

The GERDA Cherenkov Muon Veto Detector System

SFB Transregio 27 - A3

Heidelberg

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bmb+f - Förderschwerpunkt

Astroteilchenphysik

Großgeräte der physikalischen
Grundlagenforschung

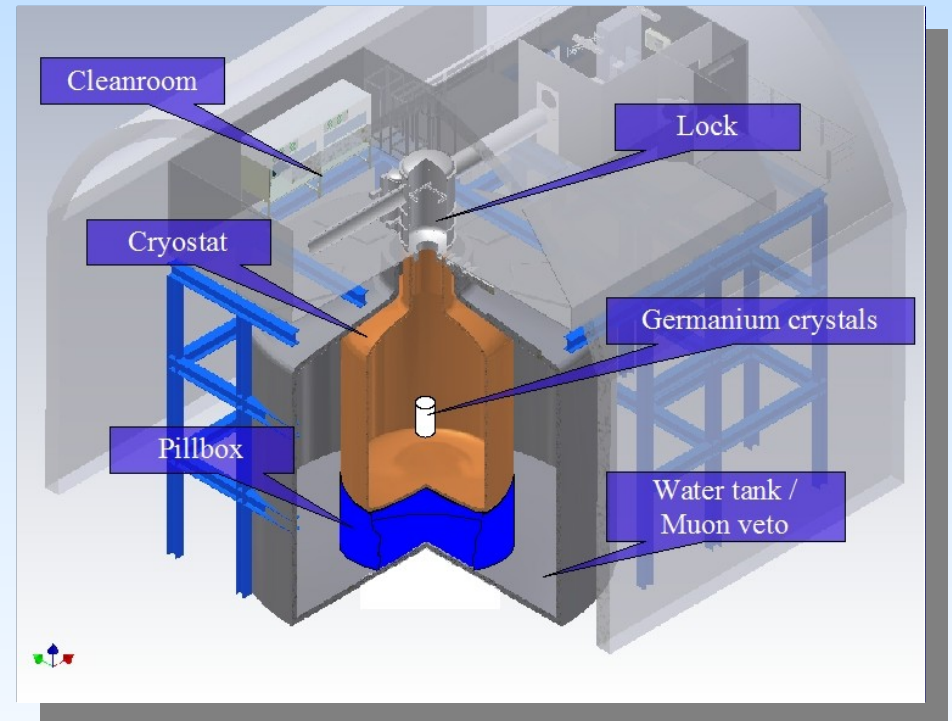


Content

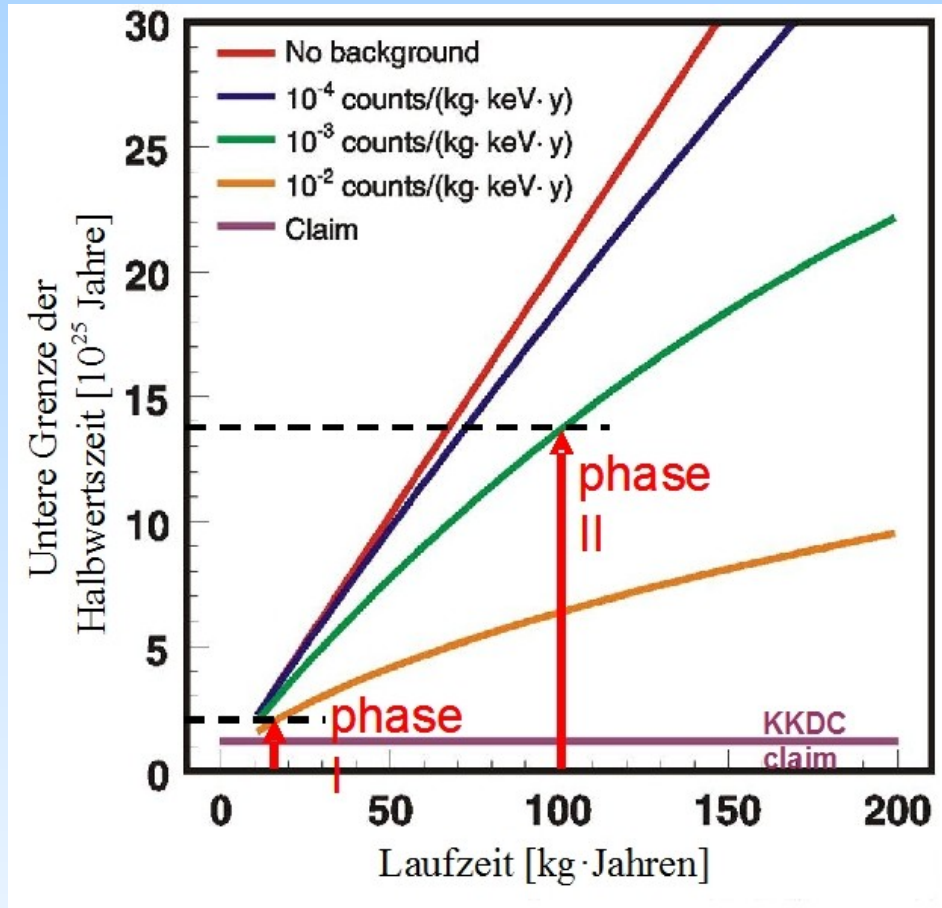
- Motivation of the GERDA muon veto
- First steps to the final muon veto
- Muon induced background analysis
- Construction of the muon veto



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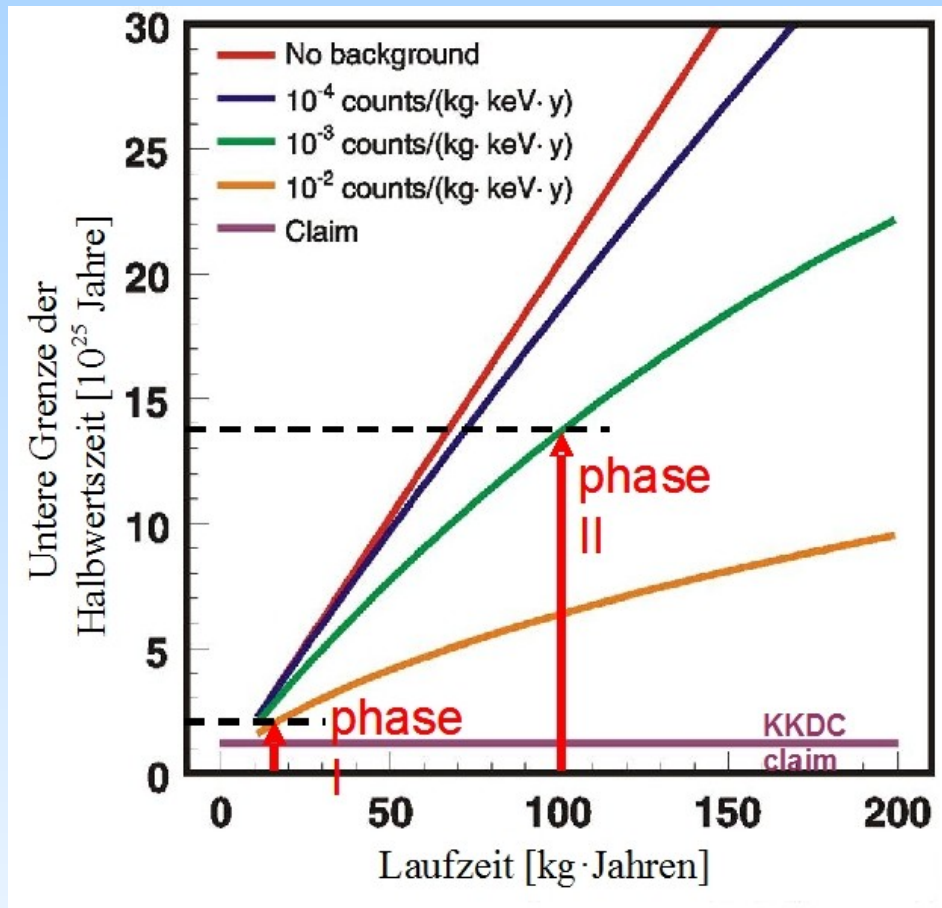


GERDA Sensitivity



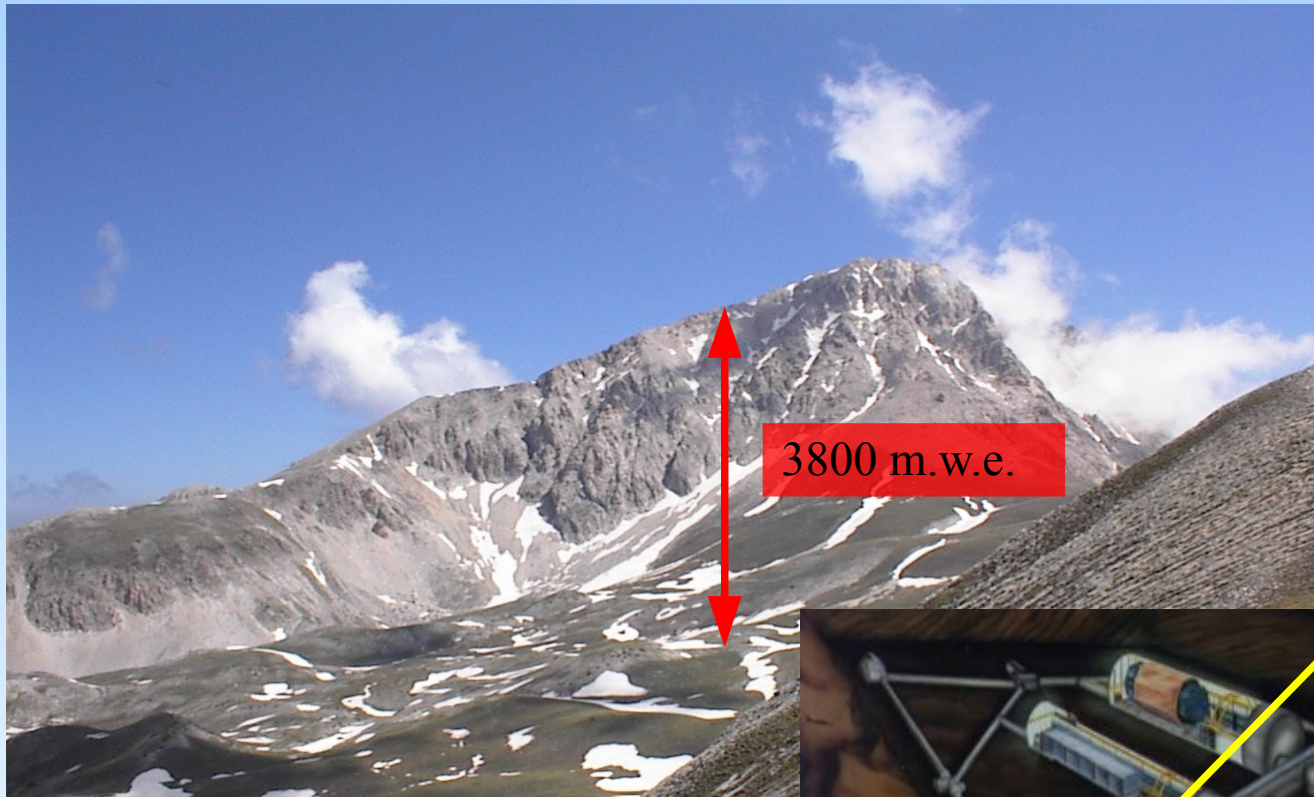
- GERDA will detect the neutrinoless double beta decay of ^{76}Ge
- Very rare process with life time $T_{1/2} > 2 \cdot 10^{25}$ years
- Large target mass needed
- Long time measurement
- Background suppression 10^{-3} counts/(keV · kg · year)

GERDA Sensitivity

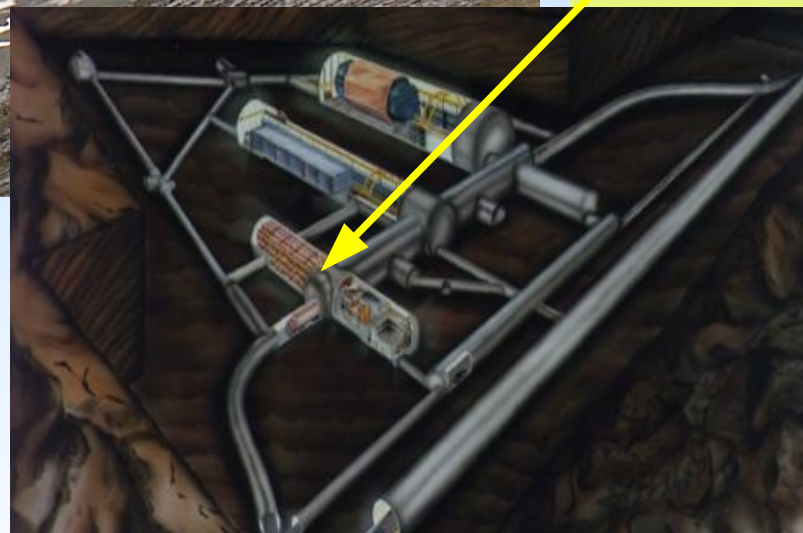


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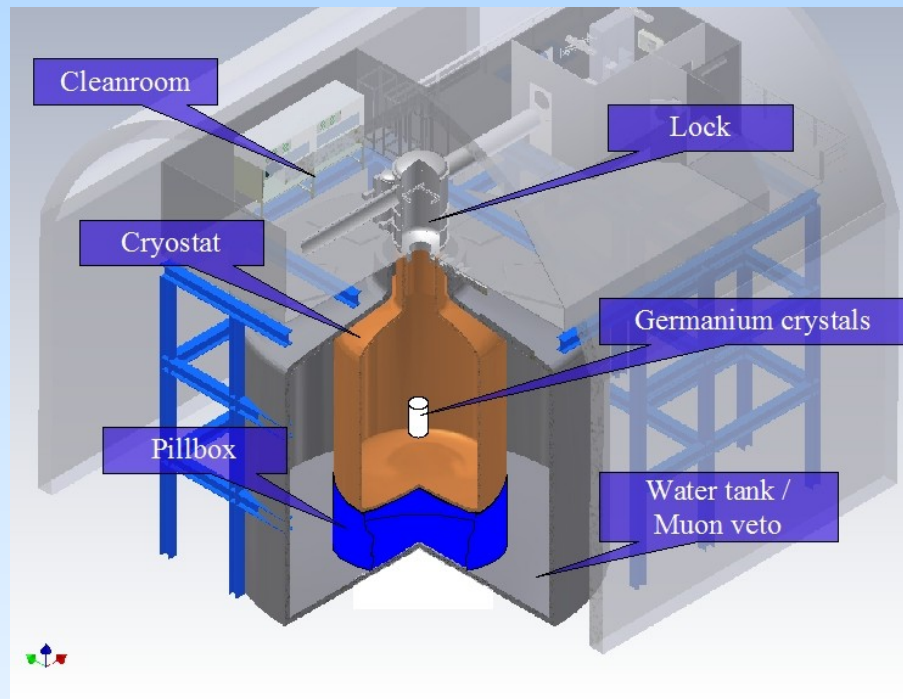
GERDA Shielding



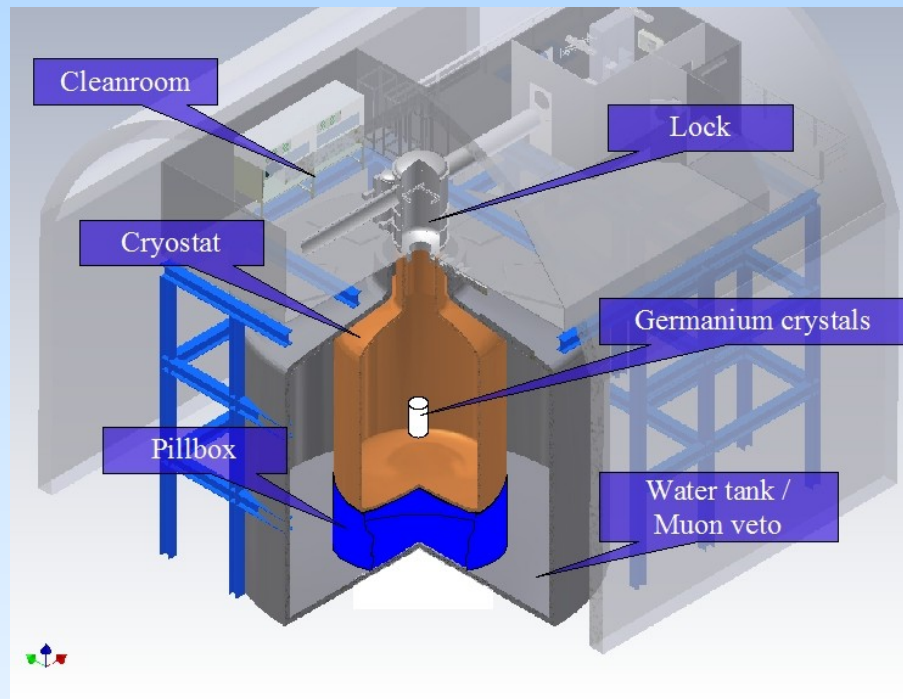
Hall A, LNGS
(between LVD
and CRESST)



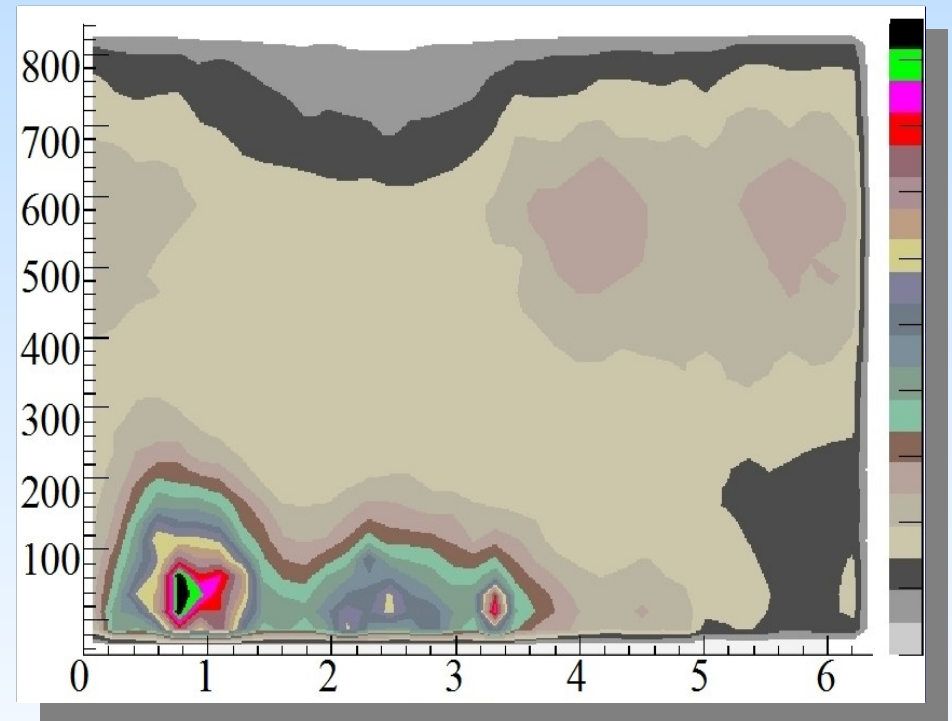
GERDA Shielding



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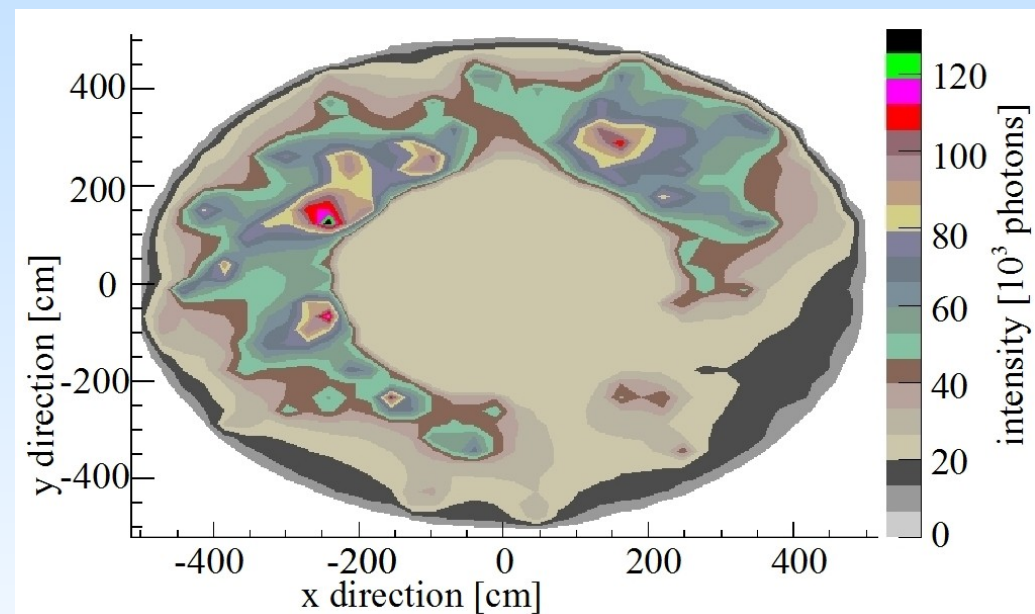
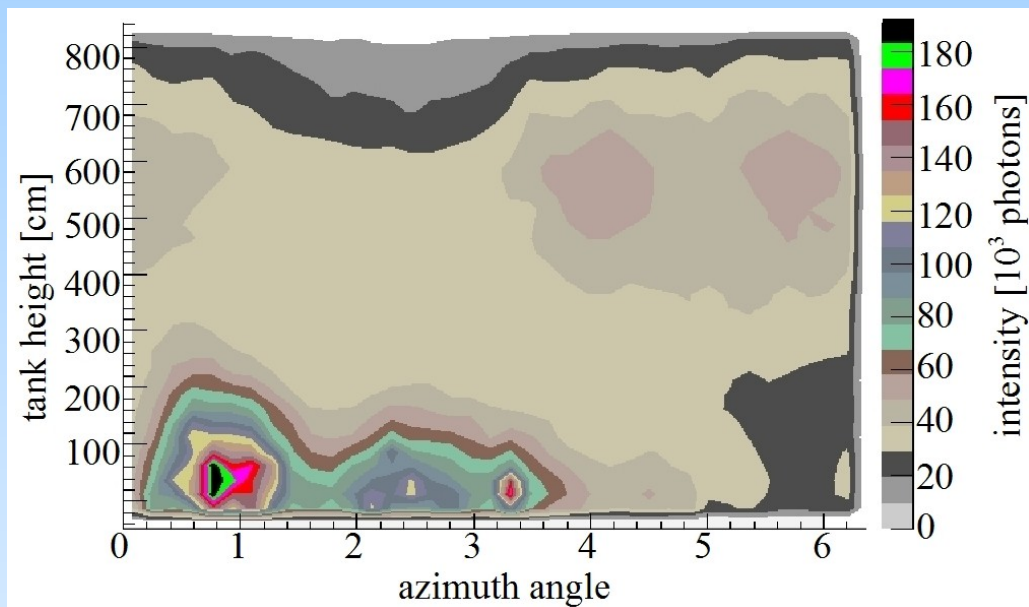


Muon Veto Constrains

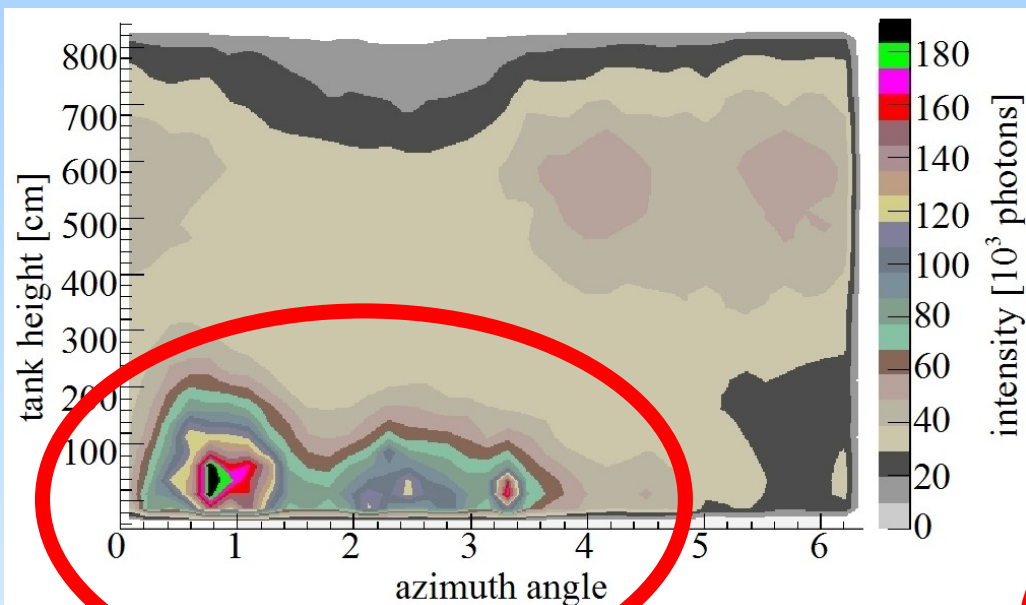
- Water tank as active Cherenkov veto
 - ~ 80 Photomultiplier Tubes could be financed
 - Tank dimensions ($d = 10$ m; $h = 10$ m)
- Plastic veto panels on top of clean room



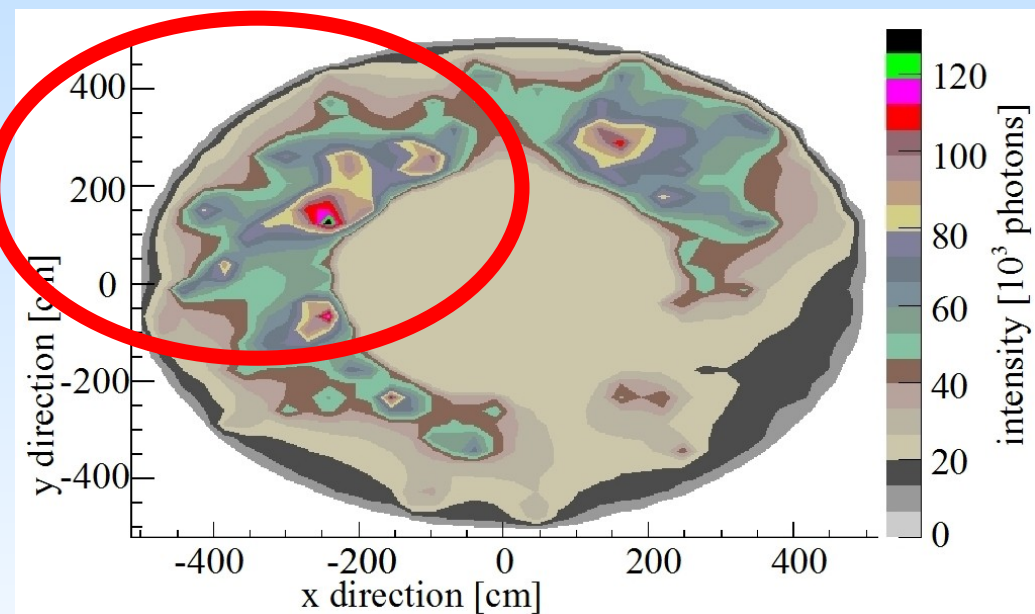
Intensity Maps



Intensity Maps

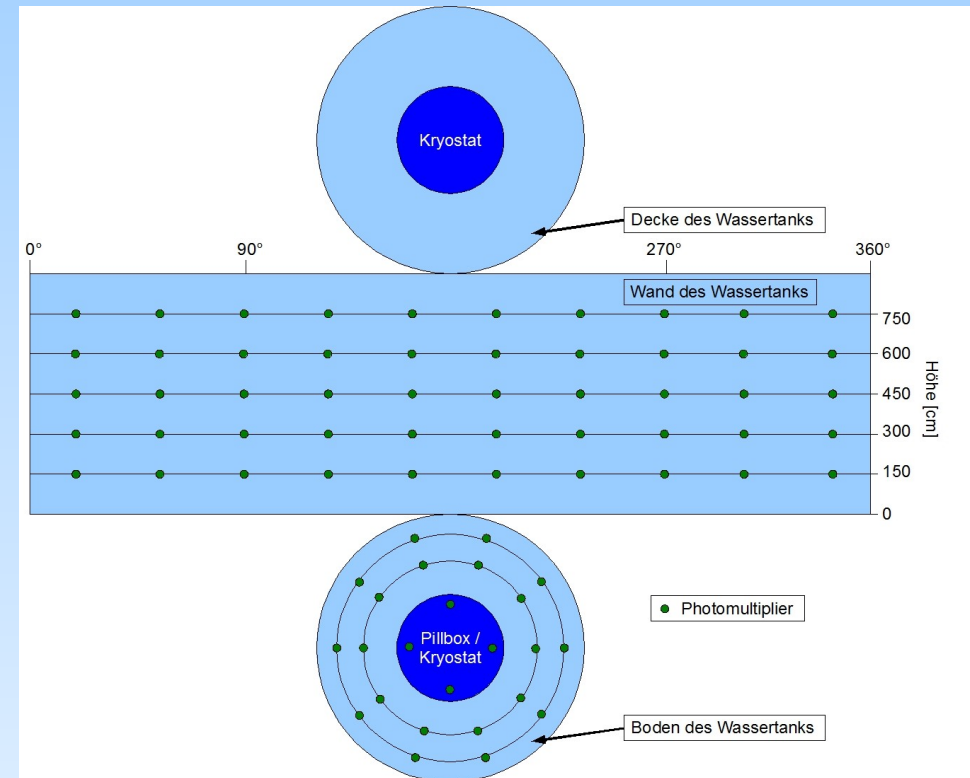
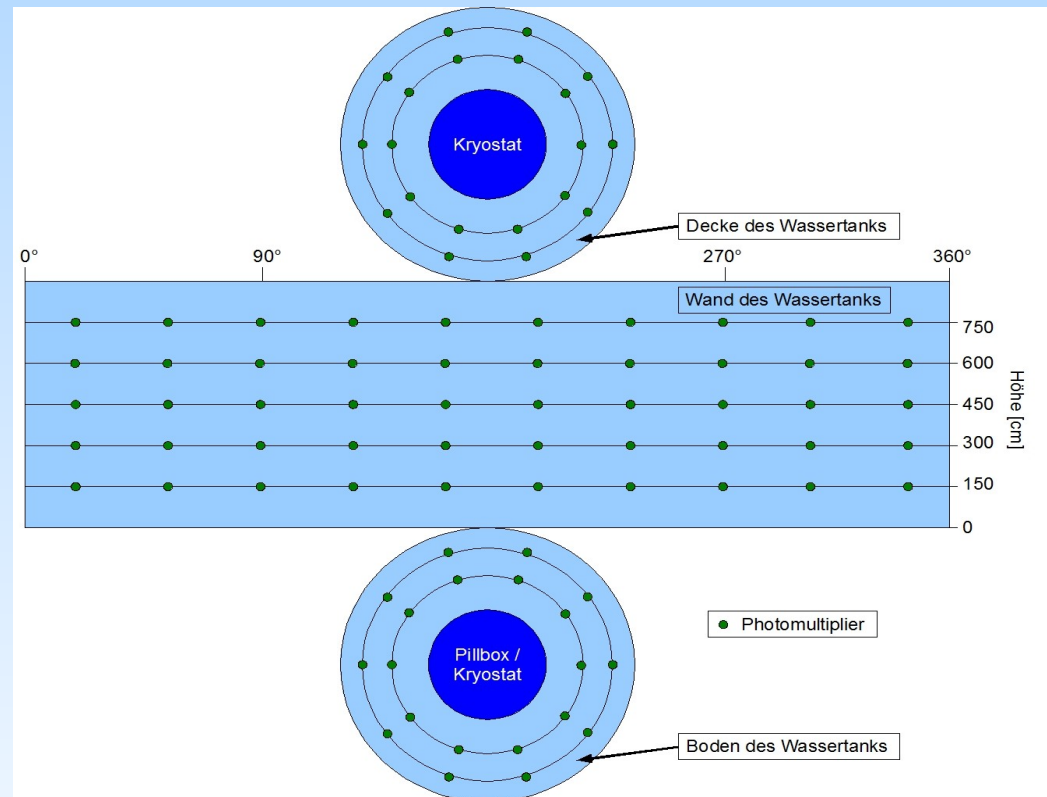


Region of high intensity



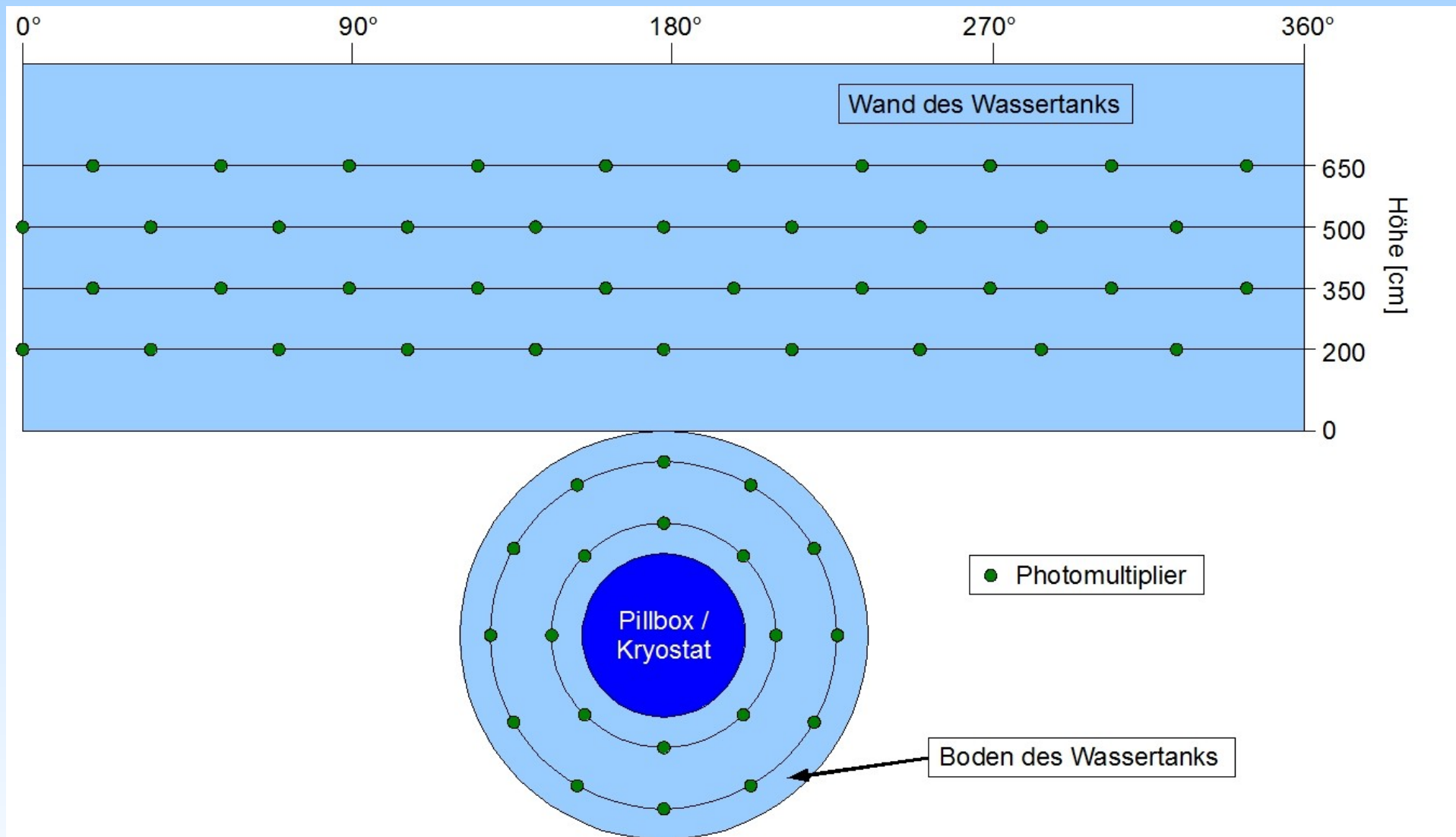
PMT Distributions

- PMTs on top ?
- 40 or 50 PMTs on the wall?



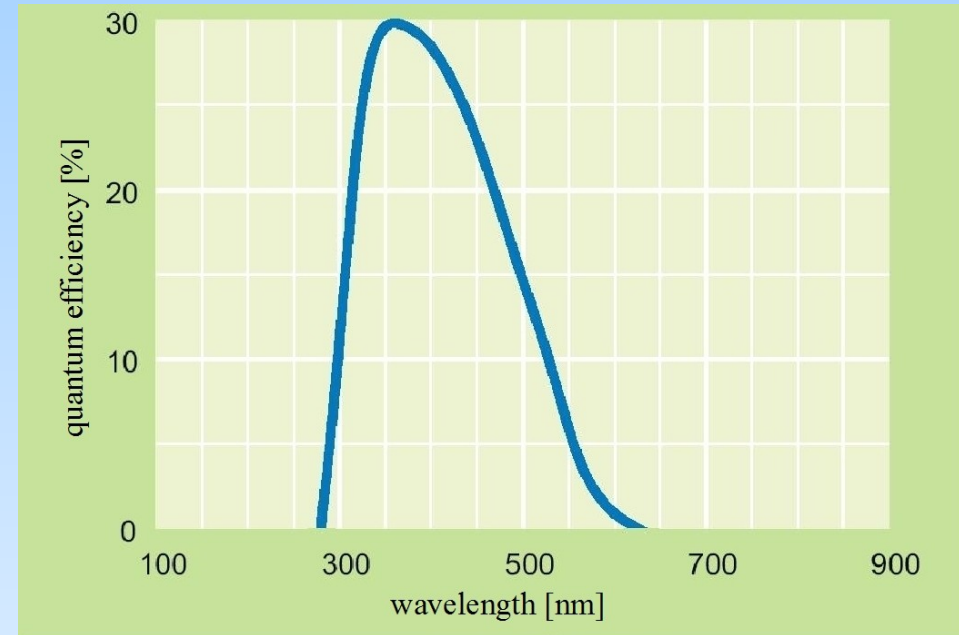
- even distribution?
- Pillbox or no Pillbox PMTs?

PMT Distributions



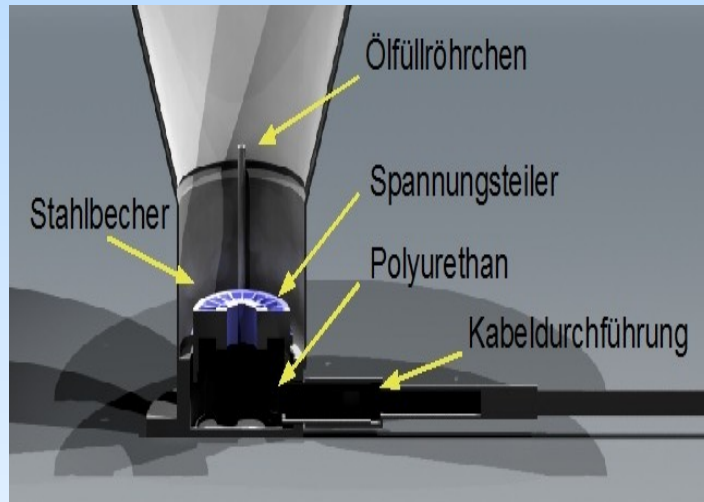
Muon Veto Hardware - PMT

- 8 inch type Photomultiplier
- 9350KB & 9354KB ETL



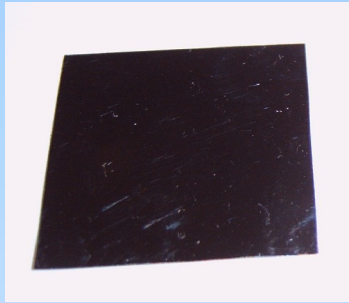
Muon Veto Hardware - PMT

- stainless steel encapsulation
- sealed with PET window

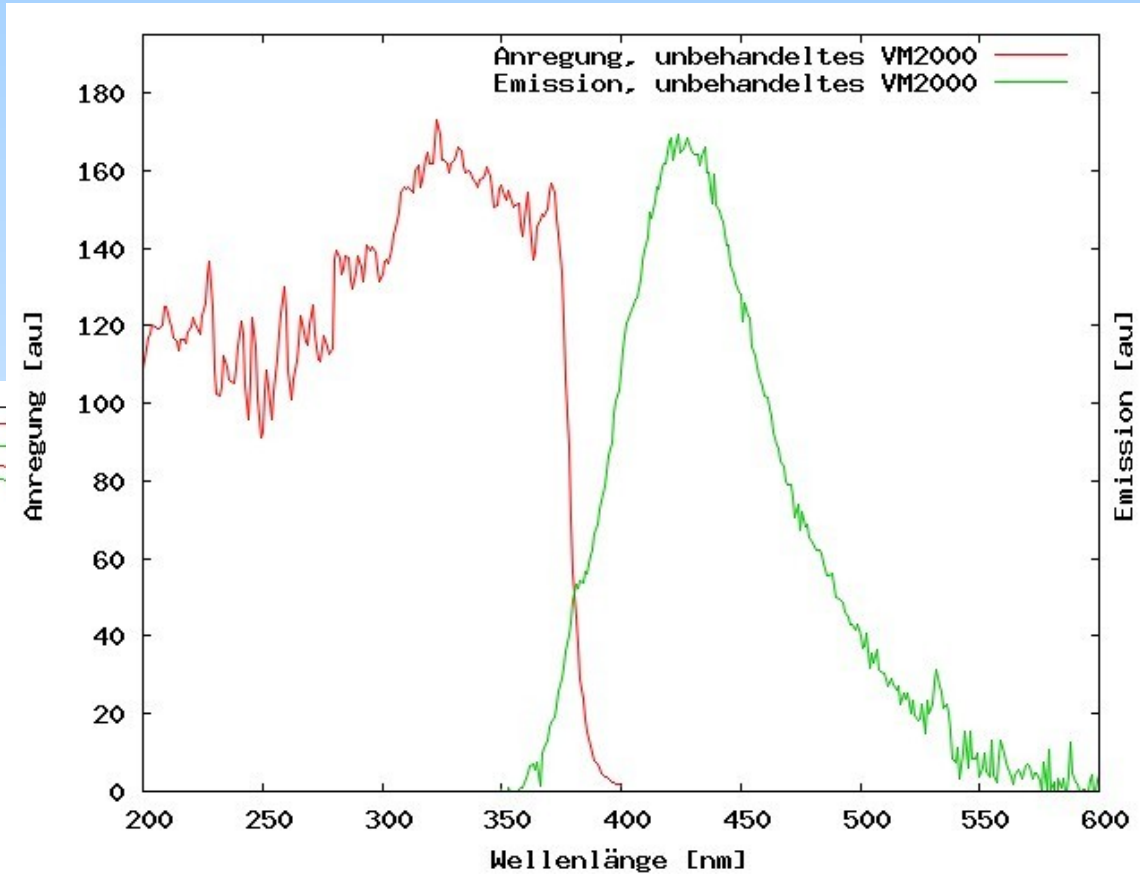
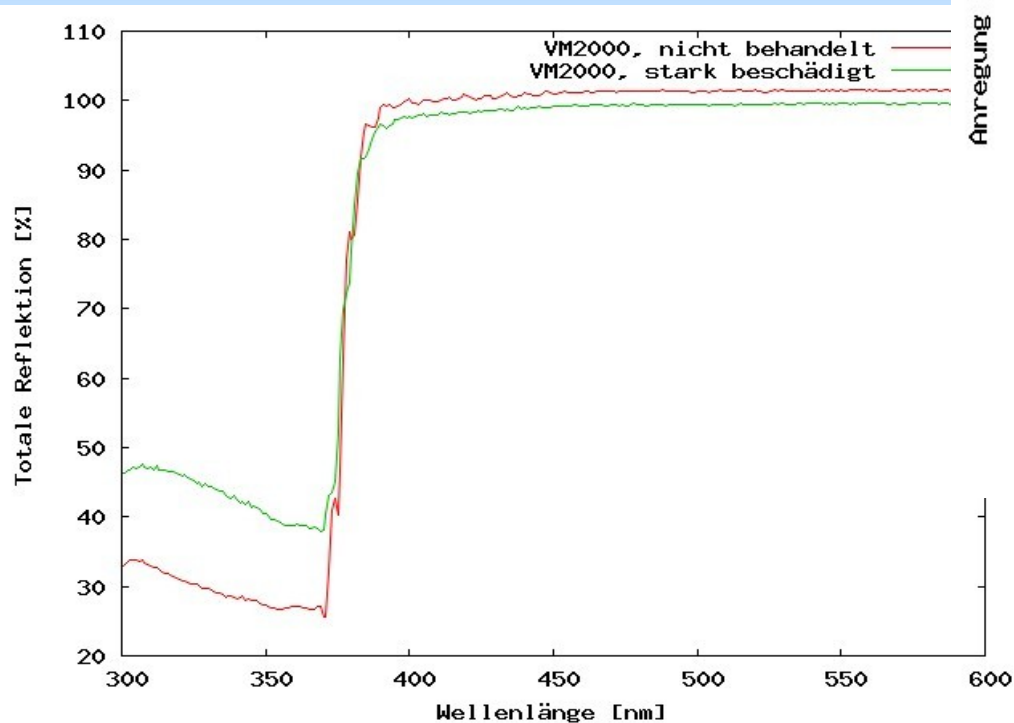


- filled with special oil
- PU coated cable RG213 U

Muon Veto Hardware - VM



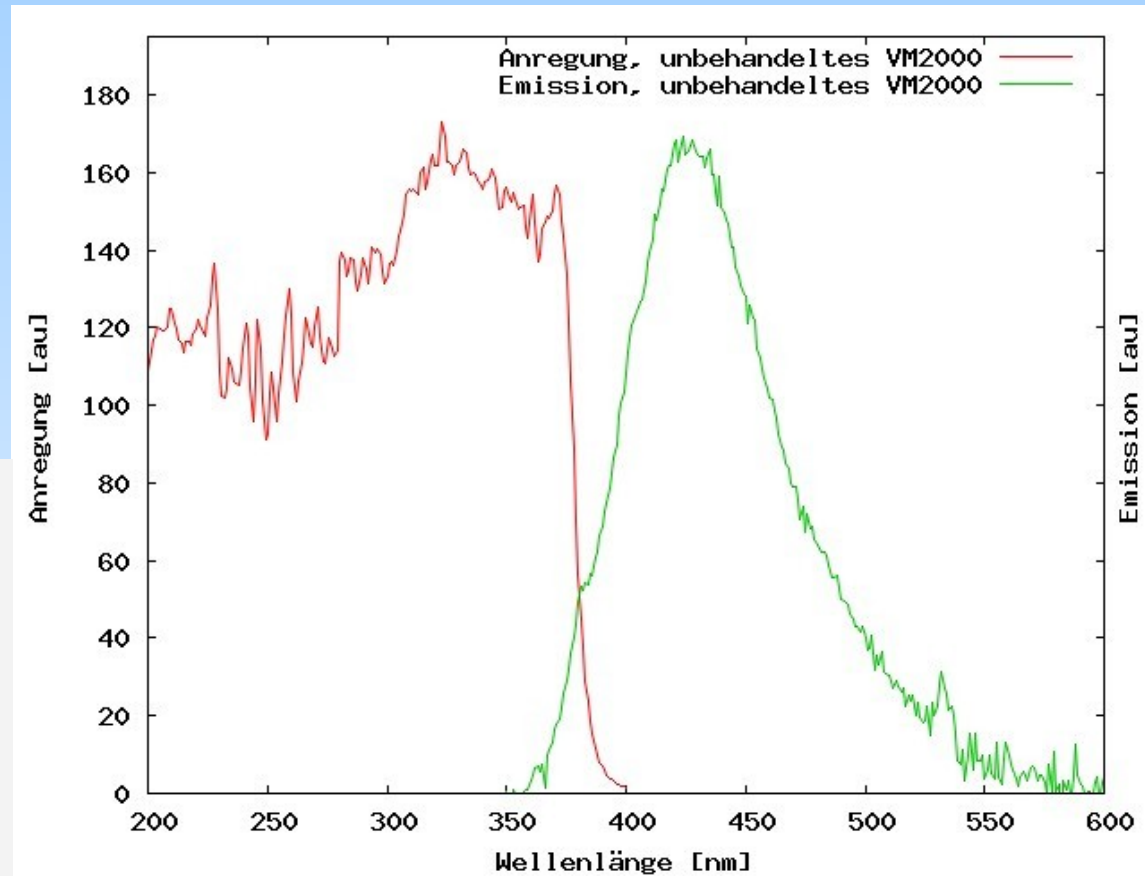
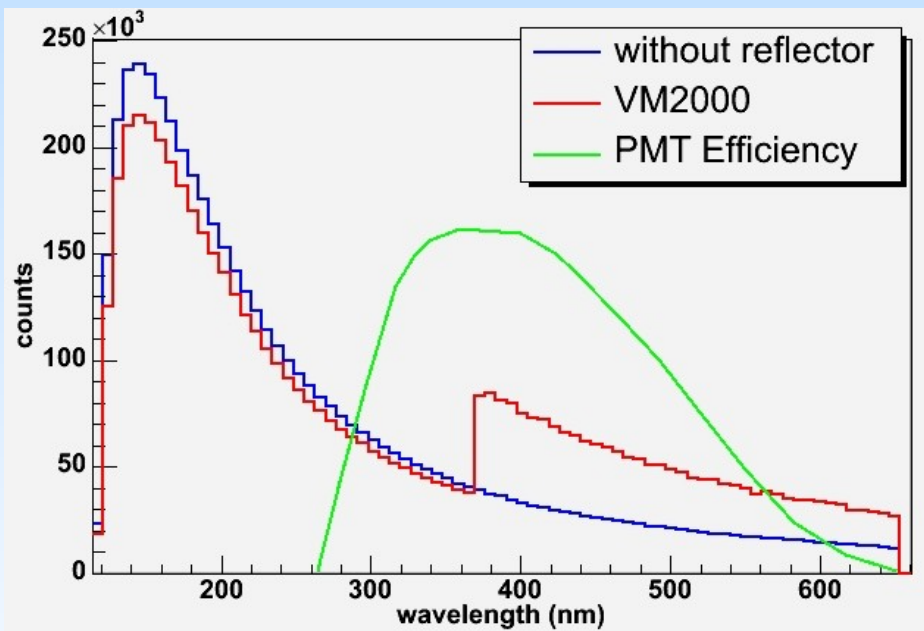
VM2000
Reflector foil
with WLS



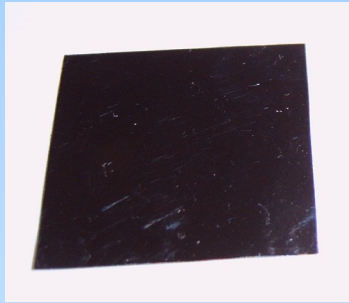
Muon Veto Hardware - VM



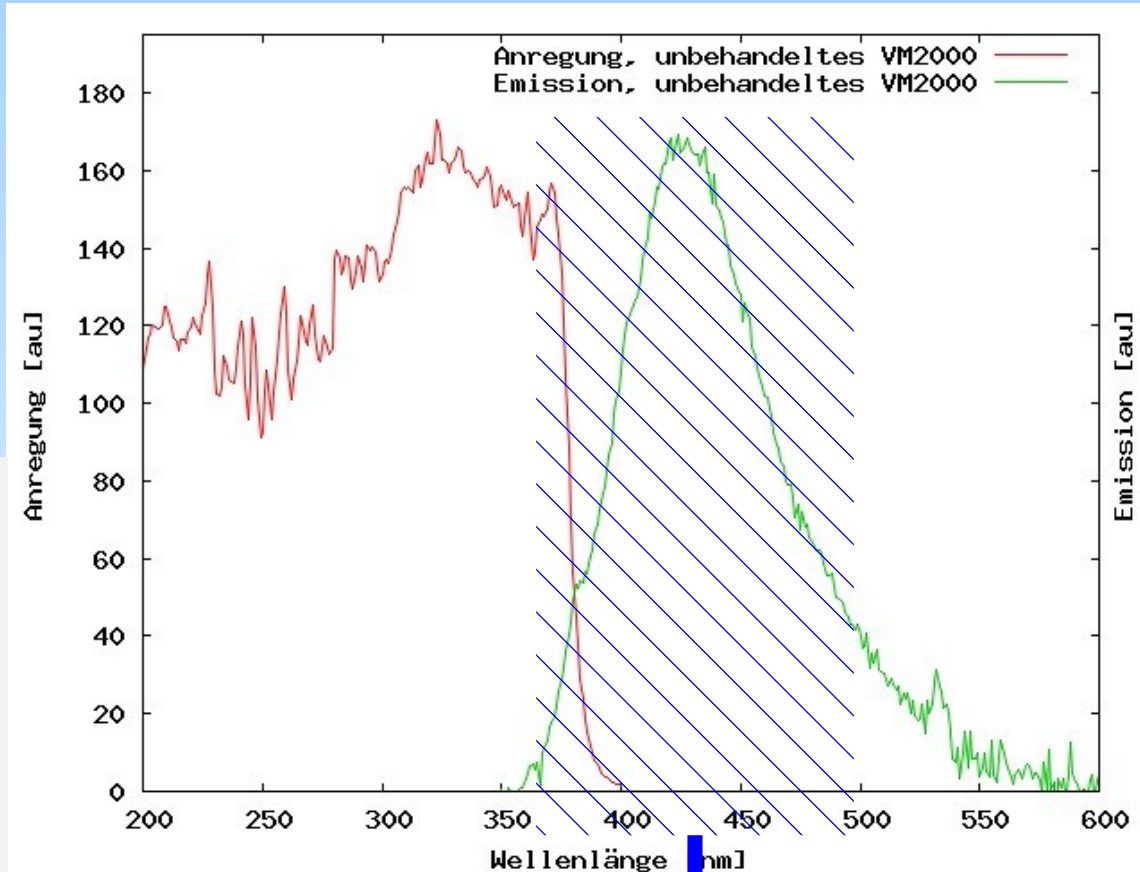
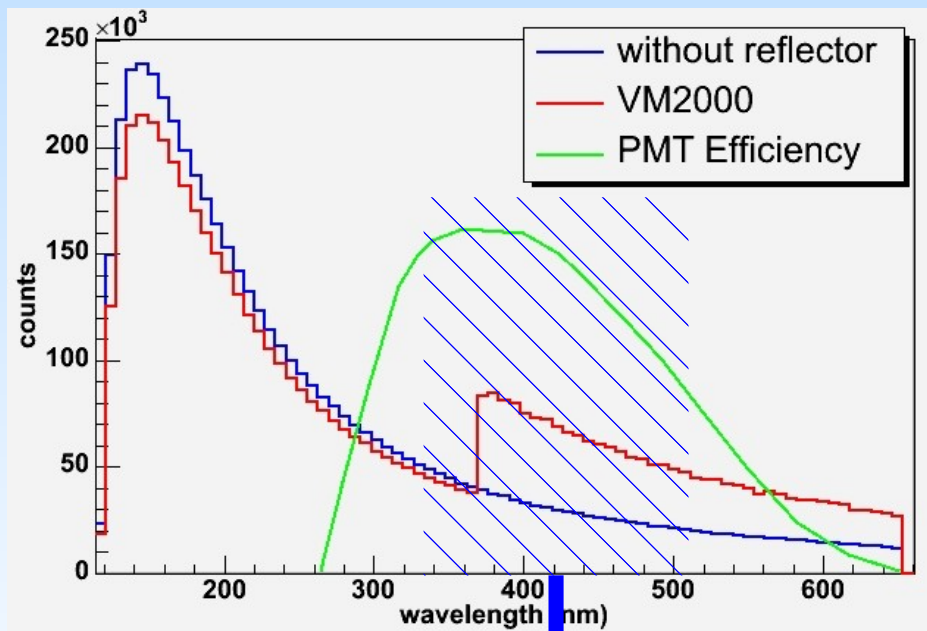
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Muon Veto Hardware - VM

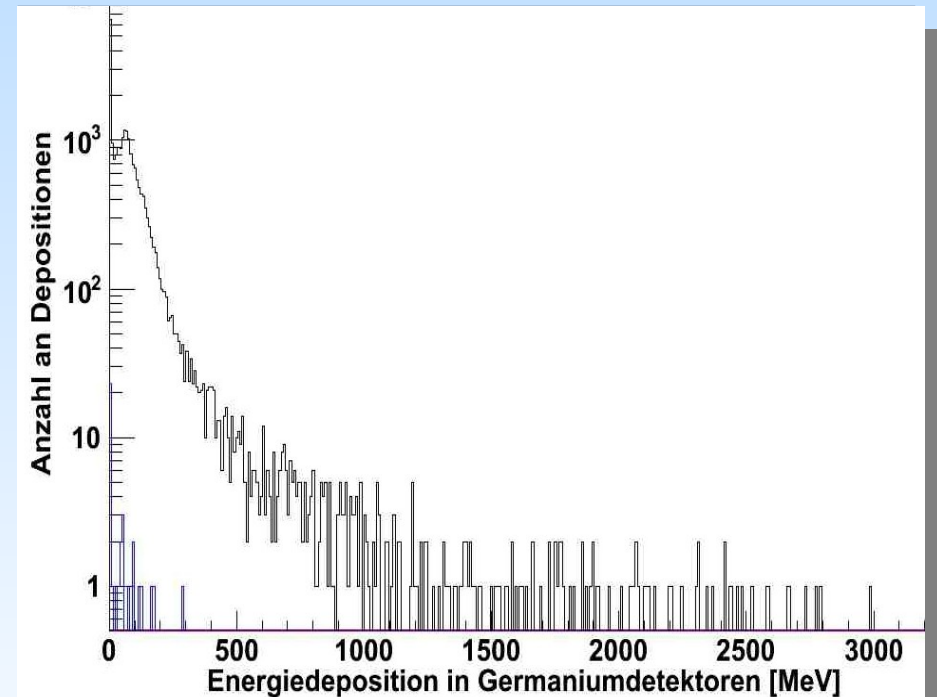


VM2000
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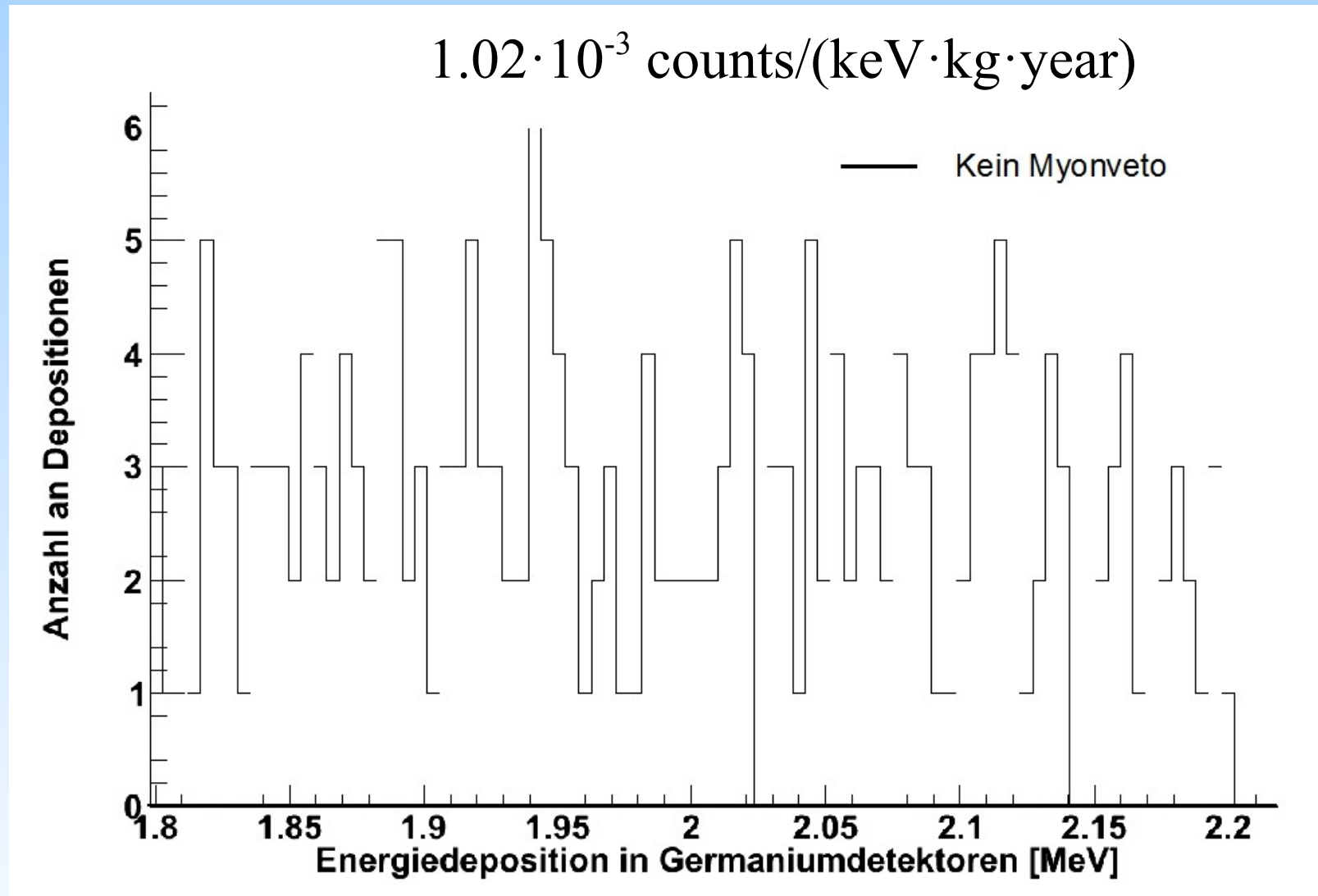


High PMT quantum
efficiency

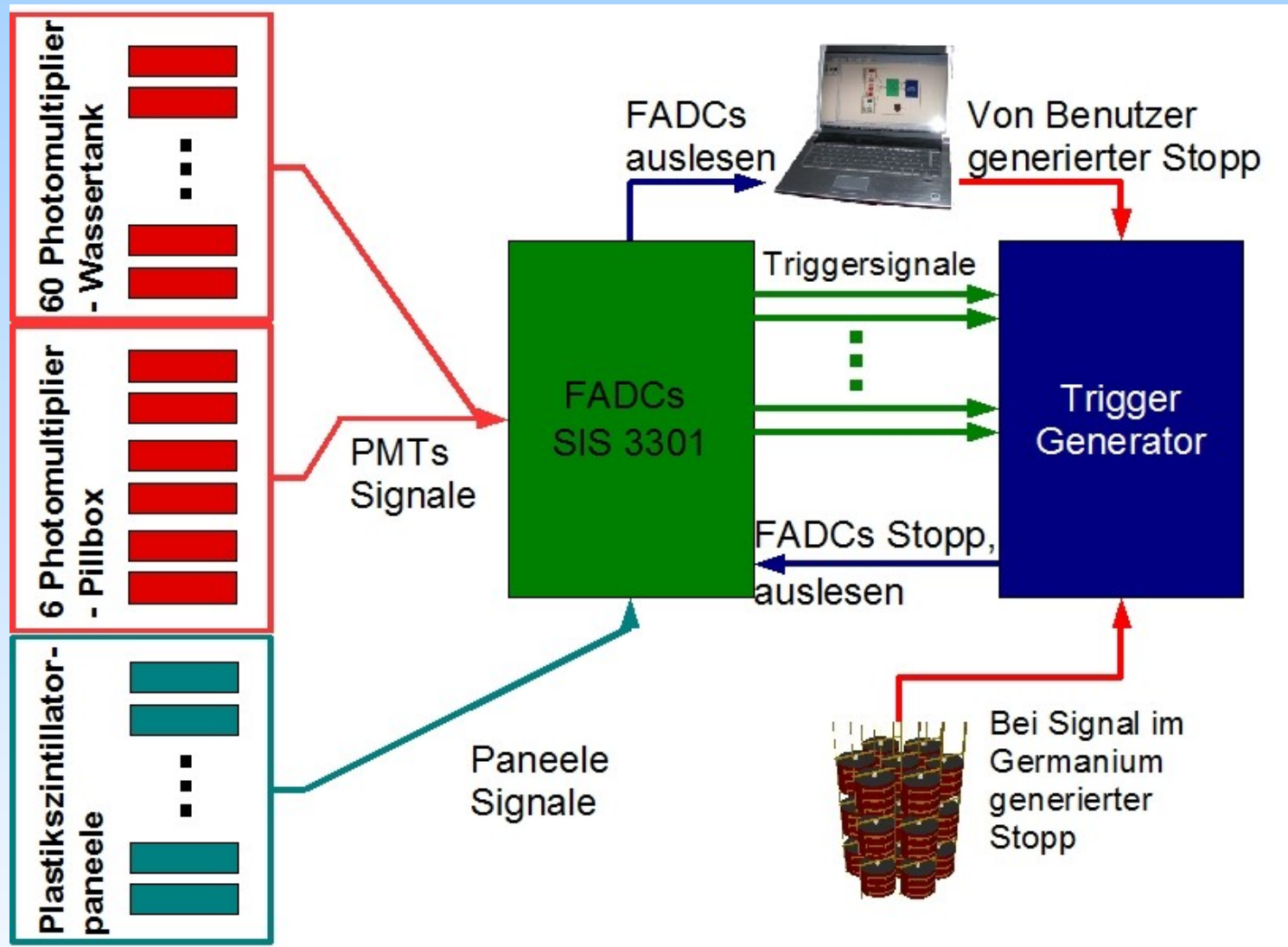
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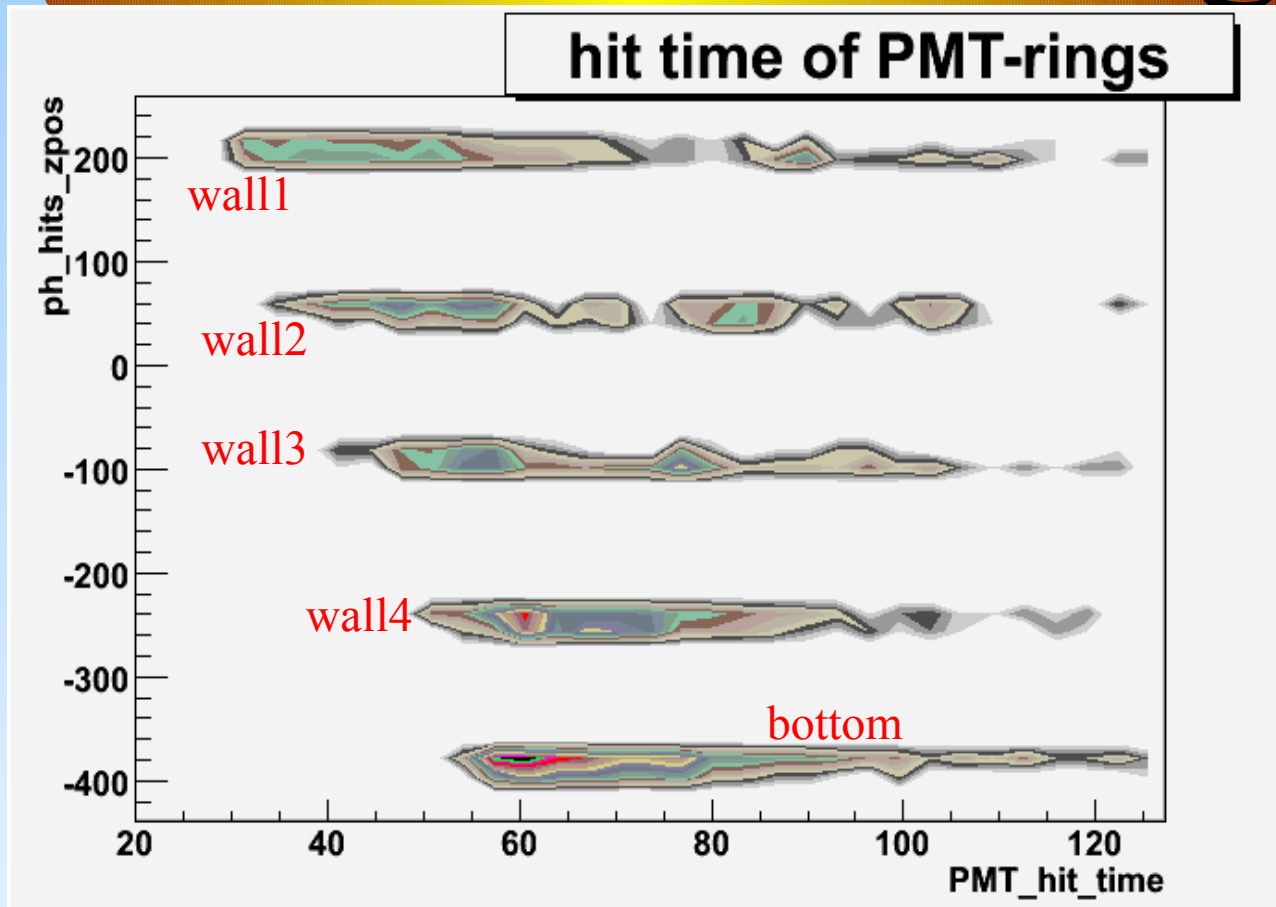
Background Analysis



DAQ Constraints



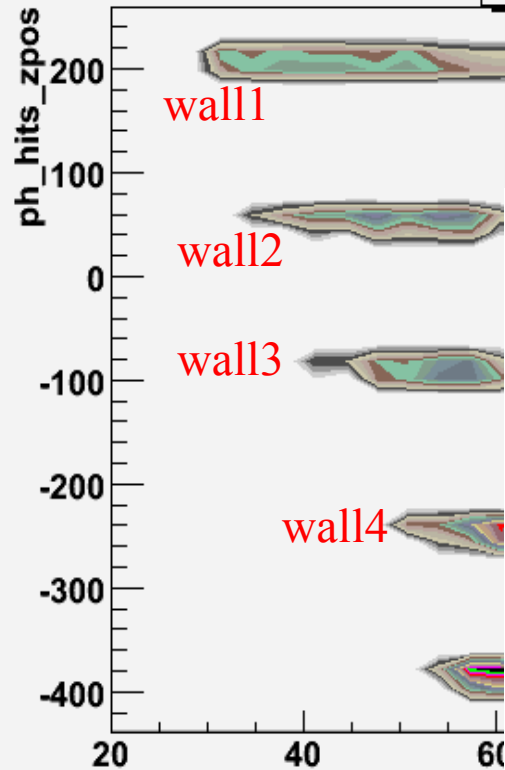
Timing



Bottom PMTs
register more
photons, but later

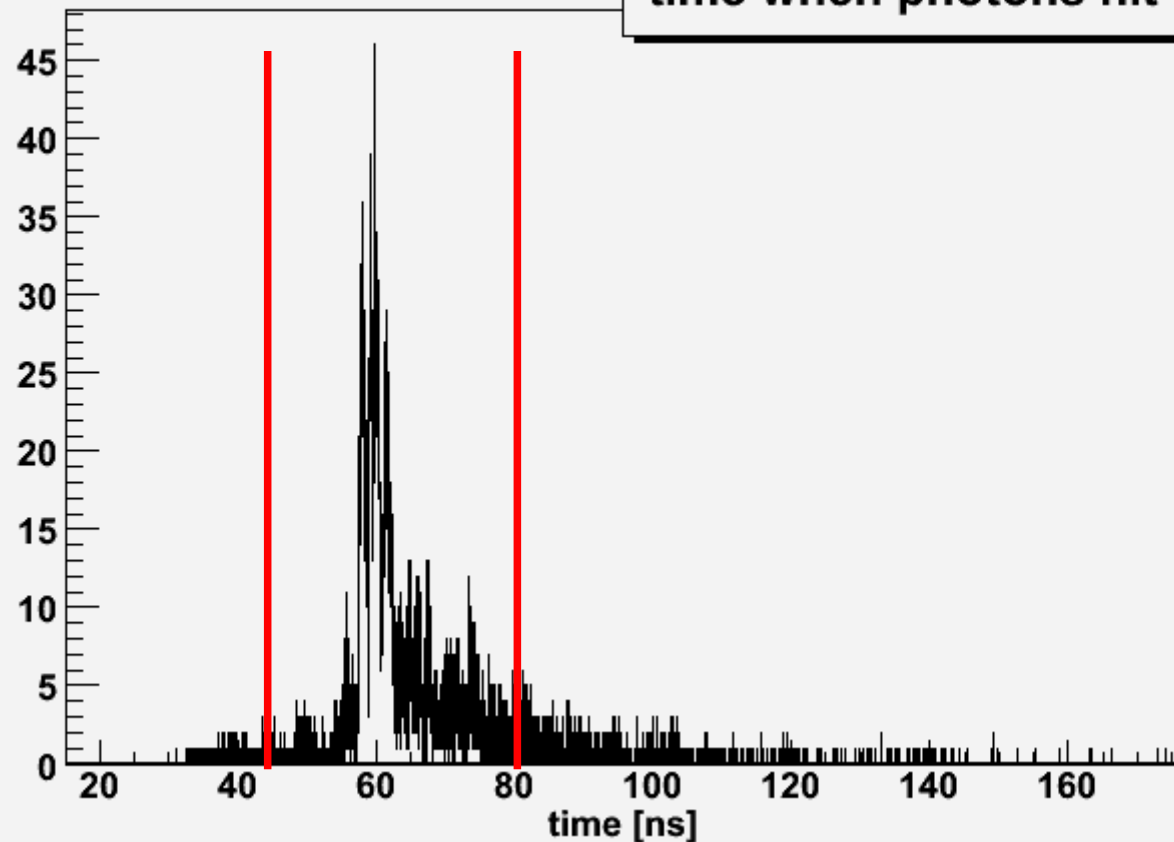
Timing

hit time of PMT-rings



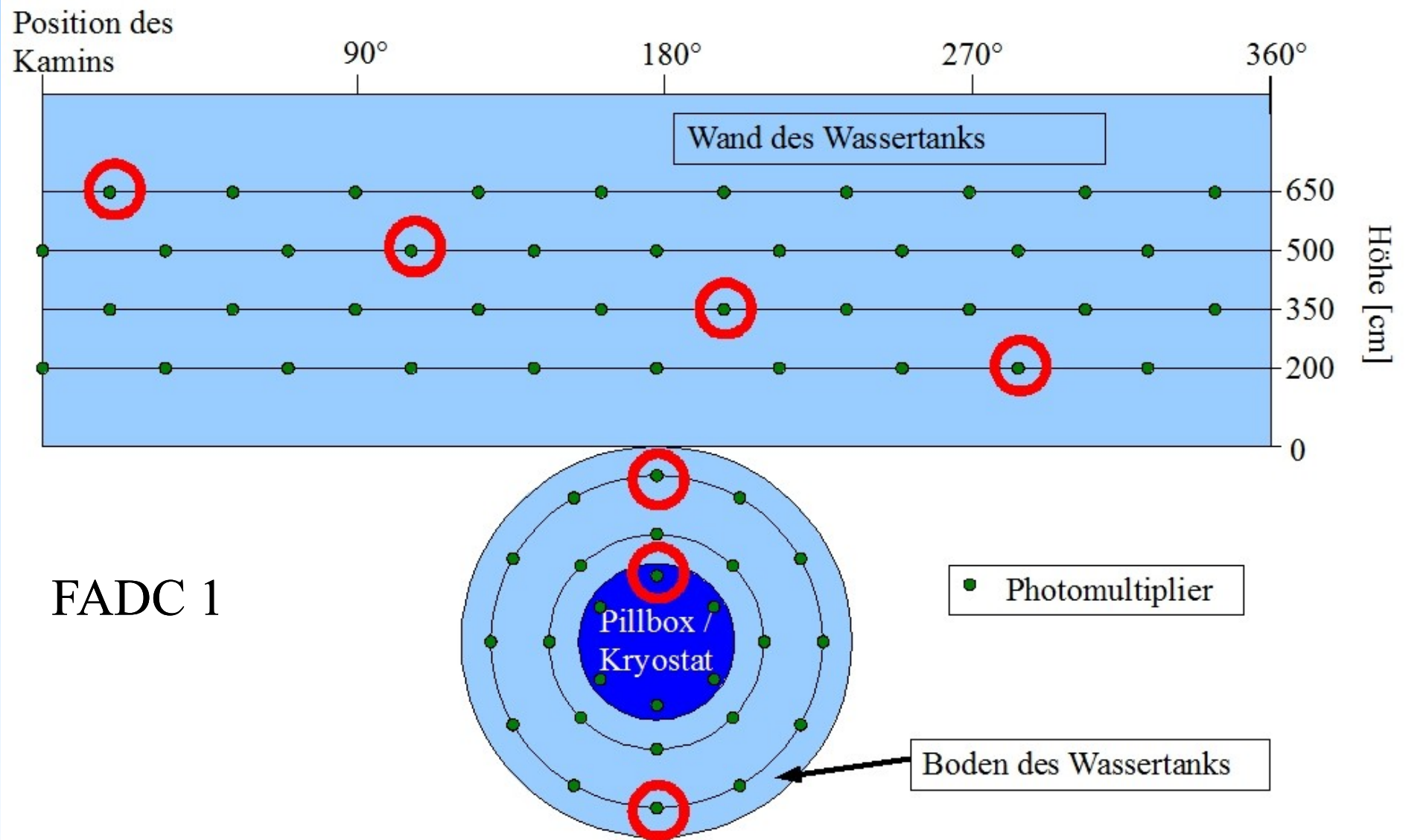
~80 % of photons
registered within
40 ns

time when photons hit PMs

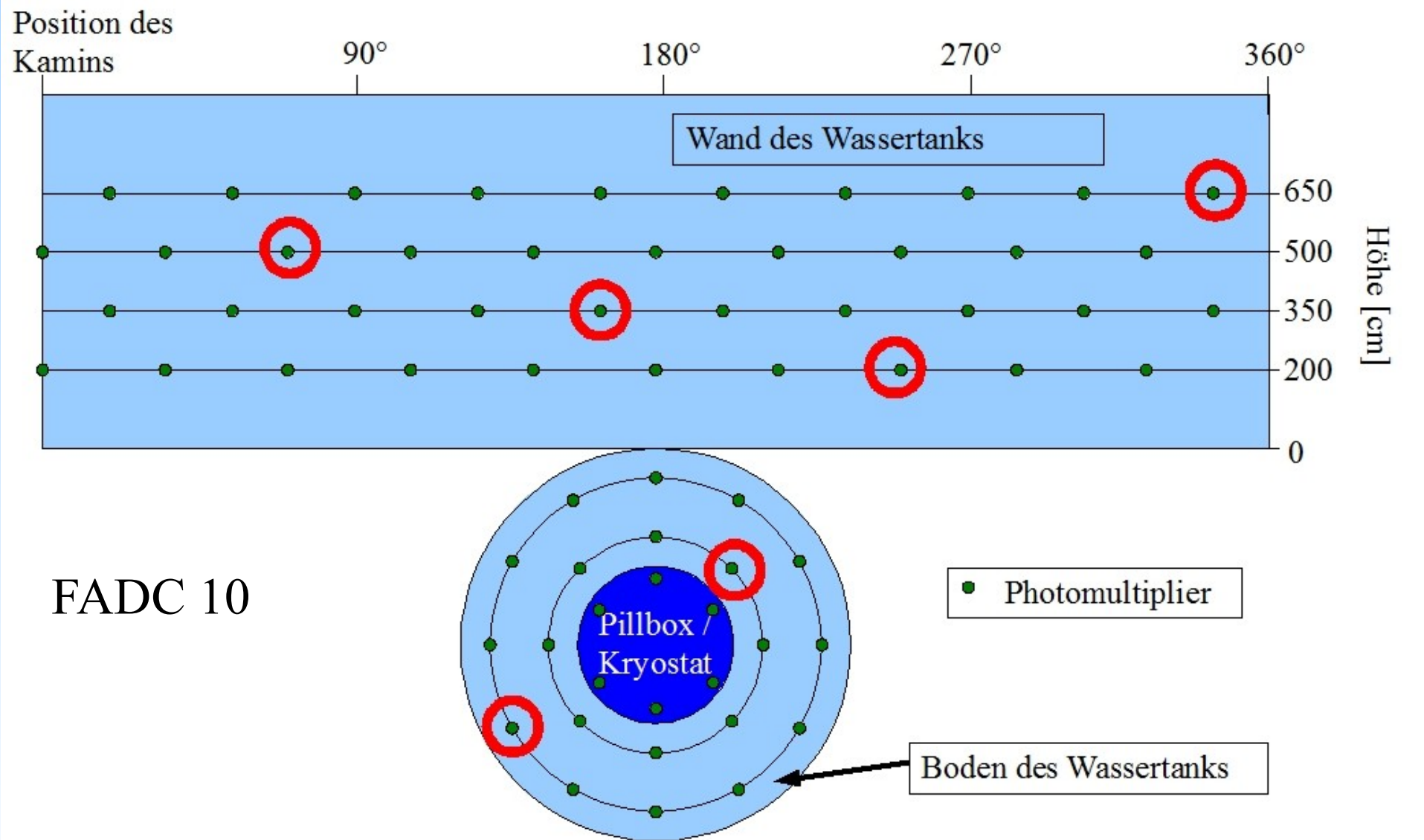


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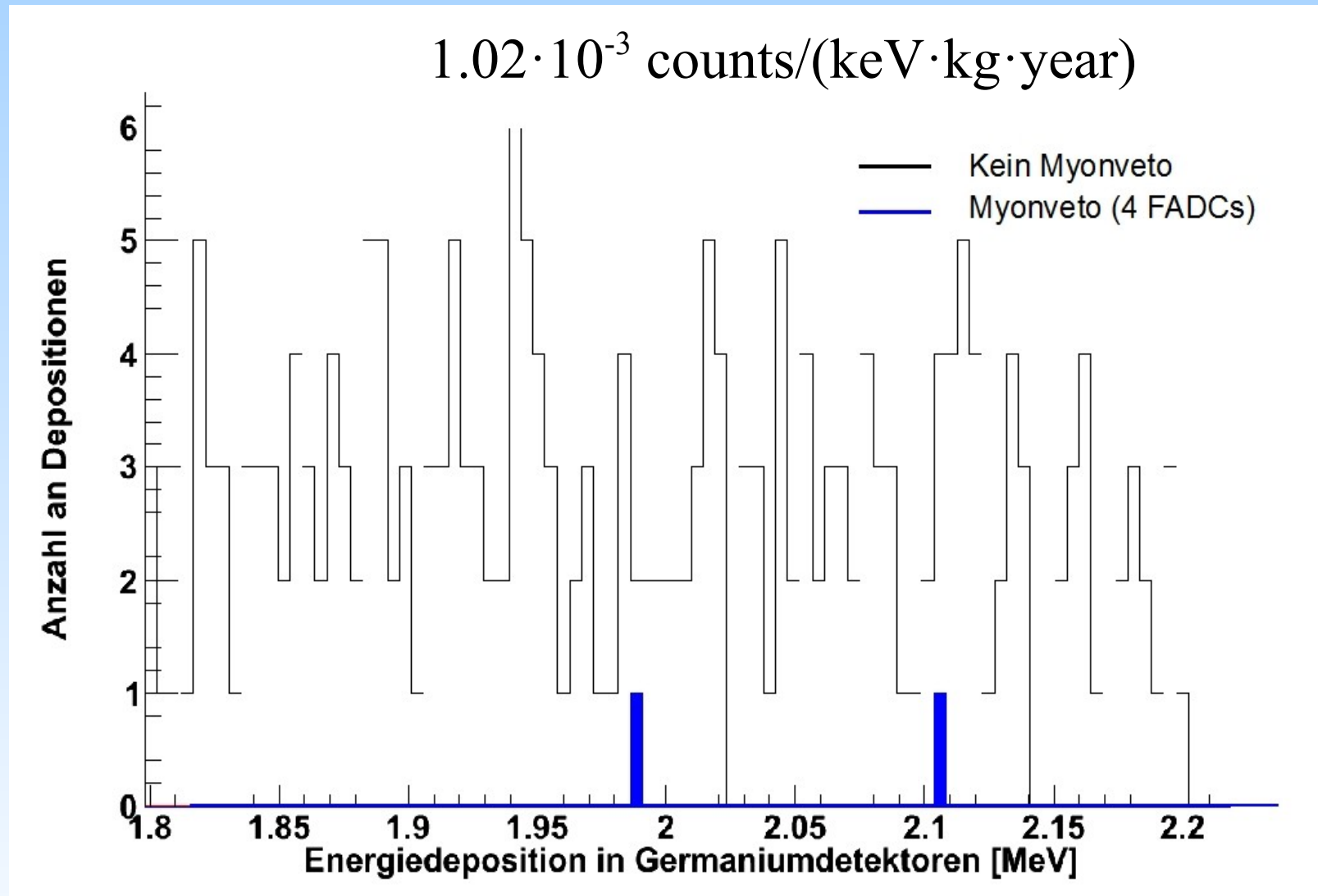
Trigger Solution



Trigger Solution



Background Analysis



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PMT Encapsulation



VM2000 Mounting



Cable Tray Mounting



PMT Mounting



PMT Mounting



Conclusion / Summary

- A muon veto for the GERDA experiment has been designed
- 66 PMTs covering the watertank and plastic panels on top of the clean room
- Extensive MC studies have been made
- An efficiency of more than 99%, reducing the muon induced background to $8.93 \cdot 10^{-6}$ counts/(keV·kg·year), can be reached
- Most parts of the Cherenkov veto have been installed
- Beginning of August the veto will be finished



Thank you!