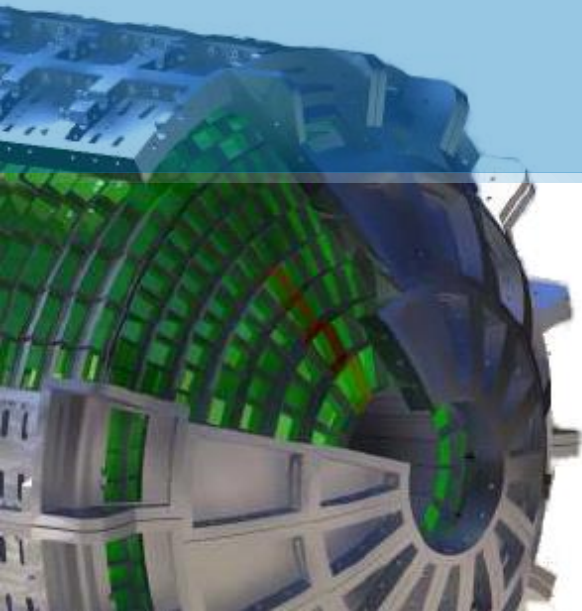# CALIFA features from the GSI S438b experiment

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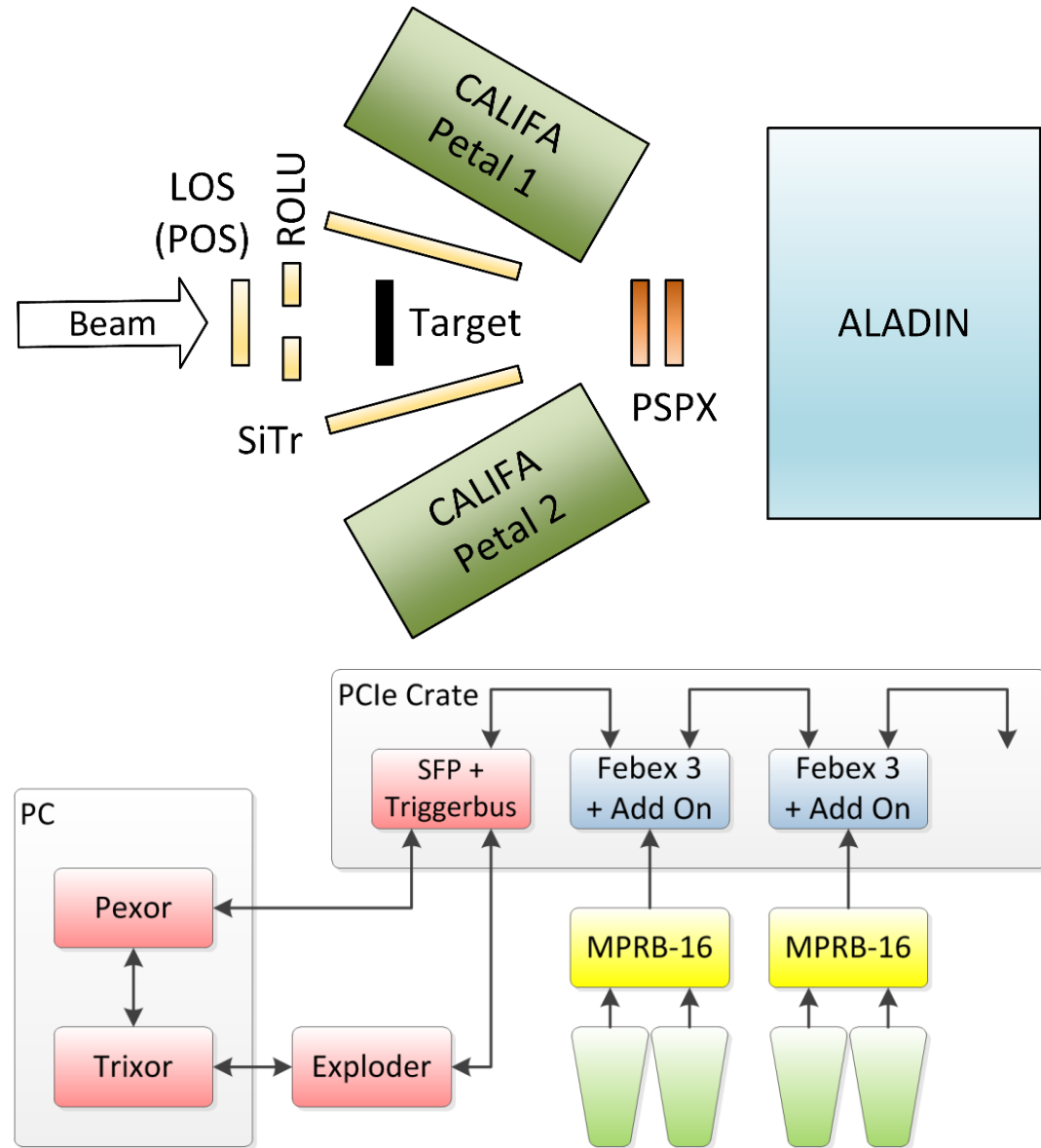Reminder: Setup
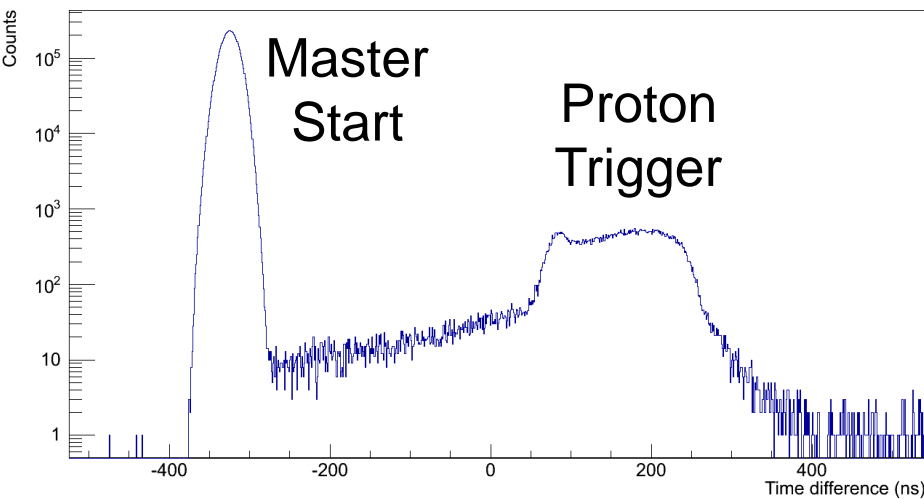
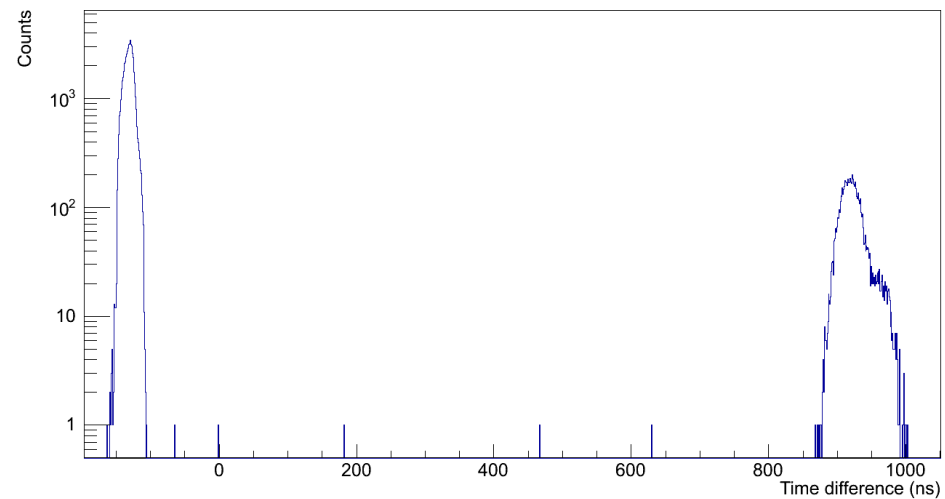Trial on Physics: p,2p

Outlook

Setup A short reminder

- Beam: ^{48}Ca, 550 AMeV
- Independent, timestamped DAQ systems

- FEBEX readout
- Firmware features:
  - Proton trigger
  - Walk correction
  - QPID
- Exploder:
  - Trigger source selectable via web interface
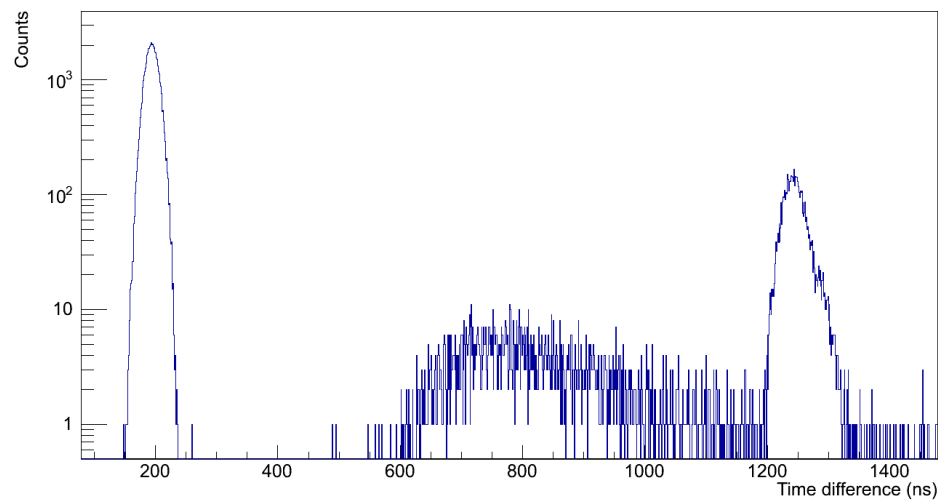 - Trigger exchange with master DAQ

WR Timestamp Difference Master - CALIFA
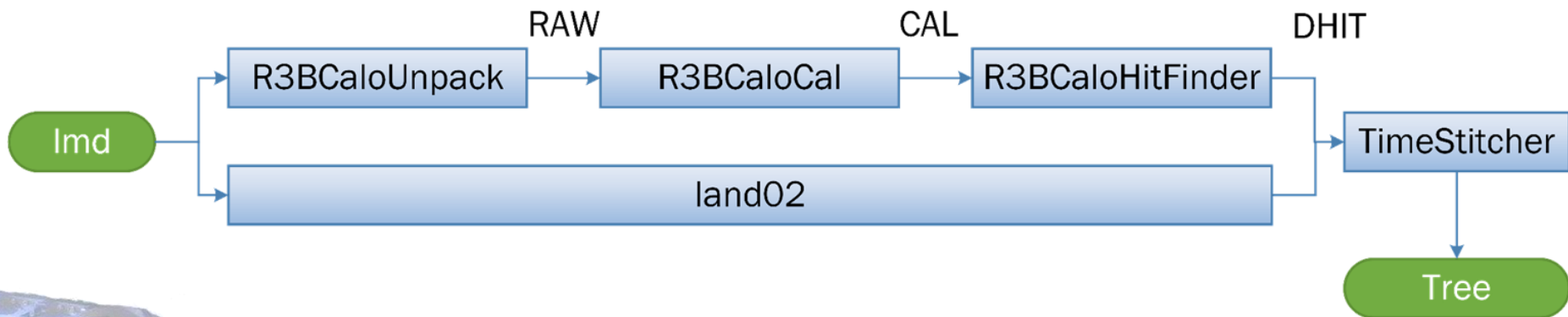
WR Timestamp Difference master - PSPX

WR Timestamp Difference CALIFA - PSPX

p,2p Analysis Overview

- Motivation:
  - Straight forward analysis
  - Clear anti-correlations

- 12h with segmented CH_2 target (PE stack)
  - Runs 296 – 301, 340, 341, 348 – 350
  - 60M events in CALIFA

- Simple approach: Merge data at highest available level


Preview version available via svn:
https://subversion.gsi.de/fairroot/r3broot/dev/mwinkel

p,2p Analysis Tasks

- **R3BCaloCal**: Energy / QPID calibration
  - ^{22}Na source: Gamma calibration in low range (~ 30 MeV)
  - Digital pulse generator: Gain between low and high range (~ 300 MeV)
  - ➢ Proton calibration?

- **R3BHitFinder**: Find hit clusters and sum up energies
  - Simple geometrical model for CALIFA Demonstrator
  - Maximum cluster size: 6° x 6° (3 x 3 crystals)
  - ➢ Different handling for proton / gamma clusters?

- **TimeStitcher**: Merge arbitrary ROOT trees
  - Using WhiteRabbit timestamps in each tree
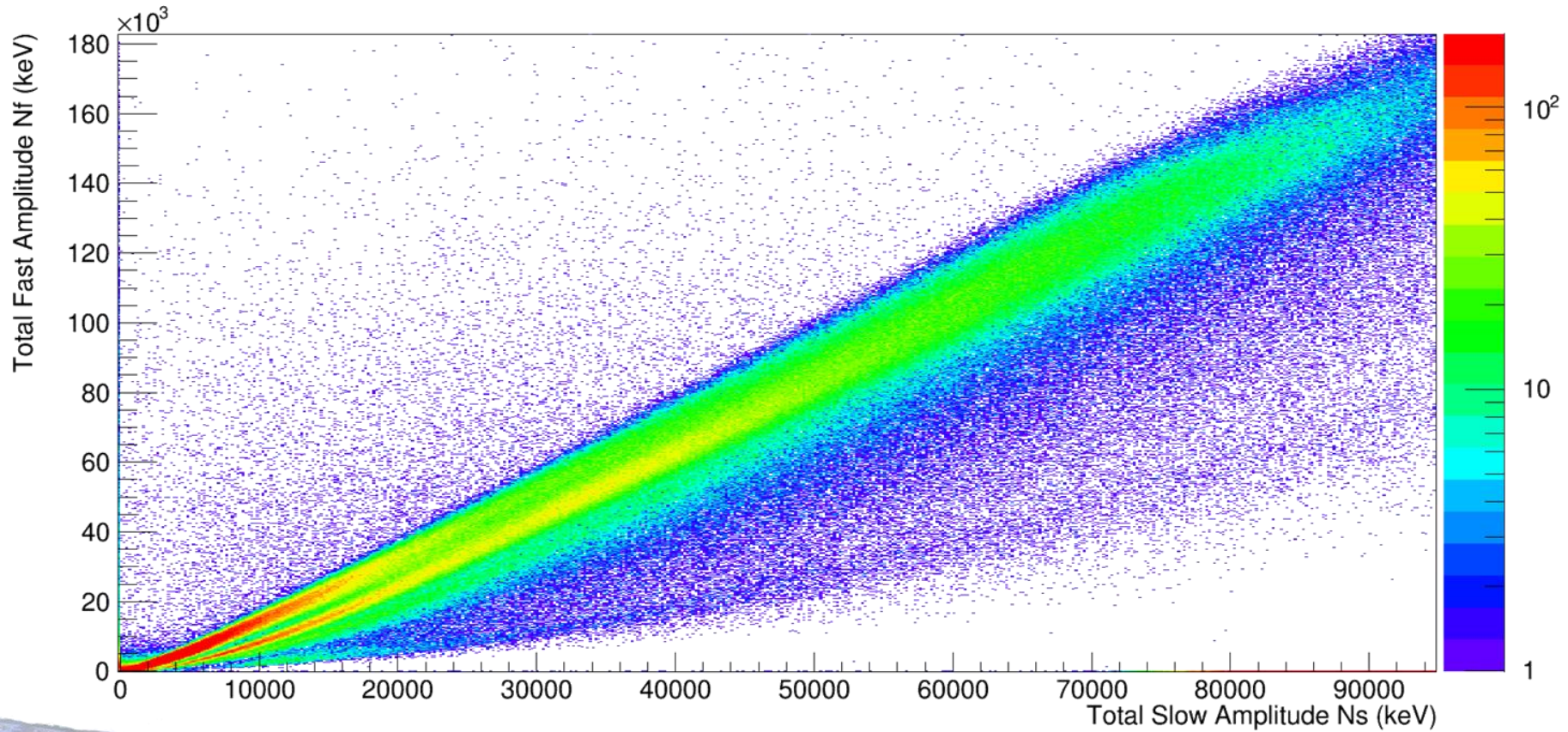 - Coincidence window +/- 500 ns
  - ➢ Fine tuning

p,2p External Requirement
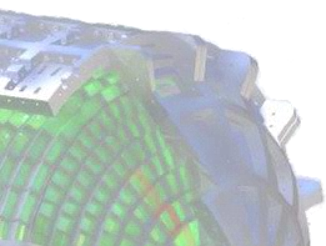
- 1 proton knockout: Residual nucleus ^{47}K

p,2p CALIFA Requirement
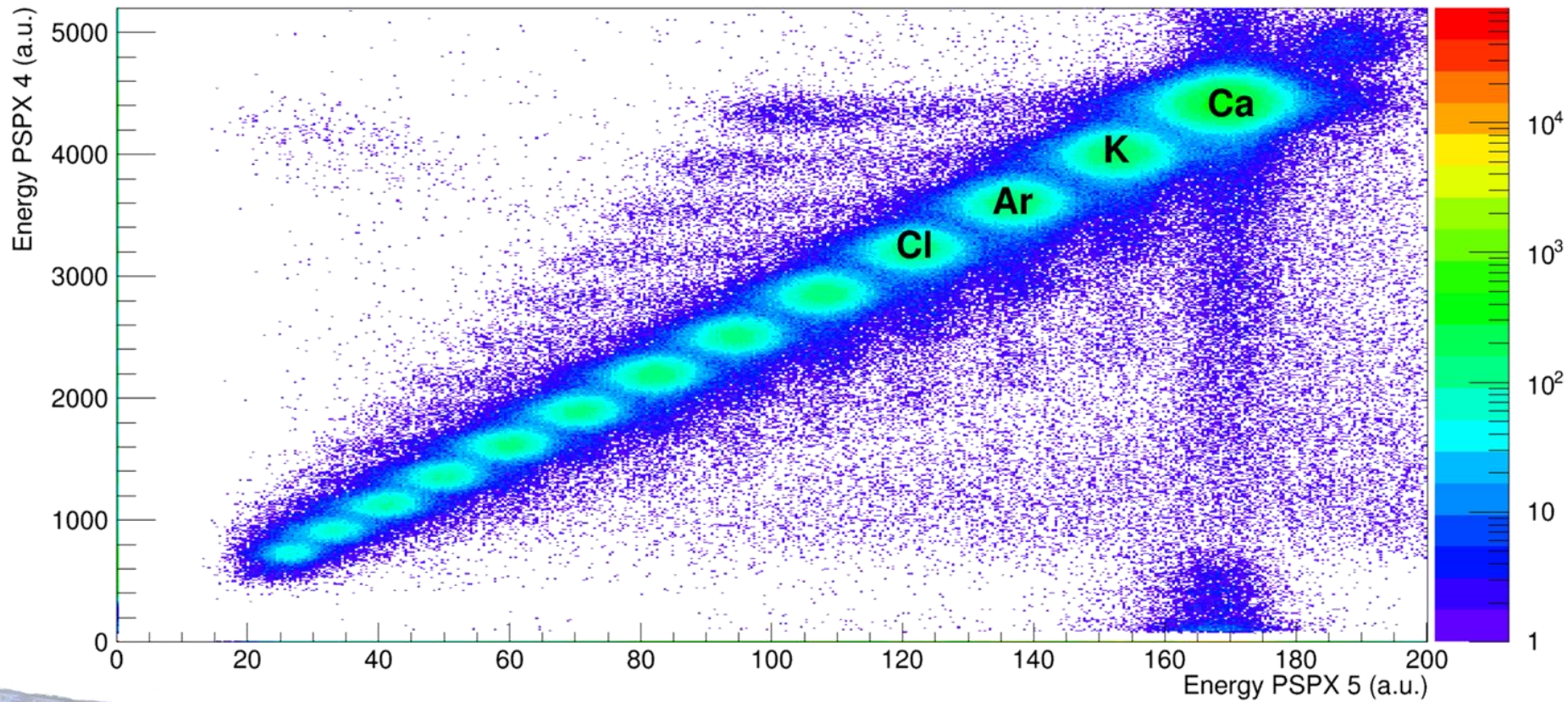
- 2 (stopped) protons in each petal
- QPID

p,2p Analysis

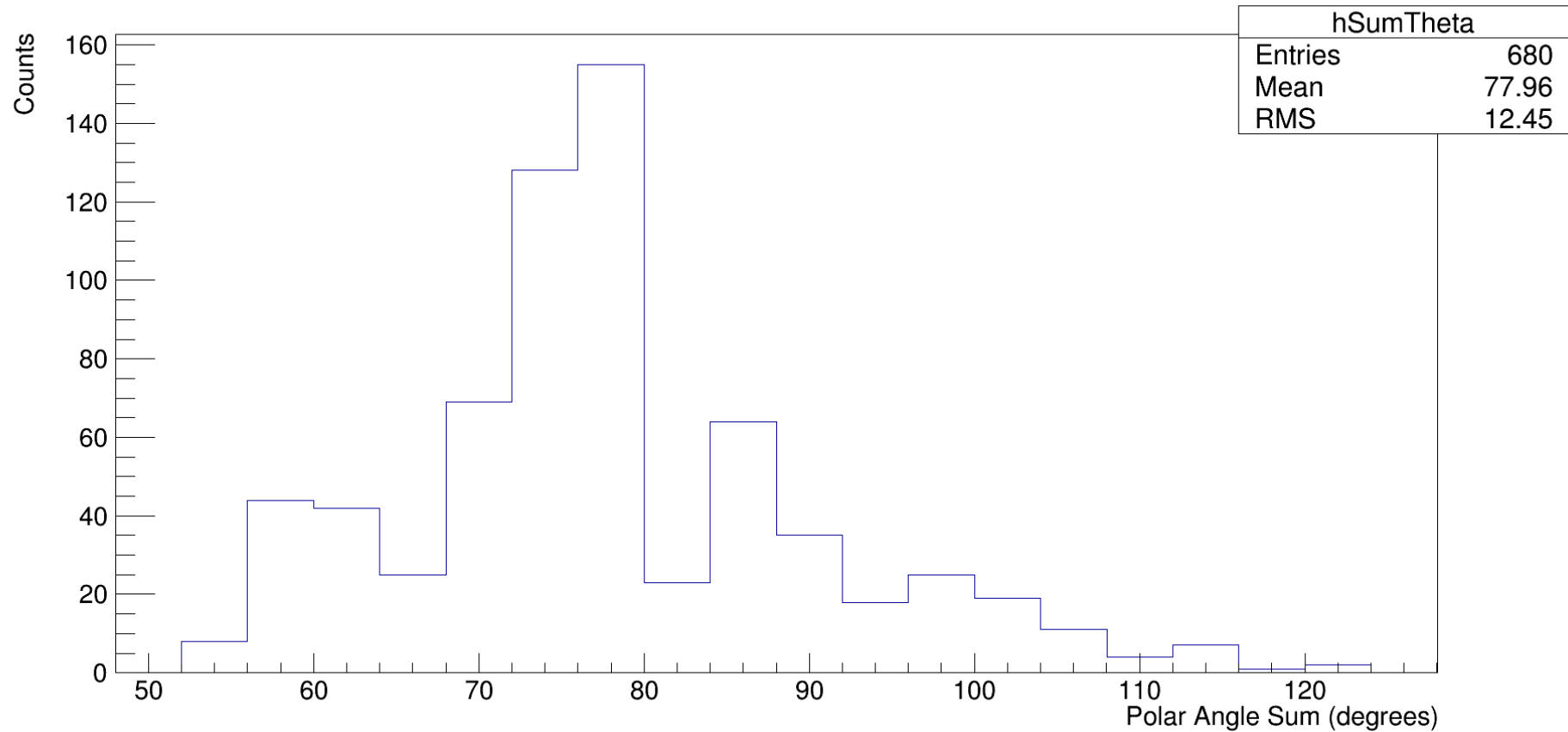- Apply cuts: Z-1, QPID
- ➢ Take highest energy stopped proton in each petal

p,2p Analysis
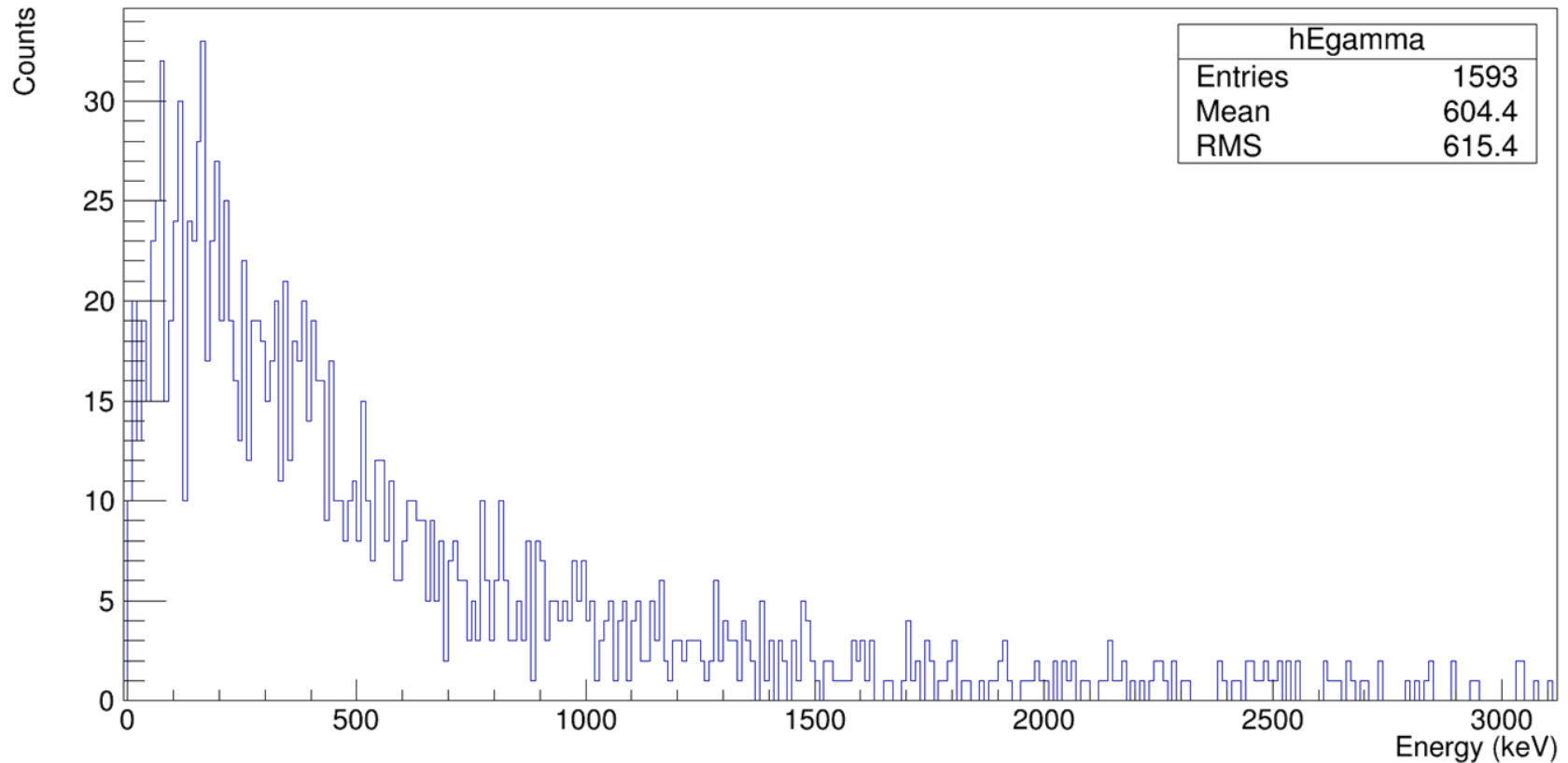
p,2p Energy Anti-Correlation?

➢ Cut on $65° \leq \theta \leq 85°$

p,2p Excited States?
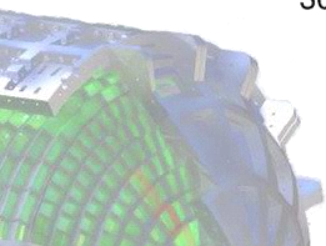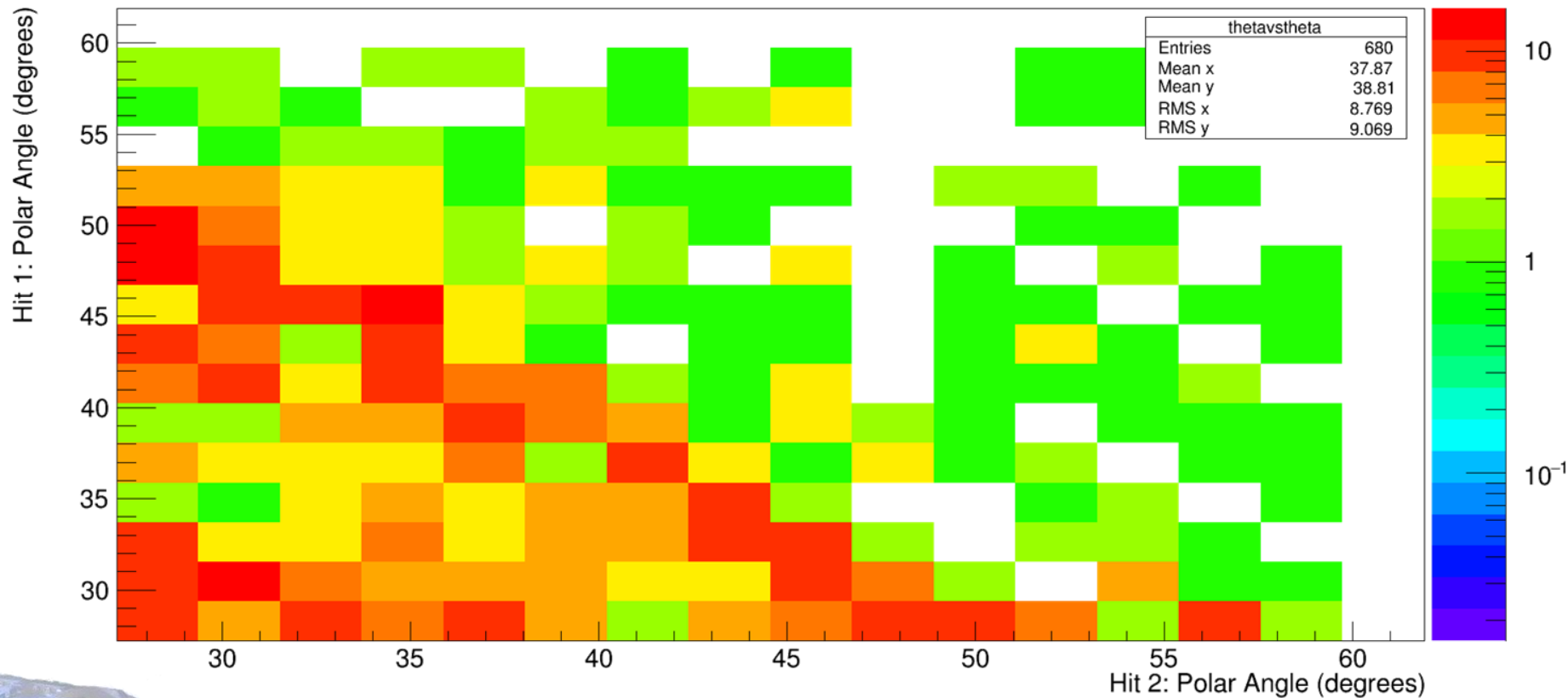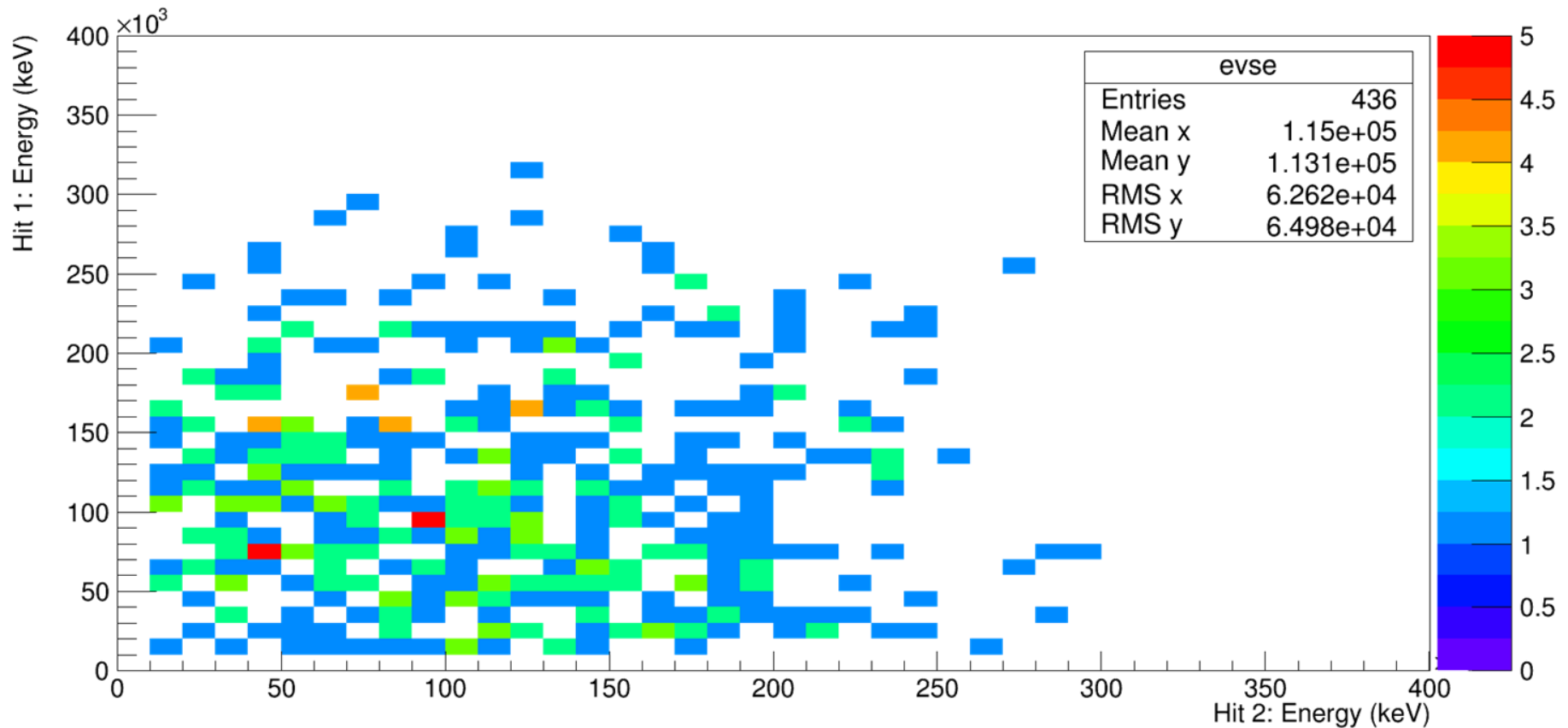
- Take all remaining hits below 10 MeV (Doppler corrected)

hEgamma	
Entries	1593
Mean	604.4
RMS	615.4

# **Problems** … and their (possible) solutions
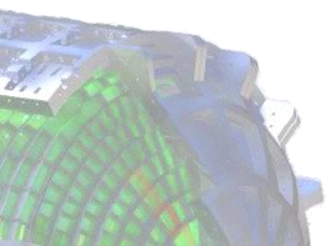
- Very low statistics
  - ➢ Full CALIFA will increase geometrical acceptance by factor 20

- „Interesting" protons hardly stopped
  - – Loss of statistics due to hard constraint: 2 STOPPED protons
  - ➢ **iPhos** method to identify punched through protons and reconstruct their full energy

- Poor angular resolution
  - – Silicon tracker not available for all runs
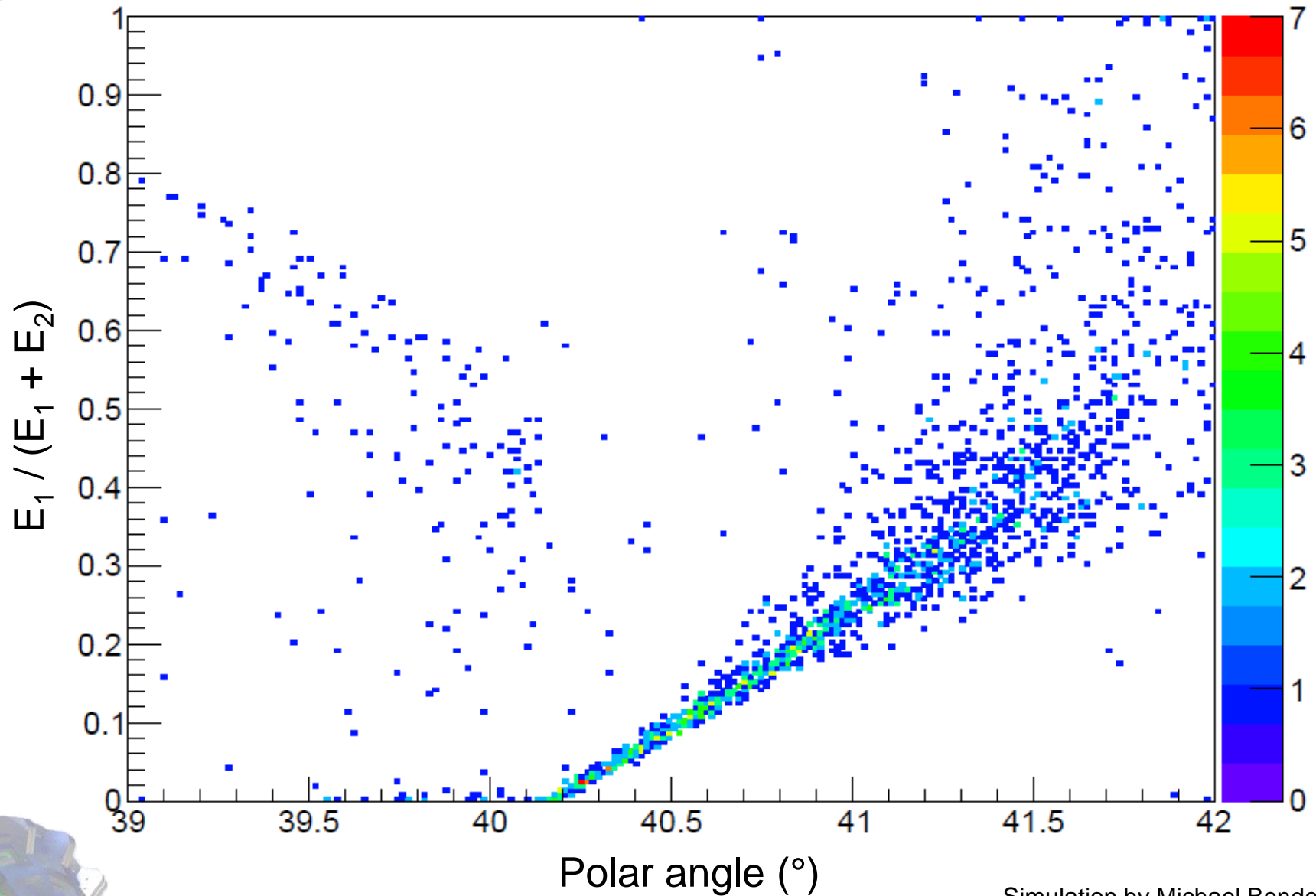 - ➢ Possible new feature: Angular reconstruction by iPhos

Angular Reconstruction

- Feature: Crystals are not directly facing target
- ➤ Protons punch through two or more crystals

- ➤ iPhos to get primary / secondary crystal
- ➤ ΔE_1, ΔE_2
  - ➤ E_{Total}
  - ➤ Δx_1, Δx_2
   - ➤ Angle

Angular Reconstruction

Simulation by Michael Bendel

Outlook
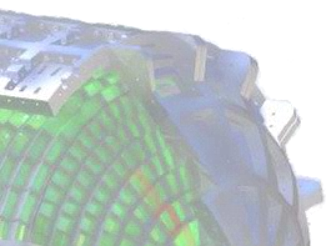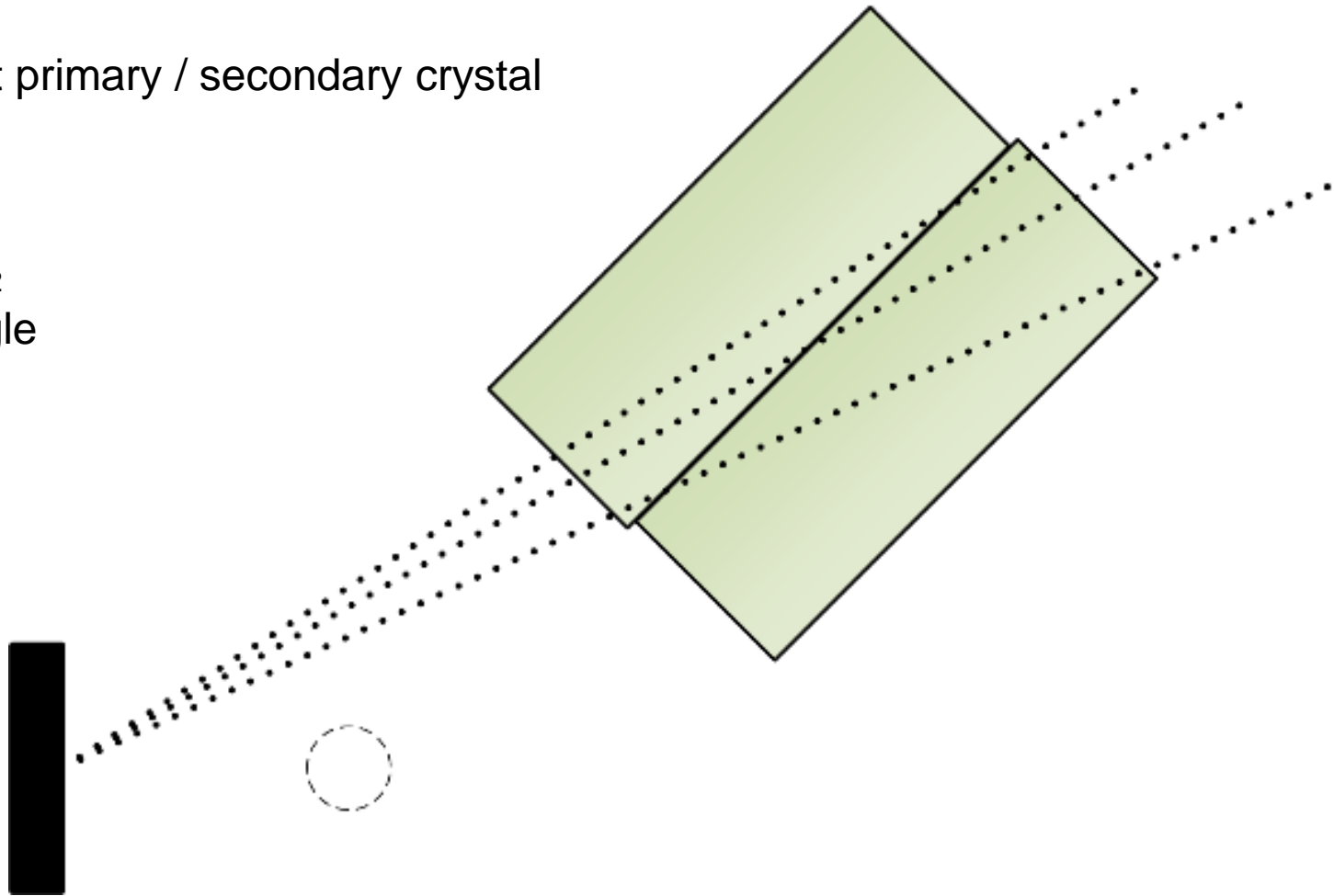
- **Next analysis steps**
    - C background subtraction
    - iPhos for full energy reconstruction
    - Silicon Tracker for fine angular resolution
    - GFI for tracking
        - ➤ Residual nucleus A reconstruction
    - Offline pulse processing using traces for comparison

- **System development**
    - CFD in FEBEX firmware
    - Multi event readout
    - New trigger system
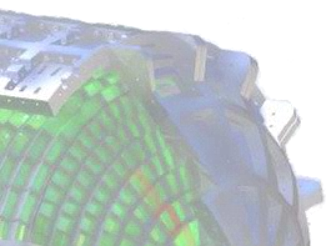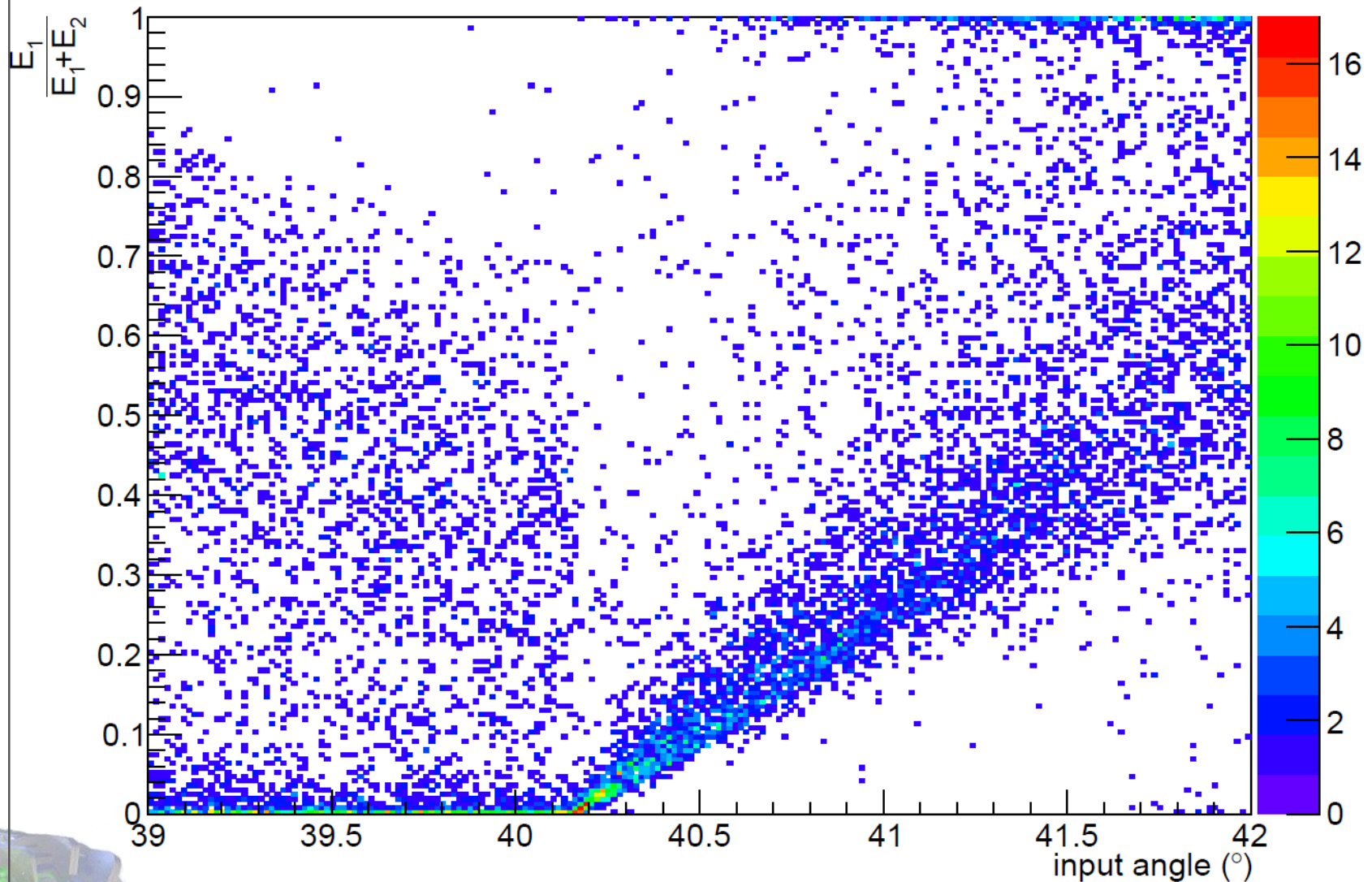   - ➤ Realtime selection of p,2p events
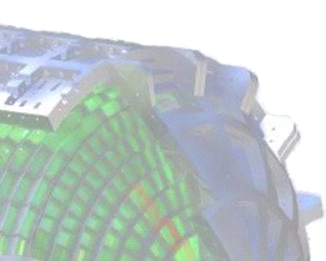
Thank You

CALIFA @ TUM

Michael Bendel, Roman Gernhäuser, Benjamin Heiss, Philipp Klenze,

Patrick Remmels, Max Winkel

Technische Universität München

Outtakes

Simulation by Michael Bendel

Technical check Trigger Walk

CALIFA
Proton

Master
Start
(LOS)