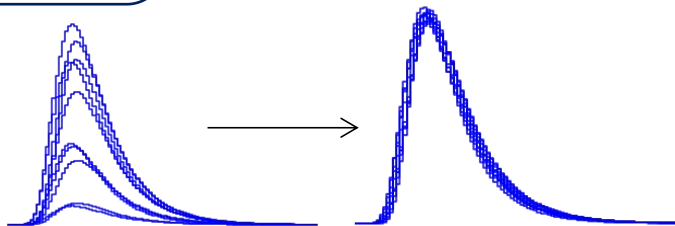


## Inputs

- Set of histograms per luminosity section.
- Cluster charge distributions split by region: BPIX L2, L3, L4, FPIX- D1, D2, D3, FPIX+ D1, D2, D3.

## Preprocessing

- Normalization.
- Filter on detector status.
- Filter on sufficient number of entries.



## Training set

- Large body of unlabeled data.

## Single histogram models

- Unsupervised anomaly detection methods.
- Several models are studied and compared.

autoencoder

NMF

...

LS

BPIX L2

score

BPIX L3

score

...

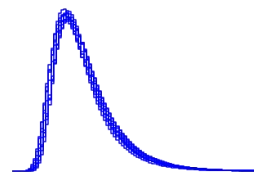
score

FPIX+ D3

score

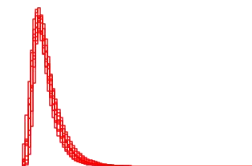
## Good test set

- Additional filters.

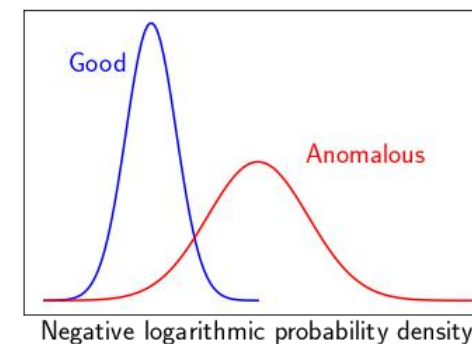


## Anomalous test set

- Predefined bad runs.
- Resampled to increase statistics.



## Testing and results



## Combination

- Fit multidimensional probability density to scores for training set.
- Low probability density indicates anomaly