



# CMS Calorimeter Trigger



## GCT Muon Auxilliary Card Update

**Tom Gorski,  
Amin Farmahini-Farahani**

***University of Wisconsin***

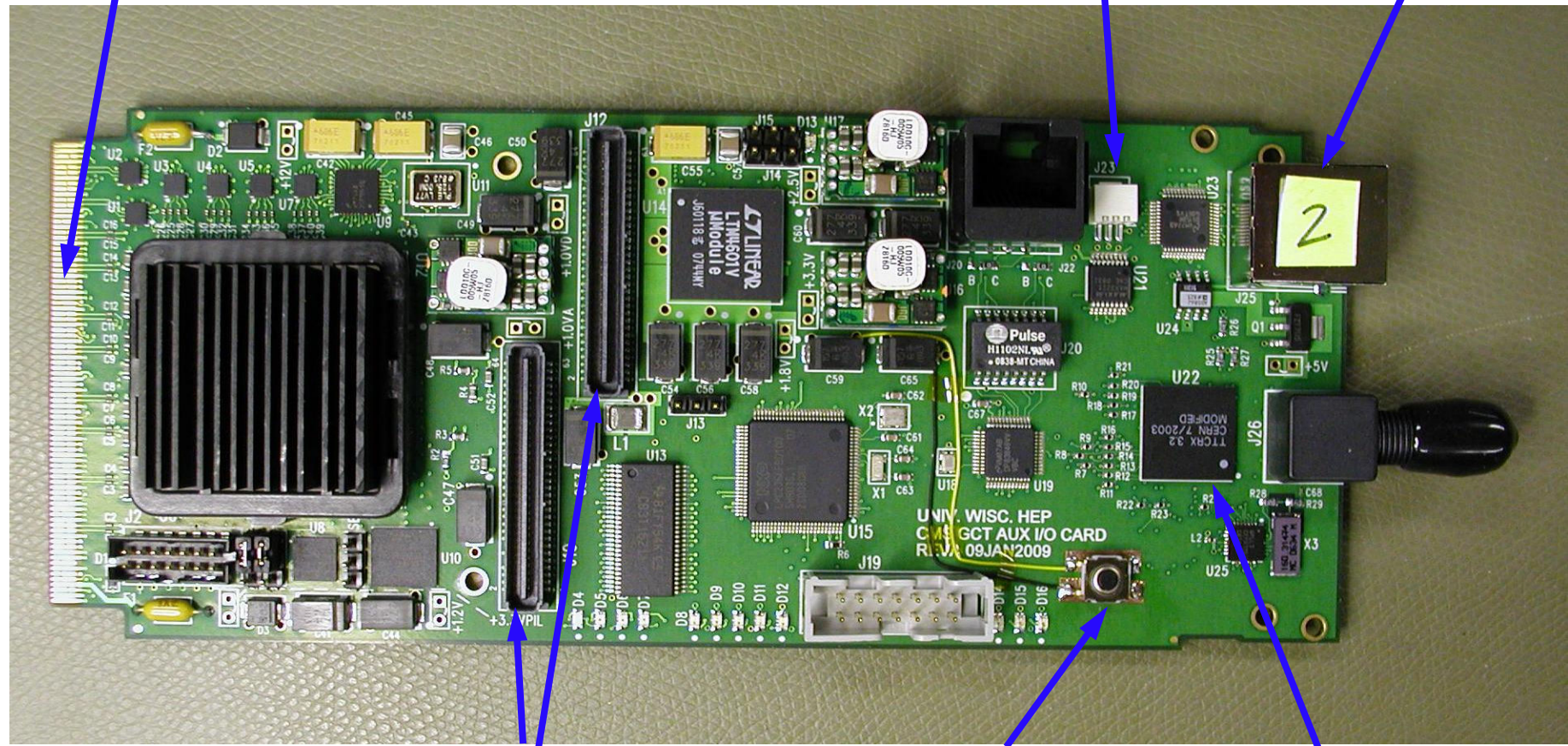
**October 28, 2009**

# GCT Muon Aux Card Update

AMC Edge Connector ( $\mu$ TCA)

RS-232

TTS



S-Link Connectors

Pushbutton Reset (for Microblaze)

TTCrx



# GCT Muon Aux Card



- Provides SLINK-64, TTC and TTS Connectivity in a Single-Width, Full-height  $\mu$ TCA form factor
- Xilinx Virtex-5 FPGA (XC5VLX110T)
  - 16 Rocket I/O GPT Links to edge connector
  - 1136-pin BGA Package
- For connecting a  $\mu$ TCA crate to the TTC and DAQ subsystems



# GCT Muon Aux Card Update



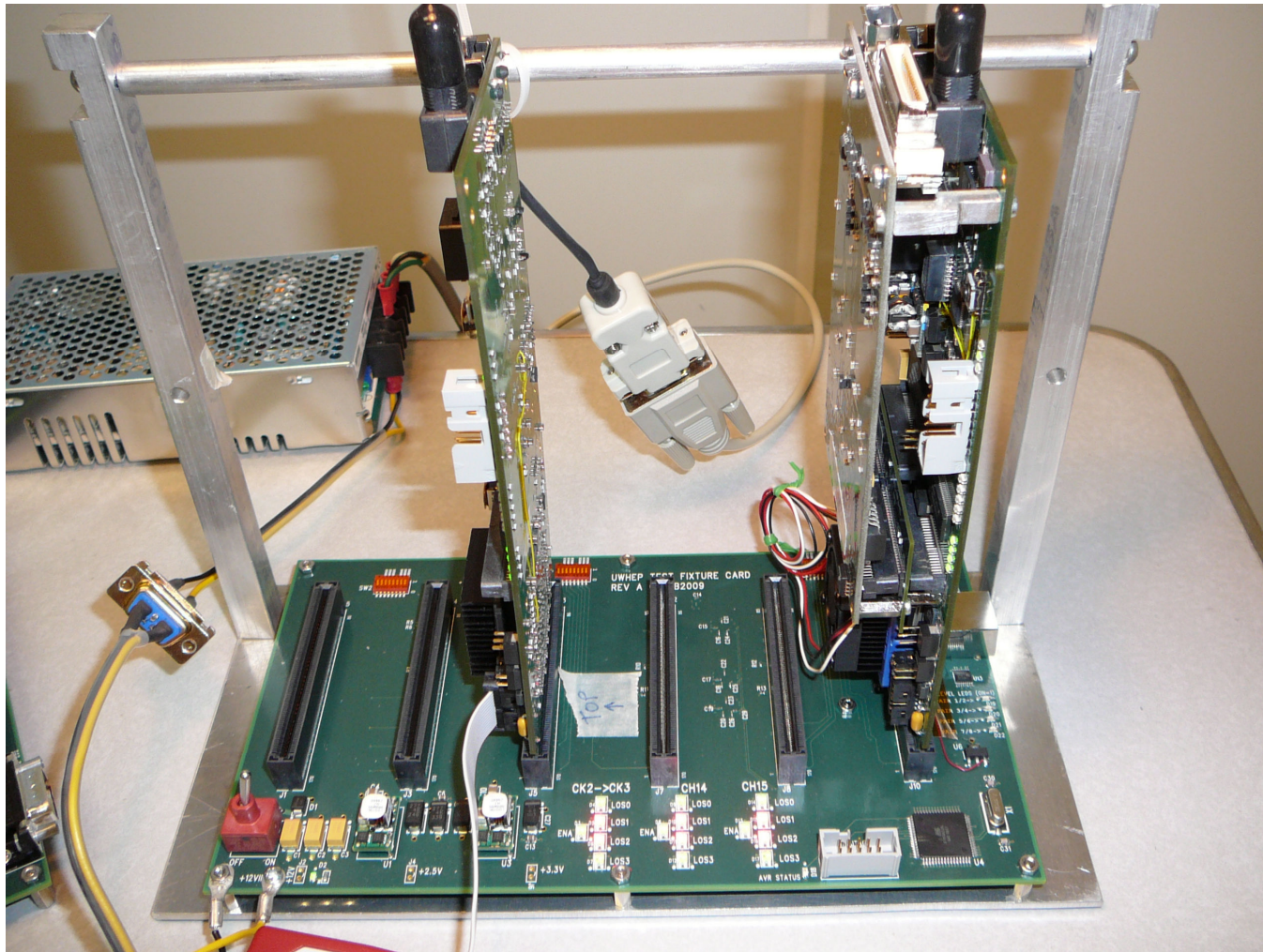
- **Testing Status: Design verification completed on TTS, S-Link, and Rocket I/O Interfaces. TTC checkout is in process**
- **Testing performed on original 2 boards. More boards to be built after design verification completed**
- **Boards will be shipped with a test program burned into Flash—connect via RS232 port/terminal**
- **Test software/firmware should be completed by end of 2009**
- **Firmware is a HDL/Microblaze hybrid**



# GCT Muon Aux Card Update



Two Aux Cards in Test Fixture Running a GTP Link Test  
(6 connections—4 passive, 2 through switches)





# Aux Card Rocket I/O Testing



- Link rate of 3.125 Gbps from 125.0 MHz oscillator
- 8b/10b encoding, 16-bit parallel interface (156.25 MHz parallel clock) between GTP tile and FPGA fabric
- Simplex connection between Transmitter and Receiver
- Uses comma (K28.5) char for sync/byte alignment
- Test Protocol: 32-byte header contains ID of Xmtting board/channel, test pattern descriptor
- Rcvr compares incoming data stream to that specified by header, capturing/counting errors
- X/R test blocks in HDL, run independently of processor
- Some results using 64-bit LFSR pseudo-random pattern:
  - Single board loopbacks to different GTP Tile: continuous run of  $5 \times 10^{15}$  bytes with zero errors (~280 hrs on 16 simultaneous ch.)
  - Board-to-Board on Slots 0 & 3 of Test Fixture: over  $2 \times 10^{14}$  bytes with zero errors (~24 hrs on 6 channels)



# Rocket I/O Test Program Output (Xmt Ch 4 to Rcv Ch 3)



LFSR Pattern

Rx Port Snapshot

Bd/Ch ID (E4)

Infinite Length

Starting Seed

Register Dump for Block 4 (uTCA port 11)

Transmit Block Register Dump:

```

Config:    0x00000013
ParamA:    0x45ECBB34
ParamB:    0x00000000
Length:    0x01000000
Status:    0x00000002
XCntH:     0x00004852
XCntL:     0x0CC2A276

```

Register Dump for Block 3 (uTCA port 4)

Receive Block Register Dump:

```

RCfg:      0x69780000
Config:    0x0000E413
ParamA:    0x45ECBB34
ParamB:    0x00000000
Length:    0x01000000
Status:    0x00000402
RCntH:     0x00004852
RCntL:     0x0998CF36
ErrCtr:    0x00000000
CapExData: 0x00000000
CapAcData: 0x00000000
CapRCtrH:  0x00000000
CapRCtrL:  0x00000000
CapErrCtr: 0x00000000

```

4-byte words Xmitted

4-byte words Rcvd/Verified

Zero Errors