SBT
News from Liquid-Scintillator detector development

Heiko Lacker, HU Berlin
11th SHiP collaboration Meeting
8th of June, 2017, Berlin

On behalf of

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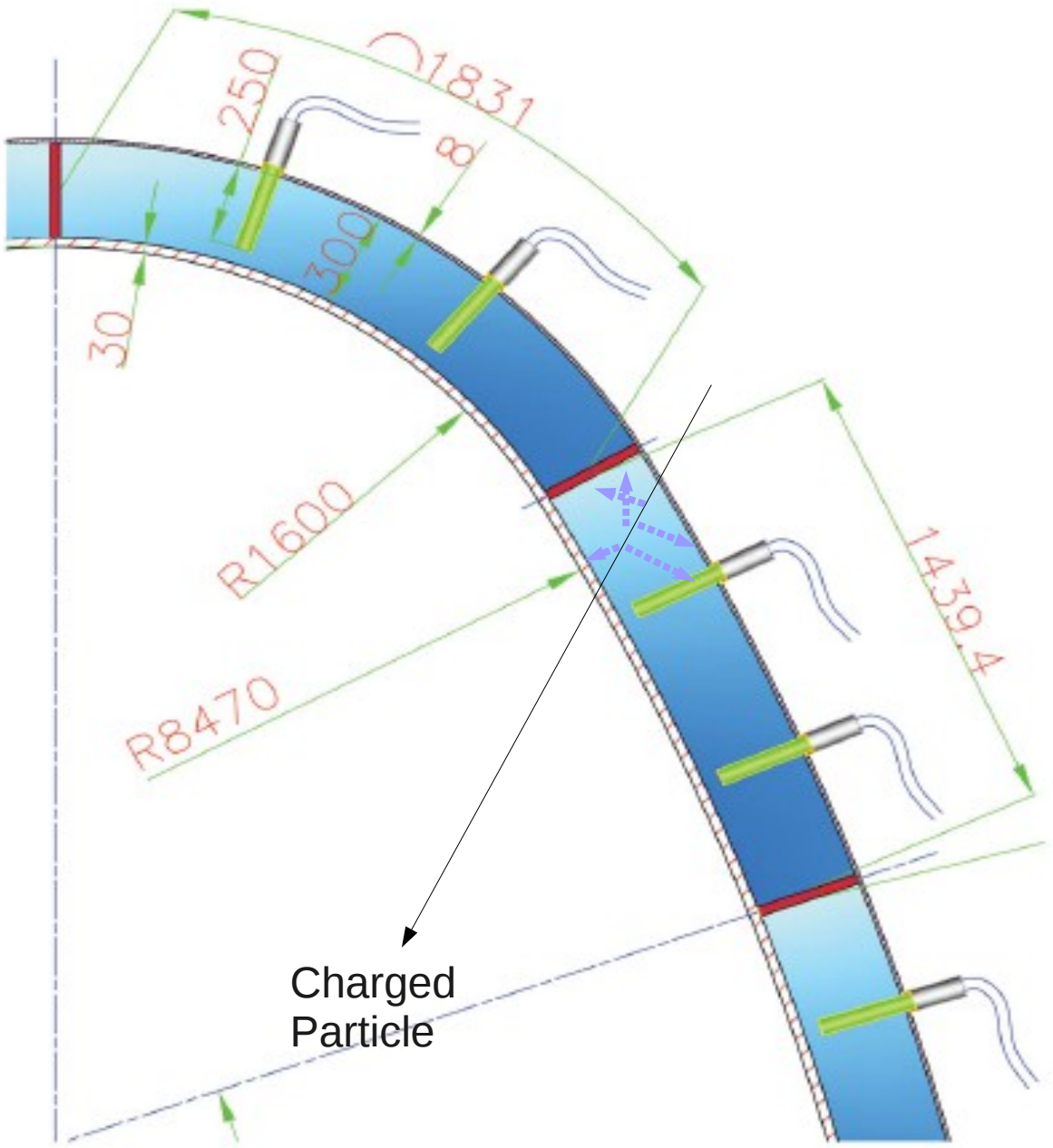
1) 1st test detector with a large-area WOM:
Efficiency and time-resolution measurements

2) Photon-transport simulations in WOM and LS

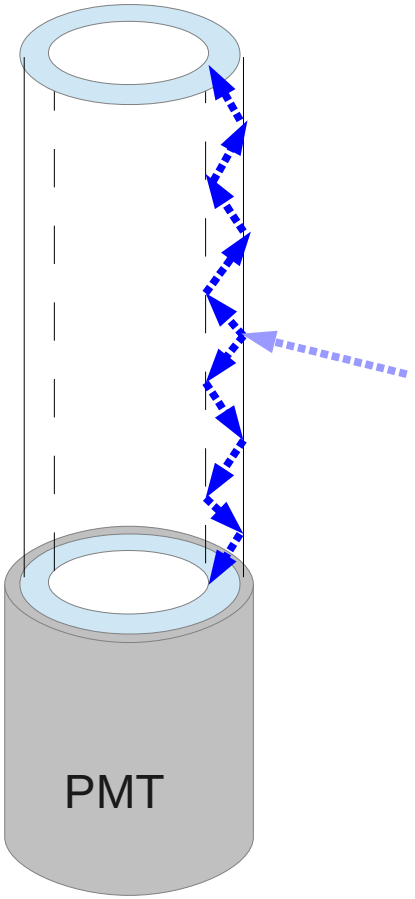
3) Towards Testbeam measurements

4) Prototype Detector for CDS phase

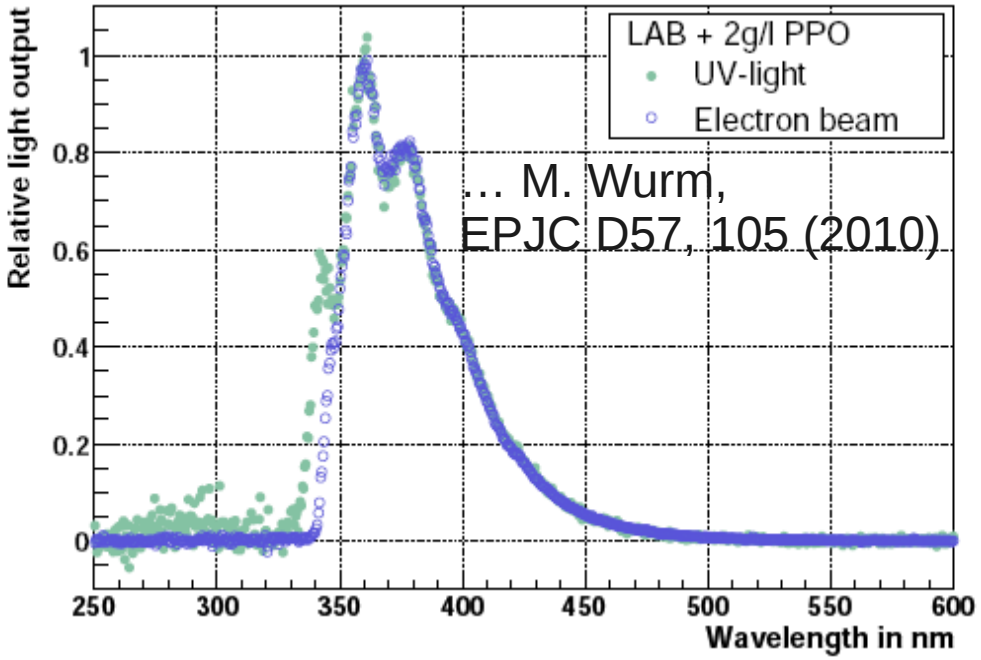
Reminder: WOM-detection principle



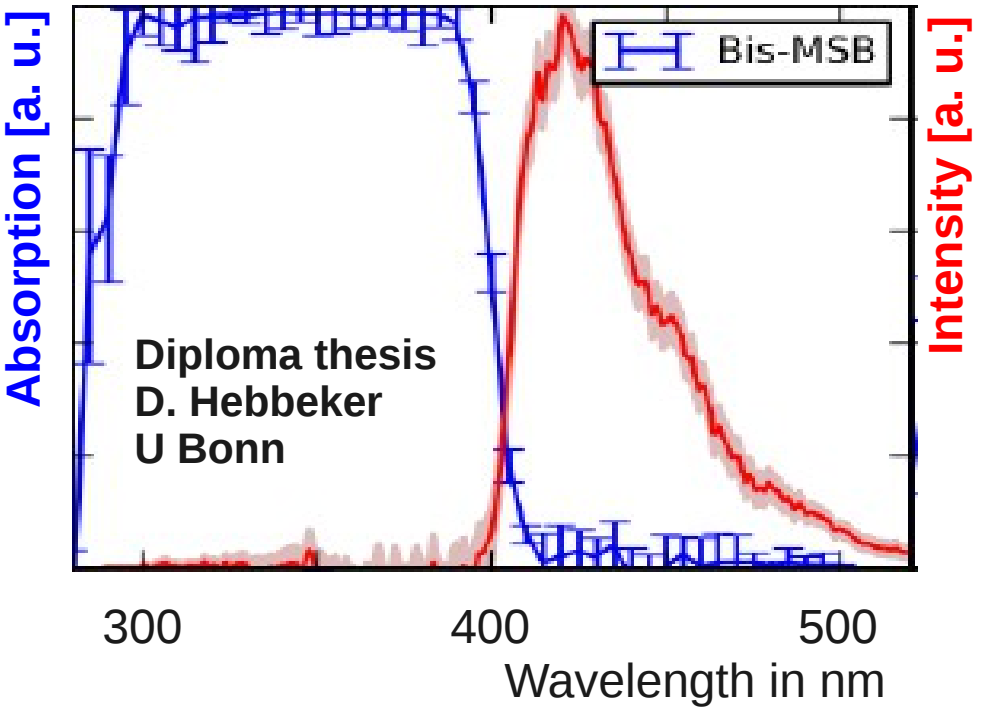
Mini-WOM
(Wavelength-shifting
Optical Module)



LS: emission spectrum



WLS: absorption & re-emission



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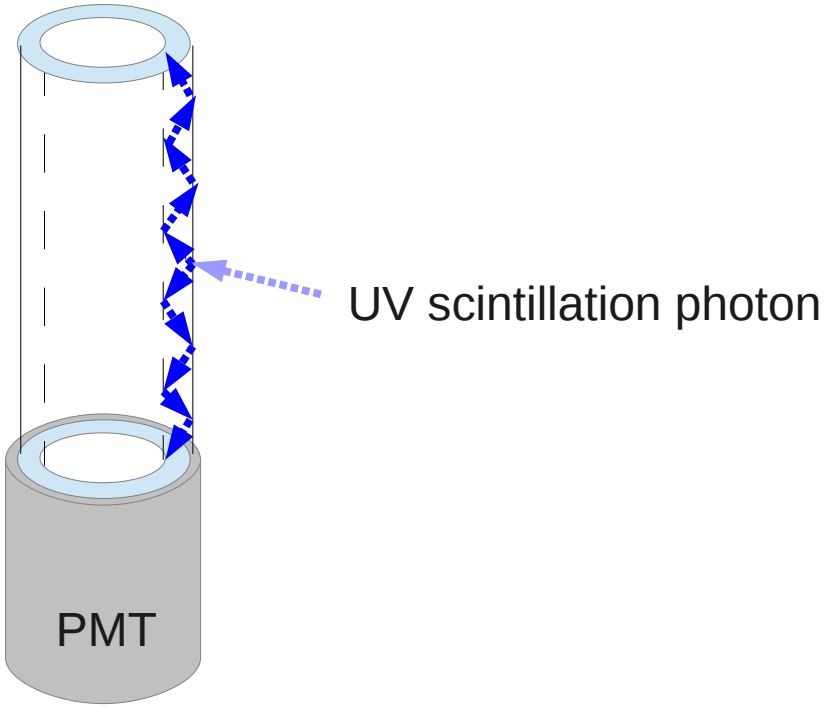
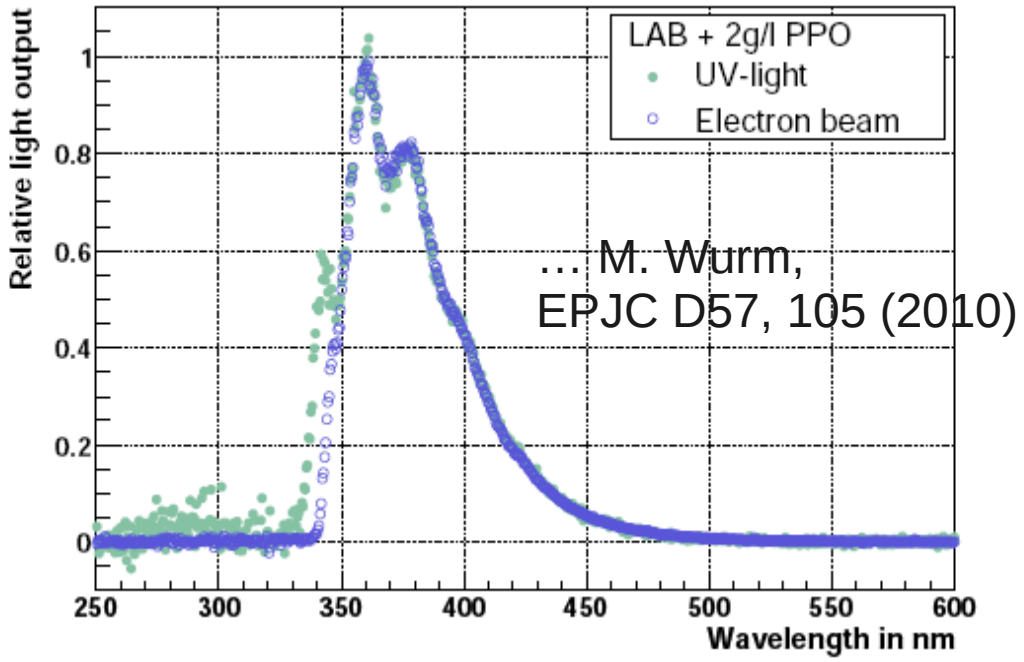
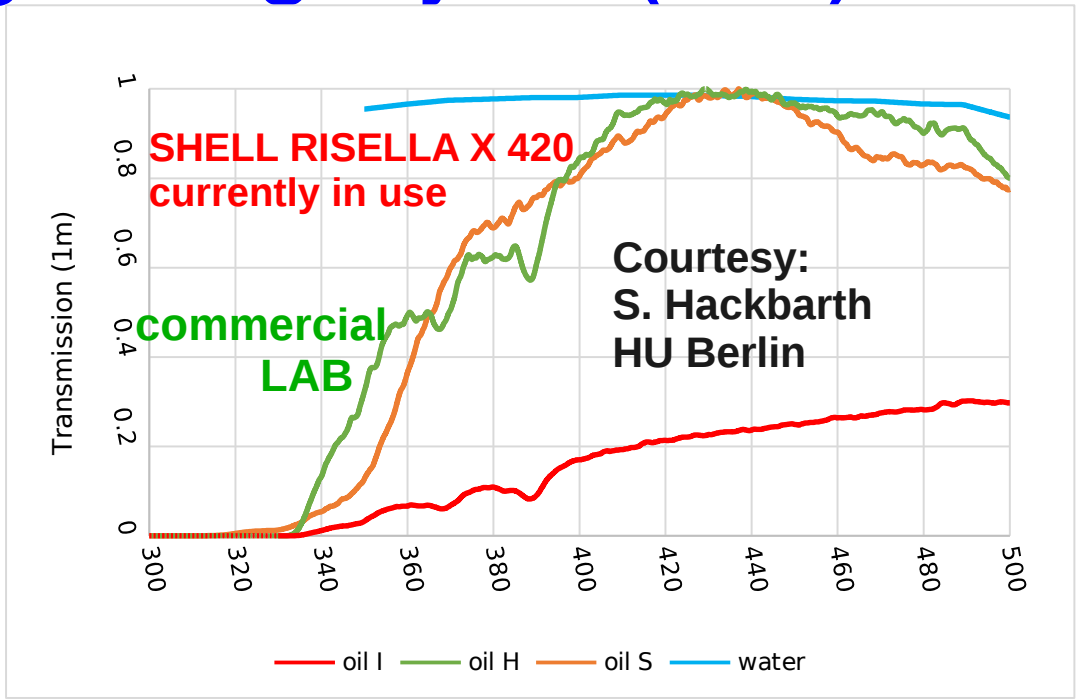


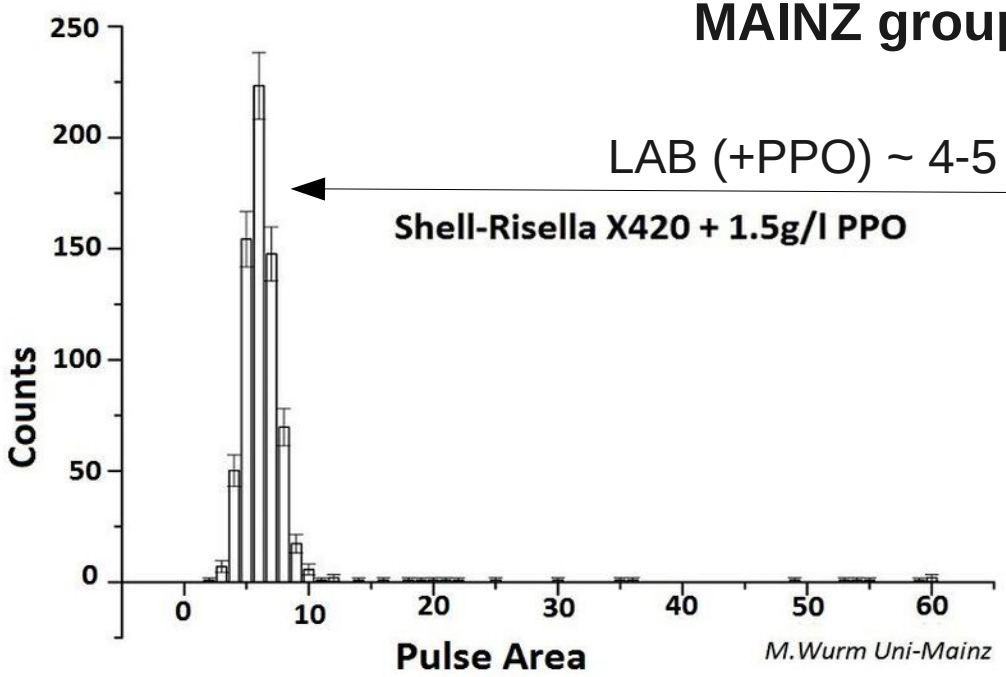
LS: absorption length & light yield (new)

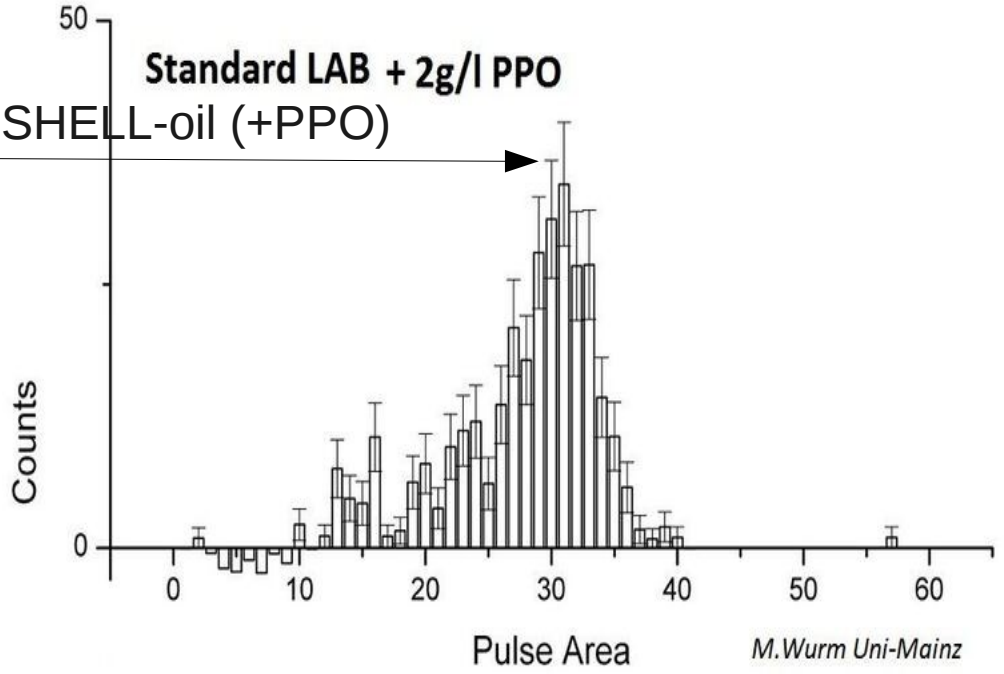




MAINZ group

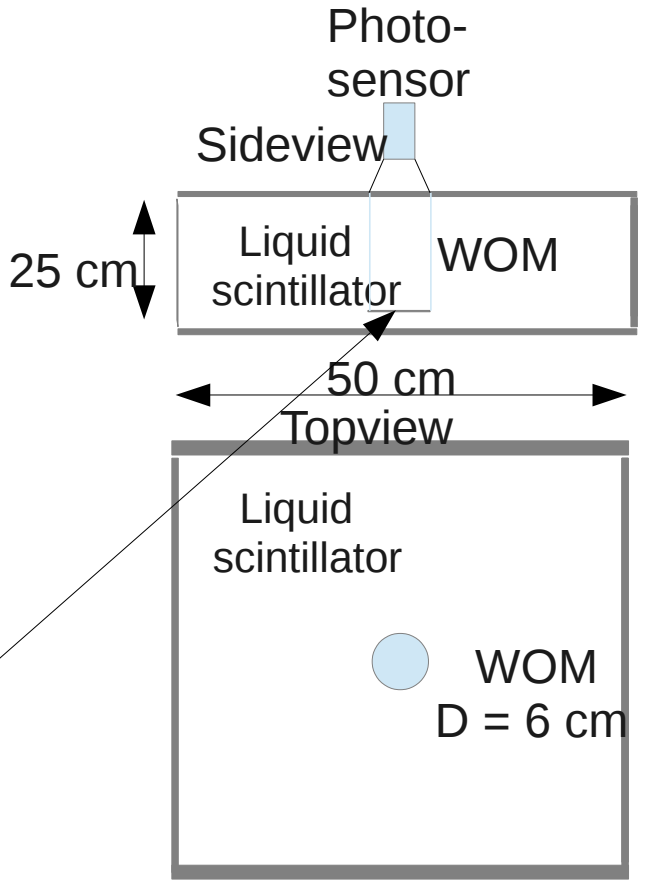
LAB (+PPO) ~ 4-5 x SHELL-oil (+PPO)





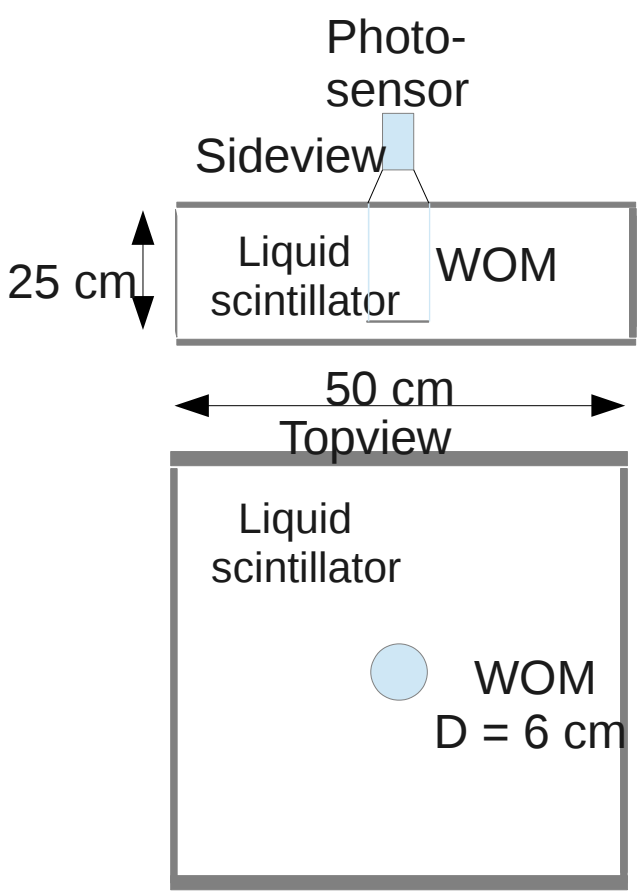
First LS-filled box with large-area WOM

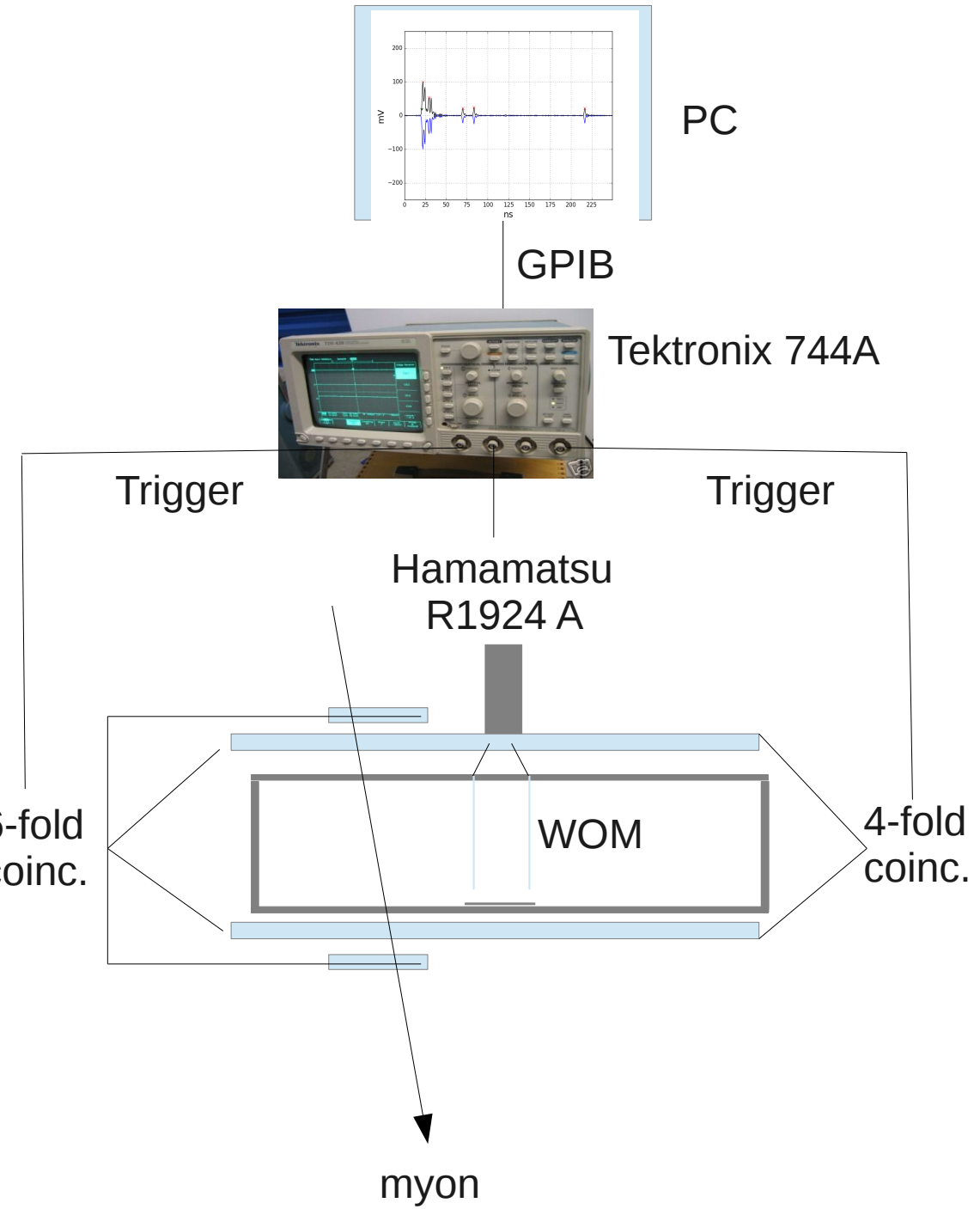
Place inside



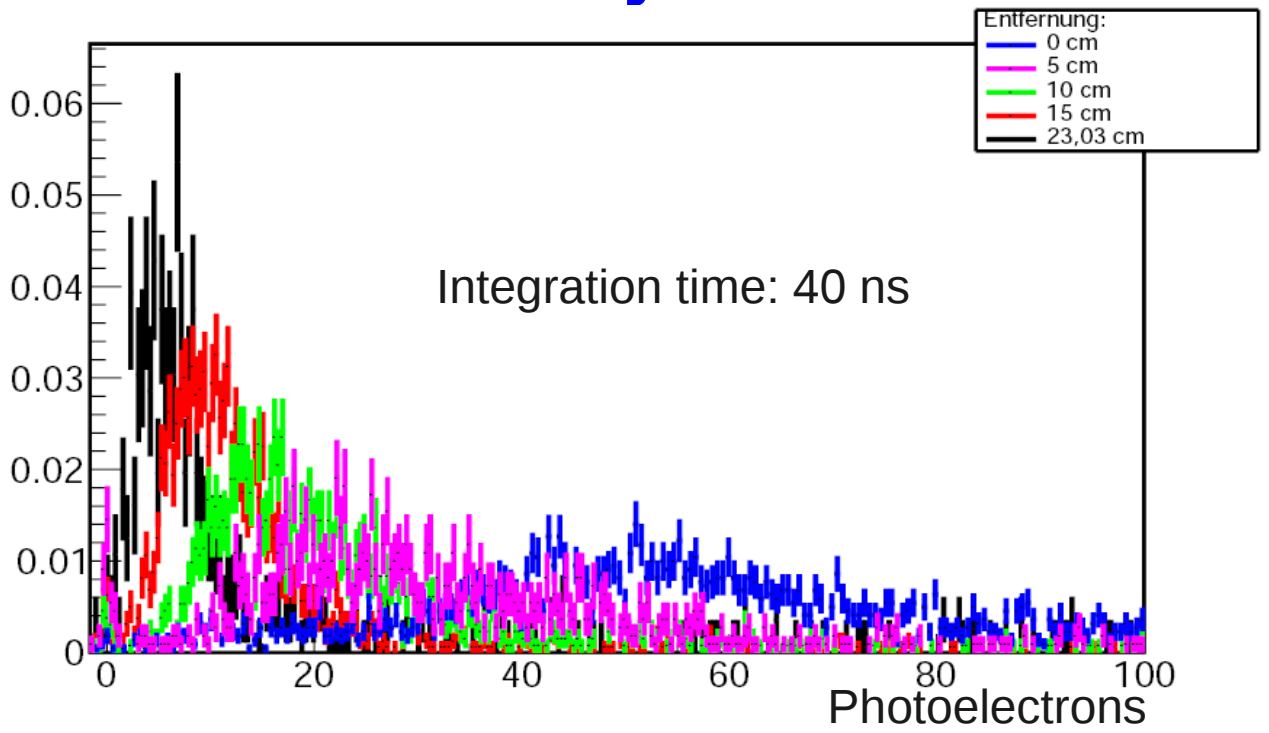
Bachelor thesis: M. Ehlert

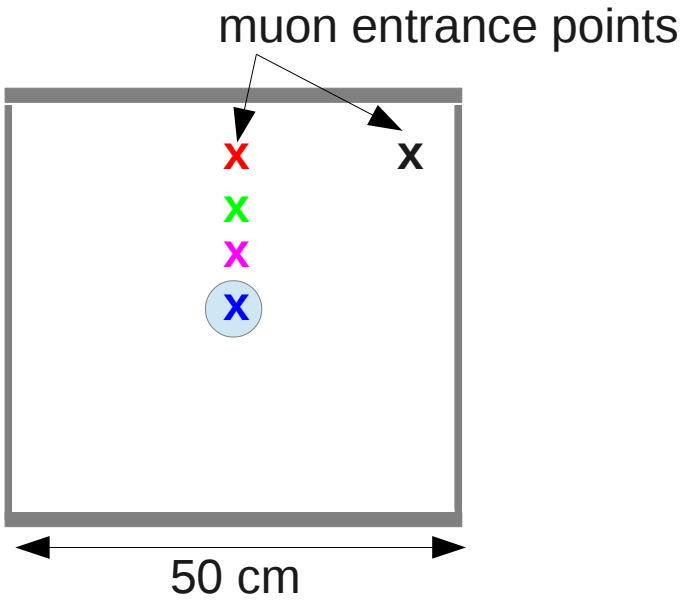
Cosmics Teststand





Efficiency measurements with cosmics



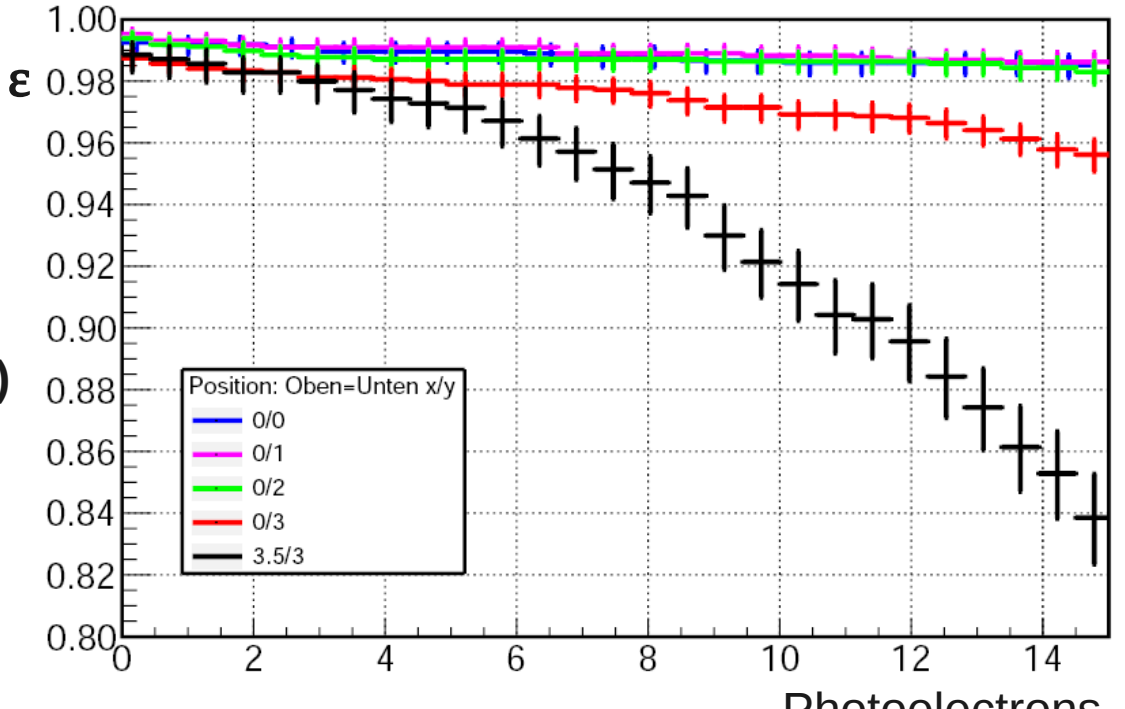


With expected light-yield increase of 4-5 when replacing SHELL oil by LAB

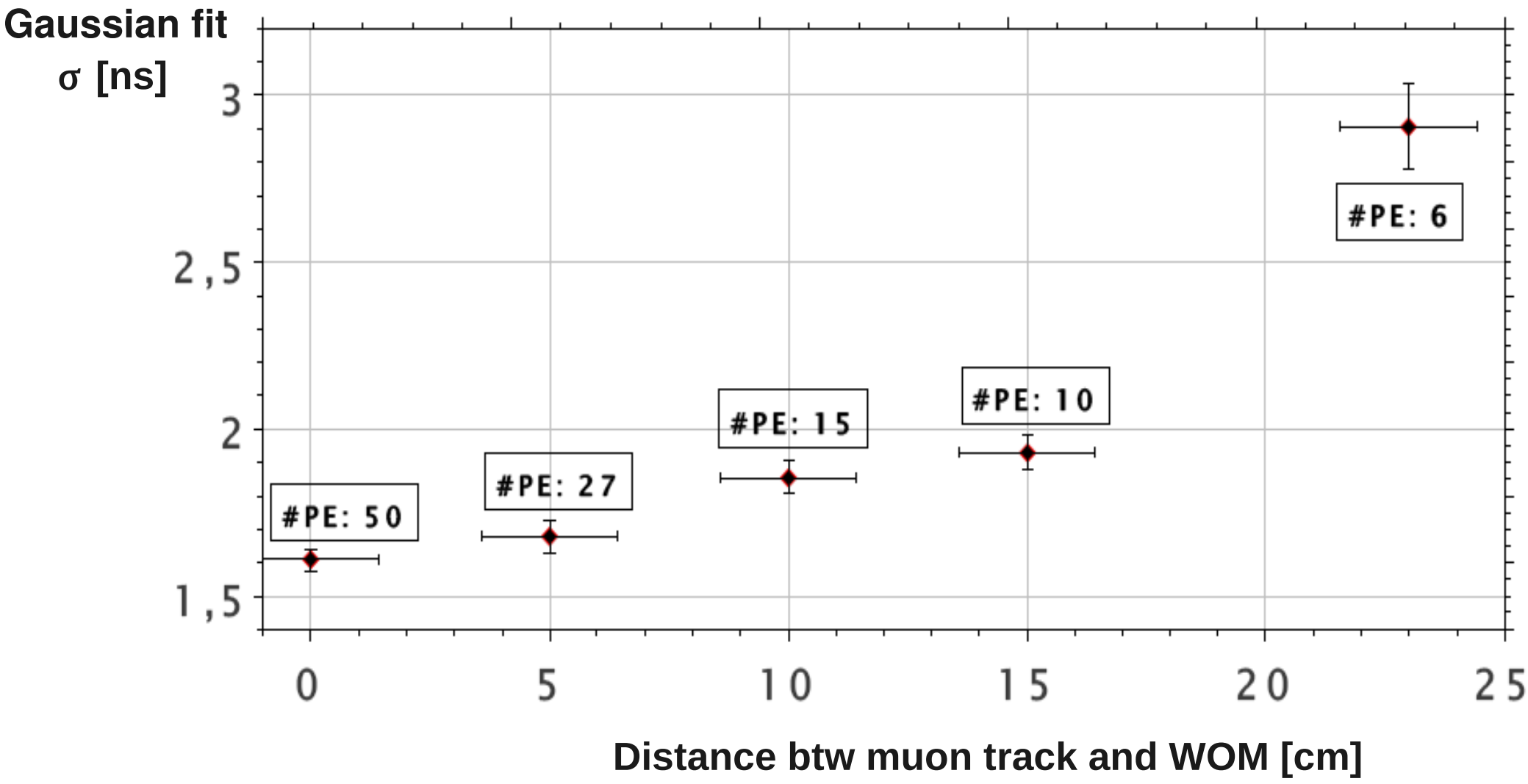
and

by adding reflecting foils (Lumirror/Tyvek) on the black-coloured box walls:

> 99% efficiency easy to reach at decent P.E. thresholds

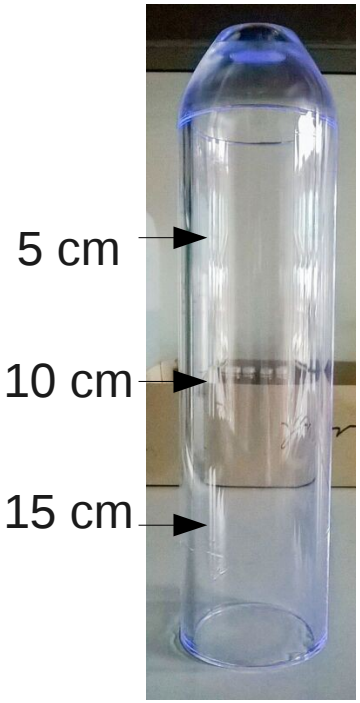


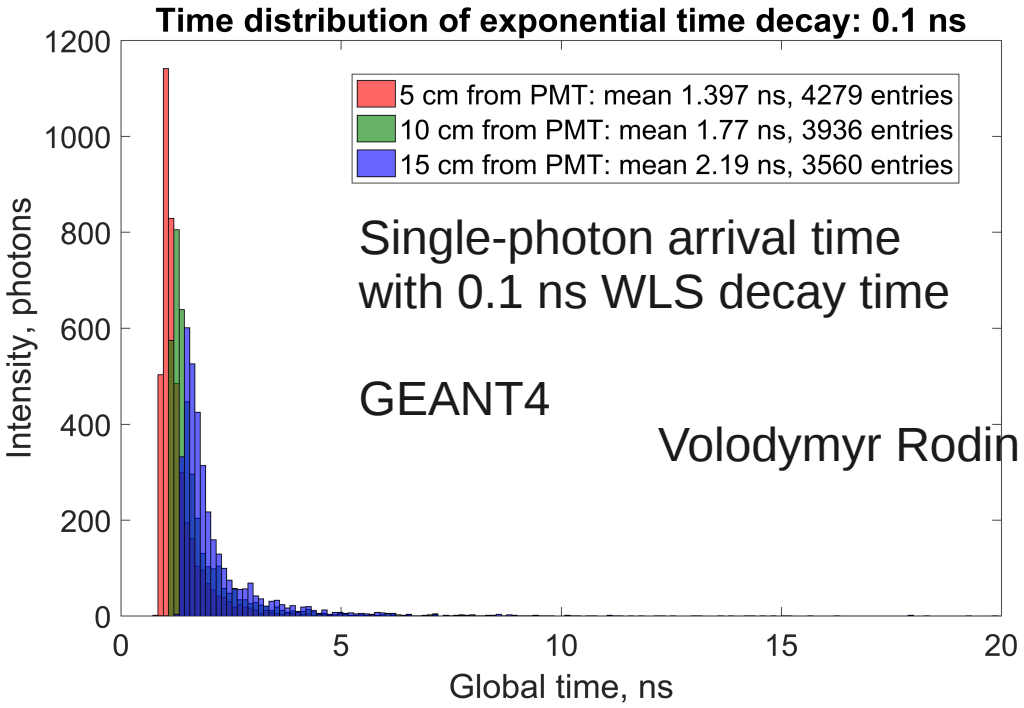
Time-resolution measurements

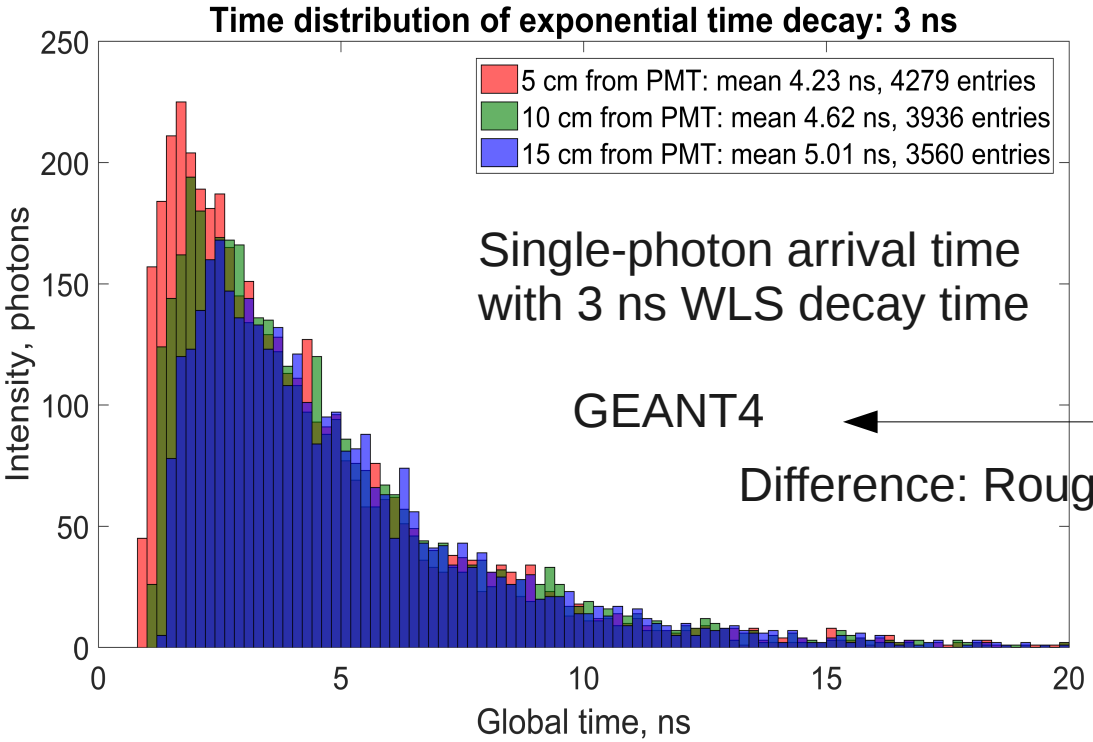


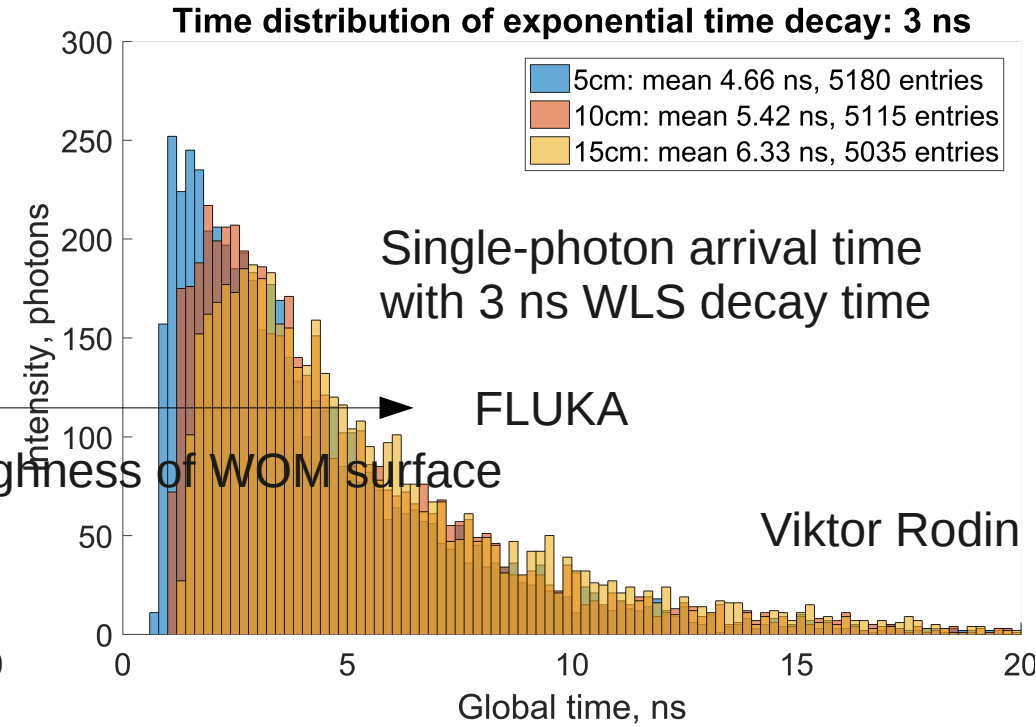
For fixed distance: O(1.6 ns) resolution at high PE yield

Towards a better WOM understanding: Photon transport simulations





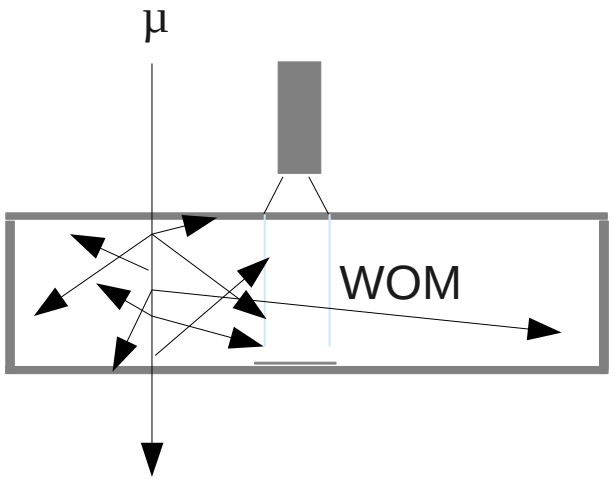


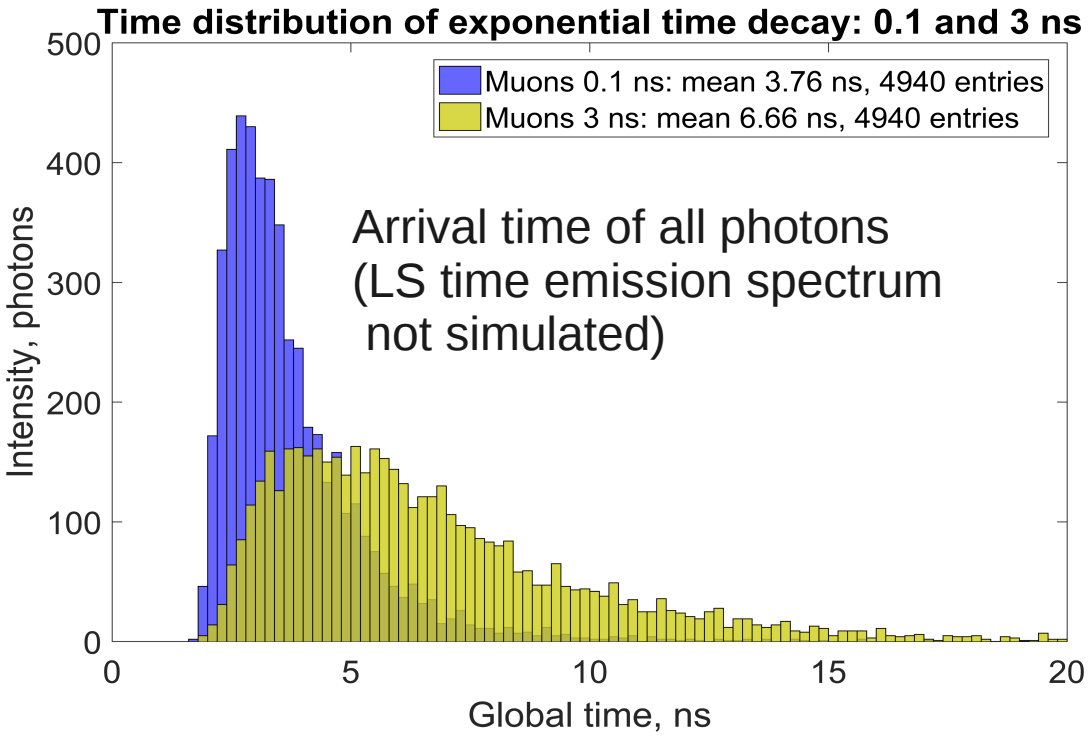


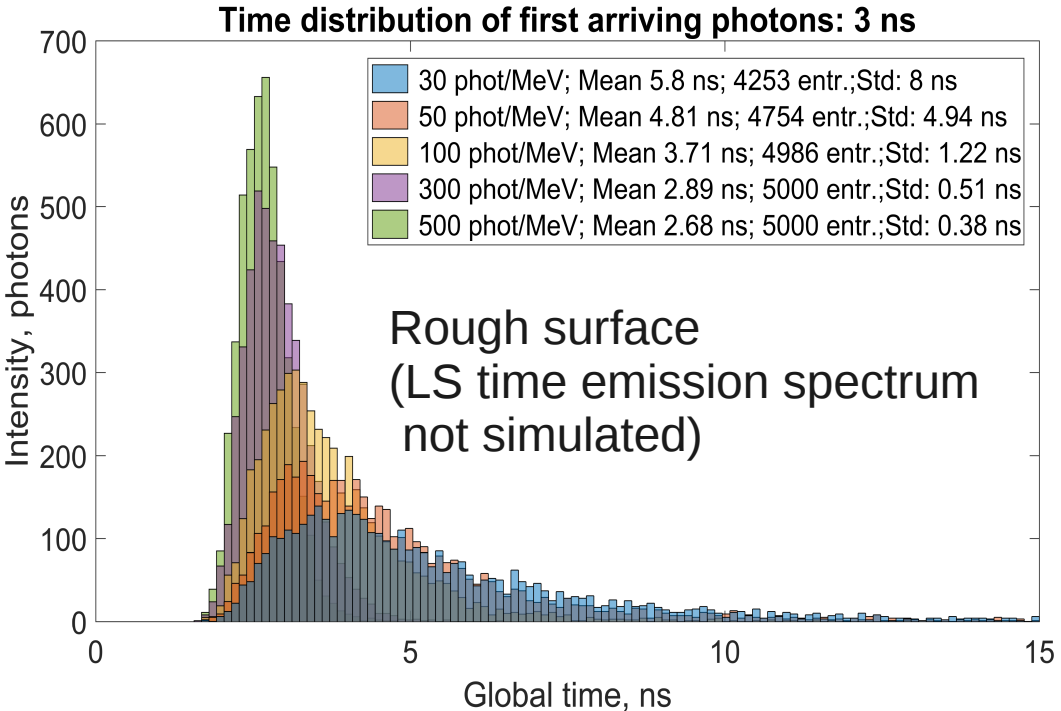
Difference: Roughness of WOM surface

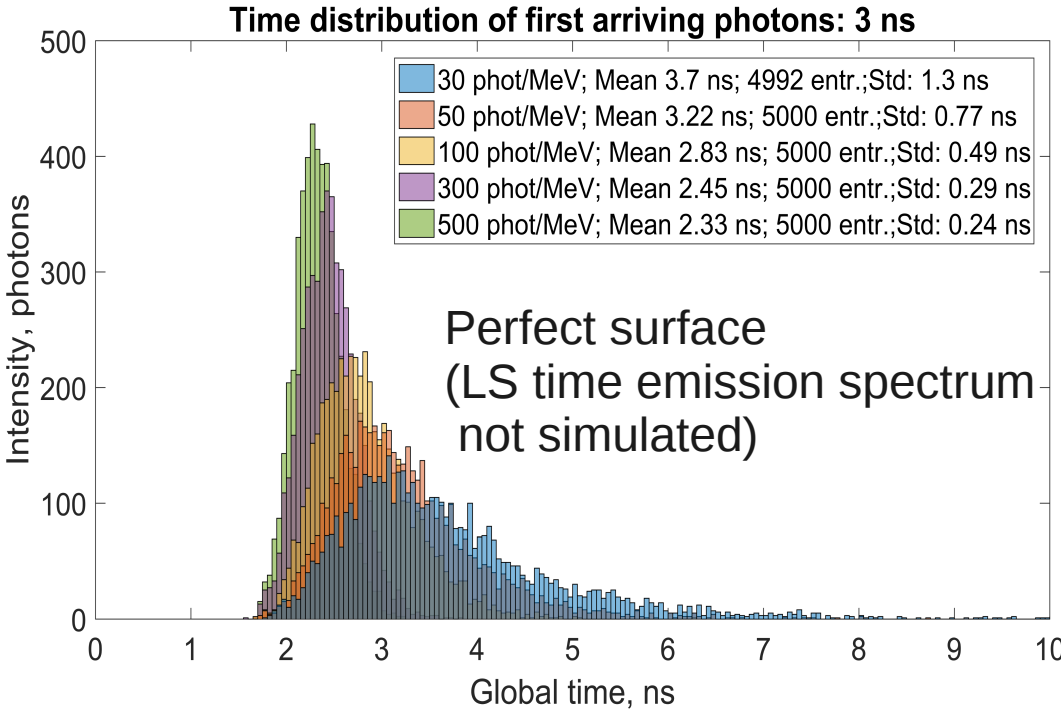
Towards a better WOM understanding: Photon transport simulations

For a welll-defined distance
btw muon track and WOM



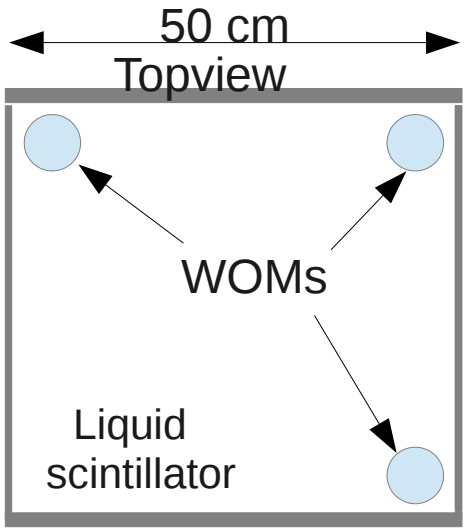






Goals for the testbeam measurement in Sep 2017

Test-detector design



First time with:

*** LAB (+PPO)**

*** Reflecting foil (Lumirror or Tyvek)**

<u>Goals:</u>

*** Light yield and efficiency measurements**

*** Time and spatial resolution (with more than 1 WOM)**

*** Dependence on particle's incident angle and entrance point**

*** Response to different particle species (muons, hadrons, electrons)**

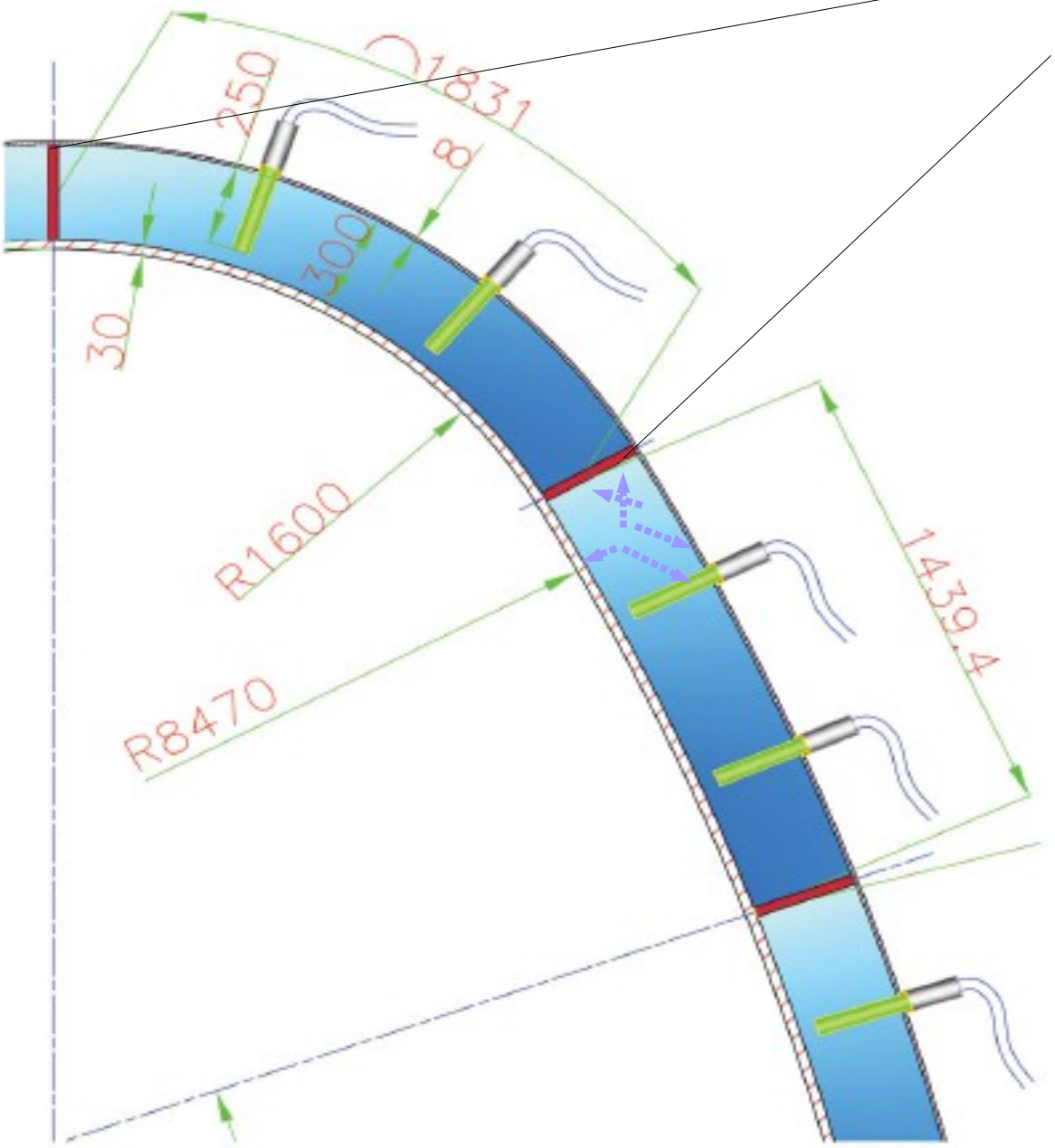
*** For electrons: produce also pre-shower with 3 cm steel plate**

<u>Readout:</u>

Hamamatsu R1924A

WAVECATCHER (purchased from LAL)

Plan: Prototype detector for CDS phase



Construct a large detector segment of O(2m x 2m) with curved walls as close to vessel design as possible

Technical questions to be addressed:

*** High-quality WOM+lightguide made out of one piece**

*** Deployment of WOMs (LS pressure, LS tightness)**

*** Deployment of reflecting foils**

*** Proof-of-Principle: LAB-PPO mixing**

*** Proof-of-Principle: Nitrogen flushing**

*** Proof-of-Principle: LS filling/exchange**

*** Prototype electronics for PMT readout**

*** SiPM as alternative photosensors and corresponding readout electronics**

*** Testbeam measurements with muons, hadrons, electrons & photons**

Summary

1) 1st test detector with a large-area WOM:
   ε > 99% well in reach (using LAB and reflecting foils)

   LS+WOM time-resolution measurements: O(1.6 ns)

2) Photon-transport simulations in WOM and LS
   help to understand performance and possible improvements

3) Test detector with multiple WOMs
   being prepared for September2017 testbeam

4) Plan for a large-scale prototype detector for CDS phase
   to address a number of technical questions