MD Proposal:

BLM Spike pattern recognition for automatic collimation alignment

Motivation

- The collimators alignment starts the movement of nearly 100 collimators in parallel to approach them to the beam while monitoring the 100Hz stream of BLM data.

- If the closest BLM has a spike above a pre-selected thresholds the involved collimator is automatically stopped.

- At present, the user is required to manually determine if a collimator has touched the beam or if the spike is due to other sources, for example due to cross-talk from an upstream collimators that has touched the beam.

- In addition, the loss threshold must also be manually increased for the collimator to continue approaching the beam.

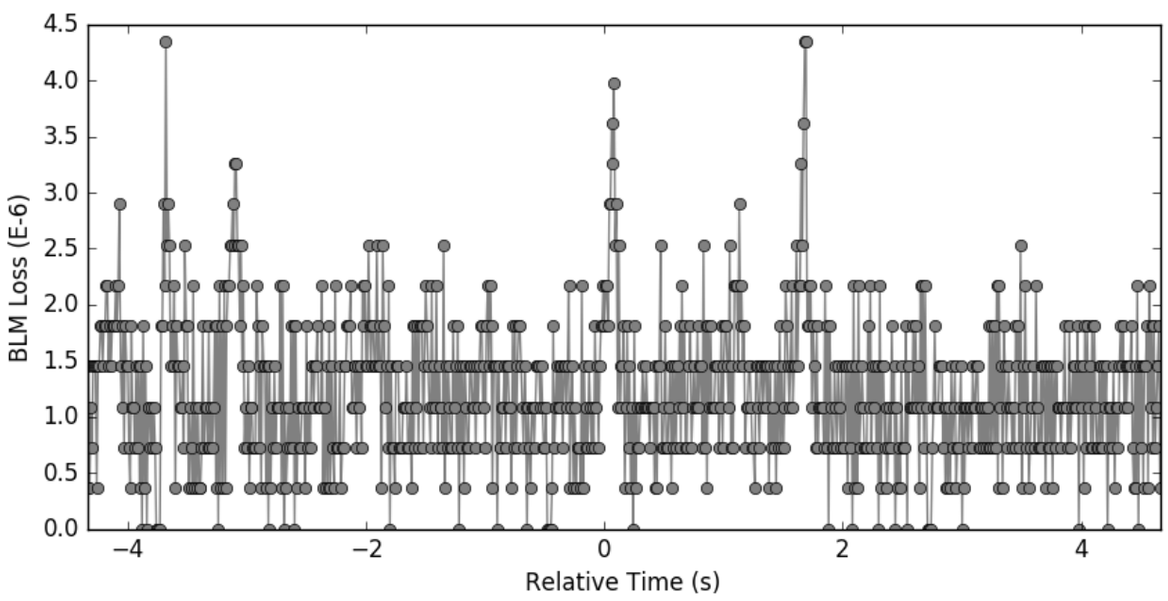
- This process needs to be automated in order to save time between each alignment movement.

Required test

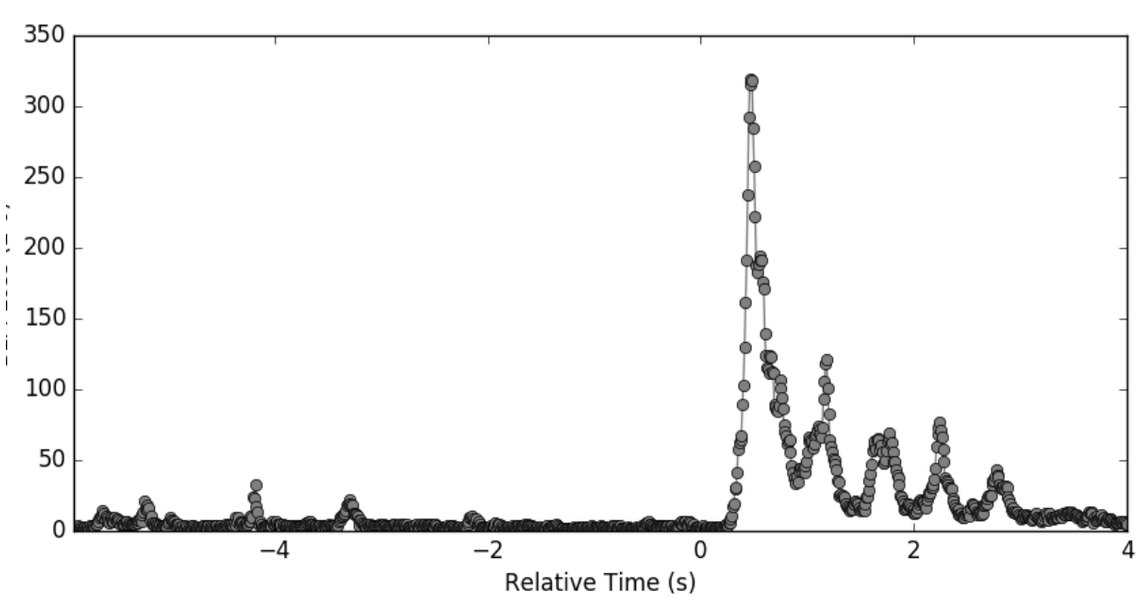
- Adding Machine Learning models to the new FESA class allows for automatically classifying loss spikes, the decision made will be logged for offline analysis.

- Example:

<u>*No Spike*</u>



<u>*Spike*</u>



- Moreover, adding a threshold selection method to the FESA class allows for automatically selecting a new threshold each time a collimator is moved inwards.

MD request

- Beam **below SBF at injection** energy: 1-3 nominal bunches or equivalent in pilot bunches

- Only one beam (no preference)

- Procedure: Start collimator alignment at injection and get the classification of the spikes during the alignment

- Time: **4 hours**

Implementation

- Spike Classification - A combination or one of the following Machine Learning models will be used:

  Logistic Regression, Neural Network, SVM, Decision Tree, Random Forest

  These models have been trained on previous alignments and will be used to predict future spikes.

- Threshold Selection - The idea is to create a buffer of preceding data (10 seconds) and use its average to deduce an ideal threshold for the current collimator position.