PRAD ANALYSIS SOFTWARE

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Outline

- Introduction

- Software structure

- Current status

- To-do list

- Summary

Introduction

■ Analysis software PRadDecoder (or PRadEventViewer with GUI)

 – *Mainly C++ code, dependent on Qt (GUI) and root (histogram, fitting, and so on)*

 – *Remote repository https://github.com/Chao1009/PRadEventViewer*

 – *Other contributors: Weizhi Xiong, Maxime Levillain, Xinzhan Bai*

■ Simulation PRadSim

 – *Full HyCal simulation, has GEM material and structure, but treated as an ideal position recorder smeared with 0.1 mm resolution*

 – *Remote repository https://github.com/Chao1009/PRadSim*

 – *Output is in data-file format, can be directly read by the analysis software*

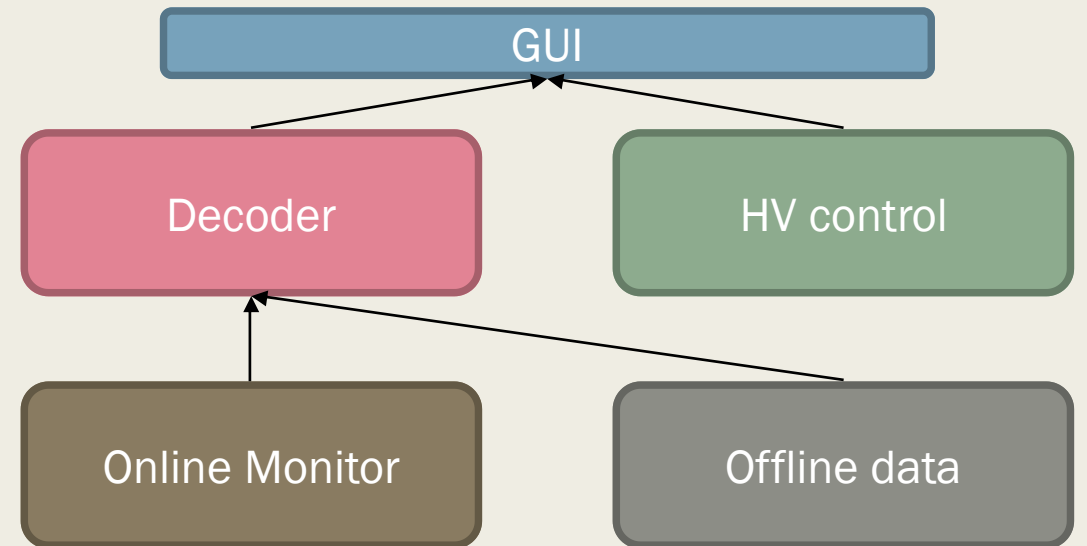 – *Other contributors: Maxime Levillain, Weizhi Xiong, Chao Gu*

Introduction

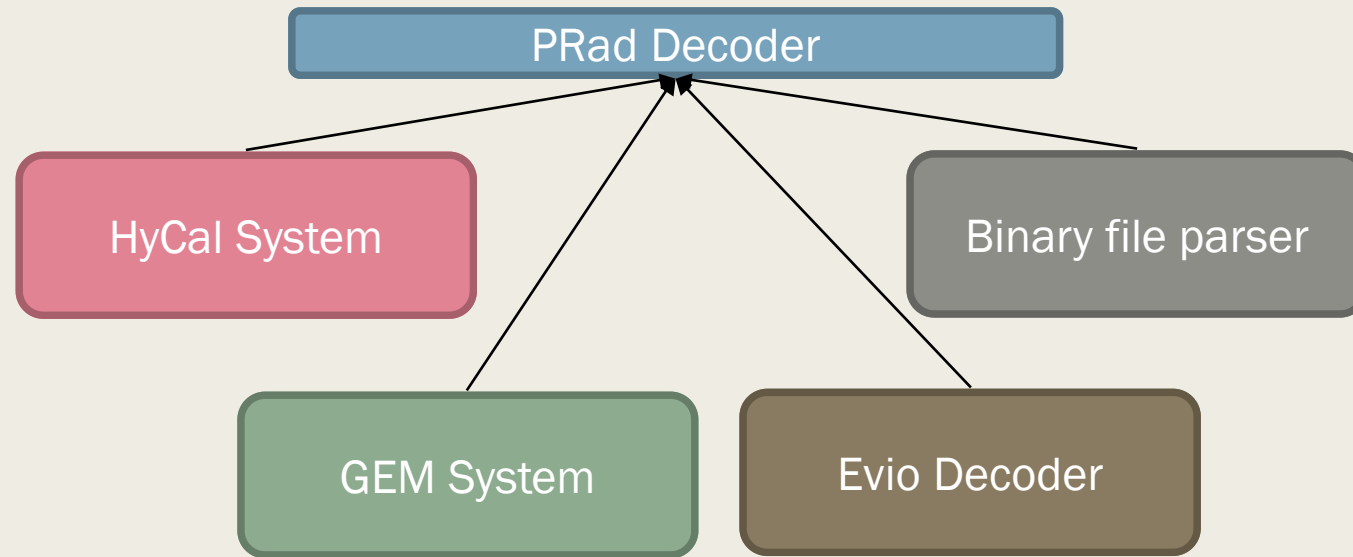- Read an event from simulation with GUI
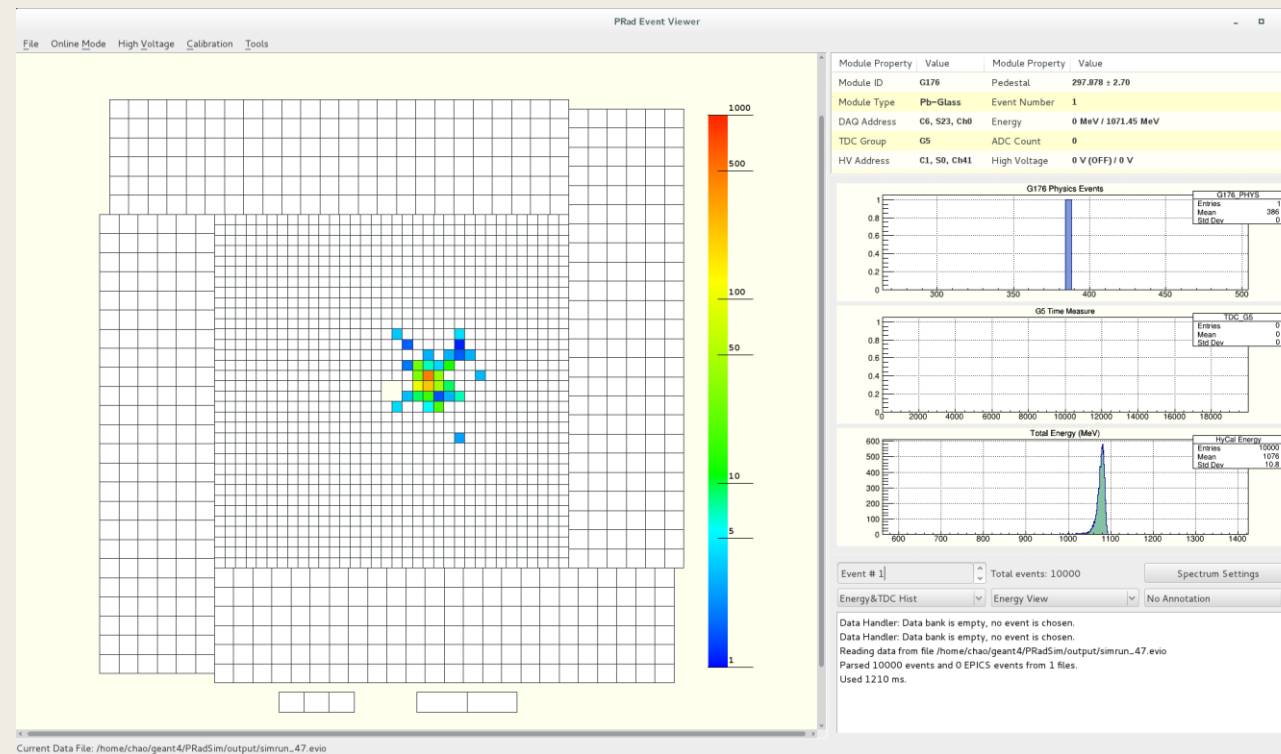
Software Structure

- Software package
  - *Decoder for both HyCal and GEM*
  - *GUI for HyCal, high voltage and data monitoring*
  - *High voltage control*
  - *Online data monitor*

- Decoder is a standalone library
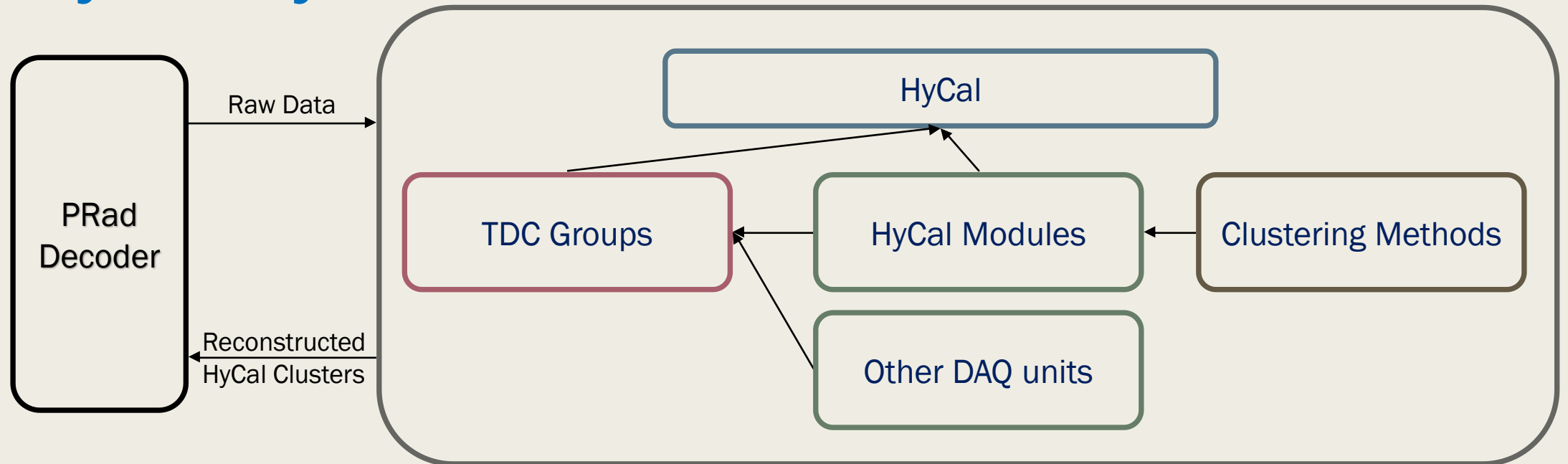 - *Can be used with other analysis software, such as root*

PRad Decoder Structure

- PRad Decoder
  - *Decoding evio files*
  - *Reconstruction on HyCal, GEM*
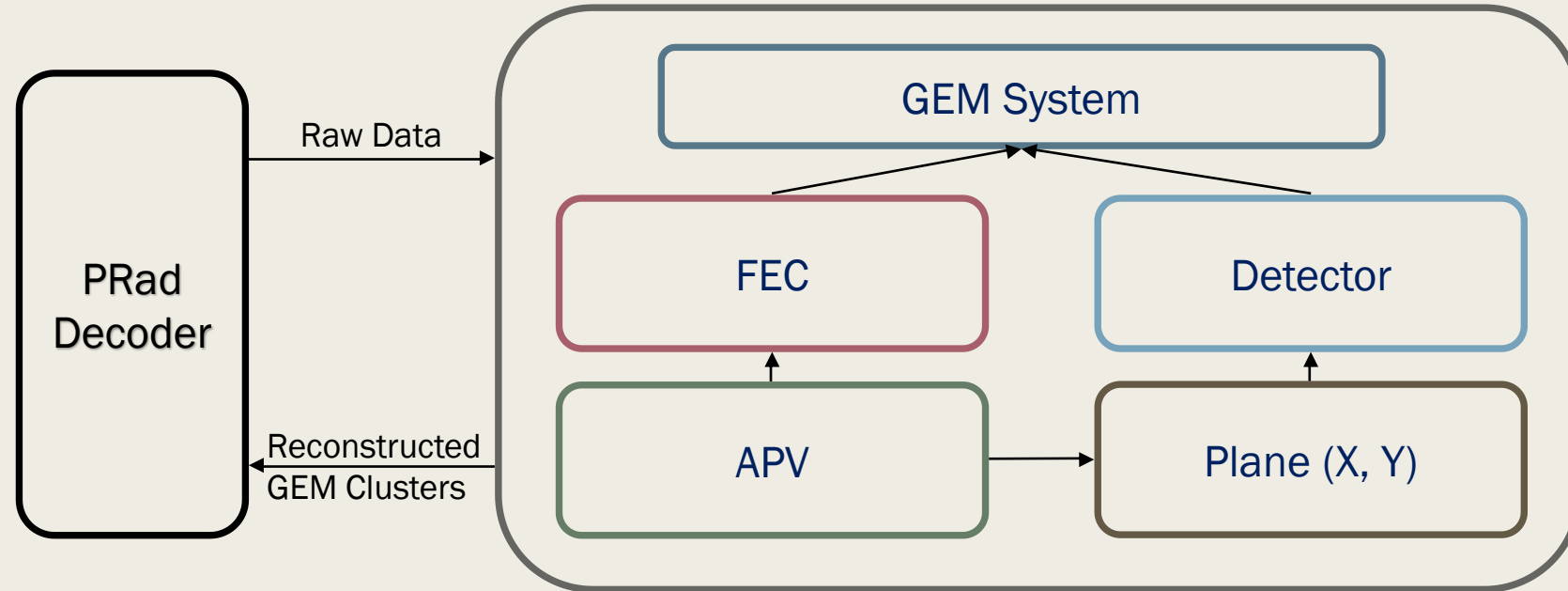 - *Save data to binary (DST) files*

HyCal System

- ■ HyCal Part
  - – *Clustering methods are from PrimEx (Ilya Larin)*
  - – *DAQ units (module, LMS PMT, scintillator PMT)*
  - – *TDC groups*
  - – *Clustering methods (Island, Square)*

GEM System

- GEM Part
  - *Decoding and clustering methods are from Xinzhan Bai and Kondo Gnanvo*
  - *DAQ part (FECs, contain APVs)*
  - *Physical part (2 detectors, each has two planes of strips, Cartesian type)*
  - *APVs are connected to GEM detector planes*

Current Status

■ Pre-process of the data (DONE)

    – *Decoding raw data file in CODA evio format*

    – *Get information about pedestal, gain by fitting experimental data*

    – *Replay the data file with zero-suppression*

    – *Replayed data available on PRad work space*

■ Reconstruction of the data (ONGOING)

    – *Finalizing clustering for HyCal and GEM*

    – *Finalizing calibration from snake-run, refine the calibration by physics events*

    – *Coordinates transform and matching among 2 GEM detectors and HyCal*

    – *Bad events rejection*

    – *Replay the zero-suppressed data on cluster level*

To-do list

- HyCal Clustering
  - *Tests with simulation, compare Square clustering (5x5) and Island clustering*
  - *Implement* energy correction *on edge, central hole and bad modules with the help from simulation and HyCal cluster profile from PrimEx*
  - *Know the energy and position* resolution
  - *Weizhi Xiong is mainly working with Ilya Larin on this part*

- GEM Clustering
  - *Tests on the clustering (cluster splitting, false-cluster rejection, and so on)*
  - *Know the position* resolution
  - *(Suggestion) Implement full simulation for GEM based on the code from SoLID*
  - *Xinzhan Bai is mainly working on this part*

To-do list

- Calibration
  - *Finalize the calibration from snake run*
  - *Maxime Levillain, Ilya Larin and Li Ye have been working on this part, now waiting for the final calibration constants*
  - *Refine the calibration constants based on physics events*
  - *? will work on this part*

- Coordinate system
  - *Get the XYZ offset for each detector in the beam center frame.*
  - *Study the tilting angles for each detector (? will work on this part)*
  - *Transform all the detectors to the beam center frame*
  - *Xinzhan Bai studied the coordinates offset between two GEM detectors*
 - *Weizhi Xiong is developing the coordinate system*

To-do list

- Bad events rejection

  - *False-clustering of cosmics on HyCal, messy showers from beam line, false-clustering on GEM*

  - *Cluster profile check on HyCal (Yuqi Yun from Duke is working with Weizhi Xiong)*

  - *Charge distribution, time samples and other criteria on GEM (Xinzhan Bai)*

  - *Coincidence between HyCal and GEM (Xinzhan Bai did some preliminary work)*

- Replay data

  - *Merge the contributions from all the aspects mentioned above*

  - *Replay the data on cluster level, only save necessary information (timing, energy, position, and etc)*

  - *Ready for cross section analysis*

To-do list
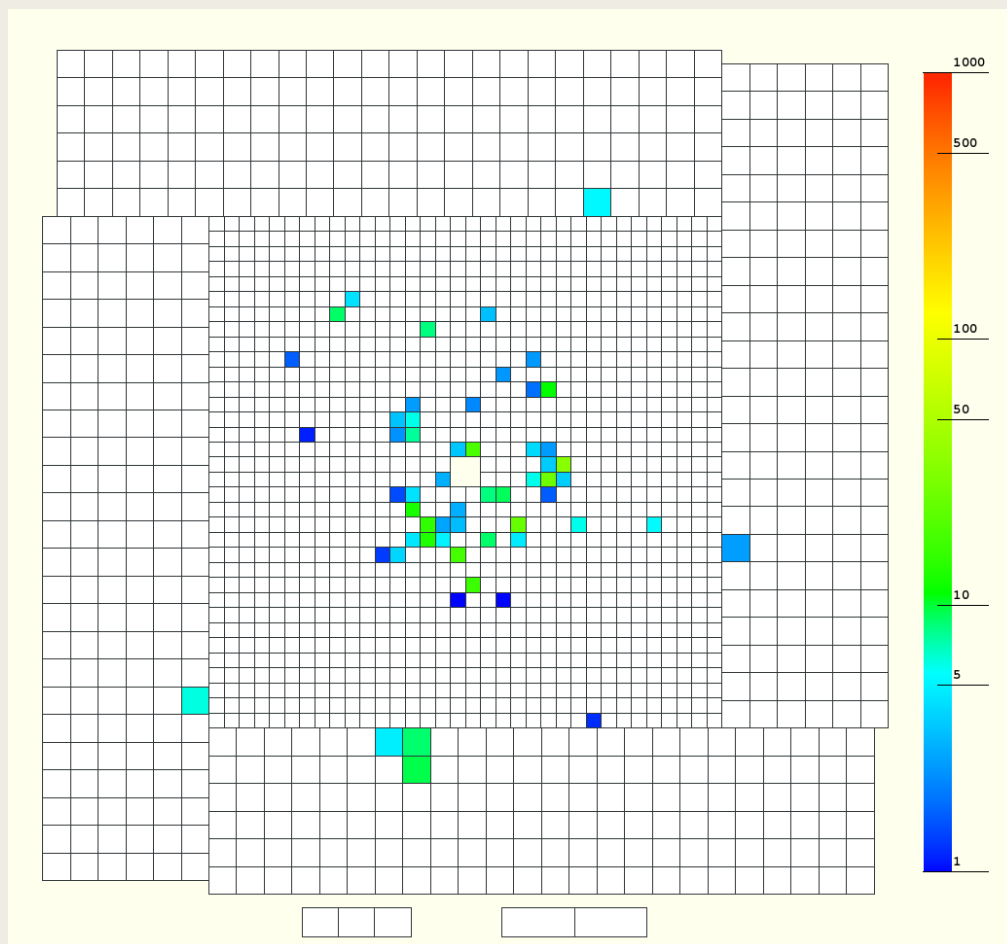
Messy shower
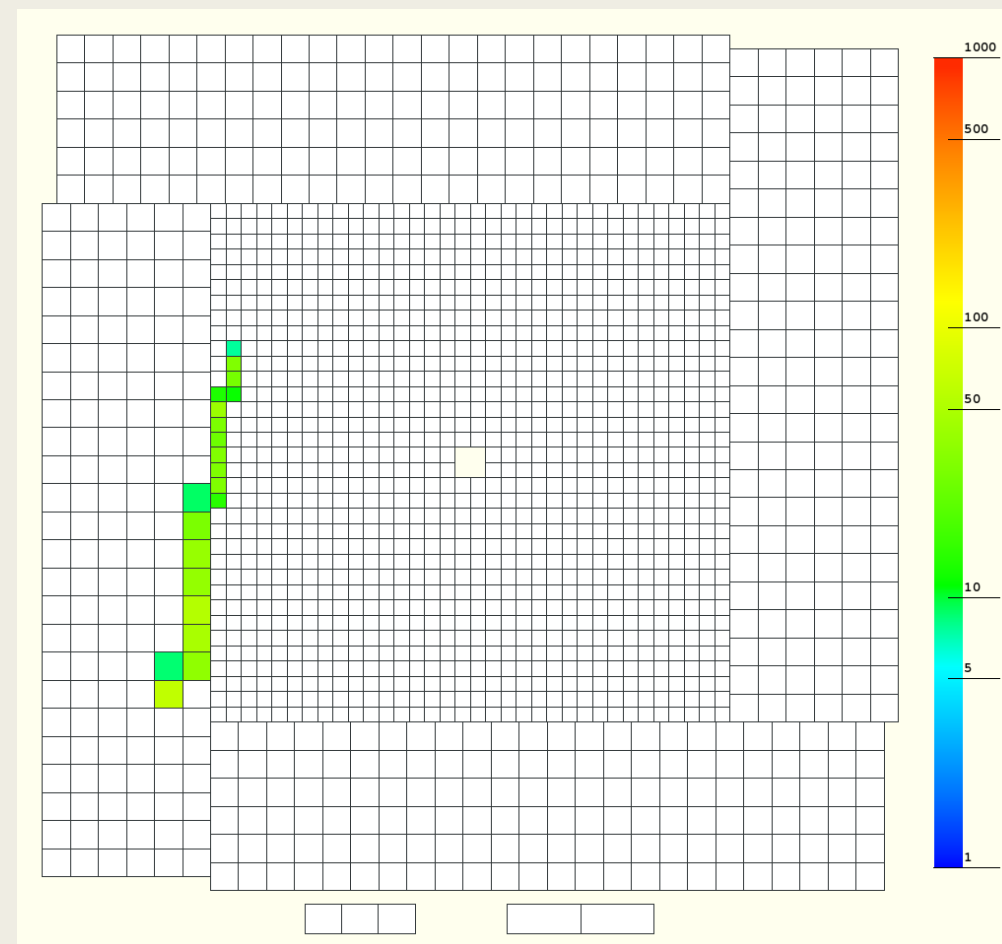
Cosmic

Summary

- We are working on the events information reconstruction, there are several items need to be done
  - *Clustering for both HyCal and GEM (Weizhi Xiong and Xinzhan Bai)*
  - *Calibration for physics run (?)*
  - *Coordinate transform (?)*
  - *Bad events rejection (Xinzhan Bai, Weizhi Xiong and Yuqi Yun)*

- Physics calibration and coordinate transform need a leading contributor
  - *Software framework will be provided*

- Once the events reconstruction is finalized, we can proceed to cross section analysis