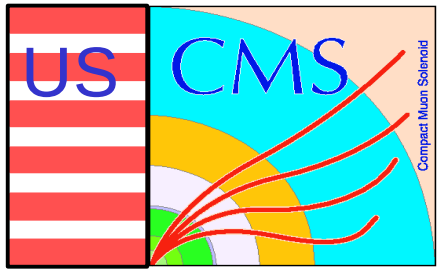
EMU Beam Tests 2003



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EMU Meeting, FNAL

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EMU Test Goals: Review

- **Goals before spring 2003**
  - Simultaneous operation of multiple CSCs (2-3)
    - Production versions of on-chamber electronics
    - Common gas, cooling, HV, LV, Slow Control and DAQ systems
      - Implement TTC and DDU, Slow Control compatibility for Slice test?
  - Synchronization, calibrations, continuous slow control monitoring
  - Two crate operation modes to test:
    - All CSCs read out on one full backplane
    - CSCs read out on 2-3 individual small backplanes
      - Simulates multi-crate operation; tests TTC and Slow Control (Dynatem)
  - Final pre-production versions of crate electronics and firmware
  - Trigger and DAQ: rate/performance analysis
- **Test categories**
  - Hardware performance tests: trigger and DAQ rate capability
  - Integration tests: timing, slow control, DAQ/trigger/run control

Integration Tests

- **Assume basic operations completed**
  - Multiple CSCs with gas, cooling, HV, etc.
  - Cosmic/scintillator and calibration pulse timing ready
- **Slow Control, configuration and monitoring**
  - Use what is available now, implement DCS later…
  - Board initialization
    - Hard/soft resets, load constants (DAC, masks, etc)
    - Boards ready-to-go after reset! (No Slow Control initialization req'd)
  - Calibration setup and pulse generation
  - LVDB power on/off control
    - Add crate and HV power control later
  - Status monitoring: board errors & temperature/voltage/current
- **DAQ/Trigger/Run Control**
  - Trigger control (TTC and/or OSU Test Control Board)
  - Event readout (via DDU), storage, display: on/off-line processing
  - Communicate with Slow Control: later, when DCS is ready

Performance Tests

- **What can be done at FAST sites?**
  - **Calibration tests**
    - Trigger/Readout rate capabilities, DAQ volume limitations
    - Regular and Random triggering at high rate (OSU Test Control Board)
  - **Pulse pattern generation for trigger testing**
    - Trigger efficiency/performance
  - **Cosmic ray testing**
    - Scintillator trigger mode (LCT & L1A, synched by OSU TCB?)
    - Self-trigger LCT mode, use scintillator L1A or LCT == L1A?
    - A/CLCT trigger threshold/efficiency tests
      - ALCT.and.CLCT & ALCT.or.CLCT operation tests
    - ALCT/CLCT/TDC BX timing variance
    - DAC & HV threshold effects on efficiency?
    - Position resolution studies?
  - **Continuous Slow Control monitoring**
    - Includes FMM functionality too (via VME for now)

Testing Plan: Phase I

- **Phase I Testing: hardware rate tests, one CSC first**
  - **Requires LHC-realistic firmware capabilities for FULL EMU system**
    - **Multi-event buffering for Anode & Cathode DAQ data (~10 events?)**
    - **Minimal readout of Anode & Cathode DAQ data (localized in space and time)**
      - **Full dump modes are prescaled or on demand only**
    - **Full pattern finding capability**
  - **DAQ Tests: Random LCT and L1A with known average rates**
    - **Realistic event volume at LHC rates, readout via DDU**
      - **LCTs will be randomized in space and time**
    - **No DAQ analysis software needed**
      - **Monitor DDU status for errors and buffer overflows/warnings**
      - **Event display may be useful (online or offline) to verify settings and functionality**
  - **Trigger Tests: *Trigger testing plan requires UCLA expert input!***
    - **How to generate and test correlated A/CLCT at high rates?**
      - **Source(s) centered on A/CFEB and/or at boundaries between FEBs?**
      - **Random Buckeye pulse patterns at high rate? What about anodes?**
      - **Include cosmics with the above options? Self LCT or Forced LCT?**

Testing Plan: Phases II & III

- **Phase II Testing: multi-CSC tests**
  - Repeat Phase I rate tests with 2 CSCs in one crate
  - Perform "low rate" tests with cosmics
    - Gives correlated Anode & Cathode triggers in all CSCs
    - Collect multi-CSC cosmic data for analysis & reconstruction tests
  - May need improved event display/reconstruction capability
    - How to display a muon passing through multiple CSCs?
    - Histogram booking, etc. for multiple CSCs
- **Phase III Testing: multi-crate tests**
  - Similar to Phase II tests
  - Requires multi-CCB communication w/coordinated fast control
    - TTC and/or OSU TCB board
      - TTC support from Rice: 6U crate, TTCvi/vx, and PC with software
  - Requires multi-Dynatem communication for slow control
    - Current "CFEB Control" software is sufficient basically as-is

Equipment Needs (1)

Institution responsible for each of the following:

digital oscilloscope with probes				FAST
pulse generator for random trigger				FAST
BNC/Lemo cables, tees, terminators and BNC-Lemo adapters				FAST
scintillator trigger system			FAST	
3 CSCs and gas system		FAST		
HV supplies and cables	FAST			
cooling and tubing		FAST		

Instrumentation for 3 CSCs: already at FAST sites, CSCs & electronics available**

AFEBs	CMU
AFEB-ALCT cables	CMU
15 CFEBs	OSU
15 CFEB-DMB cables	OSU
3 DMBs	OSU
3 TMBs	UCLA
15 CFEB-TMB cables	UCLA
3 ALCTs	UCLA
ALCT-TMB cables	UCLA
3 LVDBs	UW
power cables to LVDB	UW
power cables from LVDB	UW
LV power (400 Hz source?)	UW
3 LVMBs	UCD

Equipment Needs (2)

Crate equipment:**	
VME peripheral crate(s)	FAST
full and 3 partial VME backplanes	FAST
Dynatem (slow control VME computers)	OSU/FAST
1 10-base-T switch, cables/Tees/terminators	FAST
3 CCBs	RICE
1 DDU with fiber spools for DMB readout	OSU
1 Linux PC with gigabit/S-Link to readout DDU	OSU
(1-2 fast hard drives, dual CPU with 64-bit/66MHz PCI)	
TTCvi/vx and support, for 3 CCBs	Rice
NIM crates & Modules (delays, logic, etc)	FAST
CAMAC crate & controller, TDCs, etc	FAST
signal cables, short and long (Lemo/BNC)	FAST
Trigger/Test Control Board (TCB)	OSU
Software:	
DCS Slow Control (Dynatem/VME/JTAG routines)	UCR
Temporary Slow Control (Dynatem/VME/JTAG routines)	FAST/OSU
Trigger/Run Control	FAST/OSU
DAQ (CAMAC/VME/G-bit readout & storage)	FAST/OSU

***Some equipment may already be present at FAST sites.*

Proposed Schedule

- **Phase I & II Hardware Tests at UCLA (January 2003)**
  - First perform 1 CSC DAQ/Trigger rate tests
  - Multi-CSC tests follow immediately
  - Immediately followed by Phase III multi-crate tests if time allows
- **Multi-Crate operation, UF/UCLA (February 2003)**
  - Concurrent with Multi-CSC testing if possible
- **Maintain operational testing capability**
  - Functional for weeks afterward to allow add-on upgrades
    - Allows additional time for Structured Beam and Slice test preparation
    - Slow control improvements, DAQ/Trigger/TTC tuning, etc.
      - Integrate new L1 Trigger hardware
- **LHC Structured Beam Test at CERN (May 19, 2003)**
  - GIF or H2 test area? How many CSCs?
- **Slice test at CERN SX5 (2004)**