DRAFT Detailed Run Plan DESY Beam Test 28 October – 11 November

For this plan we assume at least two 6 hour shifts 09:00 - 15:00 - 21:00 with 4 people per shift letting 2 taking turns to stay or go to eat.

Information on DESY test beam:
https://www.sciencedirect.com/science/article/pii/S0168900218317868?via%3Dihub

Day 1: Monday 28 October: start-up activities

- Obtain the DACHS card in Building 6, RM 110
- IN-PERSON Safety lecture at 13:00 in Building 1C RM 210
- Unpack and install
- Position calorimeter with laser
- Map crystal centers to XY table with or without beam and align overall detector to the beam path as desired
- Start setting up DAQ (evening)
- Train new authorized users to set the interlock. Currently Douglas, Ethan, and Ivica are the only authorized users.

Day 2: Tuesday 29 October – complete setup MIT calorimeter

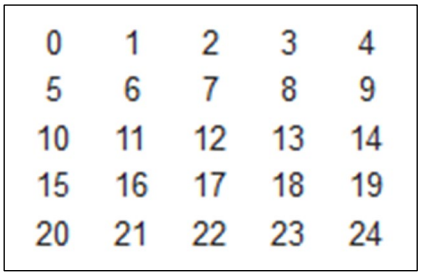
- Complete DAQ setup (including trigger)
- Light leak check, go slow, one channel then iterate. The MIT calorimeter is very light tight by construction and based on previous tests.
- Cooling setup & leak check.
- Verify signals in scope. there is a patch panel from the test beam area to the counting room to see signals but that involves a delay so setting timing is not so clear.
- DAQ process and throughput verified.

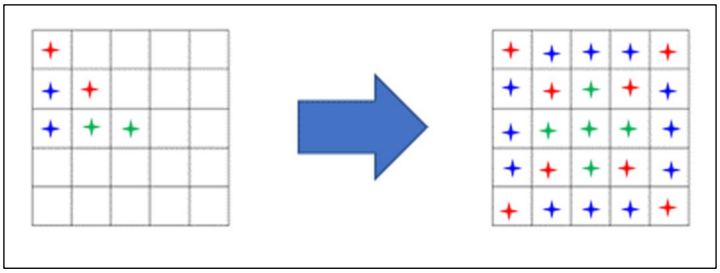
Day 3: Wednesday 30 October – Gain matching, energy deposition, and position scans

- Pedestal run
- Gain match PMTs with 5.2 GeV beam (25 crystals at ~10-15 minutes each = 6 hours)
    - Our typical procedure is to use the lasers to align the crystal array horizontally and vertically and then determine the centres of each crystal and with respect to the XY table coordinates. Then we trust these XY coordinates to centre a 5.2 GeV beam on each crystal and adjust the HV for that crystal so the peak is in channel 3800 of the QDC after correcting for the pedestal of that channel. This is quick and dirty and gets the HV to a few volts. We don't store the data just record the final voltage.
- Measurement with beam at the central crystal – energy deposition measurements
- Start taking scans (overnight?) – for more information on the scans from previous measurements see: https://iopscience.iop.org/article/10.1088/1748-0221/18/09/P09001
    - Note: data rate will depend on the collimator aperture.
    - Horizontal scan across the central three horizontal crystals for 13 positions (every ~5 mm) and four energies at each position 2, 3, 4, and 5 GeV. Collecting 10,000 events for each position and four energies will take approximately 30 minutes so **6 hours per scan**.

Day 4: Thursday 31 October – Switch 2 PMT channels to 2 SiPM channels in MIT prototype

- Exchange two crystals+PMT in MIT prototype calorimeter with two crystal+SiPM modules (1-2 hours?)





Left: Typical crystal labeling as the beam sees them; Right: possible positioning of the 2 SiPM channels. The nominal positioning will be the central crystal and one location on the cross (green symbols)

- Gain match.
    - Should be carefully done considering the SiPM output is significantly different from the PMT, pulse shape recovery time etc.
- Measurement with beam at the central crystal – energy deposition measurements
- Start taking scans (overnight?)

Day 5: Friday 1 November – Contingency

- Complete measurements from previous days or uninstall MIT prototype and install Orsay prototype

Day 6: Saturday 2 November – Install the Orsay prototype

- Calibrate pedestals
- Take data with 1 SiPM readout option (eg. 16 independent SiPM)
- Measurement by aiming the beam at the central crystal; energy deposition measurements

Day 7: Sunday 3 November – Switch to different readout option (16 SiPM in parallel)

- Measurement by aiming the beam at the central crystal; energy deposition measurements

Day 8: Monday 4 November – Switch to the next readout option

- Measurement by aiming the beam at the central crystal; energy deposition measurements

Day 9: Tuesday 5 November – Switch to the next readout option (discrete electronics)

- Measurement by aiming the beam at the central crystal; energy deposition measurements

Day 10: Wednesday 6 November - Contingency

- Complete measurements from previous days or uninstall Orsay prototype and install Crytur prototype

Day 11: Thursday 7 November – Install Crytur Calorimeter

- Pedestal run
- Gain matching
- Start data taking, e.g., scans
    - Note: data rate will depend on the collimator aperture.
    - Horizontal scan across the central three horizontal crystals for 13 positions (every ~5 mm) and four energies at each position 2, 3, 4, and 5 GeV. Collecting 10,000 events for each position and four energies will take approximately 30 minutes so **6 hours per scan**.

Day 12: Friday 8 November – Continue data taking

- Continue data taking

Day 13: Saturday 9 November – continue data taking

- Continue data taking

Day 14: Sunday 10 November – Contingency/Disassembly

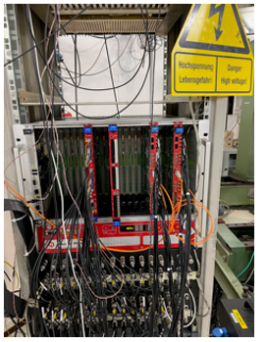
- Complete any measurements
- Disassemble everything
- Repack
- Clean counting room
- Clean test beam area

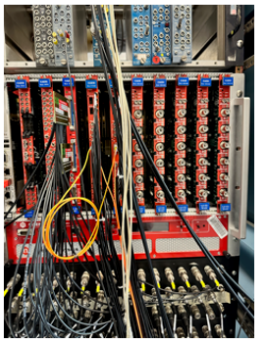
APPENDIX:

MIT 5x5 Prototype Materials List

- ❑ (From Douglas) MIT would bring/ship these to DESY for the beam test:
  - the 5x5 PbWO4 calorimeter plus 5 spare crystals and spare PMTs and ESR foil.
  - LeCroy 1458 HV Mainframe and a number of -HV and +HV pods. The PMTs typically take ~-1000 V at room temperature.
  - VME crate with controller, 32 channel CAEN QDC (V792), and two 16 channel CAEN Digitizers (V1725S, 14 bit 250 MHz)
  - splitter panels if you want to run QDC and Digitizer in parallel
  - 100' of signal cables (need the length to delay signal until trigger electronics is ready to give trigger)
  - HV cables
  - fibre optic cables
  - chiller ? (I don't think you will want to cool the calorimeter too much but maybe a stable temperature is useful at 15 - 25 C can use just water as the recirculating fluid). Transformer for German power.
  - a trigger scintillator with PMT
  - one or two computers with monitor, key board, etc.
  - toolbox and various odds and ends
- ❑ Pictures of the setup:
  https://wiki.jlab.org/cuawiki/images/a/a7/20240405_DESY_TB.pdf

MIT 5x5 Prototype Readout





- ❑ The MIT readout consists of:
  - ➢ One (1) CAEN V792 - QDC, 12 bit, 32 channels via adapter board from ribbon connector on module to individual Lemo cables (see images)
  - ➢ Two (2) CAEN V1725S - Digitizers, 14 bit, 250 MS/s each with 16 channels input via MCX connectors to Lemo cables, optical fibre readout (see first image)
- ❑ Also in the first image are two (2) 50 ohm splitter boards, 16 channels input, 32 channels output BNC with Lemo adapters. I'll ship four (4) such splitter boards.
  - ➢ This image is from our old configuration where we also had a NIM crate with the trigger logic and a huge LeCroy mainframe HV unit.
- ❑ The new configuration is shown in the second image.
  - ➢ One (1) CAEN VME crate with:
    - one (1) CAEN V4718 crate controller/bridge (not pictured, this just arrived this week),
    - CAEN V812 CFD module 16 channel,
    - CAEN V976 quad logic AND/OR/MAX module,
    - V792 (described above),
    - two (2) V1725S (described above), and
    - five (5) CAEN V6533N 6 channel HV modules, SHV connectors.

Two channel SiPM for MIT 5x5 Prototype

- ❑ Plan is to have a pre-amplifier circuit that will match the gain of the SiPMs to the gain of the PMTs before feeding the signals into the rest of the MIT prototype readout.
- ❑ (Larry) Reworking the pre-amplifier board to match with the mounting piece from Josh and assemble 2 SiPM and 2 pre-amp boards to be sent to JLAB by the first week of September.
  - will include the short cable that ends in an SMA connector and 2 power cables.
  - How long does the power cable need to be? will check to see if I have two SMA to BNC cables that are about 2 feet long that I can also send with the boards.
  - Expected wires from each board: 1 BNC signal cable, 3 twisted pairs (6 wires total) for HV, ground, +5, -5, and thermistor connections. 1 cable to interface with the LED
  - power and thermistor cable should be shielded. May have enough of a cable like this to make a couple 5-10 foot cables. Is this the best option or do we need to make a longer cable or different type of cable for these connections?
- ❑ (from Larry) Needed at DESY – could be provided by IJCLab-Orsay supplies:
  - 2 channels of bias voltage at about 42V
  - +5V supply (~30 mA needed total for both boards)
  - -5V supply (~30 mA needed total for both boards)
- ❑ (Josh) Working on assembling materials for mounting
- ❑ Ship to MIT before end of September or directly to DESY