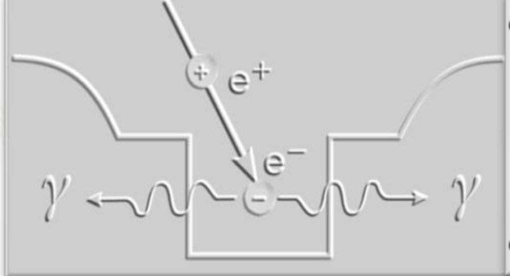

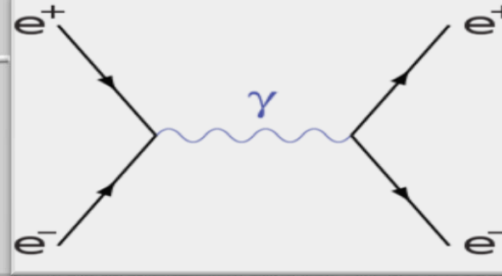

Treffen deutscher Positronengruppen 2012:

Problems caused by backscattering of 1.27MeV photons for PALS

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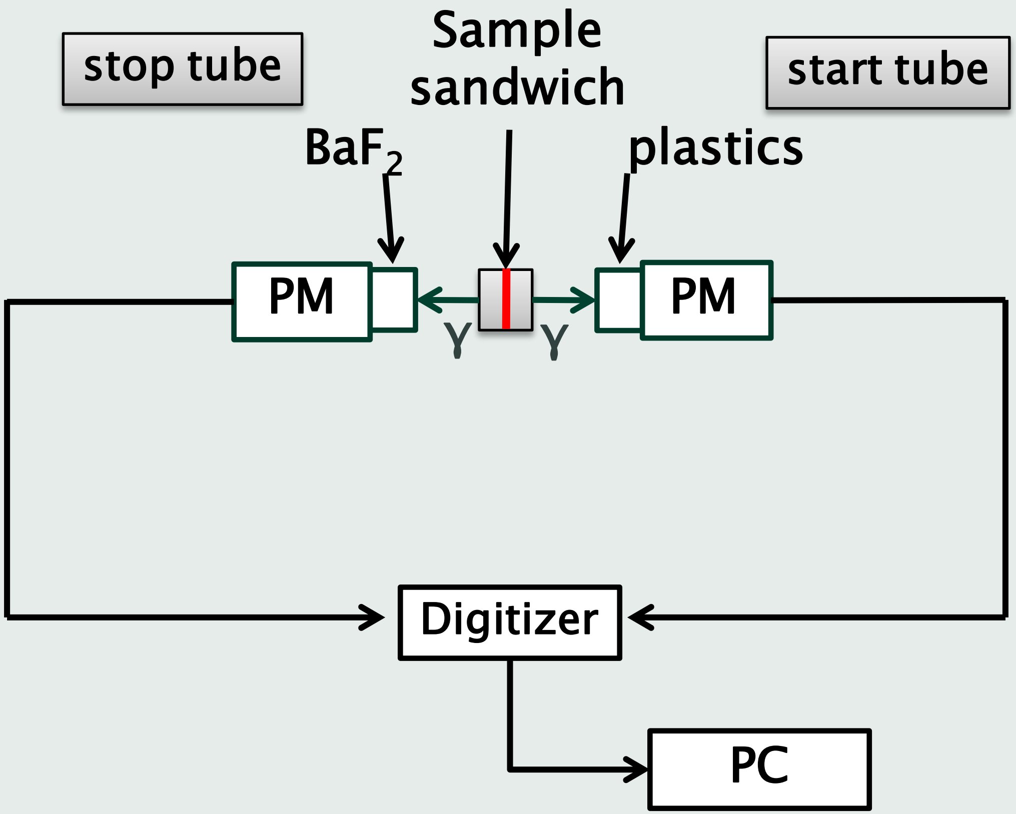
Abstract

1. Common PALS–Setup

2. Possible backscattering scenarios

3. Changes in the experimental setup

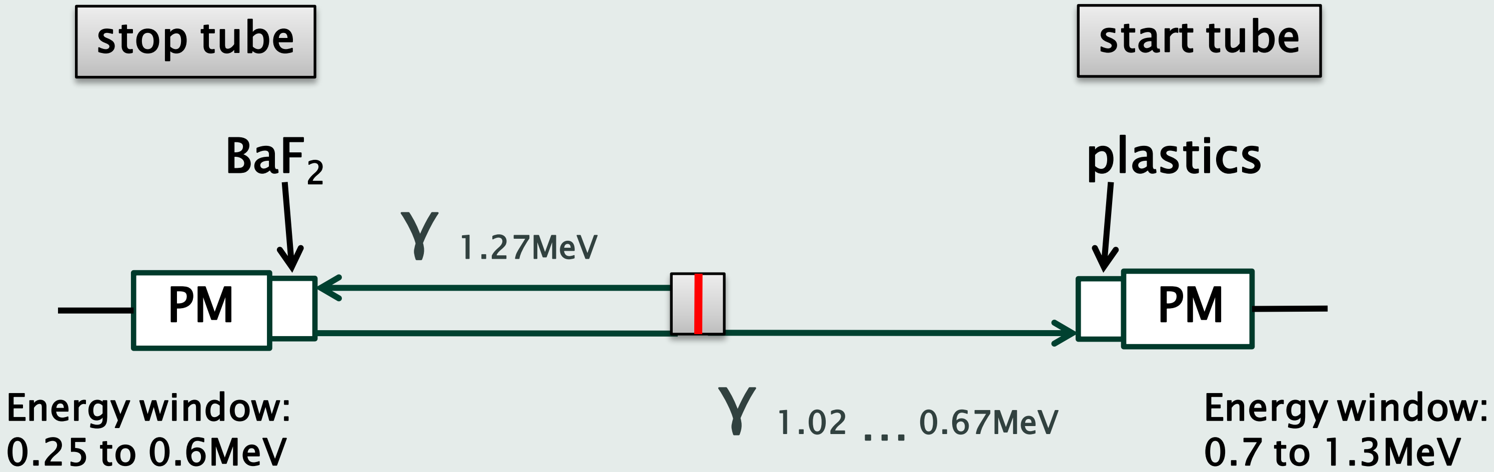
Common PALS-Setup



- Photomultiplier with BaF_2 scintillator as stop tube
- Photomultiplier with plastic scintillator as start tube
- 1.27MeV-photon @ e^+ birth
- 2 * 0.511MeV-photon @ annihilation
- Positron lifetime as difference between detection of birth and annihilation photon

Possible backscattering scenarios

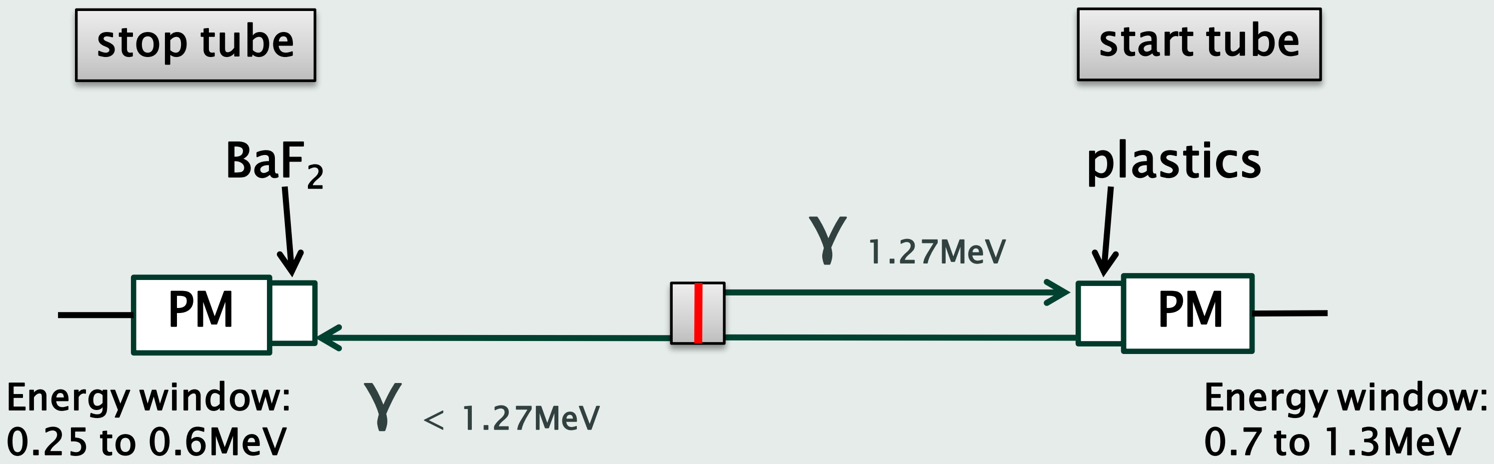
1st scenario



- 1.27MeV-photon triggers stop-signal and loses energy
- Backscattering of 1.27MeV-photon at BaF_2 scintillator
- Photon with enough energy left to trigger start-signal at tube with plastic scintillator
- Assumed effect: prompt curve

Possible backscattering scenarios

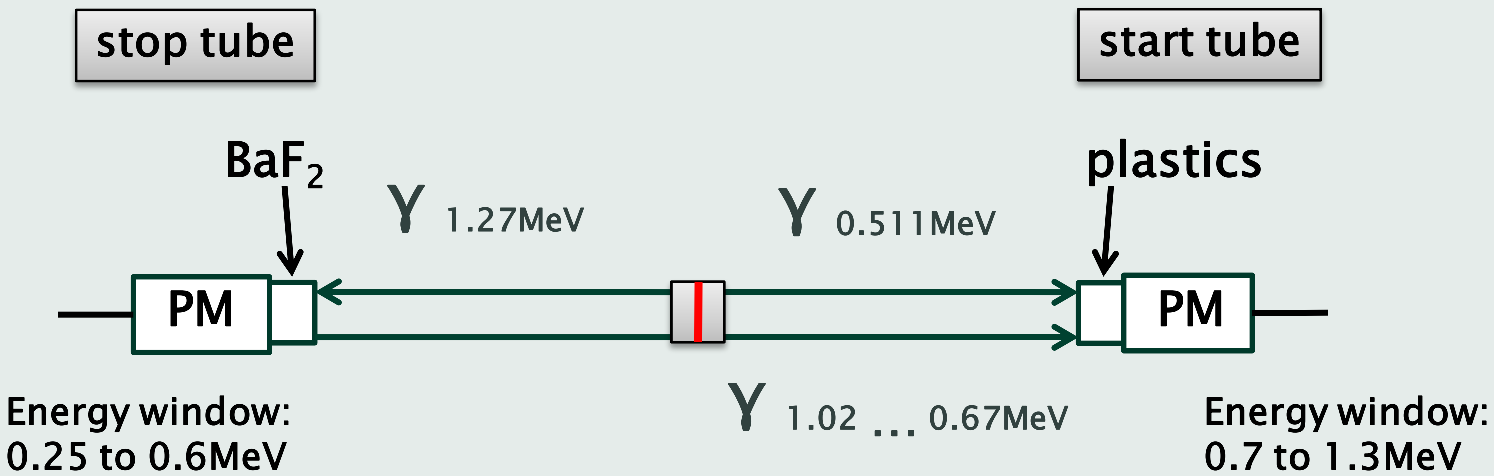
2nd scenario



- 1.27MeV-photon triggers start-signal with energy < 1.27MeV
- Backscattering of photon at plastic scintillator
- Enough energy left to trigger stop-signal at tube with BaF_2 scintillator
- Assumed effect: prompt curve

Possible backscattering scenarios

3rd scenario

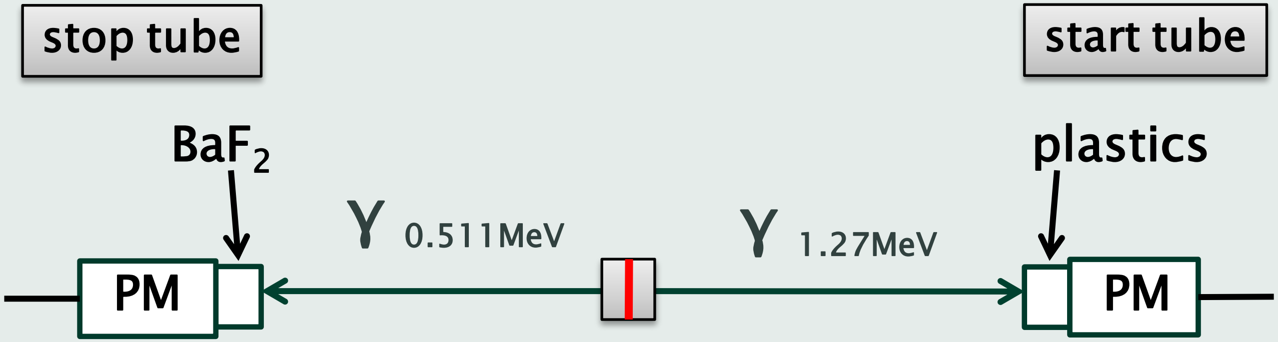


- 1.27MeV-photon triggers stop-signal and loses energy
- Backscattering of photon at BaF2 scintillator
- Arrival of backscattered photon and annihilation photon in the rise time of start tube → start-signal
- Assumed effect: prompt curve

Changes in the experimental setup

- Problem: pure silicon, positron lifetime: τ = 210ps instead of 219ps
- Experimental setup:

start and stop tubes face to face 180°

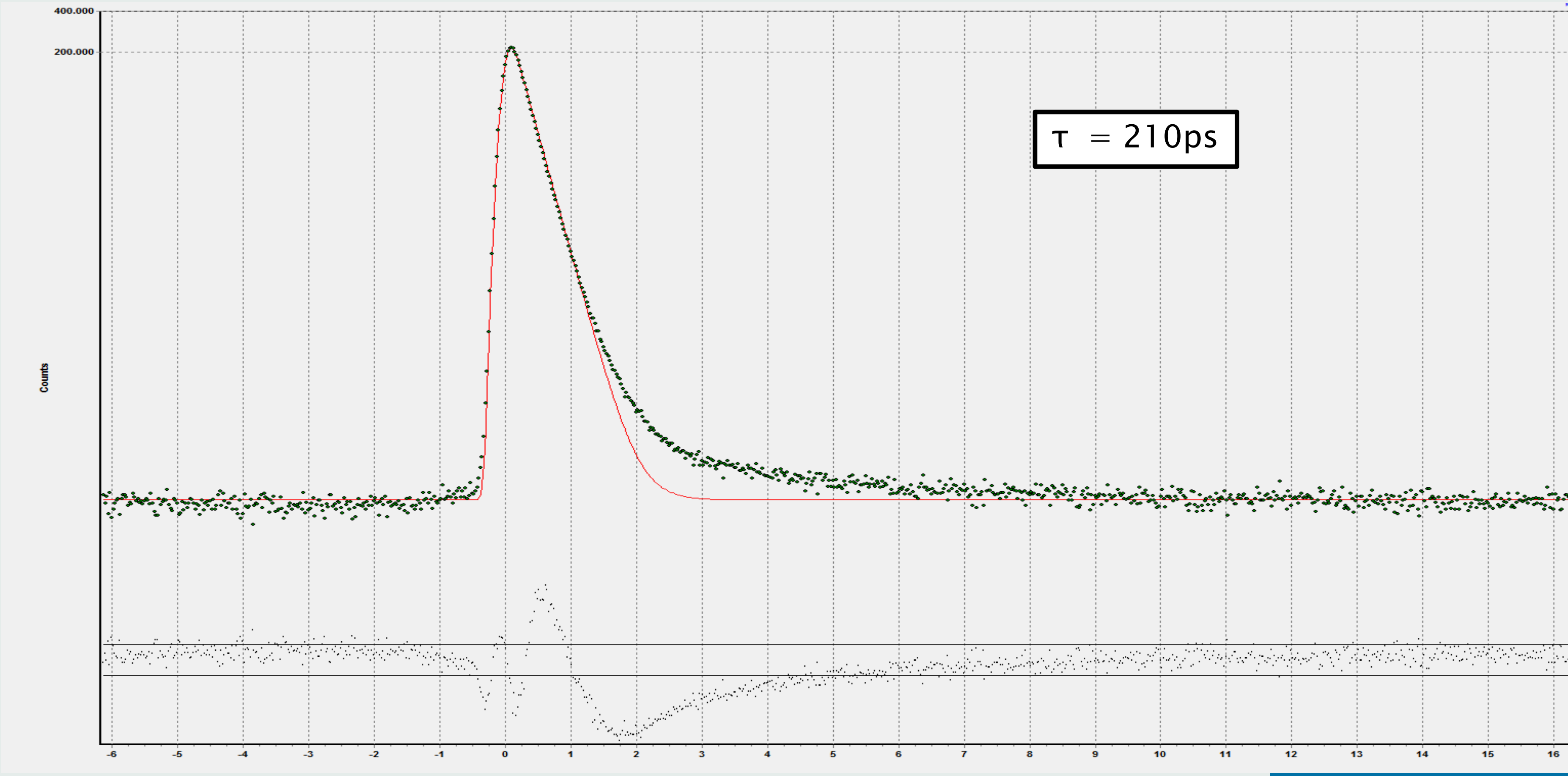


Energy window:
0.25 to 0.6MeV

Energy window:
0.7 to 1.3MeV

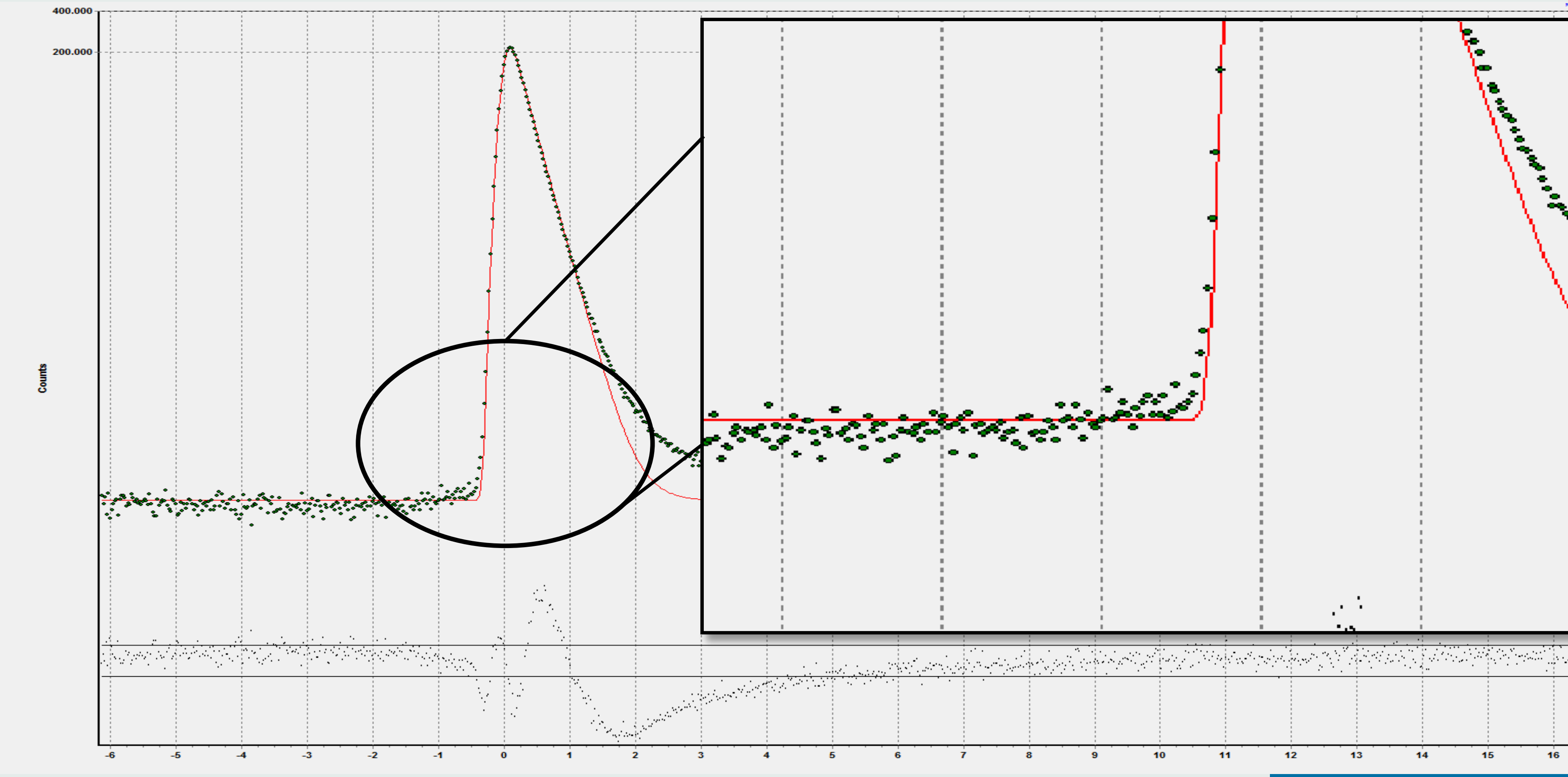
Changes in the experimental setup

- Problem: pure silicon, positron lifetime: τ = 210ps instead of 219ps



Changes in the experimental setup

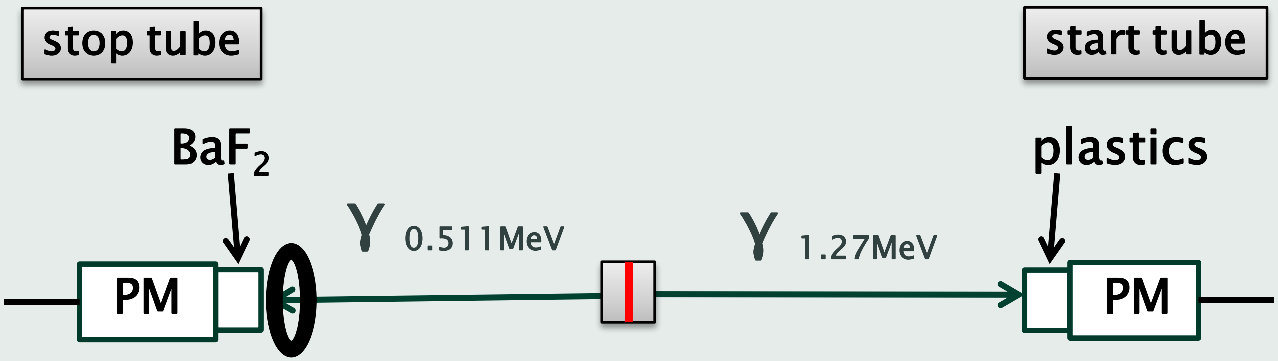
- Problem: pure silicon, positron lifetime: τ = 210ps instead of 219ps



Changes in the experimental setup

- First idea: Pb-shield with hole in middle in front of stop tube with BaF_2 scintillator
- Experimental setup:

Pb-shield to reduce backscattering angle
for 1.27MeV-photons from BaF_2 scintillator



Energy window:
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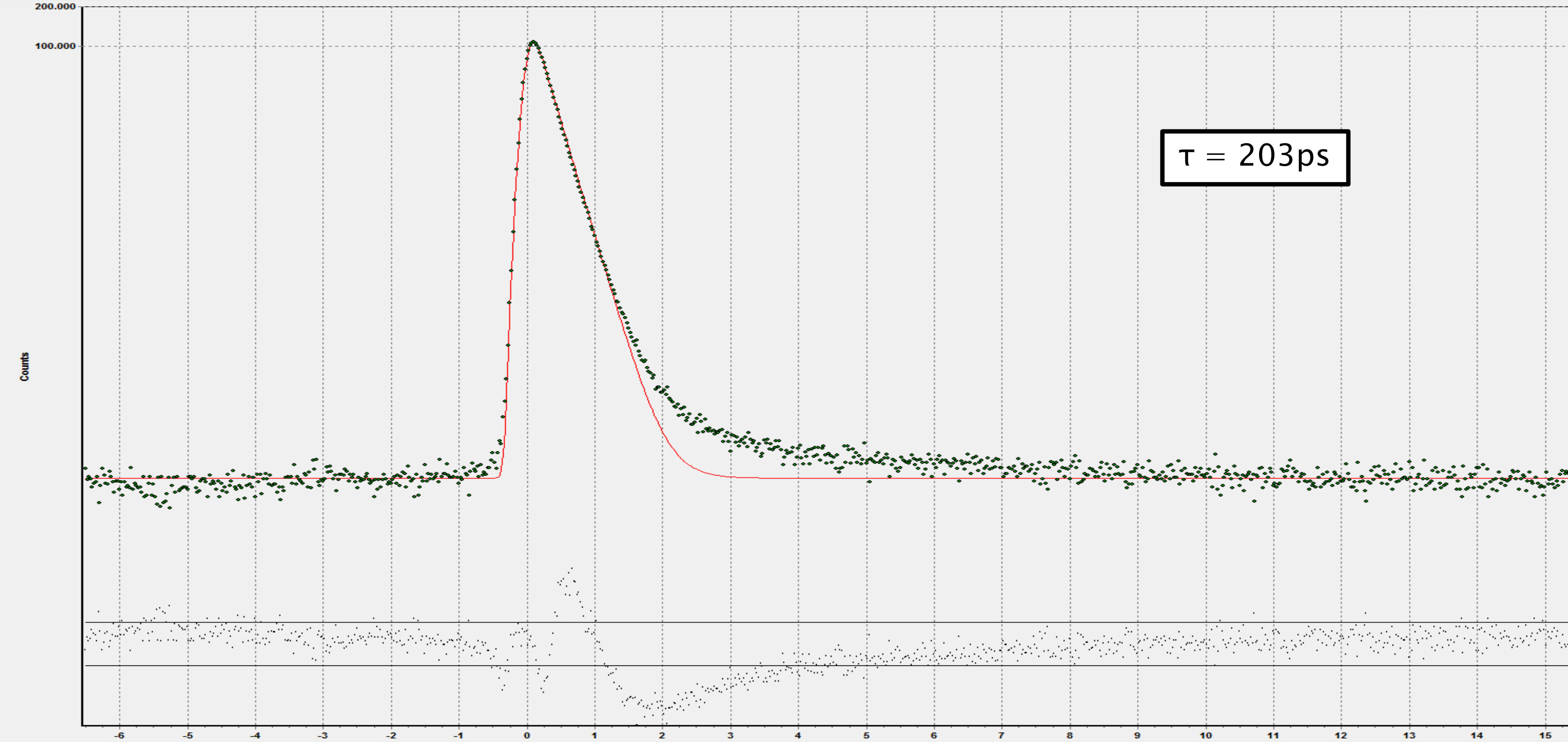
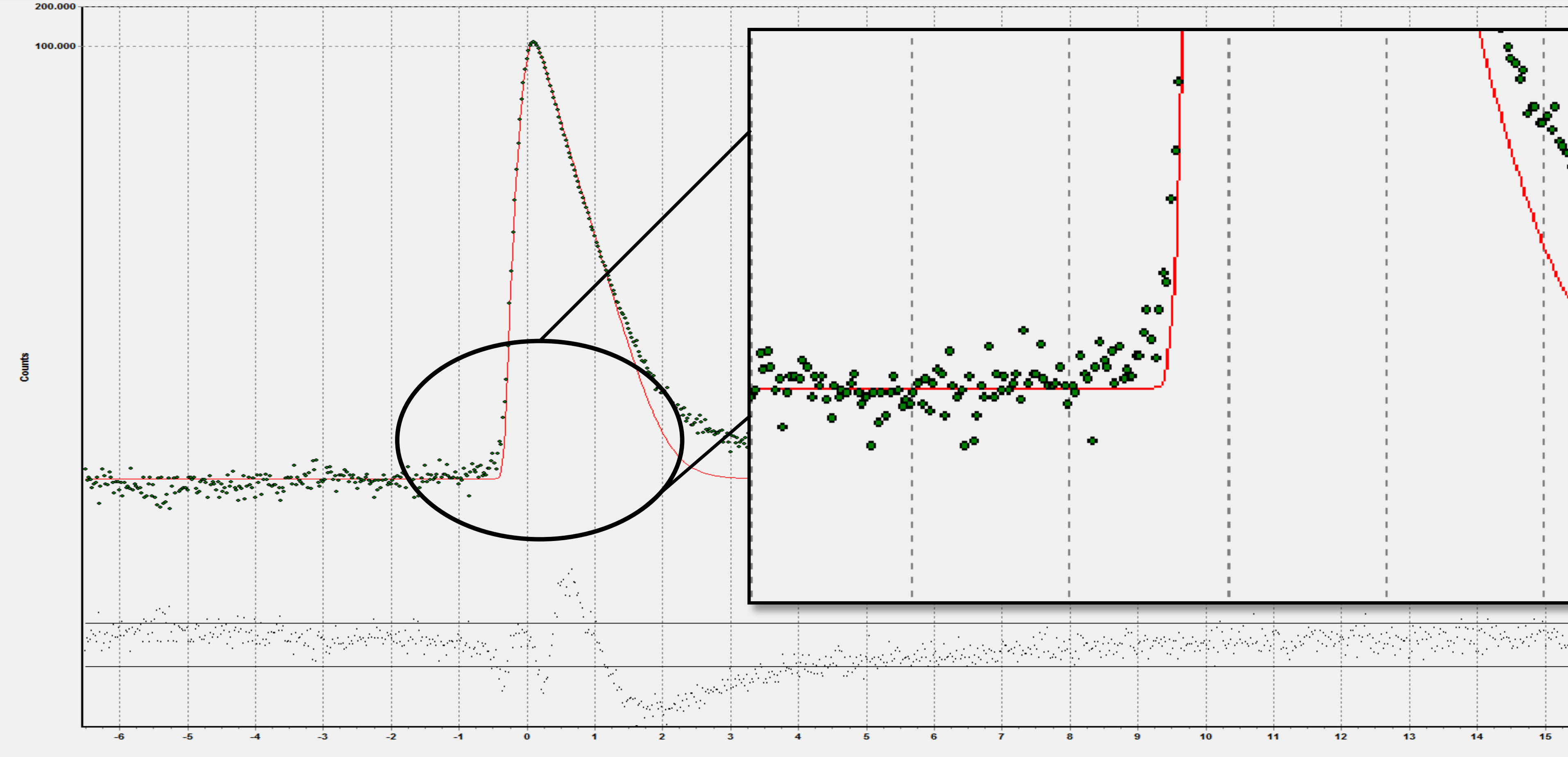
Changes in the experimental setup

- First idea: Pb-shield with hole in middle in front of stop tube:



Changes in the experimental setup

- First idea: Pb-shield with hole in middle in front of stop tube:

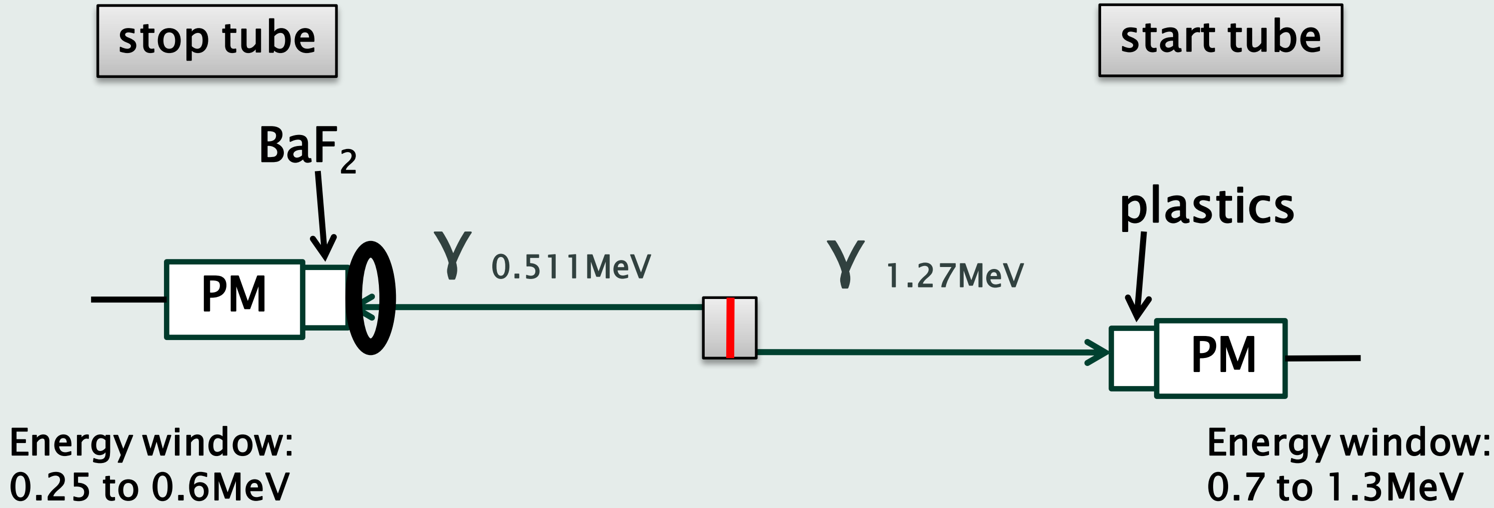


Changes in the experimental setup

- Second idea: start and stop tubes offcentered + Pb-shield with hole in middle in front of stop tube with BaF_2 scintillator

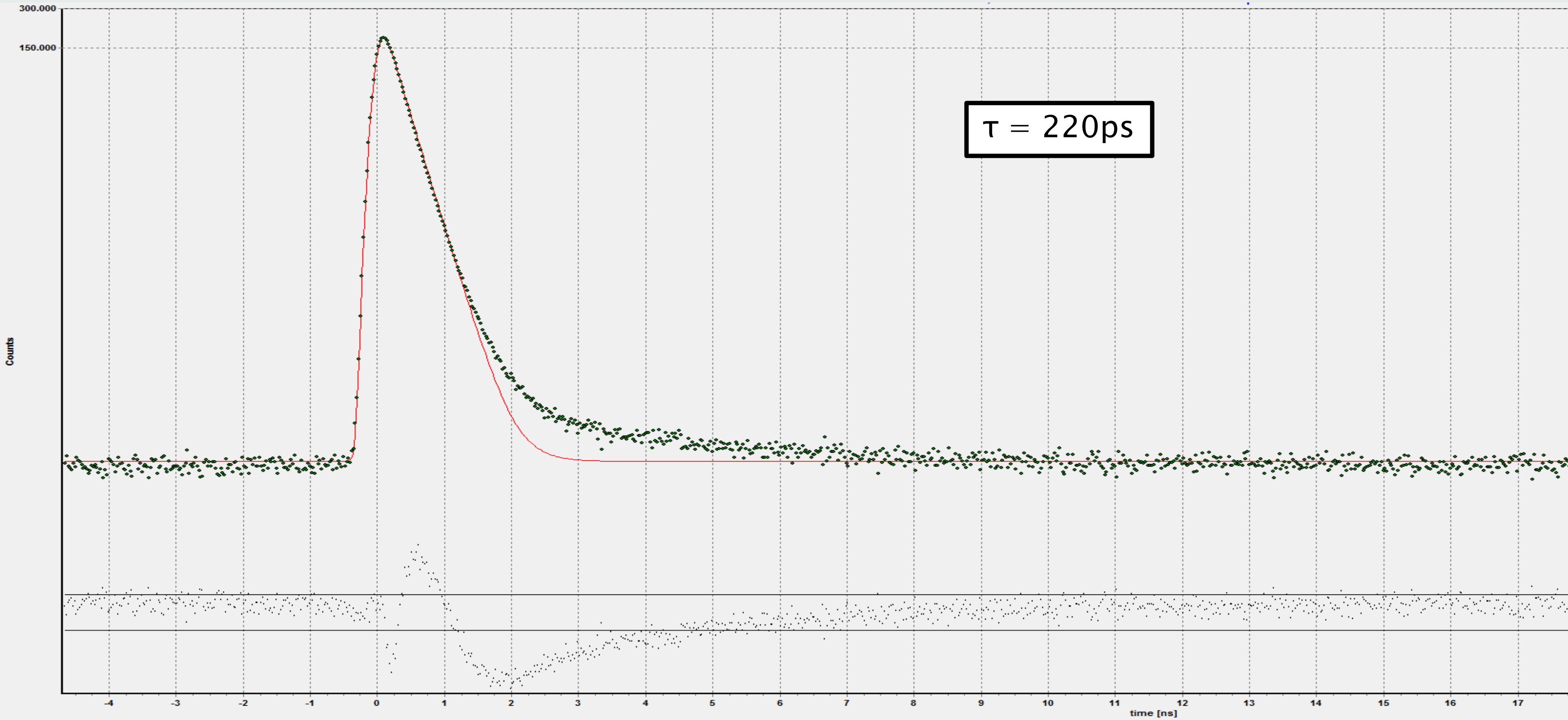
- Experimental setup:

Pb-shield in front of stop tube and both tubes offcentered to reduce backscattering angle for 1.27MeV-photons from BaF_2 scintillator



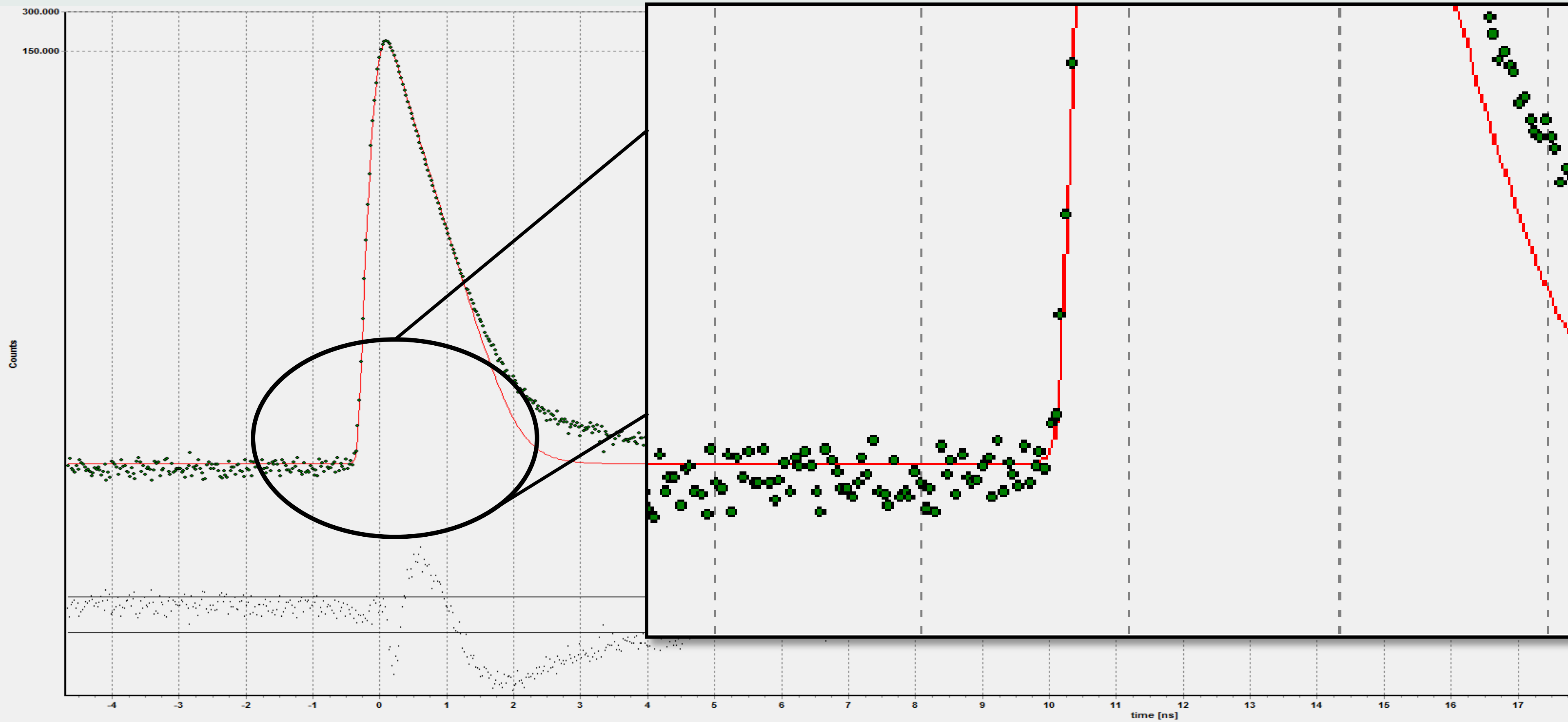
Changes in the experimental setup

- Second idea: start and stop tubes offcentered + Pb-shield with hole in middle in front of stop tube



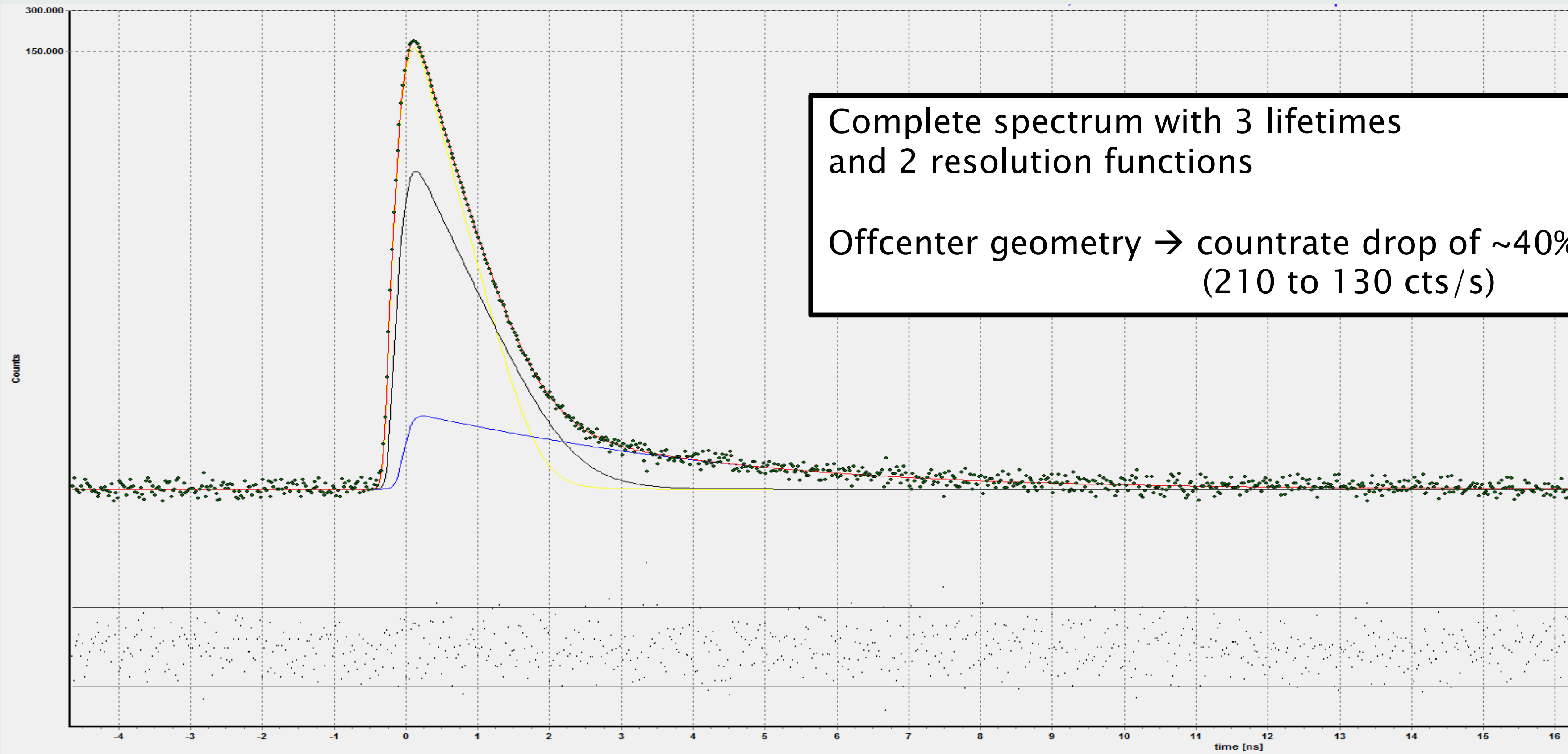
Changes in the experimental setup

- Second idea: start and stop tubes offcentered + Pb-shield with hole in middle in front of stop tube



Changes in the experimental setup

- Second idea: start and stop tubes offcentered + Pb-shield with hole in middle in front of stop tube: τ = 220ps



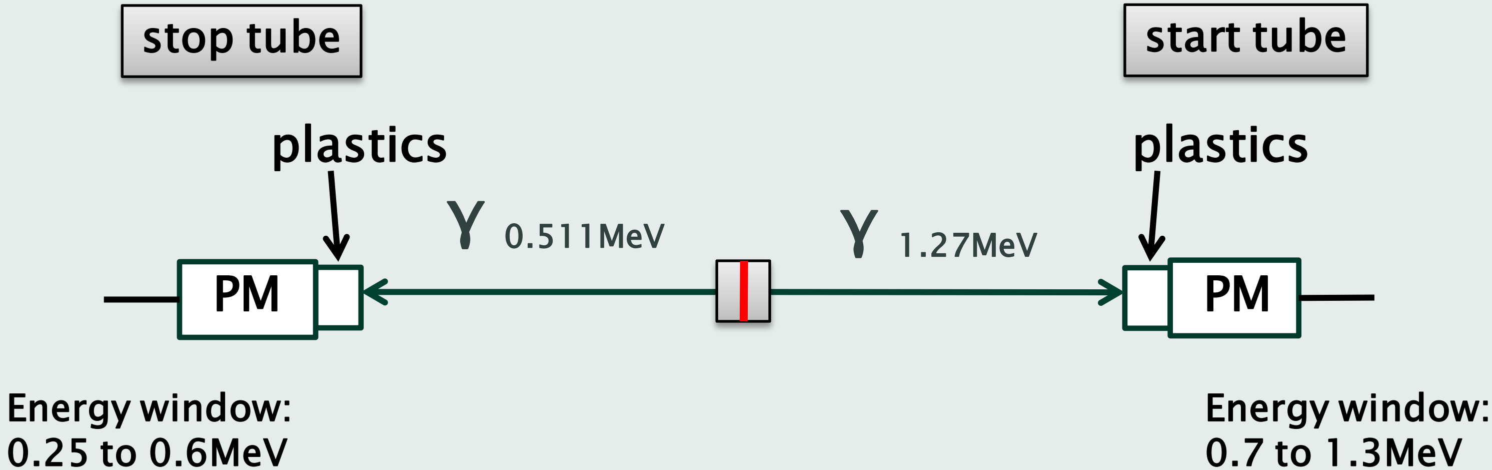
Complete spectrum with 3 lifetimes and 2 resolution functions

Offcenter geometry → countrate drop of ~40% (210 to 130 cts/s)

Changes in the experimental setup

- Standard PALS-setup with two plastic scintillators → no problems with the lifetime for silicon $\tau = 220$ ps

- Experimental setup:



- But much lower countrate of ~ 70 cts/s

Thank you for your attention