Offline Gain Calibration of Experiment 7

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Outline

- **Introduction** of offline gain calibration
- **BASF2 results** (median, GT=data_reprocessing_prompt)
- **Medians** of cluster charge distribution in MC and data
- **Open question :** Why median ?
- Summary and Outlook

Introduction of offline gain calibration

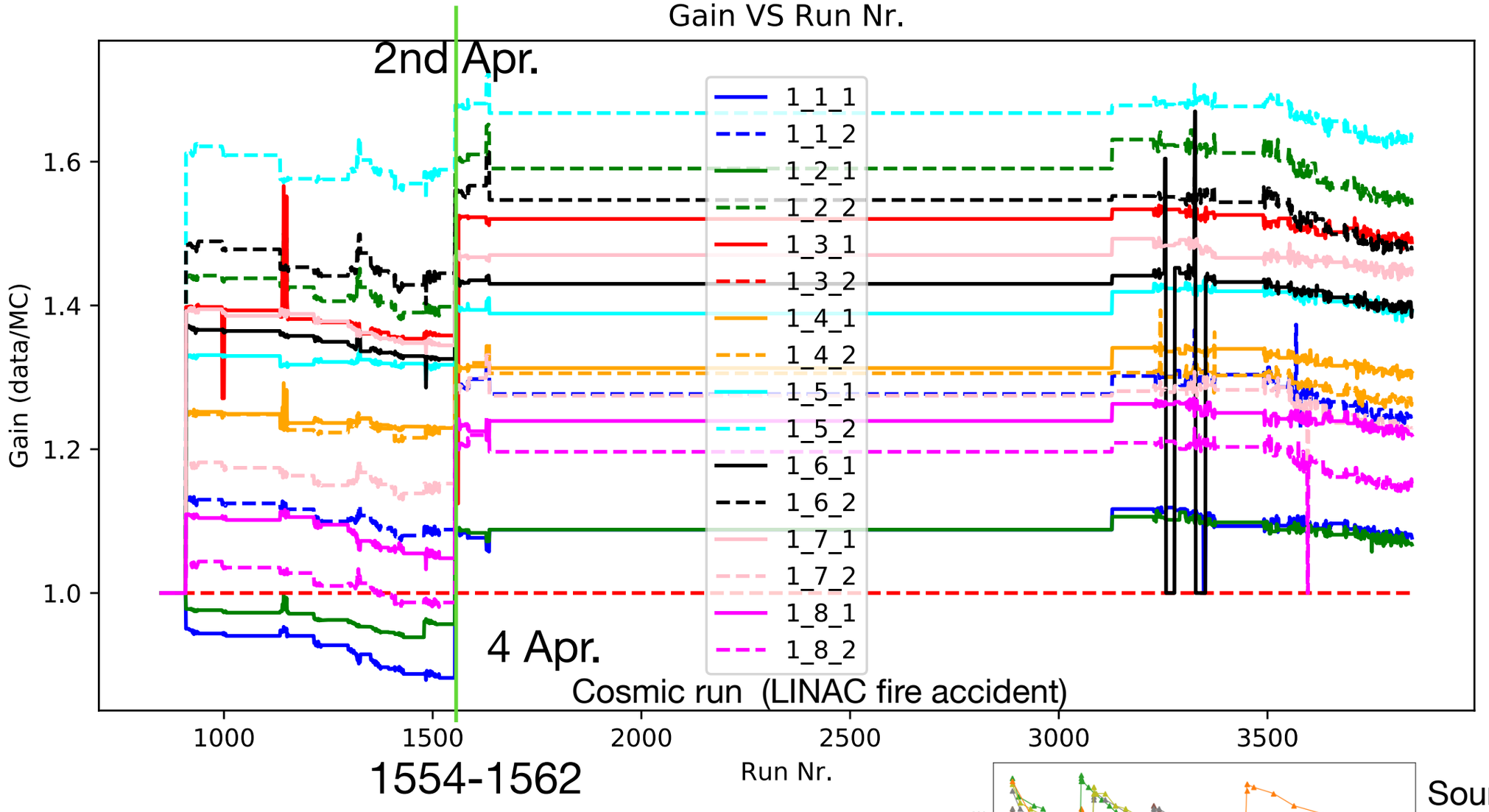
- General gain calibration: Determine Energy/ADU ratio
- Methods used in Phase2 have been applied
  - MC simulation based on beam test data and background
    - Evaluate the MPV of cluster charge distribution
    - Calculate the ratio of this MPV from Data to MC
- In the current stage, gain is the MPV ratio and the understanding of phase3 data is still ongoing

BASF2 Gain vs Run Nr.

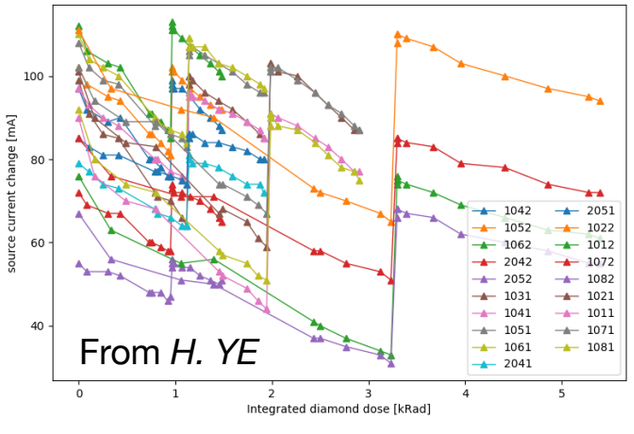
Up to Run 3847

- Layer 1

Gain = Median in Data/MC, cluster size >=2



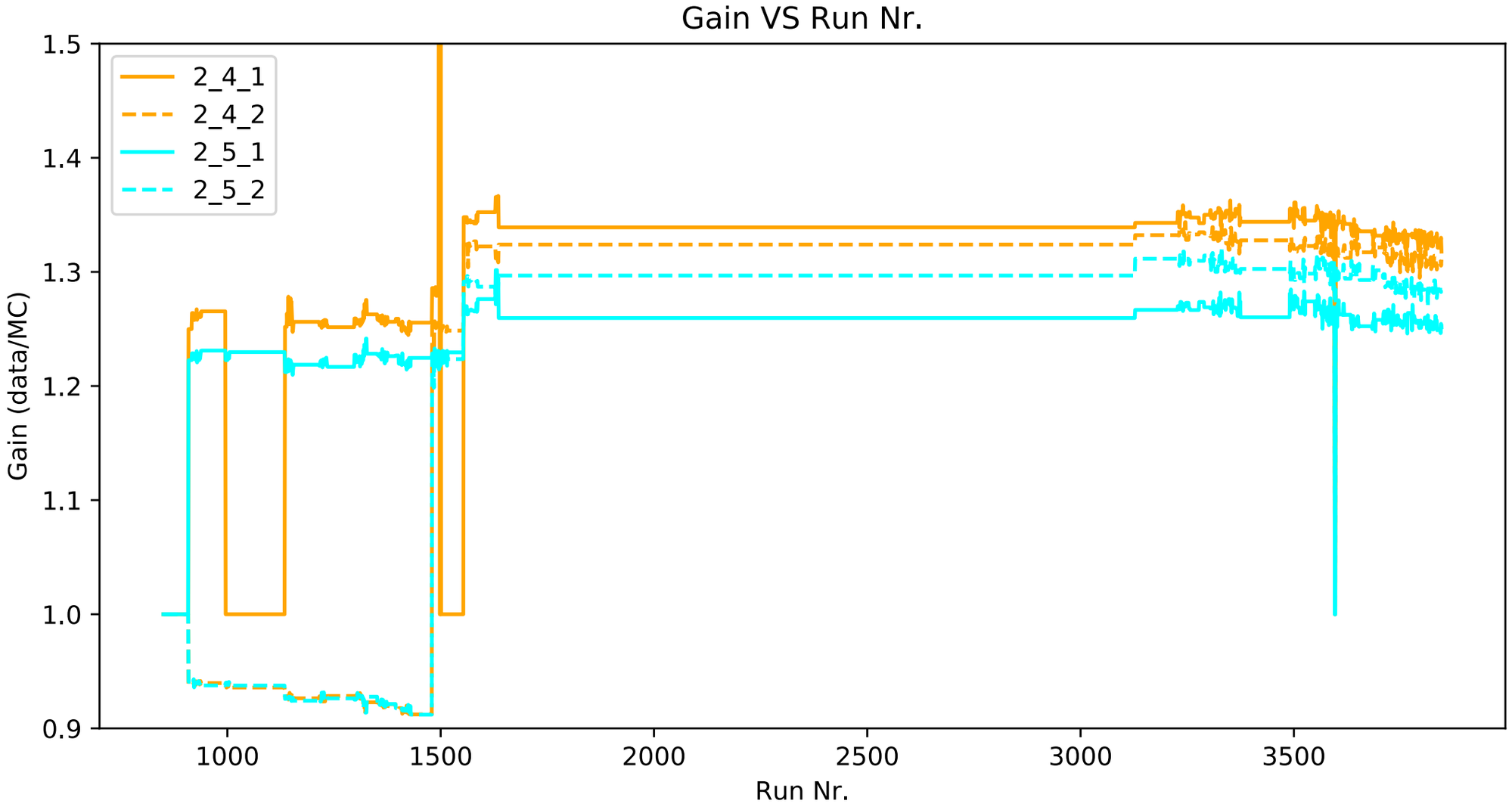
- Gain <u>decreases</u> as dose increases
- Improved after gate-on voltage tuning



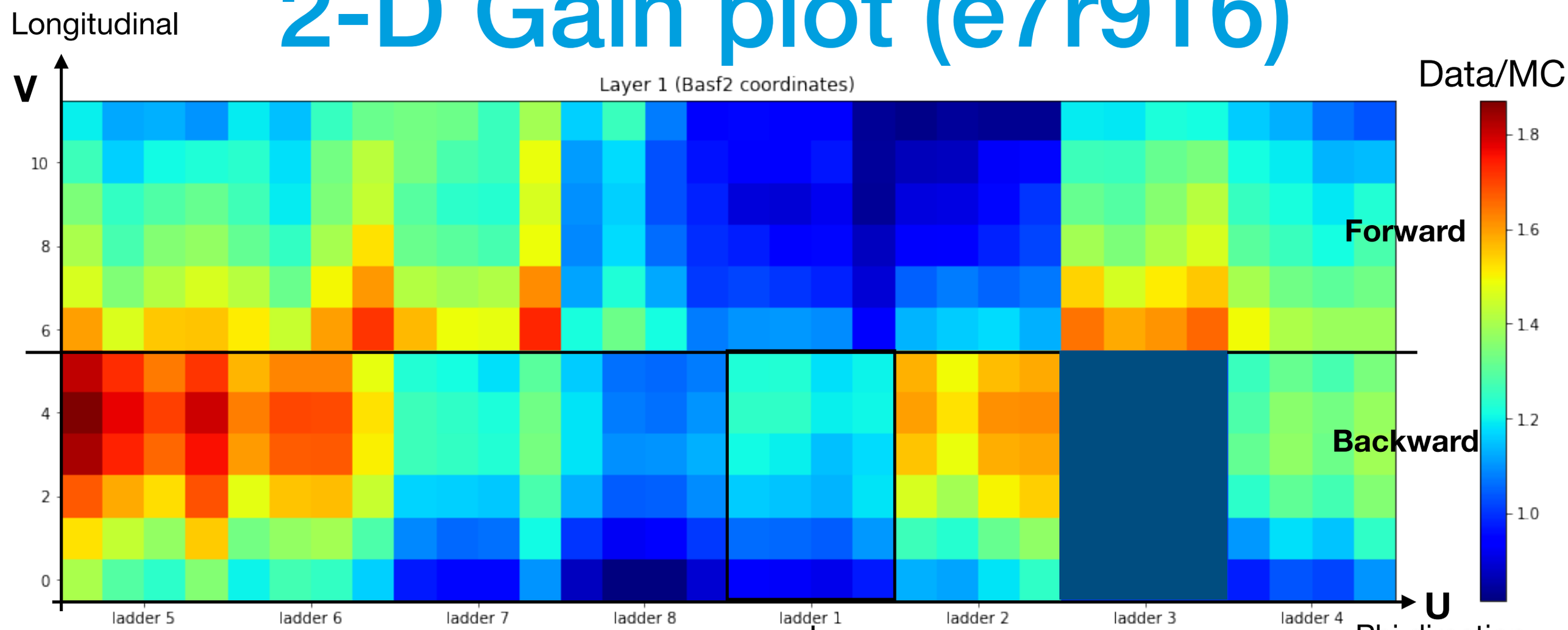
Source current vs Diamond dose

BASF2 Gain vs Run Nr.

- Layer 2



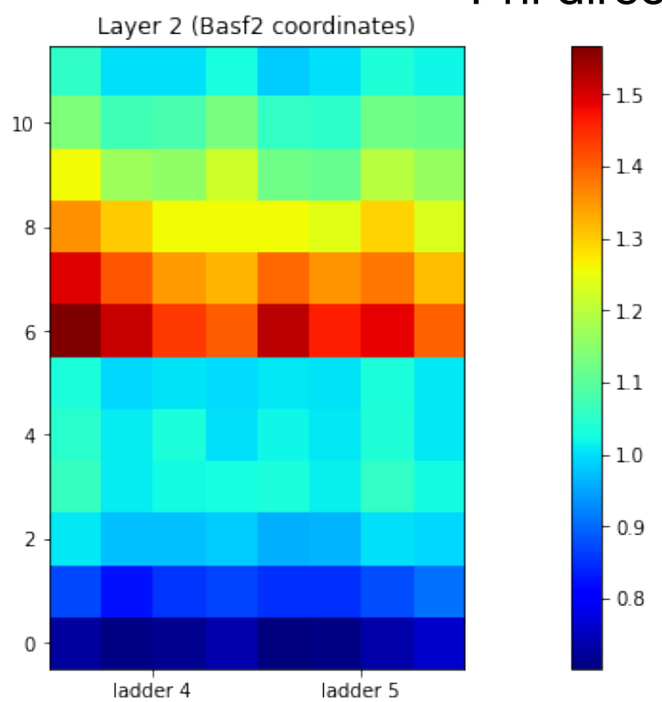
2-D Gain plot (e7r916)



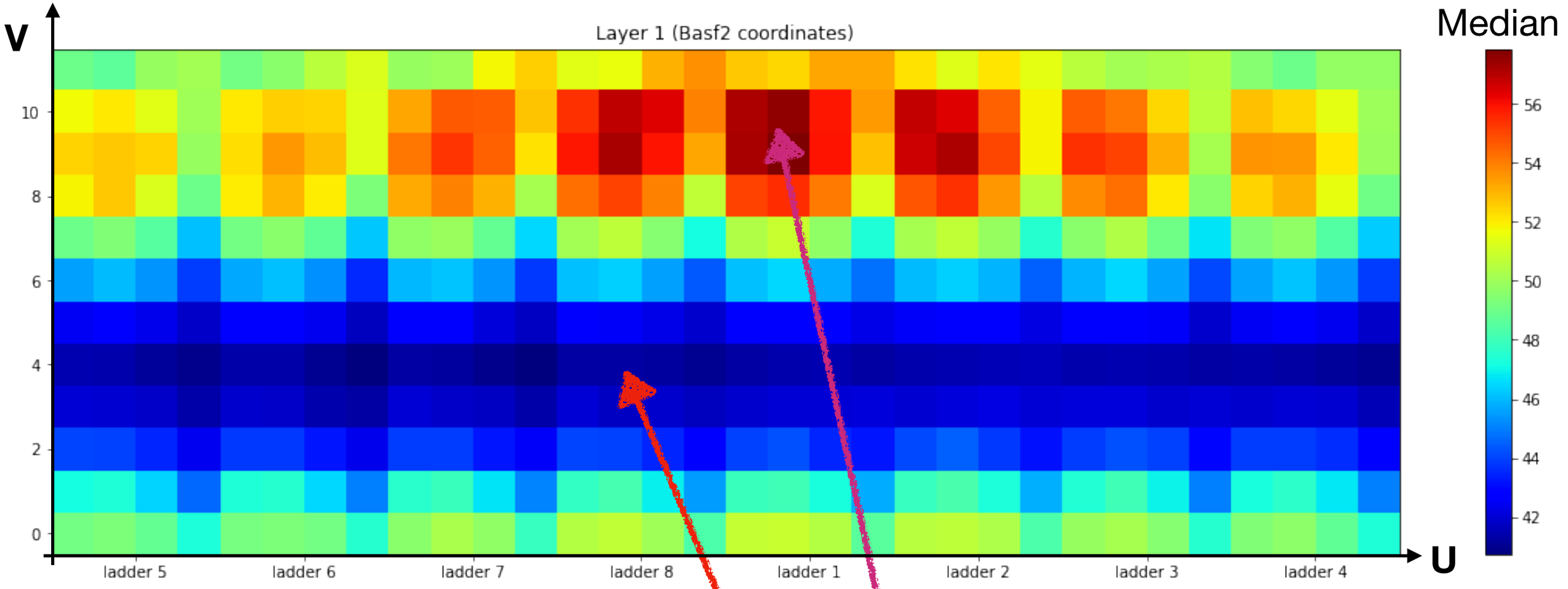
6 switchers in V and 4 DHPs in U -> 24 bins

$\phi_0 = 0$

- A large variation across different regions (Why?)
  - Background? Module optimisation?
- Are MC values reliable?
- What's the medians/MPVs from data and MC?



Medians in MC



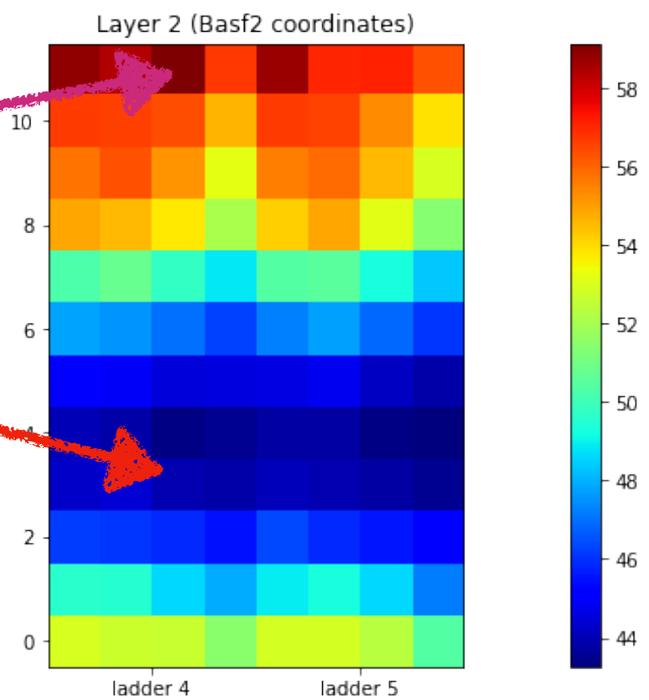
$\phi_0 = 0$

(Cluster size)

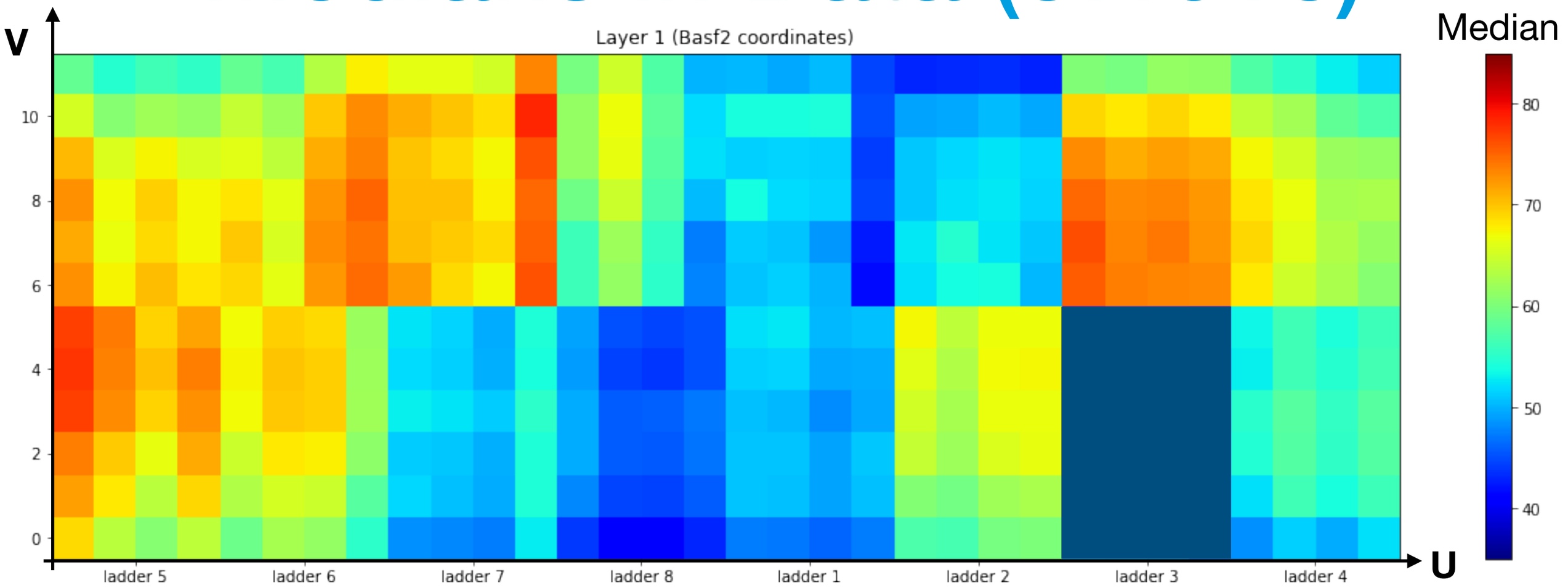
- Influence of pixel multiplicity ?
- Data results on the next slide

Background In Simulation?

Near IP

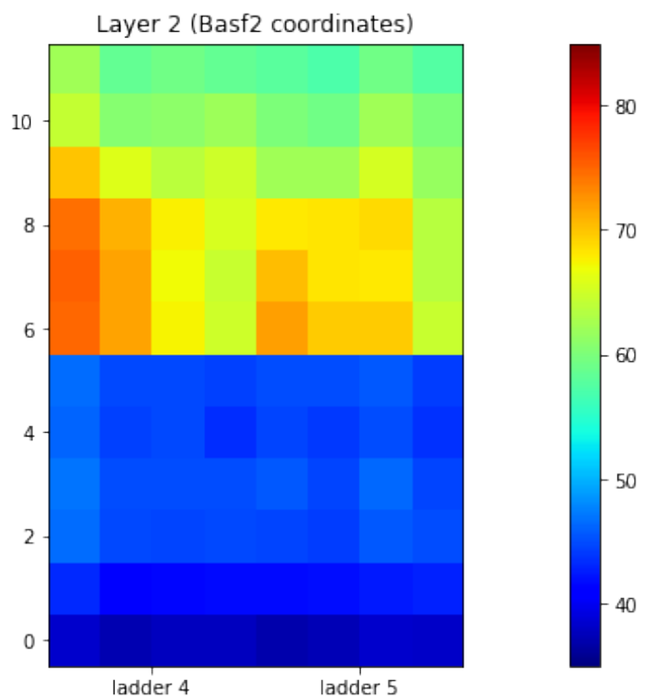


Medians in Data (e7r916)

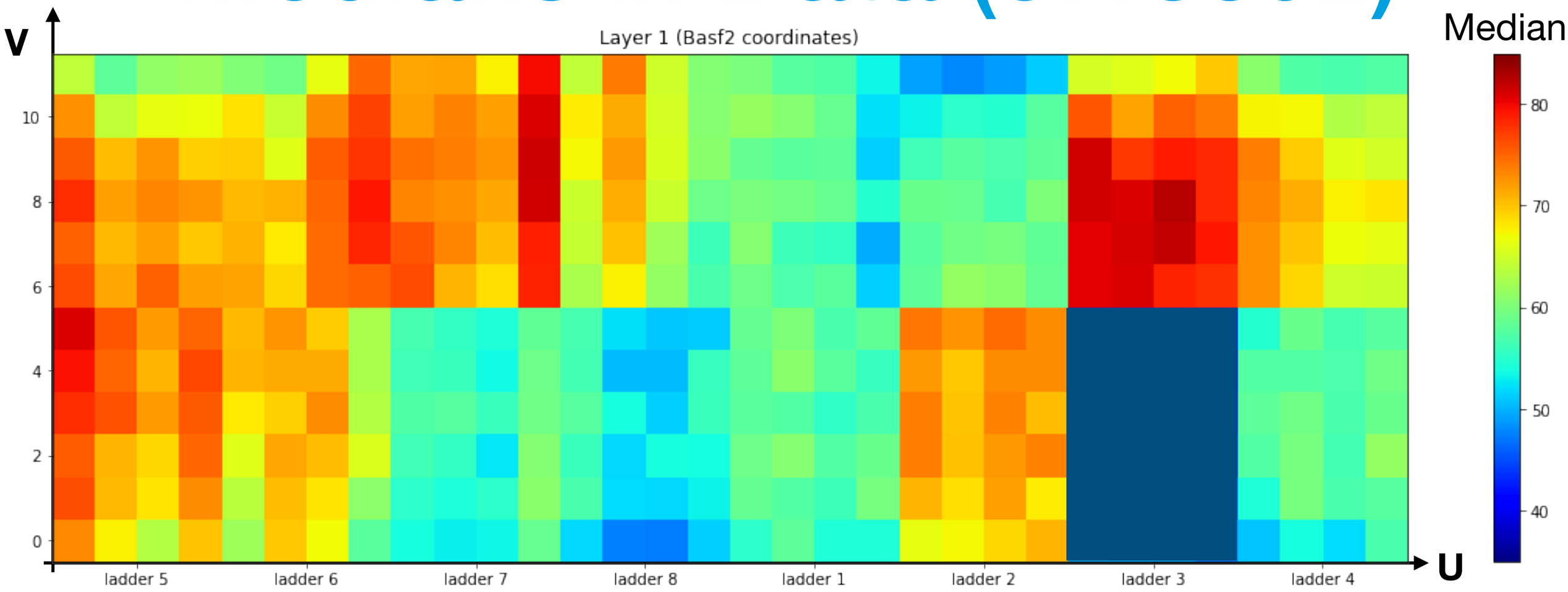


$\phi_0 = 0$

- Real life, similar gradient in other runs up to run3847
-

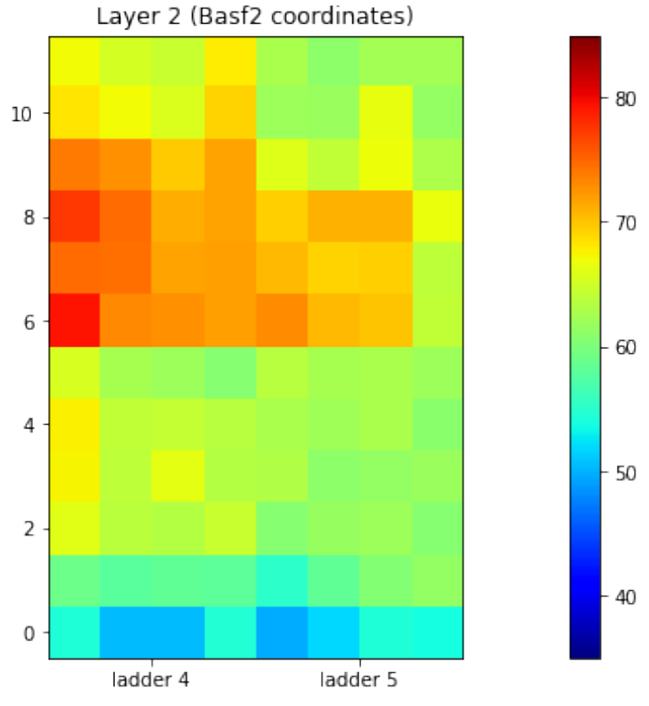


Medians in Data (e7r3392)

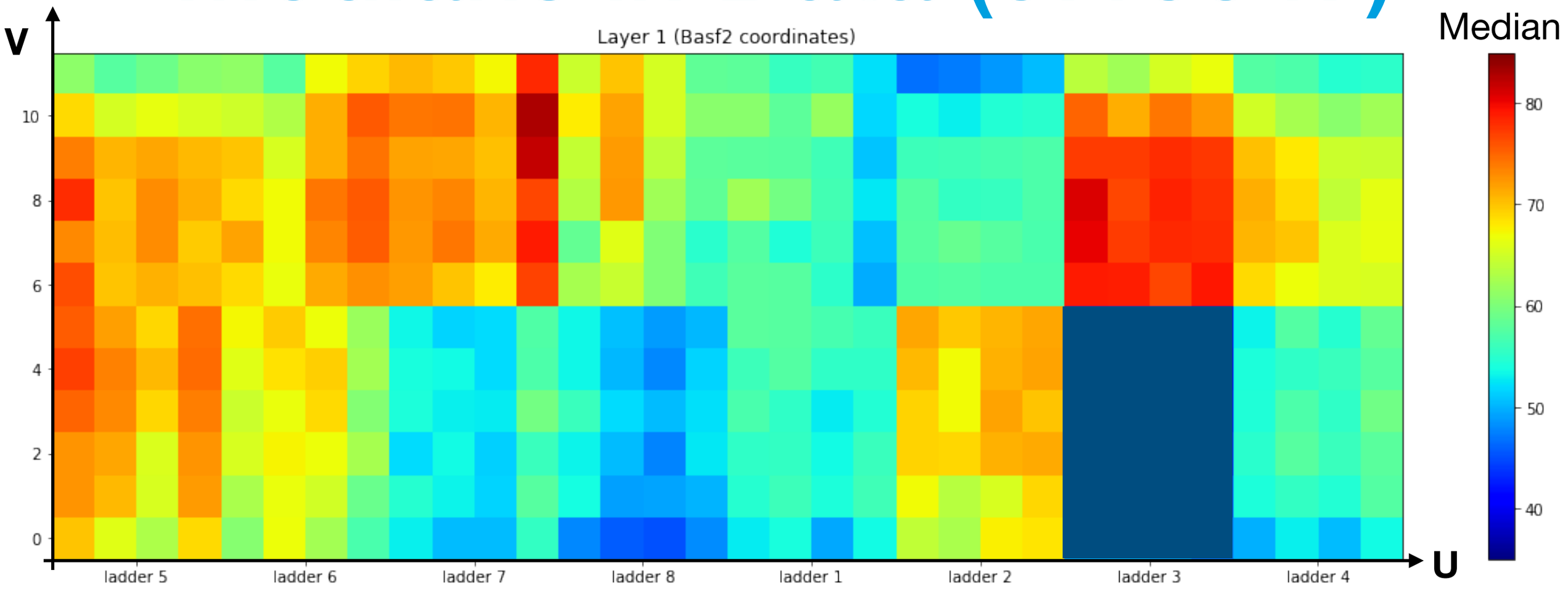


$\phi_0 = 0$

- Real life, similar gradient in other runs up to run3847
- Improved after tuning

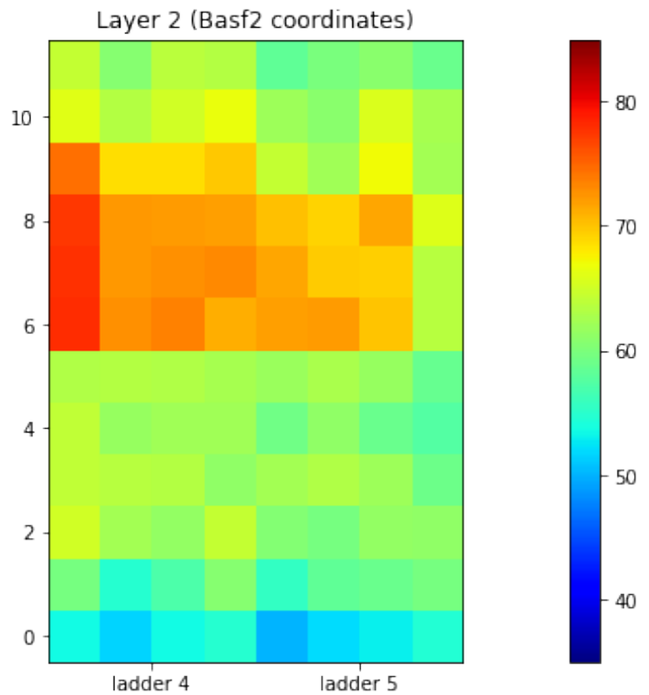


Medians in Data (e7r3847)



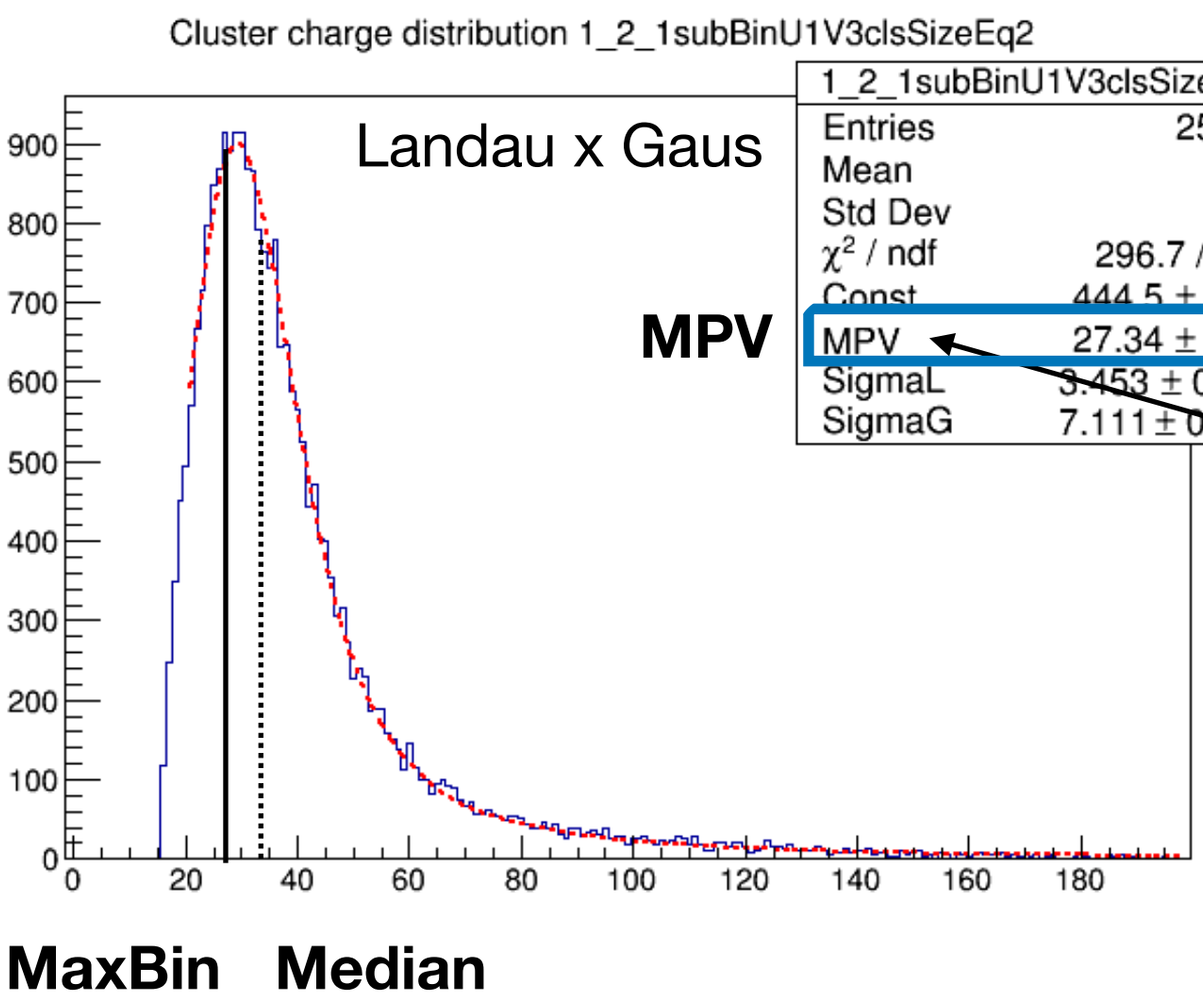
$\phi_0 = 0$

- Real life, similar gradient in other runs up to run3847
- Q: Why median? Not MPV?

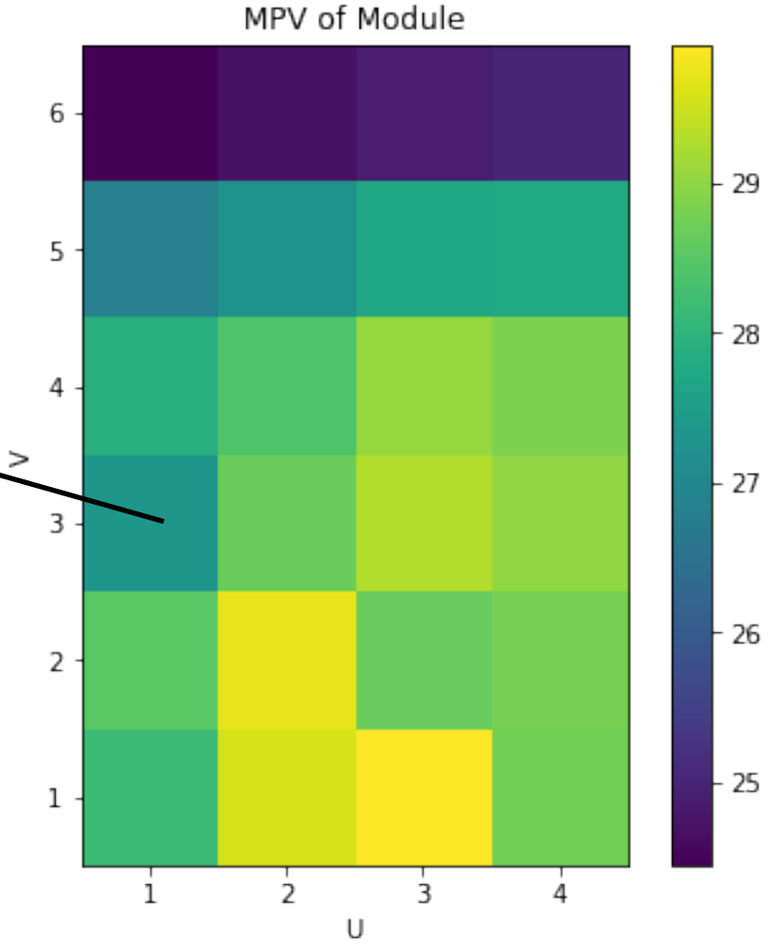


Open question: Why Median?

- Variables: **Median**, **MPV** from fit, **MaxBin** of 1D histogram



1_2_1, cluster size = 2



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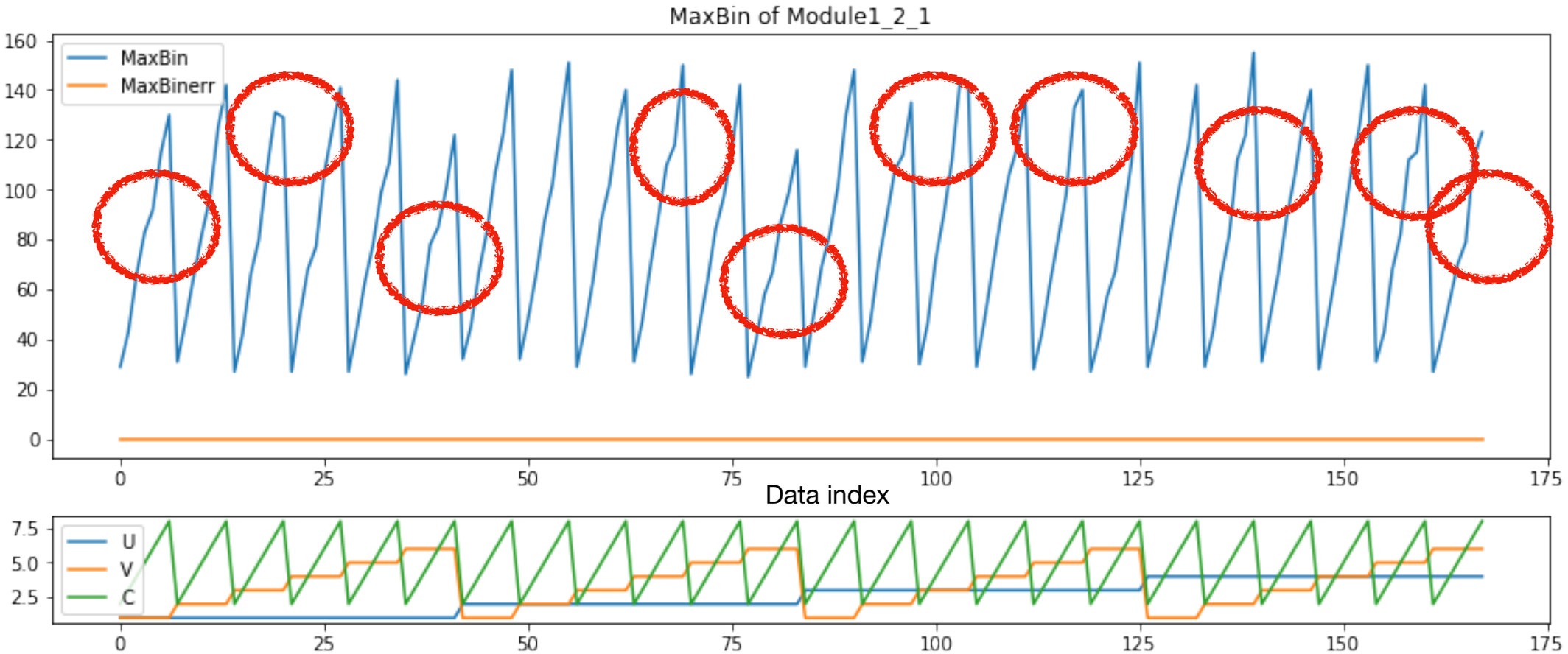


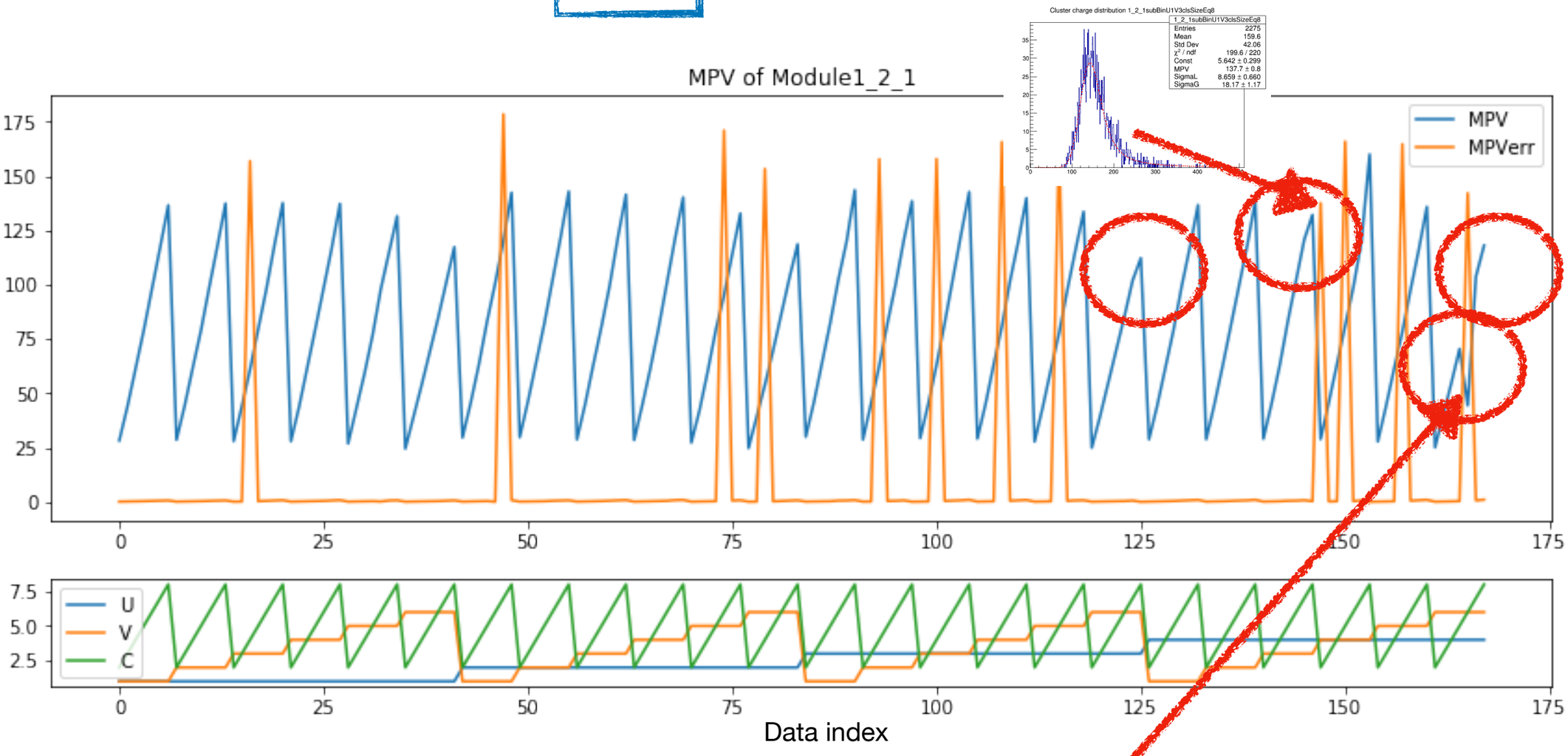
cluster charge distributions of **different regions** and **cluster sizes**

MaxBin vs cluster size is **not stable,** many **outliers**

Sensitive to statistics

Open question: Why Median?

- Variables: **Median**, **MPV** from fit, **MaxBin** of 1D histogram



cluster charge distributions of **different regions** and **cluster sizes**

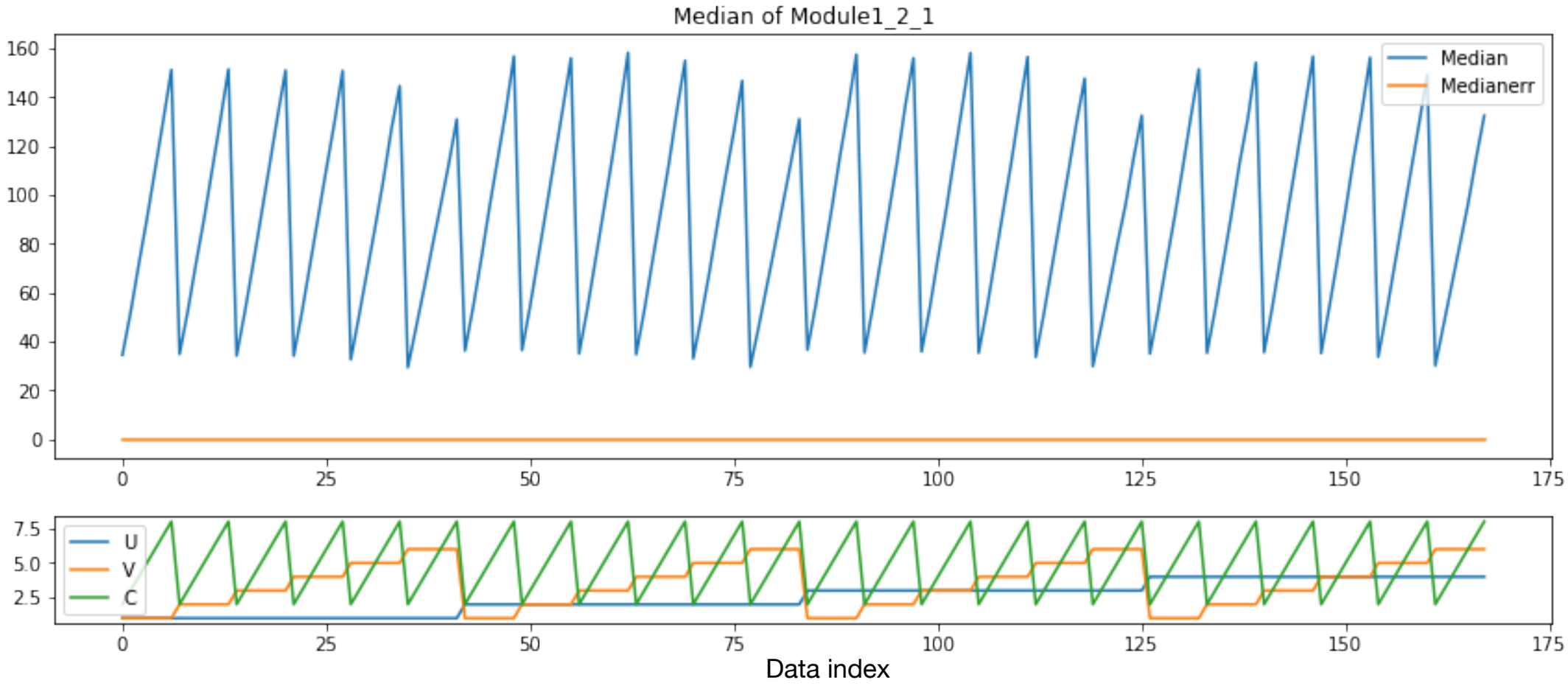
MPV vs cluster size is quite **linear, outliers, slow**

Failures in fitting

Sensitive to statistics

Open question: Why Median?

- Variables: **Median**, **MPV** from fit, **MaxBin** of 1D histogram



cluster charge distributions of **different regions** and **cluster sizes**

Median vs cluster size is **linear,** almost **no outlier**

Median is still preferred

Summary

Gain evolves as expected

MPV (median) has a large variation in different regions

Median of cluster charge distribution is still preferred

Outlook

- Relative calibration of the modules (regions) using clusters from tracks
  - Known source (mainly Bhabha), known angle
  - Low statistics
- Calibrate w.r.t. photons from synchrotron radiation
  - Only a few modules have the photon peaks in Phase3
- Measure the energy conversion factor with sources using Phase2 modules (Botho et al.)
- Understand the nature of the observed pattern and the difference between data and MC with connection to:
  - Sally's background studies
  - Joana's cluster angle calibration

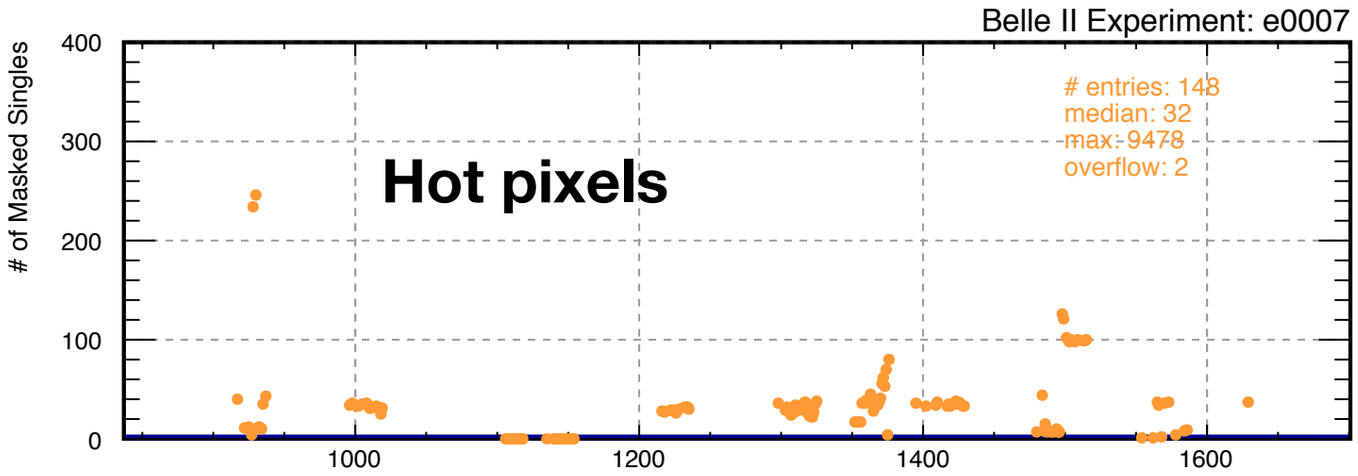
Thank you!

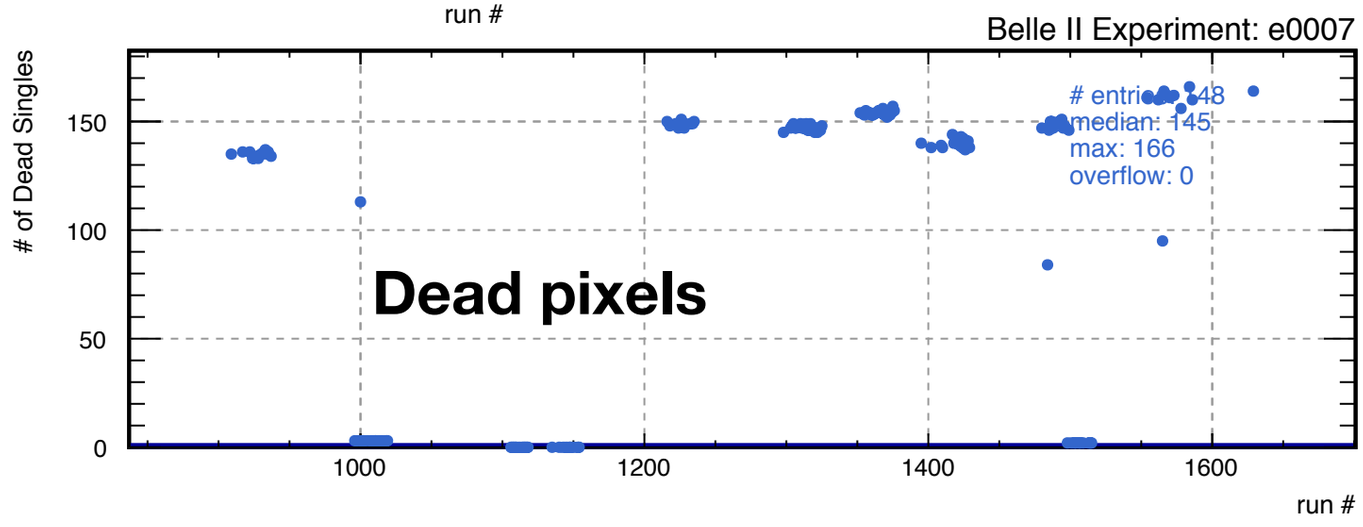
Hot/Dead pixel masking

- Hot pixel masking and occupancy have been presented in Monday/Tuesday meetings (Maiko's slides)

- Results are also available in PXD website:

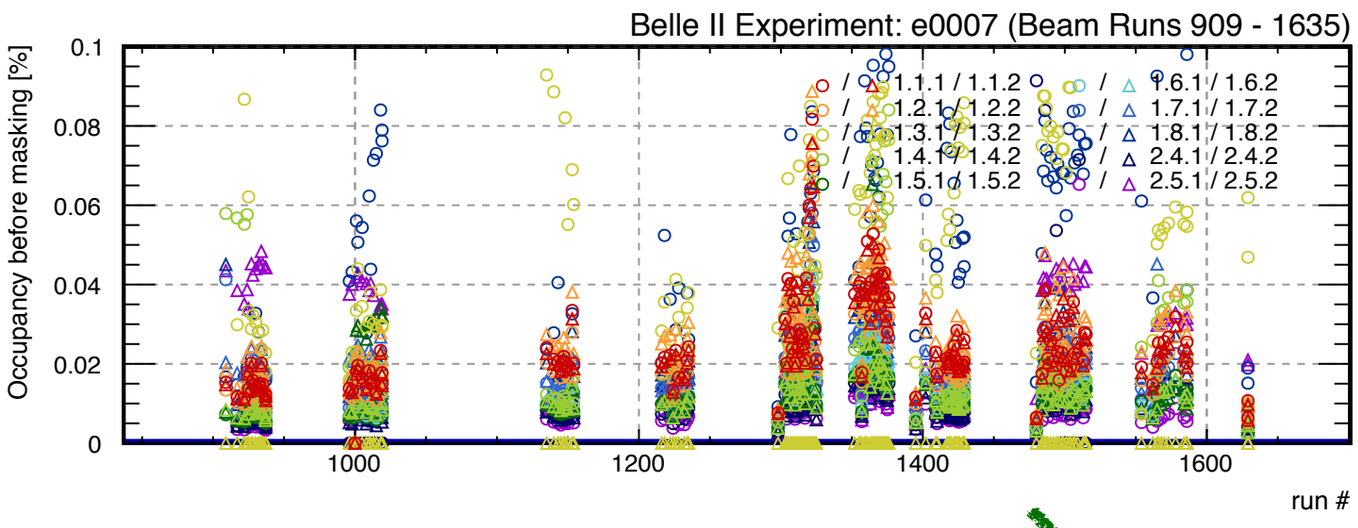
https://pxd.belle2.org/OfflineCalibration/2019_Phase3_Exp0007/

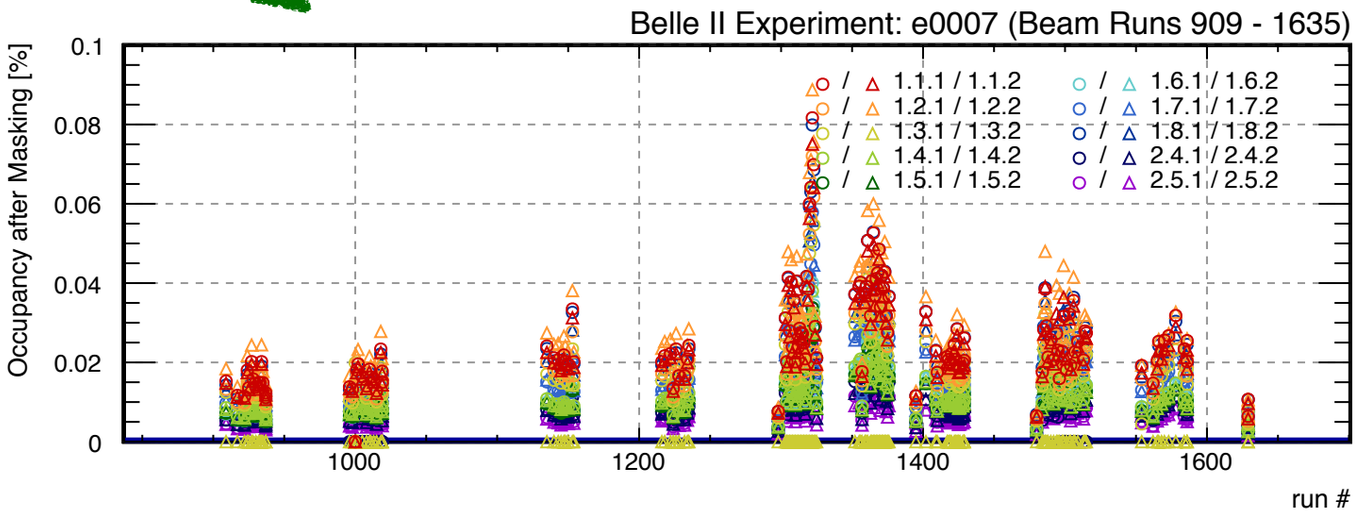




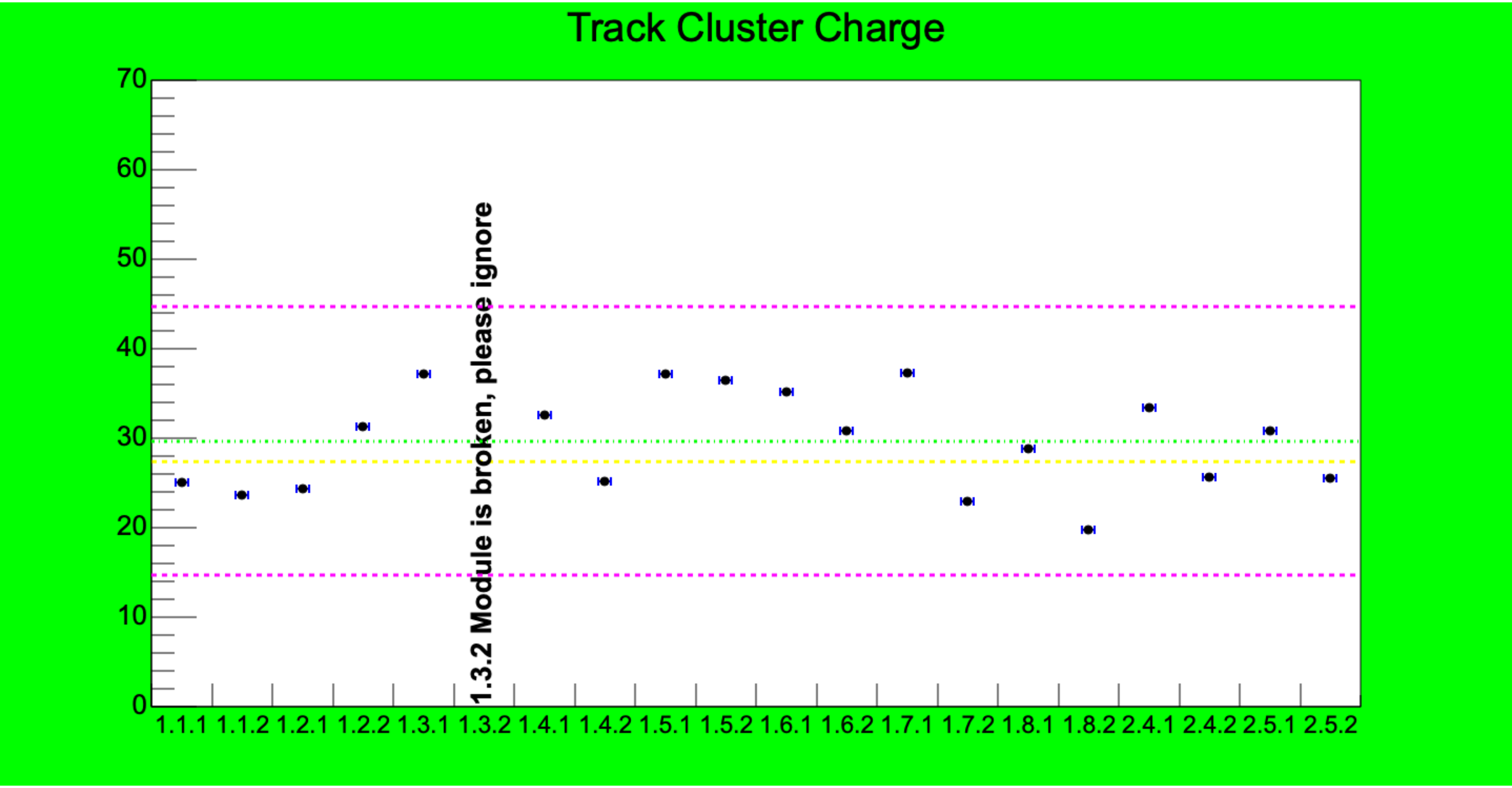
Off-line Occupancy

- Occupancy improved after hot pixel masking



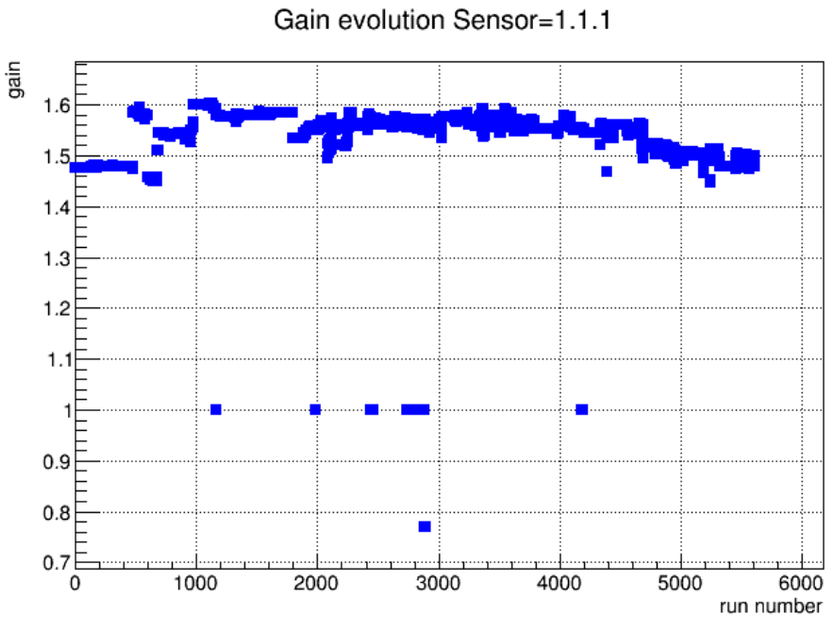


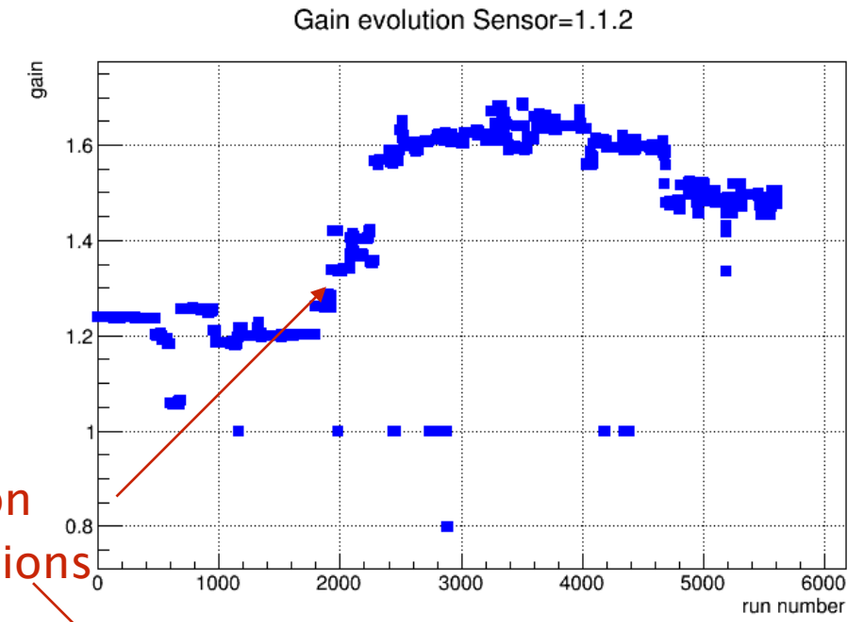
DQM


Track Cluster Charge
70
60
50
40
30
20
10
0
1.3.2 Module is broken, please ignore
1.1.1 1.1.2 1.2.1 1.2.2 1.3.1 1.3.2 1.4.1 1.4.2 1.5.1 1.5.2 1.6.1 1.6.2 1.7.1 1.7.2 1.8.1 1.8.2 2.4.1 2.4.2 2.5.1 2.5.2

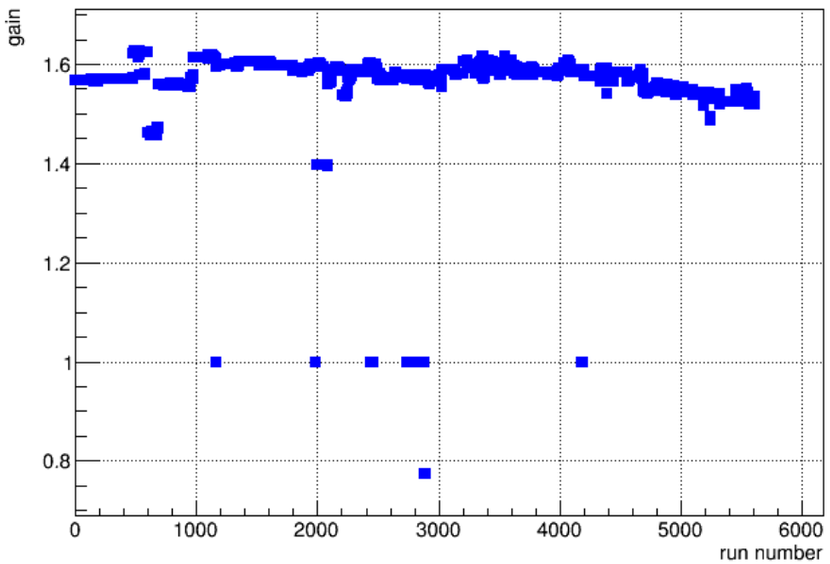
Gain Calibration Results for Phase2

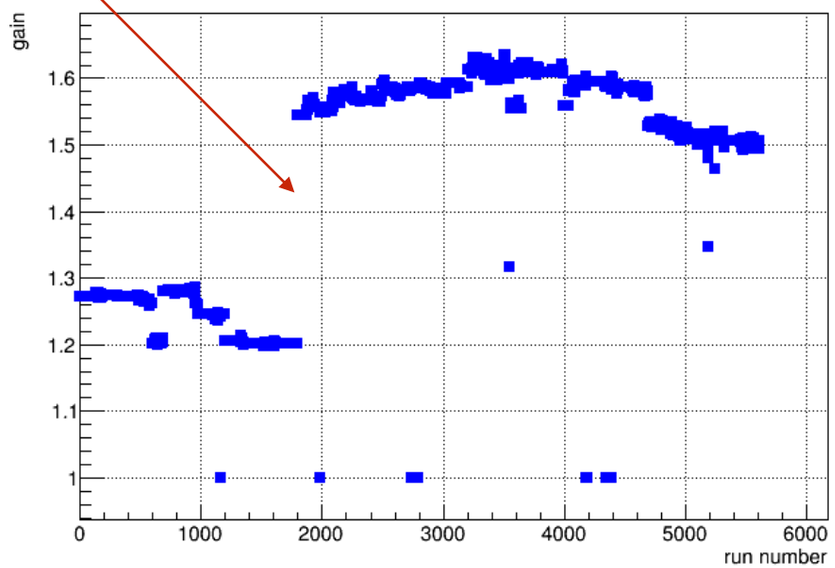
data/MC ratio of MPV (median)





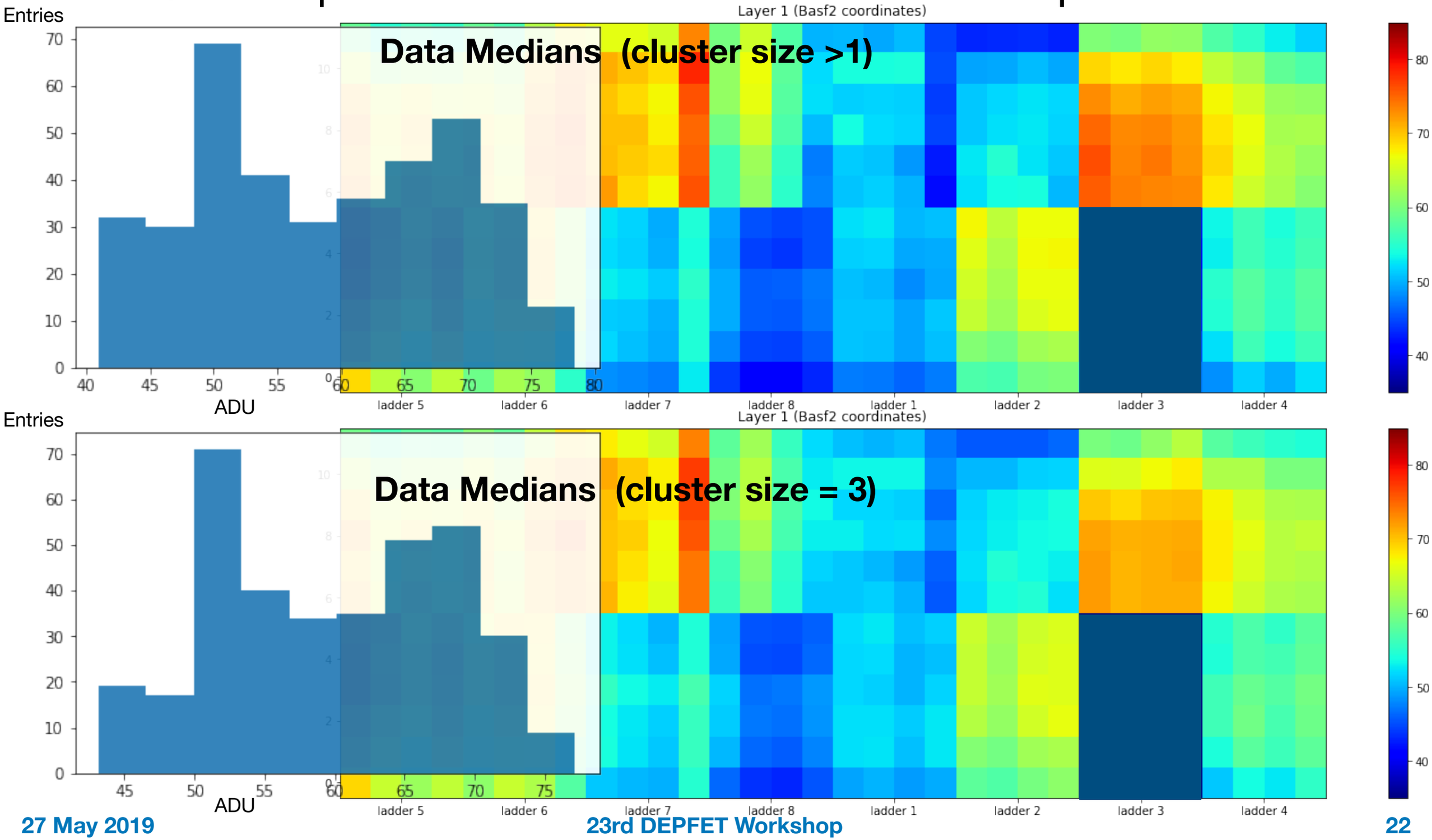
Gate-on optimisations





Possible improvements

- Current procedure is sensitive to cluster components



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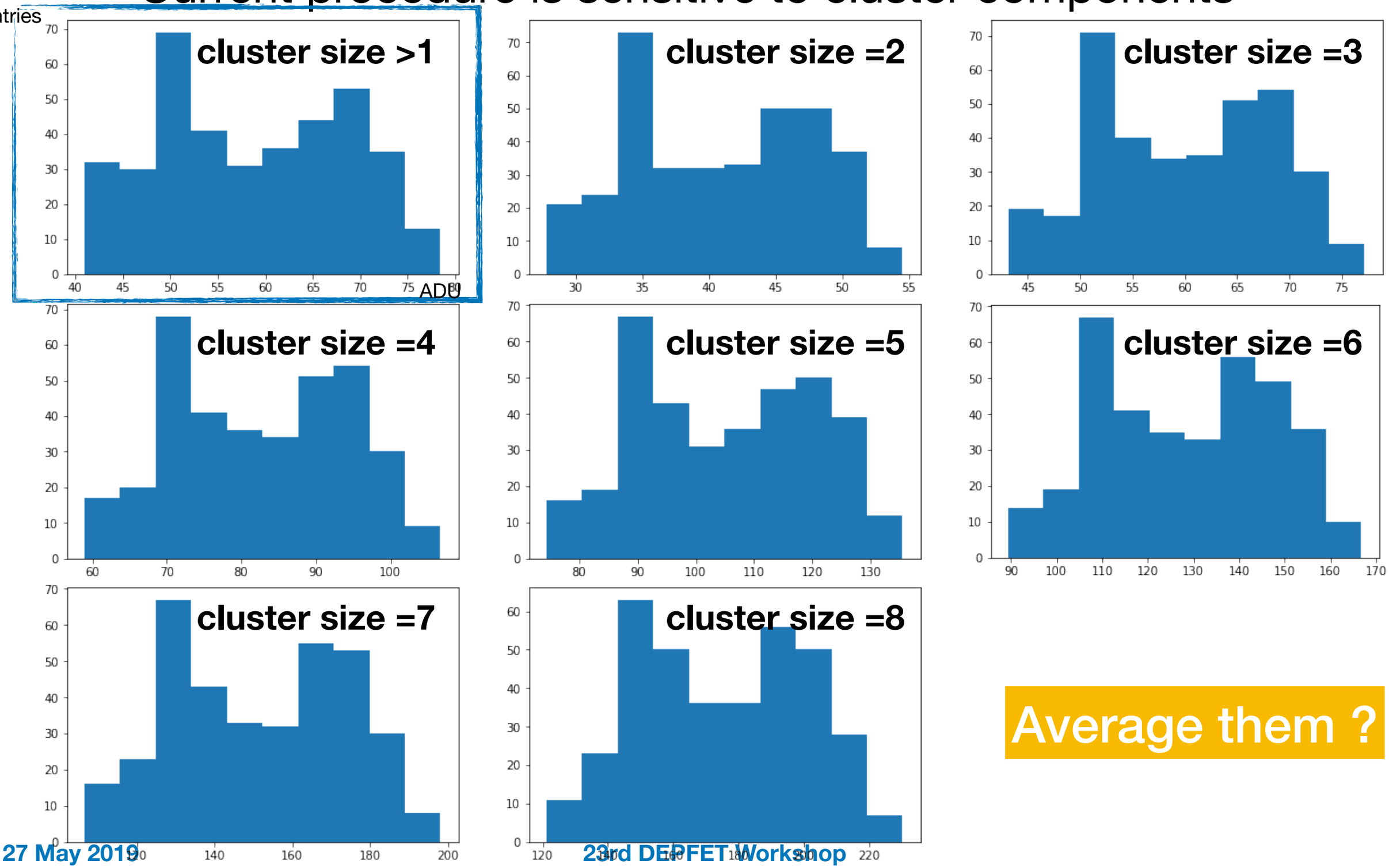

Average them ?

Photon Peak

- Module 1_3_1 e7r401

https://kds.kek.jp/indico/event/27591/contribution/10/material/slides/0.pdf
https://kds.kek.jp/indico/event/27872/contribution/14/material/slides/0.pdf
https://kds.kek.jp/indico/event/30835/contribution/3/material/slides/0.pdf