The Level-1 CSC Trigger Simulation — Status & Results —

D. Acosta

University of Florida

with major contributions from

S.M. Wang (UF), B. Tannenbaum (UCLA), T. Cox (UCD), R. Wilkinson (Caltech)

Outline:

- Software Status
- L1 Trigger results:
  - Background rates
  - Single muon efficiency

CSC Software Status

- Full C++ description for ORCA written from scratch in the last 6 months
  - Muon package:
    - Detector geometry
    - Hit unpacking
    - Digitization

    } (Cox, Wilkinson)
    - Persistency (Wilkinson)
  - Trigger/L1CSCTrigger package:
    - Trigger primitive formation (Tannenbaum)
    - Regional track-finder (Acosta, Wang)
- Available in head version, tested with ORCA3
- Each subpackage tested independently, but full system integration tests still ongoing
- No OO track reconstruction for CSC system yet
  - Cox and Wilkinson will start this in December
- Preliminary physics results on the Level-1 trigger performance only are derived from a combination of standalone programs

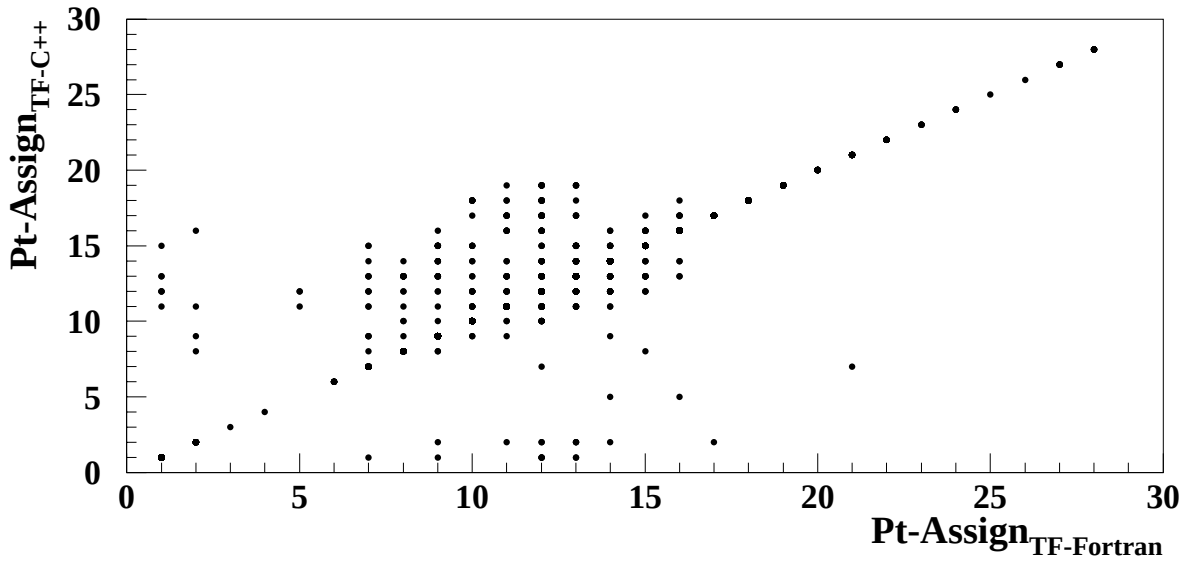
CSC Trigger Primitives in ORCA

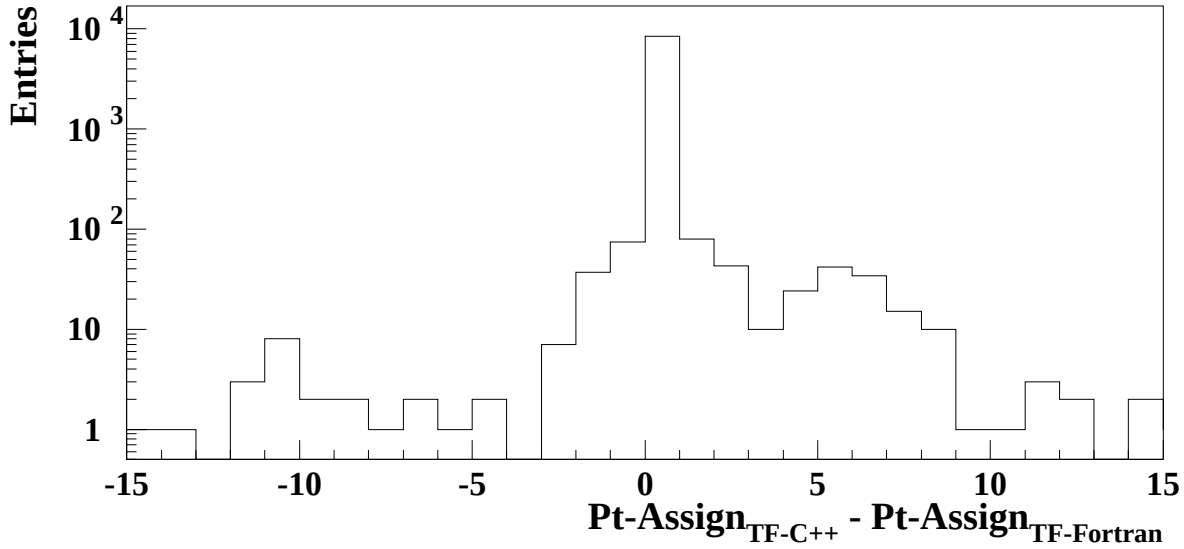
- Have entire trigger path coded:
  - Anode & Cathode LCT Processor (B. Tannenbaum)
    - Anode uses LCT99 logic
    - Cathode uses LCT99 logic + bend + Hi/Low p_T
  - Motherboard (BHT & N. Wisniewski)
    - Associates best ALCT with best CLCT
  - Portcard (BHT & N. Wisniewski)
    - Sorts by ALCT quality * CLCT quality
  - Sector Receiver (BHT & T. Truong)
    - Uses LUT to determine ϕ & η from strip & wire group number.
- Code is fast
- Can read from .fz files
- Can read from database
- Must still include:
  - Pattern based CLCT finding
  - RPC information for ghost-busting at motherboard
- Must still compare CMSIM and ORCA resolution

The CSC Track-Finder in ORCA

- C++ description written by Acosta
- Object design and algorithms follow hardware:
  - 12 Sector Processors (6 per endcap) instantiated
  - Each Sector Processor contains
    - 5 Extrapolation Units
      - Link track stubs from 2 stations
    - 2 Track Assembler Units
      - Form tracks from extrapolations
    - 1 Final Selection Unit
      - Select best distinct tracks
    - 1 Assignment unit
      - Assigns P_T, ϕ, and η using a **3-station sagitta measurement**
  - Output is the three highest rank tracks
  - 1 Muon Sorter collects all tracks and selects the four highest rank (to be collected by the Global Level-1 Muon Trigger)
- DT / CSC overlap region is presently not treated
- Software debugged by making detailed comparisons with a Fortran simulation (Wang)

Comparison of P_T



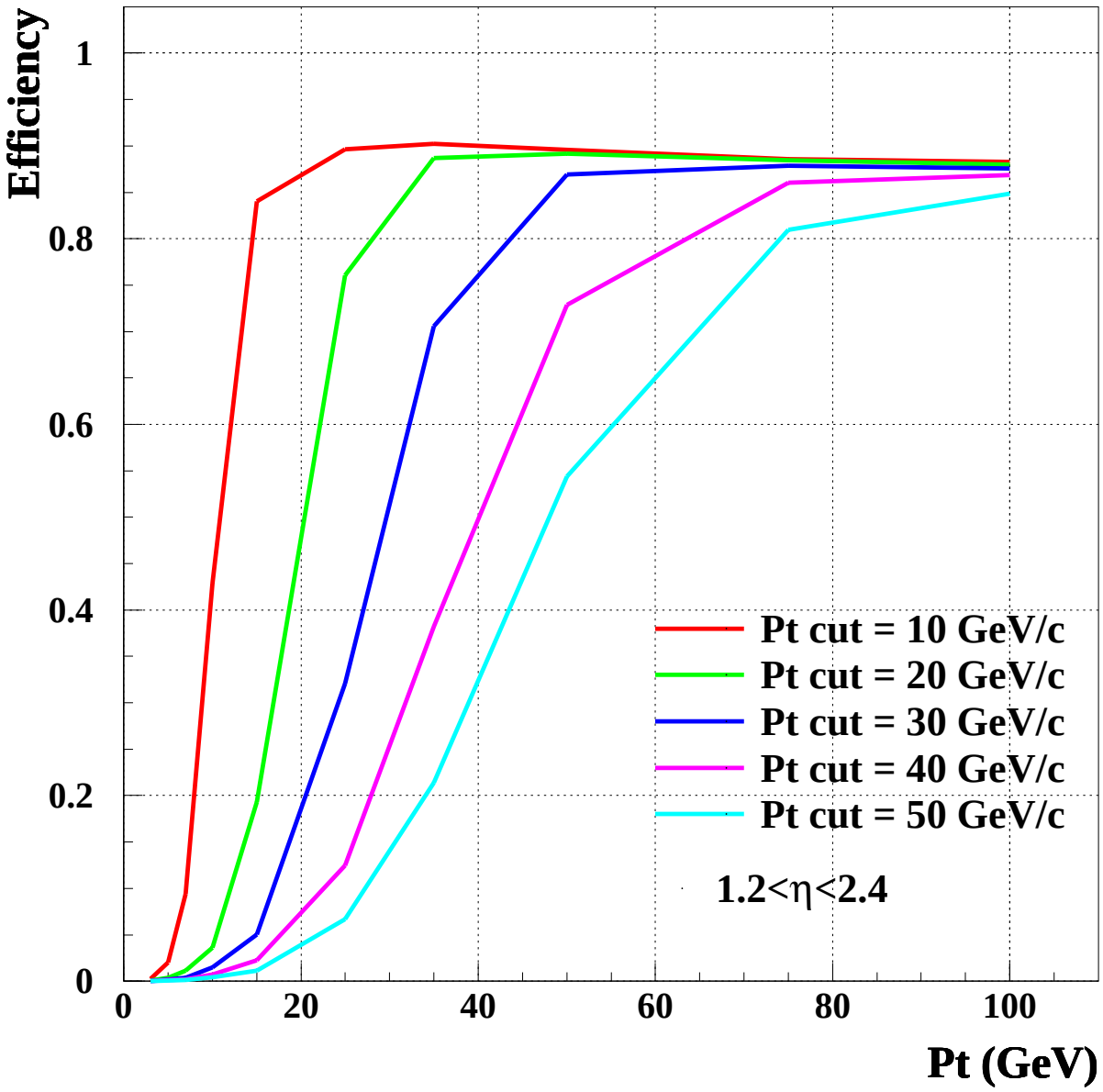


Difference due to slightly different Track Assembly procedures for multiple trigger primitives in one station

L1 CSC Trigger Results

- CSC software for ORCA is not fully validated yet
  - This is being addressed **now**
- C++ Track-Finder is shown to be equivalent to Fortran version
- Therefore, use trigger primitives from CMSIM and a standalone Track-Finder to extract background rates and single muon efficiencies
- Limitations:
  - Does not test system in ORCA
  - Trigger primitive simulation in CMSIM is naïve (but so is the one in ORCA presently)
  - Results will be “conservative”
- Florida is producing large MC samples for Muon HLT studies, so switch back on digitization for some samples.
  - Samples generated using same parameters as for HLT: Pythia and CMSIM116
  - Use unweighted Pythia Min Bias events

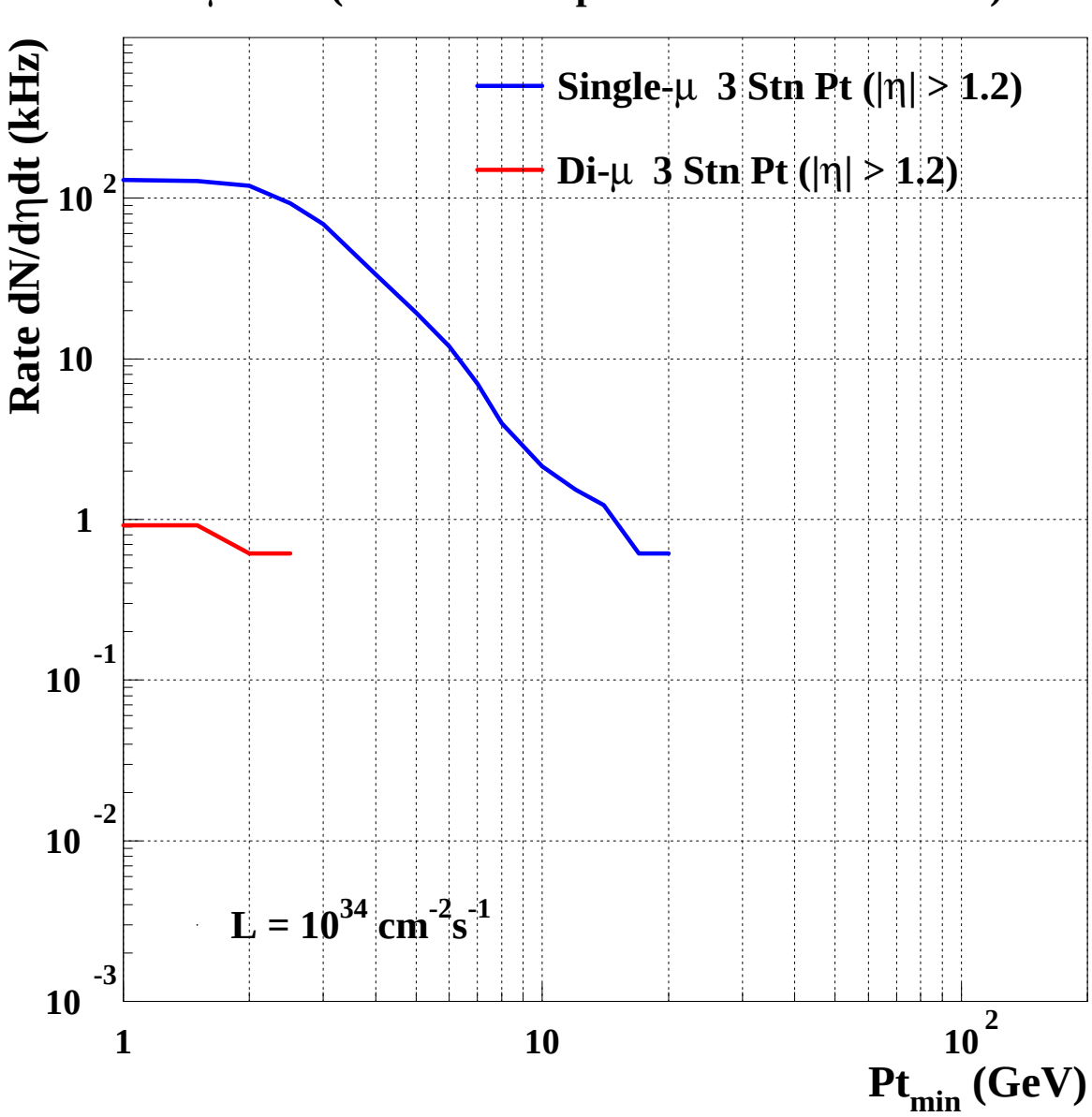
Single Muon Trigger Efficiency Turn-on Curves



Includes geometrical acceptance

L1 CSC Trigger Rate (per unit rapidity)

760K unweighted Pythia Min Bias events, $P_t^{hard} = 0$, with pile-up, put through the Track-Finder simulation
Rate is for 10^{34} luminosity assuming $\sigma = 55$ mb



Target rate of 1 kHz for single muons is achieved with 3-station sagitta measurement for a threshold of ~15 GeV