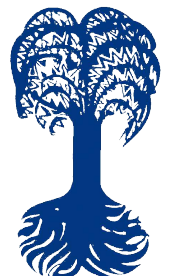


The Muon Veto DAQ

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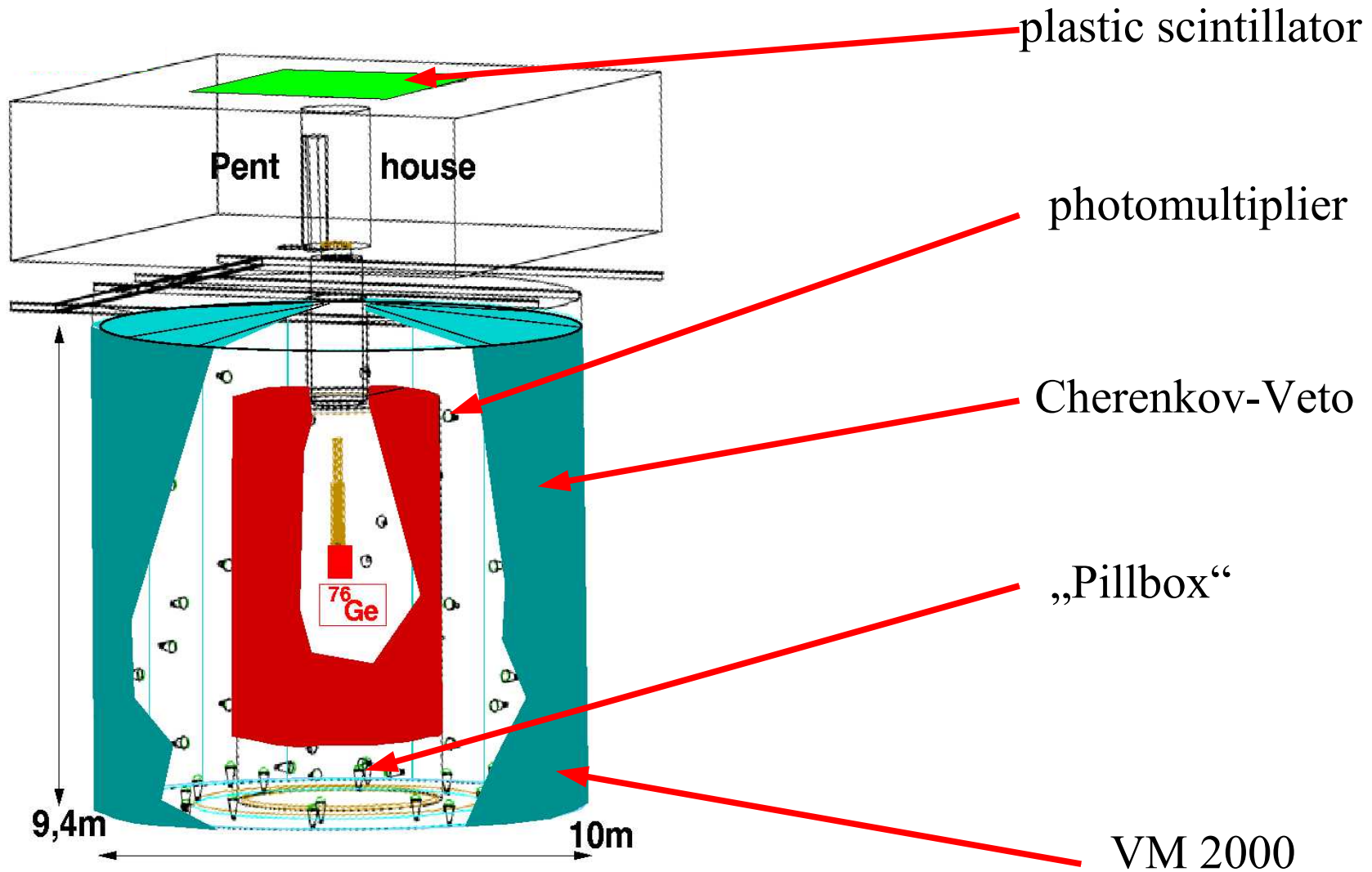


Outline

- Muon Veto Facts
- Muon Veto in Phase I
- Muon Veto in Phase II
- Summary and Outlook



Muon Veto Facts



Muon Veto Facts



Muon Veto in Phase I

Phase I will be used to improve μ trigger, figure out a hit pattern for muon classification ...

Simulations:

- Muon background (no Veto): $1.02 \cdot 10^{-3}$ counts/(keV kg y)
- Trigger threshold on 1 p.e. for each PMT
- Channels of one FADC are “OR”ed
- 4 FADCs trigger within 30ns

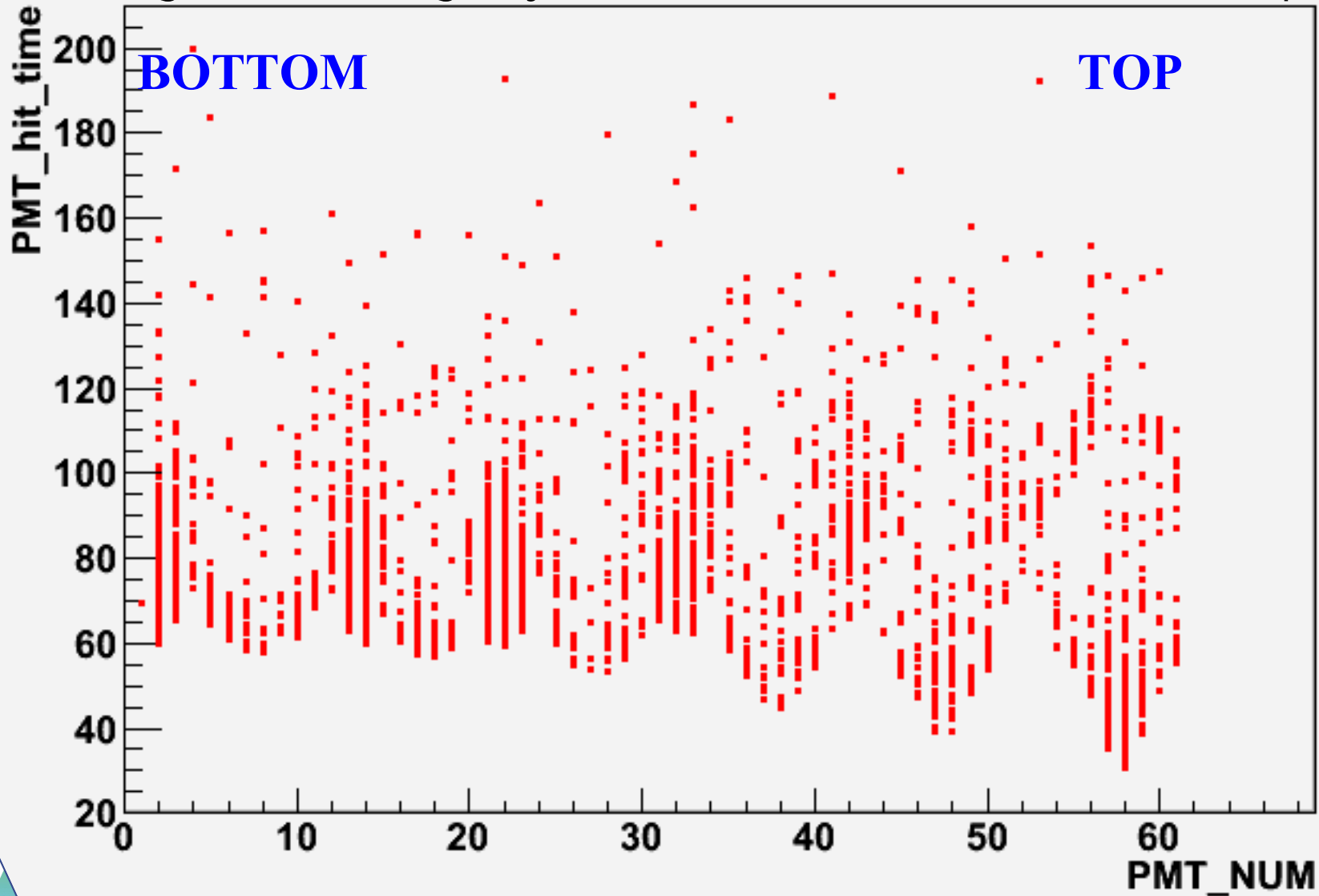
Efficiency: 99.56 ± 0.42 %

accidental coincidences: ~ 60 μ Hz

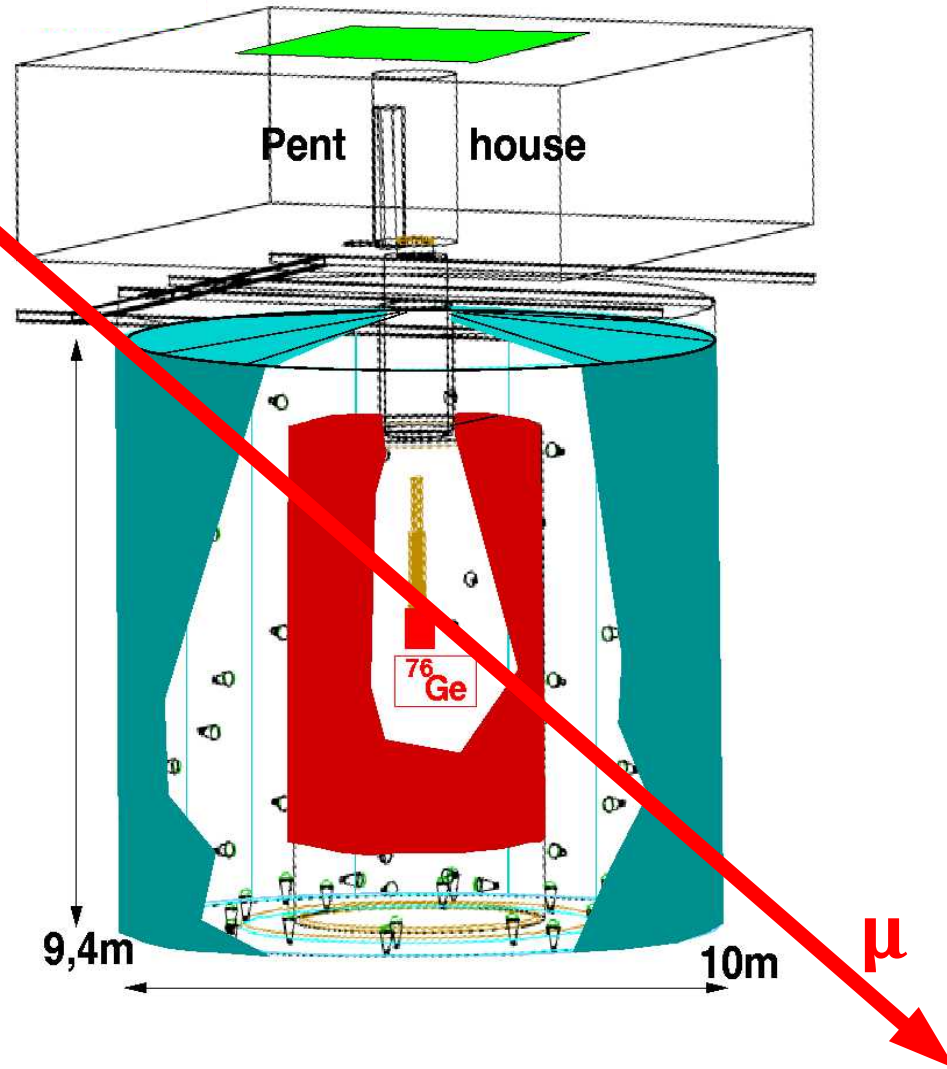


Muon Veto in Phase I

single Muon hitting only Water Tank, without Pillbox, 1 dot = 1 p.e.

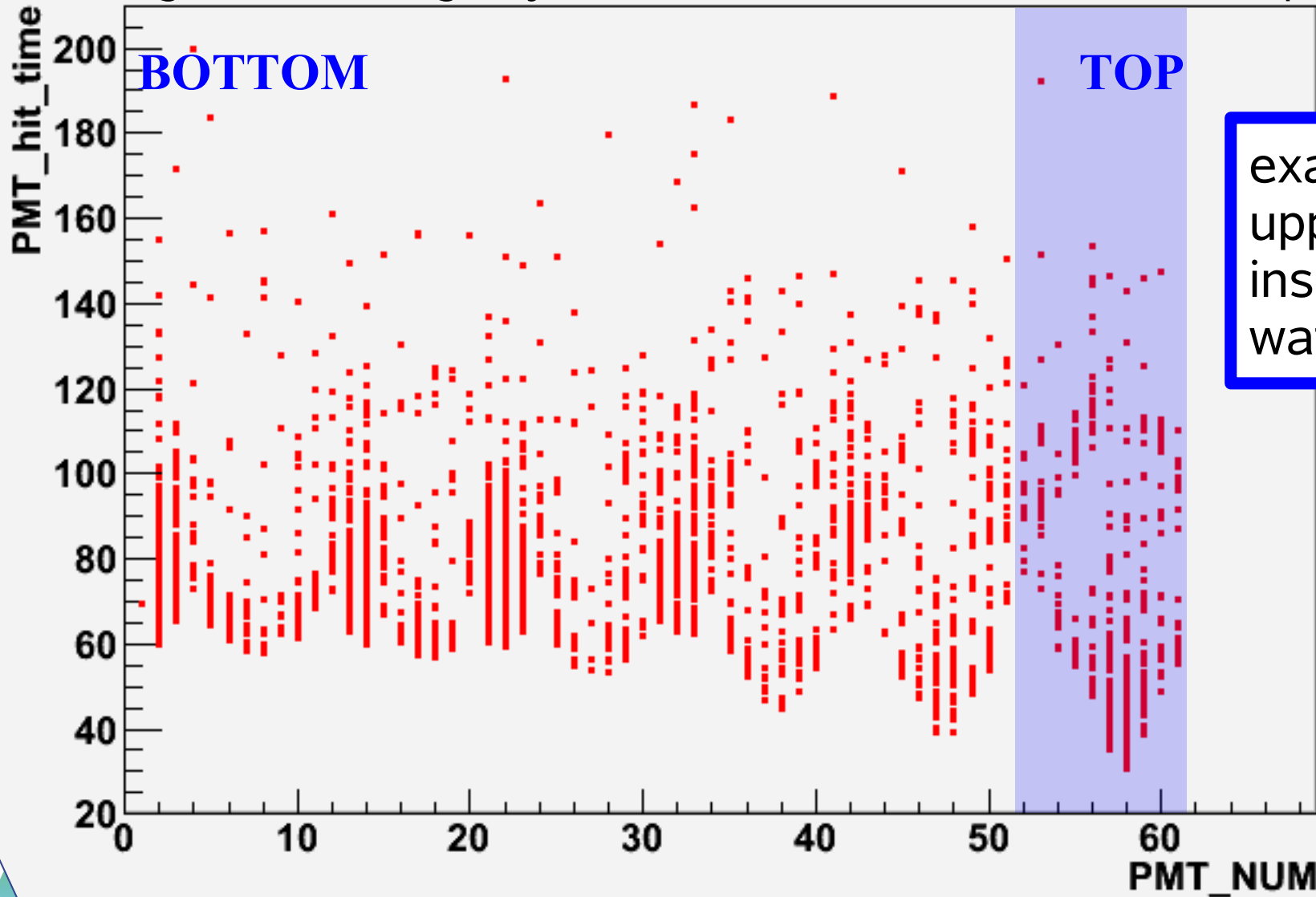


Muon Veto in Phase I



Muon Veto in Phase I

single Muon hitting only Water Tank, without Pillbox, 1 dot = 1 p.e.

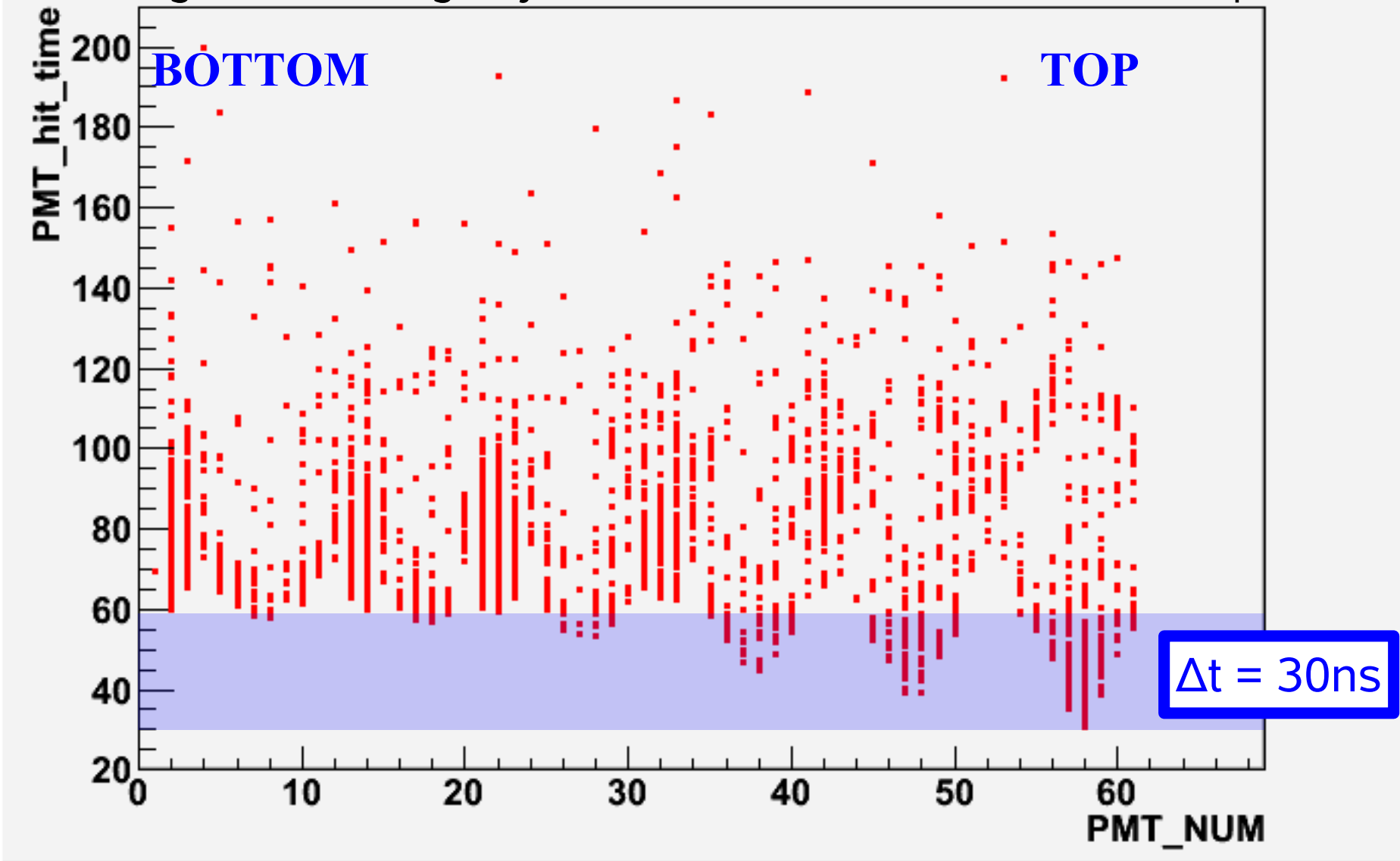


example:
upper ring
inside
water tank



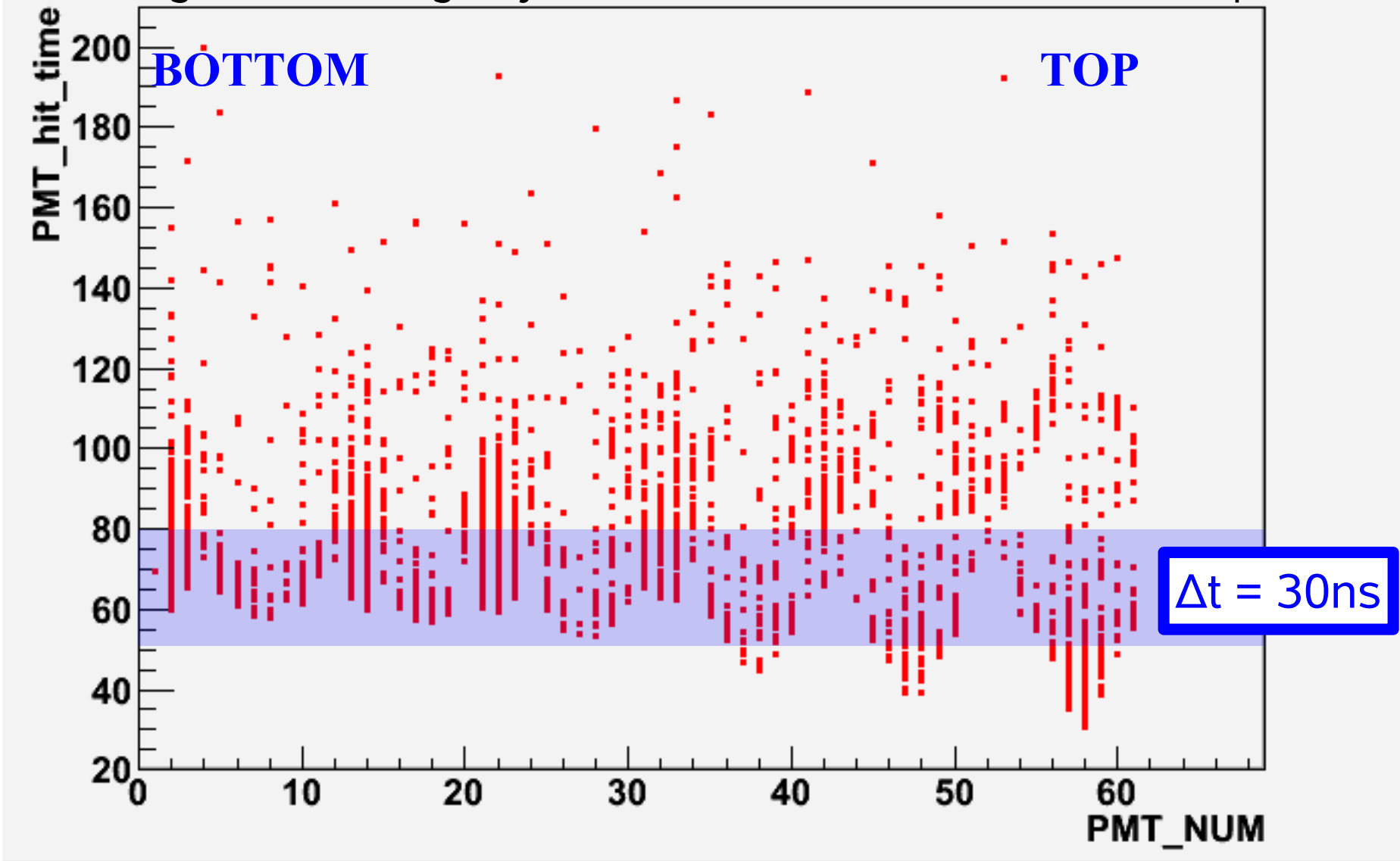
Muon Veto in Phase I

single Muon hitting only Water Tank, without Pillbox, 1 dot = 1 p.e.



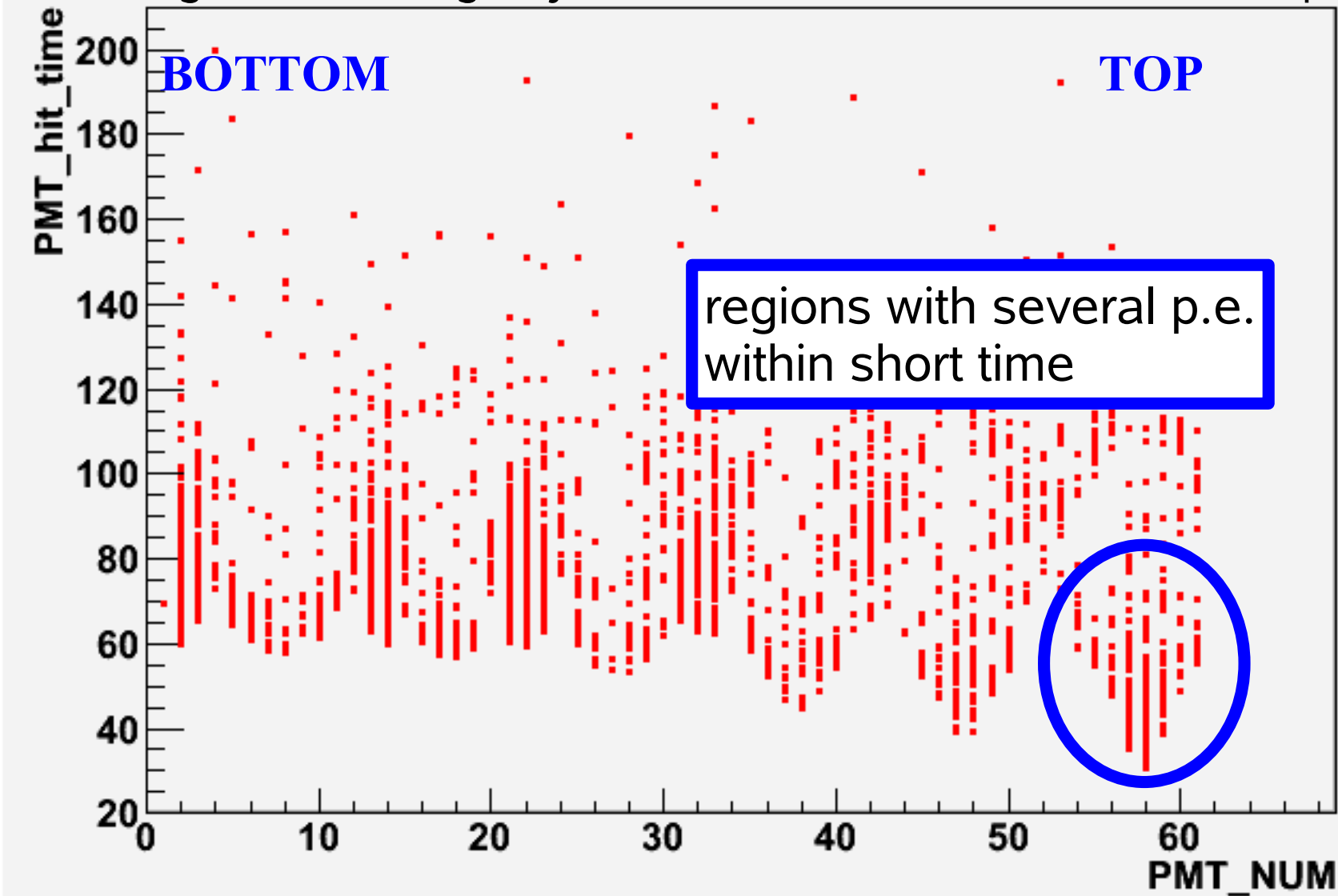
Muon Veto in Phase I

single Muon hitting only Water Tank, without Pillbox, 1 dot = 1 p.e.



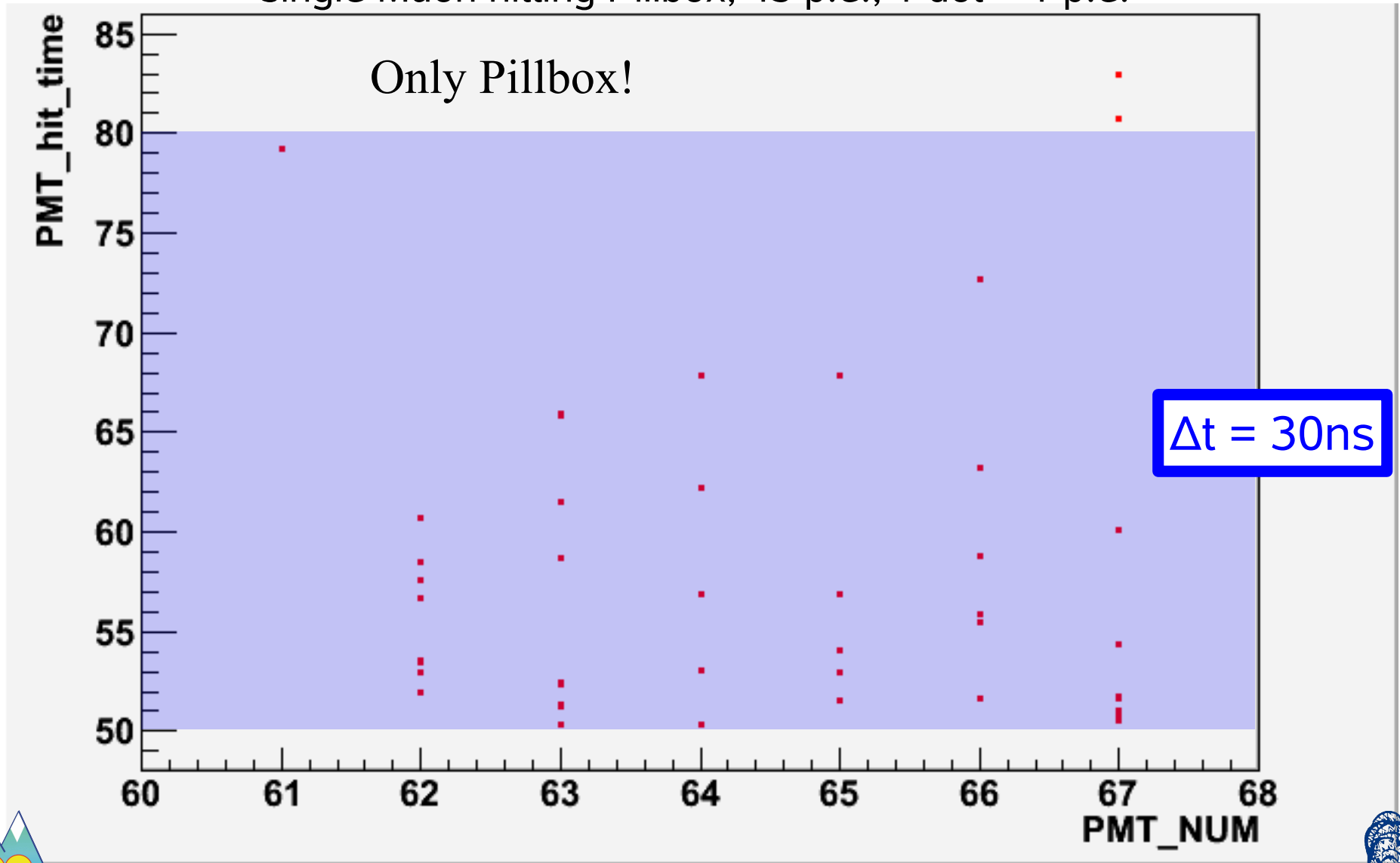
Muon Veto in Phase I

single Muon hitting only Water Tank, without Pillbox, 1 dot = 1 p.e.



Muon Veto in Phase I

single Muon hitting Pillbox, 45 p.e., 1 dot = 1 p.e.



Muon Veto in Phase I

different pattern for different class of muons?

Parameter space:

- trigger value (2 p.e. \leftrightarrow 1 p.e.)
- coincidence time window (30ns \leftrightarrow 40ns)
- coincidence FADCs (3 FADCs \leftrightarrow 4 FADCs)

problems / improvements:

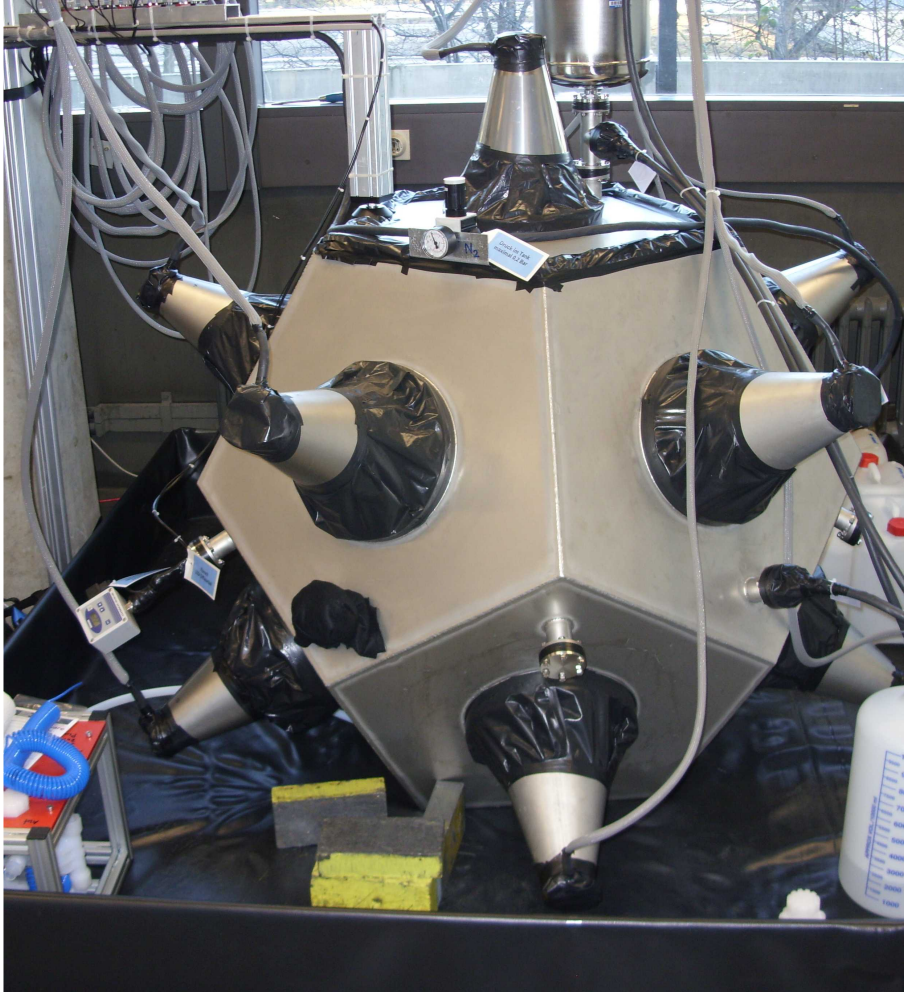
- accidental coincidence may decrease drastically (acc. coincidence mainly due to dark rate [i.e. 1p.e.] of PMTs)
- Veto efficiency may decrease but simulations show an efficiency $> 98 \%$



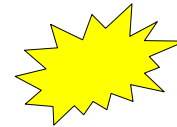
Tests needed!!



Muon Veto in Phase I



Na-22

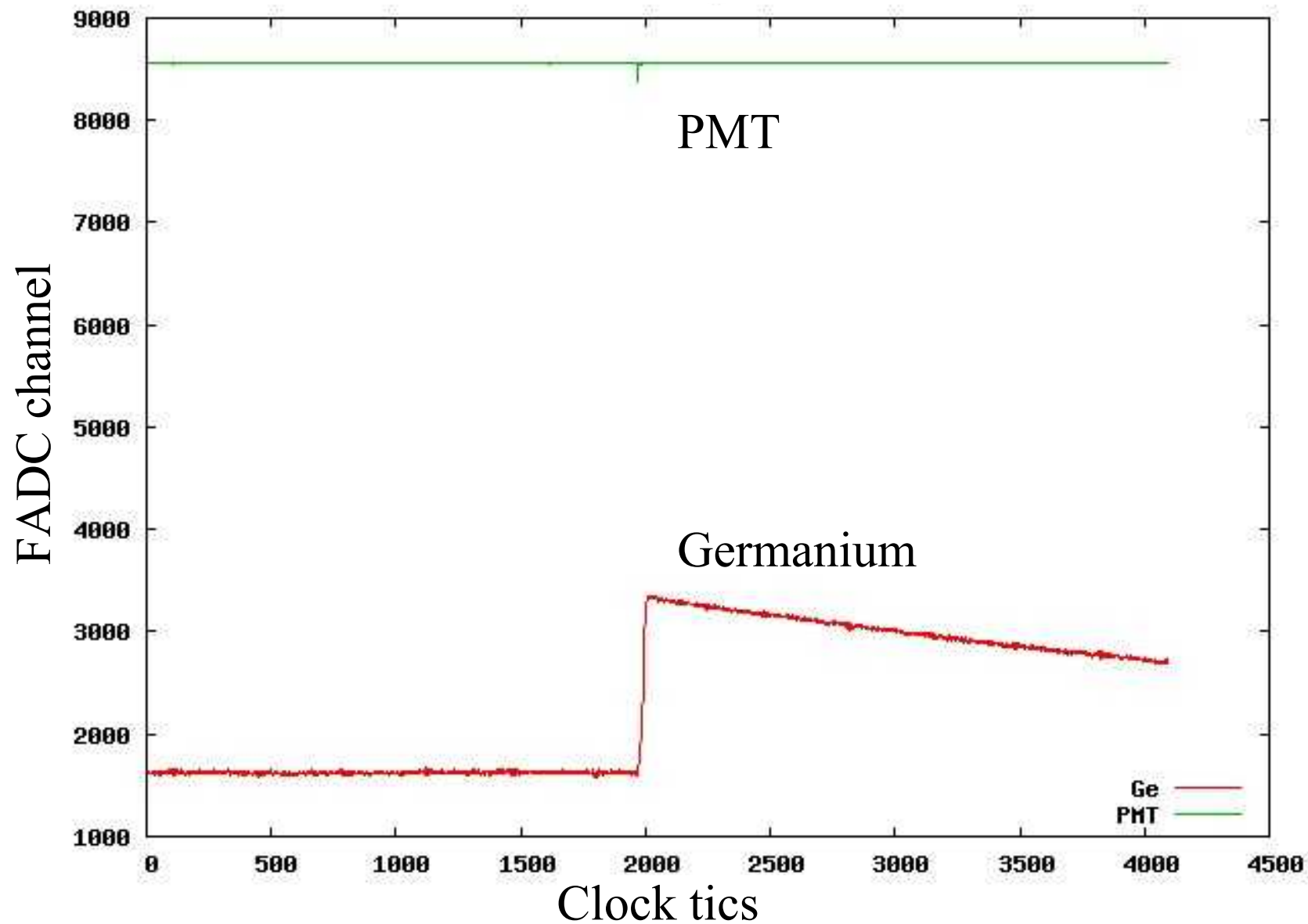


Germanium

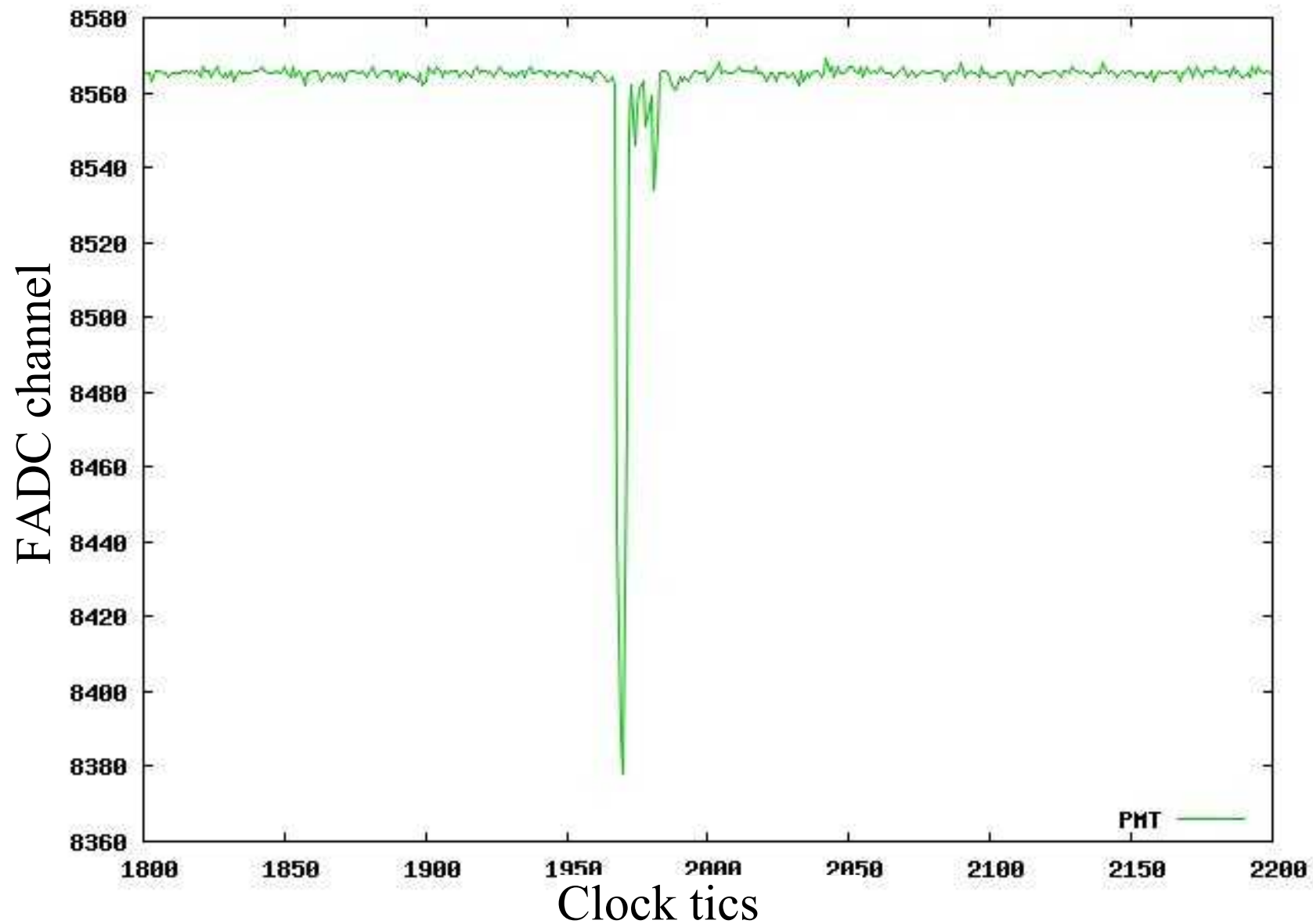
“Dodi” - dodecahedron, 11 GERDA-PMTs,
VM2000, liq. Scint. (DoubleChooz)



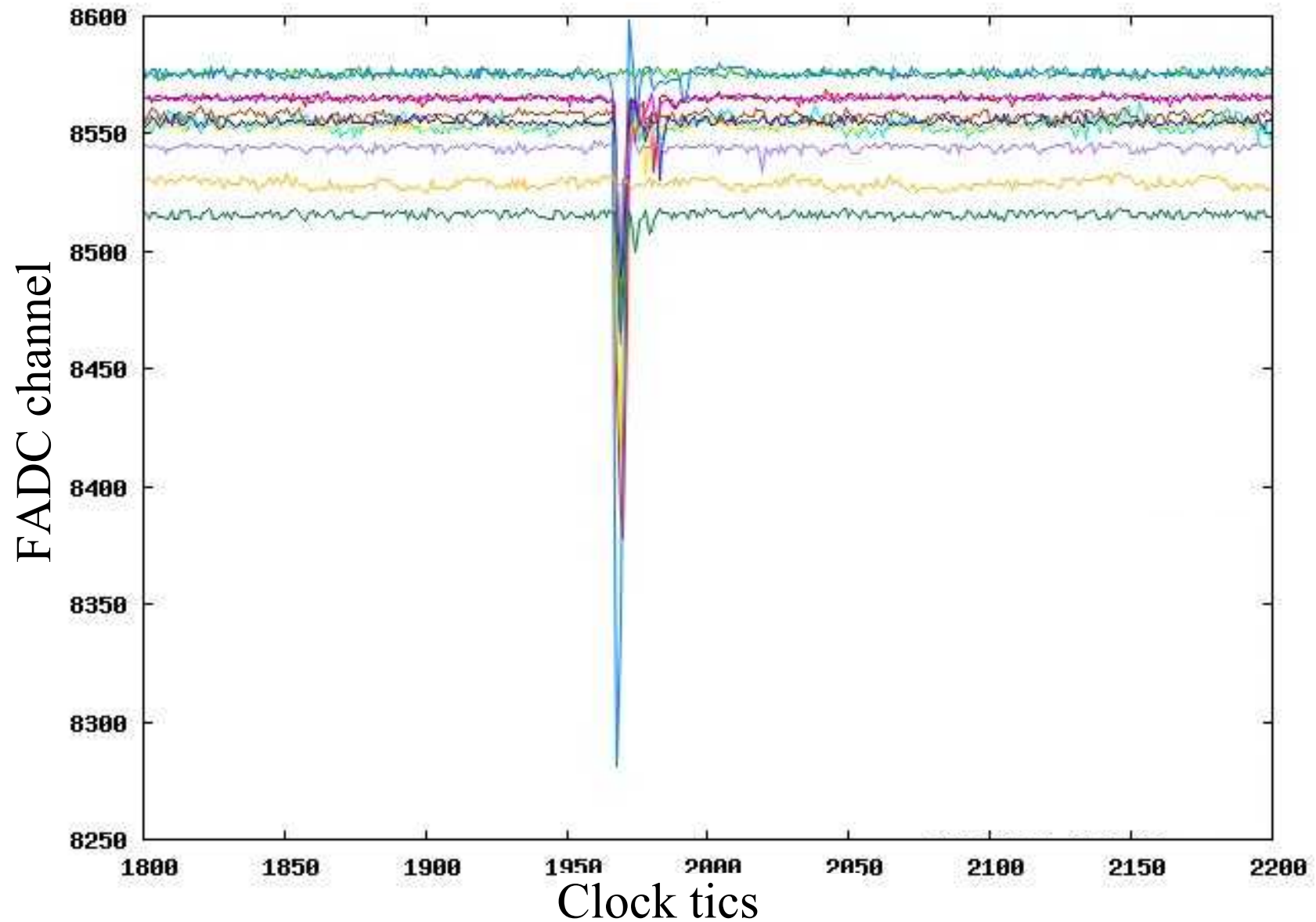
Muon Veto in Phase I



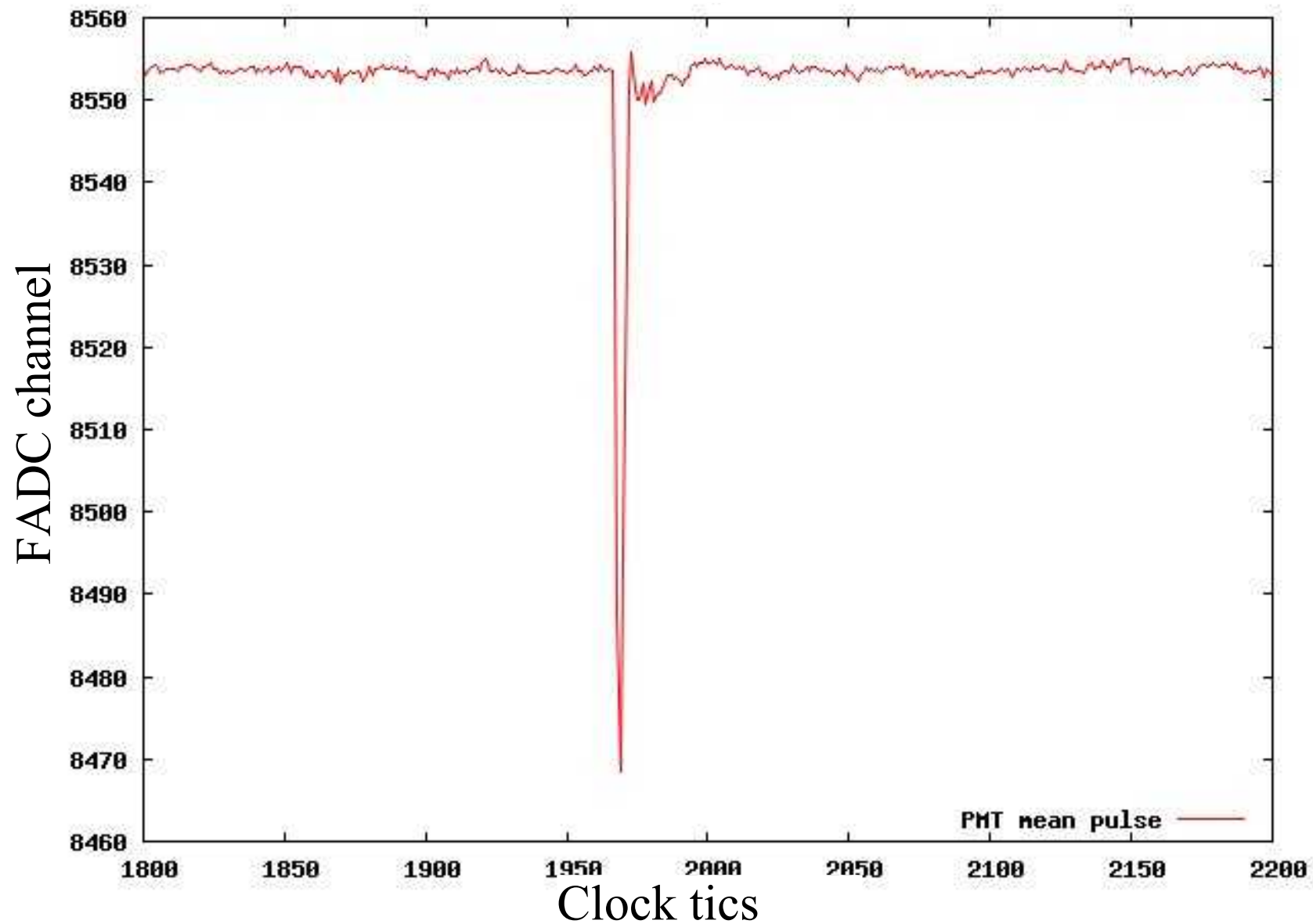
Muon Veto in Phase I



Muon Veto in Phase I

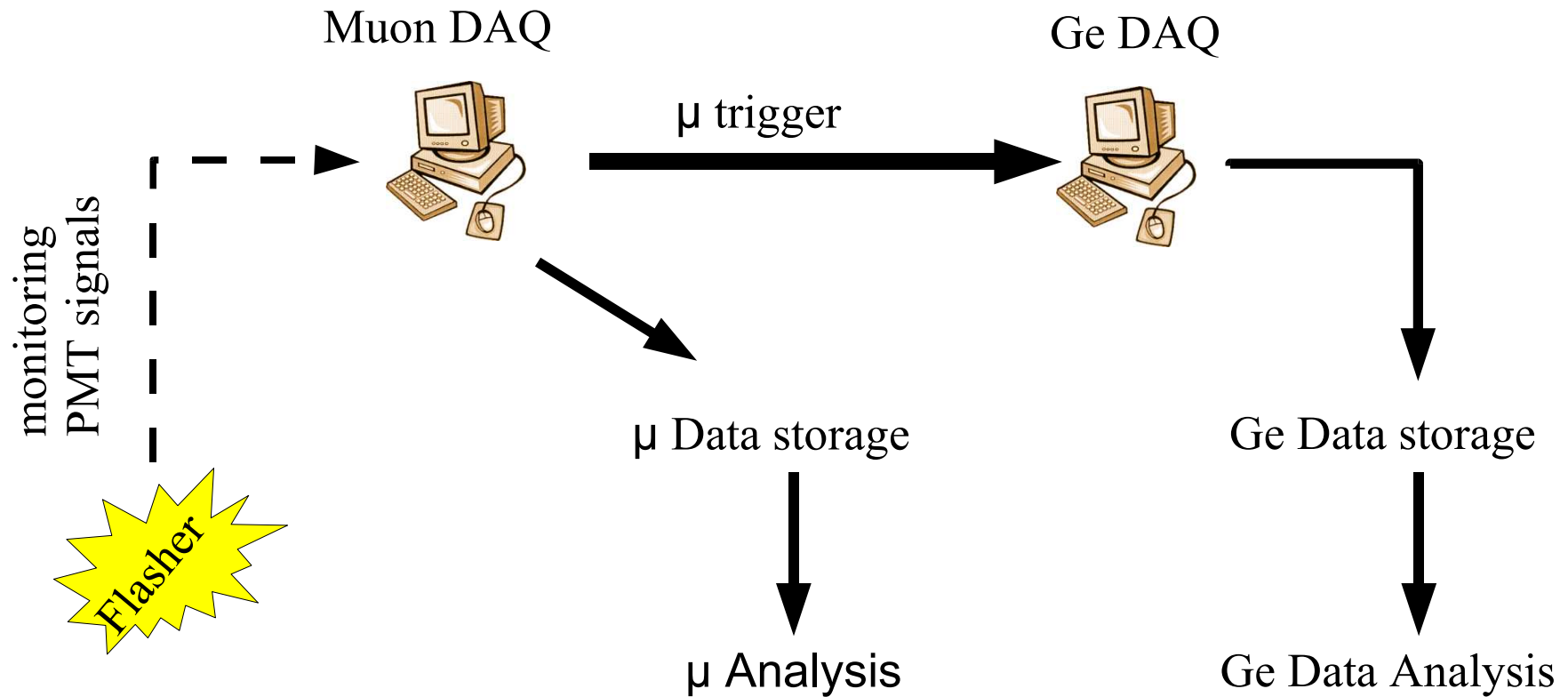


Muon Veto in Phase I



Muon Veto in Phase I

suggested interface with Ge DAQ



Muon Veto in Phase II

To reach Phase II sensitivity, a good Muon rejection is necessary!

With techniques learned in Phase I



possible μ background: $1 \cdot 10^{-5}$ counts/(keV kg y)
or even better!

reminder: μ 's: $1.02 \cdot 10^{-3}$ counts/(keV kg y)



Summary / Outlook

- good Muon rejection is needed.
- during Ge DAQ calibration time, μ DAQ is experimenting with data for learning.
- with experience in Phase I, a good muon rejection is possible in Phase II.
- Phase II: combined DAQ for both Ge and muons.



Thank you for your attention



Muon Veto in Phase I

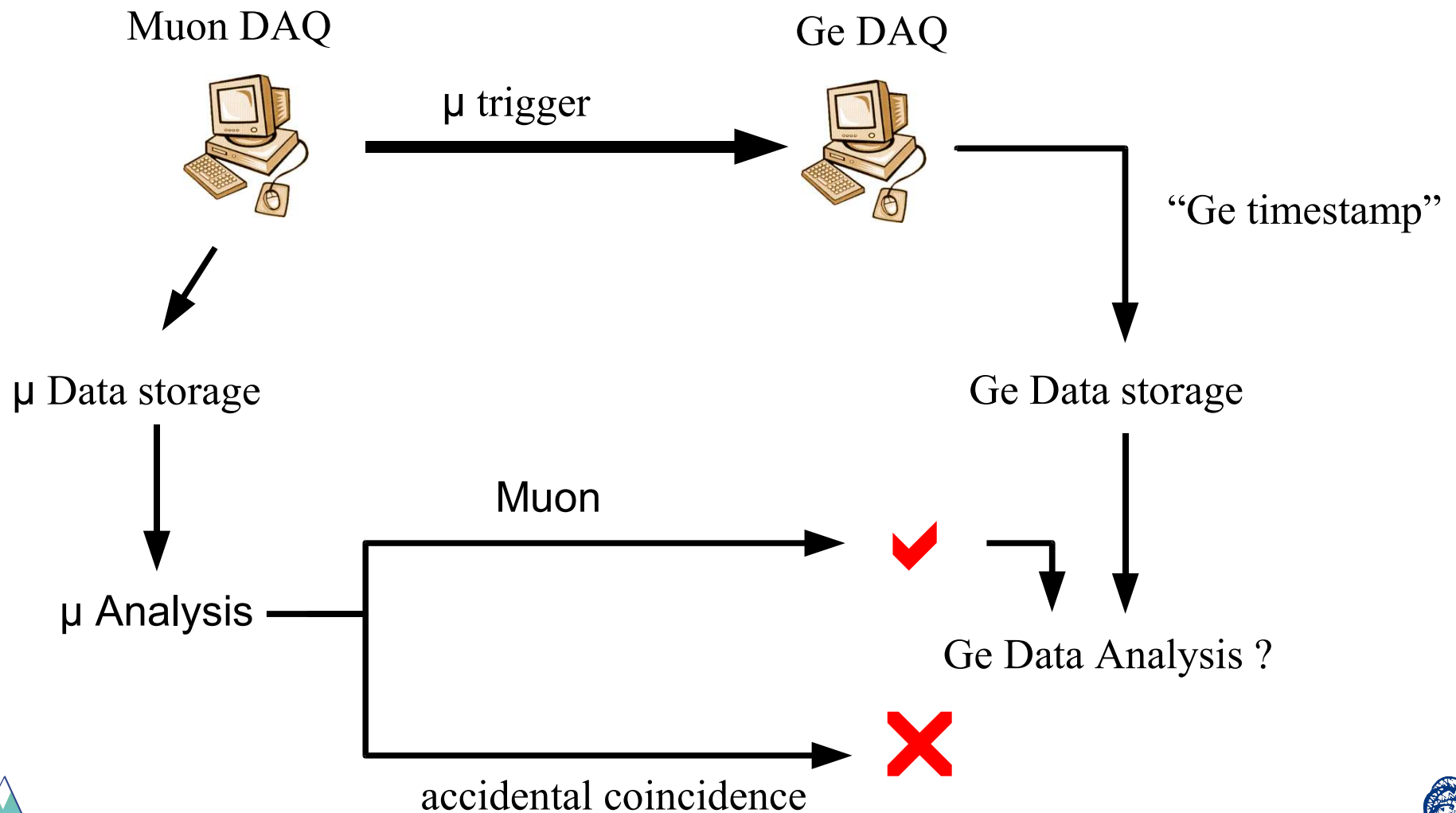
suggested interface with Ge DAQ:

a) Muon Veto sends trigger signal to Ge DAQ, so every muon will be recorded by Ge DAQ as “trigger from outside”, with timestamp within Ge DAQ. Offline analysis of Muon Veto data reveal



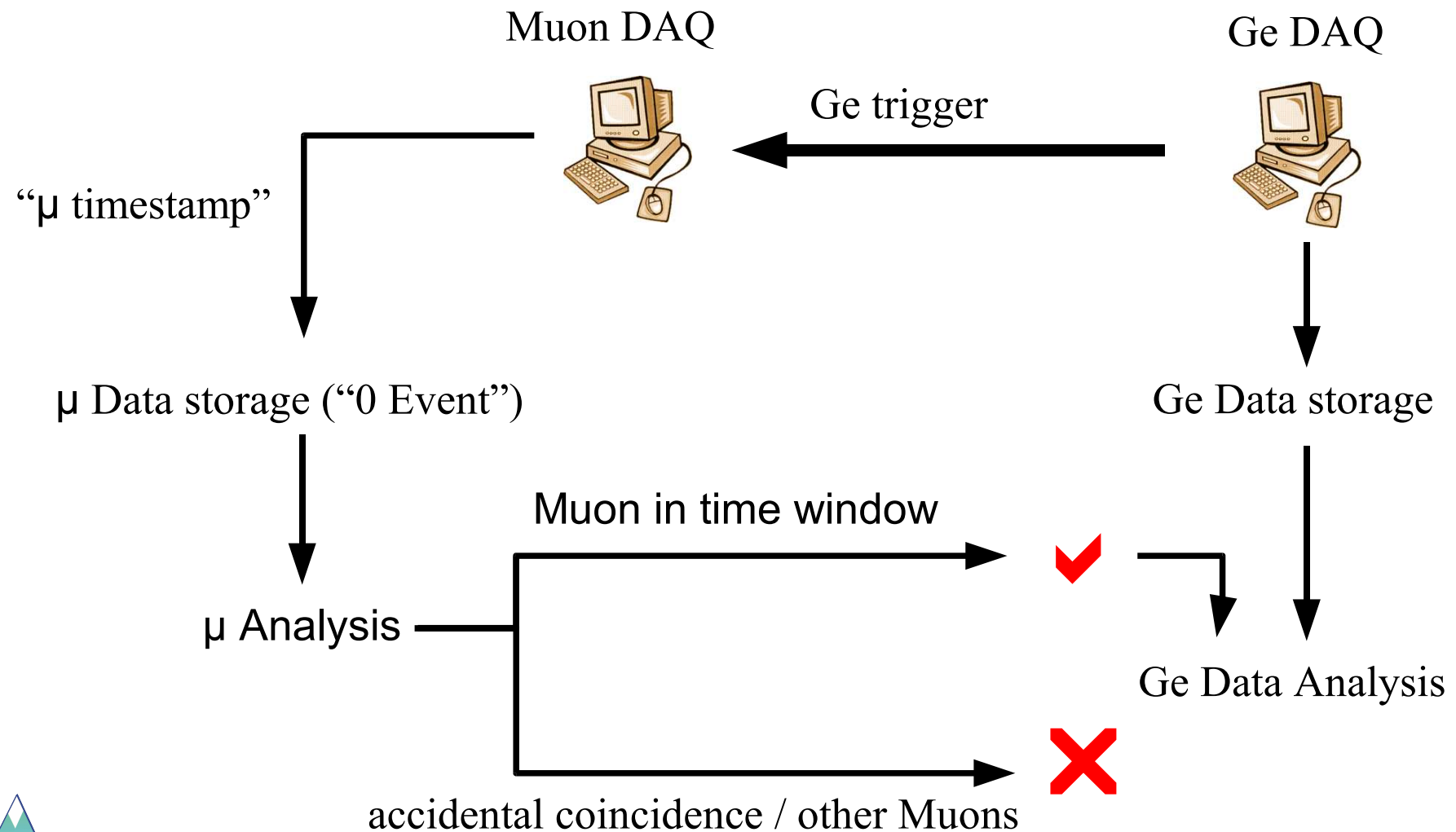
Muon Veto in Phase I

suggested interface with Ge DAQ version A



Muon Veto in Phase I

suggested interface with Ge DAQ version B



Muon Veto in Phase I

Q: Do we need a Muon Veto?

aimed background: $1 \cdot 10^{-2}$ counts/(keV kg year)

Muons (no Veto): $1.02 \cdot 10^{-3}$ counts/(keV kg year)

(Simulations by Markus Knapp)

A: Yes, but even without Veto, the aimed background should be reachable.



