



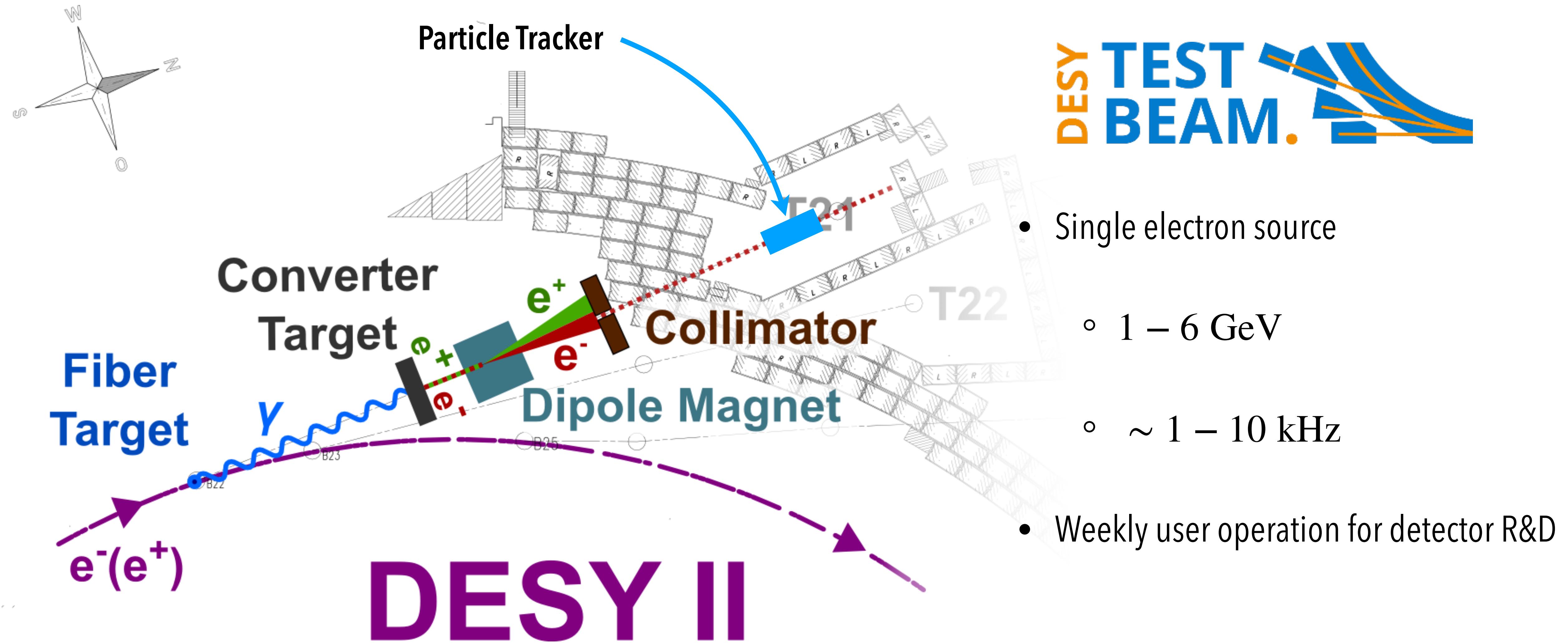
# Optimisation of the Trigger System at the DESY II Test Beam Facility



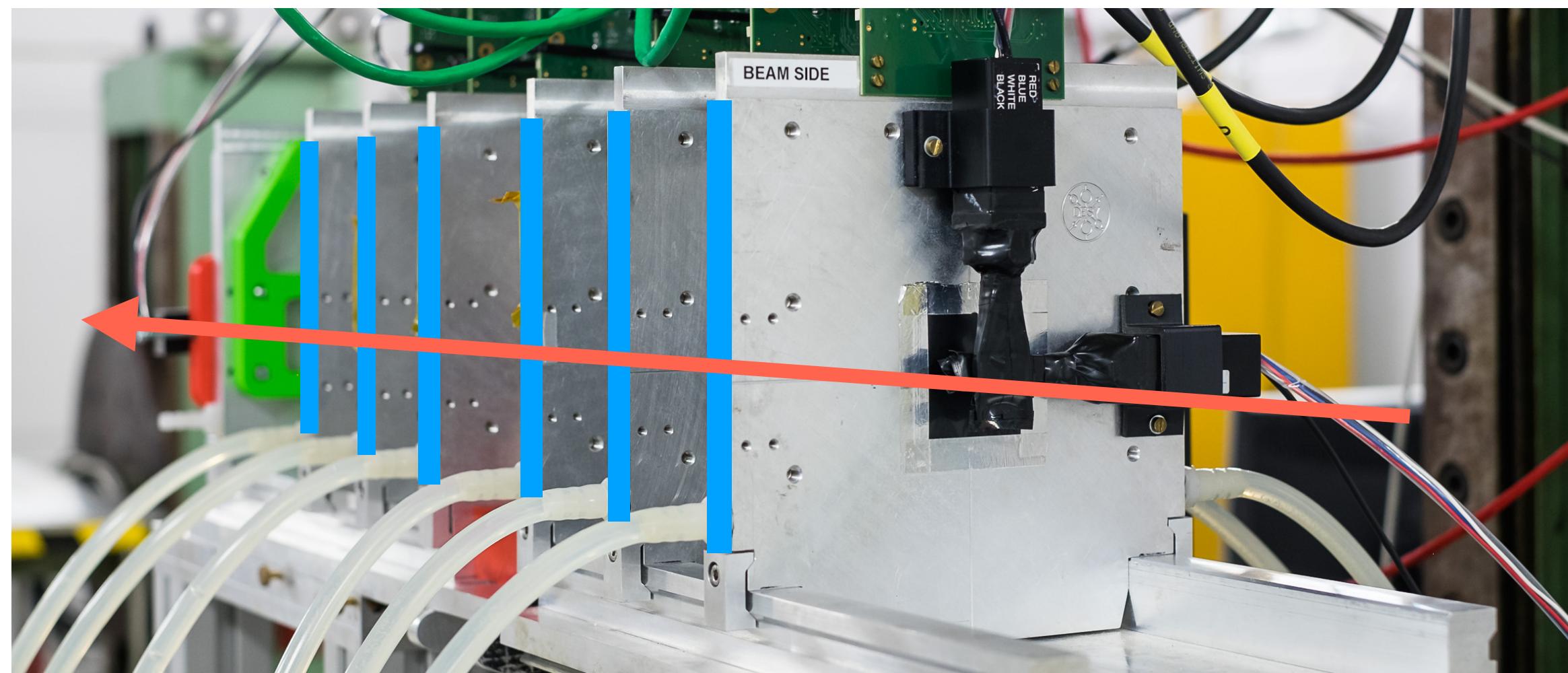
Robert Hammann, 05.09.2019  
DESY Summerstudent Program 2019



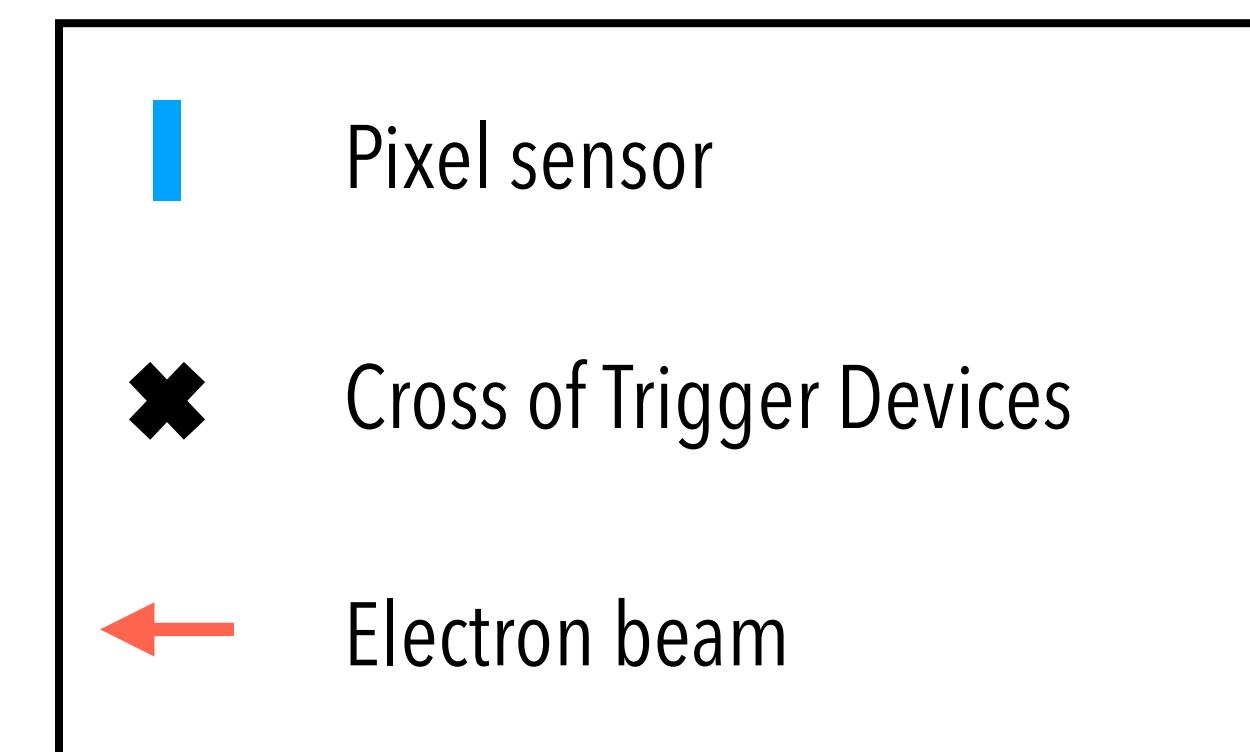
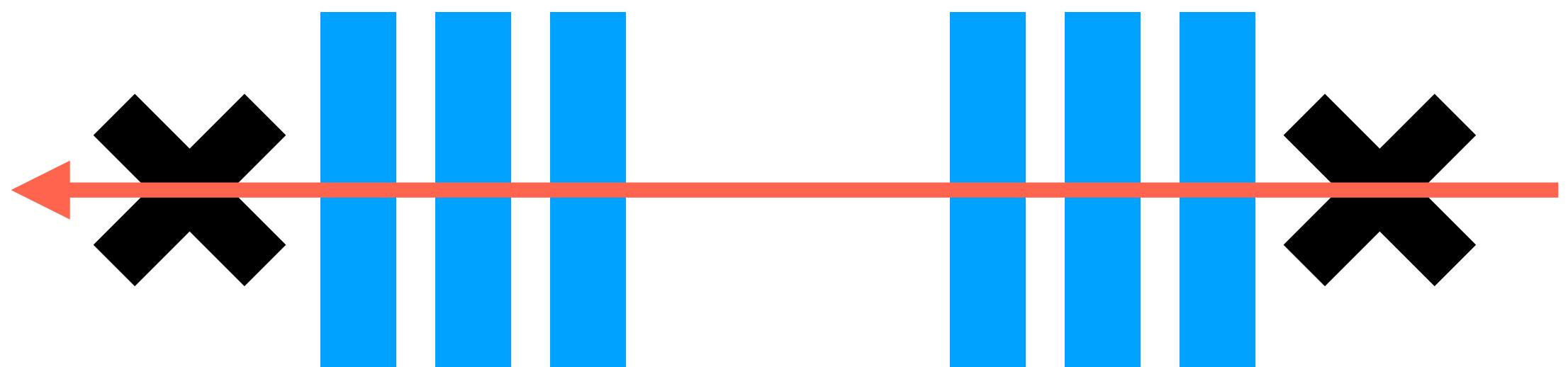
# What is the DESY II Test Beam Facility?



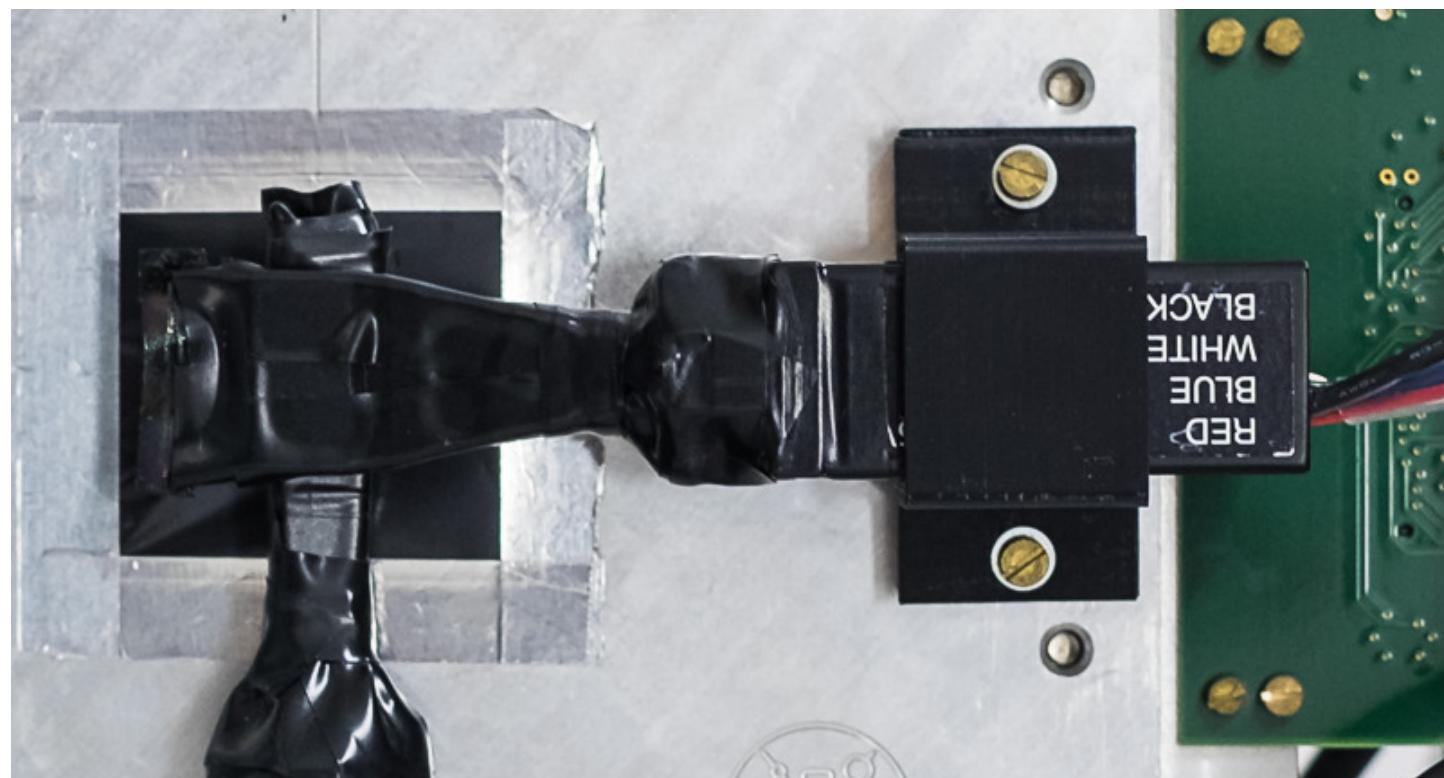
# Why do we trigger?



- Data synchronisation
  - Only acquire data if an electron is passing
  - But: Measure as many electrons events as possible
- Optimise parameters of trigger system

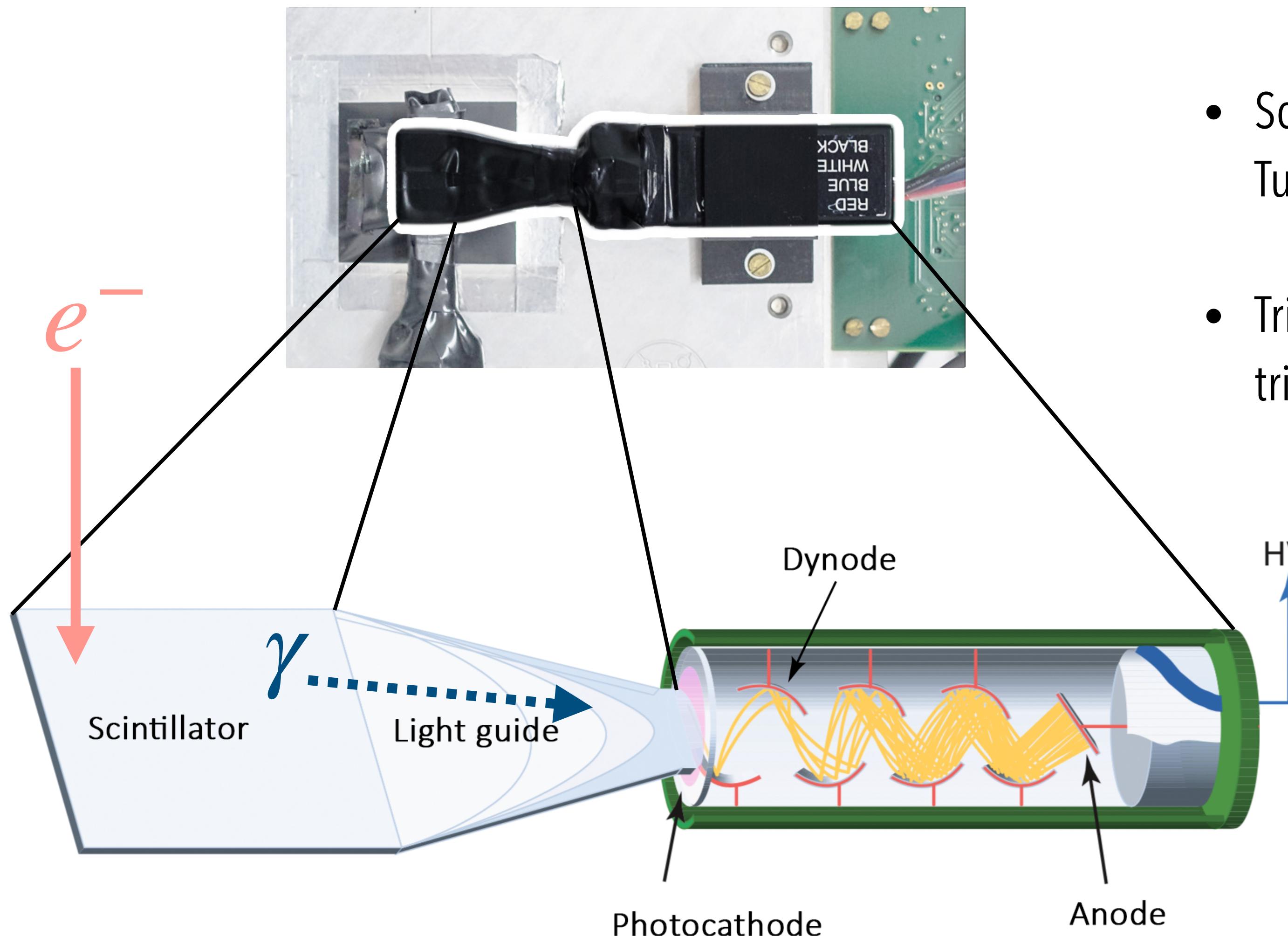


# How do we trigger?



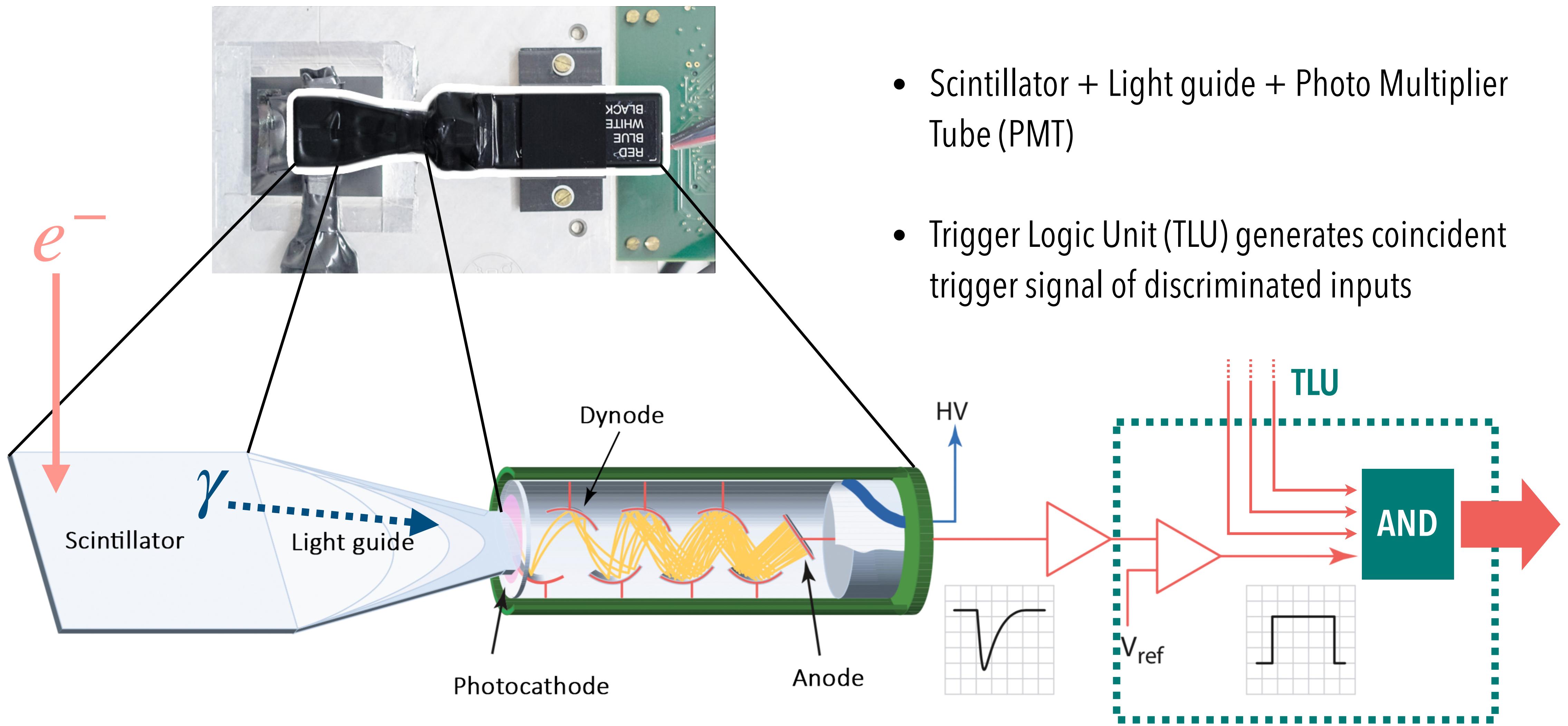
- Scintillator + Light guide + Photo Multiplier Tube (PMT)
- Trigger Logic Unit (TLU) generates coincident trigger signal of discriminated inputs

# How do we trigger?

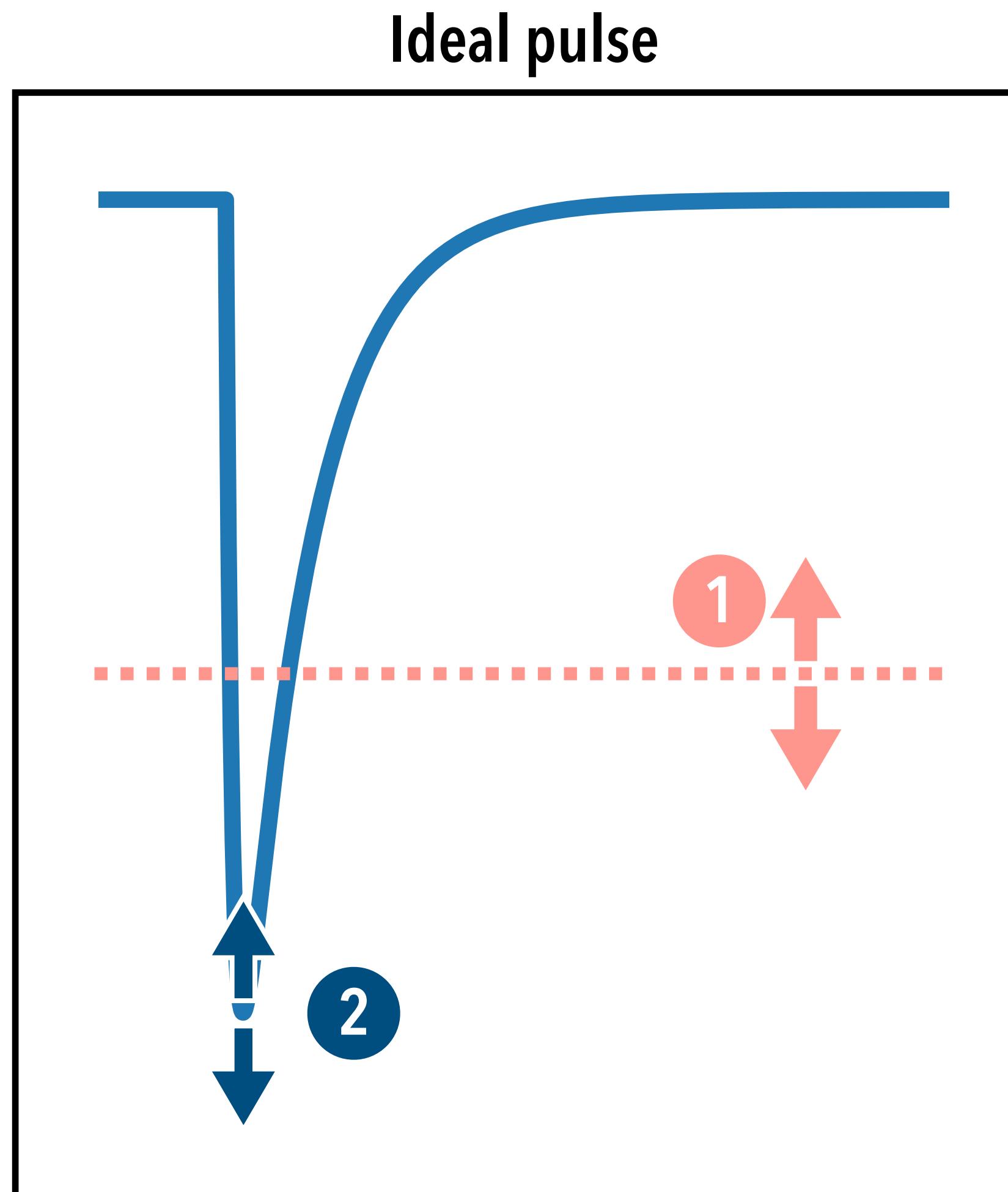


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# How do we trigger?



# What are the Parameters?



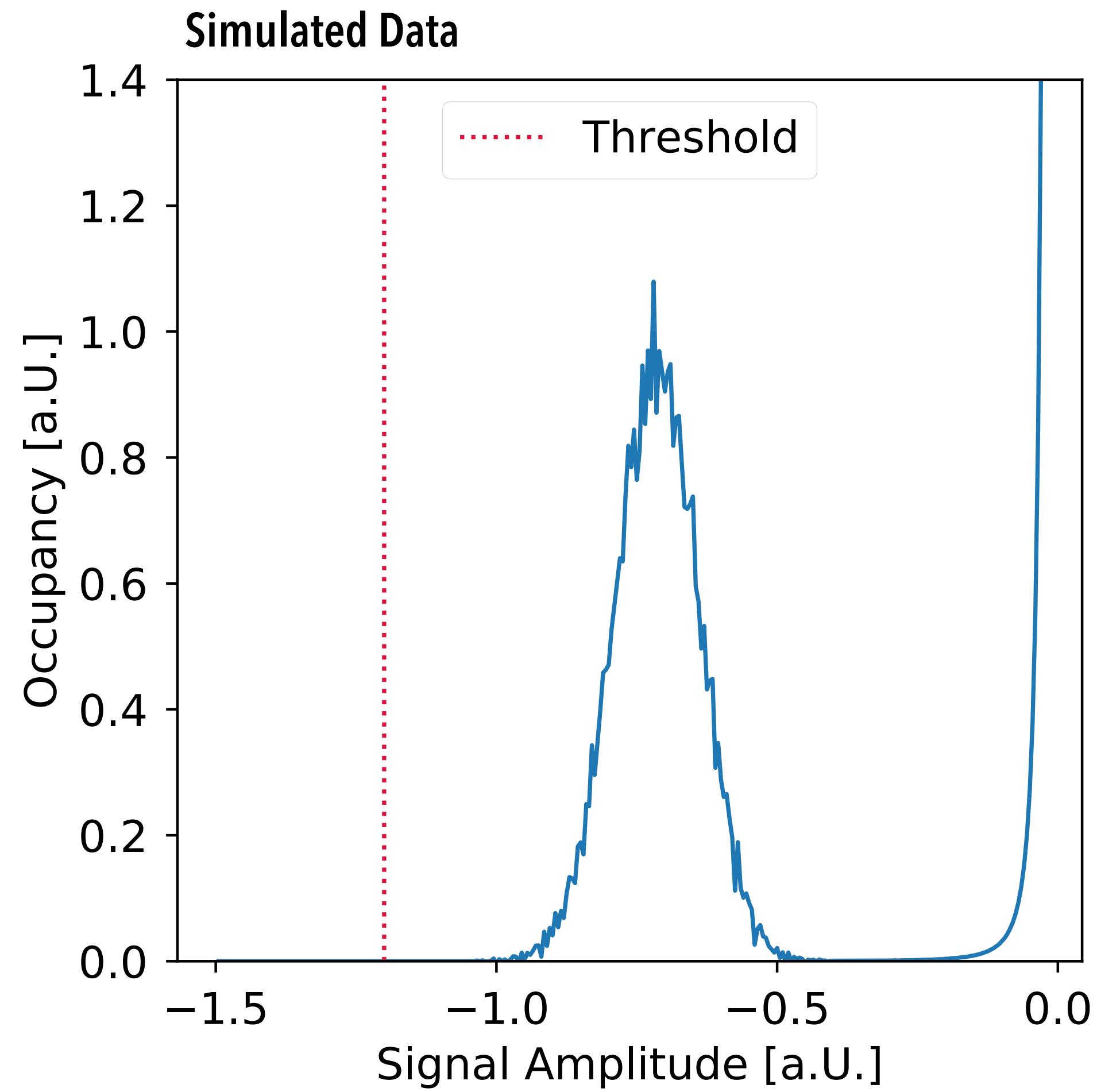
**Individual for each PMT (currently fixed)**

- 1 TLU threshold → Sensitivity of TLU
- 2 PMT voltage → Gain of PMT → signal height  
(as low as possible)

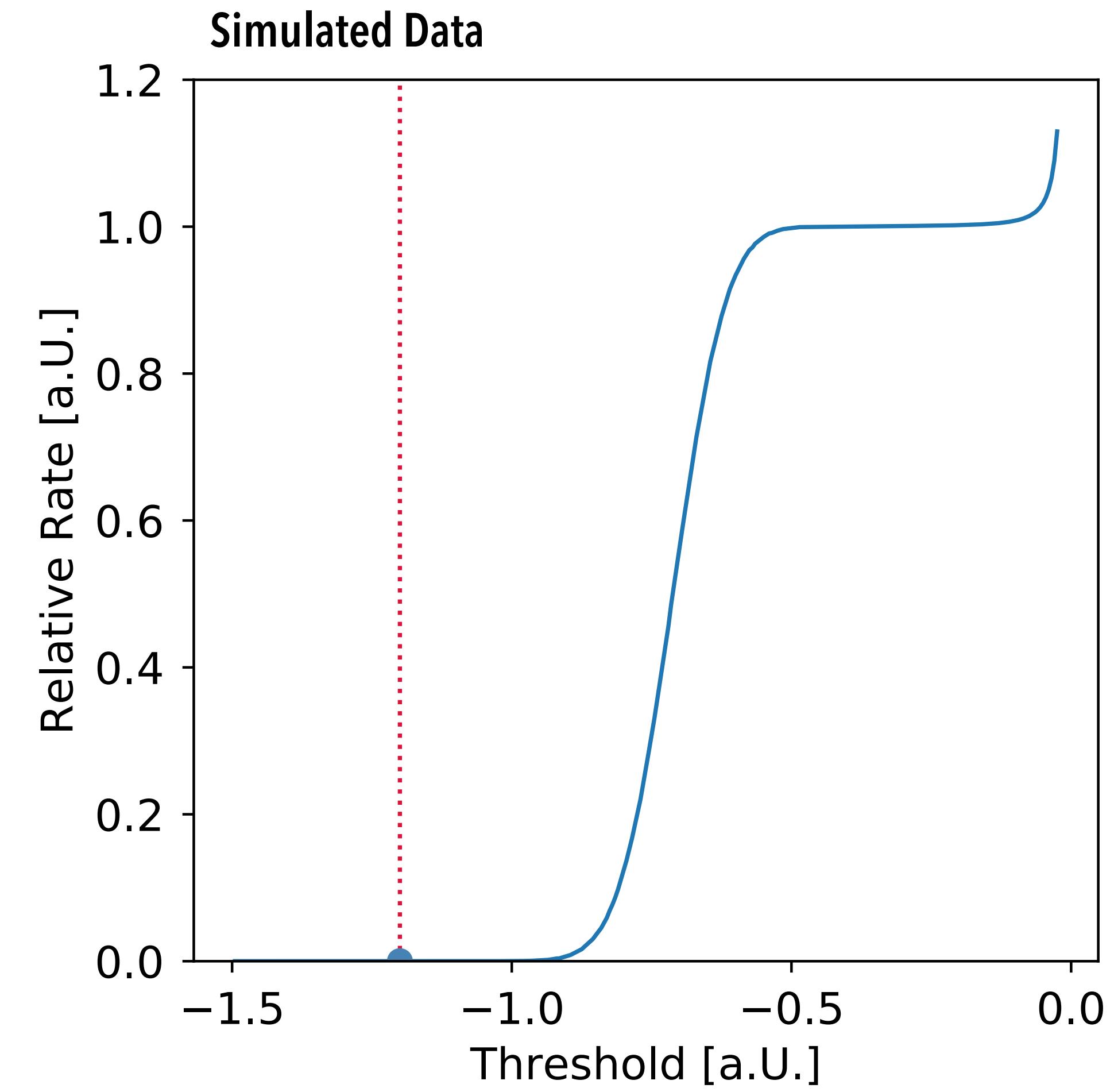
**Global Parameter**

- (Geometrical overlap)

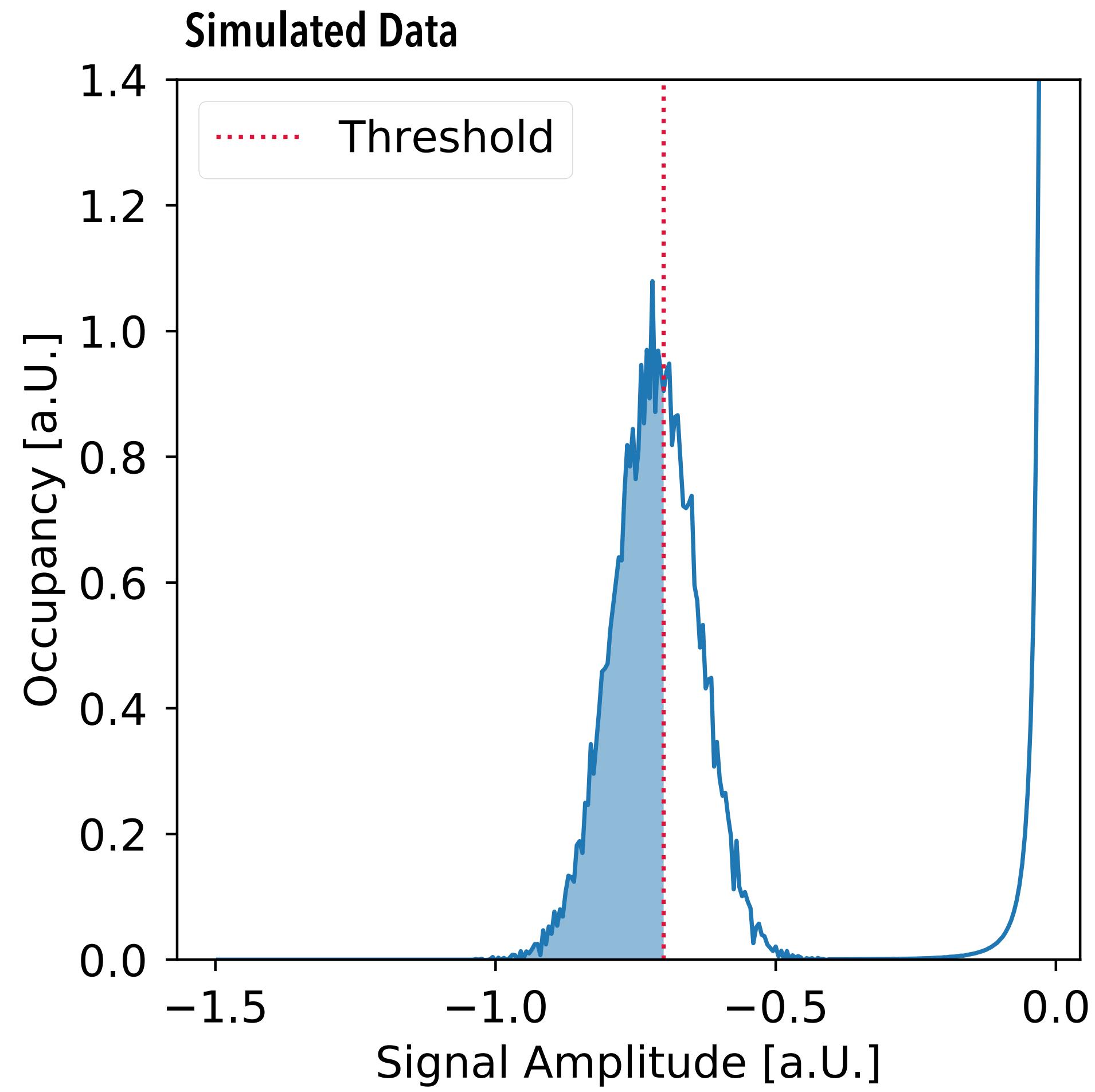
# Threshold characteristics - Expectation



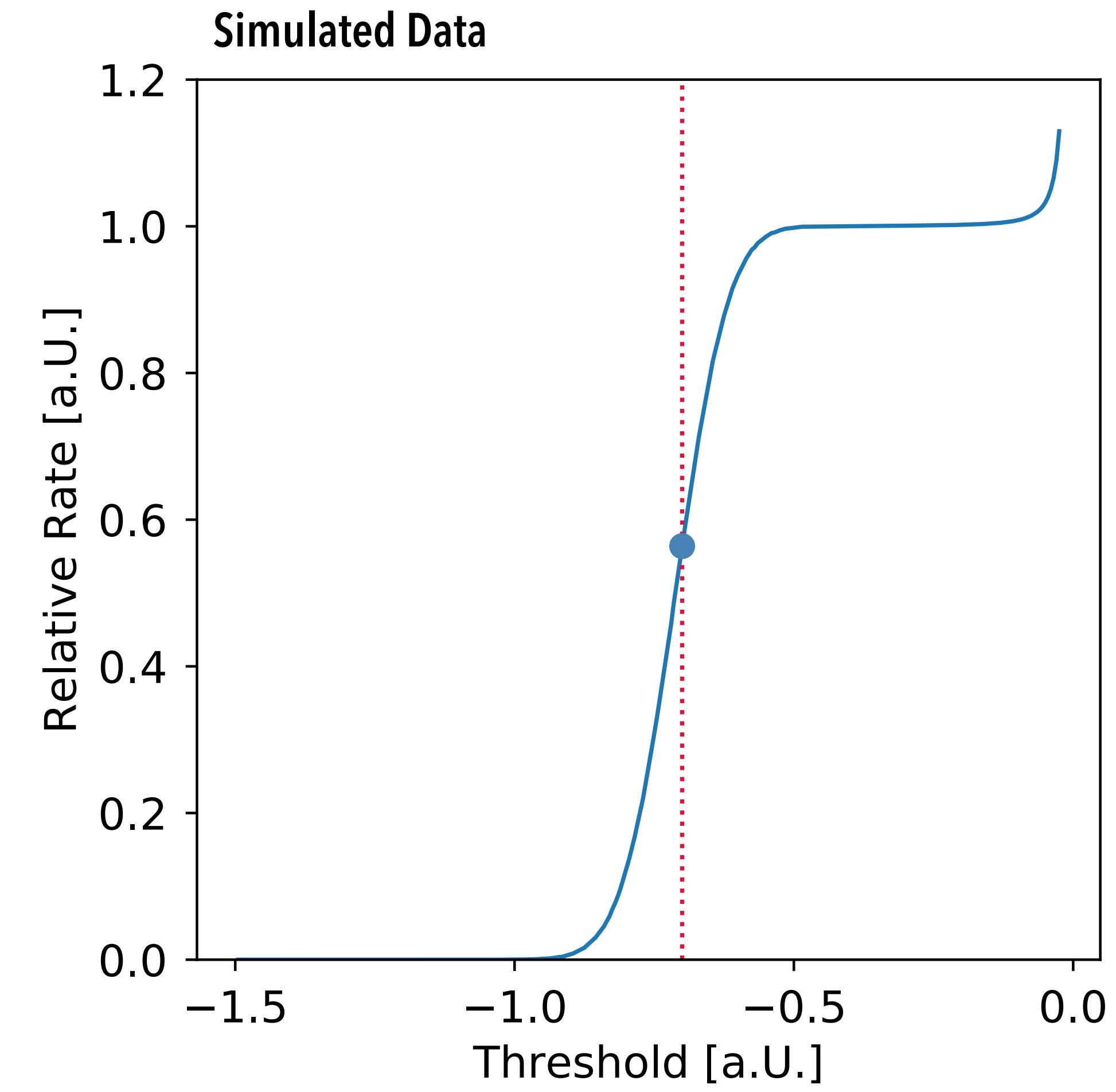
Integrate



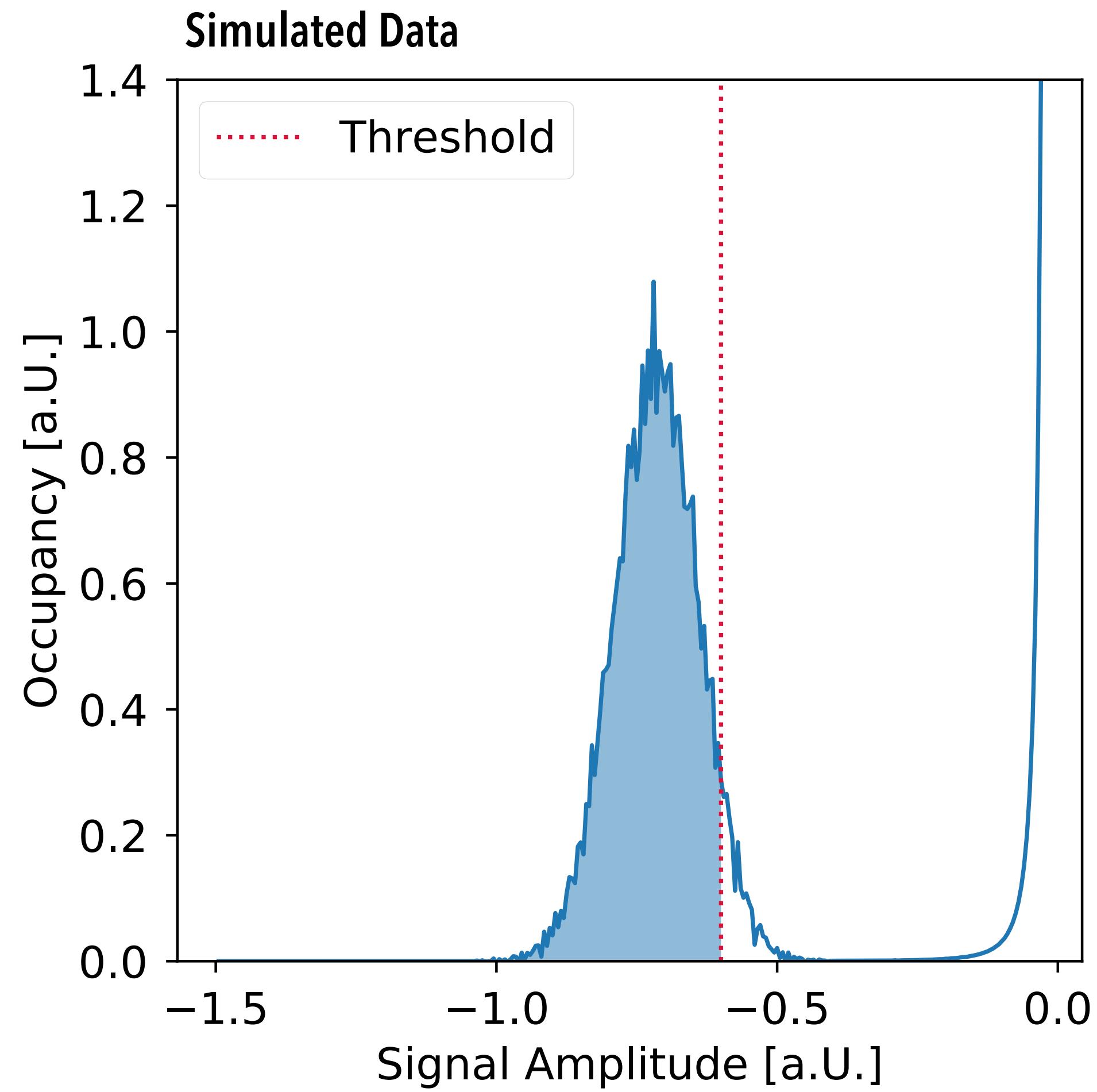
# Threshold characteristics - Expectation



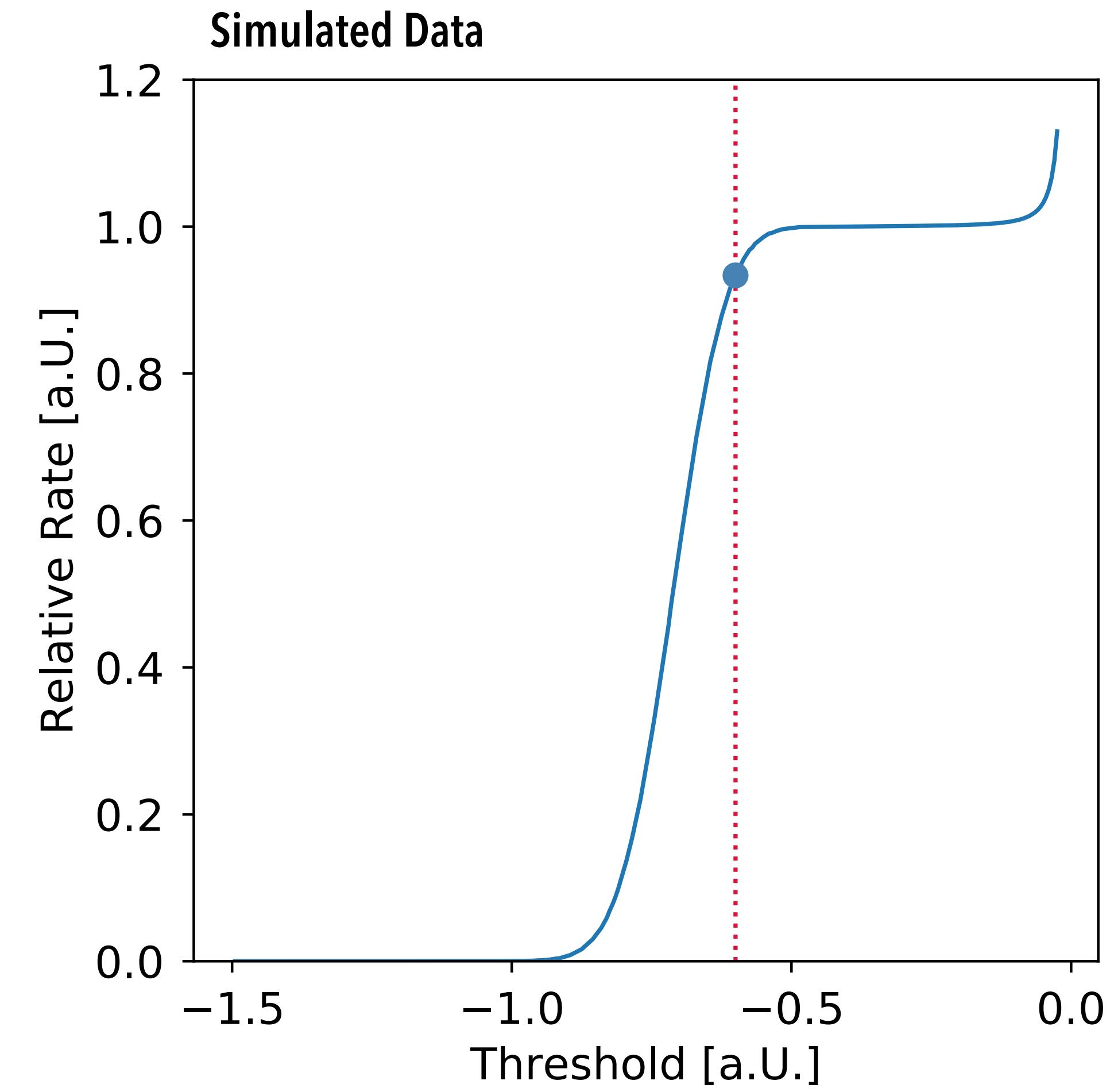
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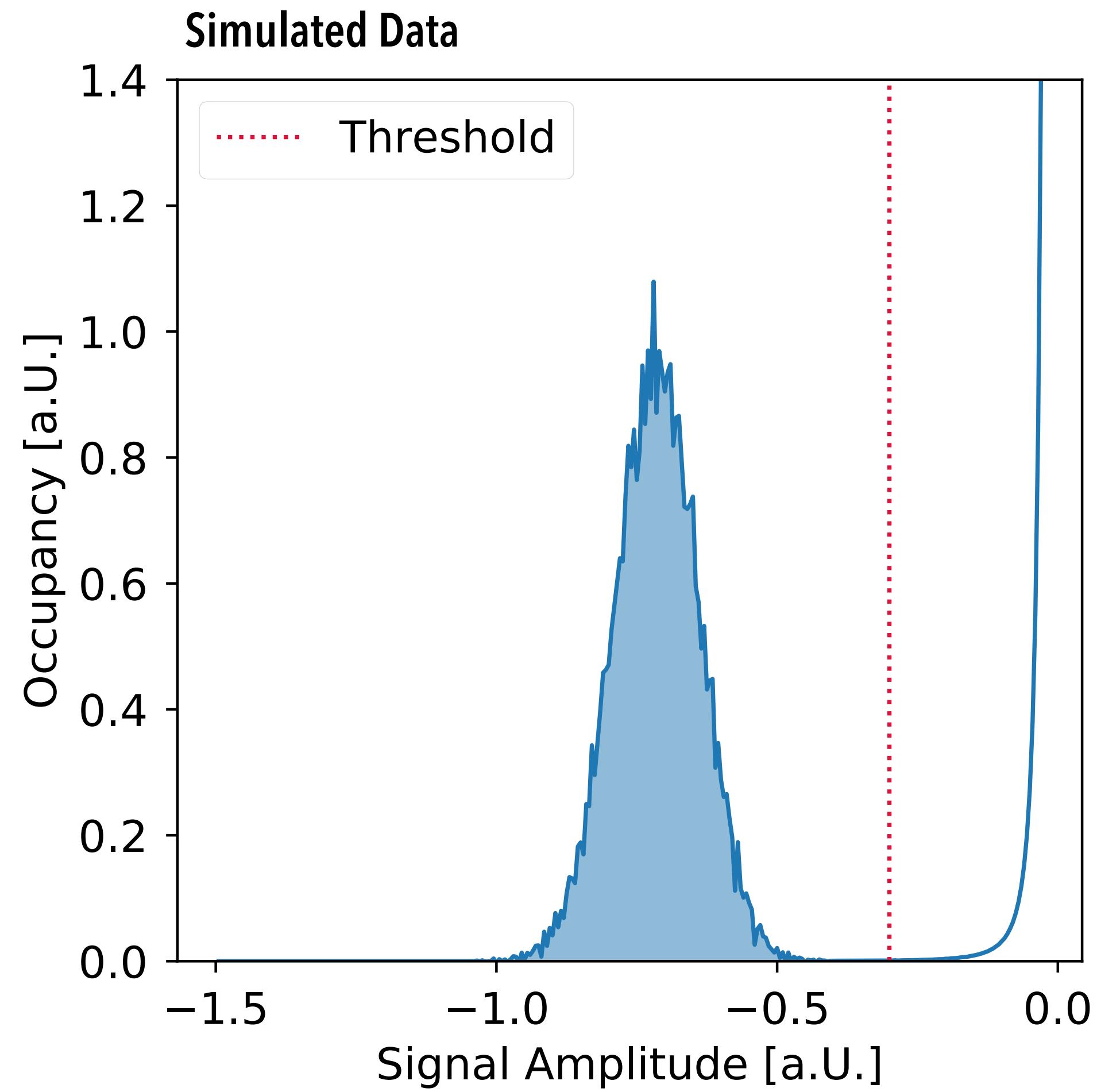
# Threshold characteristics - Expectation



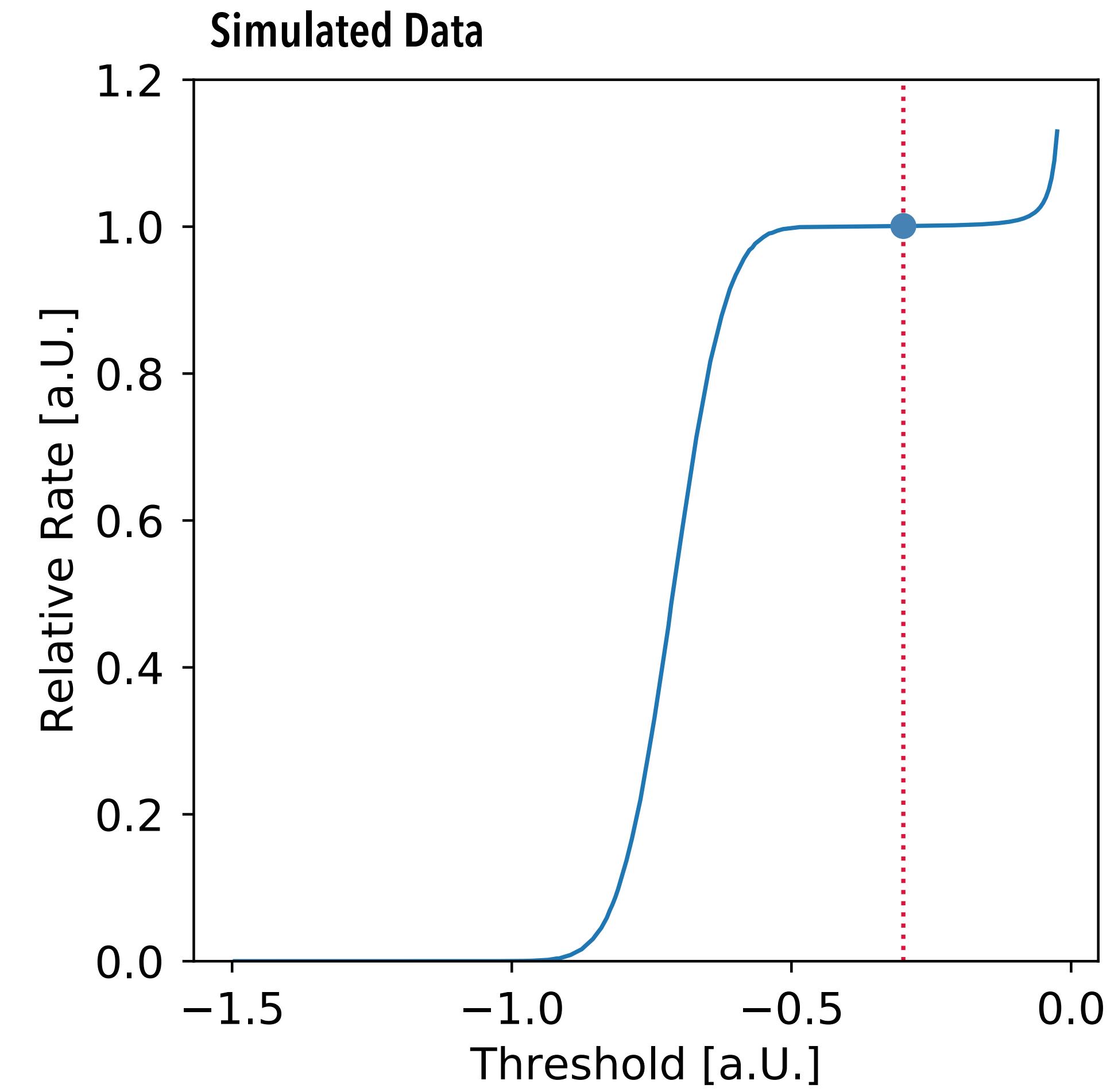
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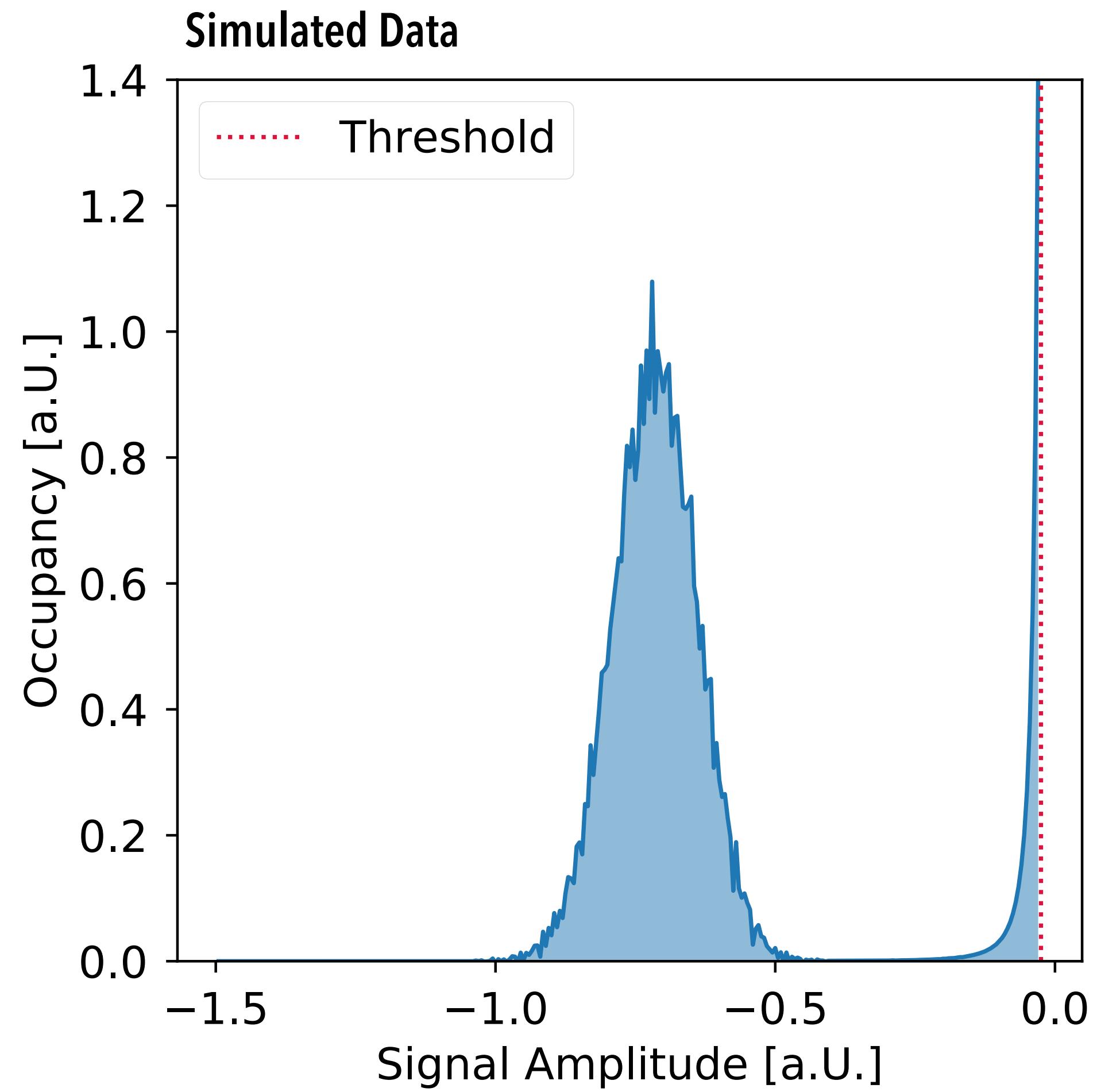
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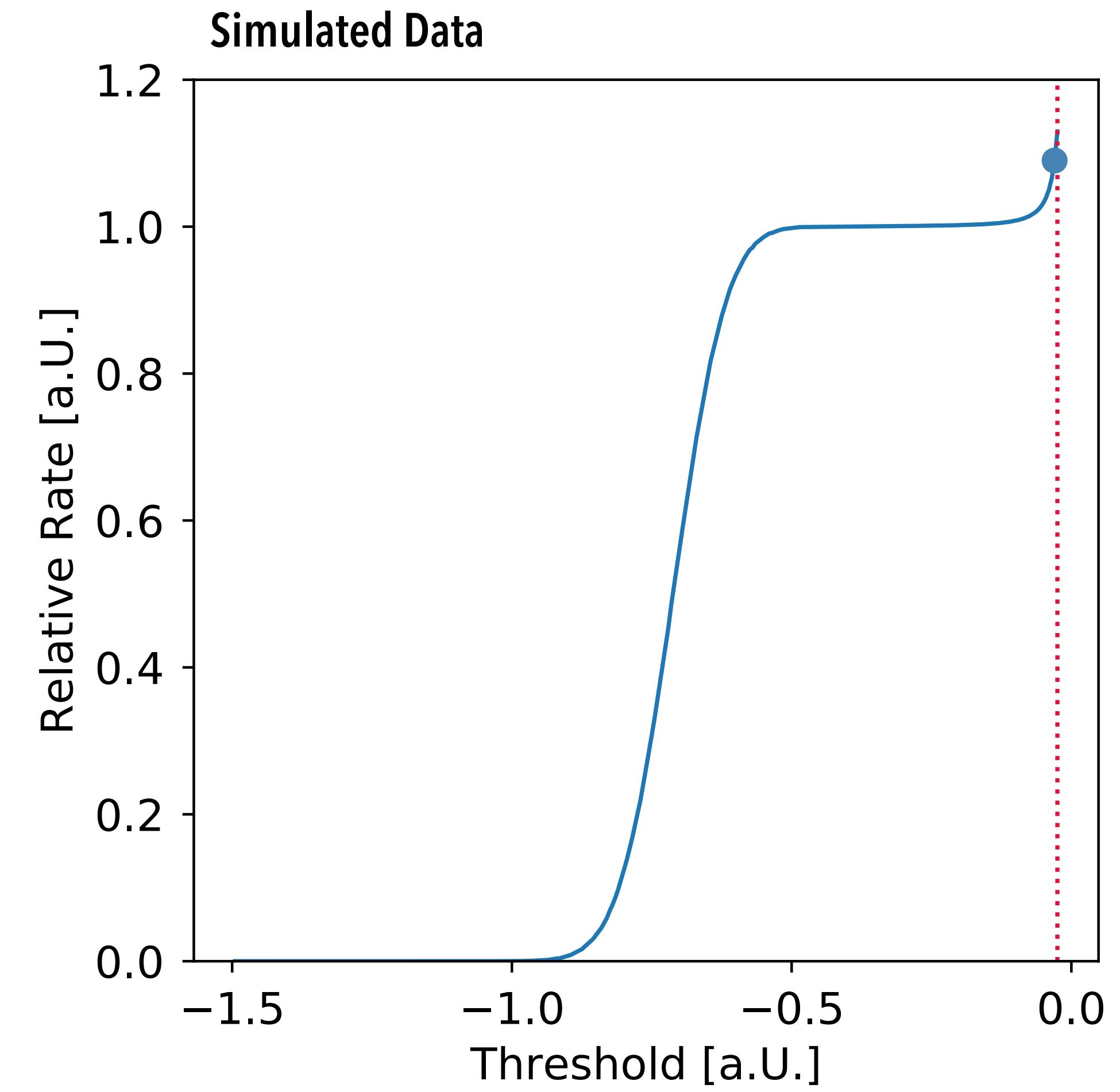
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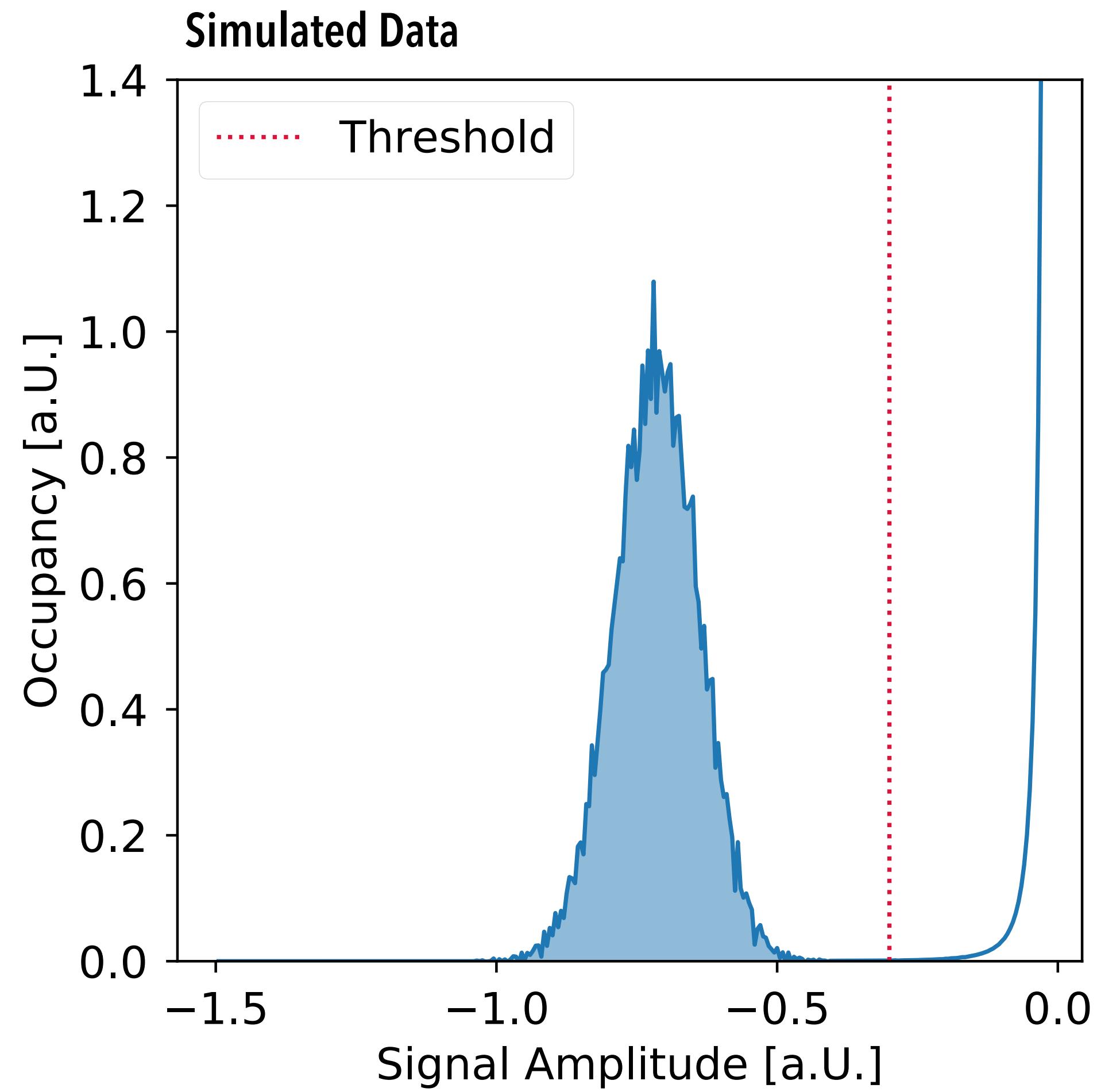
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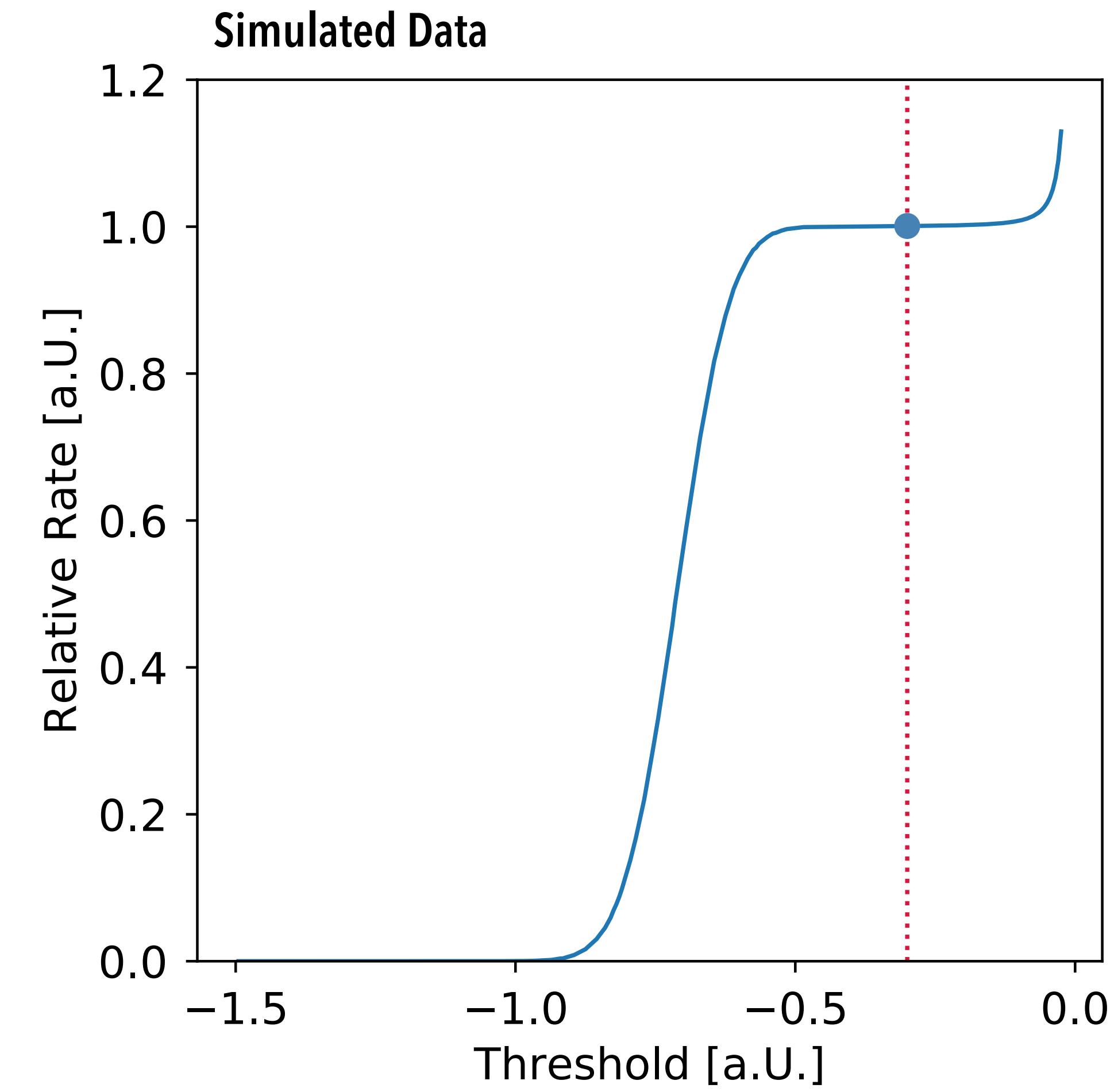
Integrate



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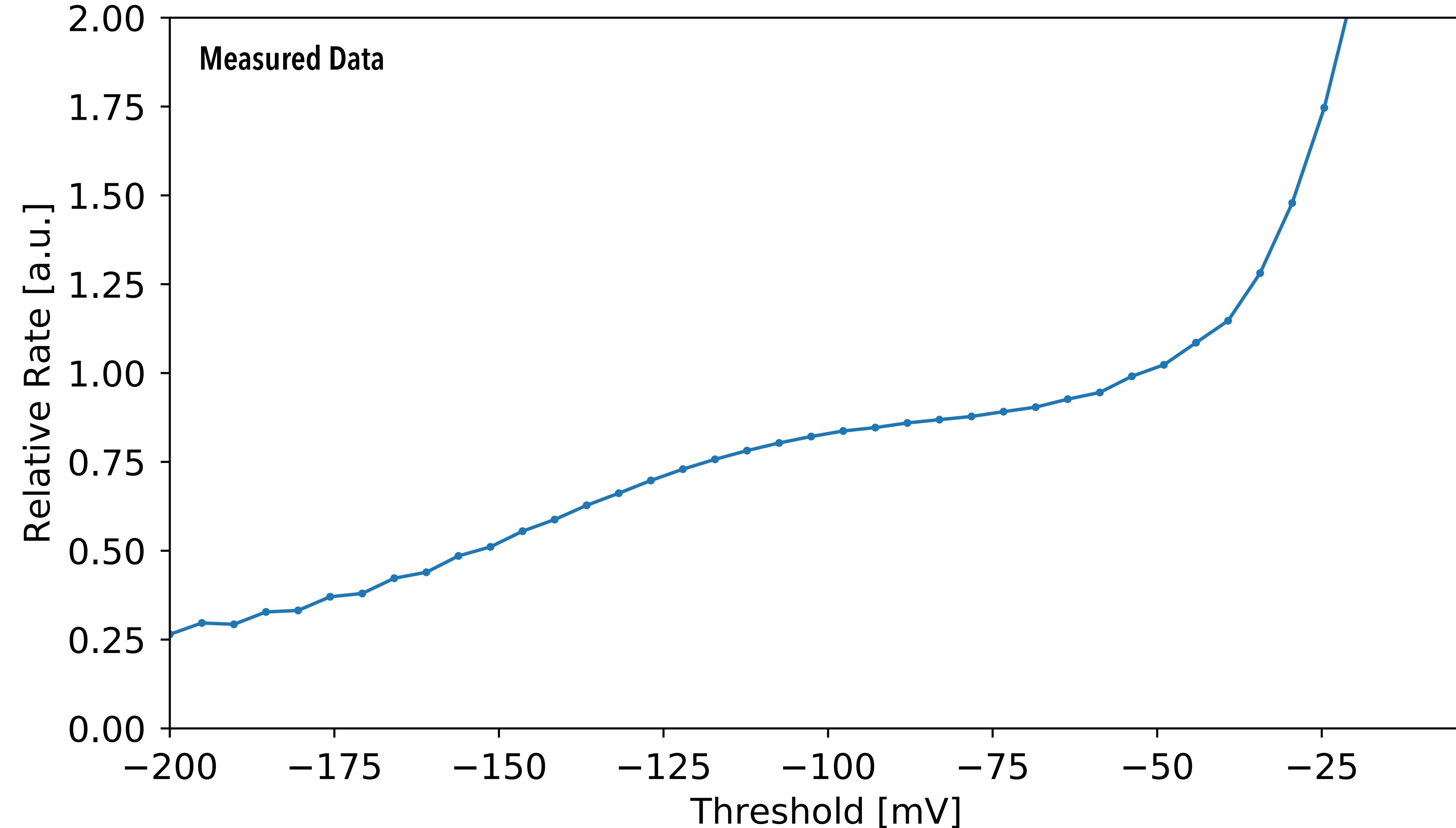


Integrate



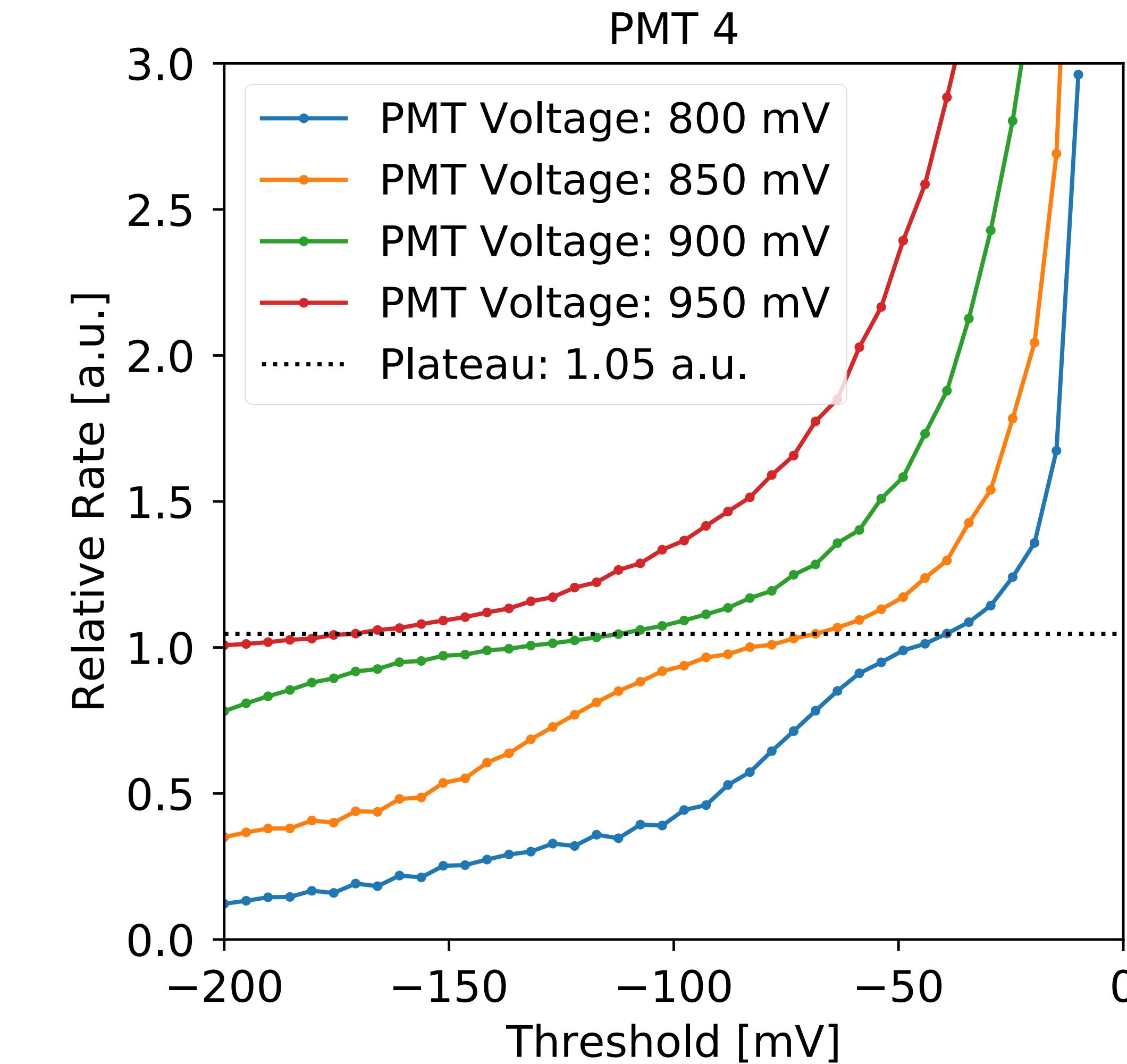
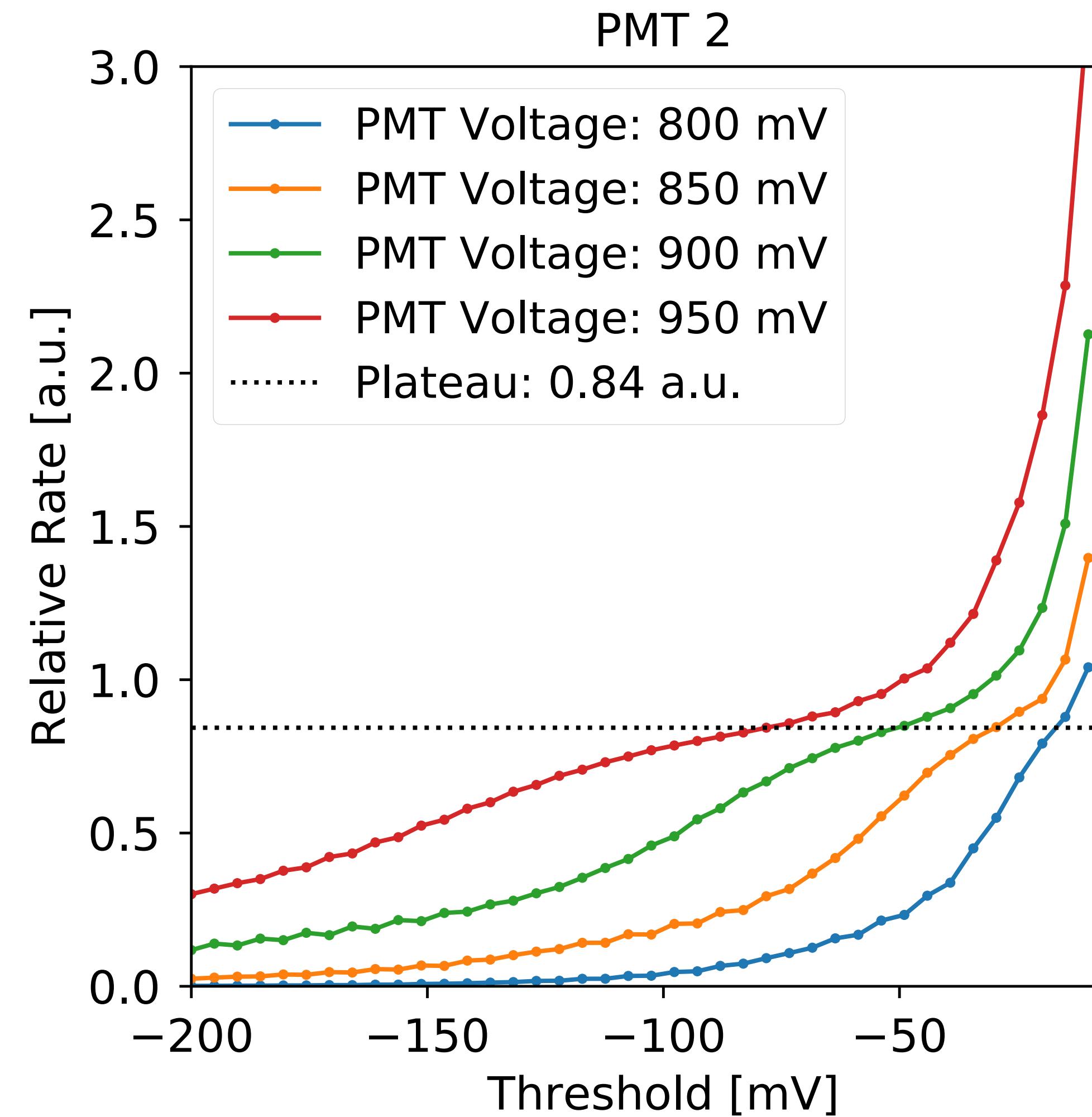
1

# Threshold characteristics - Reality

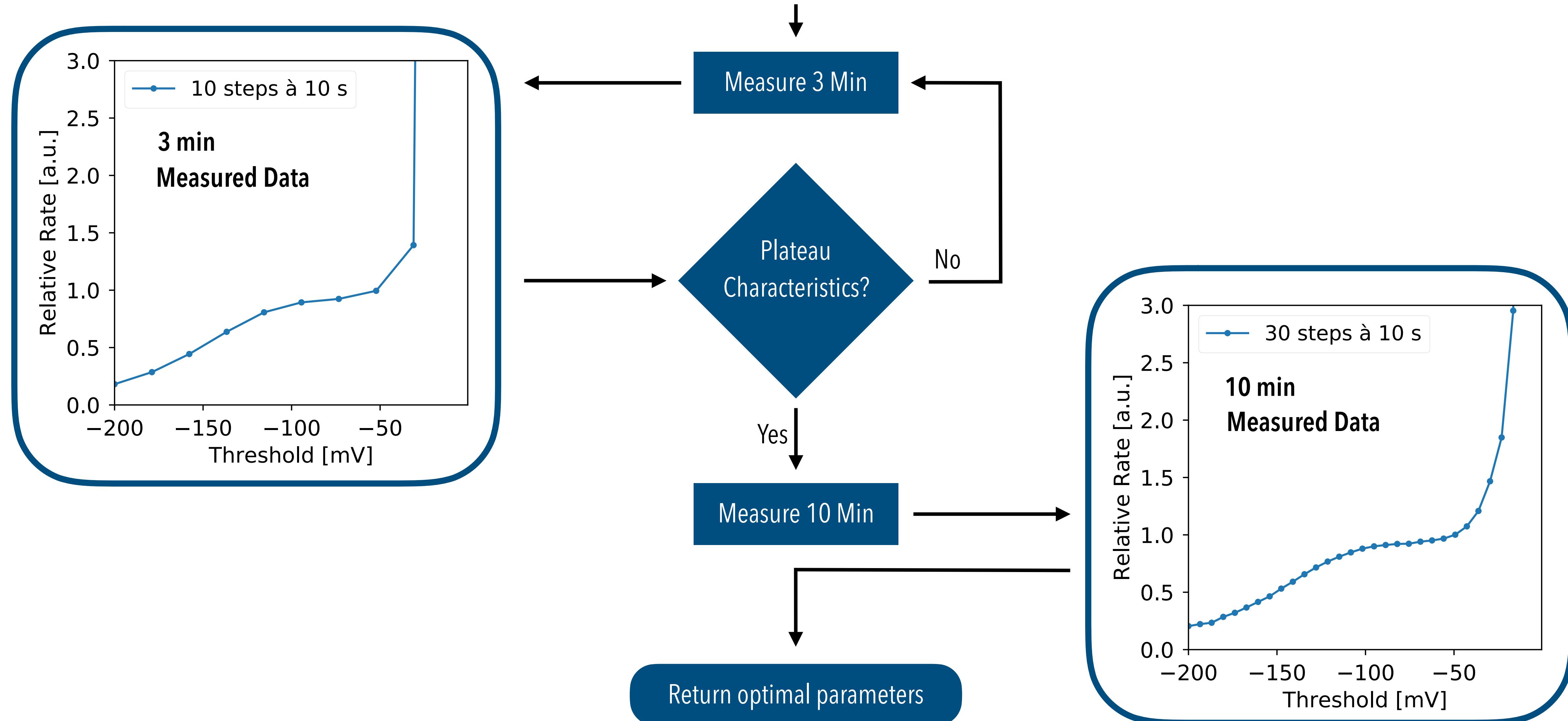


2

# Dependency on PMT voltage

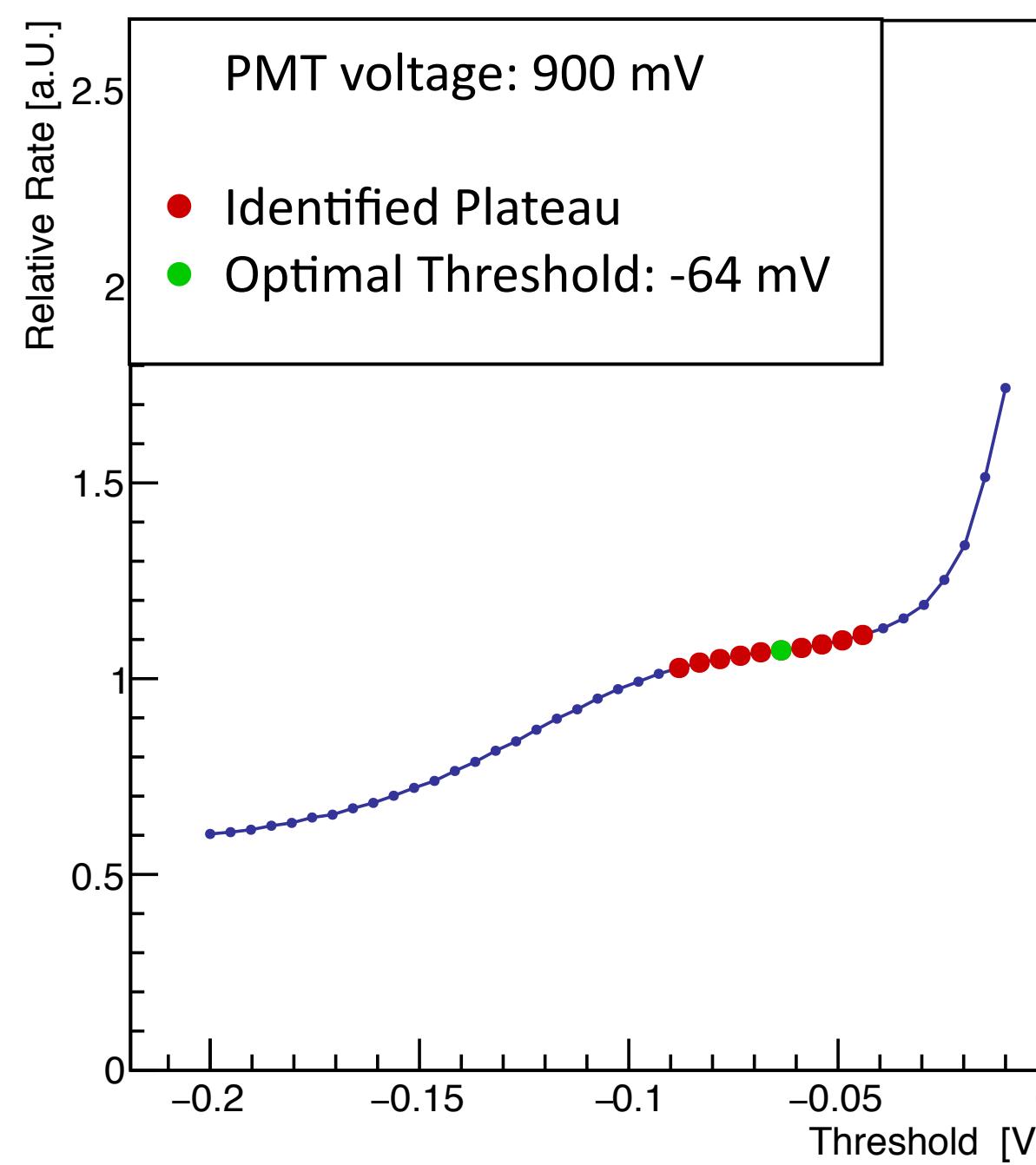


# Implementation - Flow Diagram

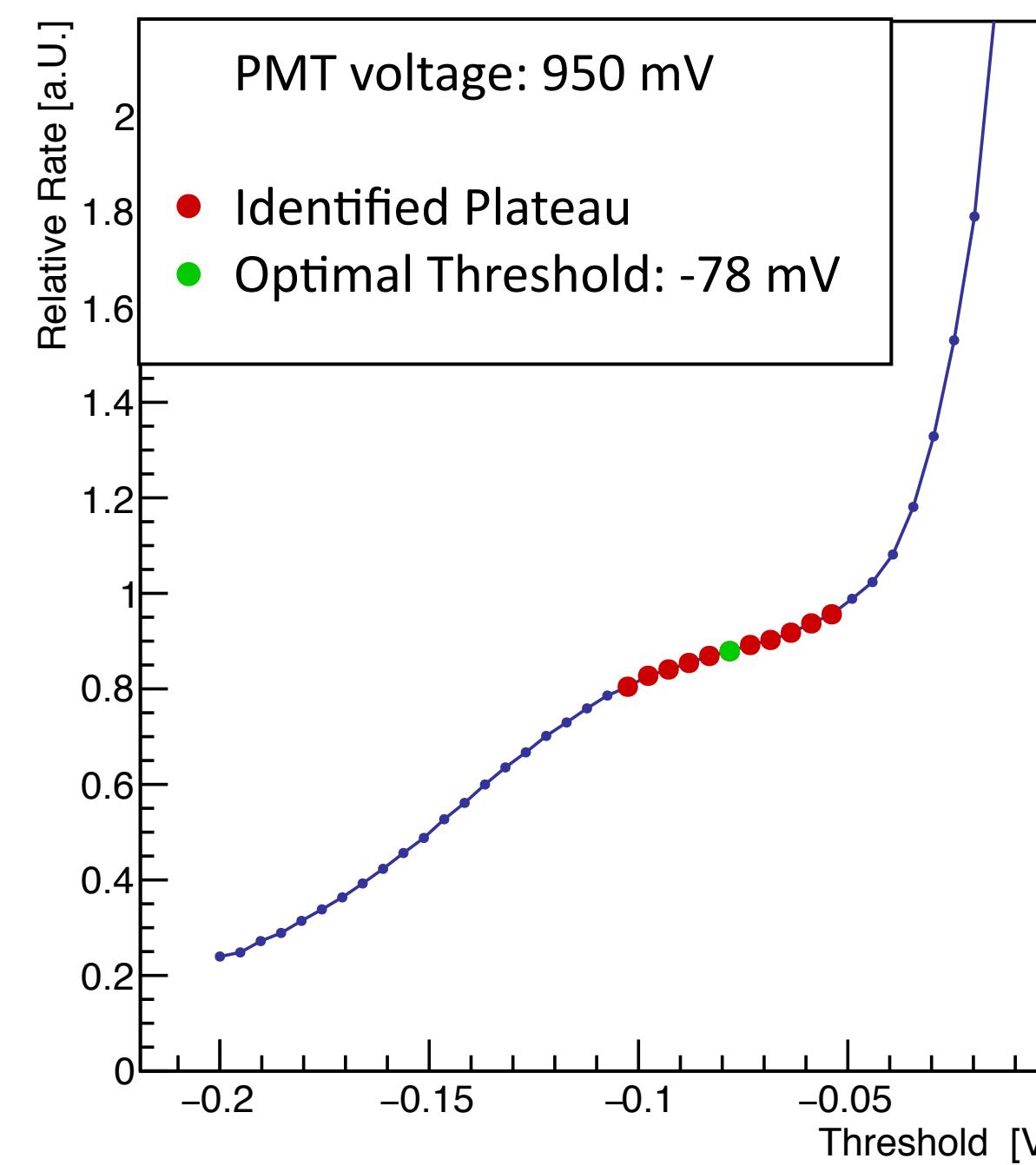


# Finding optimal values

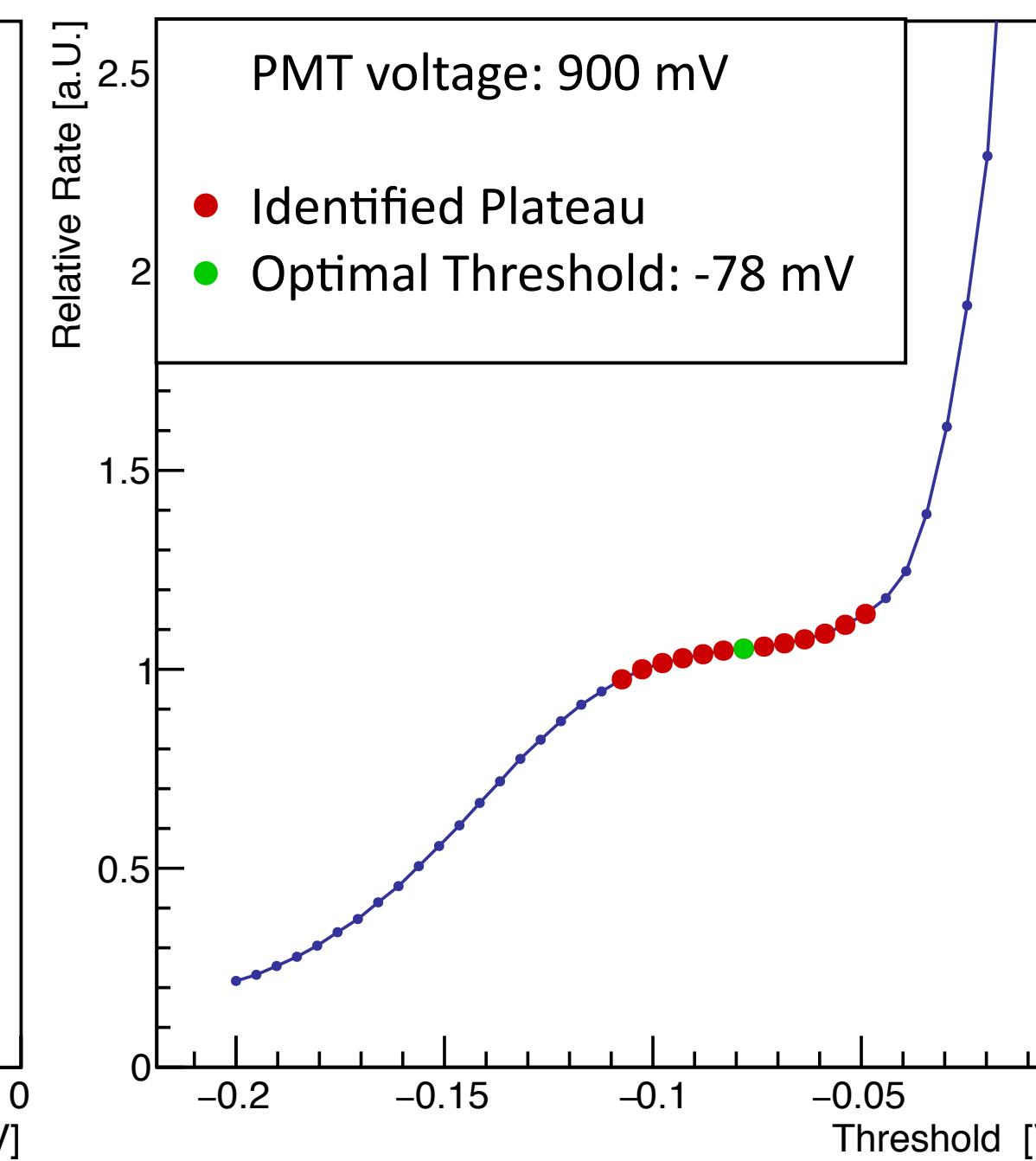
PMT 1



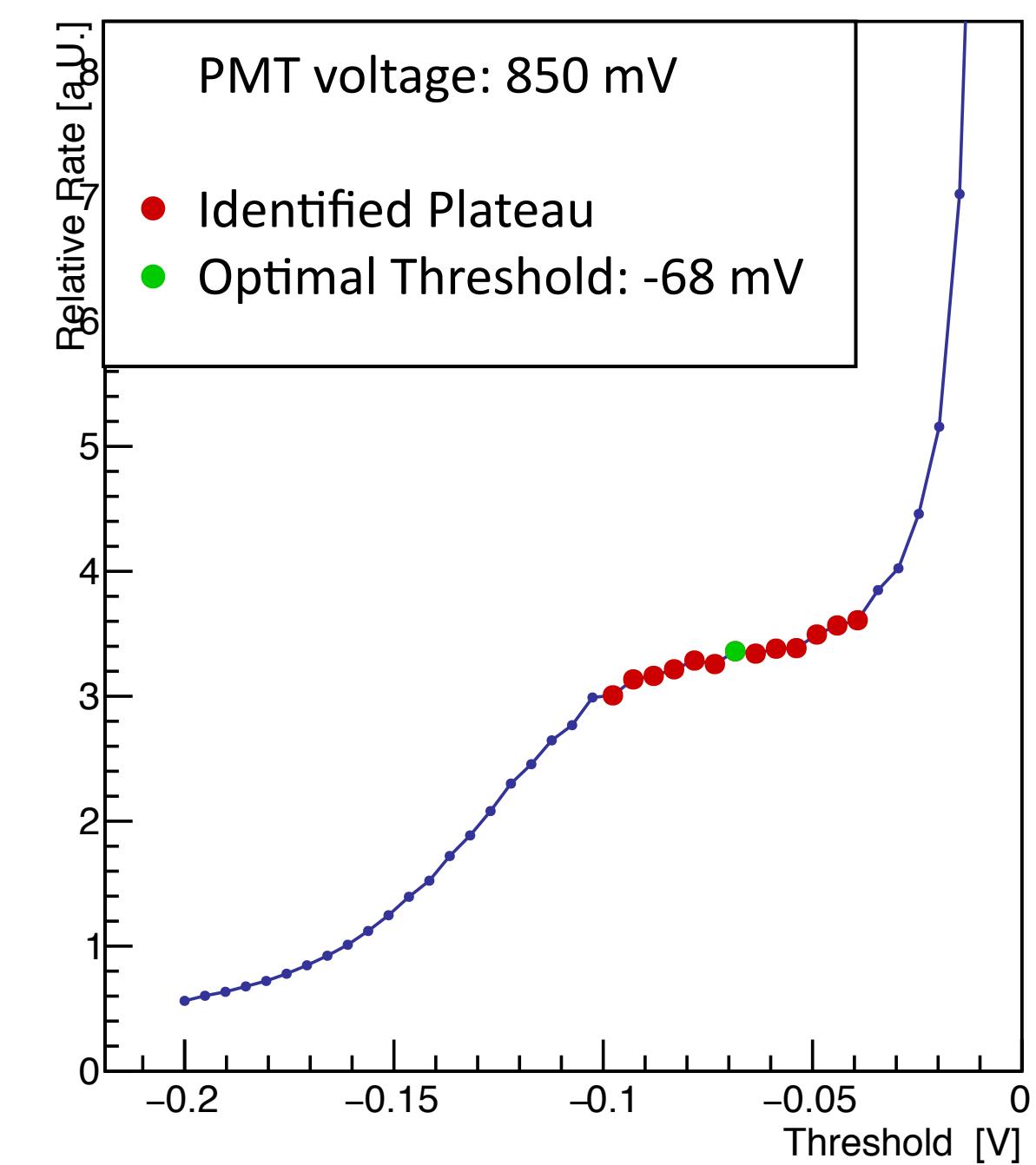
PMT 2



PMT 3

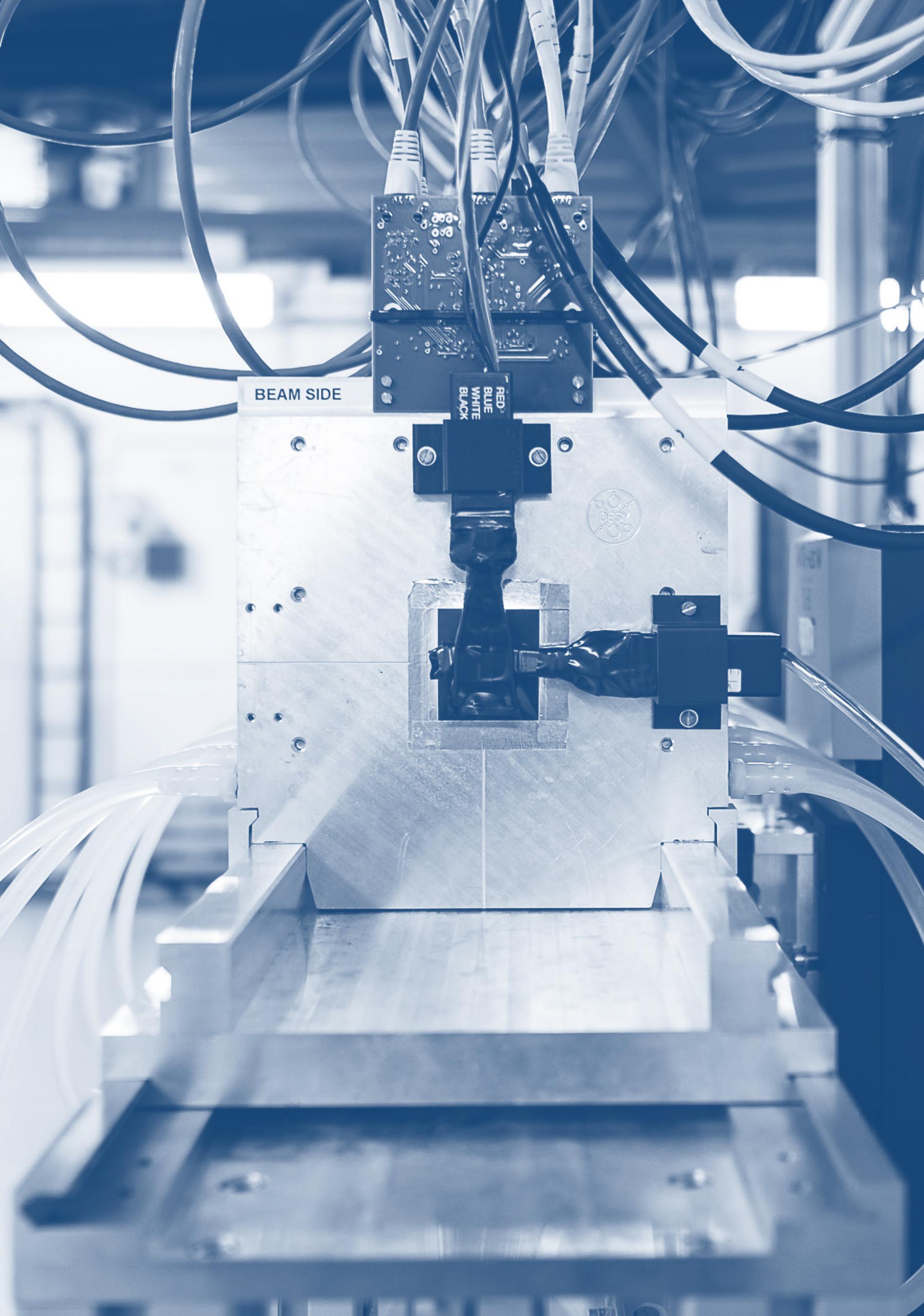


PMT 4



# Conclusions & Outlook

- Successful implementation of automated optimisation of the trigger system of the DESYII test beam facility
- Results already used for other experiments
- Applicable for any scintillator + PMT device
- XY-stage for mechanical overlap prepared



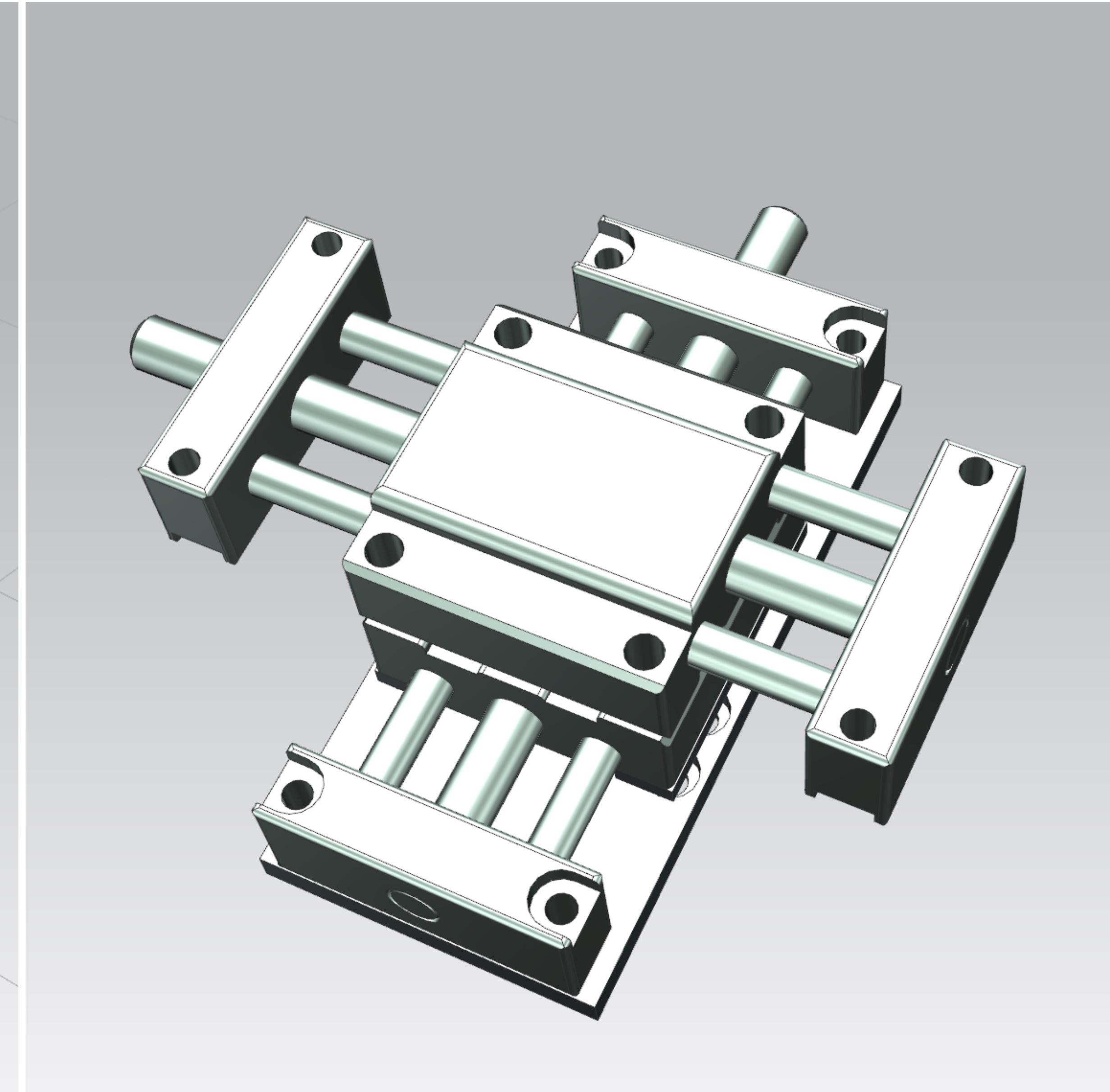
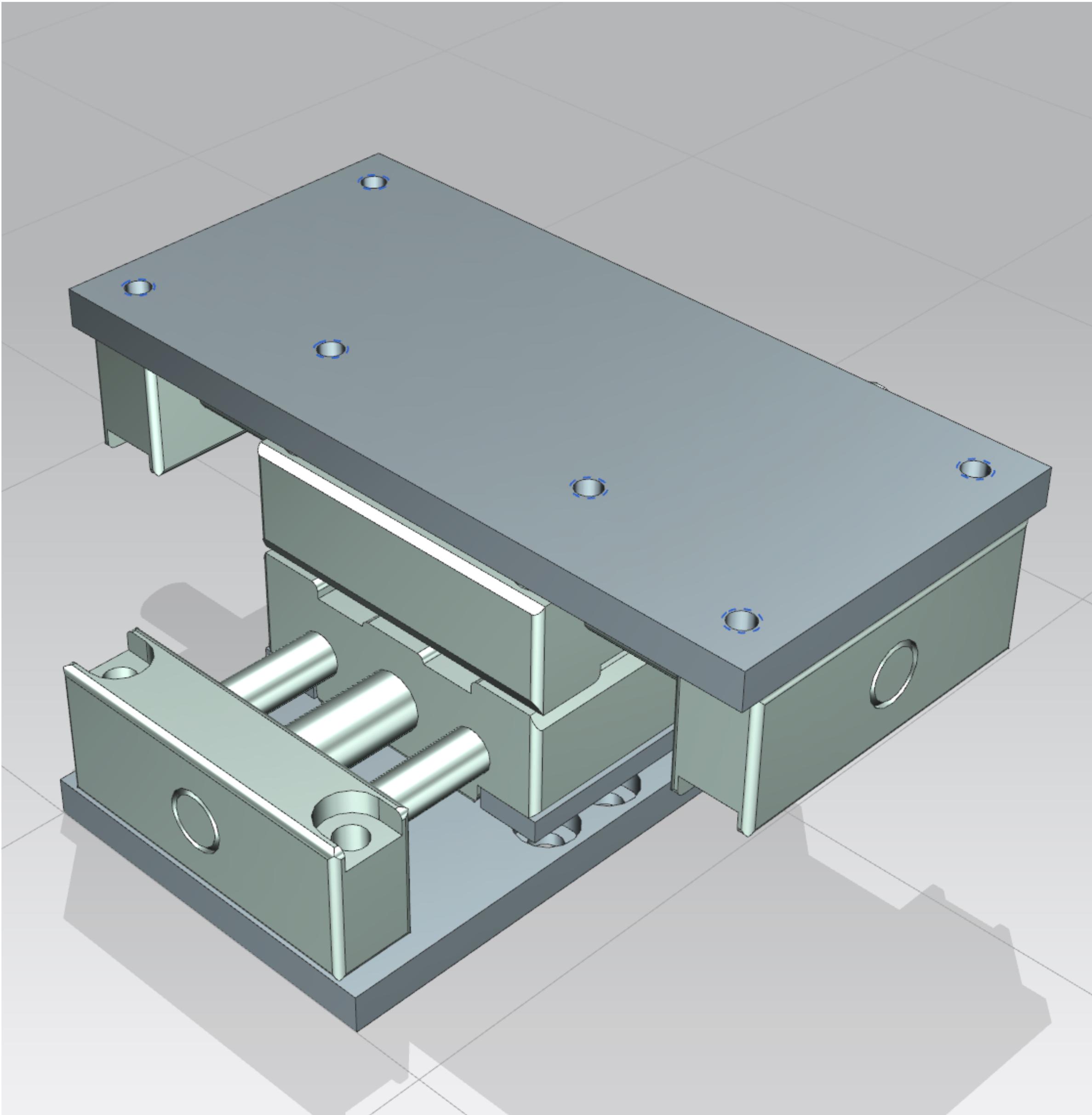
# Backup

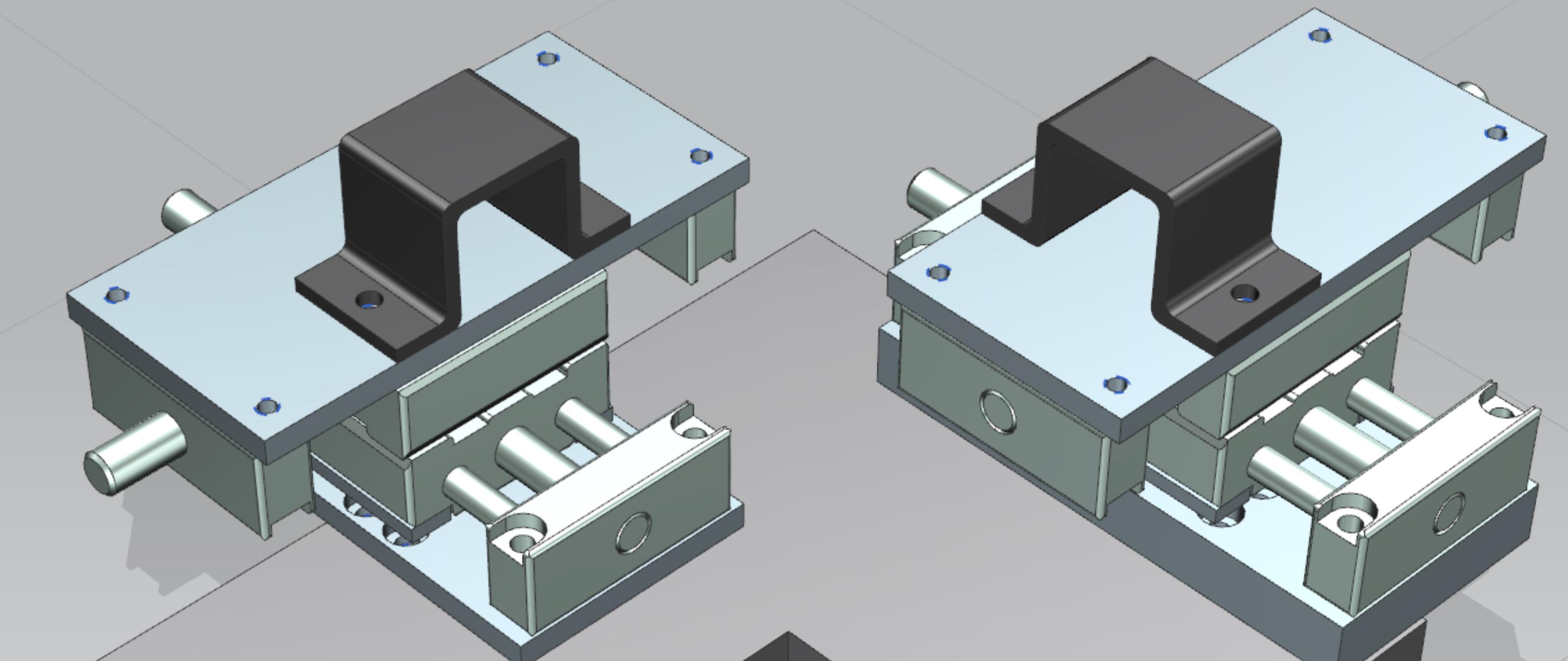
BEAM SIDE

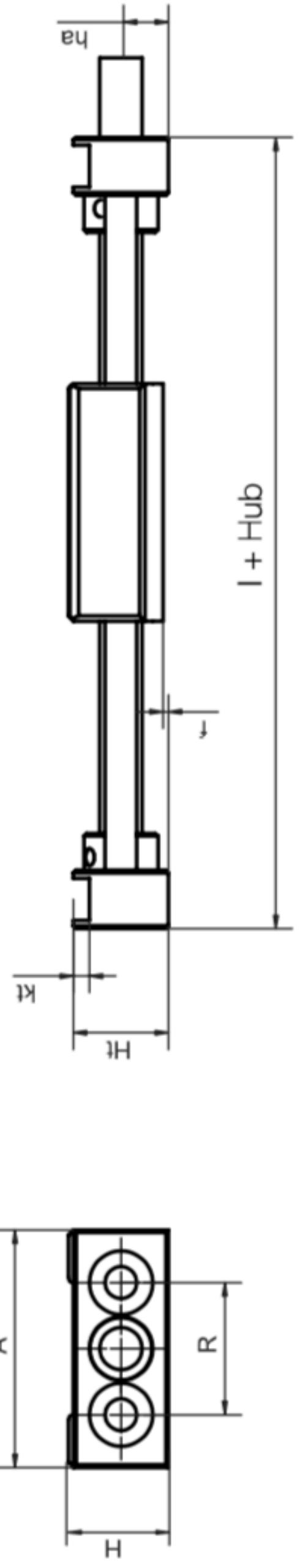
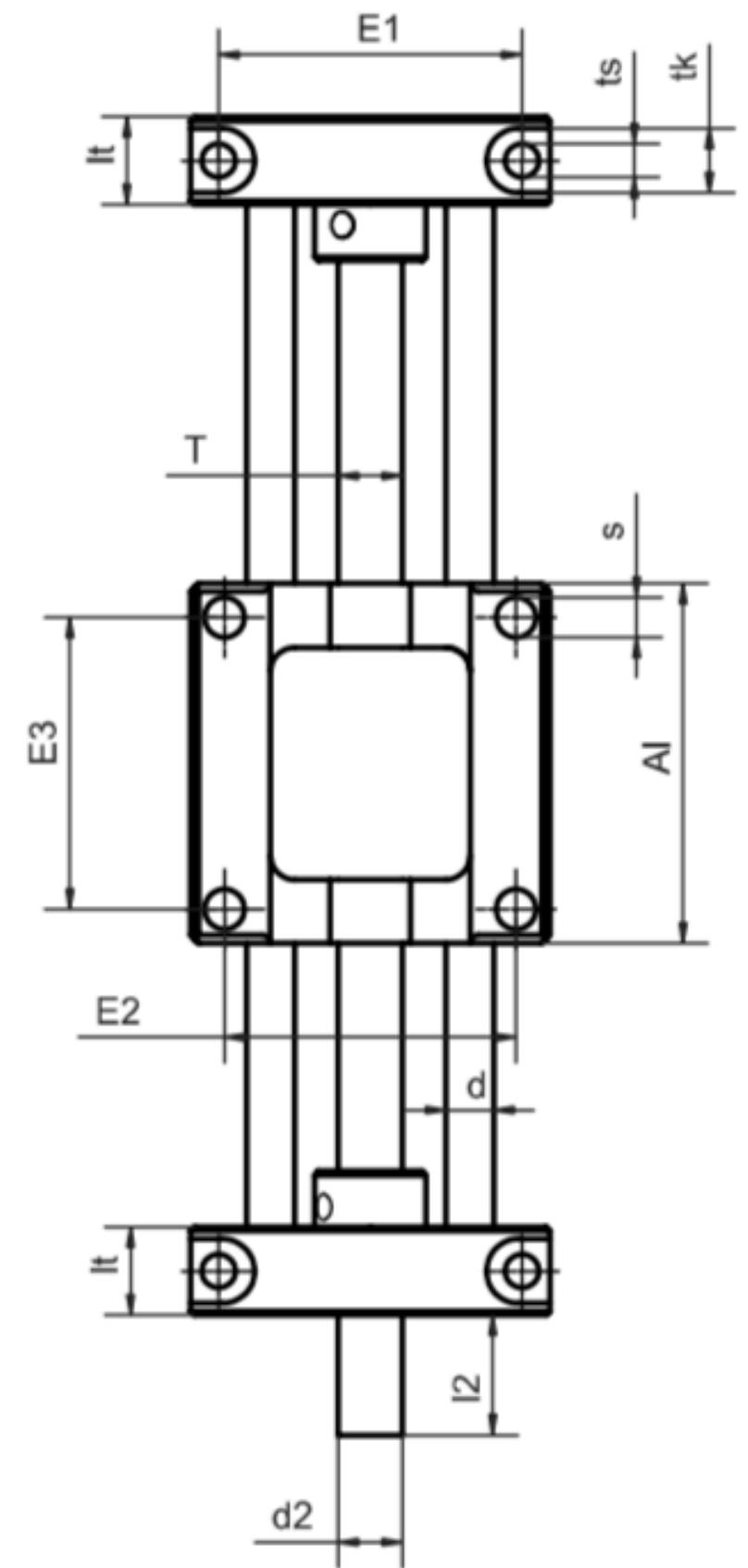
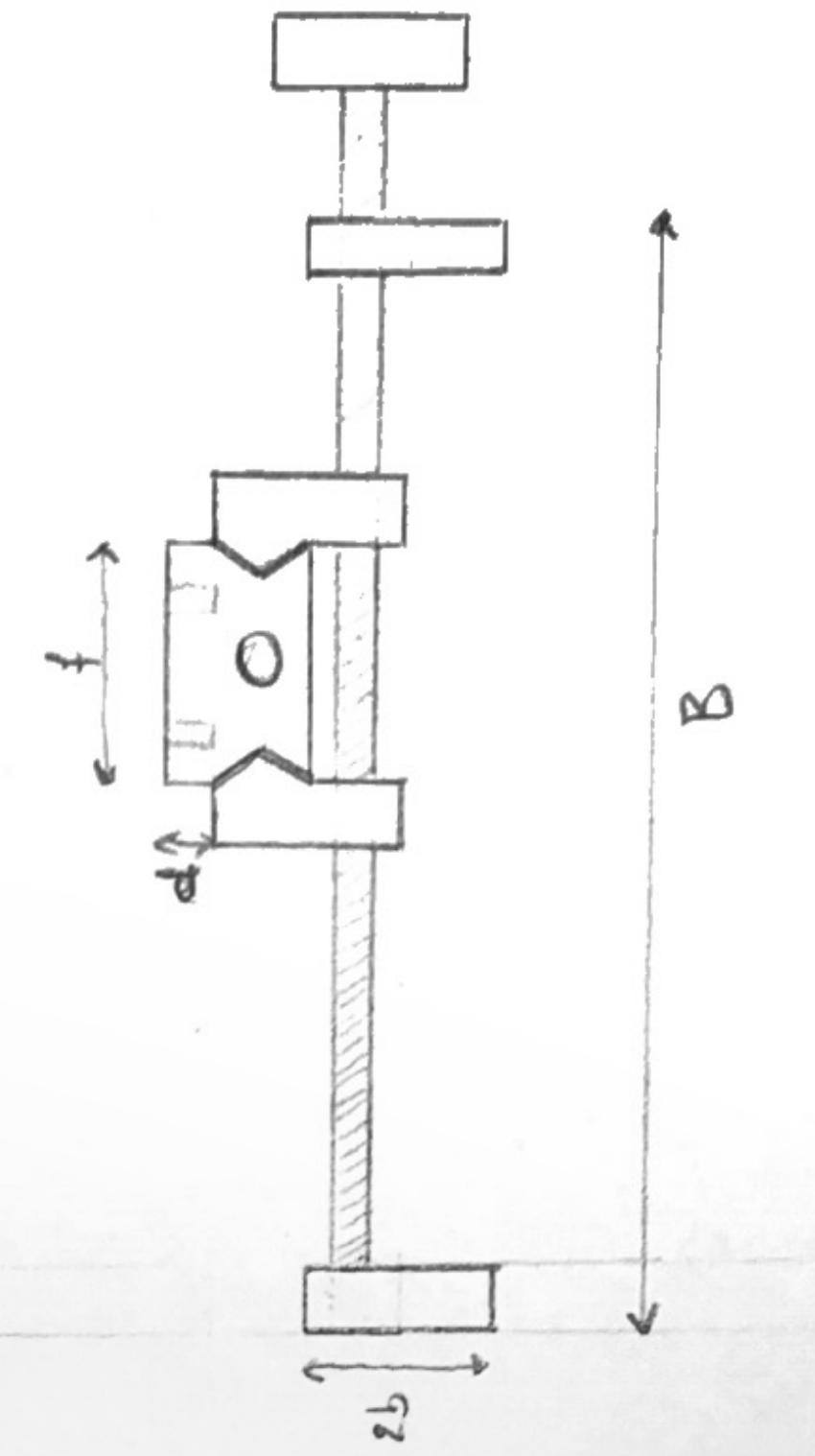
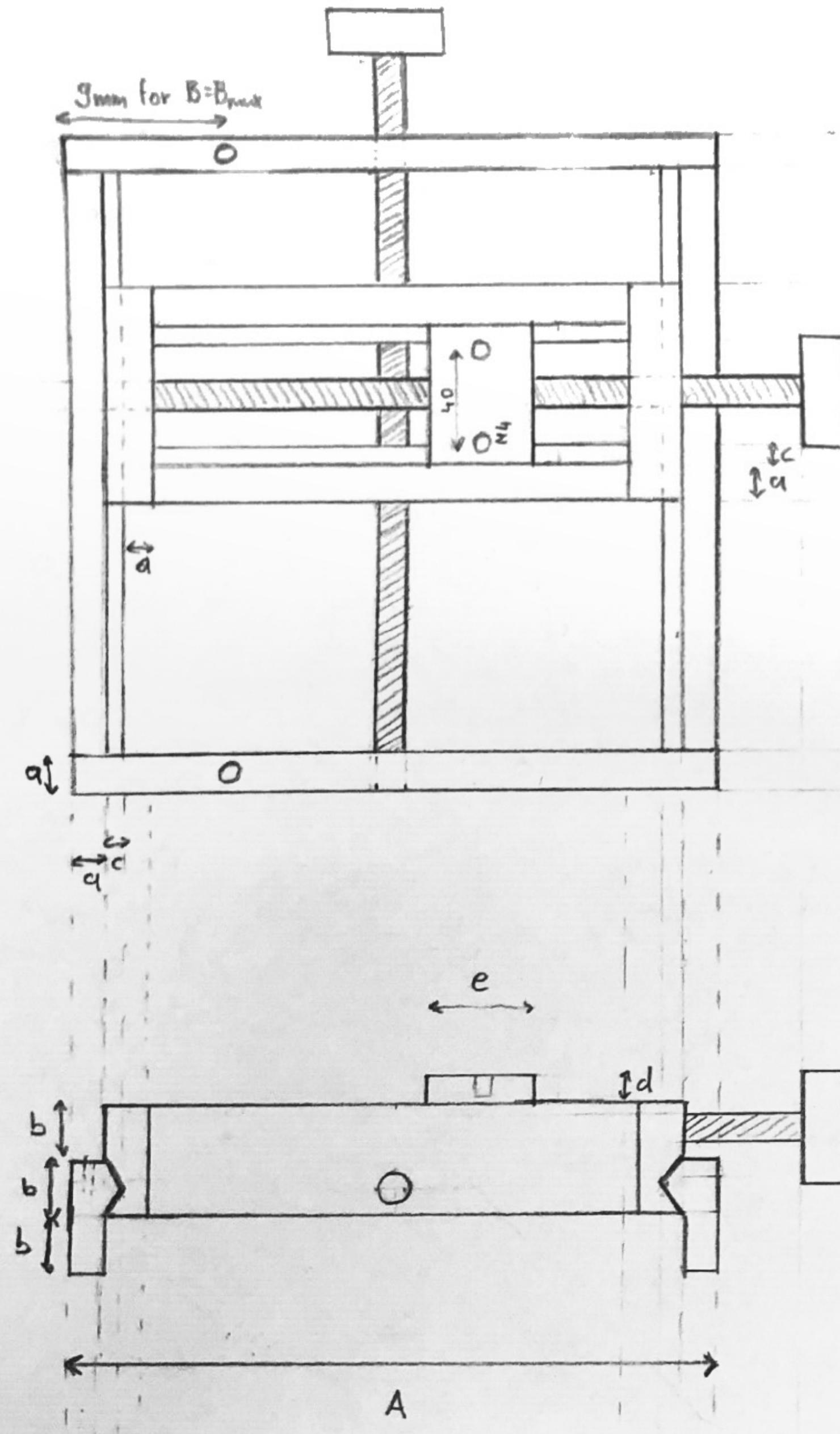
RED  
BLUE  
WHITE  
BLACK

BEAM SIDE

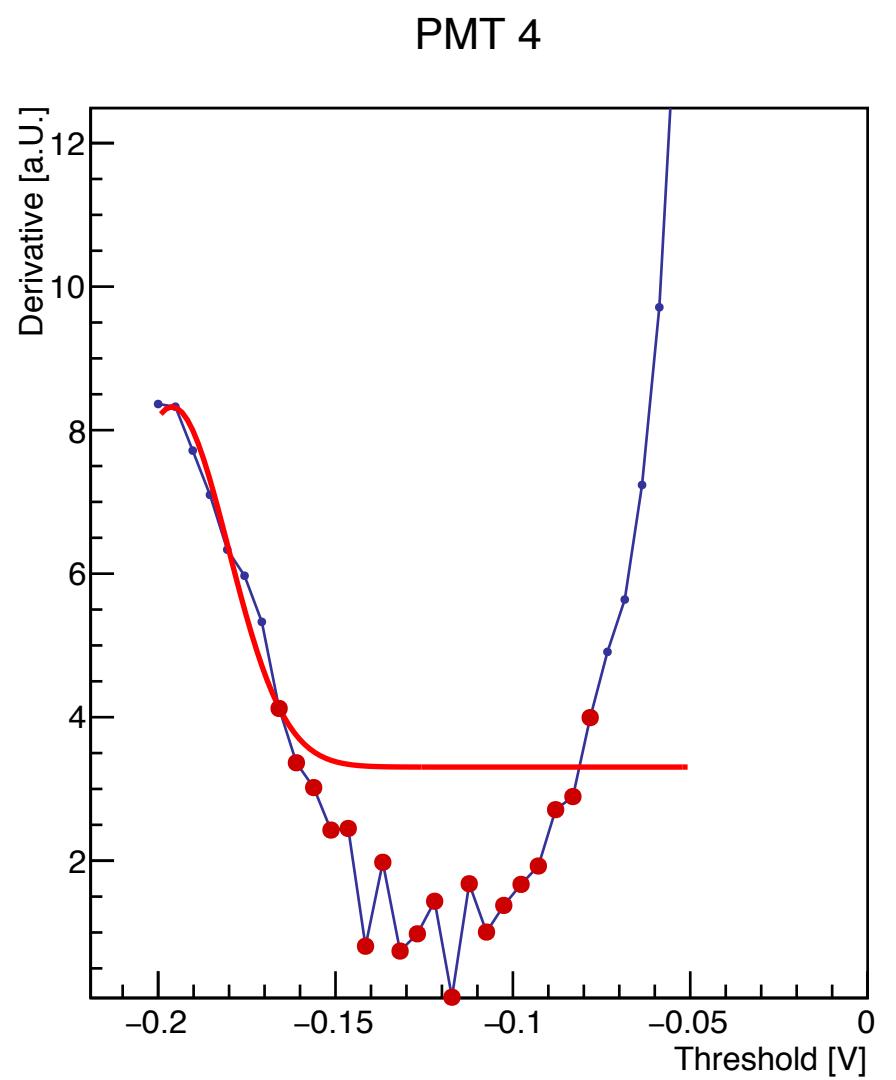
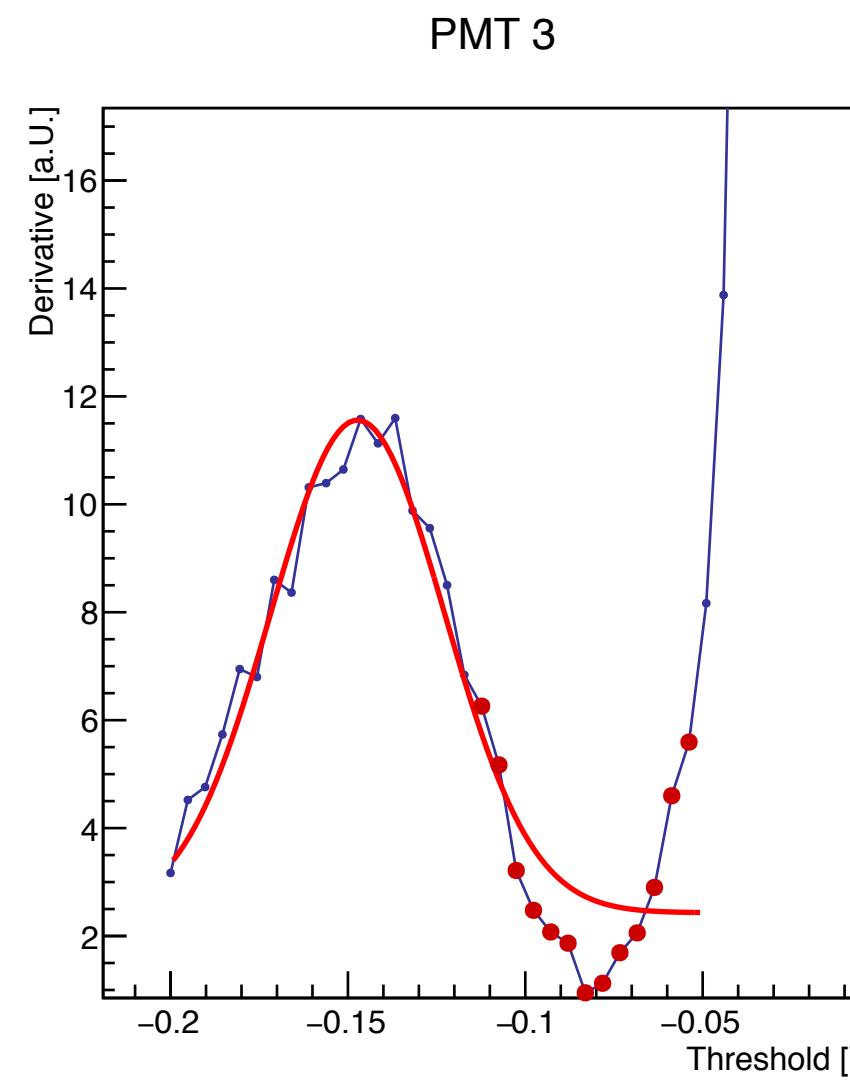
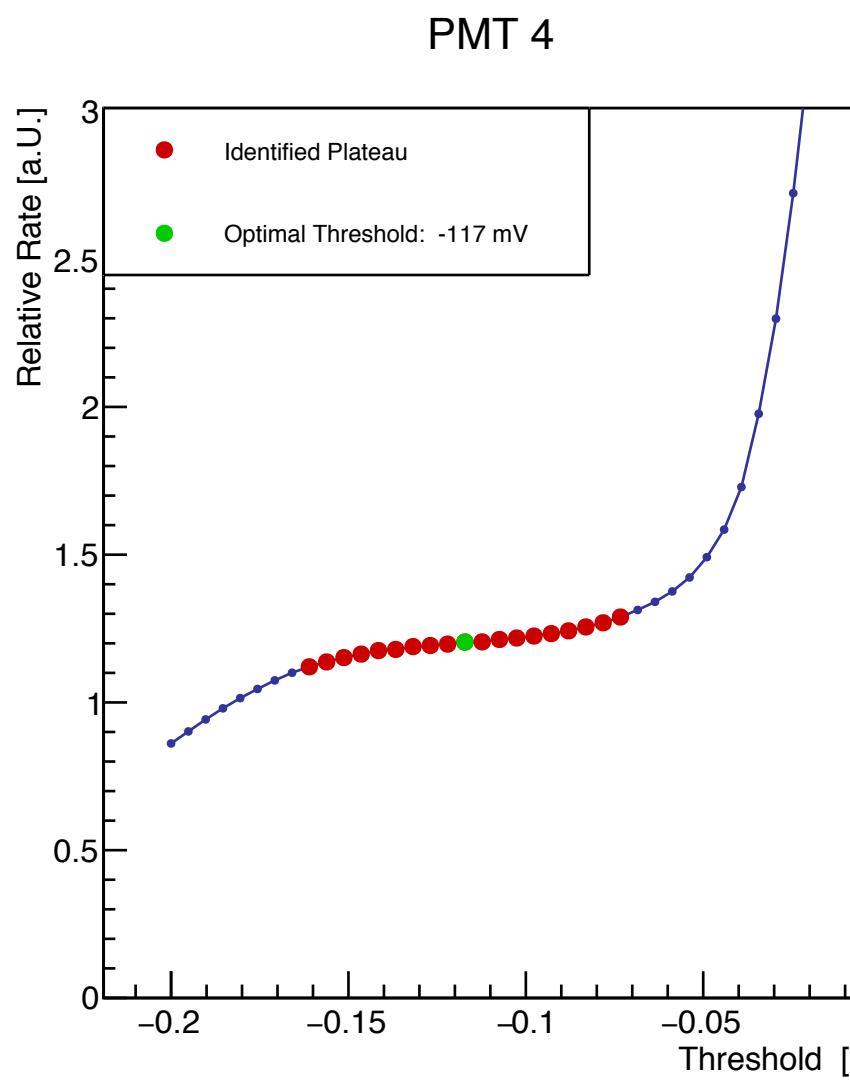
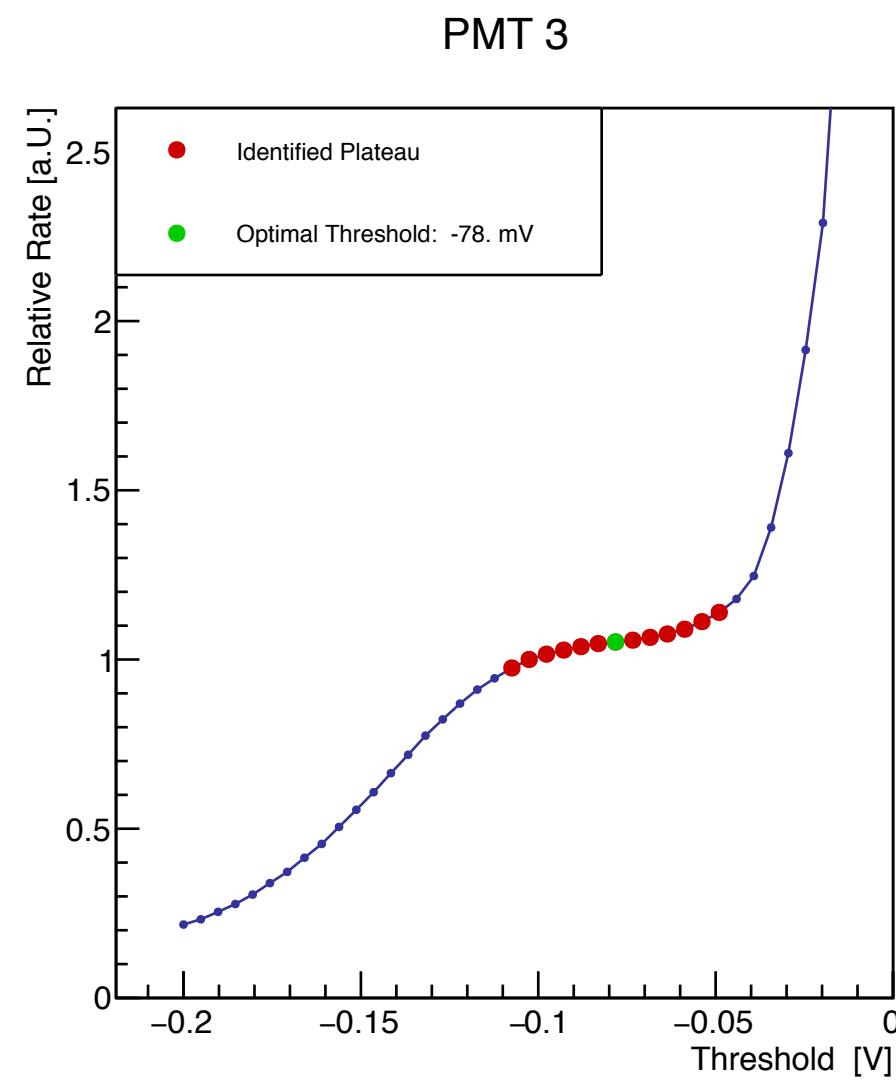
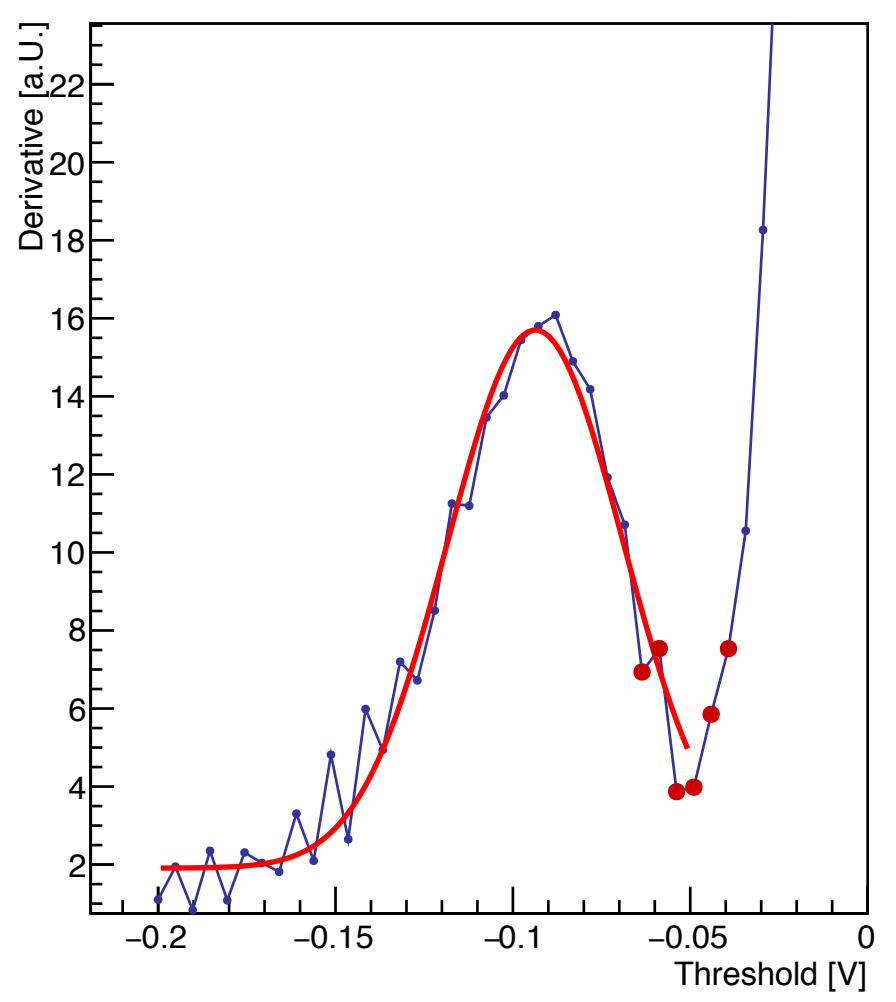
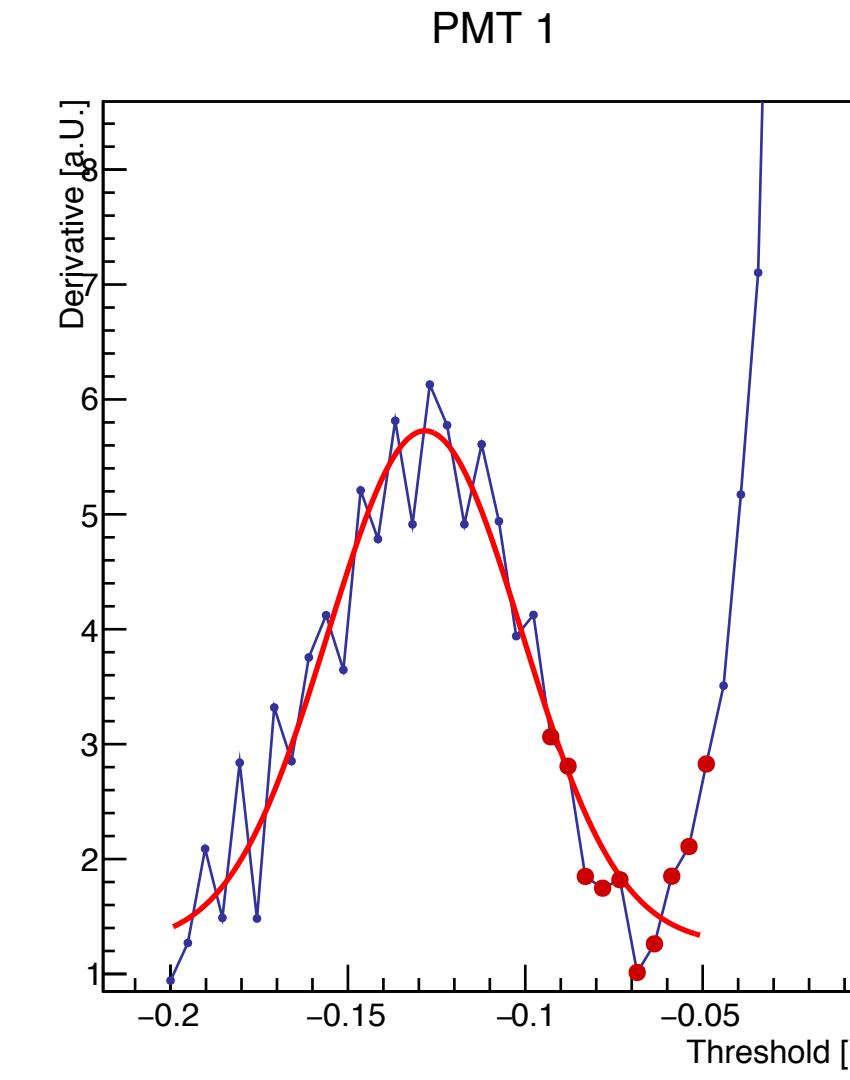
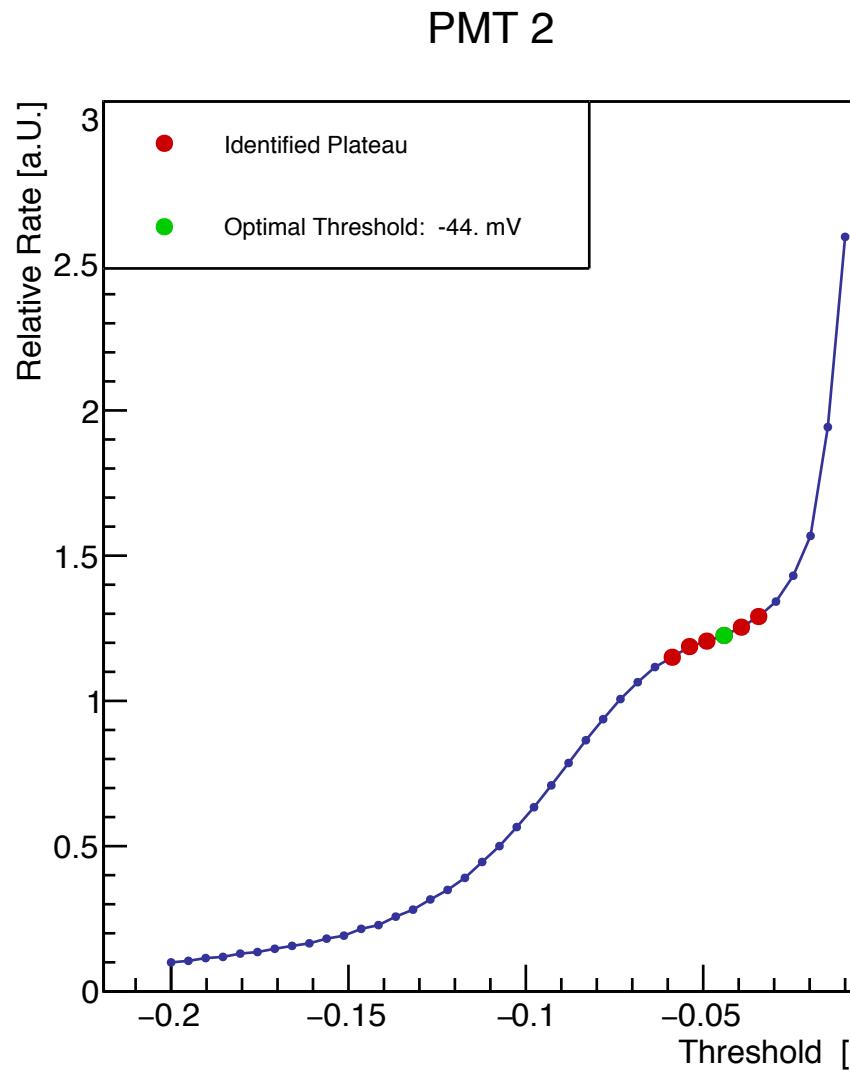
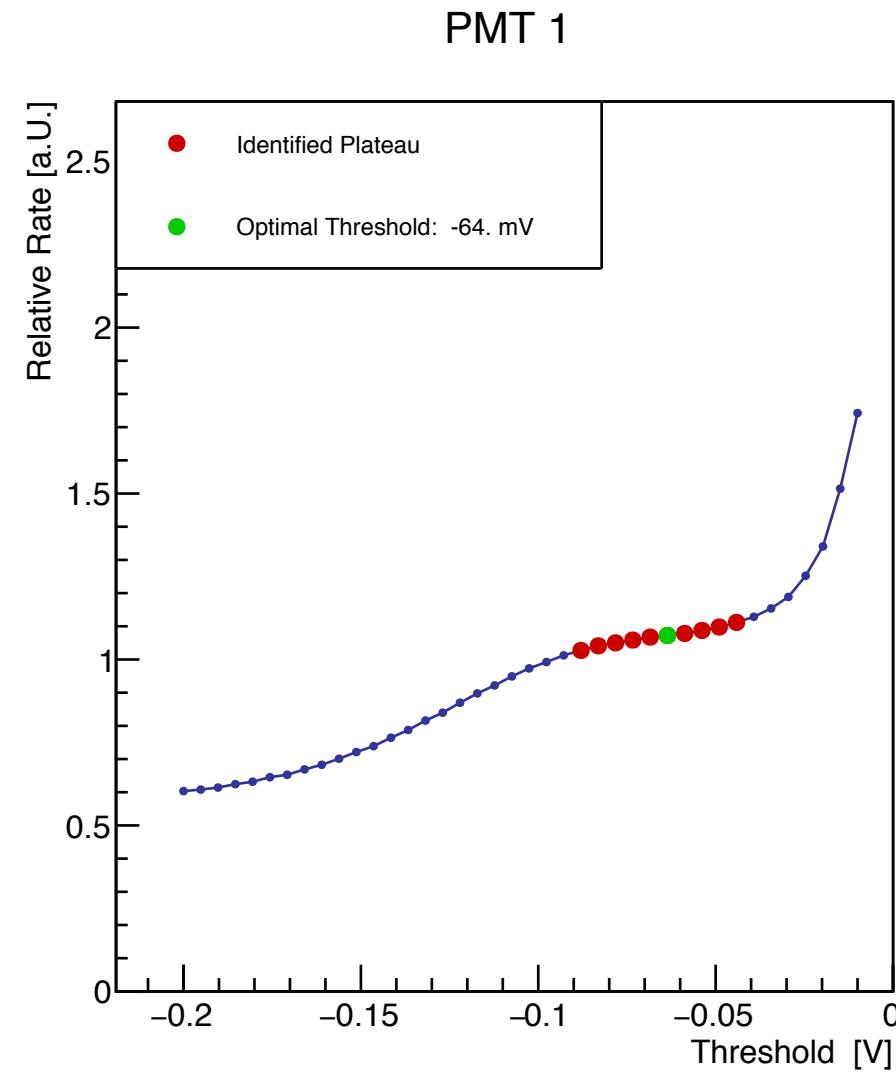




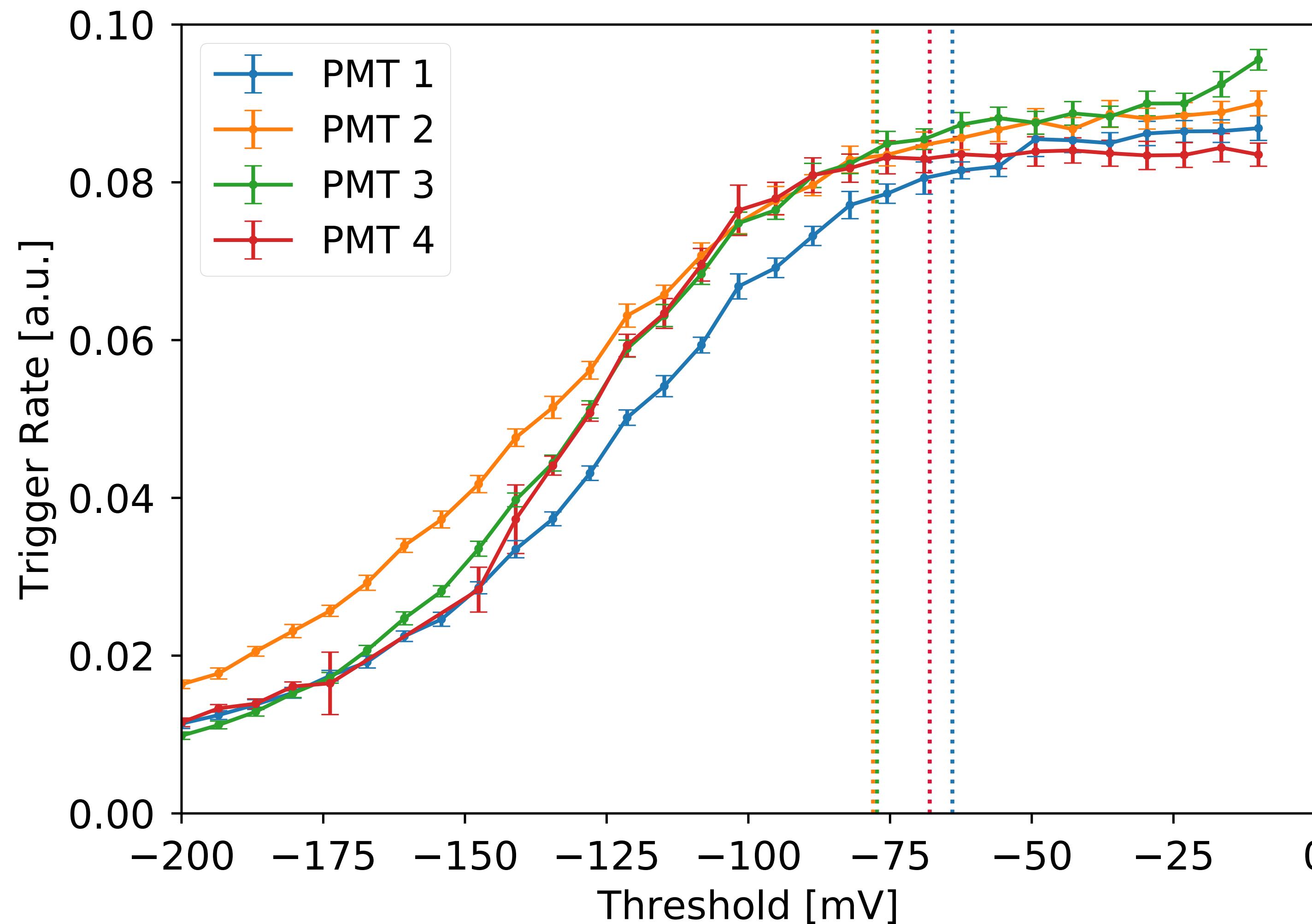




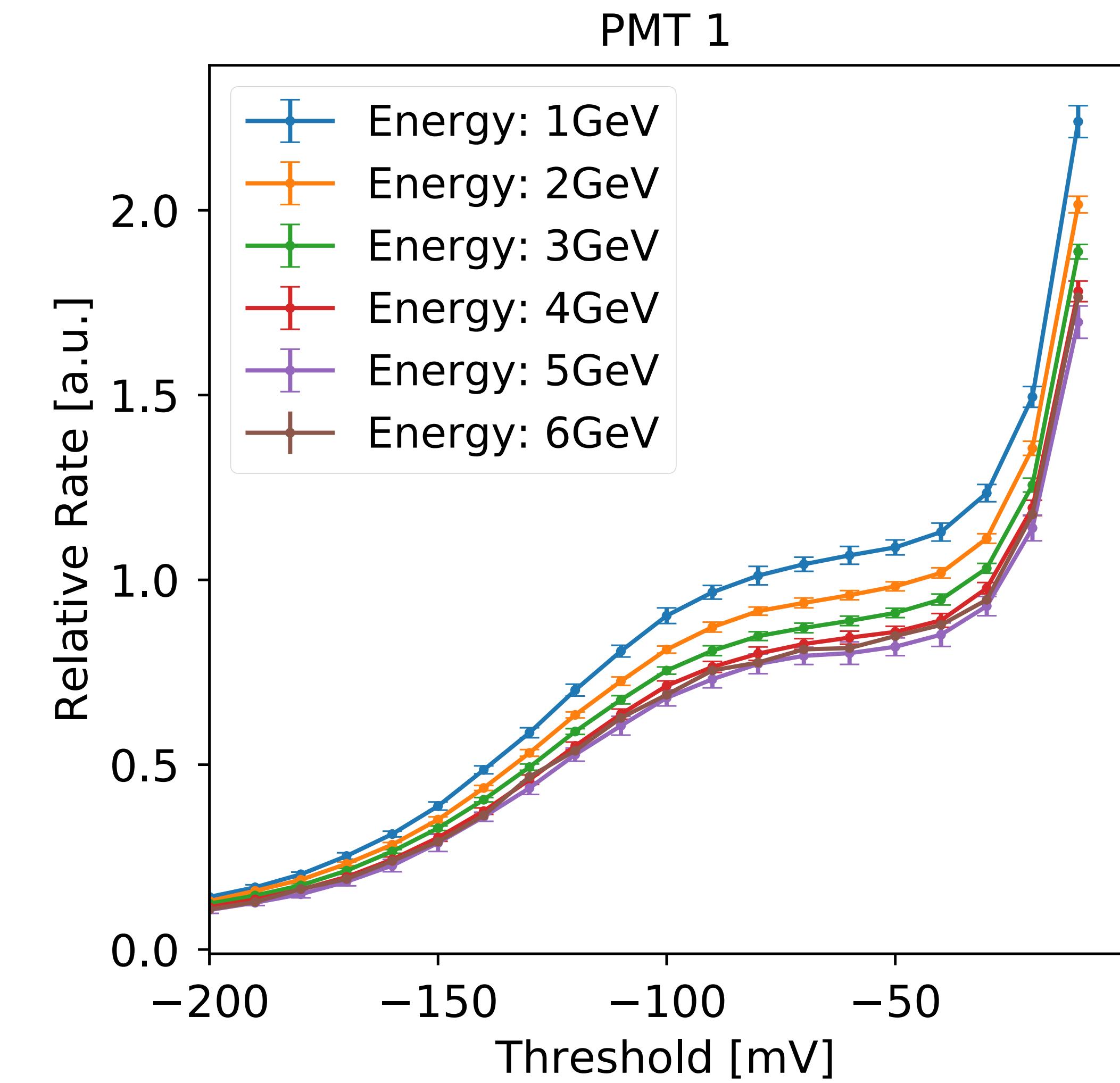
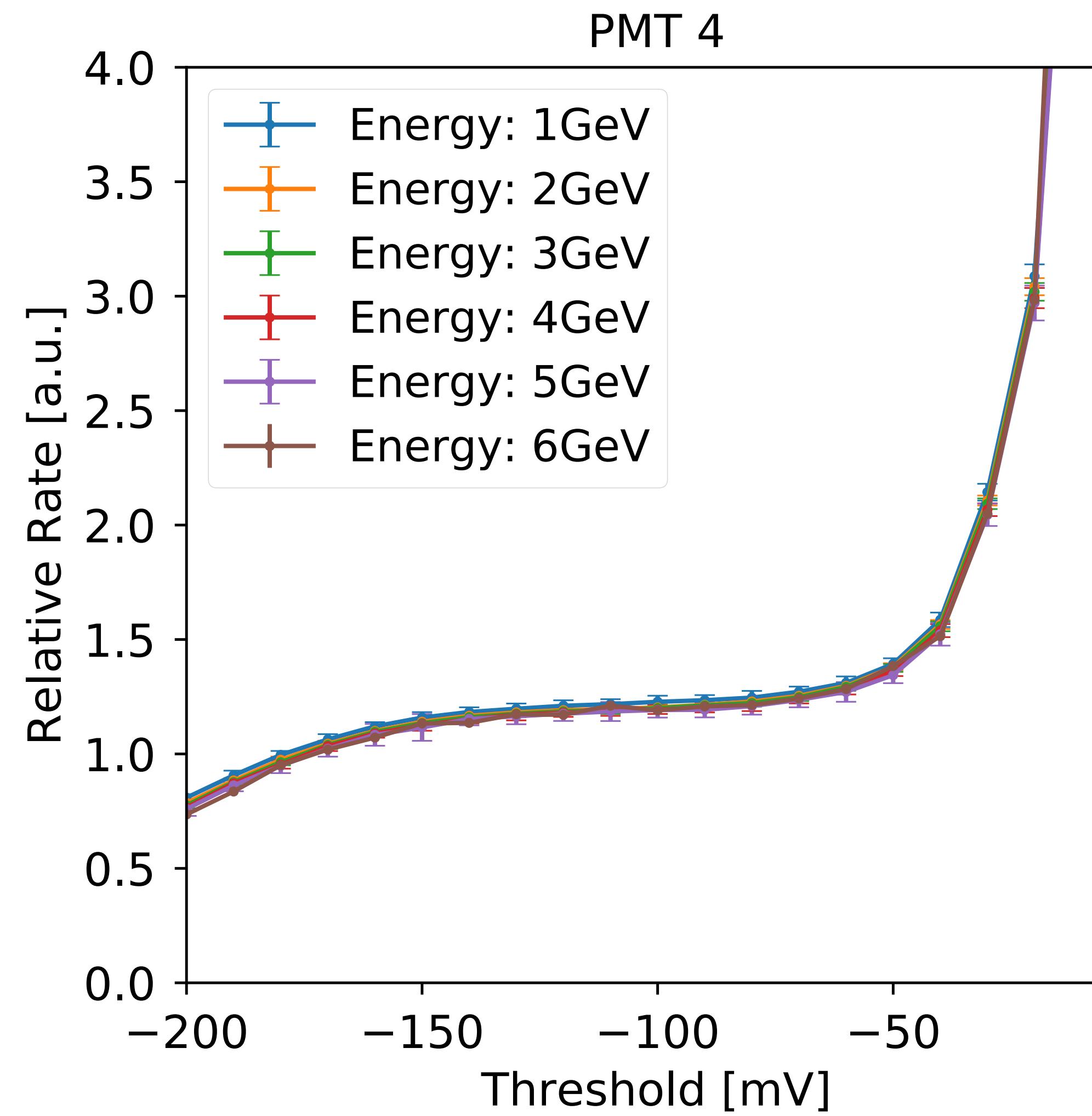
# How the Algorithm works



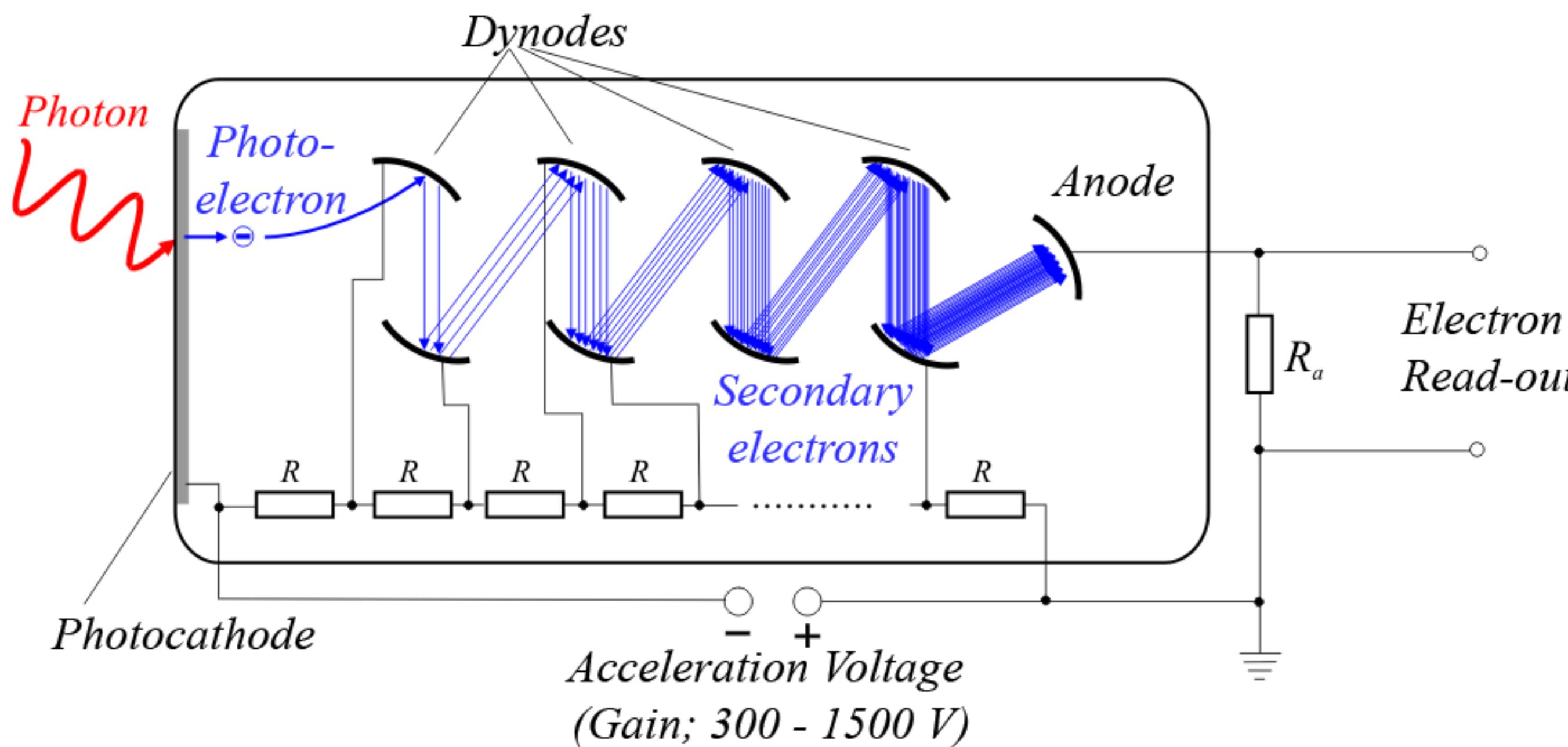
# Trigger Rate



# Energy dependency



# How does a PMT work?



- Photocathode + amplification system
- Single Photon
  - Single Photoelectron
  - Acceleration to first dynode
  - Multiple electrons
  - Avalanche effect
- Amplification of  $10^5 - 10^7$