Performance of double-strip prototype of the J-PET detector

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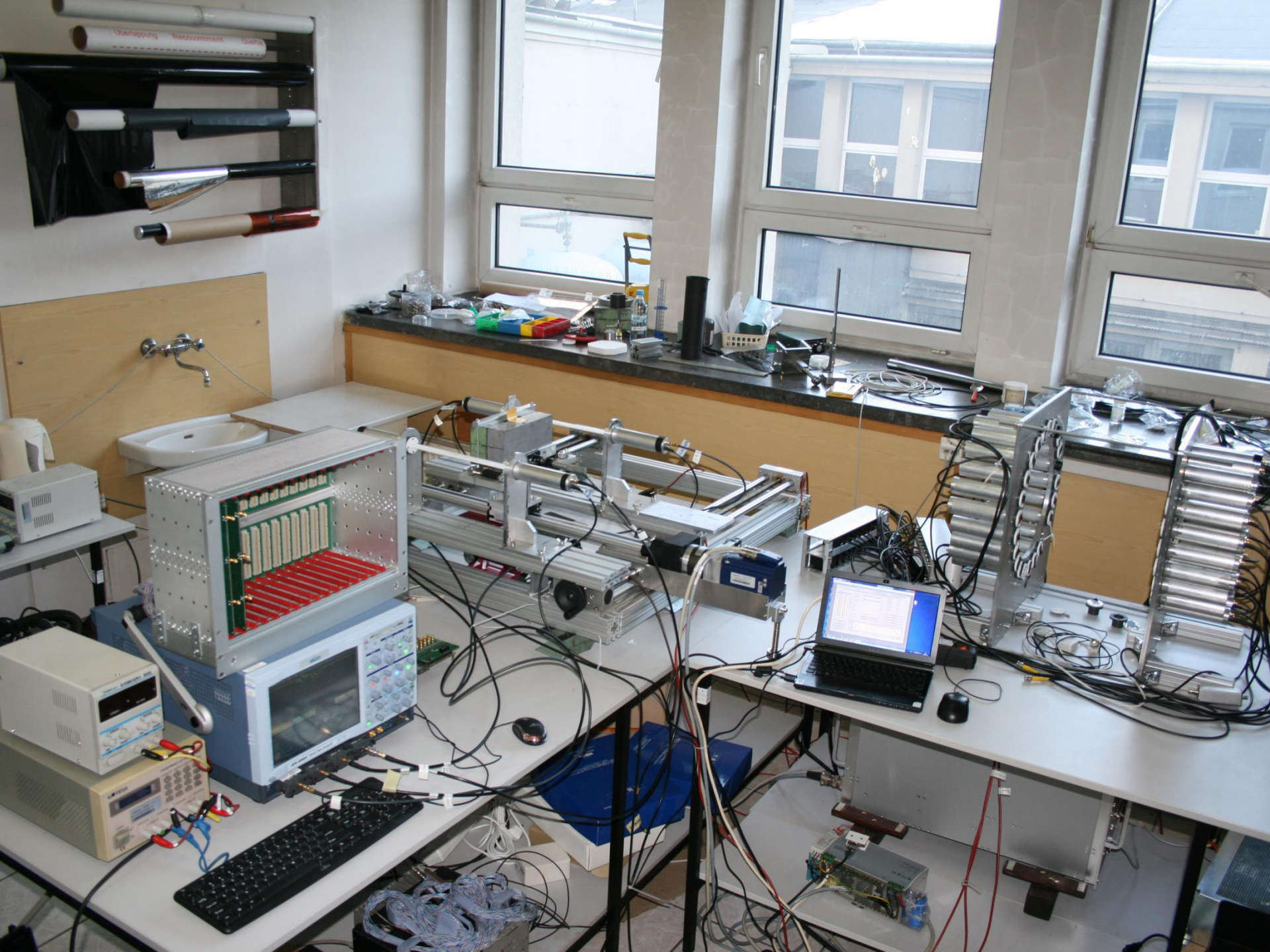
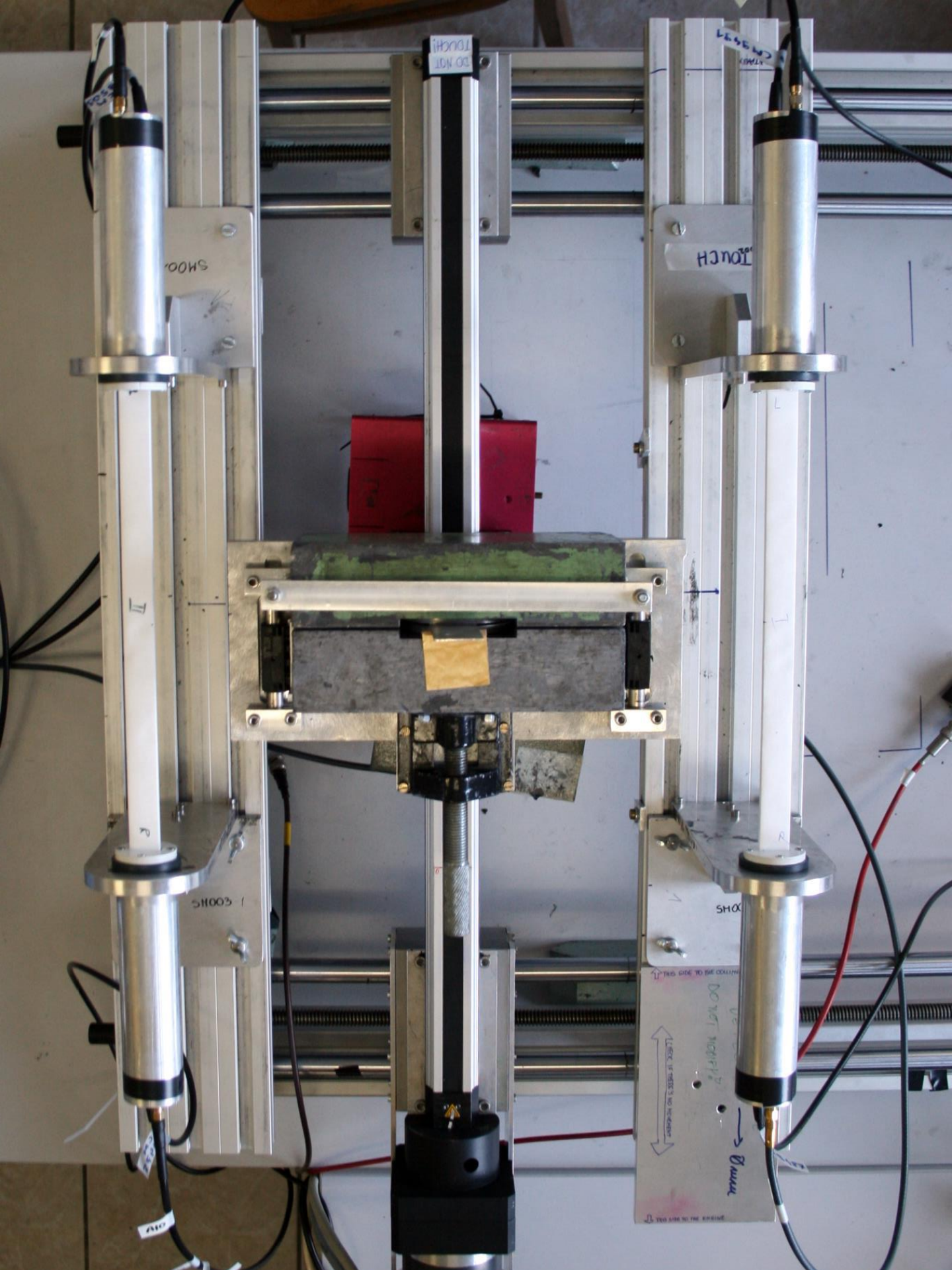
Doctus
Małopolski fundusz stypendialny dla doktorantów

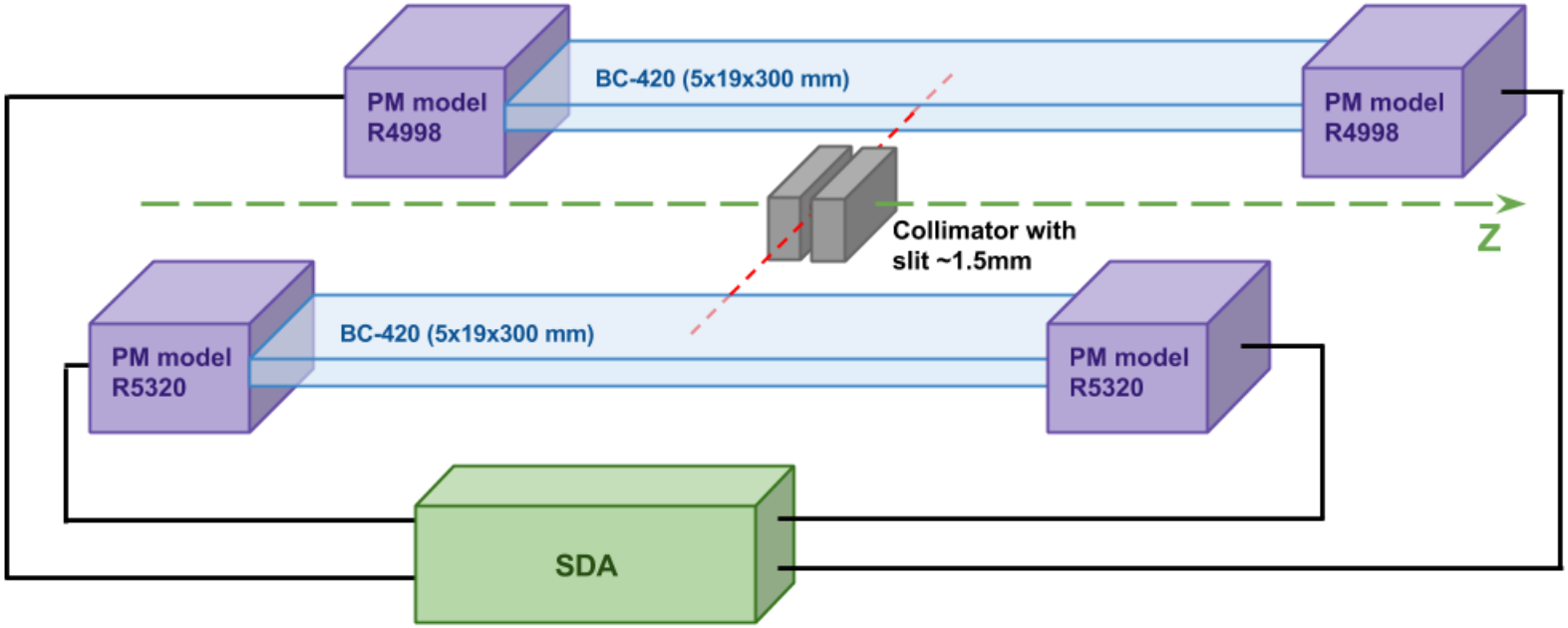
J-PET

Outline

1. General scheme of double strip prototype
2. Single photoelectron signals
3. Anihilation gamma quanta beam collimation
4. Time Of Flight resolution
5. Observed charge spectra
6. Measurements performed so far

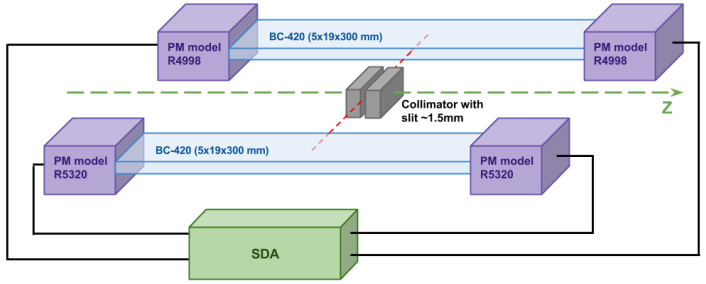


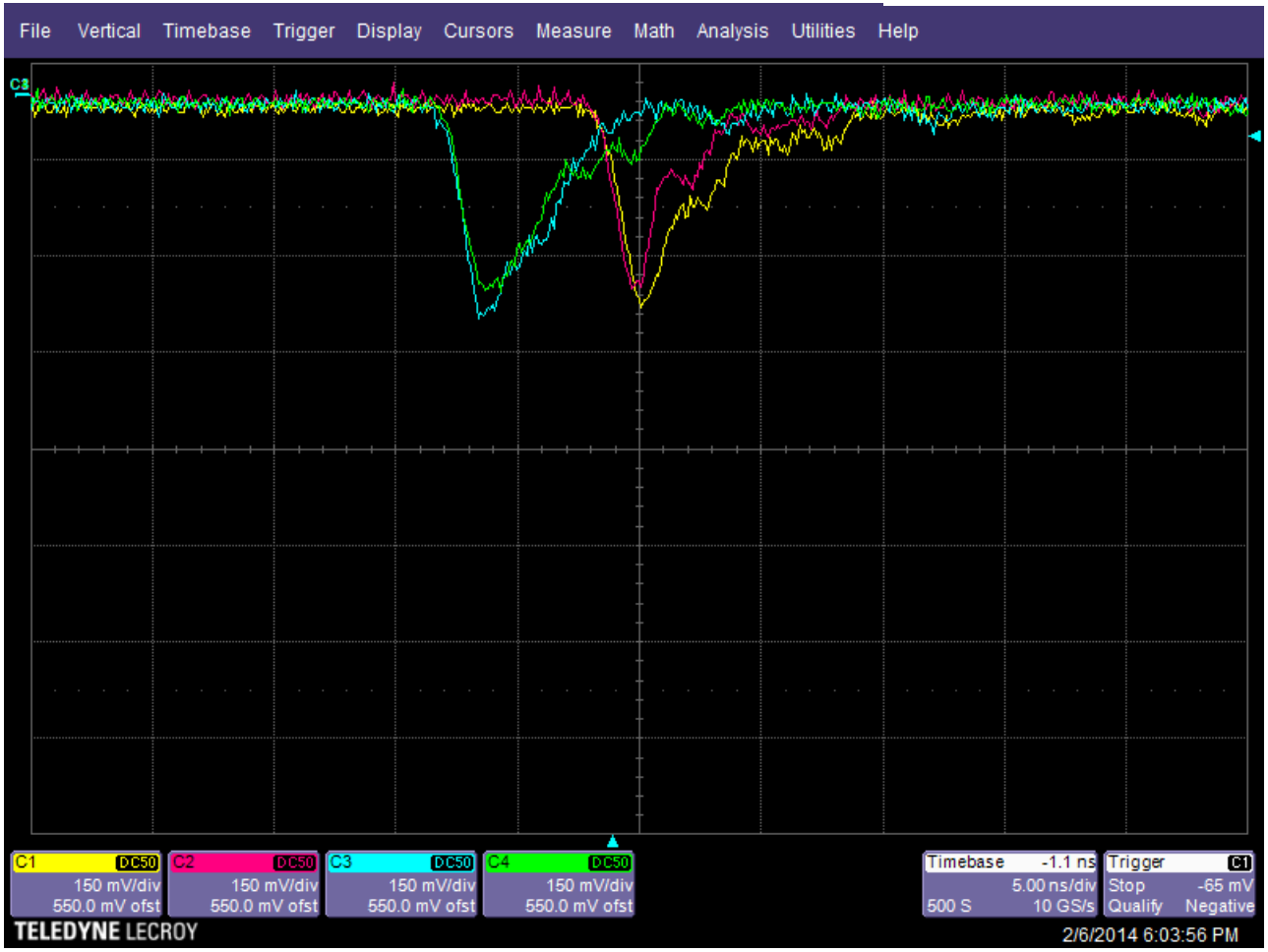

DO NOT TOUCH!
TOUCH

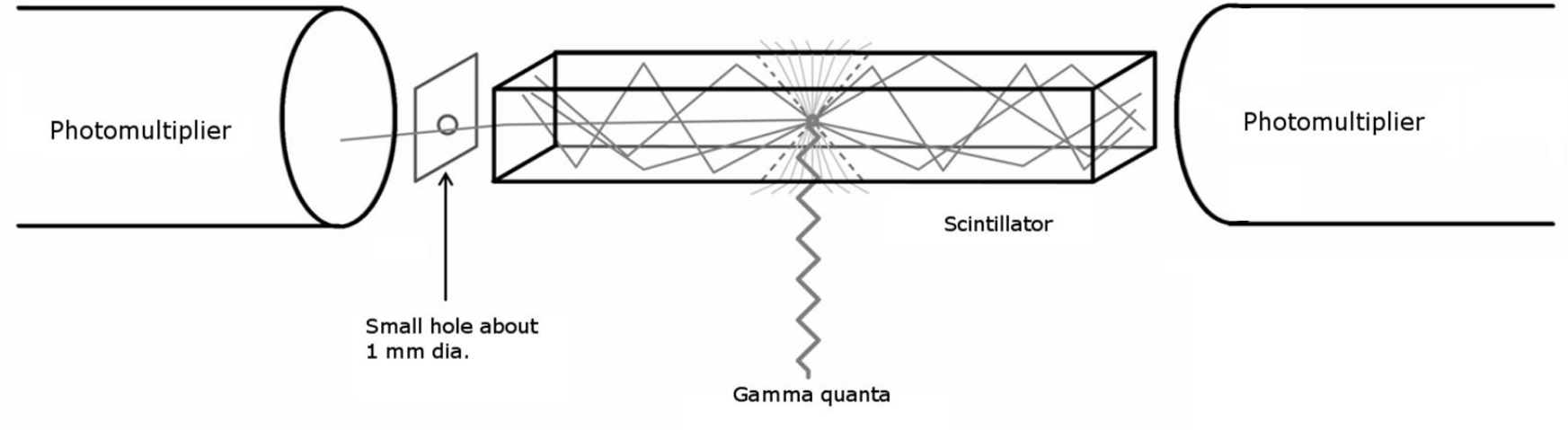


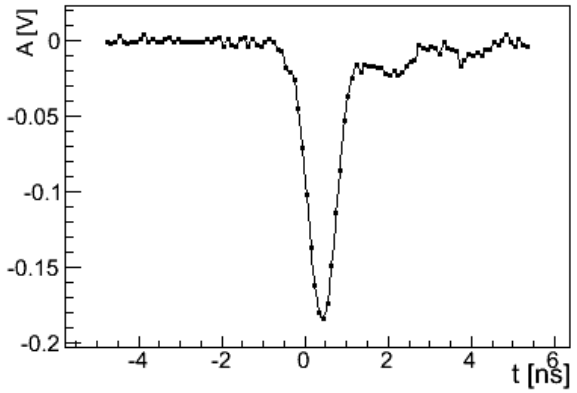
Our aim is to achieve the best possible time resolution by optimising each component of setup above

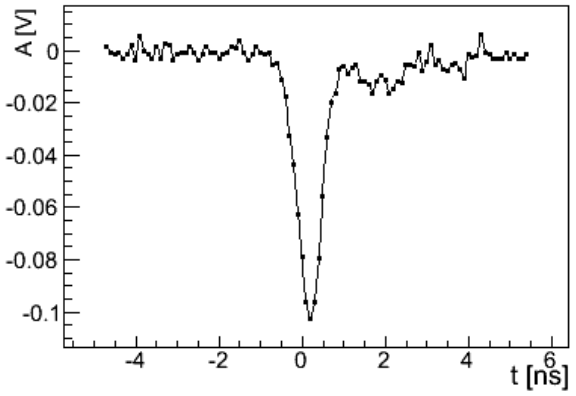
Scintillator properties	BC420	Photomultiplier properties	R5320/R4998
Rise time [ns]	0.5	Rise time [ns]	0.7
Decay time [ns]	1.5	Transit time typ. [ns]	10
Pulse width, FWHM, [ns]	1.3	Transit time spread [ns]	0.16

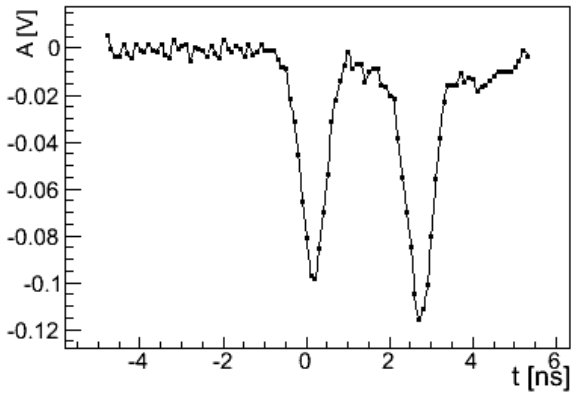

PM model R4998
BC-420 (5x19x300 mm)
PM model R4998
Collimator with slit ~1.5mm
Z
PM model R5320
BC-420 (5x19x300 mm)
PM model R5320
SDA

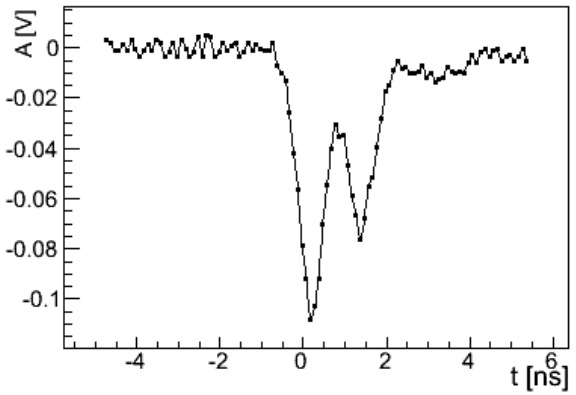

File Vertical Timebase Trigger Display Cursors Measure Math Analysis Utilities Help
C1 DC50 150 mV/div 550.0 mV ofst
C2 DC50 150 mV/div 550.0 mV ofst
C3 DC50 150 mV/div 550.0 mV ofst
C4 DC50 150 mV/div 550.0 mV ofst
Timebase -1.1 ns 5.00 ns/div 500 S 10 GS/s
Trigger C1 Stop -65 mV Qualify Negative
TELEDYNE LECROY
2/6/2014 6:03:56 PM



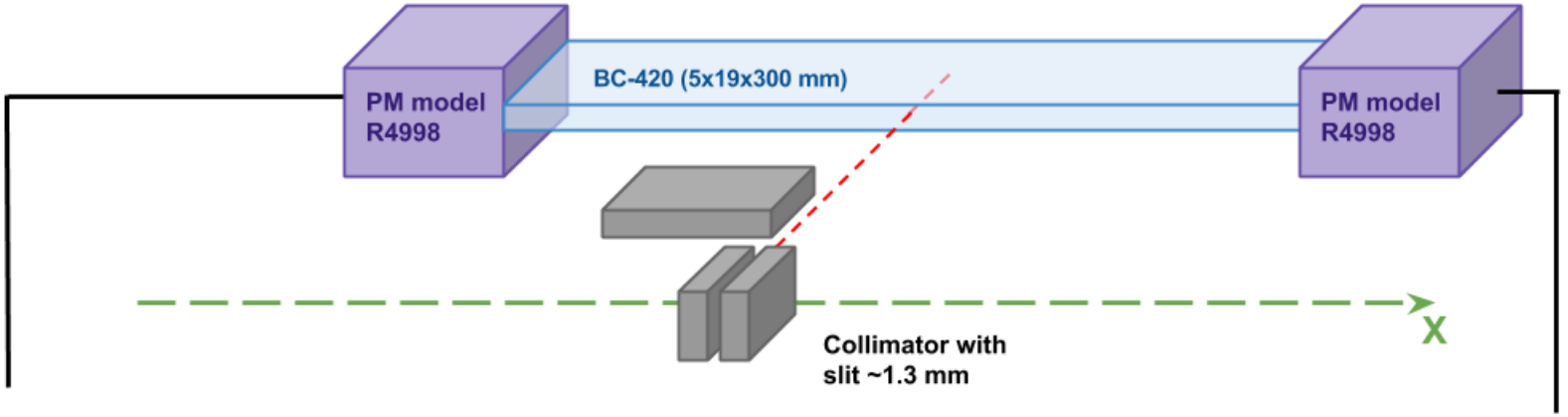








Very fast single photoelectron signals (rise time = 0.7 ns)

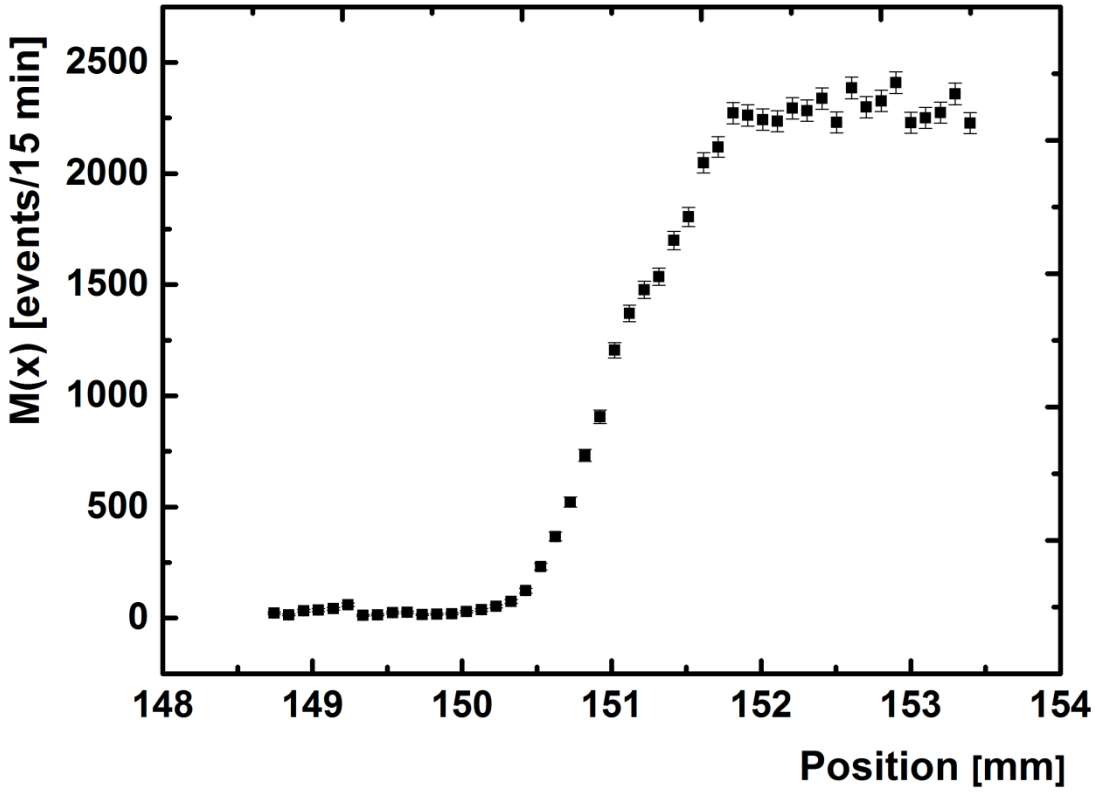


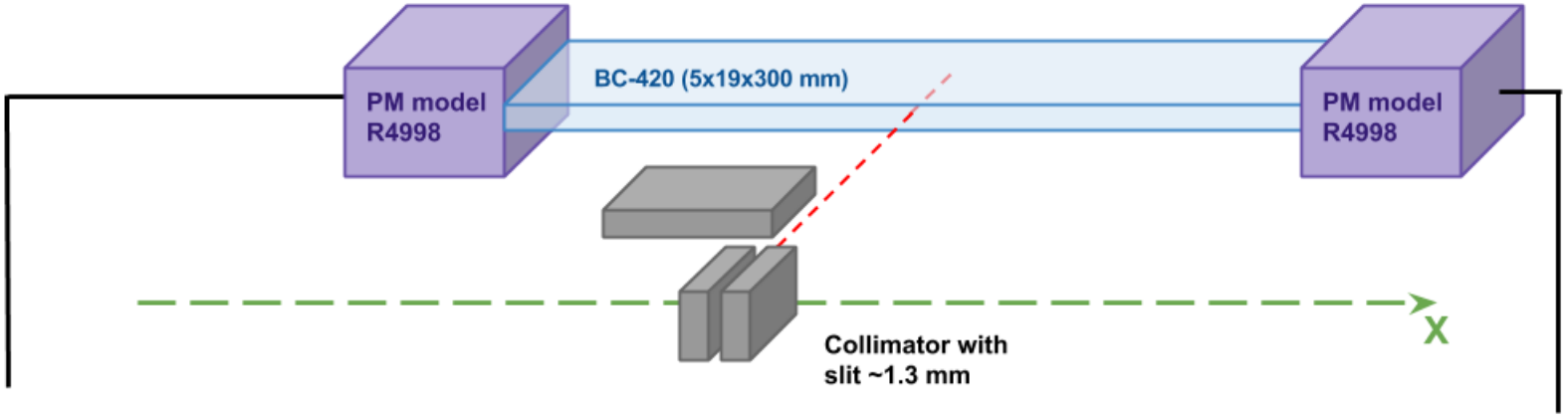
$$M(x) = h(x) * g(x) = \int_{-\infty}^{+\infty} h(x - x')g(x')dx'$$

$$g(x) = \begin{cases} 1 \;\; if \;\; x \in [x_0, +\infty] \\ 0 \;\; if \;\; x \notin [x_0, -\infty] \end{cases}$$

$$M(x) = h(x) * g(x) = \int_{-\infty}^{x_0} h(x - x')dx'$$

$$\frac{d}{dx}M(x) = h(x - x_0)$$





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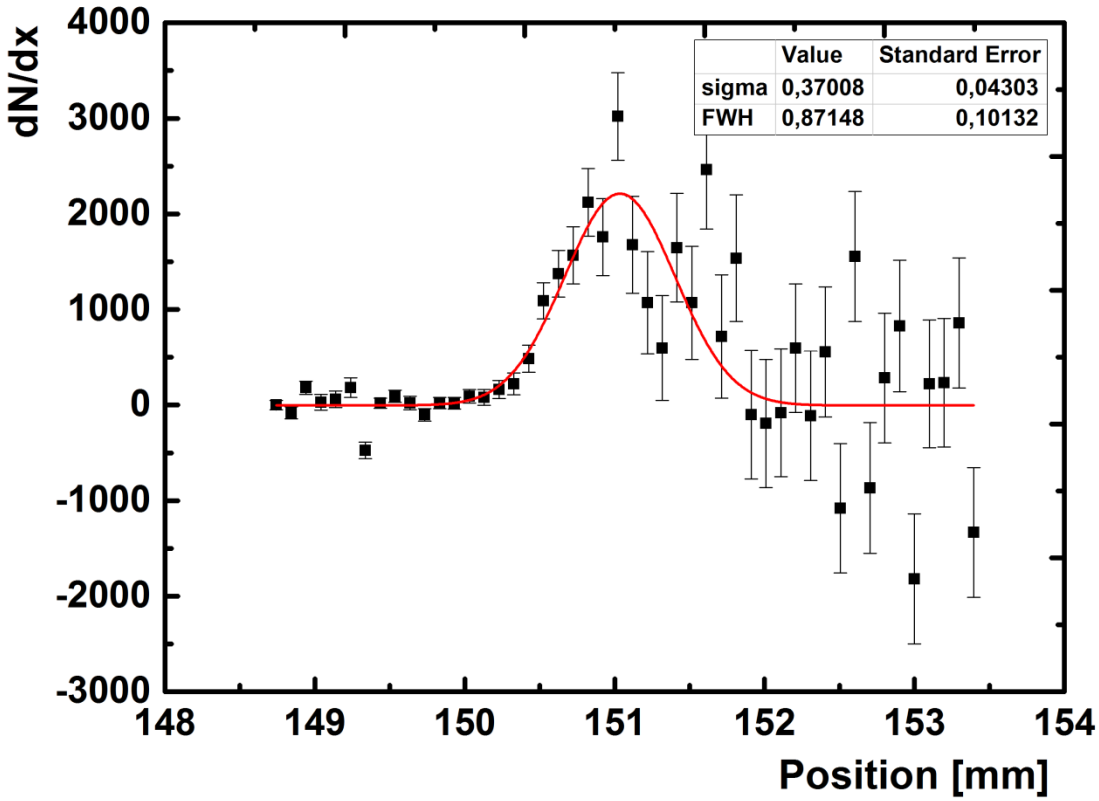

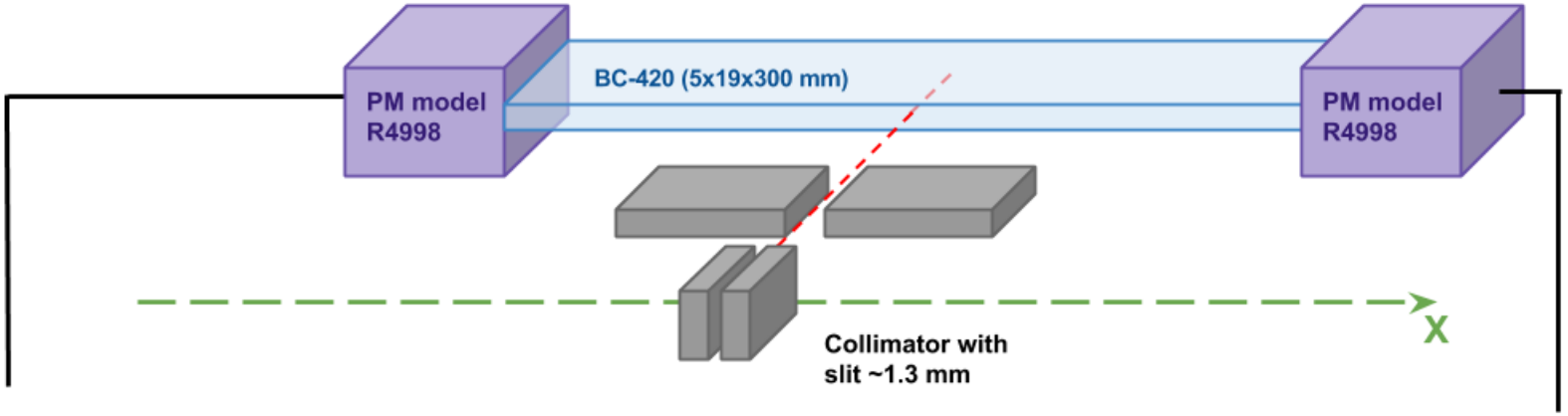

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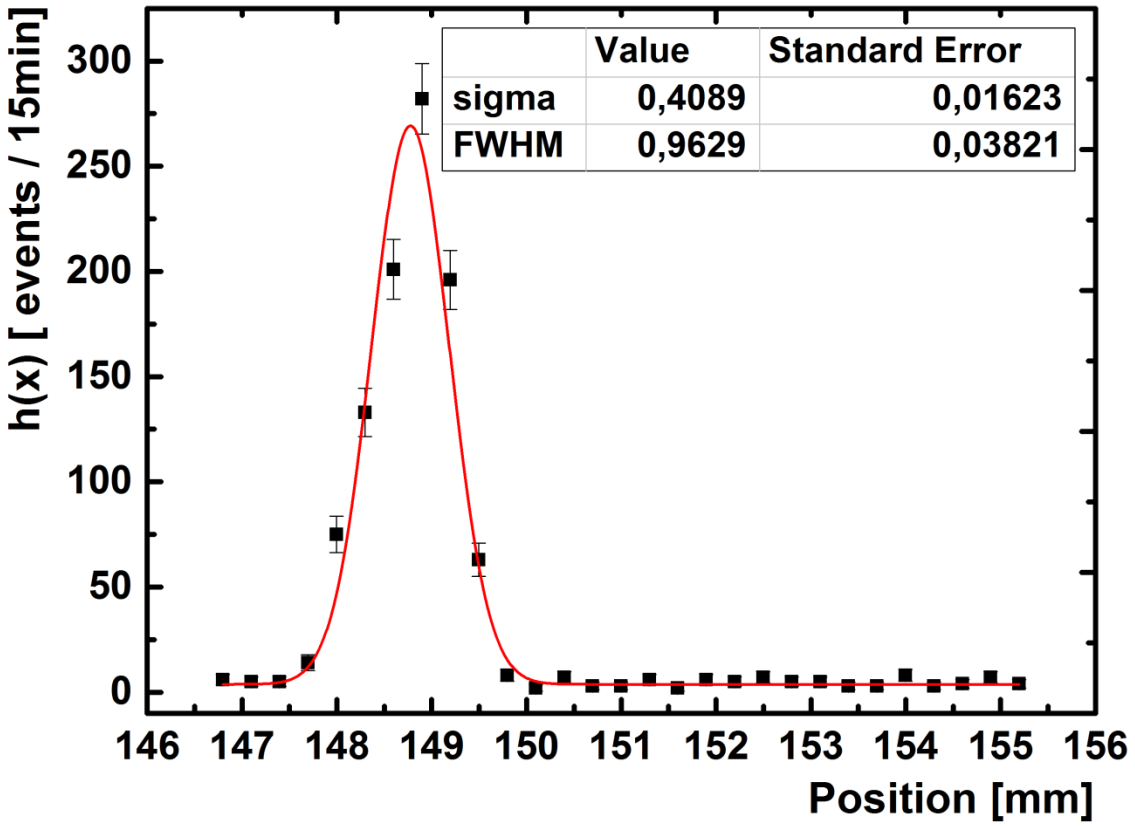
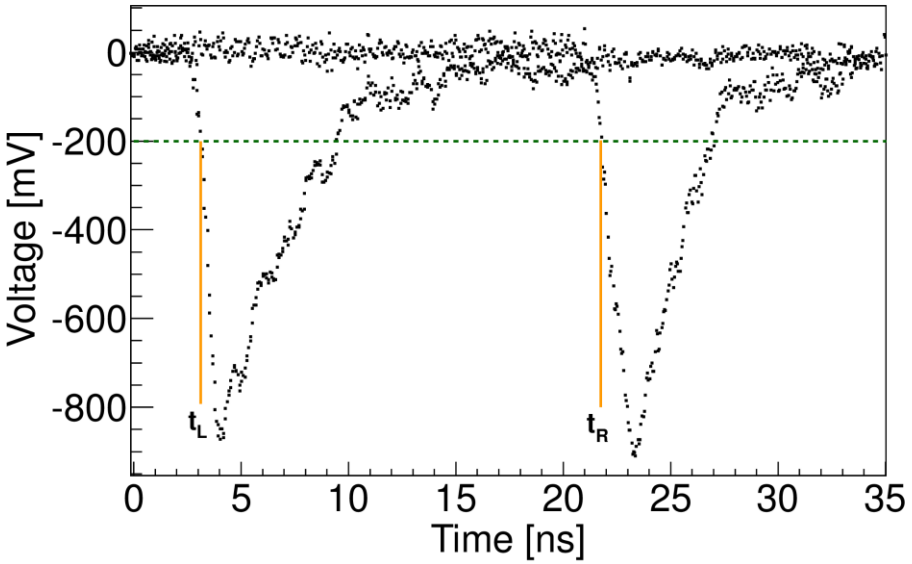
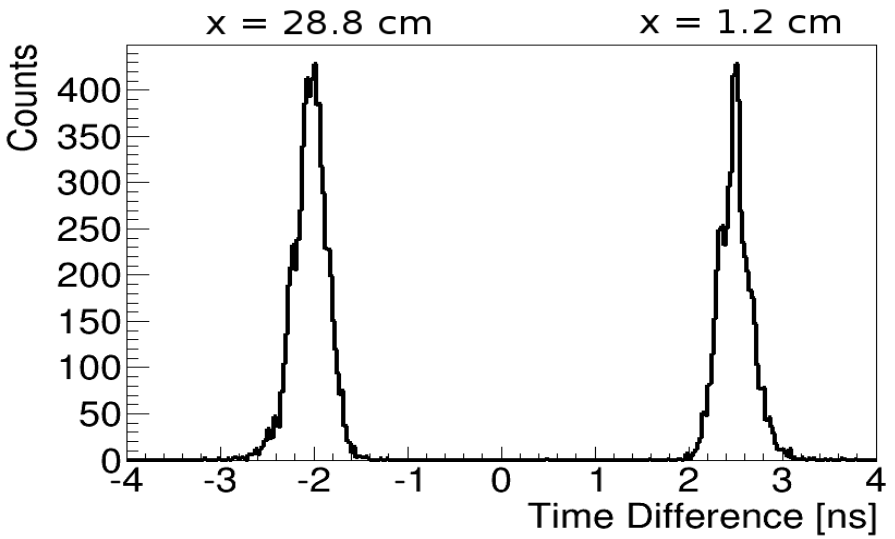
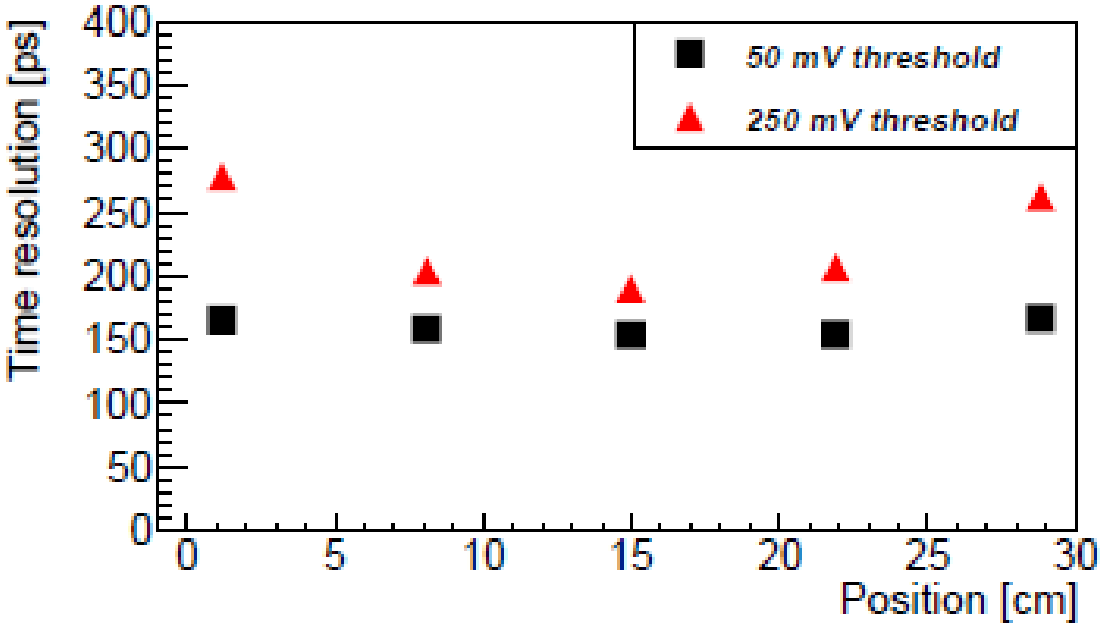


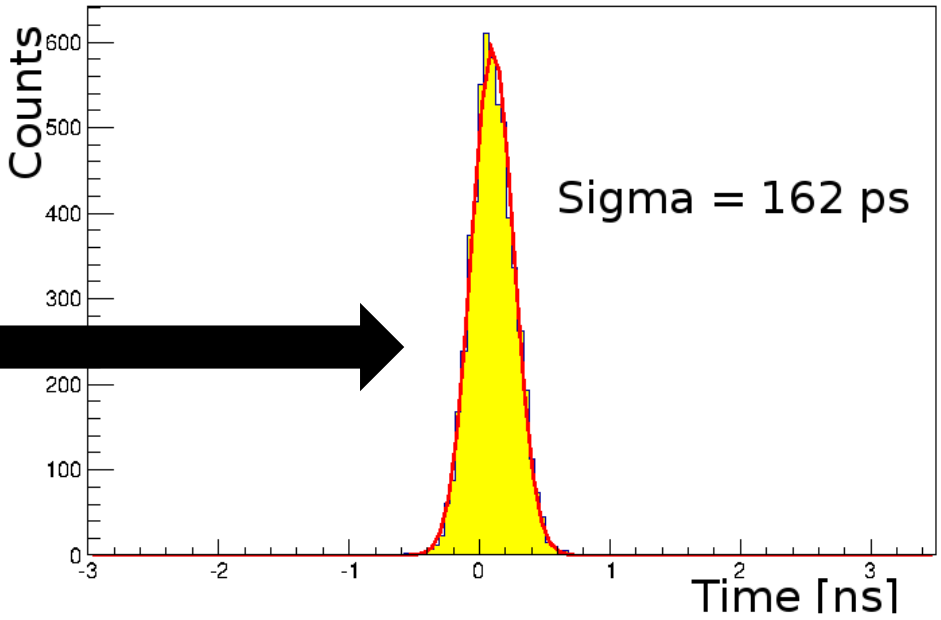


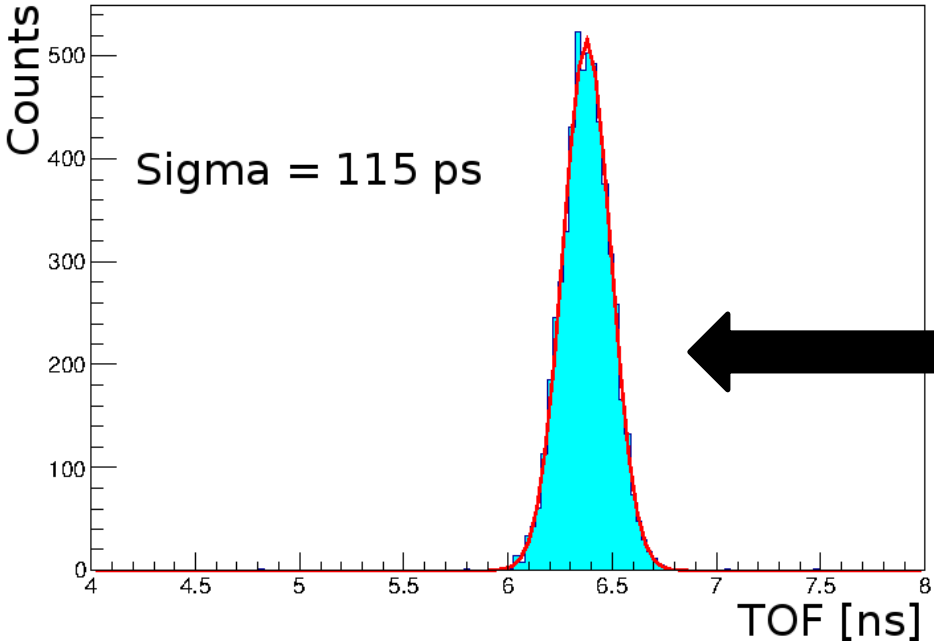




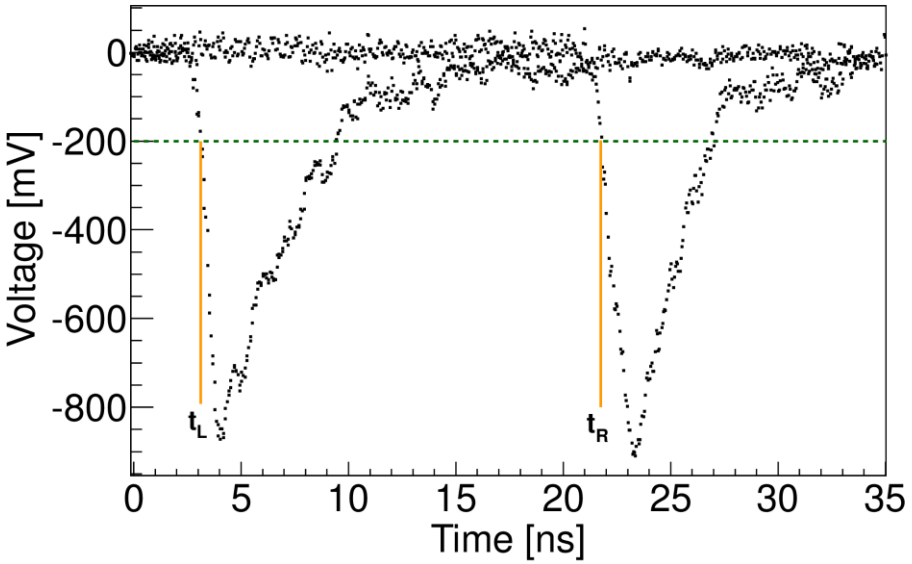
For ΔT ≈ 160 ps translates to less than 1 cm spatial resolution along strip

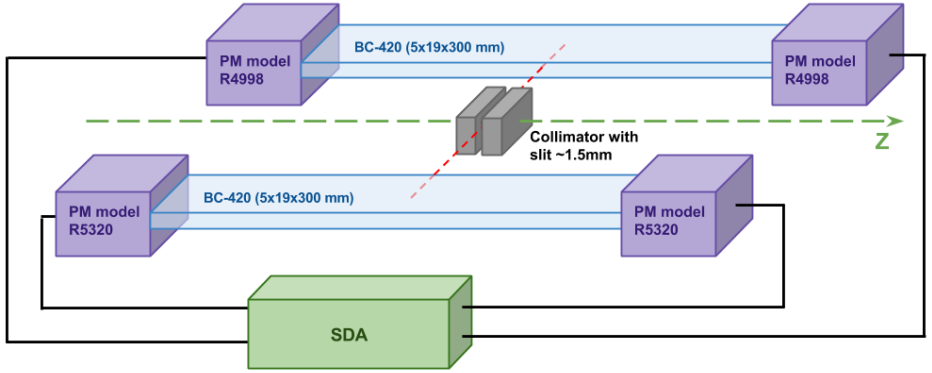
Single strip
time resolution





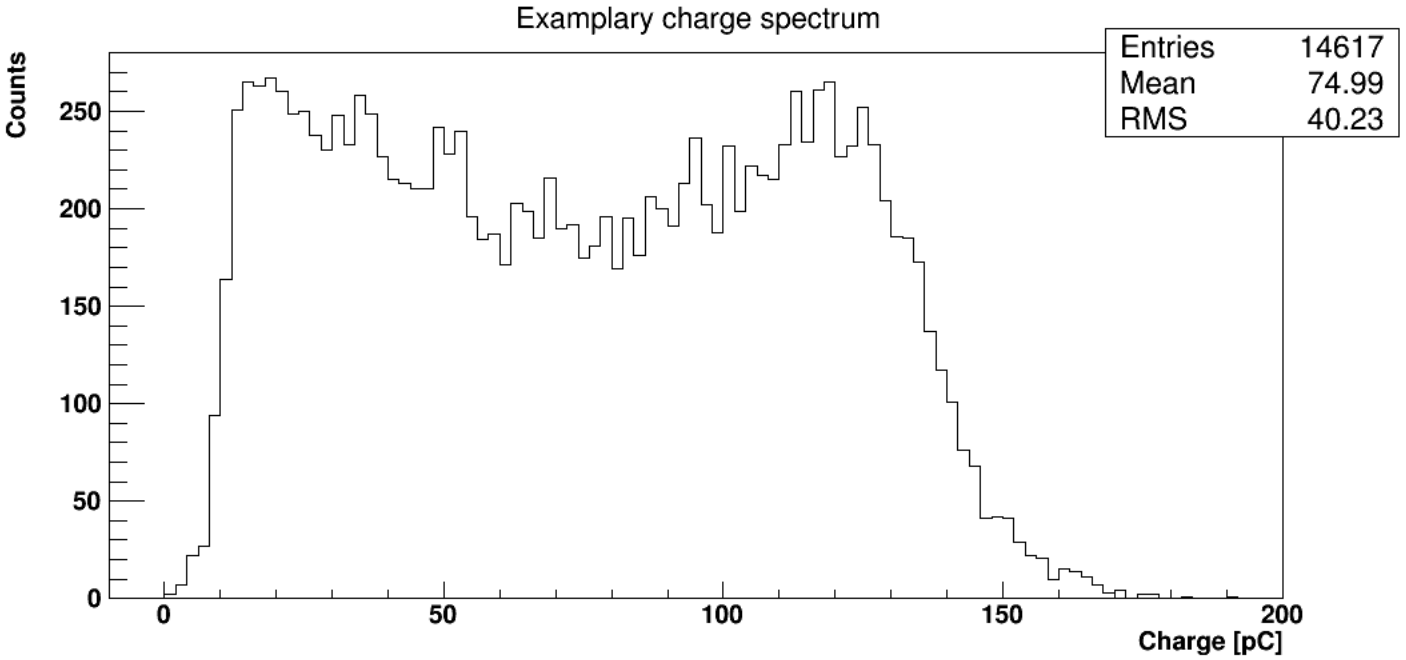
TOF resolution

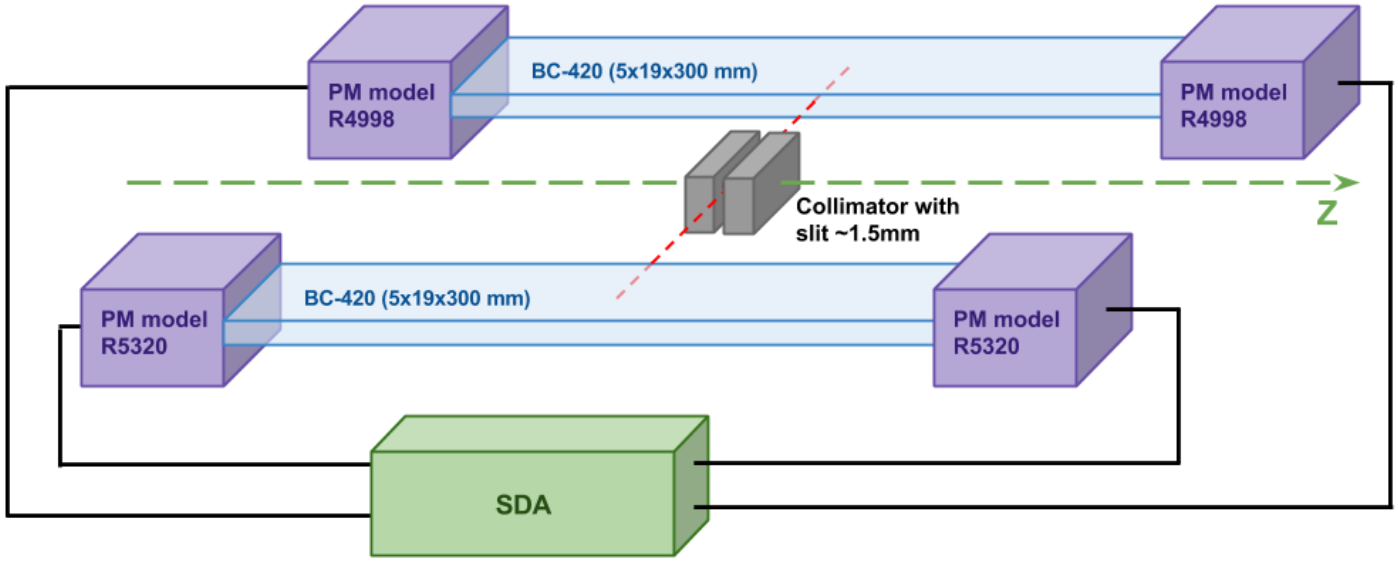




$$Q = \int I dt = \int \frac{U}{R} dt$$

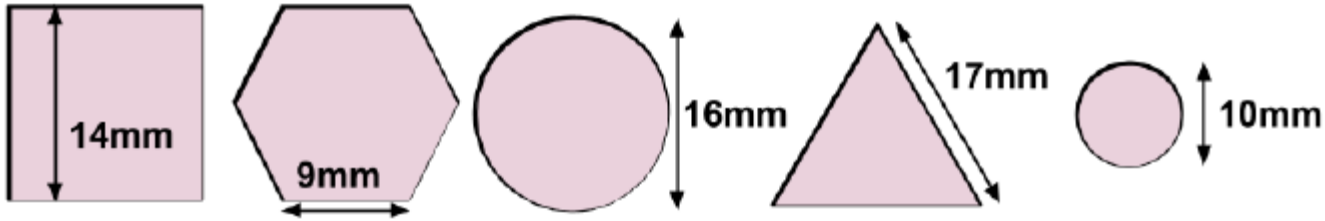
R = 50 Ω





Photomultiplier properties	R5320/R4998	R9800
Rise time [ns]	0.7	1.0
Transit time typ. [ns]	10	11
Transit time spread [ns]	0.16	0.27

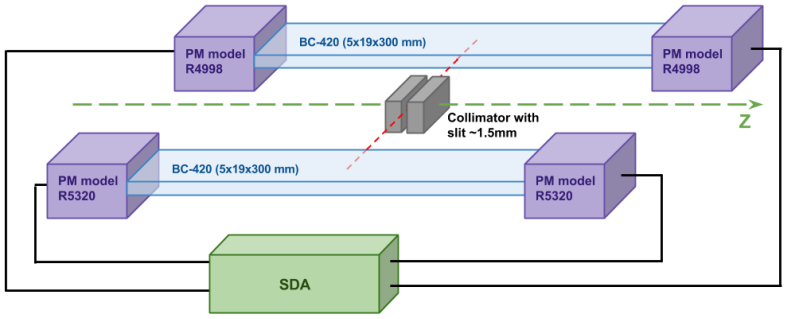
Intersections
Square
Rectangle
Circle, small
Circle, big
Triangle
Hexagon



Foils
No foil
Mylar
Aluminium
Tyvek
Teflon
Vikuiti

Scans with 3 mm step
5x19x300 mm^3
11x16.5x300 mm^3
8x18x300 mm^3
14x14x300 mm^3
5x19x500 mm^3
11x16.5x500 mm^3
8x18x500 mm^3
14x14x500 mm^3

Other
Lightguides
Mirrors
Small scintillators
Beam profiles
Bare sources
PMTs callibration
New PMT model tests
New scintillator tests



Thank you for your attention