The GERDA Muon veto

Florian Ritter – Kepler Center for Astro and Particle Physics
Universität Tübingen

Frühjahrstagung

Freiburg

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DPG

Outline

GERDA: 0ν2β experiment to investigate
Majorana nature of neutrino

(talk of J. Schubert T30.4)

1. Muon veto
2. DAQ
4. Plastic scintillators & first tests
5. conclusion & outlook
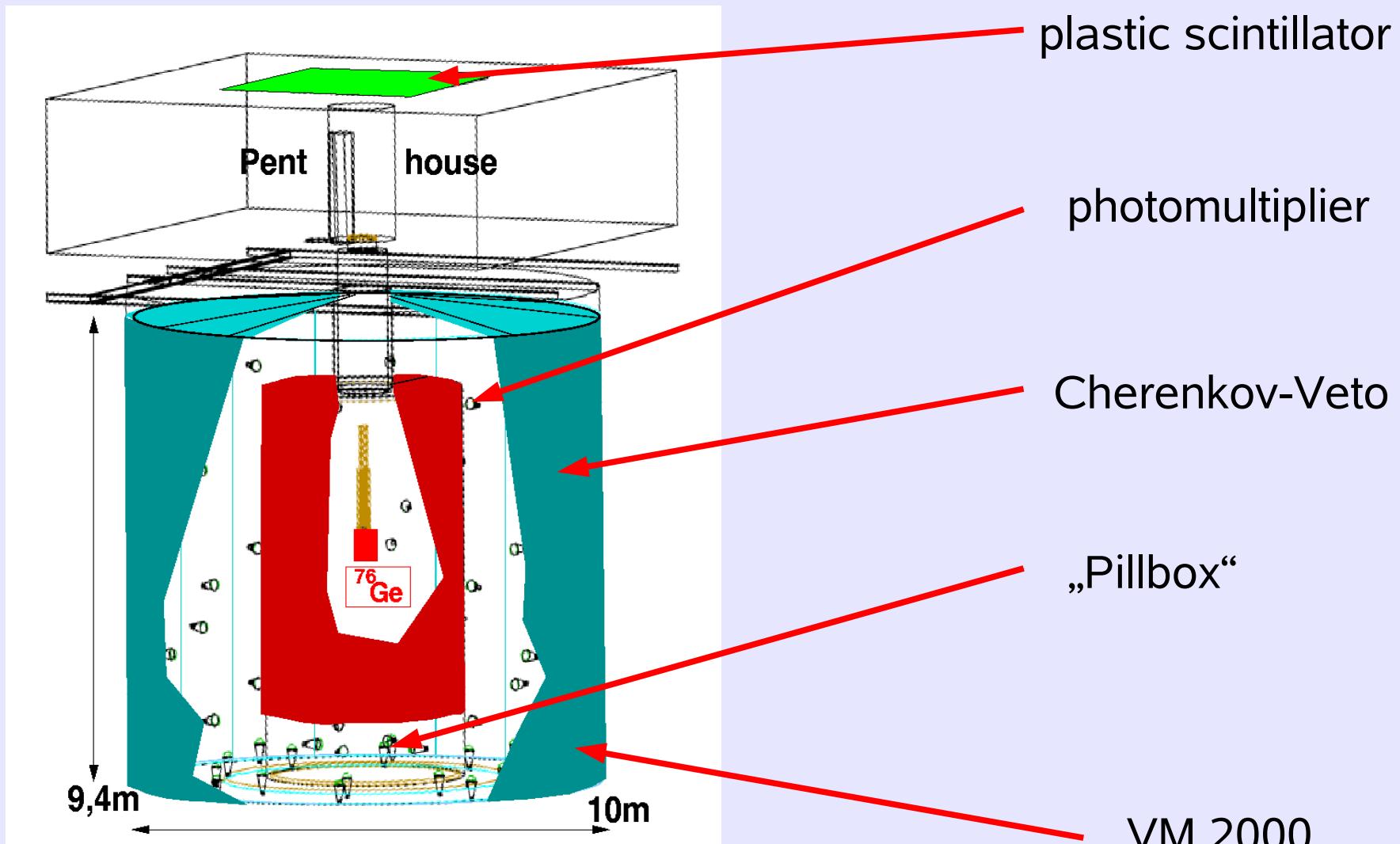
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The GERDA Muon veto

plastic scintillator

photomultiplier

Cherenkov-Veto

„Pillbox"

VM 2000

Pent house

^{76}Ge

9,4m

10m

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Time information

Bottom PMTs register more photons, but later
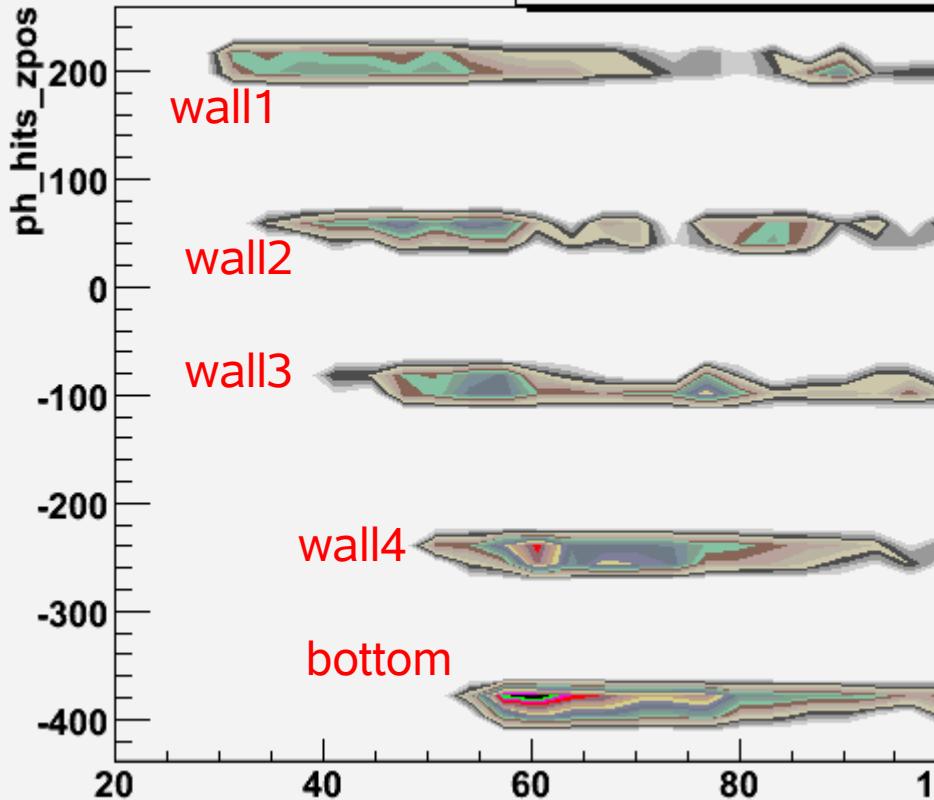
~80 % of photons registered within 40 ns

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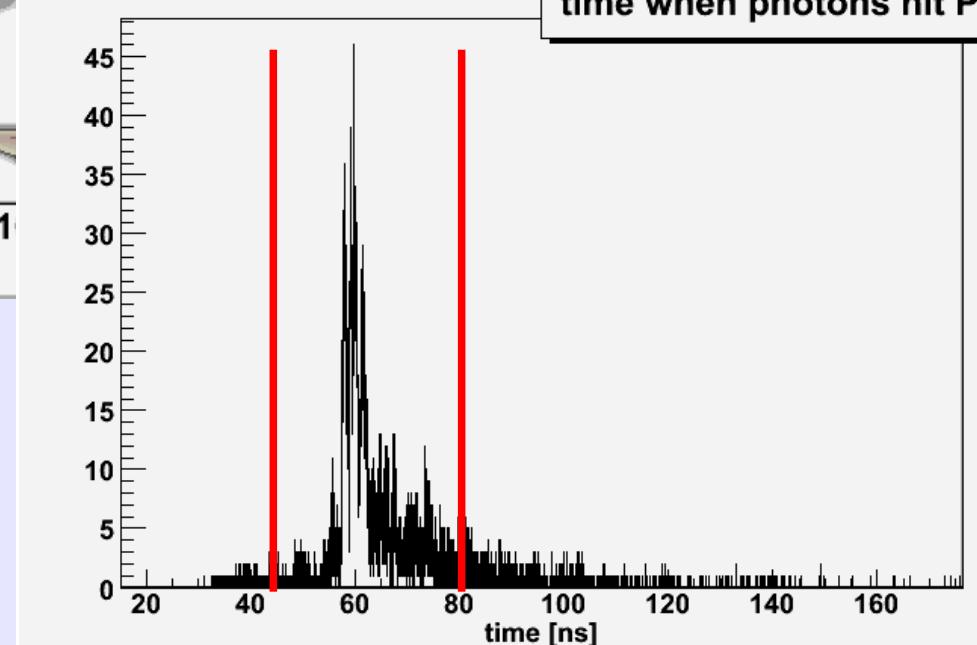
DAQ Setup 1

one trigger generator, triggering on „Trigger out" of the FADCs

✗   triggering on FADCs

✔   low cost (less modules)
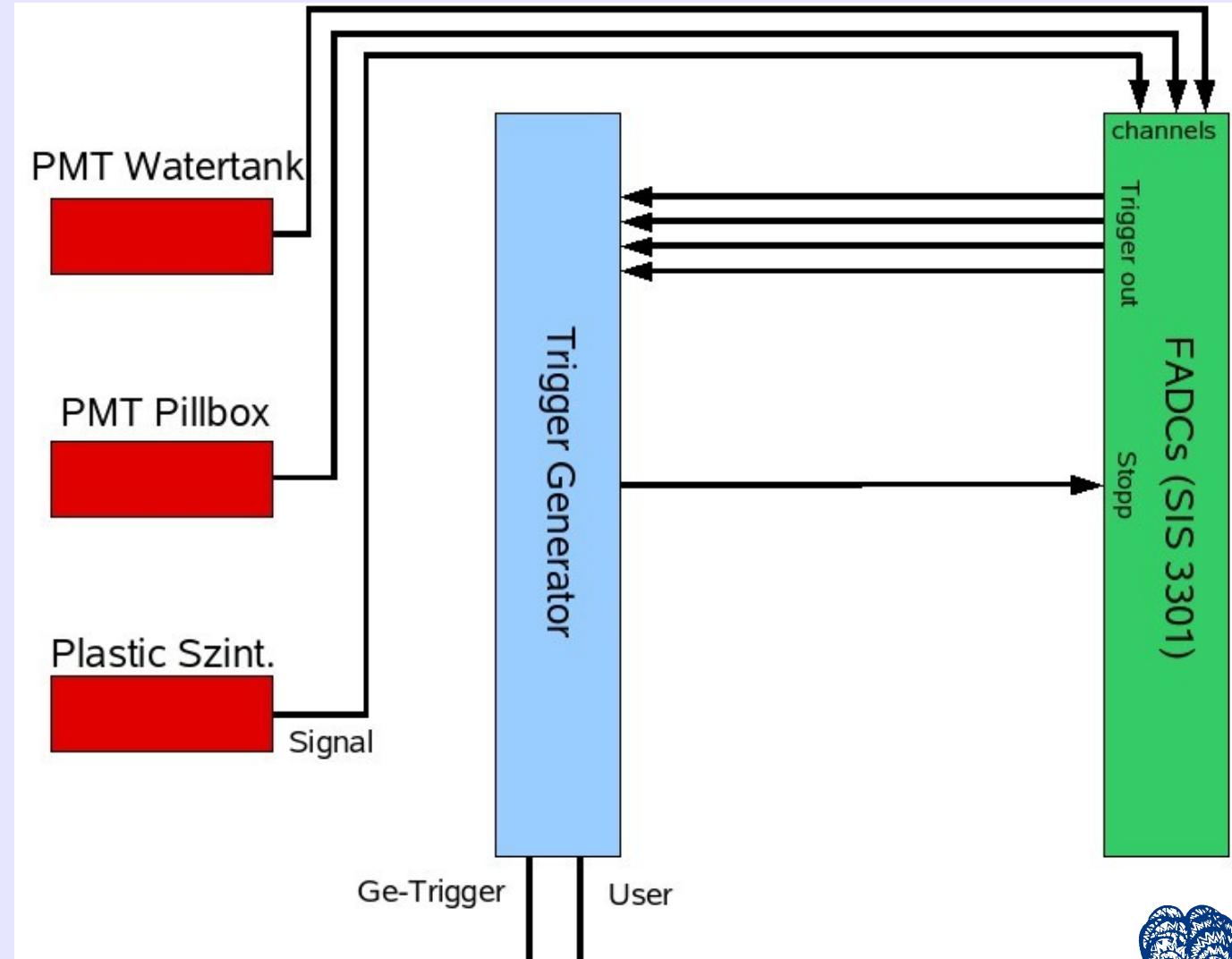
DAQ Setup 1 -
Expected random rate

- different FADC channel combinations have to be tested

- simple combination: one PMT of the pillbox and one of each ring of the watertank per FADC (plastic scint. on extra FADCs)

assuming dark rate for one PMT: 5 kHz

ΔT (ns)	# FADCs	rand. rate (Hz)	efficiency
30	4	3,42E-02	98.5%
30	3	1,27E+01	99.5%

problem: „1 FADC triggers" means „x PMTs trigger" (x= 1...8)

--> combination of PMTs on one FADC have to be choosen carefully!!!

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DAQ Setup 2

up to 7 Discriminators
(Leading Edge Disc.)

plus one (or more)
trigger generator (tbd)

✗   cost intensive
     (more modules)

✔   triggering on PMTs
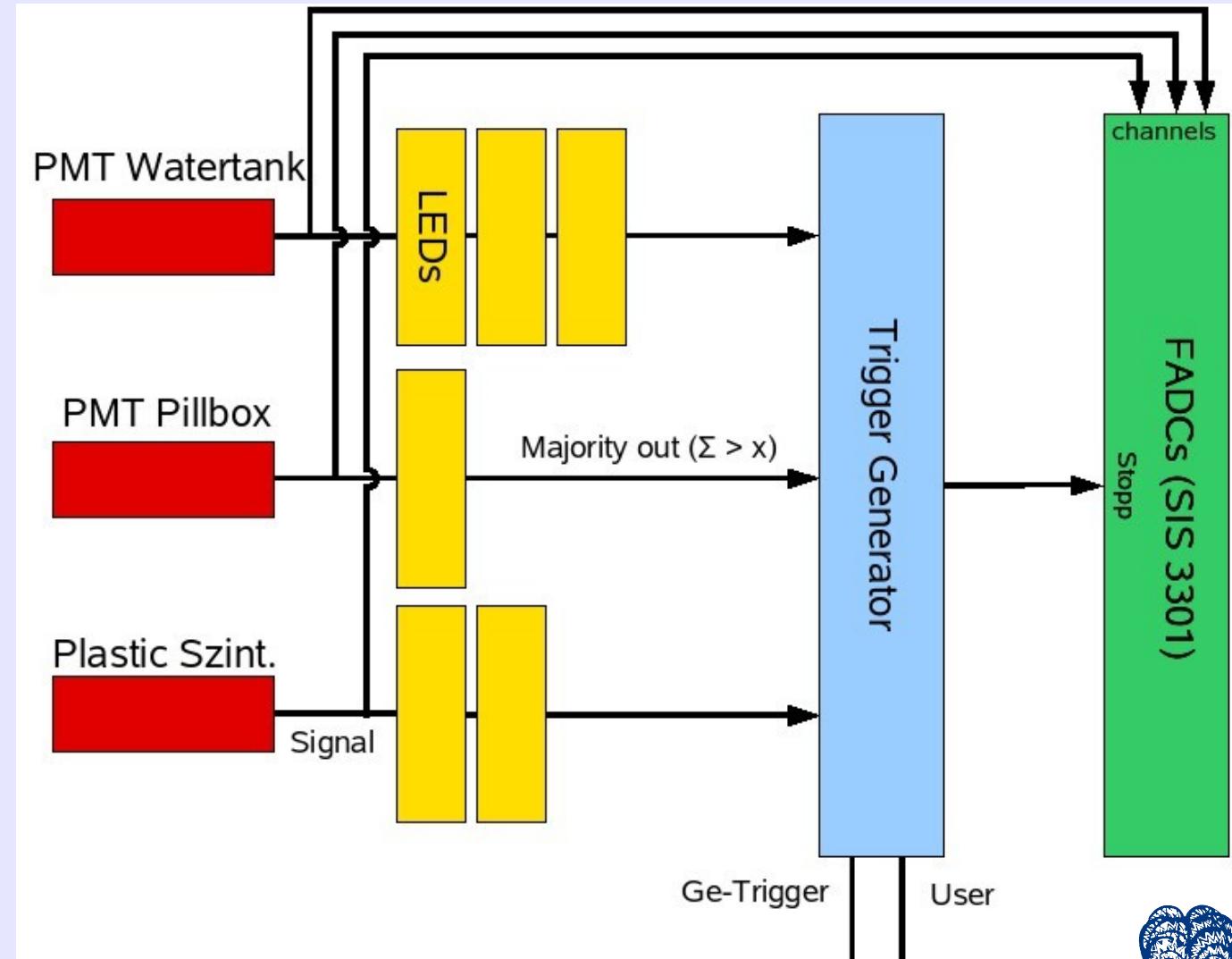
DAQ Setup 2 -
# Expected random rate

assuming dark rate for one PMT: 5 kHz

• Trigger on single photomultiplier signals

# pill	# water	ΔT (ns)	total eff.	random rate (Hz)
2	5	30	99,6%	1,13E+01
3	5	30	99,4%	2,25E-03
4	6	30	99,2%	2,53E-07

--> random rate decreases dramatically
with only small change in efficiency

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Plastic scintillators

compensating strip (Al foil)

wavelength shifting fibers

polystyren-based plastic scintillator plate
200 x 50 x 3 cm

mirror

PMT-based photosensor

cable connectors

front-end electronics

outer packing

UV LED

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First test with plastic scintillator

- **baseline**
- **pulse height**
- **Integral**

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First test with plastic scintillator

Integral
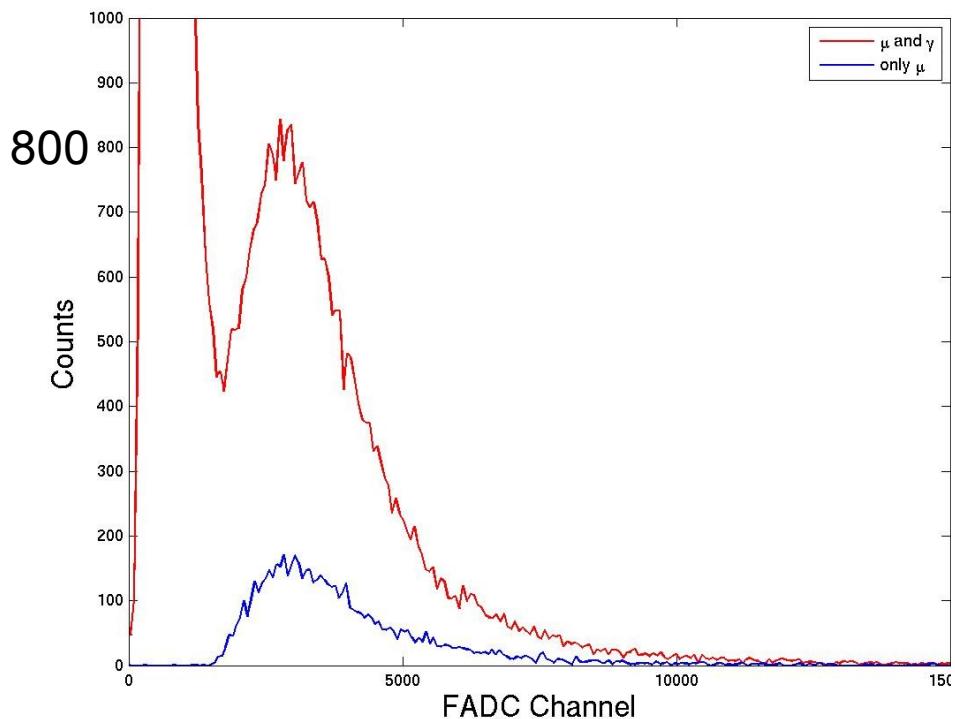
Pulse height
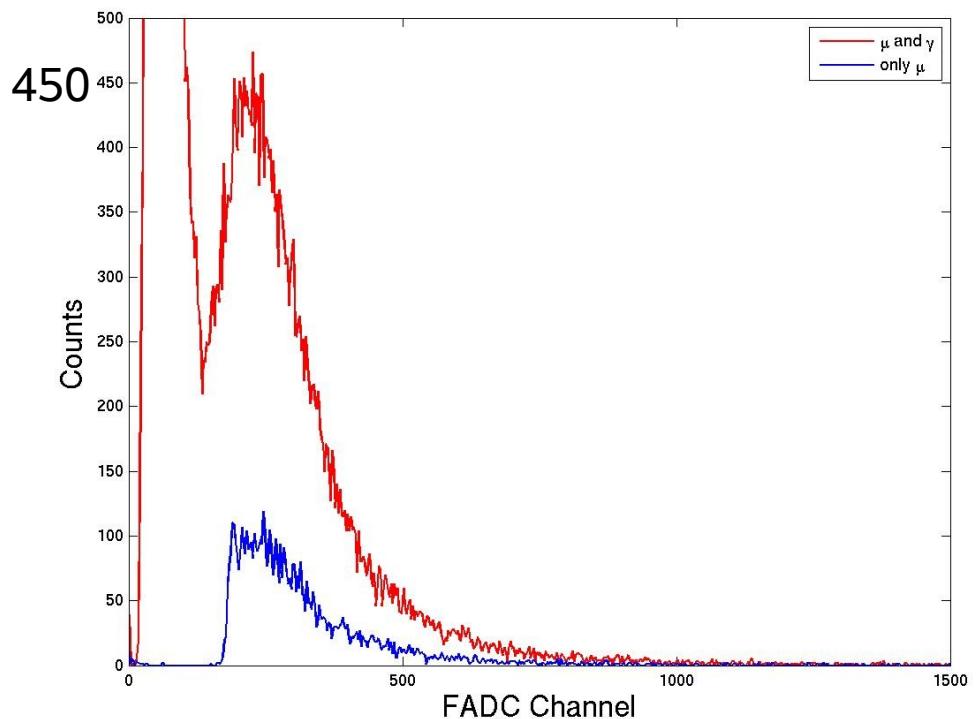
both options are reasonable

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# Threshold optimization

Panel 03
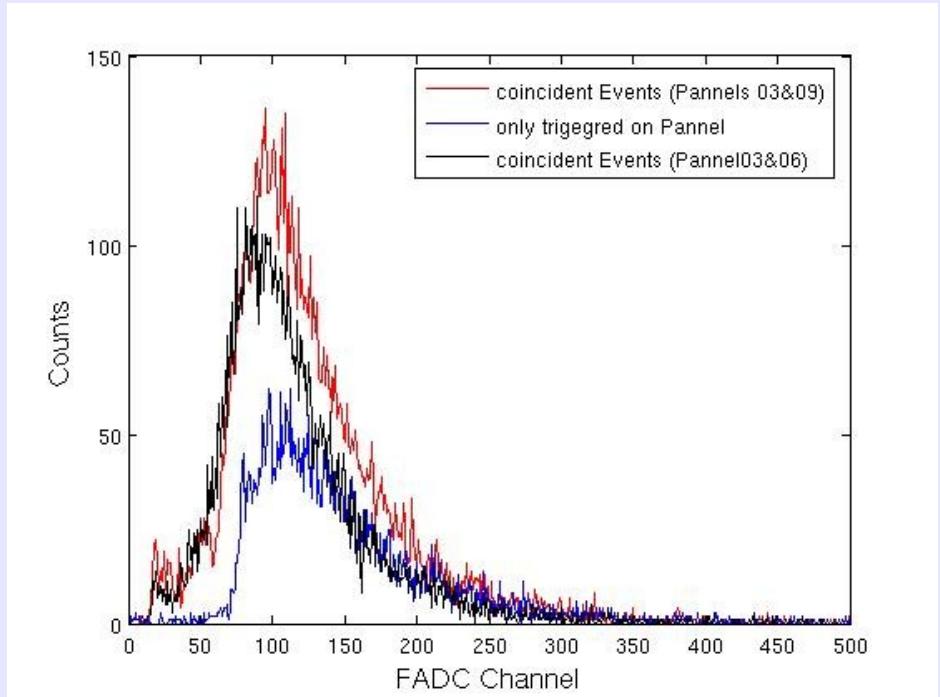
Panel 06
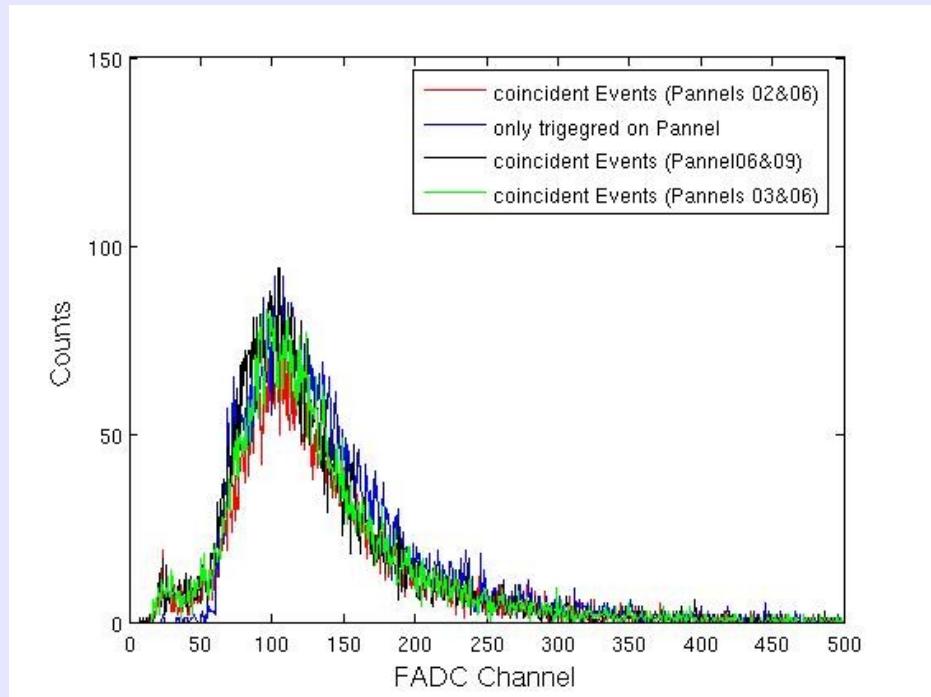
threshold triggering (blue) ⟷ coincidence (red, black and green)

➤ if threshold is choosen carefully, no coincidence needed!!!

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conclusion & outlook

- Design of the Muon veto is fixed;
  ongoing production of PMT encapsulation

- DAQ:
  - final solution of trigger generation under
    investigation
  - test of plastic scintillators in Dubna, Heidelberg,
    Tübingen and at LNGS

DAQ Setup 1

Estimation of random rates (Setup 1, trigger on FADCs)

- Assumed dark count rate for one PMT:
  r_{PM} = 5kHz

- Time window τ = 10 ... 50ns

- FADC triggeres, when at least one channel exceeds its threshold

- Dark count rate for one FADC with 8 PMTs:
  r_{FADC} = 8*5kHz = 40kHz

- random coincidence rate (2FADCs) $r_{rand,2} = r_{FADC} * r_{FADC} * τ$

- 3FADCs: $r_{rand,3} = r_{rand,2} * r_{FADC} * τ = (r_{FADC} * r_{FADC} * τ) * r_{FADC} * τ$

- More FADCs: ...