Level-2 Calorimeter Trigger Upgrade at CDF

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Overview

- ✓ Description of the CDF Level-2 Calorimeter Trigger
- ✓ Limitation of the actual cluster finder algorithm at High Luminosity (hardware implemented).
- ✓ Upgrade path based on a new hardware and on a new algorithm (software implemented).
- ✓ Description of the new system

CDF Data Acquisition System

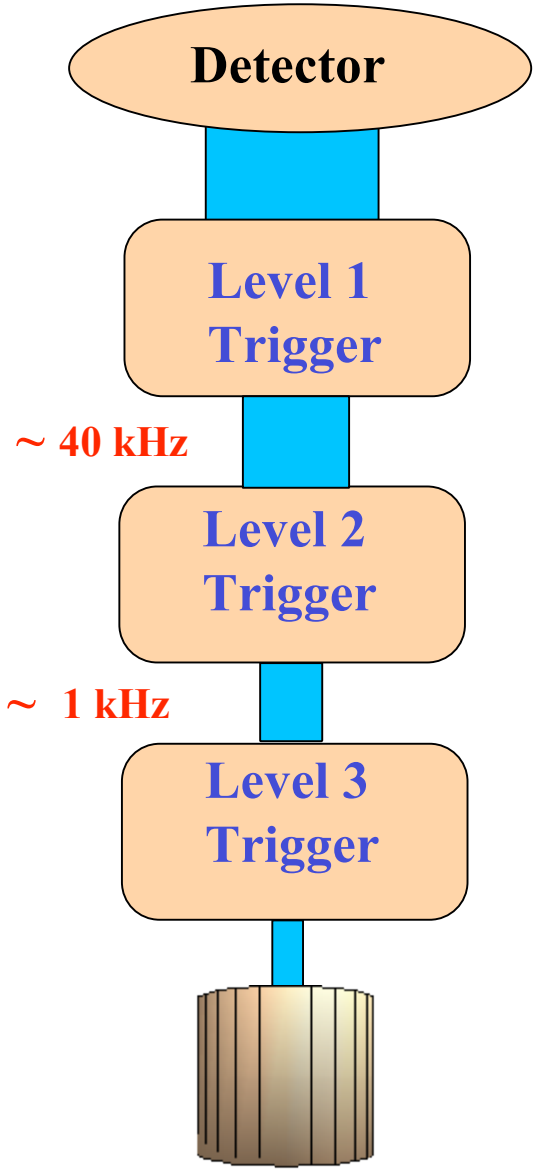
Crossing Rate 1.7 MHz
Digitization at 132 clock cycle

Synchronous 40-stages Pipeline
Data latency ~ 5.5 us

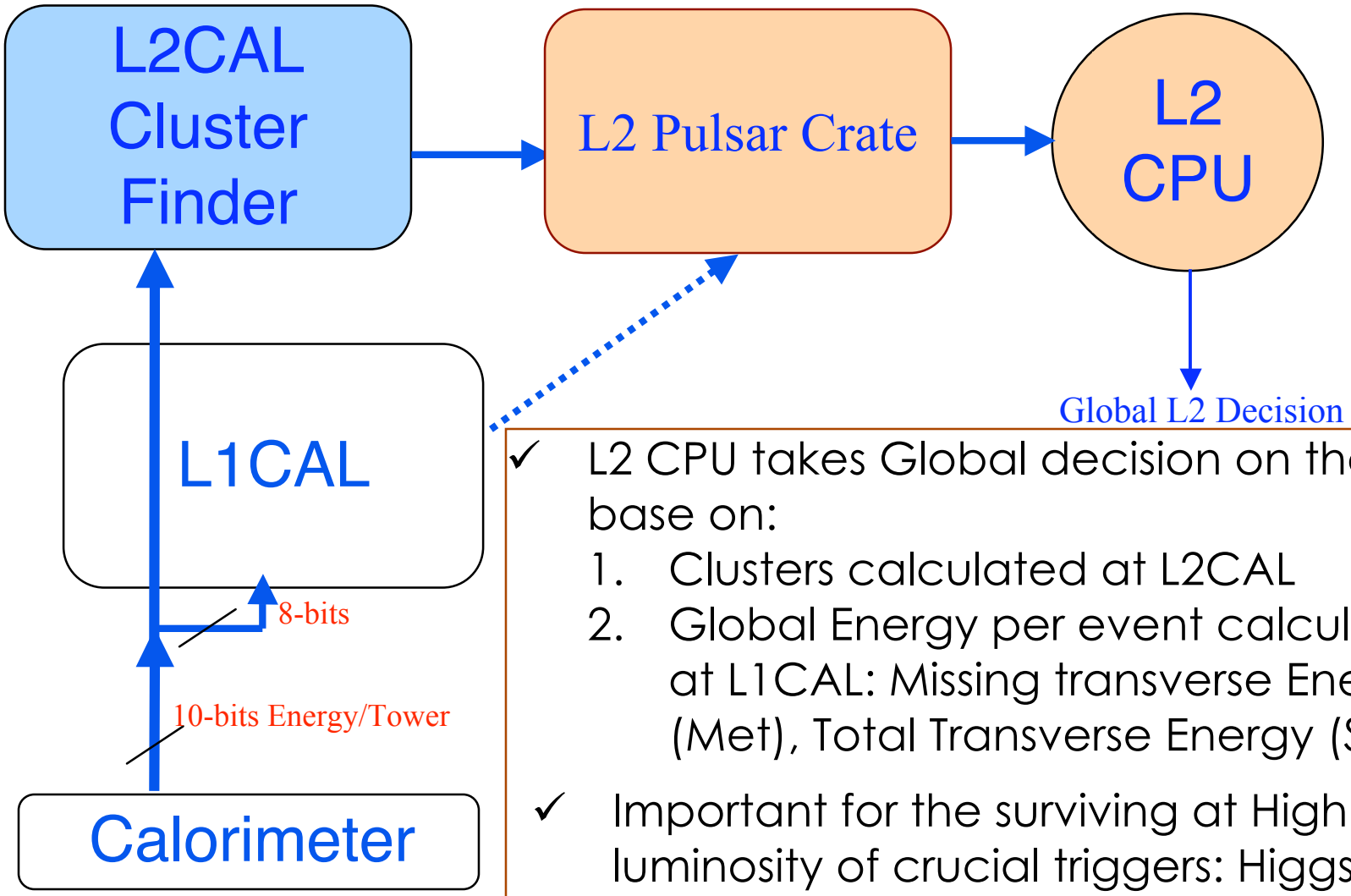
Asynchronous 2-stages Pipeline
Data latency ~ 20 us

Full detector readout
PC farms runs reconstruction

Mass Storage
Accept rate < 75 Hz



CDF Calorimeter Trigger

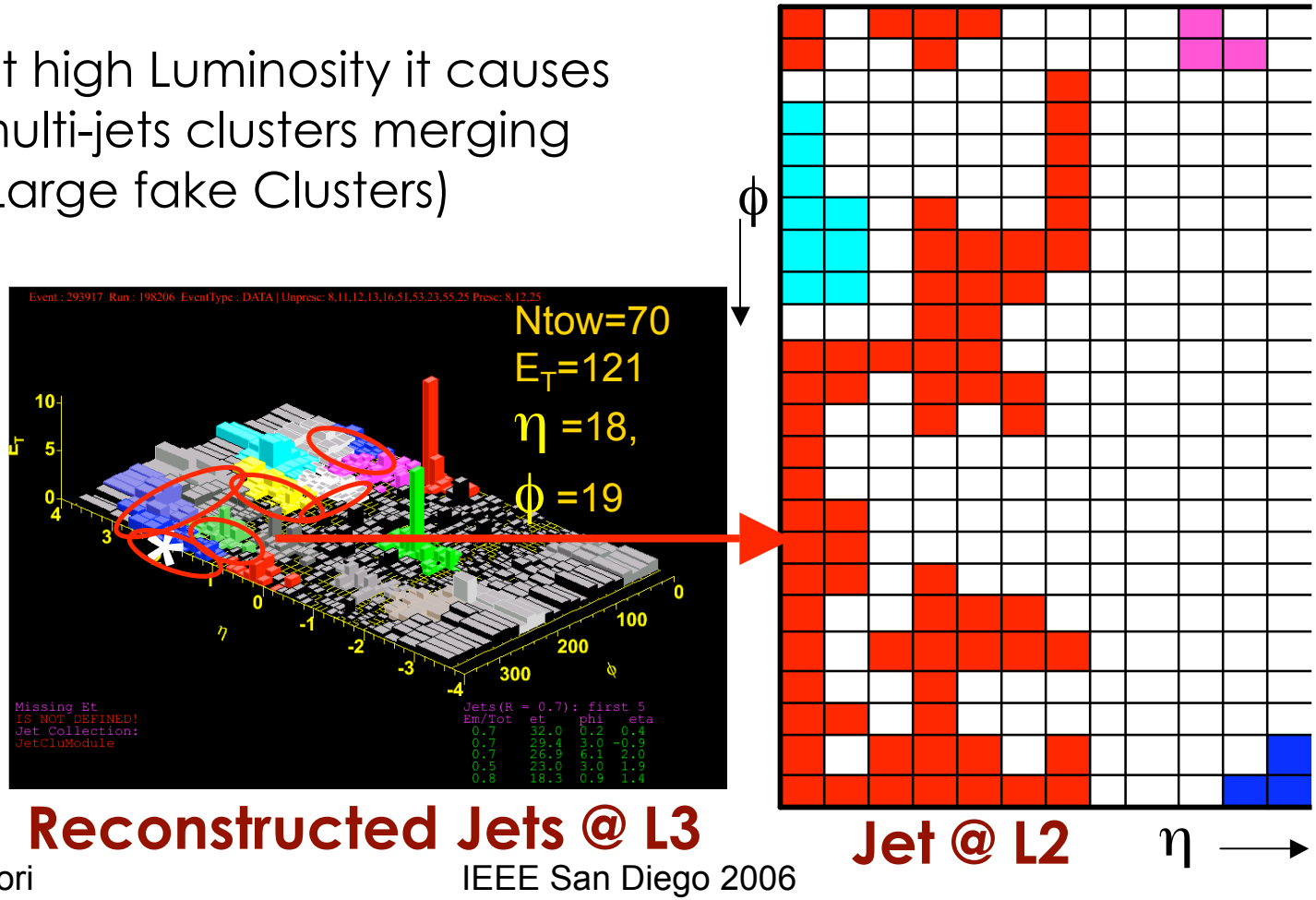


- ✓ L2 CPU takes Global decision on the base on:
  1. Clusters calculated at L2CAL
  2. Global Energy per event calculated at L1CAL: Missing transverse Energy (Met), Total Transverse Energy (SumET)
- ✓ Important for the surviving at High luminosity of crucial triggers: Higgs,Susy.

L2 Jet clustering at High Luminosity (I)

- The algorithm forms clusters combining contiguous regions of trigger towers with non trivial energy.

- At high Luminosity it causes multi-jets clusters merging (Large fake Clusters)

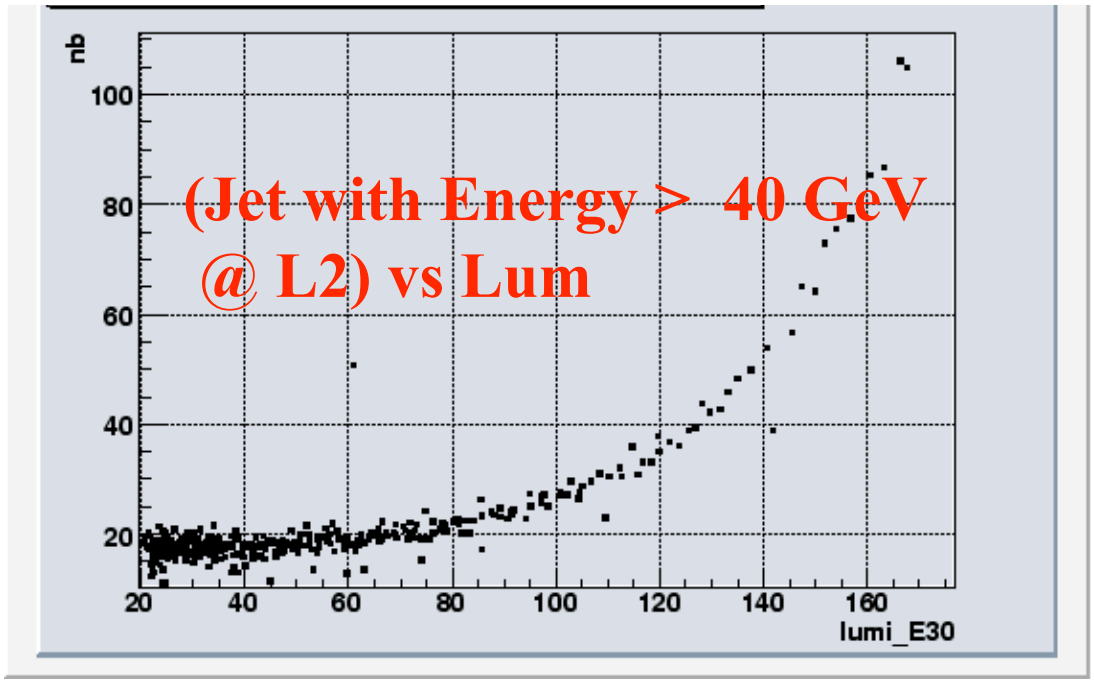


Reconstructed Jets @ L3

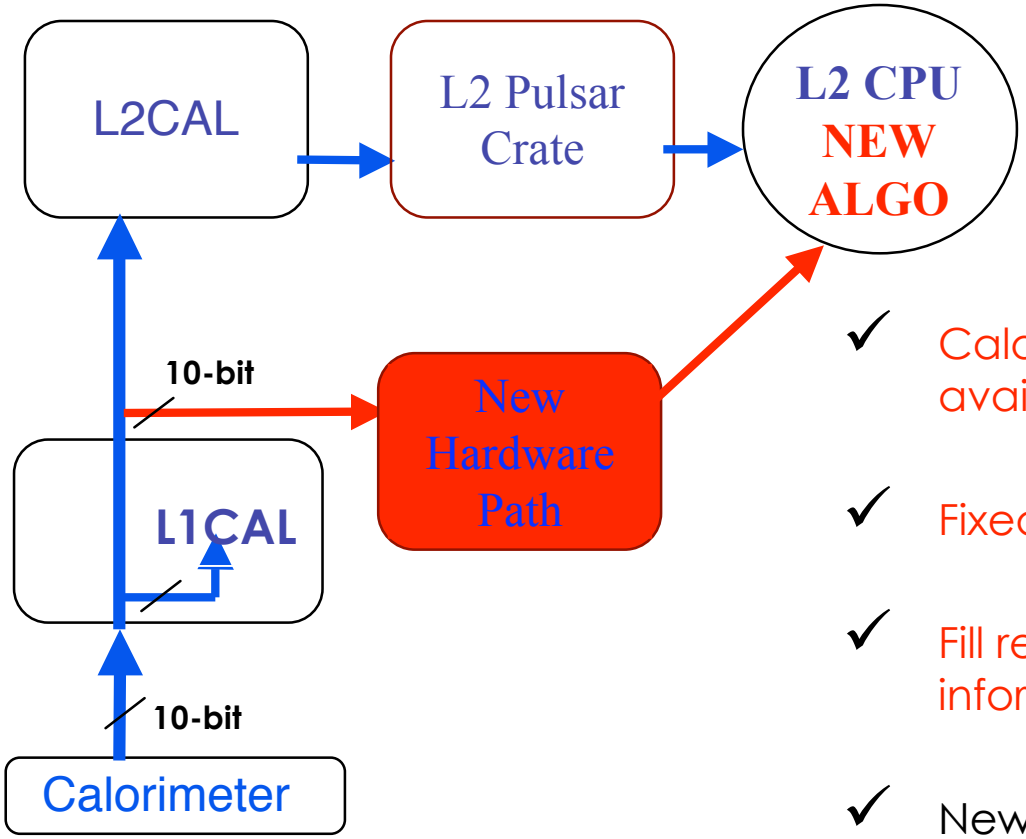
Jet @ L2

L2 Jet clustering at High Luminosity (II)

- Underlying Event energy increases due to pile-up interactions and possibly beam backgrounds
- Towers boosted above threshold clustered together in FAKE jets:
  - Jet Trigger cross sections grow rapidly with luminosity
  - High L2 Accept Rate
  - Saturation of the bandwidth



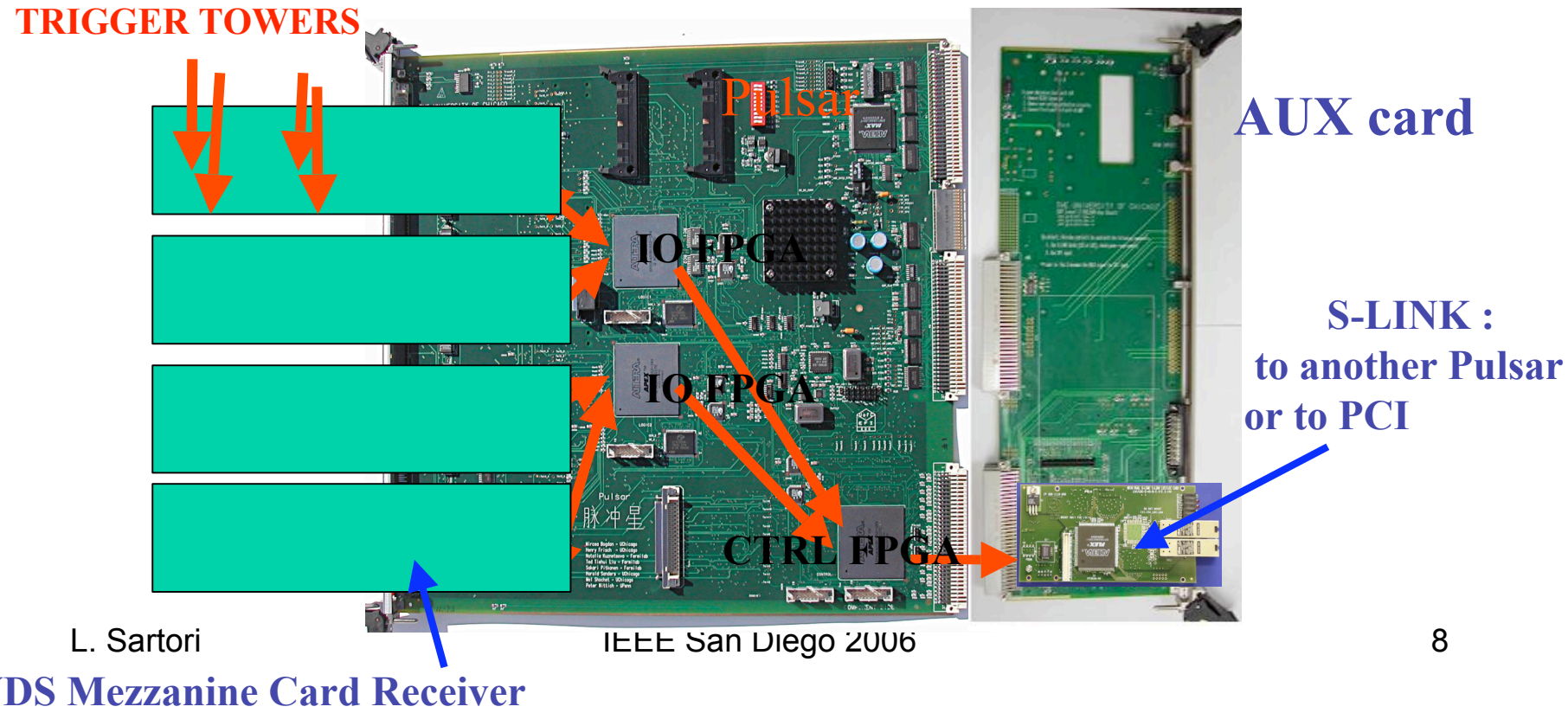
New System Overview



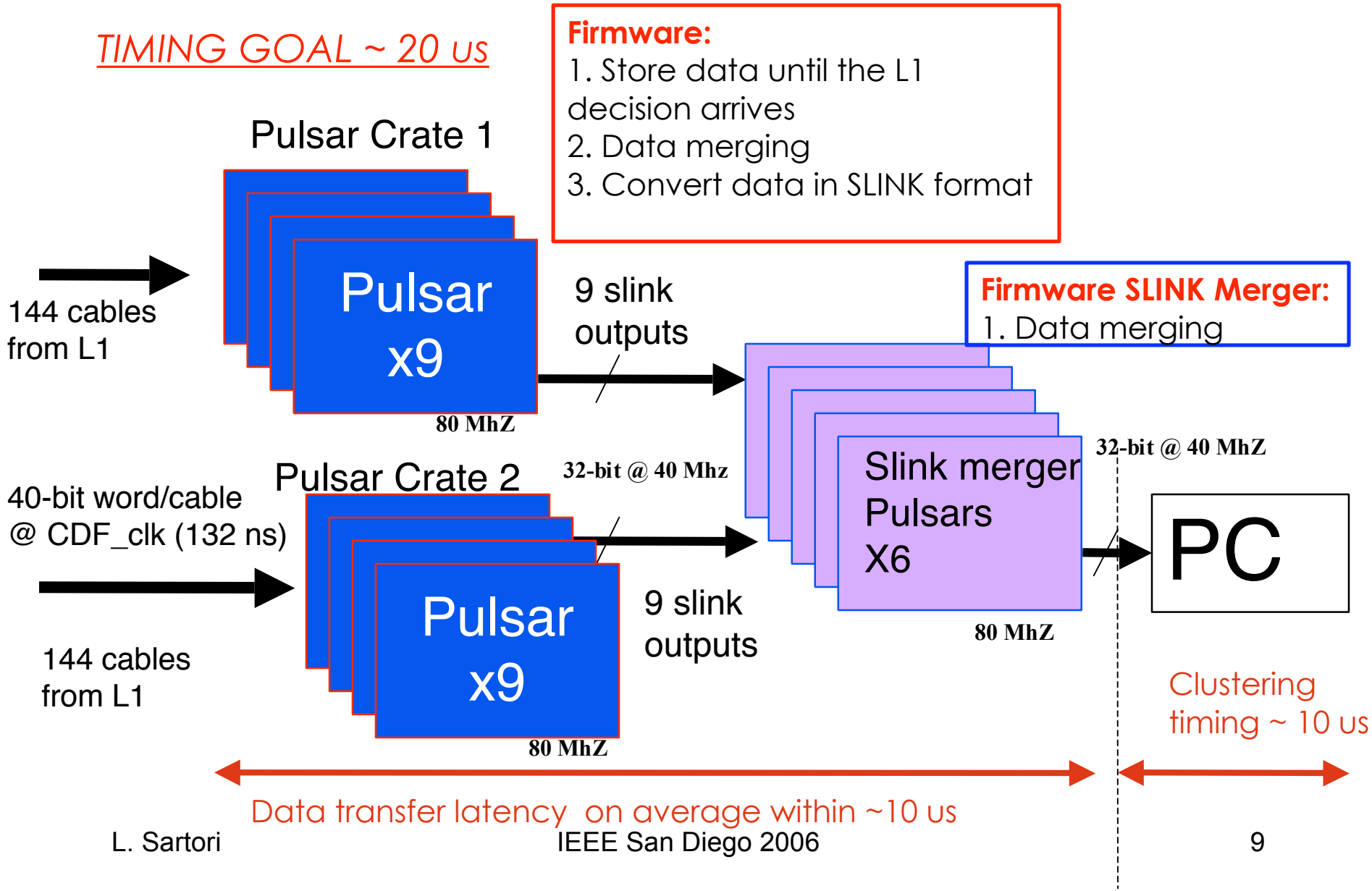
- ✓ Calorimeter trigger towers available in L2 CPU
- ✓ Fixed Cone algorithm
- ✓ Fill resolution from 10 bit based information
- ✓ New Hardware Path is required
- ✓ Commissioning in parasitic mode

Hardware Setup

- ✓ New Path is based on: Existing Pulsar Board + new LVDS Receiver Card
- ✓ **PULSAR** (**PULS**er **A**nd **R**ecorder) is a general purpose VME board developed at CDF to interface any user data with industrial link through the use of custom mezzanine card
- ✓ CERN S-LINK (Simple LINK- 80 Mbits/sec) is the standard link to allow Pulsar to communicate with CPU via commercially S-LINK to PCI interface Card.

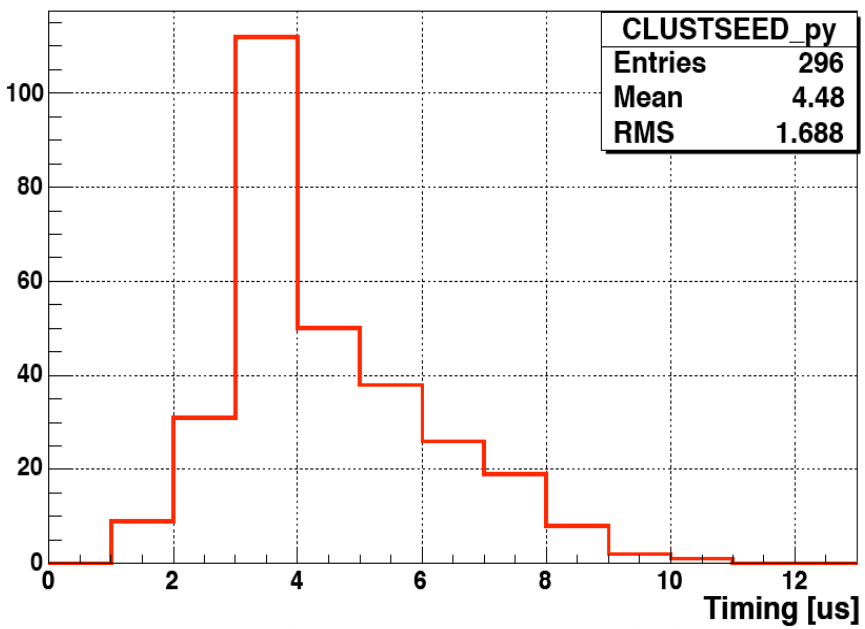


New L2CAL System



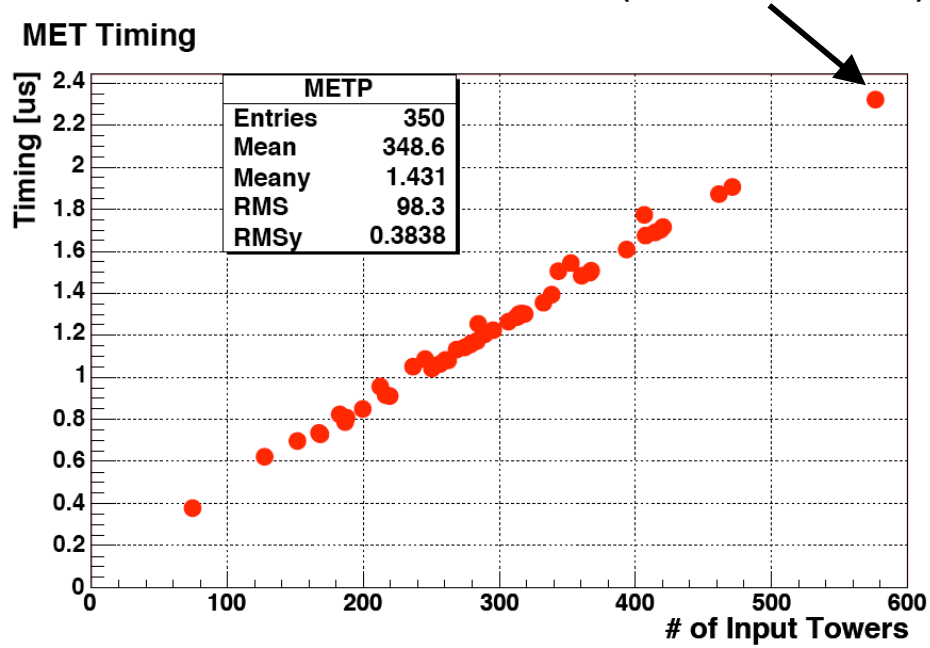
Algorithm Timing Performance

- CPU: Dual AMD Opteron 250/2.4GHz (L2 decision PC)
- Time stamps before and after algorithm execution
- Measures include MET calculation



~ 300 typical events driving the L2 trigger

Worst Case (Max # Towers)



Met timing vs # of input towers (Non-trivial Energy Towers)

Conclusions

- We presented the L2 calorimeter upgrade for CDF
- A New software implemented algorithm is the key
- New system is very flexible and can keep up with changing luminosity conditions and can be easily optimized for new physics/higgs searches
- The upgrade will grant the success of the Higgs and SUSY program
- We need to develop new trigger strategy to exploit all the new design features.
- The commissioning will be next spring