CSC Trigger Developments

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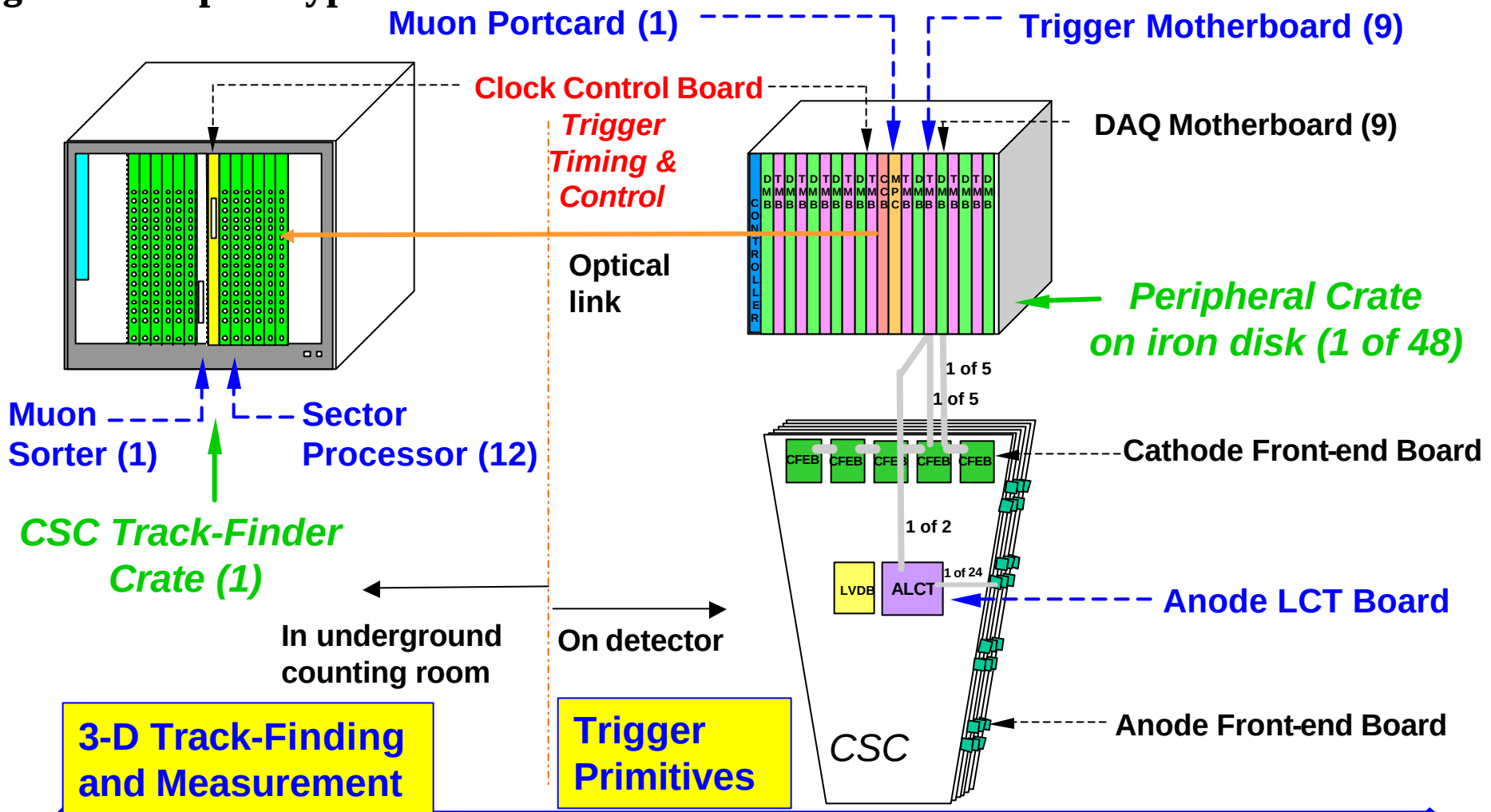
- **Prototype Status:**
  - **Muon Port Card**
  - **Sector Processor**
  - **Muon Sorter**
- **Study on the recovery of TeV muons by an improved P_T assignment algorithm**

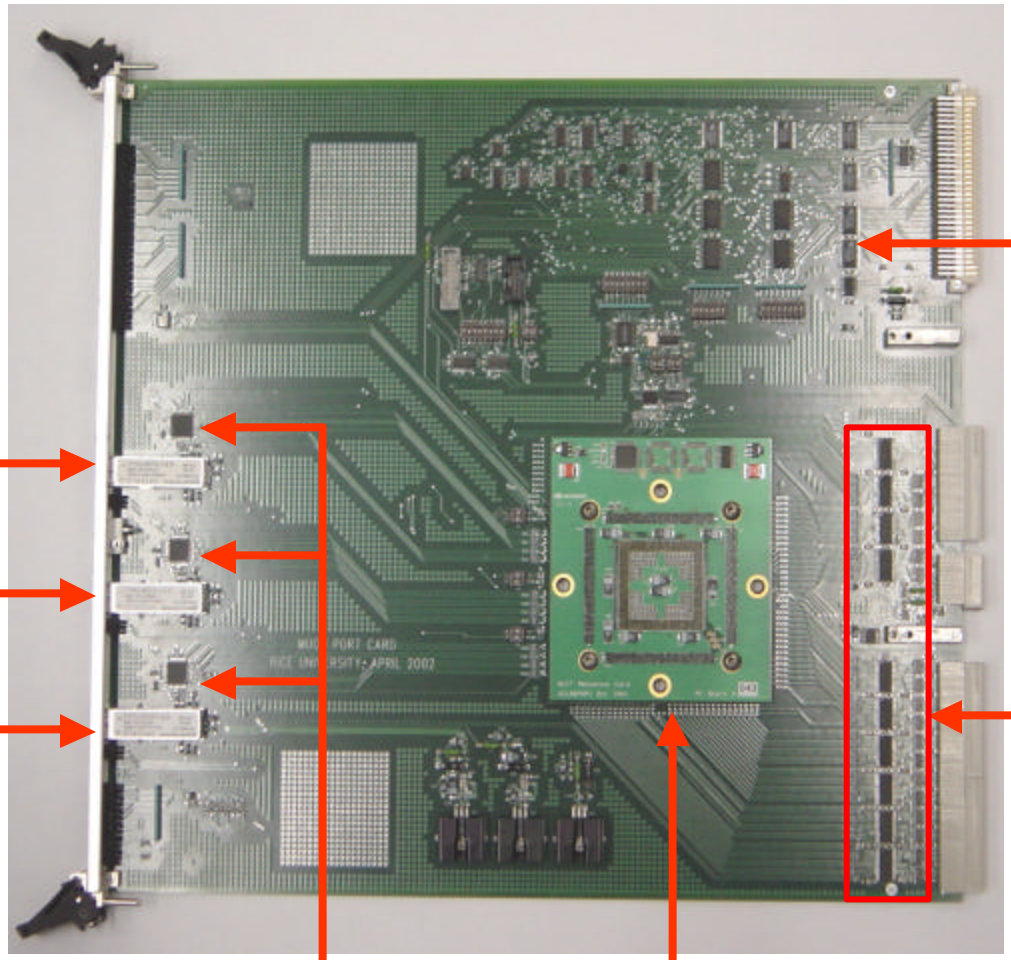
CSC Muon Trigger Scheme

TriDAS part: Second generation prototypes

EMU part: mostly in production



Muon Port Card (2nd Prototype)



MPC Design Status

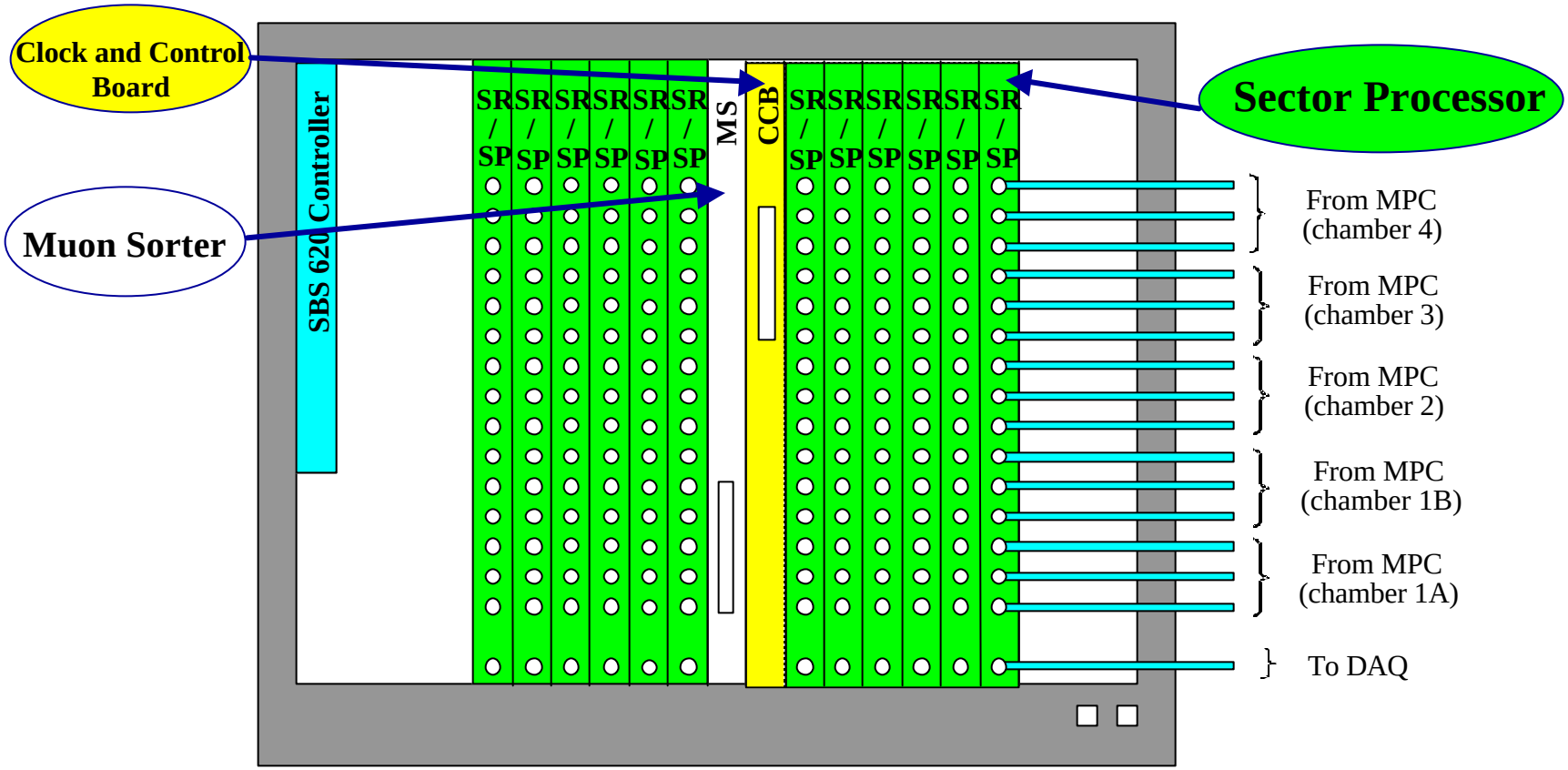
Rice

- **3 boards have been fabricated and assembled in summer**
- **Have 6 UCLA mezzanine cards in hand**
- **Tested MPC standalone (sorter logic) and with one and two Trigger Motherboards and full-size custom backplane**
  - **various patterns sent from TMB to MPC at 80Mhz**
  - **feedback "winner" bits from MPC to TMB**
  - **periodic FPGA reconfiguration from EPROMs (both MPC and TMB) upon "hard reset"**
  - **measured the board latency**

Waiting to test with Sector Receiver/Processor

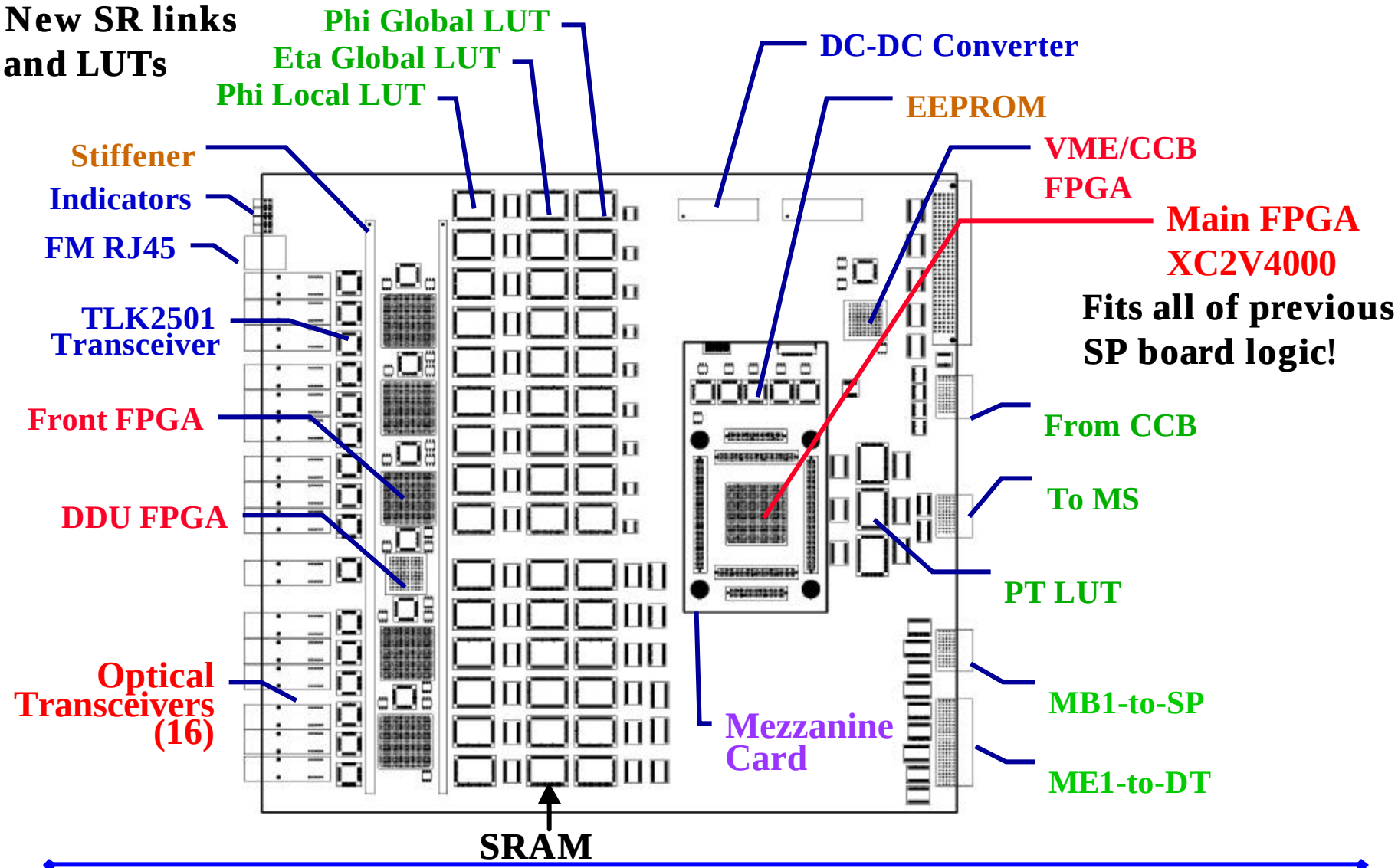
CSC Track-Finder Crate

Second generation prototypes

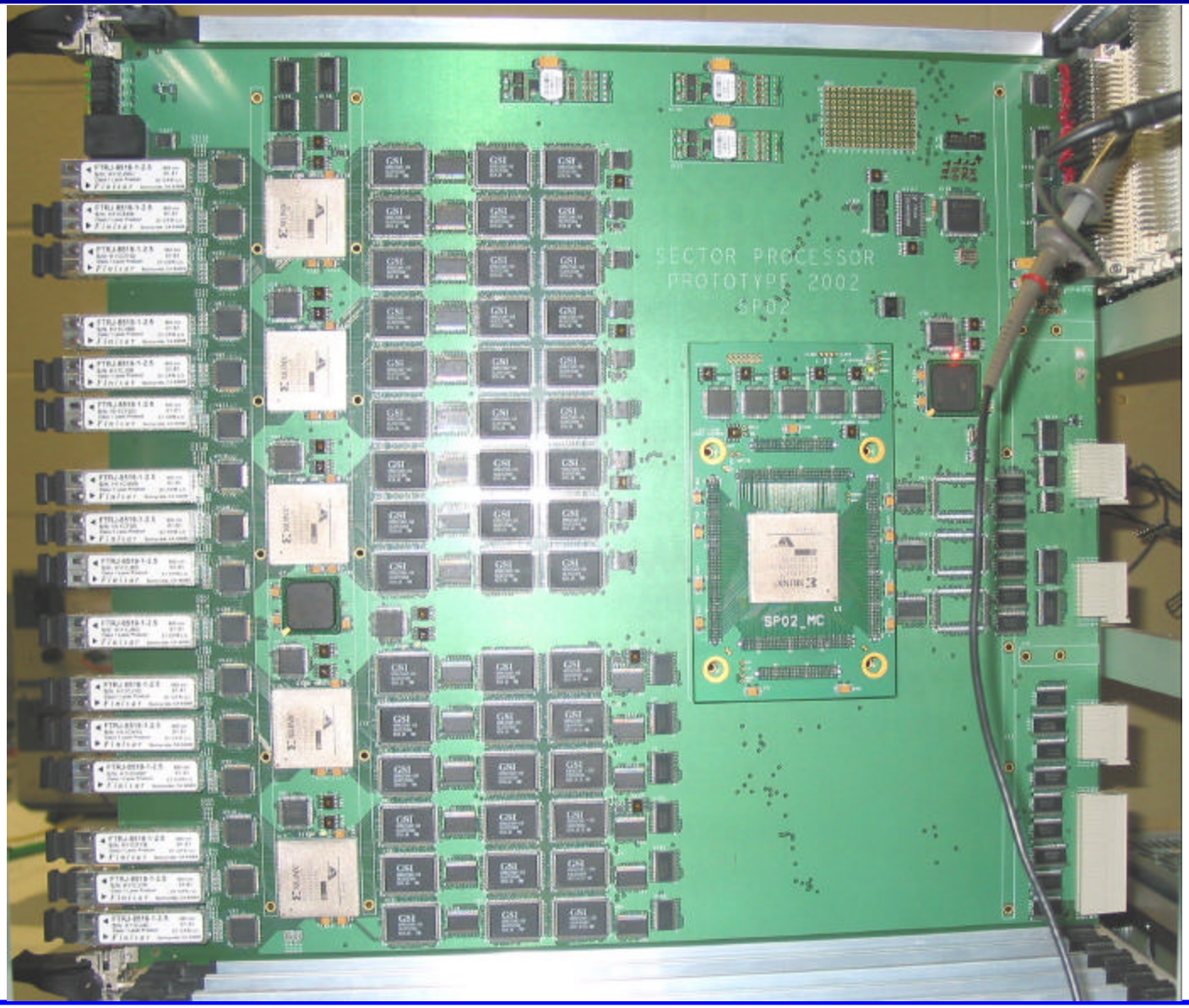


- Single Track-Finder Crate Design with 1.6 Gbit/s optical links

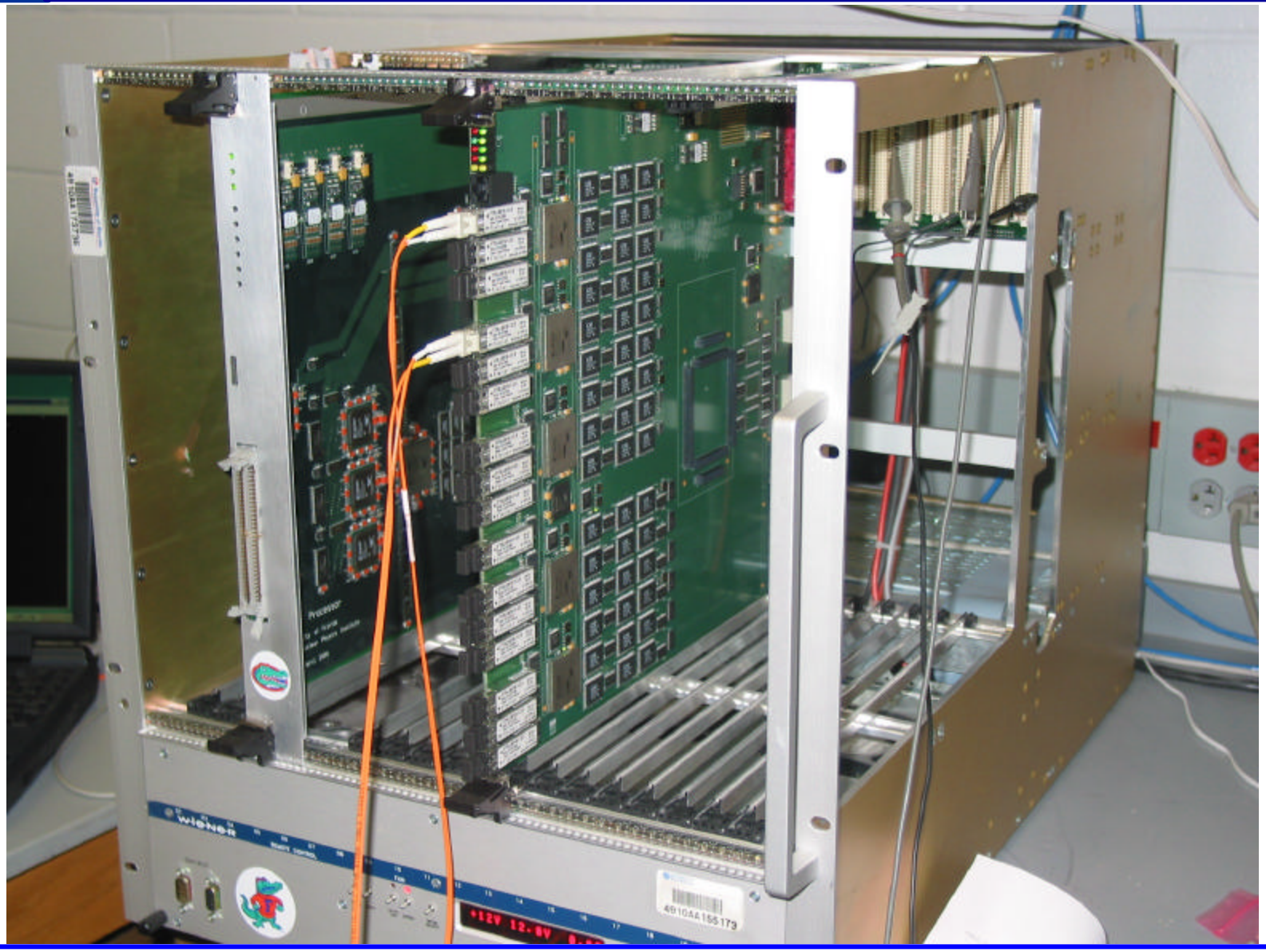
Next Generation Sector Processor



Next Generation Sector Processor



Tests underway…

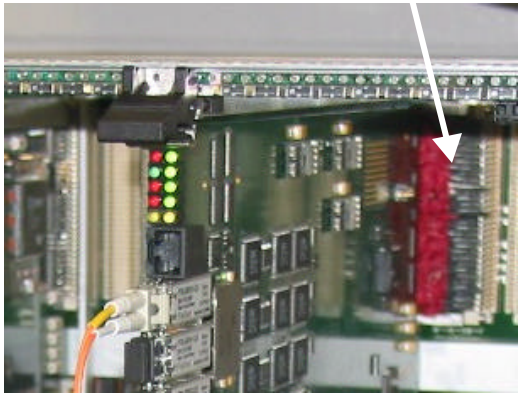


Track-Finder Test Plans

Tests

- Both SP main board and mezzanine board pass power-up and initial FPGA programming tests
  - EEPROMs programmed via JTAG through VME bus
- Validation of VME interface is underway
- Optical link tests are next

Oops…



Approximate schedule

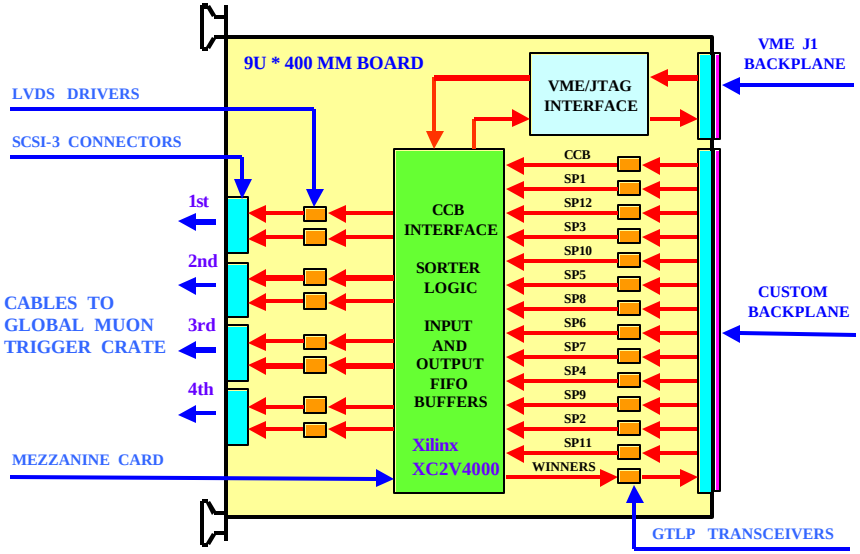
- Feb.'03: SP prototype completed, initial tests begin
- Mar.'03: MPC® SP optical link tests
- Apr.'03: SP trigger logic tests
- May.'03: CSC system tests with cosmic rays and beam tests at CERN
- June '03… : Tests with Muon Sorter and DT Track-Finder

CSC Muon Sorter

Rice Univ.

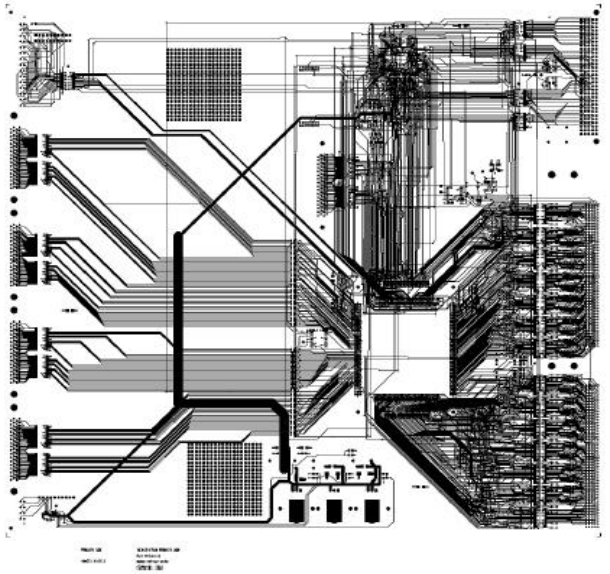
Functionality

- Selects 4 best muons out of 36 arriving from 12 Sector Processors
- Sorting is based on 7-bit Rank
- Transmits 4 best muons to Global Muon Trigger crate over LVDS links in ranked order



Status

- Board layout just completed
- Expect 3 PCBs in early March
- Uses same mezzanine card as SP
- Standalone tests in March-May
  Tests with SP starts in summer



CSC Track-Finder Control and DAQ

A draft document on the control and DAQ software framework for CSC Track-Finder has been started:

- http://www.phys.ufl.edu/cms/tfcvs/cgibin/cgi/viewcvs.cgi/TrigDAQ/doc/trigdaq.ps
- **(includes brief description of data format)**

Inputs and outputs of Sector Processors are read out upon L1A (including Sorter "winner bits")

- **Useful for High Level Triggers as well as monitoring and debugging**
- **Send by optical links to an Endcap Muon FED**

Study: P_T Misassignment from Muon Bremsstrahlung

- Poor P_T assignment is caused by track segments not collinear with actual muon.
- We should be able to eliminate these segments by examining all $\Delta\phi$ values from 4 ME stations.
- Example, for Generated Pt=75 GeV, reconstructed Pt=14 GeV:

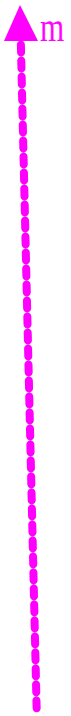
Overlapped Event Display

- $\Delta\phi_{12}$= 1 Strip
- $\Delta\phi_{13}$= 1 Strip
- $\Delta\phi_{23}$= 1.5 Strips
- $\Delta\phi_{24}$= 1 Strip
- $\Delta\phi_{34}$= 1/2 Strip

Should be < 1 strip

Station 3 Hits

Station 2 Hits

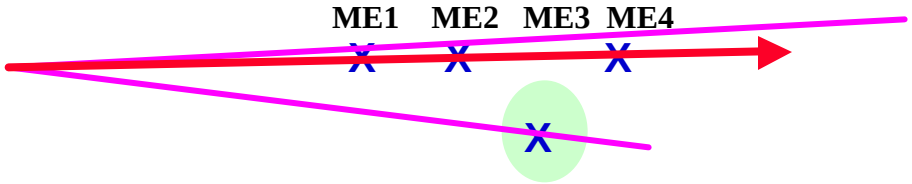


B. Scurlock

Pt Misassignment from Bremsstrahlung and Showers

We can eliminate bad LCTs by adding some simple "trajectory cleaning" logic within the Sector Processor.

For Example:



- **If $|\Delta f_{13}| > |\Delta f_{12}|$ AND**
- **$|\Delta f_{23}| > |\Delta f_{24}|$ AND**
- **$|\Delta f_{13}|$ >threshold,**

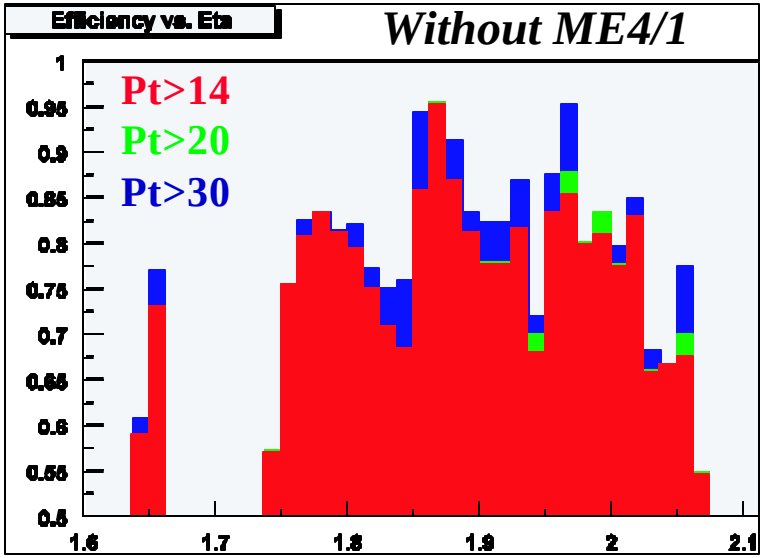
\ should drop ME3 segment from track and use (Δf_{12}, Δf_{24}) for P_T assignment.

n.b. **Translation to Verilog, and latency, must still be studied…**

B. Scurlock

TeV m Pt Assignment: Using ME4/1 and AU Correction

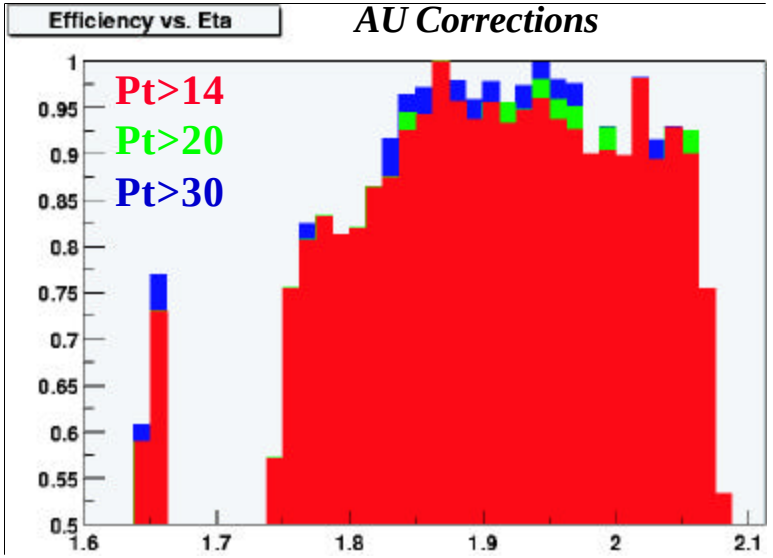
- Plot Level-1 trigger efficiency for P_T=300 GeV (P~1 TeV) muons to pass "tight" (3-station) CSC T-F requirement for adequate rate reduction. ME4/1 does recover efficiency.



ME4/2 | ME4/1

RPC Limit

With ME4/1 AND AU Corrections



1.8<h<2.1 and Pt>20

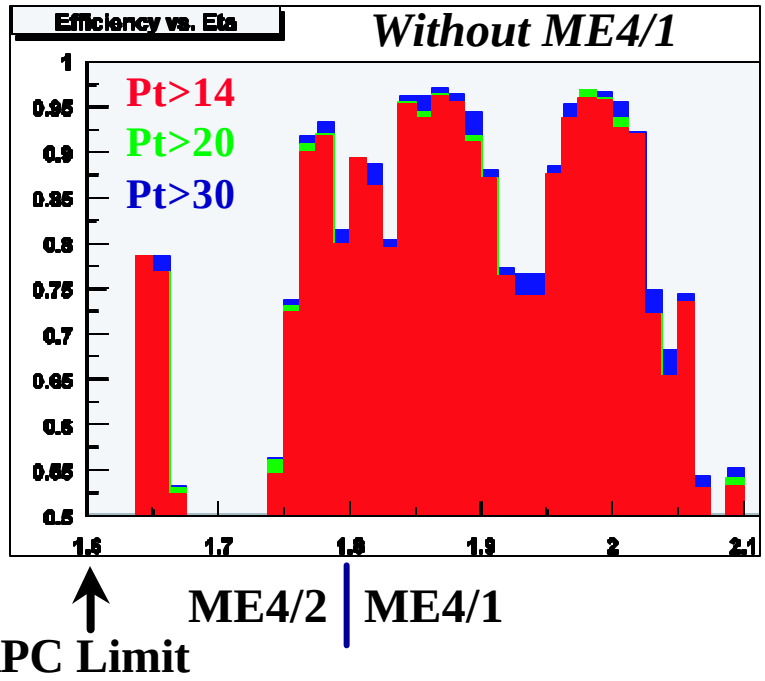
With ME4/1 AND AU Corrections:
ε = 87.8%, was 74% (No ME4/1)

De/e=**15.4% !**

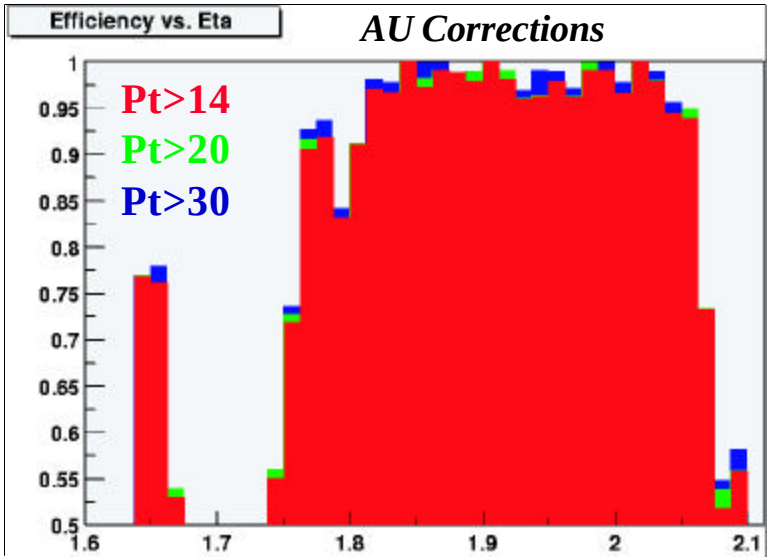
B. Scurlock

50<Pt<100 Assignment: Using ME4/1 and AU Correction

- Plot same CSC T-F efficiency for muons with 50 GeV<P_T<100 GeV to pass "tight" (3-station) requirement.



With ME4/1 AND AU Corrections



1.8<h<2.1 and Pt>20

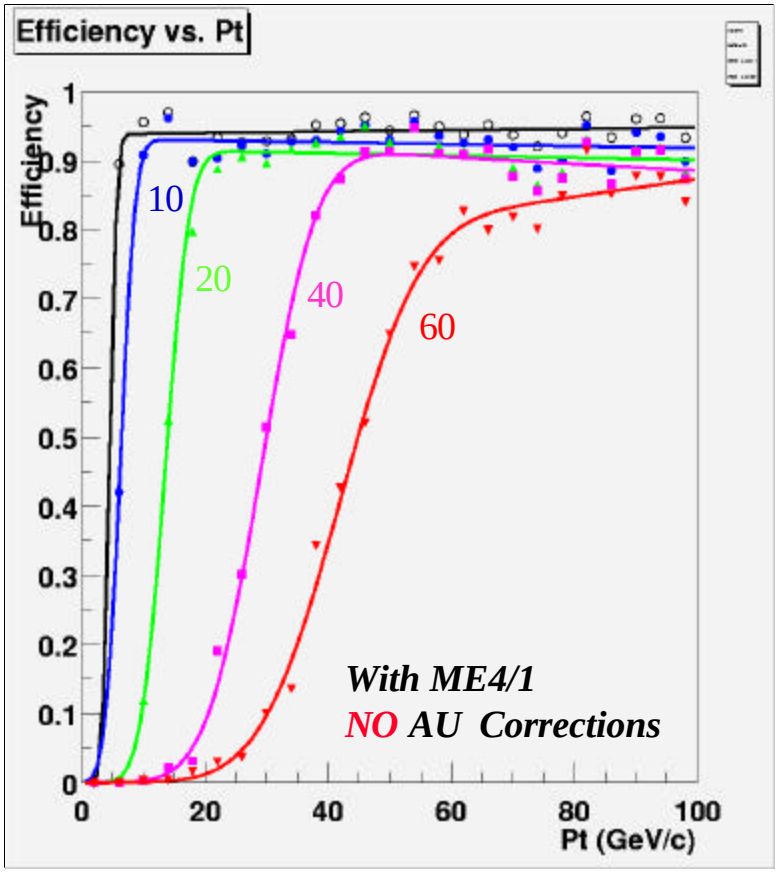
With ME4/1 AND AU Corrections:
ε = 92.6%, was 82% (No ME4/1)

De/e=**11.5%**

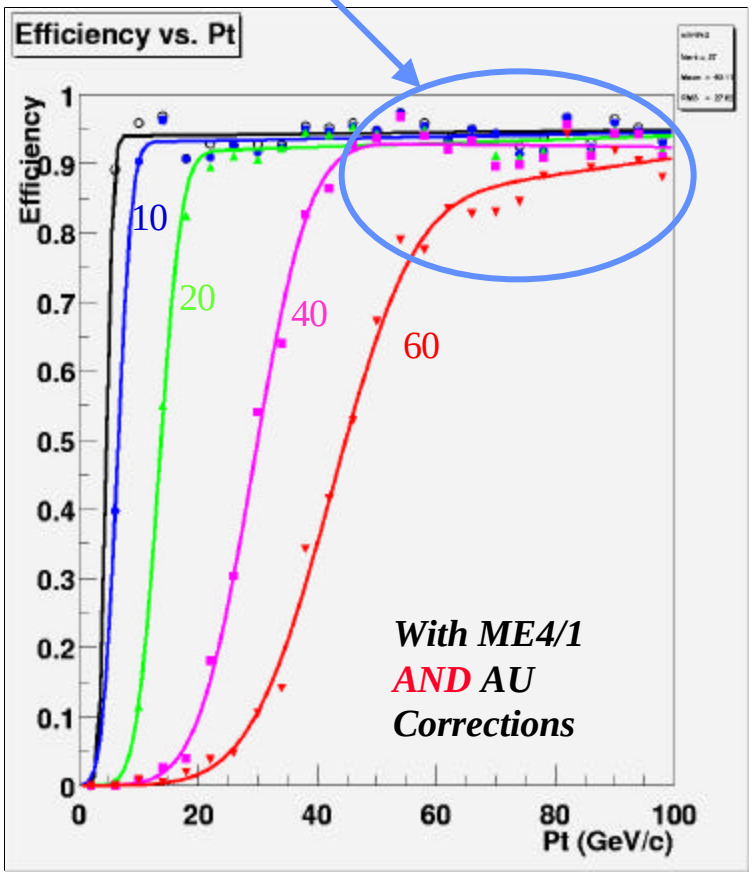
B. Scurlock

50<Pt<100 Assignment: Using ME4/1 and AU Correction

- Plot Pt Efficiency for muons with 50 GeV<P_T<100 GeV.



Note: Negative Slopes disappear



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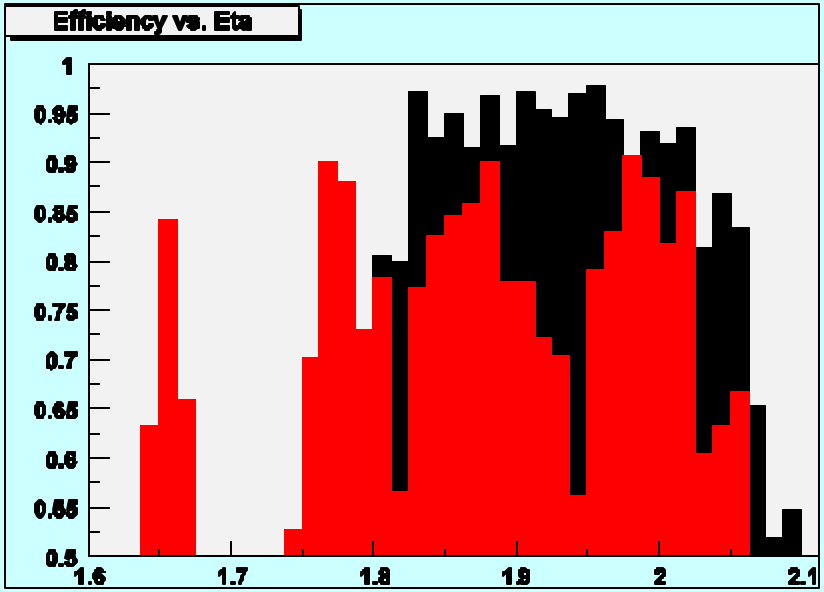
Adding Neutrons at $L = 3 \times 10^{34} cm^{-2} s^{-1}$

$P_T > 20$

Conservative choice

Single TeV m Events

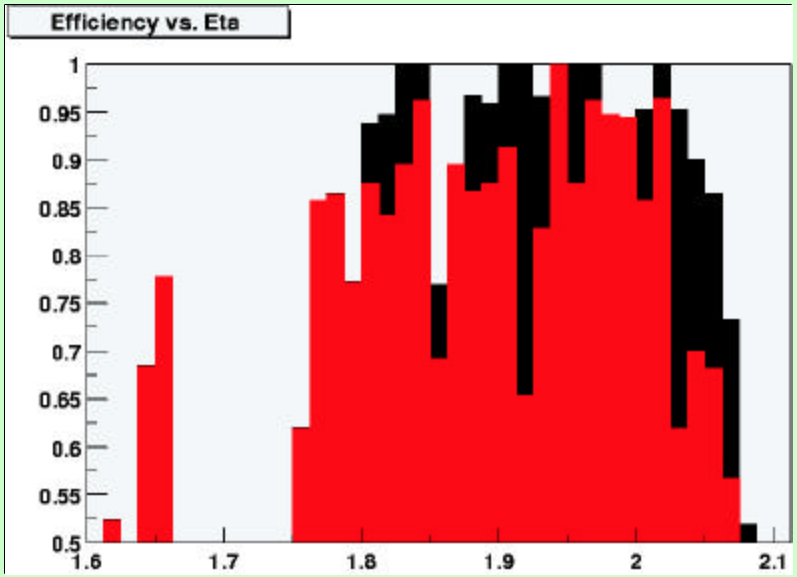


Without ME4/1: e = 72%

With AU Corrections: e = 86.3%

De/e = 20%

Single m Events $50 < P_T < 100$



Without ME4/1: e = 79.5%

With AU Corrections: e = 90.8%

De/e = 14%

Even larger improvement seen

Summary of Study

In Region 1.8<h<2.1:

e	No Neutrons No ME4/1	No Neutrons AU Correction	With Neutrons No ME4/1	With Neutrons AU Correction
$50<P_T^{gen}<100$	82%	92.6%	79.5%	90.8%
TeV	74%	87.8%	71.9%	86.3%

De/e	Neutron Effect No ME4/1	Neutron Effect AU Correction	AU Correction Effect No Neutrons	AU Correction Effect With Neutrons
$50<P_T^{gen}<100$	-3%	-2%	+13%	+14.2%
TeV	-2.8%	-1.7%	+18.6%	+20%

Only works if we re-scope ME4…

B. Scurlock