# Improving the Hydra Classifier for Data Acquisition at GlueX

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## GlueX

- GlueX studies QCD by searching for exotic mesons[1]

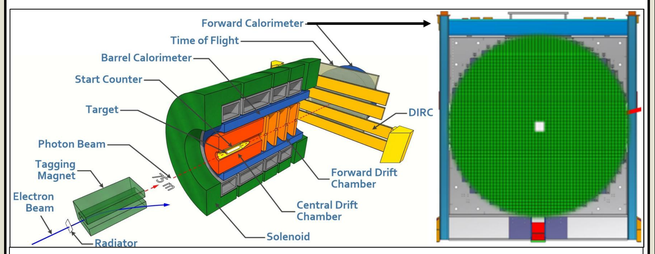



Figure 1: The GlueX detector (Left) and the FCAL Sub-Detector (Right)

- Electronics in the FCAL:
  - 2,800 channels
  - Up to 16 channels in a fADC
  - Up to 18 fADCs in a DAQ Crate
  - 12 DAQ crates in the FCAL
- Failure modes are easily visible in the occupancy plot

## Hydra

- Hydra is an extensible framework for training, managing, and evaluating AI
- Hydra aims to aid and support shift crew with data monitoring and collection
- Hydra's nominal FCAL model has five different labels, two of which are 'Good' and 'Bad'[2]

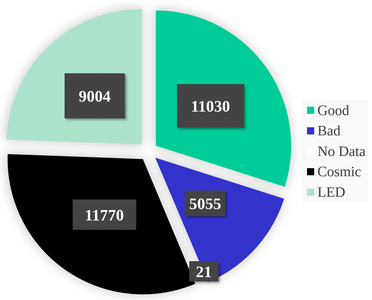



Figure 2: Plot classifications

- I aim to extend the FCAL's 'Bad' category to enable Hydra to identify broken fADC or DAQ crates

## Examples of 'Good' and 'Bad' Plots

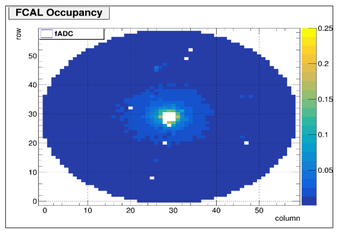



Figure 3(a): GOOD [3]

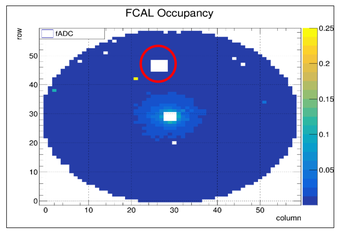



Figure 3(b): BAD fADC12_13

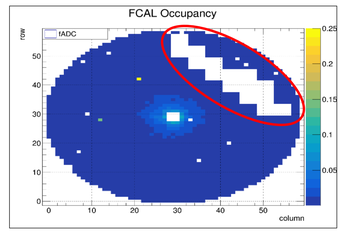



Figure 3(c): BAD Crate_17

## Research Questions

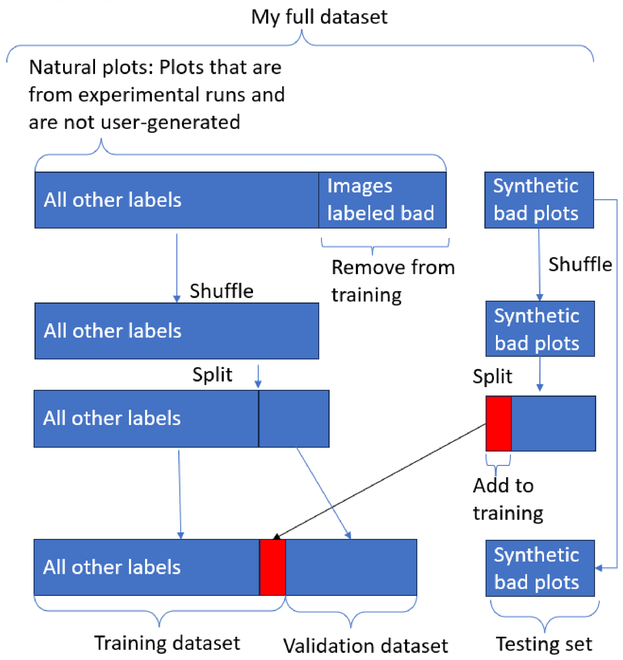
- Can our model recognize these plots that have broken electronics as 'Bad'? (Synthetic Knockout Experiment, SKE)
- Can we develop a non-machine learning algorithm that can be used to detect and identify what problem(s) exist in an image? (Non-ML Method)

### Problem: Plots that Never Occurred, Solution: The Knockout Plugin

- The Knockout plugin uses old runs to emulate a missing electronic component
- Can Hydra learn to identify 'all,' e.g., 'Bad fADC' and 'Bad Crate' problem states that may have never occurred?

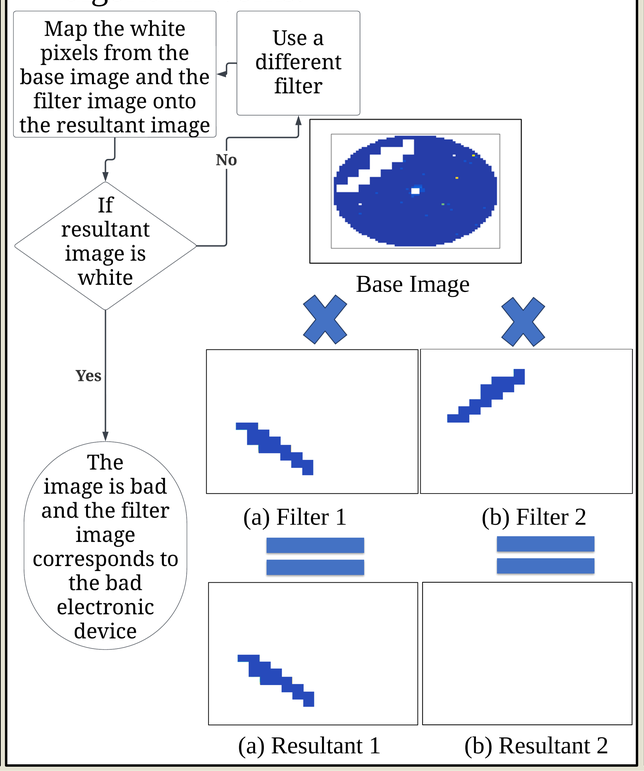
## Synthetic Knockout Experiment

- Aim: to determine how easy it is for Hydra to learn these synthetic knockout plots that I created using the Knockout plugin




## Non-ML Method

- Here's an overview of how the Non-ML algorithm works.




## SKE Results

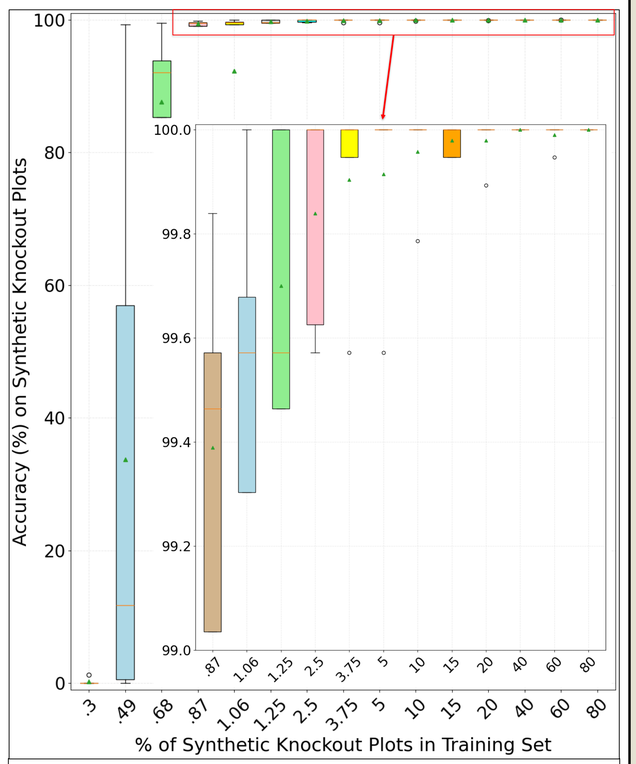



Figure 4: Results from SKE

## Non-ML Method

| | Algorithm Good | Algorithm Bad |
|---|---|---|
| Good | 11030 | 0 |
| Bad | 1275 | 5646 |

Table 1: Results from the Non-ML Method

- The 1275 here are plots that the algorithm currently does not account for

## Future Work

- Perform K-fold Cross-Validation (SKE)
- Add ~ 19 images from my synthetic bad plots in a normal Hydra training set
- Integrate the Non-ML algorithm in Hydra's workflow such that when Hydra flags something as 'bad,' the algorithm can tell you which exact fADC/Crate is broken (provided this algorithm is further optimized)

GlueX Acknowledgements: gluex.org/thanks

Acknowledgments and References