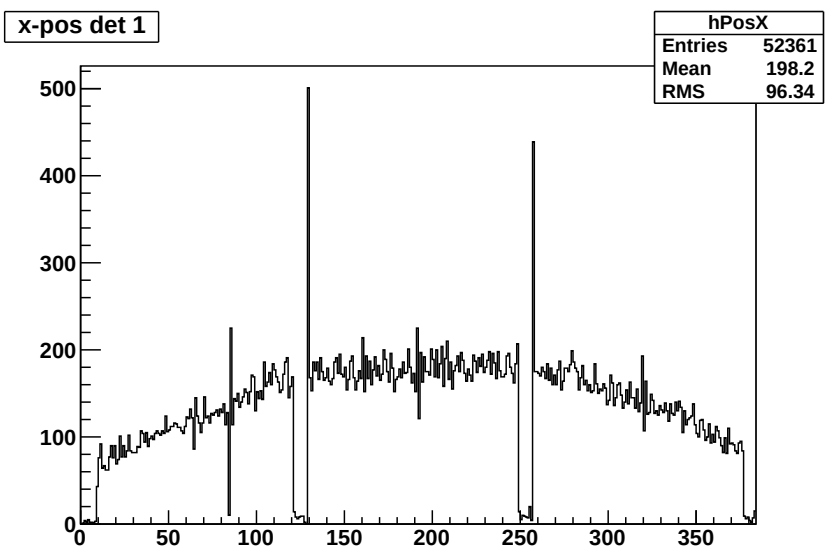
Time difference between scintillators, $\sigma \approx 1.1$ns

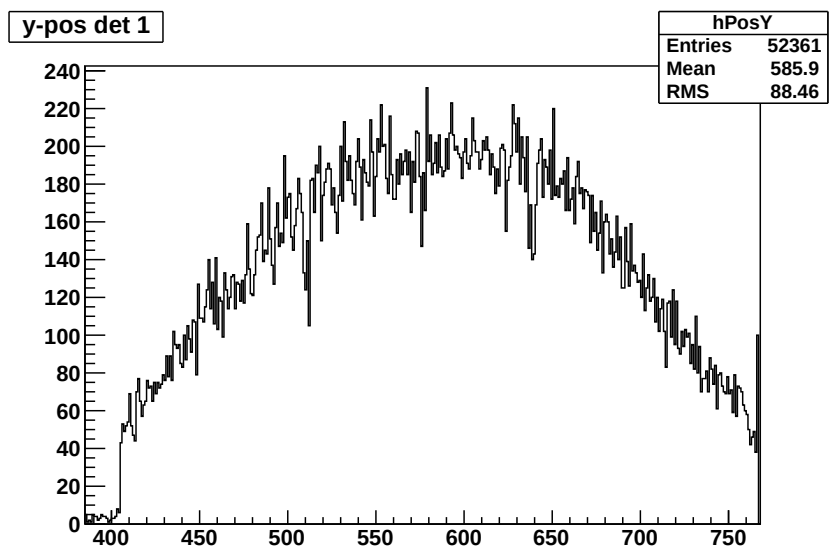
trigger = coincidence in all 4 scintillators
proton beam momentum = 2.95 GeV/c

Coordinates in a tracking detector

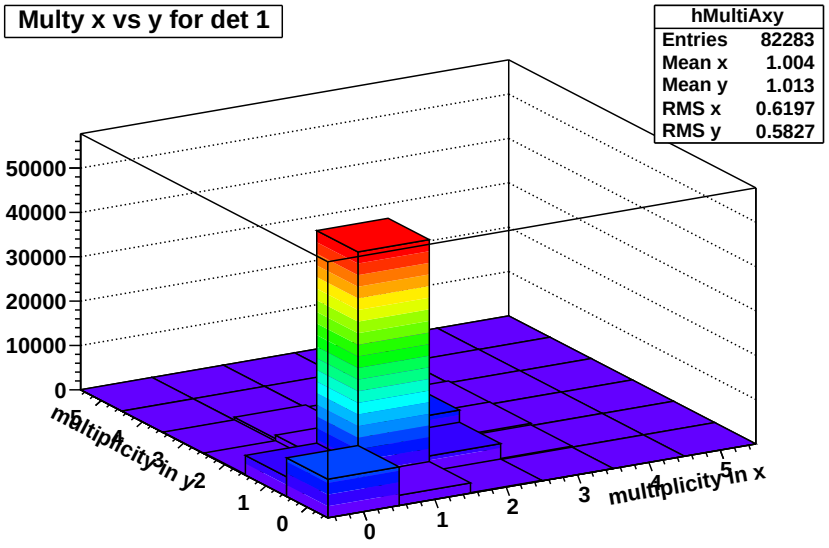


Tracking is done by Bonn group.
See talks by Simone and Hans-Georg.
All axes are ADC Channels and counts.

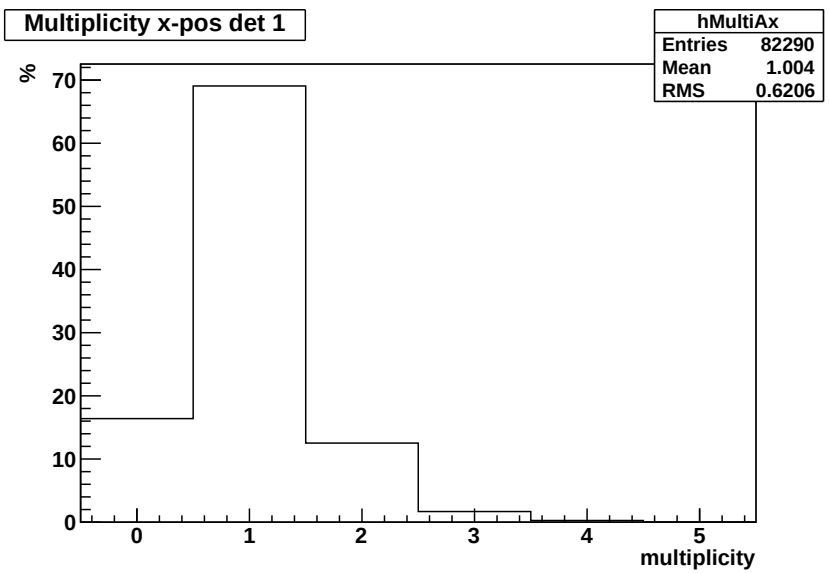


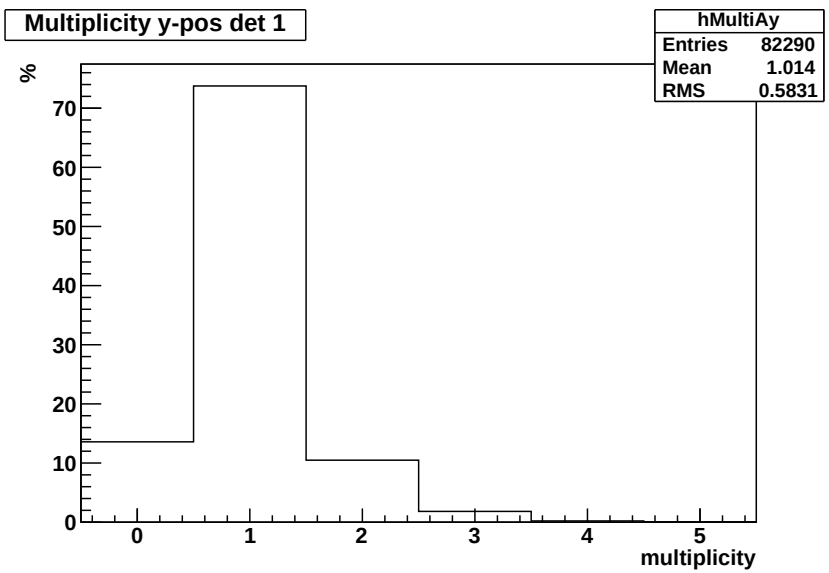


Multiplicity for a tracking detector

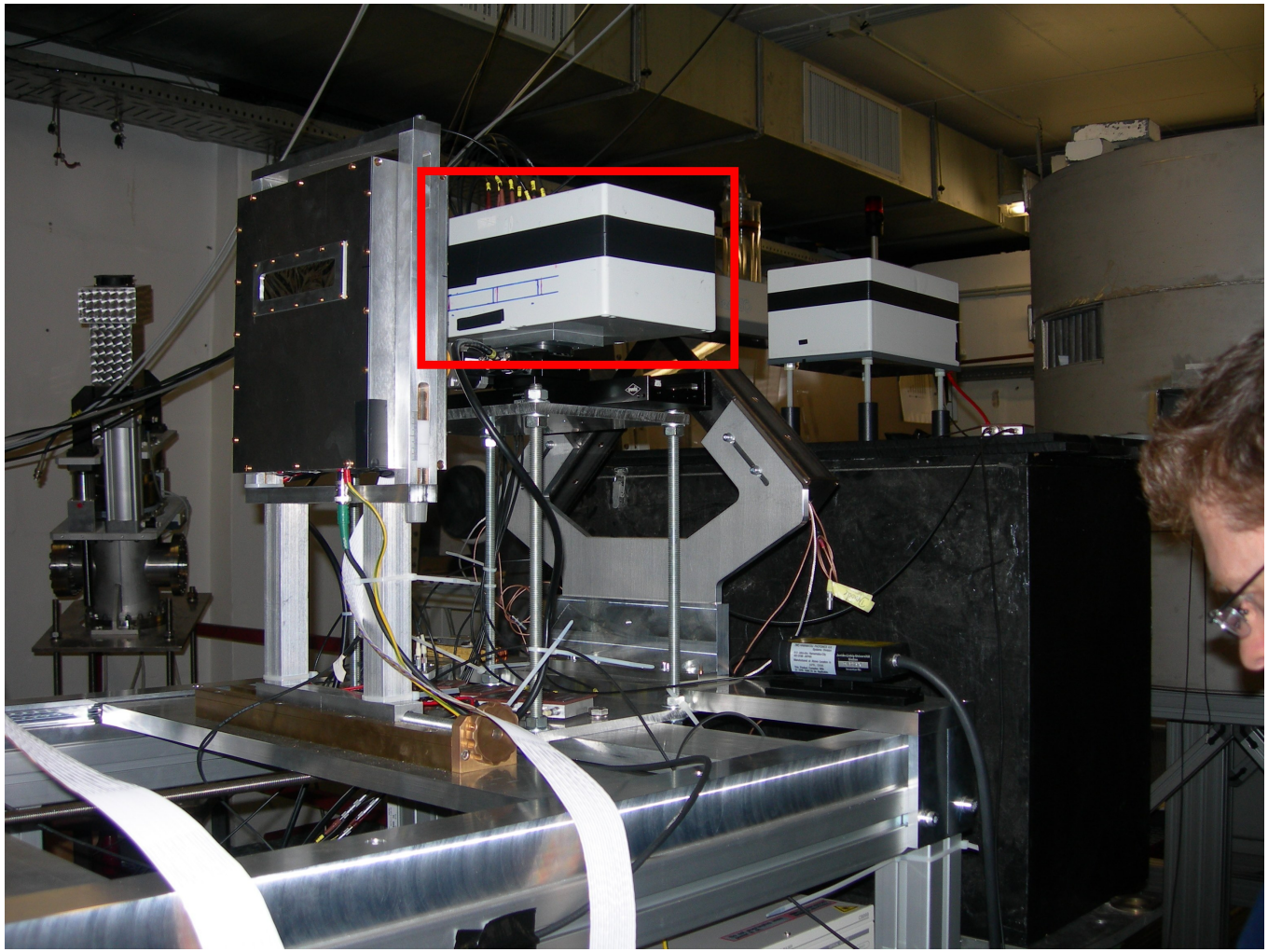


The multiplicity in tracking detectors (2 planes with 384 strips each). In most cases 1 strip per plane gives a signal.



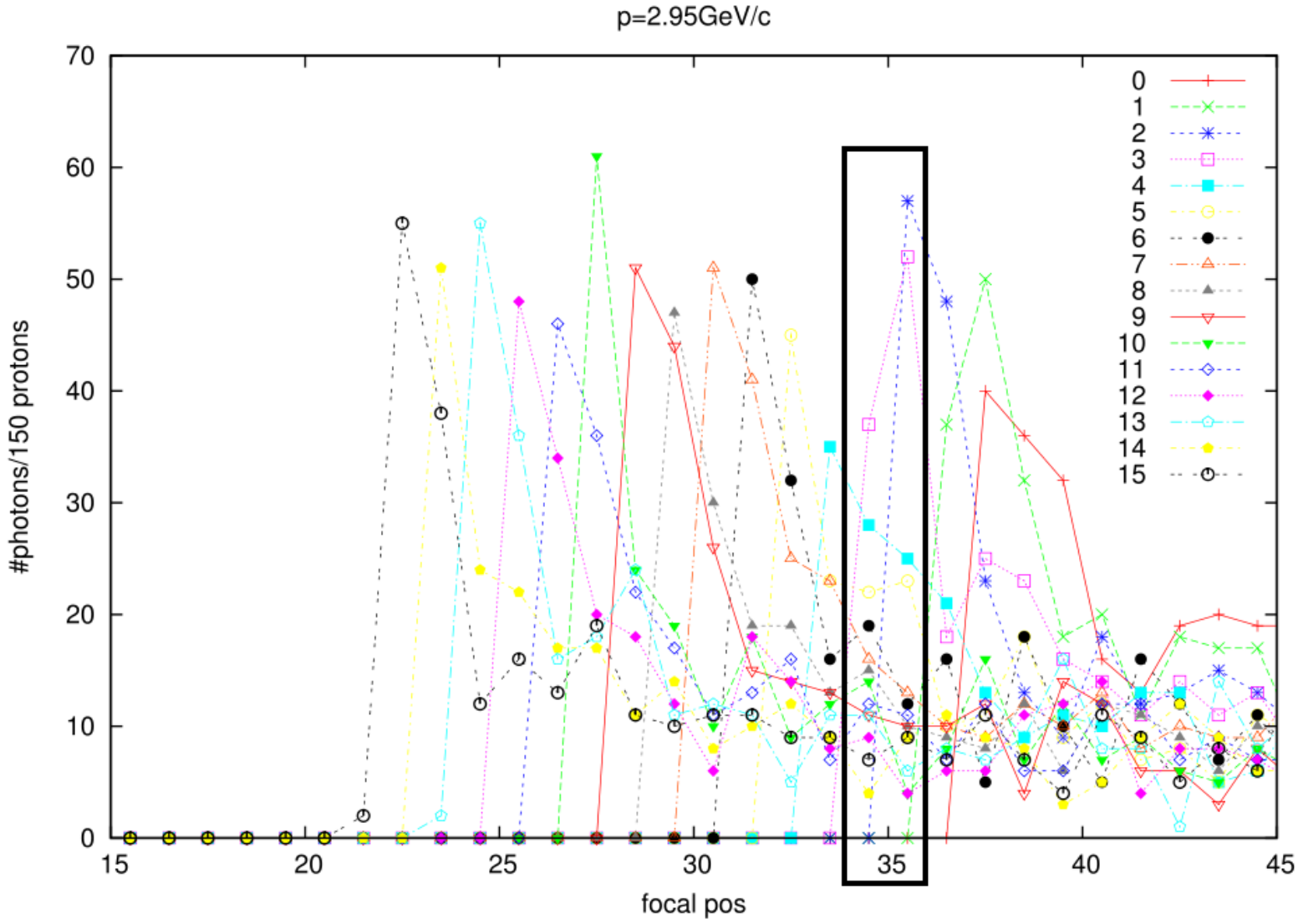


COSY test beam hall - JESSICA / NEM area



Our light guide test prototype.

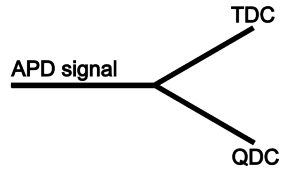
Simulation

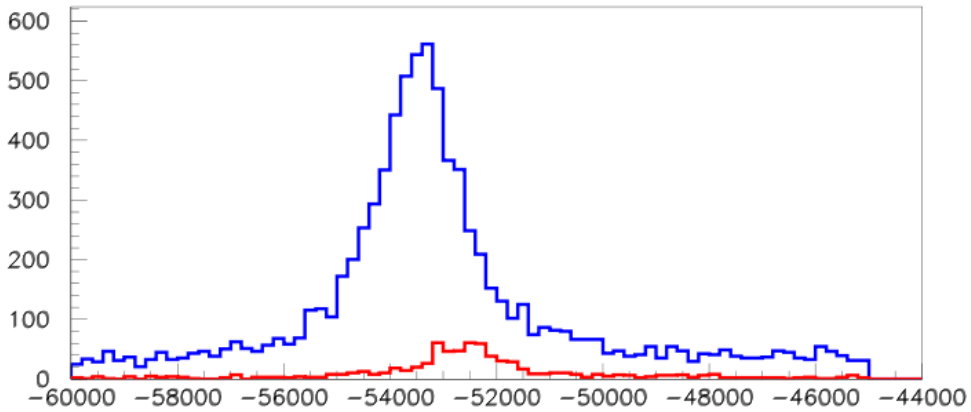


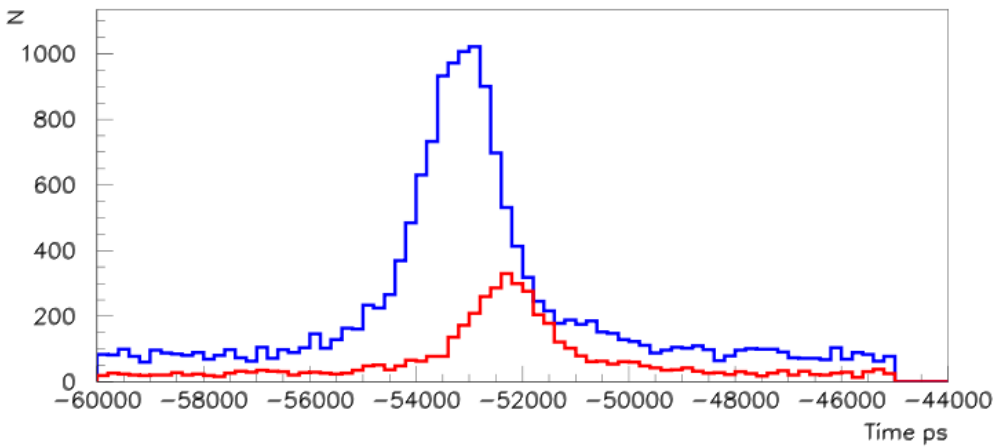
For APD1 and APD2 (position 35mm) we would expect
$\approx$ 50 photons per 150 protons per mm^2 under 3°

TDC and QDC

APD signal needs to be split to connect to TDC and QDC



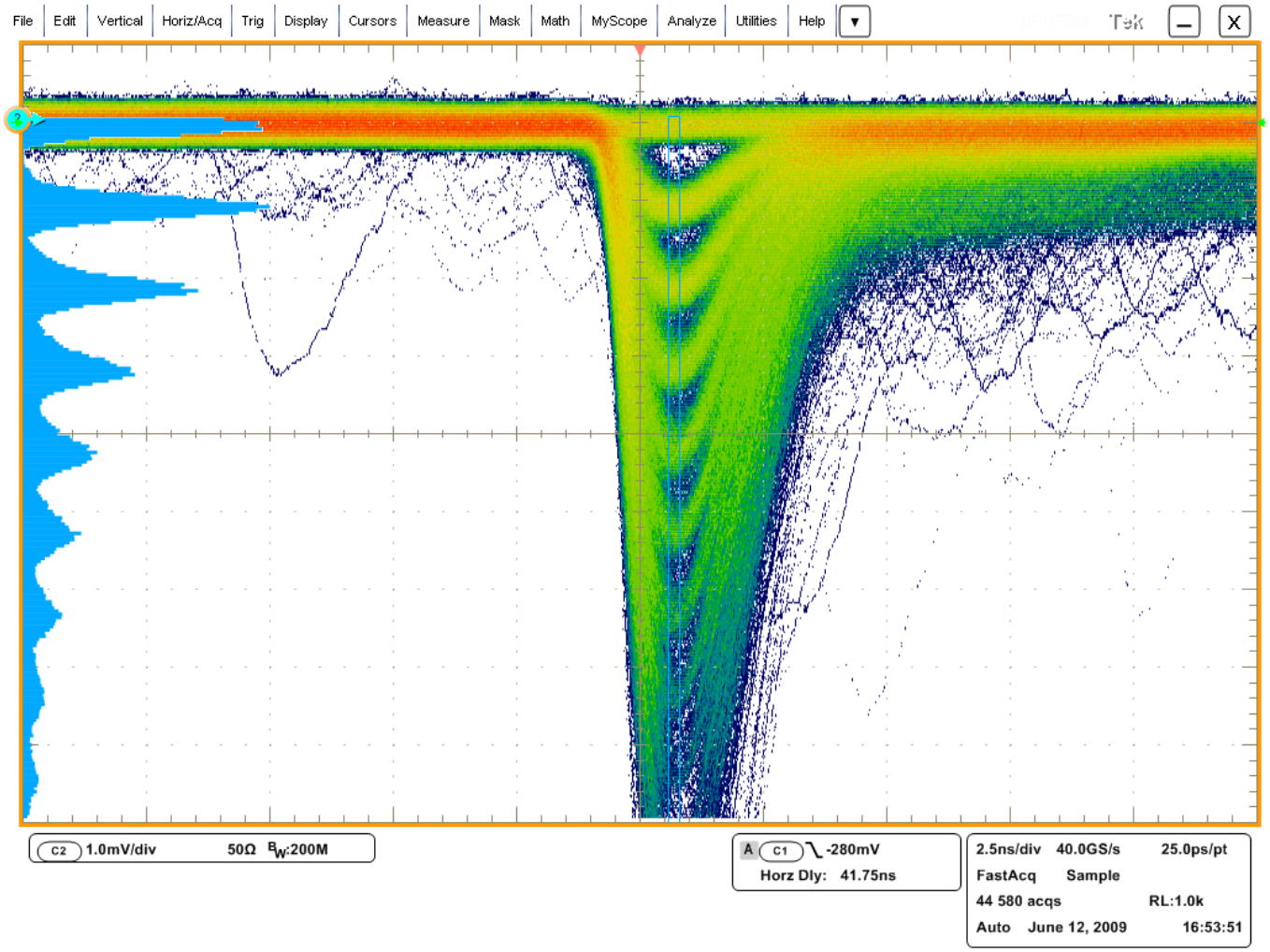




TDC spectra
red: with splitter for QDC signal
blue: without

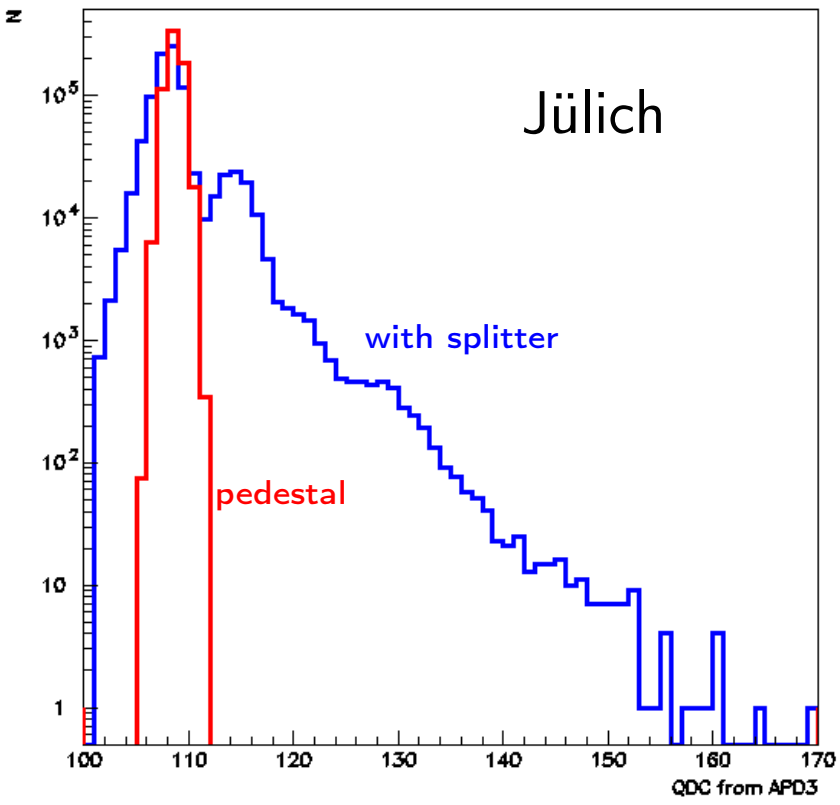
- Number of TDC events (above discriminator threshold) is very low
- Decided not to use splitter for QDC

Single photons?

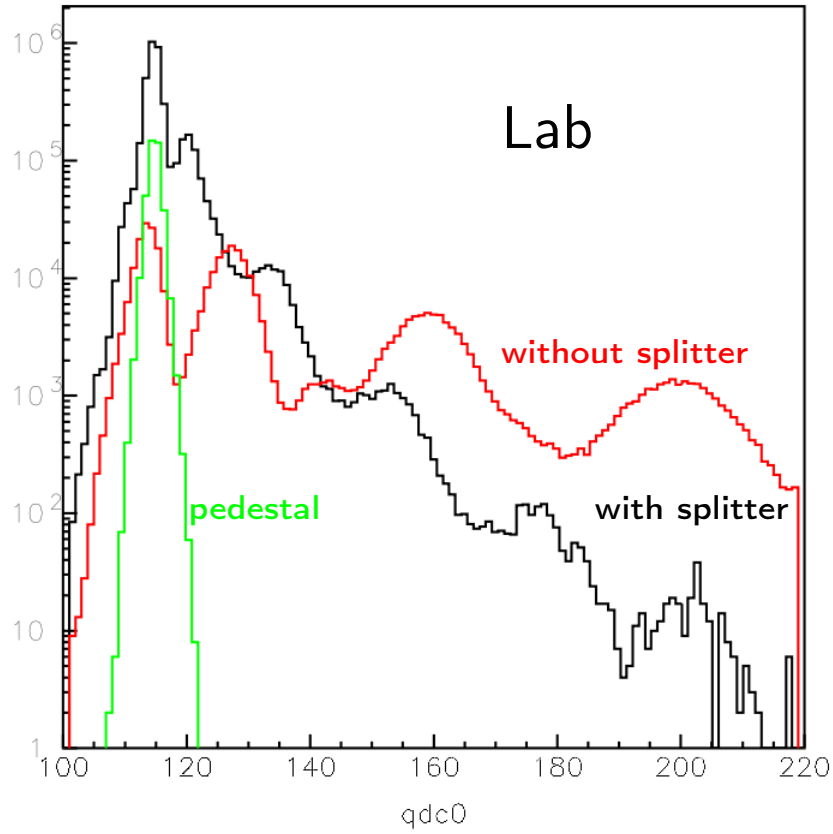


Laser test: signals for $0, 1, 2, \ldots, 8$ detected photons

Single photons?



Measured QDC spectra in Jülich test beam

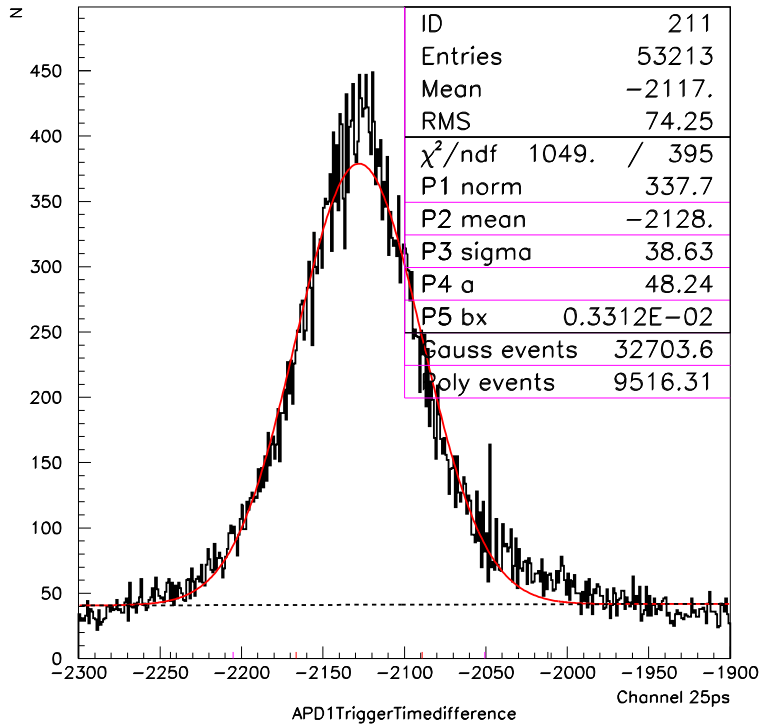


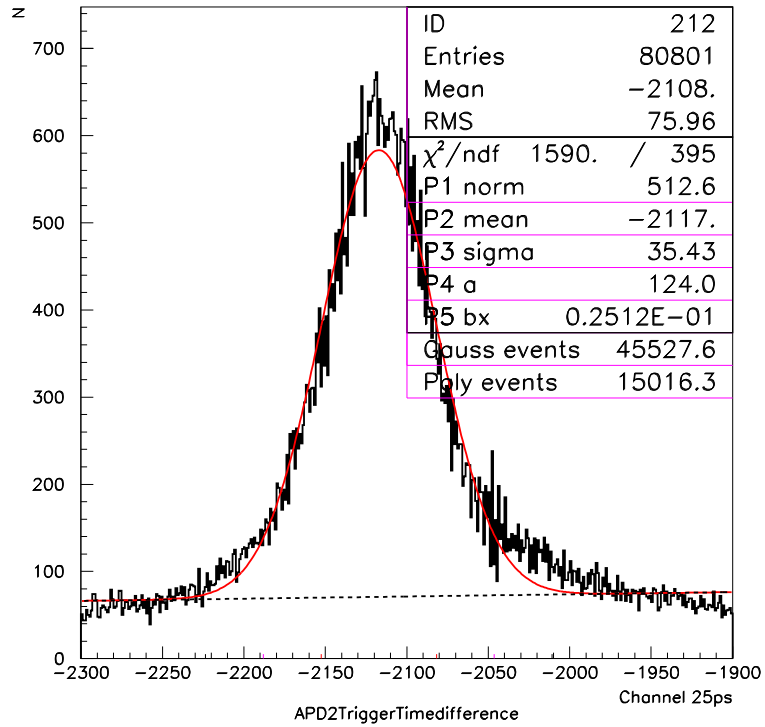
Measured QDC spectra in lab using laser

90% of Jülich events are single-photon-events

APD1 and APD2

Jülich data - 11 059 510 trigger





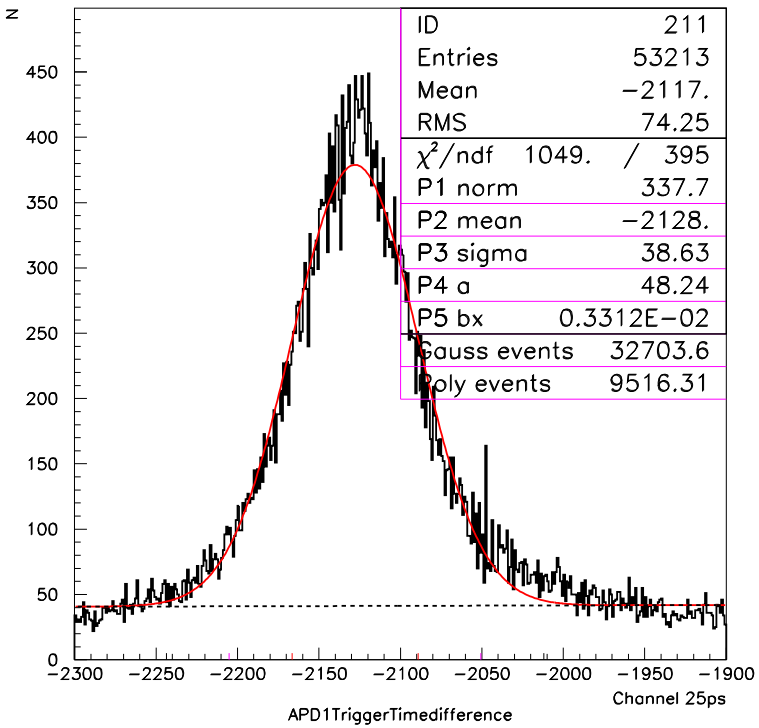
Time difference between APD1 and trigger; about 33 000 events

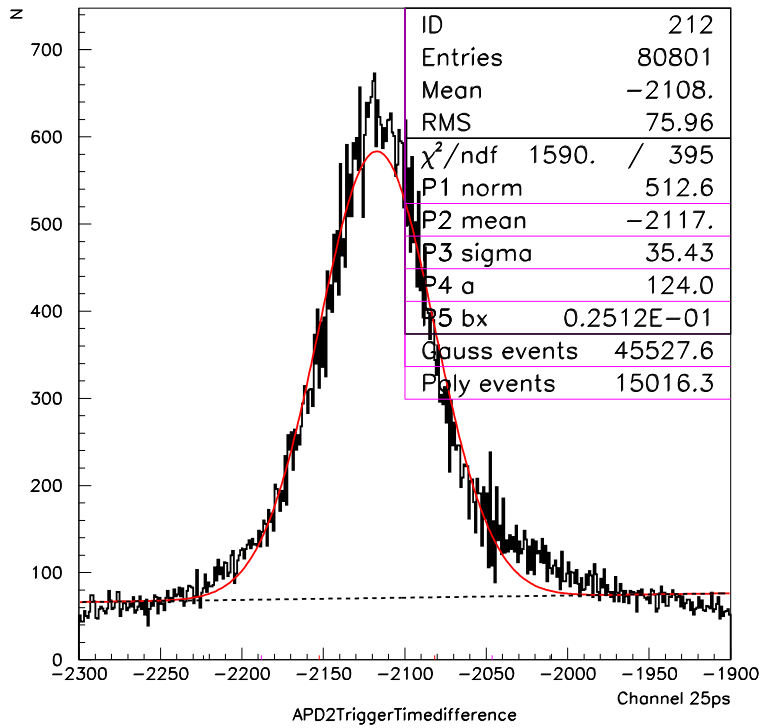
Time difference between APD2 and trigger; about 45 000 events

simulation: 3 700 000 events expected!
to be understood!

APD1 and APD2

11 059 510 trigger



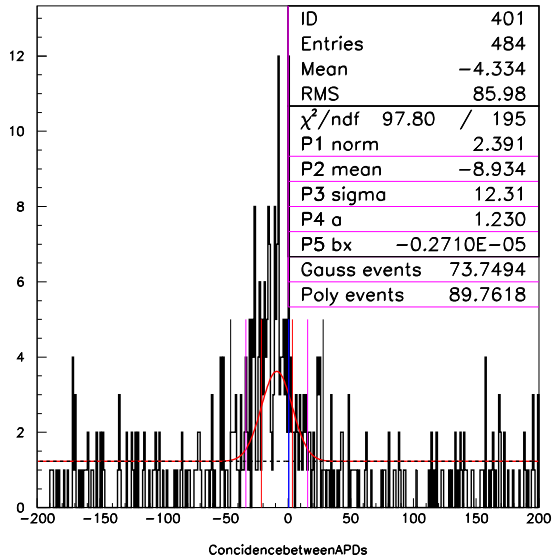


Fraction of triggers with photon signal:

Expected: $\frac{3.7\text{mil}}{11\text{mil}} \approx 33\%$

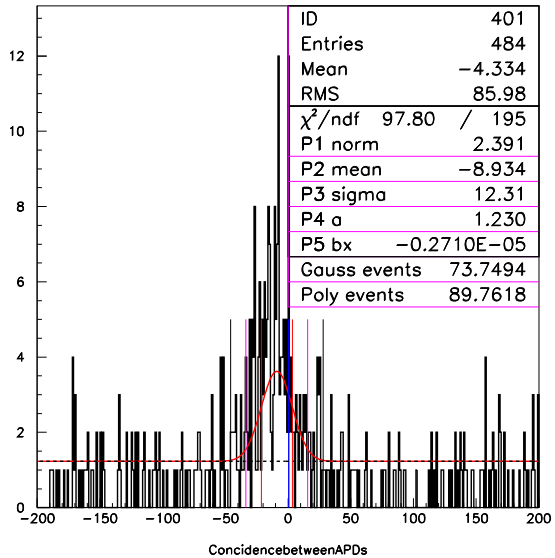
Measured: $\frac{45\text{k}}{11\text{mil}} \approx 0.4\%$

Coincidence between APD1 and APD2



$\sigma \approx 308$ps

Coincidence between APD1 and APD2

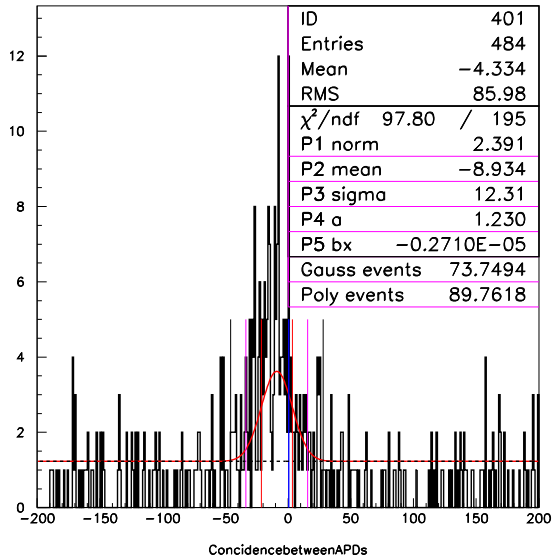


$\sigma \approx 308\text{ps}$

For single APD:

$$\sigma \approx \frac{308\text{ps}}{\sqrt{2}} \approx 218\text{ps}$$

Coincidence between APD1 and APD2



$\sigma \approx 308\text{ps}$

For single APD:

$\sigma \approx \frac{308\text{ps}}{\sqrt{2}} \approx 218\text{ps}$

very low statistics,

expected from simulation:
$(0.33)^2$ $\approx 11\%$

expected from single rate:
$(0.0030) \cdot (0.0041)$ $\approx 0.0012\%$

measured rate:
$\frac{73}{11\text{mil}}$ $\approx 0.0007\%$

Thanks

- unfortunately not much beam time
- very low statistics
- We have to understand the small photon rates.

Thanks

- unfortunately not much beam time
- very low statistics
- We have to understand the small photon rates.

The Giessen group thanks the Bonn and Jülich groups for sharing their equipment (tracking, DAQ, ...) and the good collaboration!

We are looking forward to and are preparing ...

Next test beam - April 2010

Disc prototype (half size of half disc)

We plan to equip disc with light guide(s)
and probably APDs, similar to the previous test beam