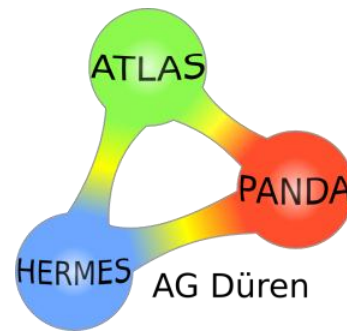


A Testing Device for the PANDA 3D Disc DIRC: „Recent Progress and First Measurements with Final Setup“

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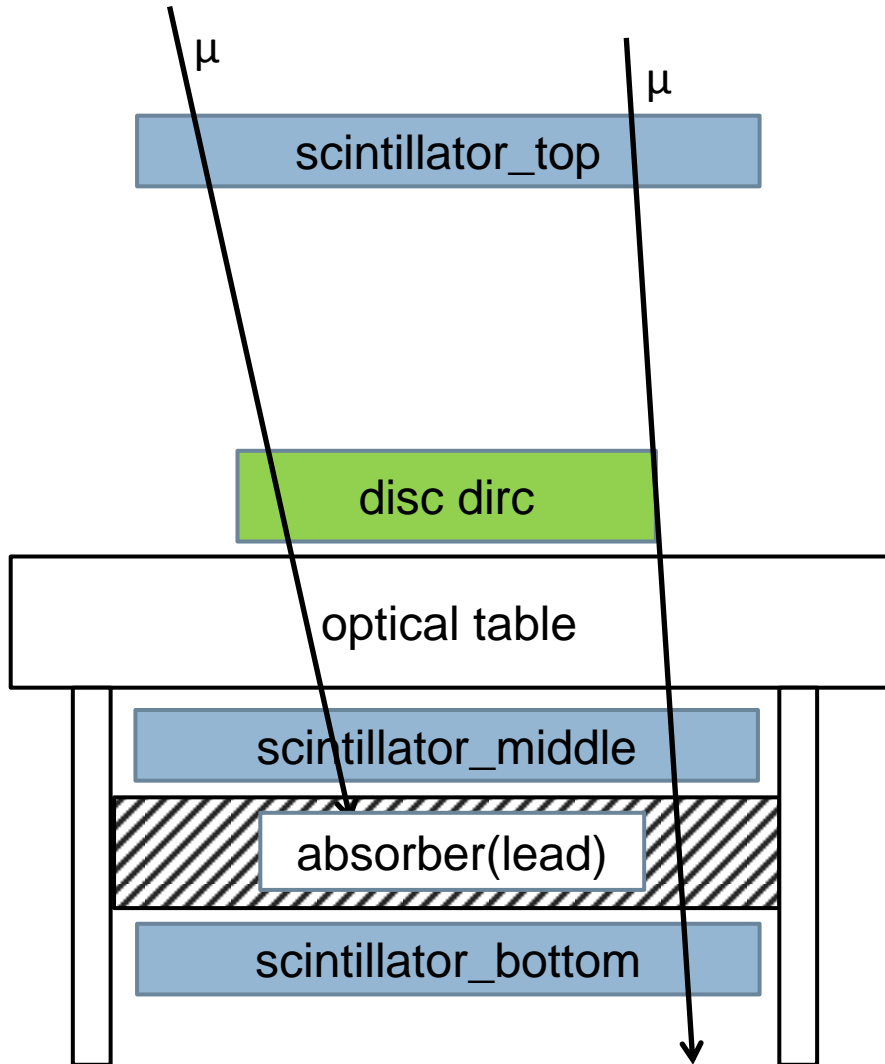
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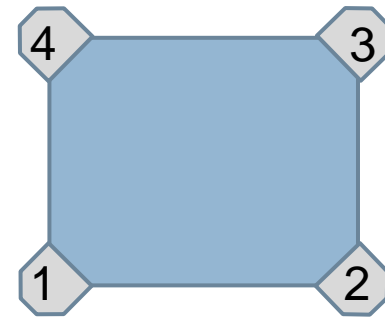
1. Recap: Basic Concept

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□ Scintillators:

- Rise time: 0.9 ns
- Decay time: 2.1 ns
- Dimensions: 50 cm x 50 cm x 2cm
- $\approx 10,000$ photons per MeV
- Equipped with 4 photon sensors



$$(50 \times 50 \text{ cm}^2 \Rightarrow \approx 40 \frac{\text{muons}}{\text{s}})$$

1. Recap: Reconstruction

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- For each scintillator
 - ▣ 4 photon detectors \Rightarrow 4 time + 4 charge measurements

- Reconstruction:
 - ▣ Chi2-Fit to Data
 - Take all time information into account and minimize: $\sum_{i=1}^4 \left(\frac{t_{i,MEAS} - t_{i,CALC}}{\sigma_{ERR}} \right)^2$

 - ▣ Solve 3-dim equation system
 - Obtain 4th time and compare to measured 4th time

 - ▣ Reconstruct position using charge measurement (# of photons)
 - So far: measurements with dSiPMs without possibility of using external trigger

1. Recap: Using dSiPMs

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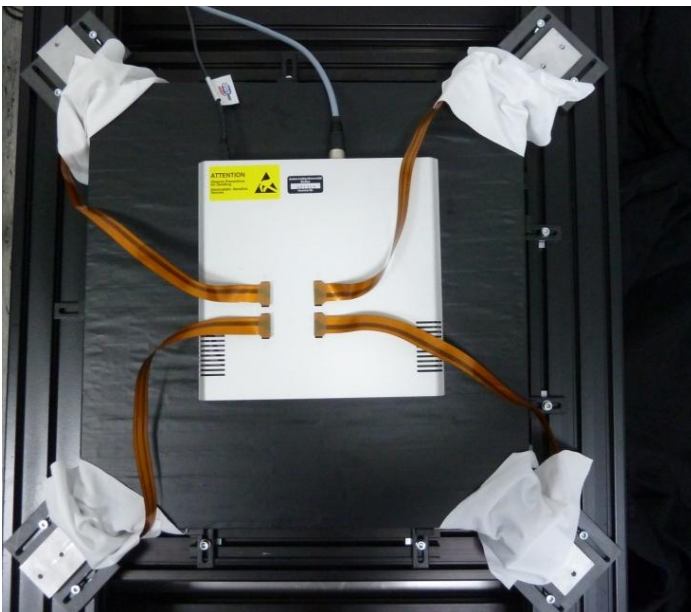
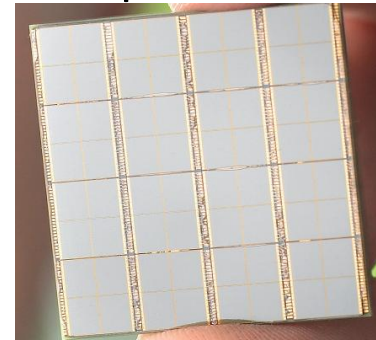
- Number of detected photons nicely agrees with simulation
- Obtained resolutions:

- Solving equation system: $\tau_{EQ} = 398ps$

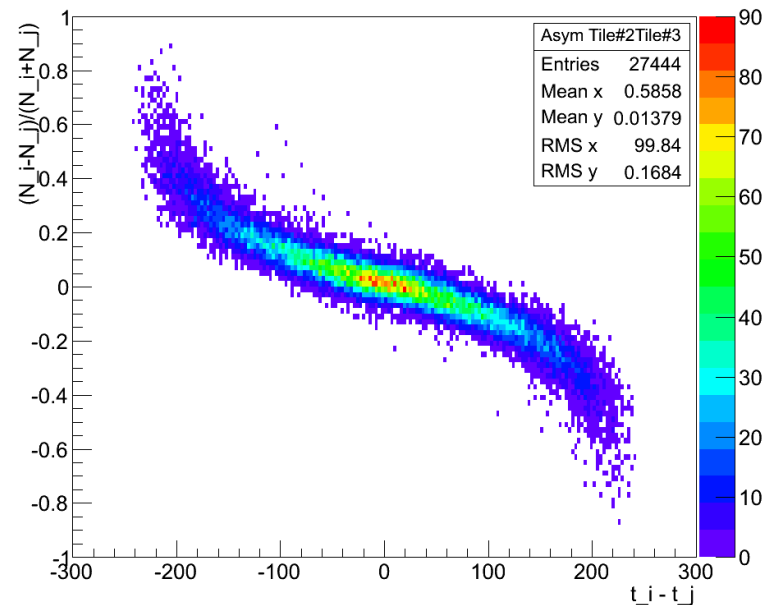
- Asymmetries (# of photons): $\sigma_x = 4.83cm$

- Chi2-Fit \leftrightarrow SolveEQ: $\sigma_x = 1.38cm$

Philips dSiPMs:



Asym Tile#2Tile#3

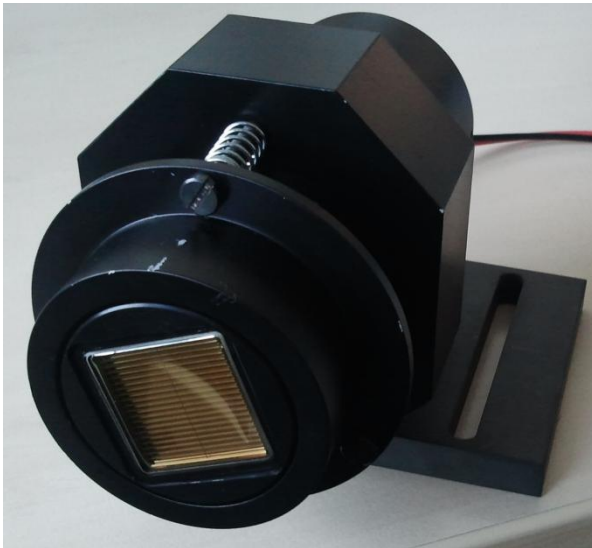


2. Components & Design

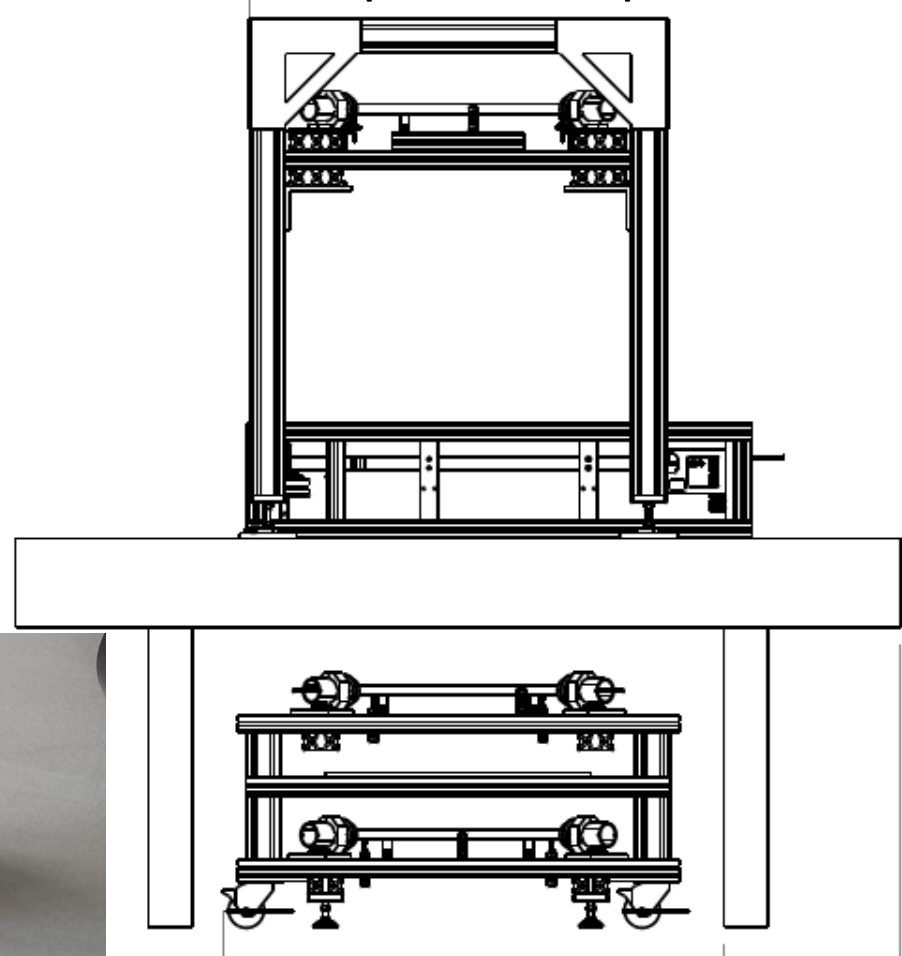
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Photomultiplier (Hamamatsu):

- 8x R9880U-110 (incl. sockets)
 - ▣ Active area: $\approx 50 \text{ mm}^2$
- 4x R11265U-100 (incl. sockets)
 - ▣ Active area: $\approx 529 \text{ mm}^2$

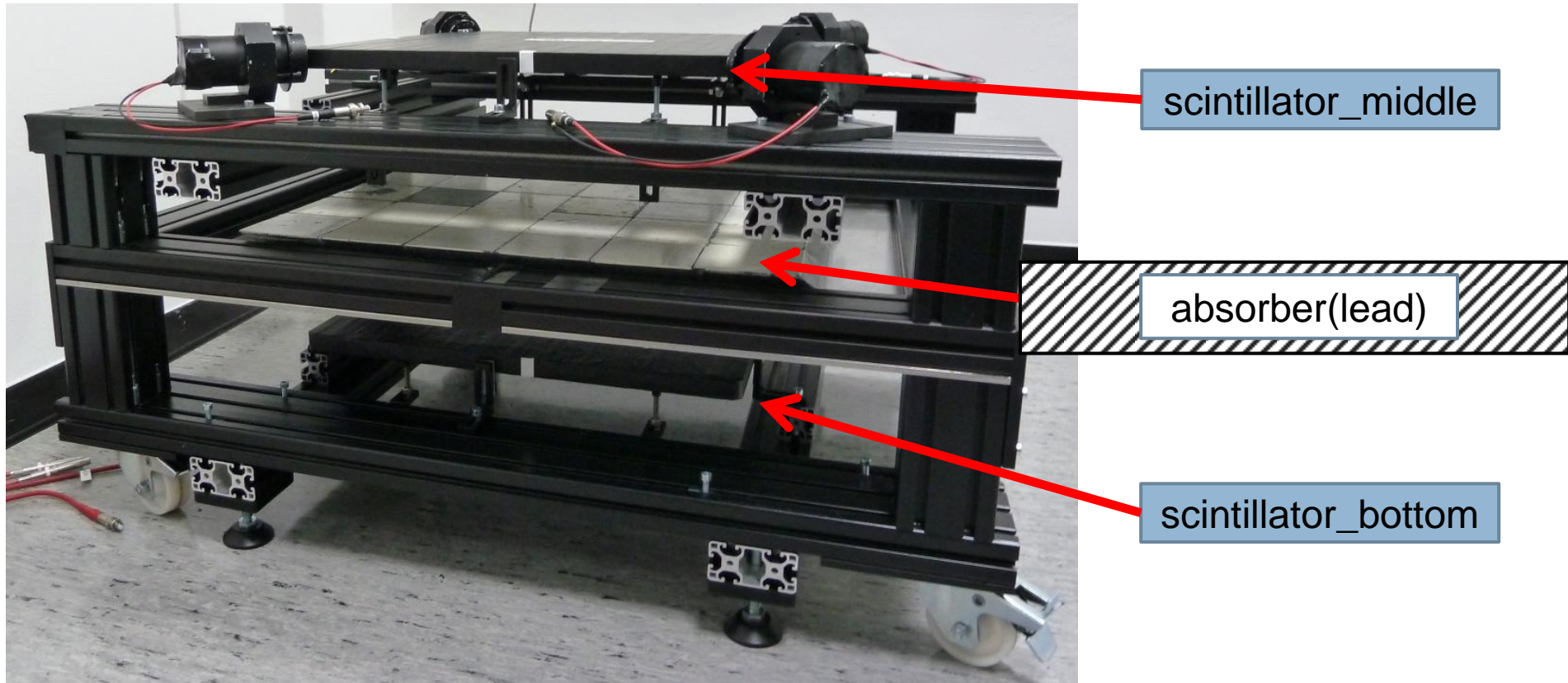


Complete setup:



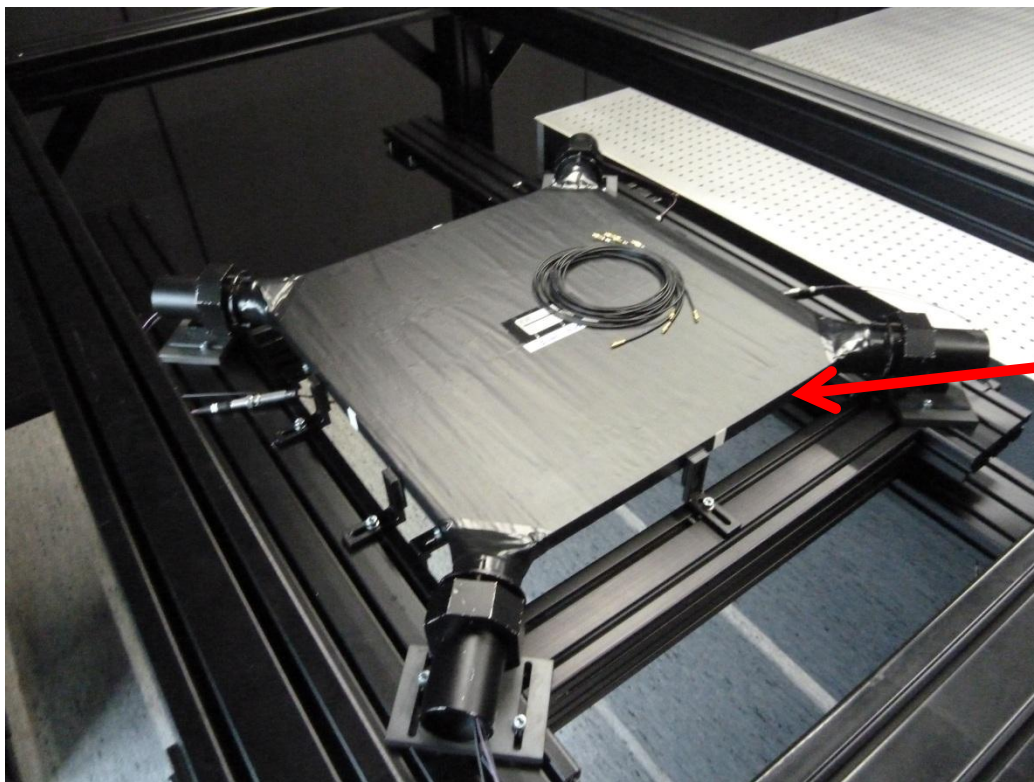
2. Setting up the Device

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2. Setting up the Device

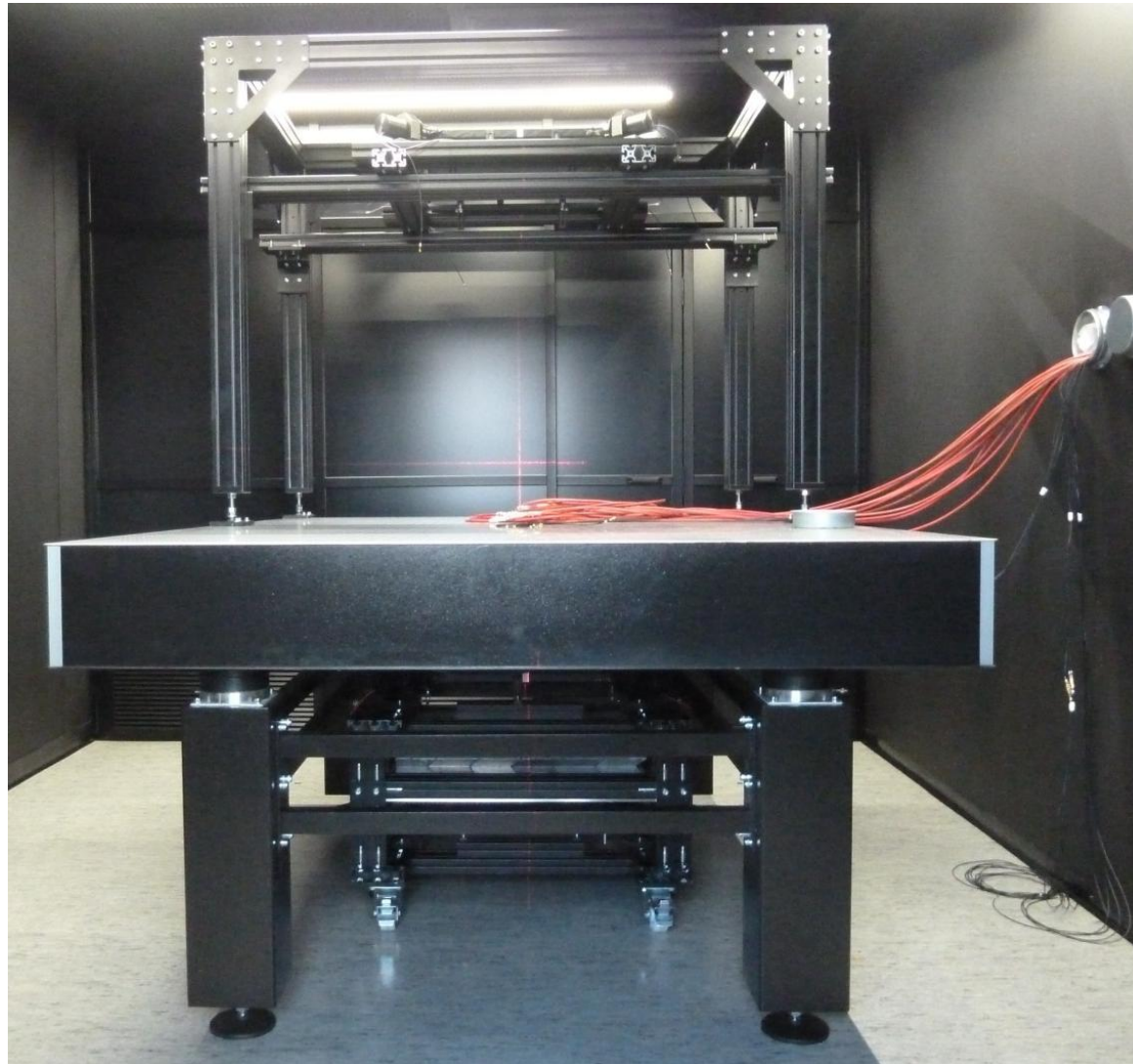
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scintillator_top

2. Setting up the Device

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2. Hardware + Trigger

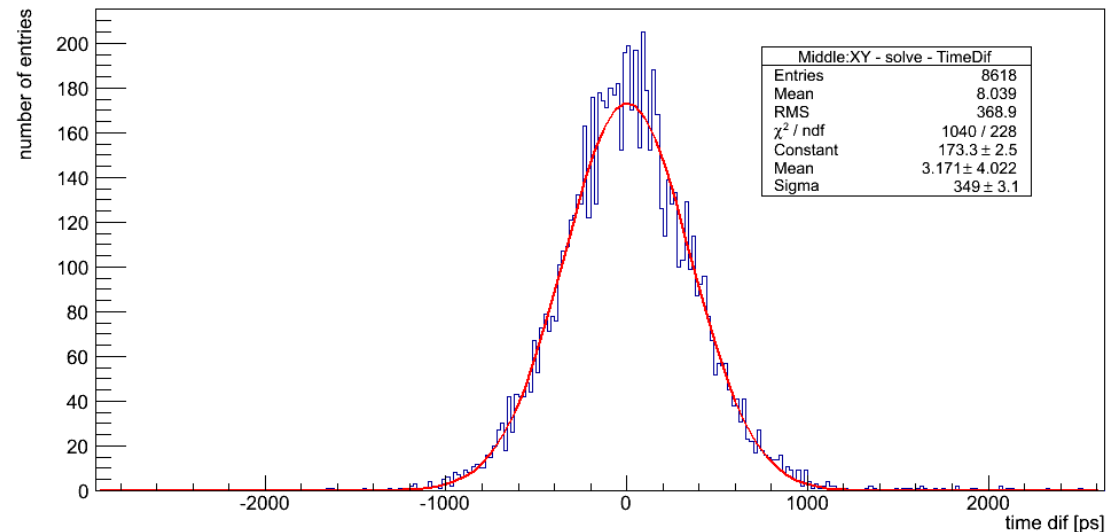
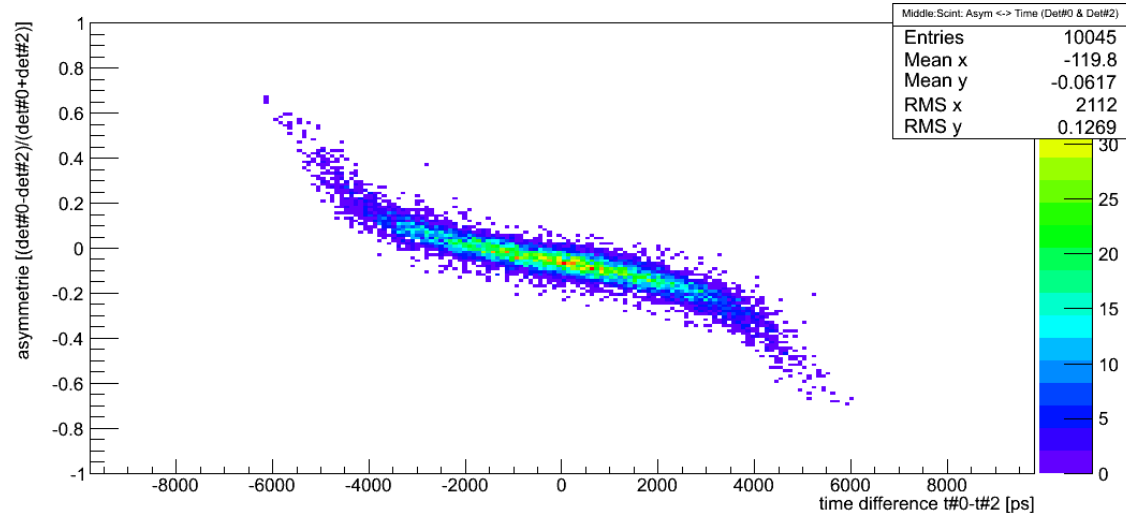
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- TRBv2 + TOF-Addon (in total 12 channels needed)
 - ▣ Use same data acquisition system as Disc DIRC prototypes
- Trigger
 - ▣ Split Signals of PMTs -> CFD -> AND-Logic
- Different trigger schemes tested and used:
 - ▣ For example: With one scintillator:
 - all 4 PMTs to detect photons in 20 ns window
 - ⇒ trigger rate $\approx 30 - 40 \frac{1}{s}$
 - ▣ For Example: With two scintillators (middle + bottom)
 - One PMT per scintillator to detect photons in 20 ns window
 - ⇒ trigger rate $\approx 10 - 25 \frac{1}{s}$

3. First Measurements

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- Trigger:
 - ▣ One PMT per scintillator
- Obtained time resolution:
 - ▣ Large PMTs:
 - $\tau_{EQ} \approx 350 \text{ ps}$



3. First Measurements

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Trigger:

- One PMT per scintillator

Obtained time resolution:

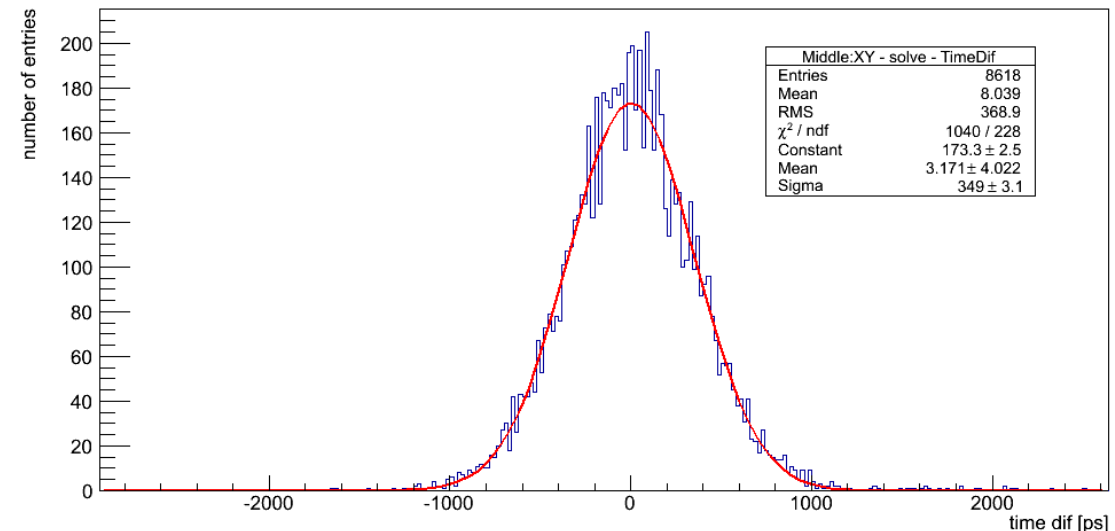
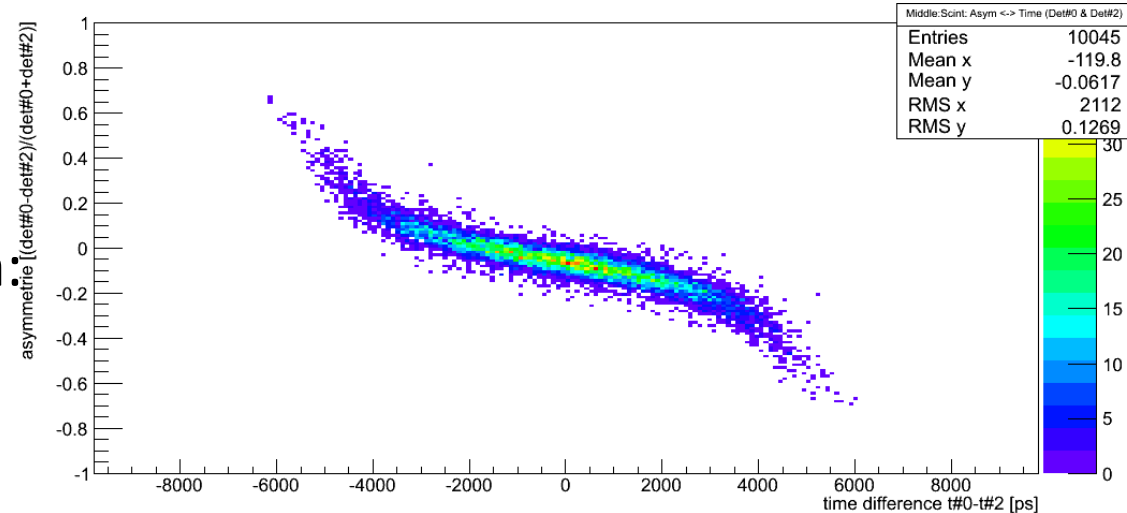
- Large PMTs:

- $\tau_{EQ} \approx 350 \text{ ps}$

- Small PMTs:

- $\tau_{EQ} \approx 1200 \text{ ps}$

- Reason: Not enough photons hitting sensor
 - Coupling to Scintillator?
 - Currently working on solutions



4. Summary & Outlook

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Summary

1. The testing device has completely been set up
2. First measurements were performed
 1. Single scintillator
 2. Multiple scintillators in coincidence

Next steps to be carried out:

1. Work on time resolution of small PMTs
2. High statistics measurements
3. Detailed analysis of taken data
4. Measurements with DIRC