Progress Report on Thesis (G_M^n)

Provakar Datta

BBCAL Calibration and Analysis Update

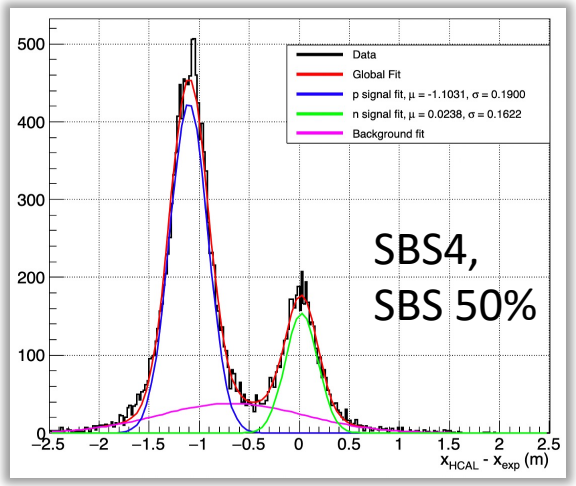
Configuration	E_{beam} (GeV)	$E_{e'}$ (GeV)	Magnet Current (A)		QA Plots OK?
			BB	SBS	
SBS-4	3.728	2.11	750	0	✓
			750	630	✓
			750	1050	✓
SBS-7	7.906	2.67	750	1785	✓
SBS-11	9.91	2.67	750	0	✓
			750	2100	✓
SBS-14	5.965	2.00	750	0	✓
			750	1470	✓
SBS-8	5.965	3.59	750	0	✓
			750	1050	✓
			750	1470	✓
			750	2100	✓
SBS-9	4.015	1.63	750	1470	✓

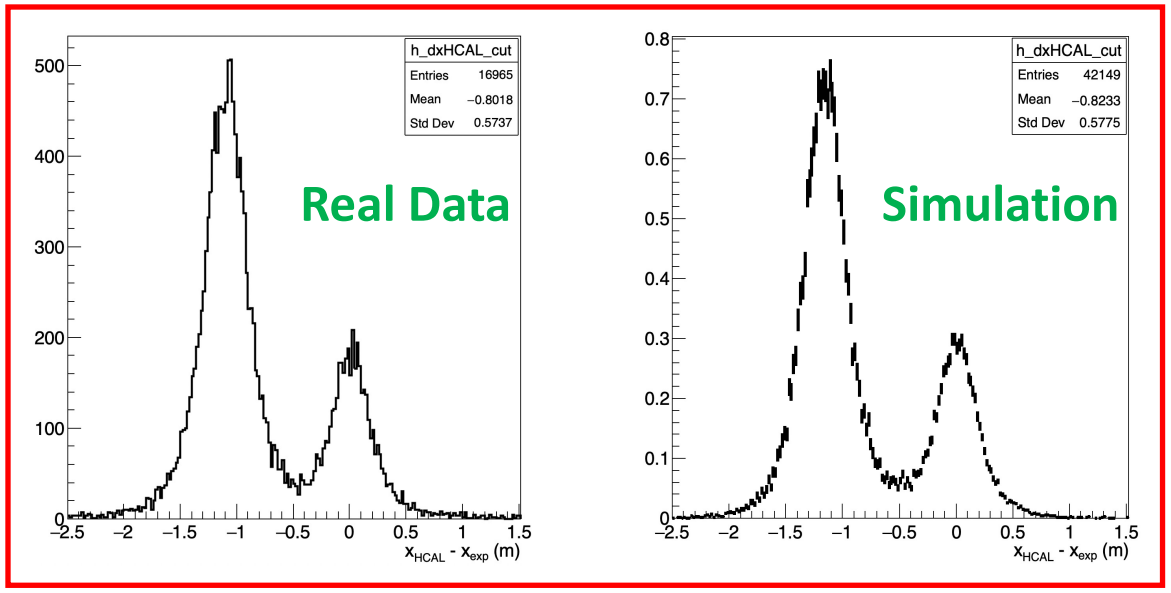
- Finished preliminary BBCAL energy calibration for all 13 different settings across 6 different SBS configurations. Achieved **5.9%** energy resolution at 3.6 GeV e^- energy.
- Preliminary ADC time offset correction with respect to BBHodo time is also done.
- Produced calibration quality assurance (QA) plots using both 1st and 2nd pass QA replay for all the SBS configurations. Concluded, BBCAL is ready for 1st pass cooking. All the plots can be found here.
- Currently investigating charge pile up effect for SBS11.

Future Work:

- Will work on fine tuning the calibration once 1st pass cooking is complete.

General G_M^n Analysis Update





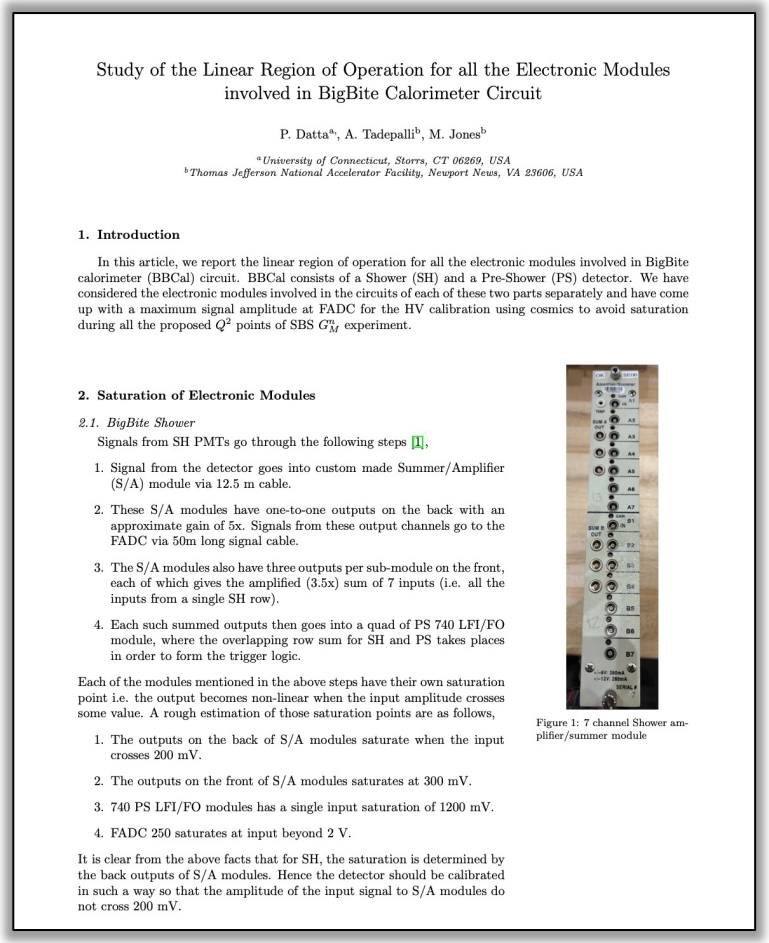
- Very crudely extracted G_M^n for SBS4.
- Successfully built LIBSBSDIG.
- Fixed HCAL simulation DB.
- Simulated, digitized, and then reconstructed QE events for SBS4 generated using existing elastic generator in g4sbs.
- Comparison between real data and simulation looks promising.
- Created GMn analysis framework to avoid duplication of scripts and improve efficiency.

Future Work:

- Make use of the well-built event generators in SIMC. [Eric & Sheren are working on it]
- Produce similar plots for other SBS configurations once 1st pass cooking is complete.

❖ Planning to graduate by Summer 2023.

Writing Documentations



Study of the Linear Region of Operation for all the Electronic Modules involved in BigBite Calorimeter Circuit

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1. Introduction

In this article, we report the linear region of operation for all the electronic modules involved in BigBite calorimeter (BBCal) circuit. BBCal consists of a Shower (SH) and a Pre-Shower (PS) detector. We have considered the electronic modules involved in the circuits of each of these two parts separately and have come up with a maximum signal amplitude at FADC for the HV calibration using cosmics to avoid saturation during all the proposed Q^2 points of SBS G_M^n experiment.

2. Saturation of Electronic Modules

2.1. BigBite Shower

Signals from SH PMTs go through the following steps [1],

1. Signal from the detector goes into custom made Summer/Amplifier (S/A) module via 12.5 m cable.
2. These S/A modules have one-to-one outputs on the back with an approximate gain of 5x. Signals from these output channels go to the FADC via 50m long signal cable.
3. The S/A modules also have three outputs per sub-module on the front, each of which gives the amplified (3.5x) sum of 7 inputs (i.e. all the inputs from a single SH row).
4. Each such summed outputs then goes into a quad of PS 740 LFI/FO module, where the overlapping row sum for SH and PS takes places in order to form the trigger logic.

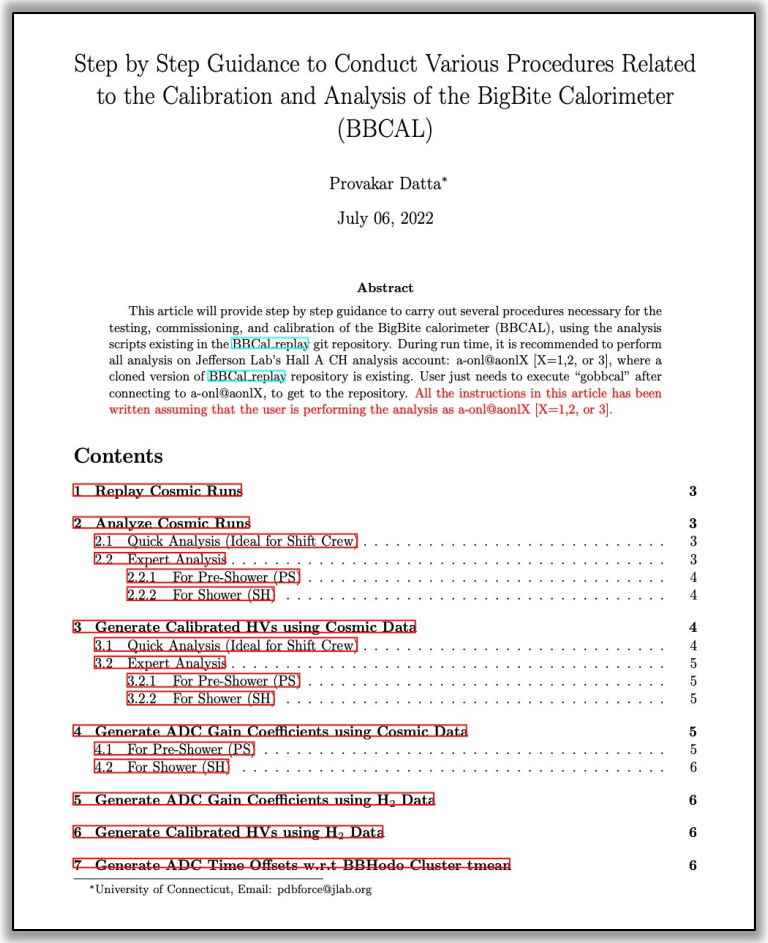
Each of the modules mentioned in the above steps have their own saturation point i.e. the output becomes non-linear when the input amplitude crosses some value. A rough estimation of those saturation points are as follows,

1. The outputs on the back of S/A modules saturate when the input crosses 200 mV.
2. The outputs on the front of S/A modules saturates at 300 mV.
3. 740 PS LFI/FO modules has a single input saturation of 1200 mV.
4. FADC 250 saturates at input beyond 2 V.

It is clear from the above facts that for SH, the saturation is determined by the back outputs of S/A modules. Hence the detector should be calibrated in such a way so that the amplitude of the input signal to S/A modules do not cross 200 mV.

Figure 1: 7 channel Shower amplifier/summer module

[Documentation on BBCAL Front-End](#)



Step by Step Guidance to Conduct Various Procedures Related to the Calibration and Analysis of the BigBite Calorimeter (BBCAL)

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Abstract

This article will provide step by step guidance to carry out several procedures necessary for the testing, commissioning, and calibration of the BigBite calorimeter (BBCAL), using the analysis scripts existing in the BBCal_replay git repository. During run time, it is recommended to perform all analysis on Jefferson Lab's Hall A CH analysis account: a-onl@aonlX [X=1,2, or 3], where a cloned version of BBCal_replay repository is existing. User just needs to execute "gobbcal" after connecting to a-onl@aonlX, to get to the repository. All the instructions in this article has been written assuming that the user is performing the analysis as a-onl@aonlX [X=1,2, or 3].

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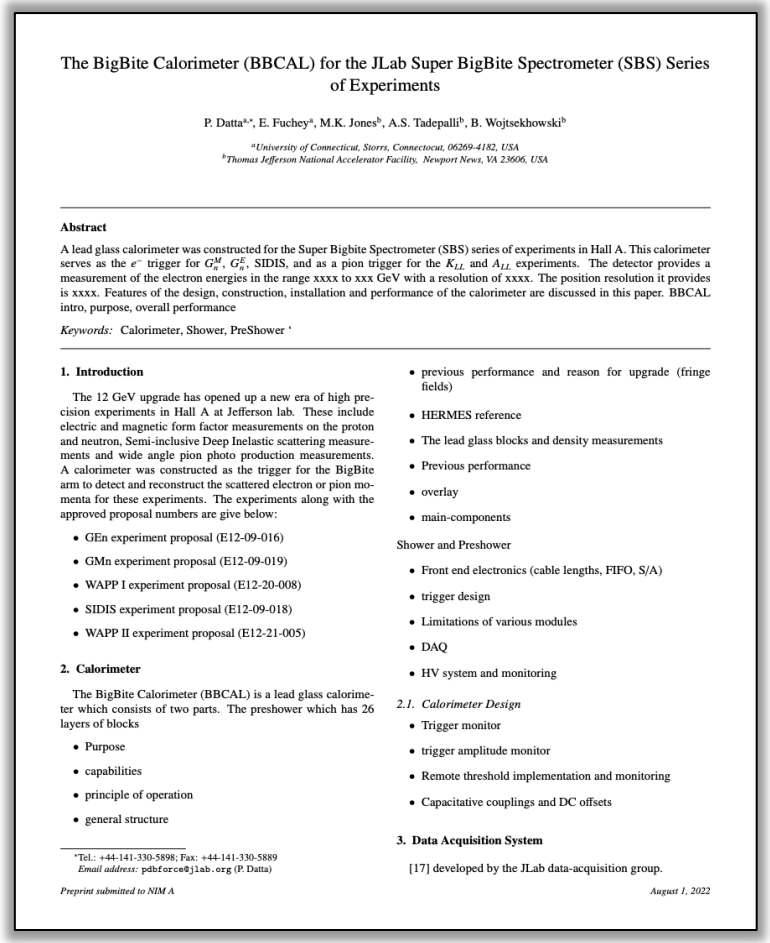
Procedure wise How-to for BBCAL*



The BigBite Calorimeter (BBCAL) for the JLab Super BigBite Spectrometer (SBS) Series of Experiments

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Abstract

A lead glass calorimeter was constructed for the Super Bigbite Spectrometer (SBS) series of experiments in Hall A. This calorimeter serves as the e^- trigger for G_E^M, G_E^E, SIDIS, and as a pion trigger for the K_{LL} and A_{LL} experiments. The detector provides a measurement of the electron energies in the range xxxx to xxx GeV with a resolution of xxxx. The position resolution it provides is xxxx. Features of the design, construction, installation and performance of the calorimeter are discussed in this paper. BBCAL intro, purpose, overall performance

Keywords: Calorimeter, Shower, PreShower '

1. Introduction

The 12 GeV upgrade has opened up a new era of high precision experiments in Hall A at Jefferson lab. These include electric and magnetic form factor measurements on the proton and neutron, Semi-inclusive Deep Inelastic scattering measurements and wide angle pion photo production measurements. A calorimeter was constructed as the trigger for the BigBite arm to detect and reconstruct the scattered electron or pion momenta for these experiments. The experiments along with the approved proposal numbers are give below:

- GEn experiment proposal (E12-09-016)
- GMn experiment proposal (E12-09-019)
- WAPP I experiment proposal (E12-20-008)
- SIDIS experiment proposal (E12-09-018)
- WAPP II experiment proposal (E12-21-005)

2. Calorimeter

The BigBite Calorimeter (BBCAL) is a lead glass calorimeter which consists of two parts. The preshower which has 26 layers of blocks

- Purpose
- capabilities
- principle of operation
- general structure
- previous performance and reason for upgrade (fringe fields)
- HERMES reference
- The lead glass blocks and density measurements
- Previous performance
- overlay
- main-components

Shower and Preshower

- Front end electronics (cable lengths, FIFO, S/A)
- trigger design
- Limitations of various modules
- DAQ
- HV system and monitoring

2.1. Calorimeter Design

- Trigger monitor
- trigger amplitude monitor
- Remote threshold implementation and monitoring
- Capacitative couplings and DC offsets

3. Data Acquisition System

[17] developed by the JLab data-acquisition group.

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BBCAL NIM*

*Work in progress.

Thank You!

Questions? Comments?