



HERD Trigger Sub-System Design and Preliminary beam test results




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Introduction

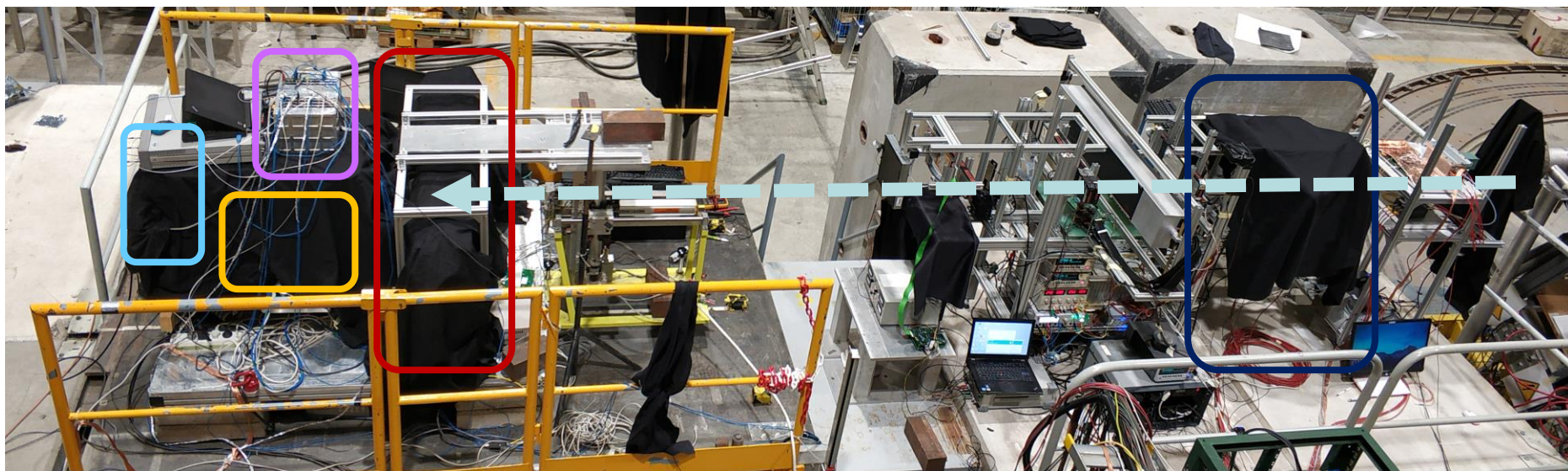
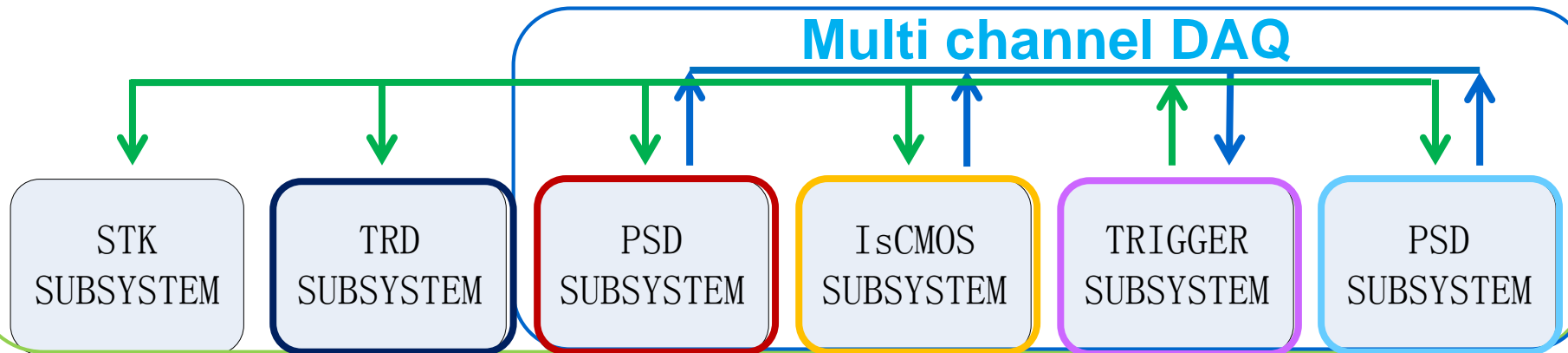


HERD Trigger Sub-System Design and Preliminary beam test results

-  Trigger sub-system design
-  Beam test and DAQ status
-  Preliminary beam test results

Trigger sub-system: role in the beam test

Trigger distribution and calibration LD driving



Trigger sub-system construction

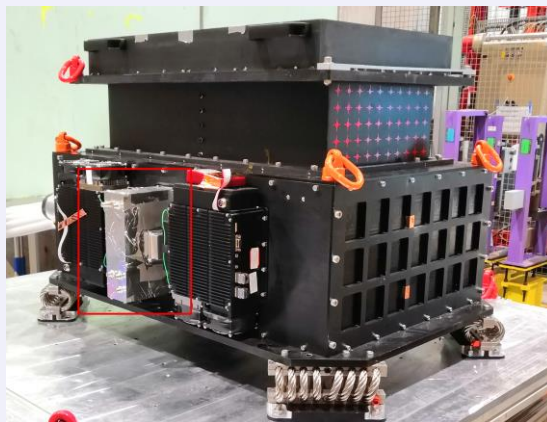
Trigger sub-system layout

Trigger fiber cluster and Attenuator



- 500 channels trigger fiber from CALO cell
- Attenuator transmittance: 1%

PMT and Front-end electronics



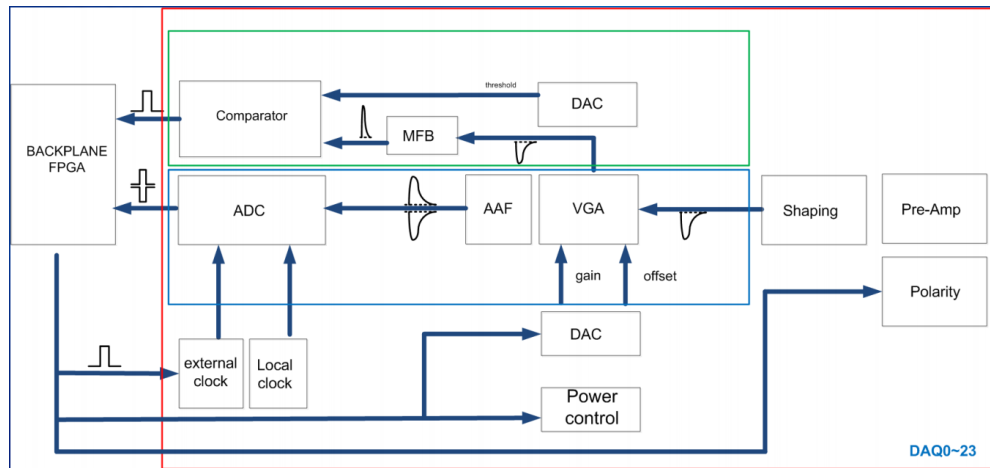
- Anode and dynode readout
- Preamplifier and Shaper integrated

Multi channel DAQ electronics



- 125MSPS \times 14bit continuous waveform acquisition
- Double channels readout

Multi channel DAQ system : v.2017 vs. v.2018



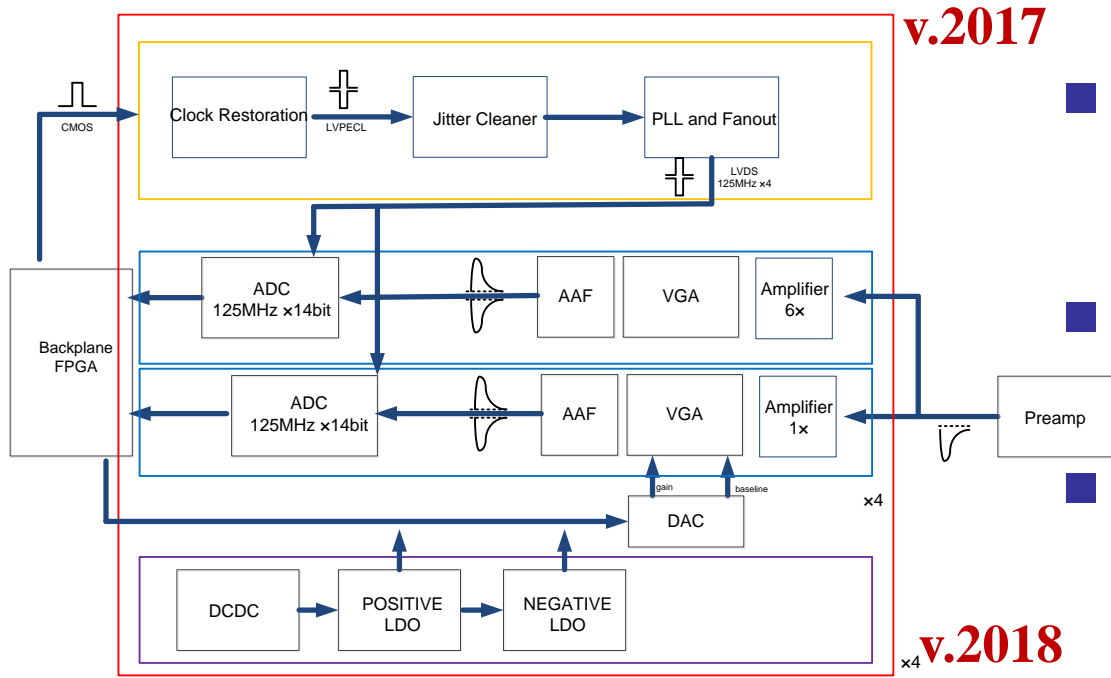
- From 20 ch \times 80MSPS \times 12bits to 32 ch \times 125MSPS \times 14bits

- New hardware: low jitter clock generation and distribution

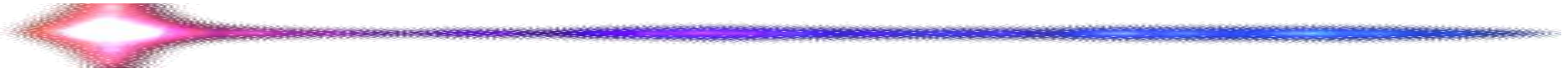
- New hardware: double channels readout to improve effective dynamic range

- New hardware: low voltage power supply noise rejection

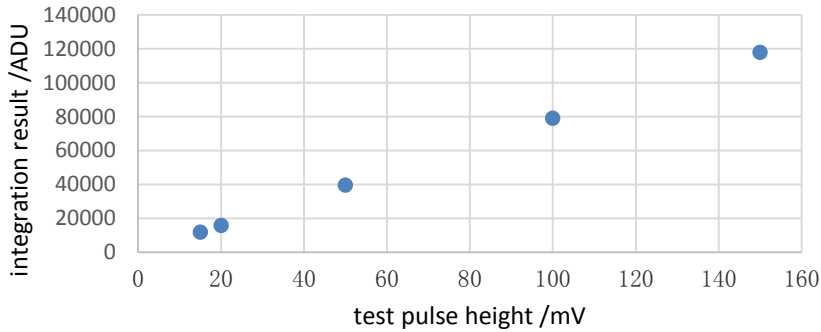
- New firmware: 100us \times 125MSPS continuous waveform acquisition



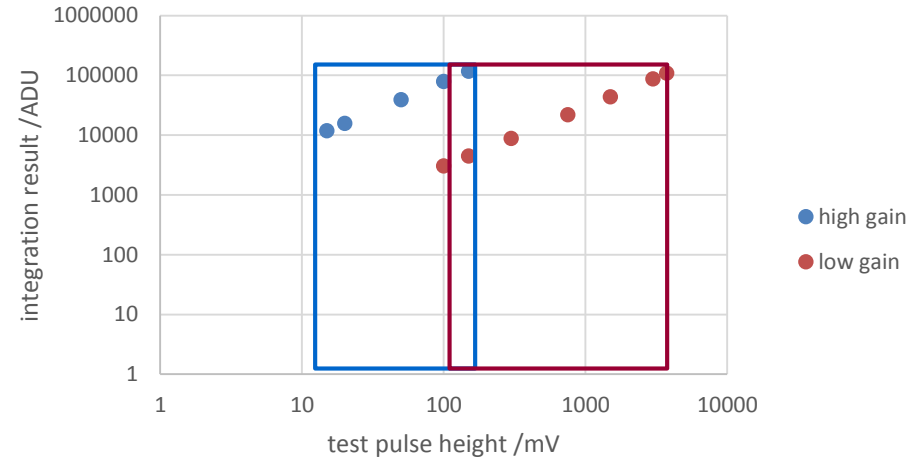
Double channels readout to improve the effective dynamic range



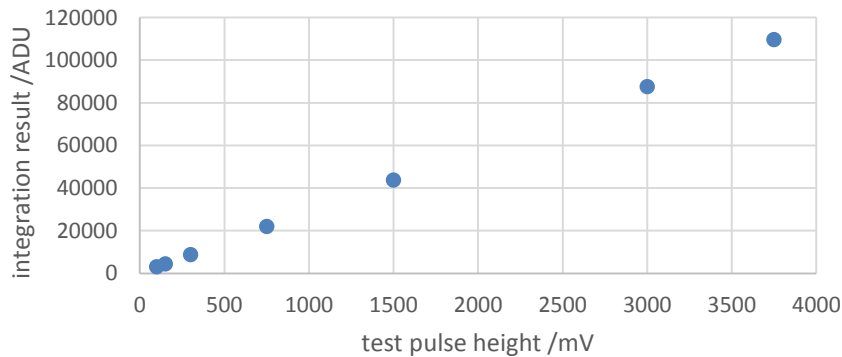
Test pulse high gain readout



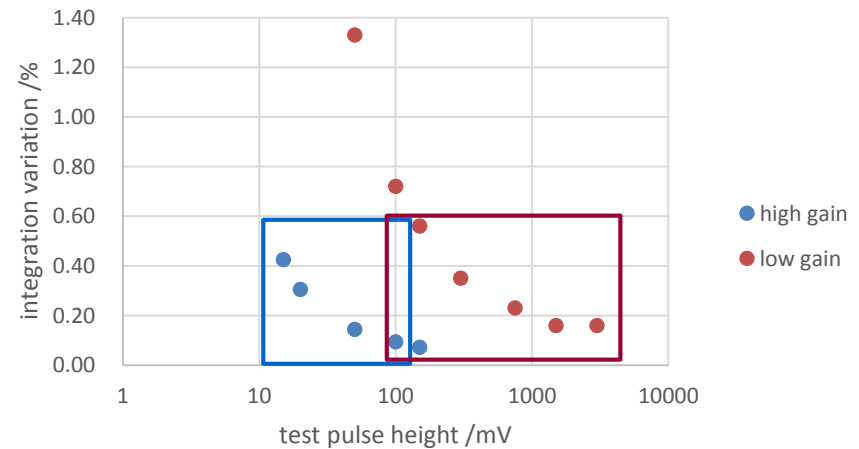
Test integration readout



Test pulse low gain readout



Test integration readout variation



Multi channel DAQ during beam test

Real-time waveform monitor

数据采集系统控制平台

硬件状态: USB1已连接 USB2已连接
采集状态: 正在采集
当前文件: 20181029-145515
采集模式: 示波器模式
总线带宽: 0.524 MB/s
PS触发计数: 14706
当前时间戳: 3天15时31分6秒
触发模式: 束流TTL触发
初始化状态: N/A %
发送命令:
80E0000A00000000
触发系统F计数: 0
触发系统DY6计数: 0
触发系统DY7计数: 0
中子脉冲计数1: 14800
中子脉冲计数2: 14599

系统初始化 PS计数清0 转ROOT
新建采集 开始采集 停止采集

横轴: 13bits 纵轴: 对数坐标

所选通道信息
通道号: 10
计数率: N/A cps
实测堆积率: N/A %
峰位: N/A
能量分辨率: N/A %

参数调节
通道使能 系统复位
子板0开关 N/A 子板2开关 N/A
子板1开关 N/A 子板3开关 N/A
开关正高压 N/A N/A 设置高压A V
开关负高压 N/A N/A 设置高压B V
事例生成方式 自触发积分 采集模式切换 离线分析
触发模式 束流TTL触发
设置周期触发频率 Hz N/A
秒脉冲时间跳清0 同步下发当前系统时间 N/A
设置积分长度 ns
设置参考光源脉冲宽度 ns
框中输入8字节控制
发送命令
触发阈值 86
VGA增益(倍数) 增益(倍数)显示
基线偏置(mv) 基线值(mv)显示

示波器 第7打拿极 第8打拿极 阳极 标准光源 长条FSD 长条FSD 小块FSD 中子能谱 MAP 塑闪中子波形1 塑闪中子波形2

示波器

4,000
3,800
3,600
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0

0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1,000

40
35
30
25
20
15
10
5
0

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120

Multi channel DAQ during beam test

Real-time histogram, count rate, peak and FWHM

触发系统测试平台

硬件状态: USB1已连接 USB2已连接
采集状态: 正在采集.....
当前文件: 20181029-172440
采集模式: 能量模式
总线带宽: 2.097 MB/s
PS触发计数: 30370
当前时间戳: 3天19时3分53秒
触发模式: N/A
初始化状态: N/A %
发送命令:
8010001000000000
触发系统P计数: 0
触发系统DY6计数: 0
触发系统DY7计数: 0
中子计数1: 30375
中子计数2: 30375

系统初始化 PS计数清0 转ROOT
新建采集 开始采集 停止采集

横轴: 13bits 纵轴: 对数坐标

所选通道信息
通道号: 0
计数率: N/A cps
实测堆积率: N/A %
峰位: N/A
能量分辨率: N/A %

道使能 系统复位

参数调节

子板0开关 N/A 子板2开关 N/A
子板1开关 N/A 子板3开关 N/A

开关正高压 N/A N/A 设置高压A V
开关负高压 N/A N/A 设置高压B V

事例生成方式 | 自触发积分 | 采集模式切换 | 离线分析

触发模式 N/A

设置周期触发频率 Hz N/A

秒脉冲冲时间戳清0 同步下发当前系统时间 N/A

设置积分长度 ns

设置参考光源脉冲宽度 200 ns

框中输入8字节控制

发送命令

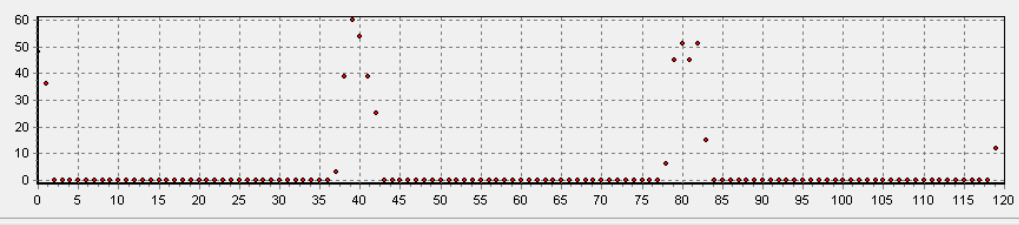
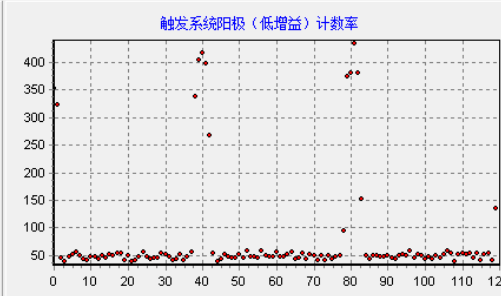
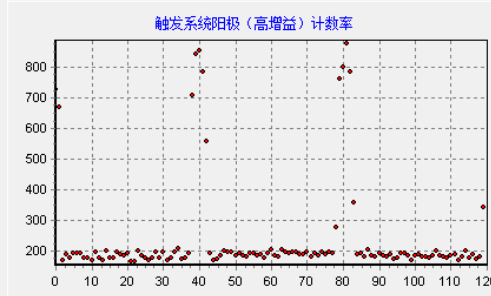
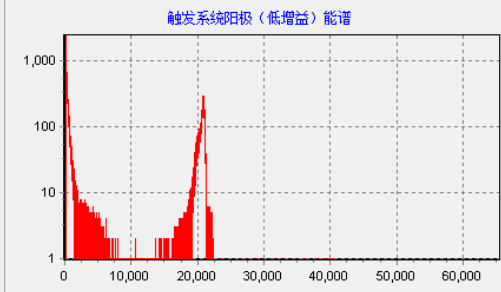
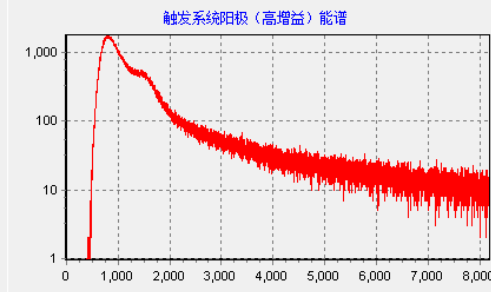
触发阈值 触发阈值显示

VGA增益(倍数) 增益(倍数)显示

基线偏置(mv) 基线值(mv)显示

- 0 16
- 1 17
- 2 18
- 3 19
- 4 20
- 5 21
- 6 22
- 7 23
- 8 24
- 9 25
- 10 26
- 11 27
- 12 28
- 13 29
- 14 30
- 15 31

示波器 第7打拿极 第8打拿极 阳极 标准光源 长条PSD 长条FSD 小块PSD 中子能谱 MAP 塑闪中子波形1 塑闪中子波形2



Multi channel DAQ during beam test

100us × 125MSPS continuous waveform

硬件状态: USB1已连接 USB2已连接
采集状态: 正在采集.....
当前文件: 20181030-021411
采集模式: 能量模式
总线带宽: 1.049 MB/s
FS触发计数: 10132
当前时间戳: 4天2时36分55秒
触发模式: N/A
初始化状态: N/A %
发送命令:
8010000000000000
触发系统F计数: 0
触发系统DYB计数: 0
触发系统DTT计数: 0
中子帧计数1: 10136
中子帧计数2: 10136

系统初始化 PS计数清0 转ROOT

新建采集 开始采集 停止采集

横轴: 17bits 纵轴: 对数坐标

所选通道信息
通道号: 0
计数率: N/A cps
实测堆积率: N/A %
峰位: N/A
能量分辨率: N/A %

通道使能 系统复位

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14

参数调节

子板0开关 N/A 子板2开关 N/A
子板1开关 N/A 子板3开关 N/A

开关正高压 N/A N/A 设置高压A [] V
开关负高压 N/A N/A 设置高压B [] V

事例生成方式 自触发积分 采集模式切换 离线分析

触发模式 N/A

设置周期触发频率 [] Hz N/A

秒脉冲时间戳清0 同步下发当前系统时间 N/A

设置积分长度 [] ns
设置参考光源脉冲宽度 [0] ns

框中输入8字节控制 [] 发送命令

触发阈值 触发阈值显示 []

VGA增益(倍数) 增益(倍数)显示 []

基线偏置(mv) 基线值(mv)显示 []

示波器 第7打拿极 第8打拿极 阳极 标准光源 长条PSD 长条PSD 小块PSD 中子能谱 MAP 塑闪中子波形1 塑闪中子波形2

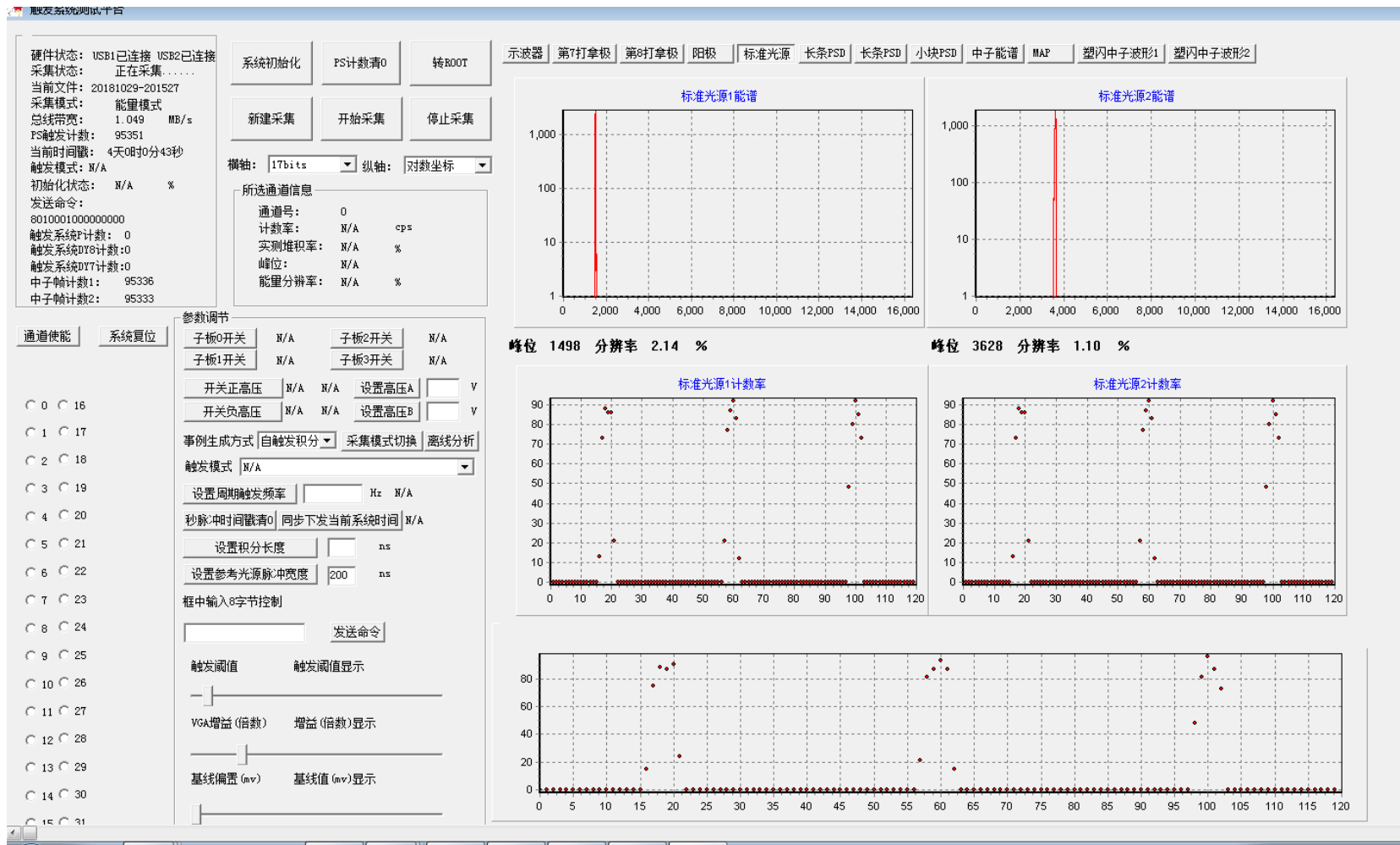
塑闪中子波形2

This scatter plot displays the data for '塑闪中子波形2'. The vertical axis (y-axis) represents the signal amplitude, ranging from 0 to 4,000 with major ticks every 200 units. The horizontal axis (x-axis) represents the time or event index, ranging from 0 to 13,000 with major ticks every 1,000 units. The data points are represented by small red circles. At the beginning of the acquisition (x < 1,000), there is a very high density of points, with many reaching the maximum value of 4,000. This density drops significantly as time progresses, with most points falling below 1,000 after x = 1,000, and continuing to decrease towards zero as x approaches 13,000.

This is a zoomed-in view of the data from the main plot. The vertical axis (y-axis) ranges from 0 to 100 with major ticks every 20 units. The horizontal axis (x-axis) ranges from 0 to 120 with major ticks every 5 units. The data points are small red circles. Most points are clustered near the zero line on the y-axis. There are several distinct points that rise above the baseline, reaching values between approximately 40 and 100. These points are scattered across the x-axis, with notable ones around x = 5, 40, 75, and 115.

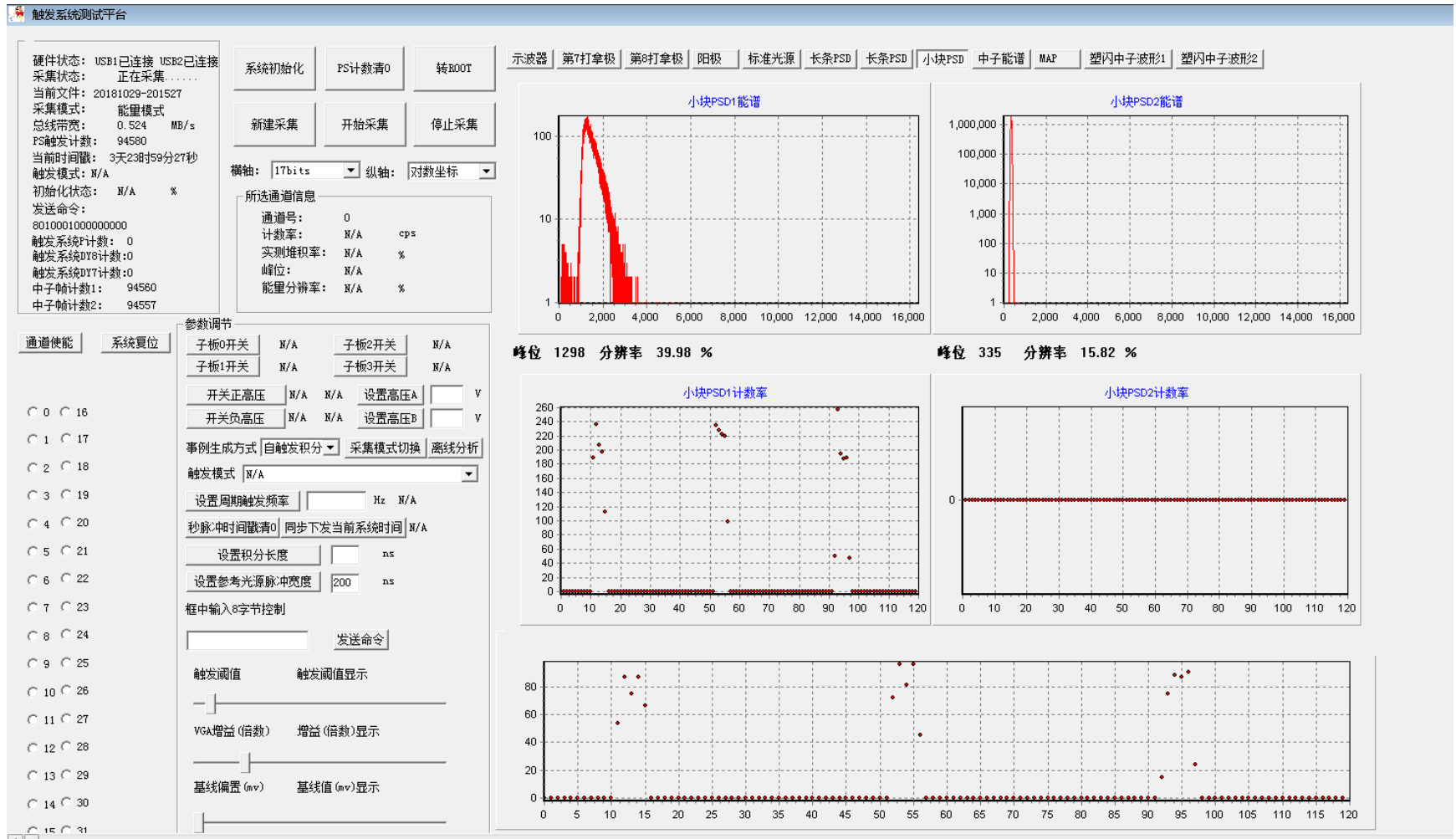
Multi channel DAQ during beam test

Standard calibration LD readout

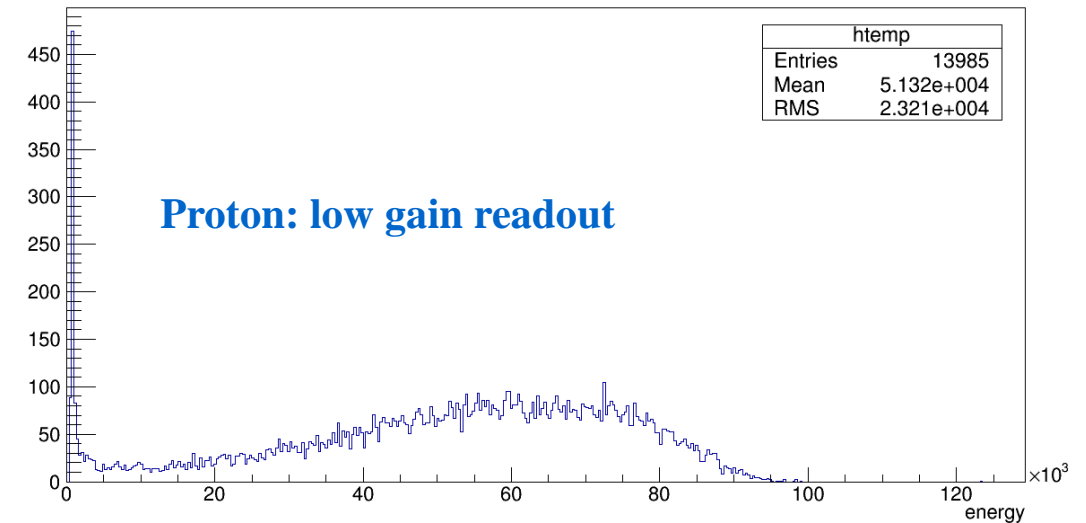
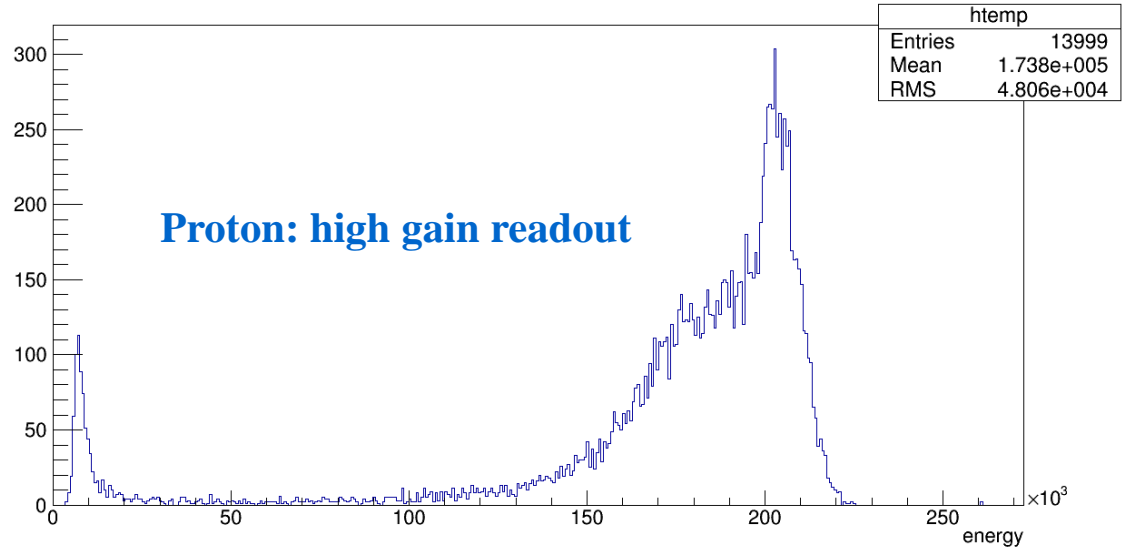
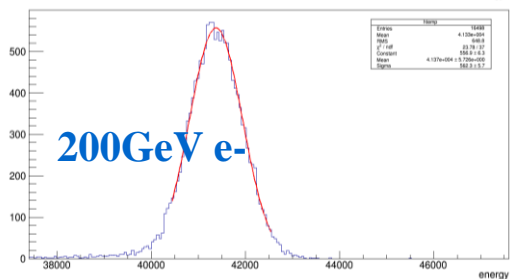
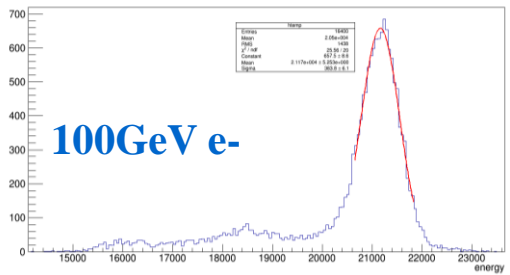
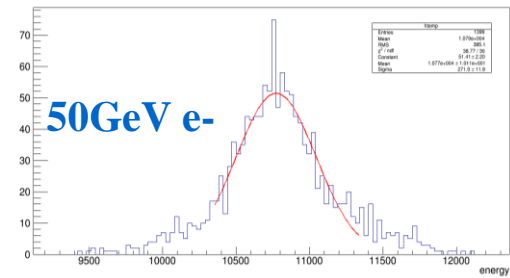
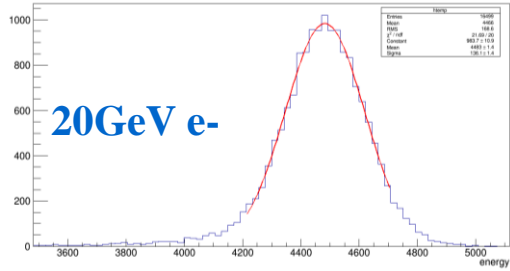


Multi channel DAQ during beam test

PSD readout

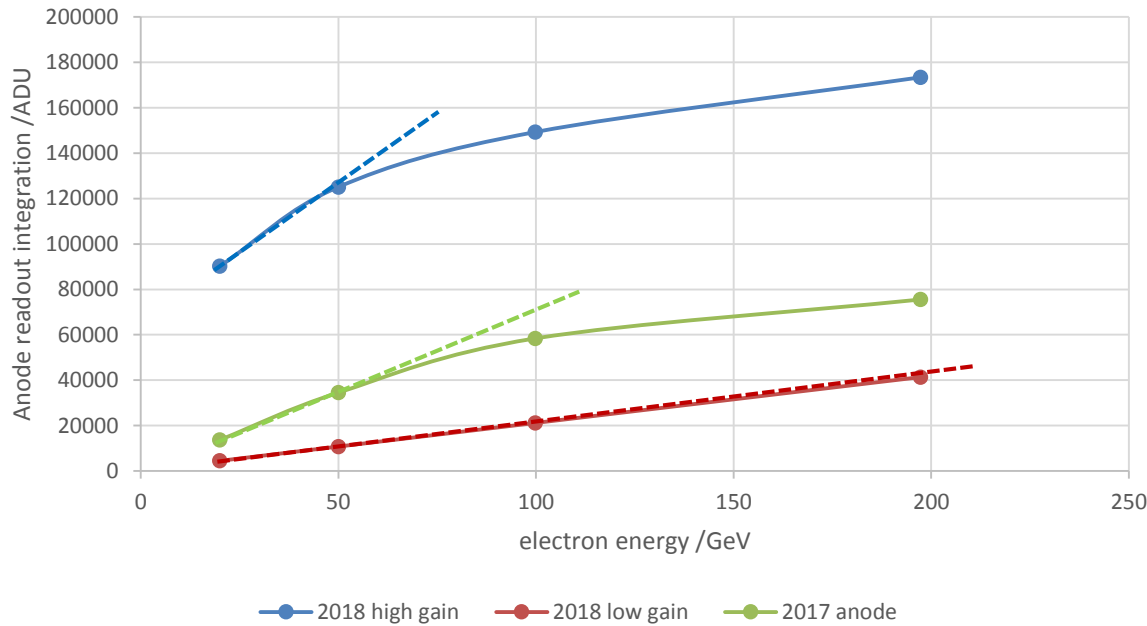


Preliminary beam test results



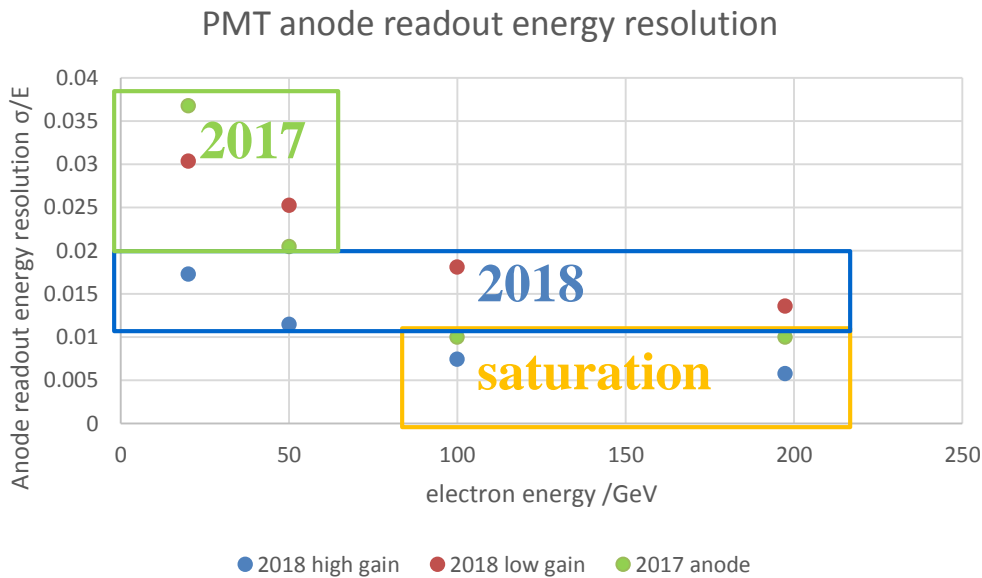
Preliminary beam test results: linearity vs. electron energy

PMT anode readout linearity



- 2017: PMT anode saturated when the electron energy > 100GeV
- 2018: PMT anode NOT saturated. Low gain could cover the electron energy range from 20 GeV to 200 GeV
- 2018: anode high gain saturation happened during readout

Preliminary beam test results: resolution vs. electron energy



- Anode readout resolution improved from 2017 zone to 2018 zone
- High gain channel decreases the lower threshold and increases the effective dynamic range

Summary



- Trigger sub-system introduction
- Beam test progress
- DAQ for TRIGGER PMT, PSD SIPM, PSD PMT, Calibration LD
- Preliminary beam test results

Work in the future

- Continue the second stage of the 2018 beam test
- Calibrate trigger PMT data with IsCMOS data
- New design with dynode readout

Thank You !