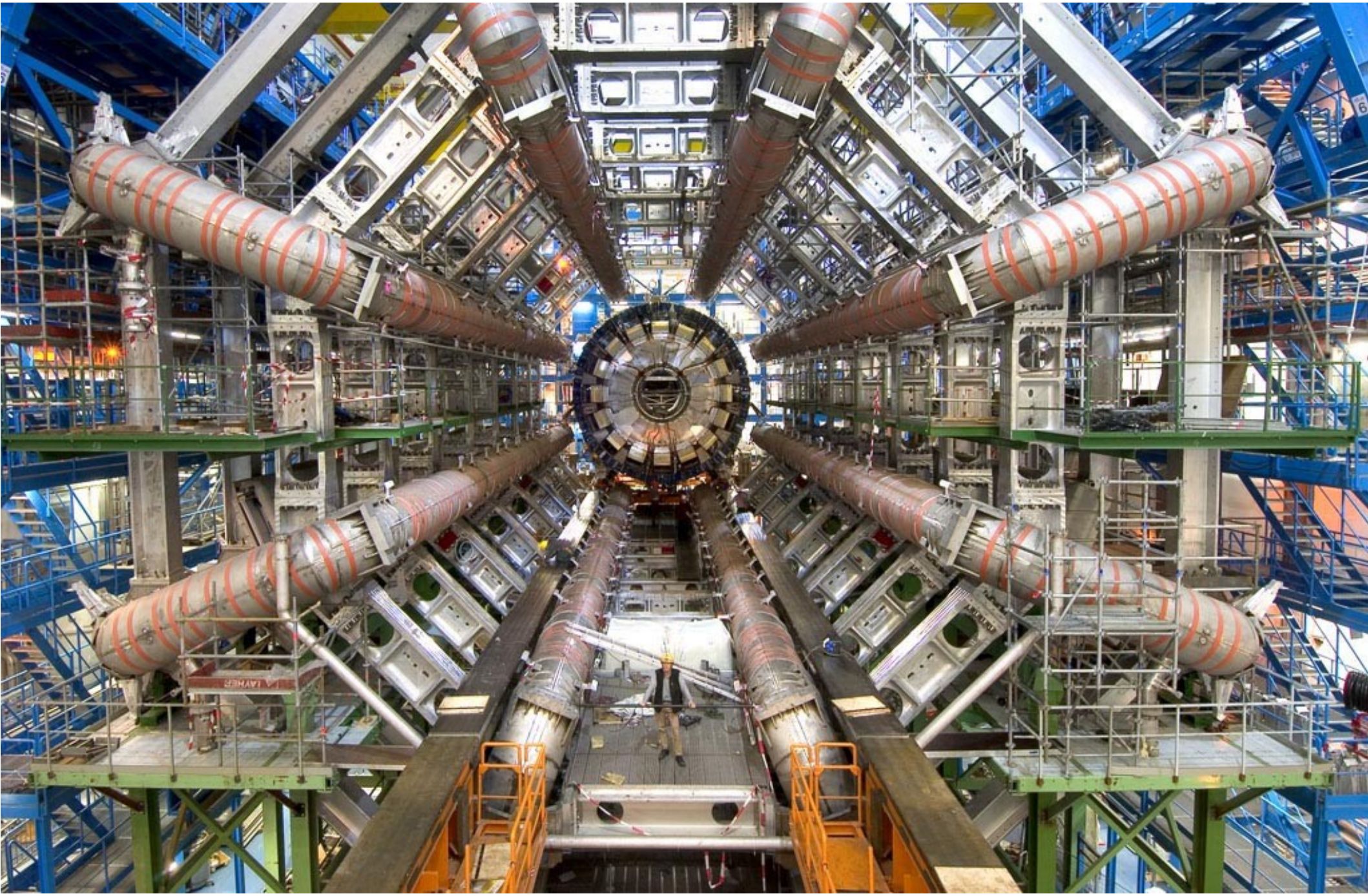
ATLAS High Level Trigger

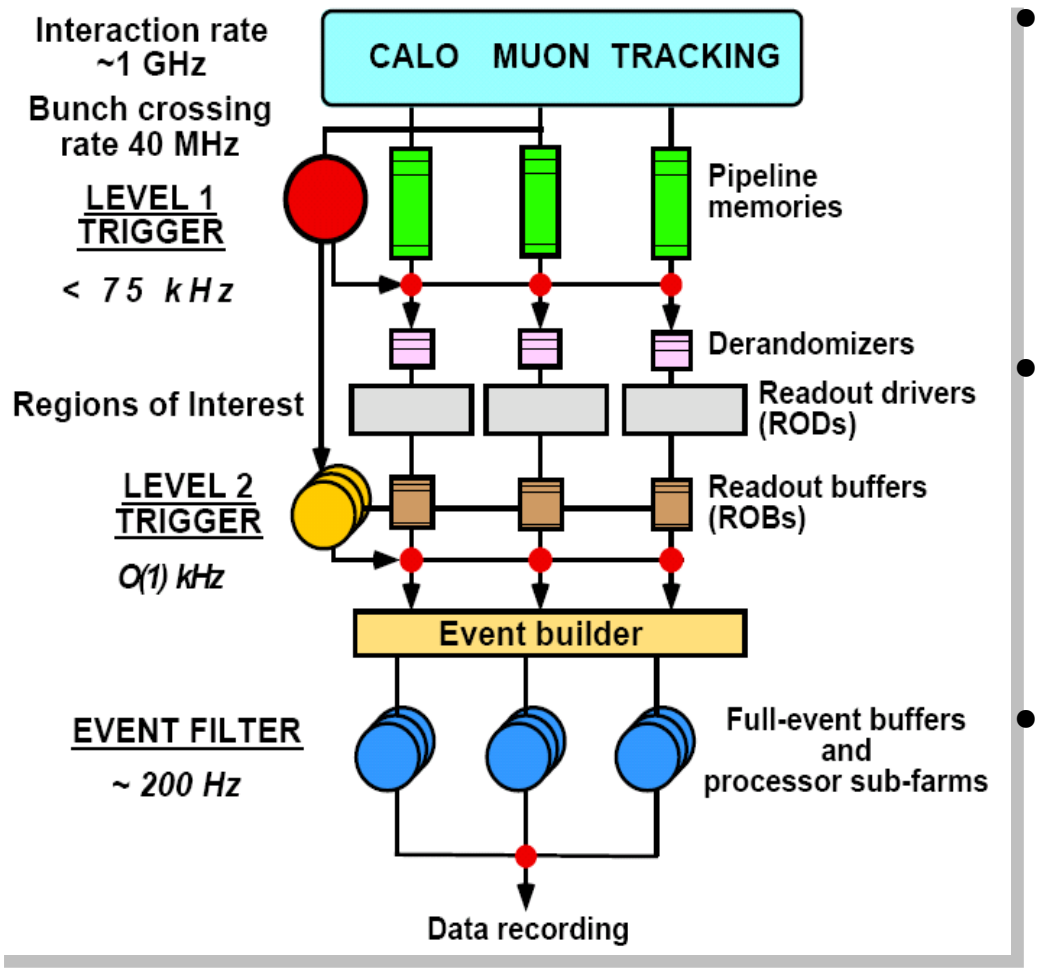
DOE Program Review
SLAC
Experimental Particle Physics Breakout Session
June 7, 2006

Rainer Bartoldus

STANFORD LINEAR ACCELERATOR CENTER



The ATLAS Trigger



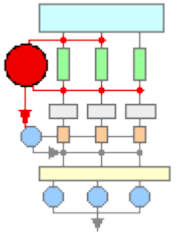
- **LVL1** (hardware) decision based on calorimeters and muon chambers; synchronous at 40 MHz, bunch crossing identification
- **LVL2** (software) (~500 nodes) uses Regions of Interest identified by LVL1; ~2% data at full granularity from all detectors
- **Event Filter** (~1600 nodes) has access to full event and can perform more refined (offline-like) reconstruction

HLT

High Level Trigger

- Algorithms
  - Refinement of Trigger Elements / RoI
  - e/gamma, muon, jet/tau/ETmiss, *b*-tagging
- Steering
  - Stepwise calling of algorithms, stepwise decisions, early reject
- Configuration
  - Must store all information on LVL1 subsystems, HLT algorithms, steering, trigger menu -> consistently
  - Used online *and* offline (analysis+simulation), “from the pit to the Grid”
  - Must scale to O(1000) nodes

One Major Challenge

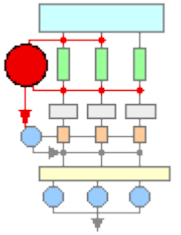


- How to deliver the O(30 MB) configuration to the LVL1 clients [no big deal] and to the ~2000 CPUs x *n* cores x *m* processes HLT clients [A BIG DEAL]
- All clients will need this information essentially simultaneously, from an SQL database replica or some sort of cache at the start of a run
- This is an absolutely essential feature of the system; TMK it has not been demonstrated in any experiment, anywhere near that scale
  - If you spent 1s on each node the whole system would take 45 min to configure!
- One of the first areas where SLAC got involved

The BaBar Experience

- Many important challenges in ATLAS/TDAQ right now appear (all too) familiar from a BaBar perspective
  - Trigger Configuration
    - Extremely important to achieve consistency accross all pieces of the system, flexibility, accountability, analysis access, simulation
  - Processor Scalability
    - Crucial to manage O(2000) nodes on startup, control, concurrent Online DB access, real-time monitoring
  - Online/Offline release integration
    - Vital to provide coherent, functional releases, manage dependencies
- The current SLAC team has met these before (if not quite at this scale). It's a challenge for us, too

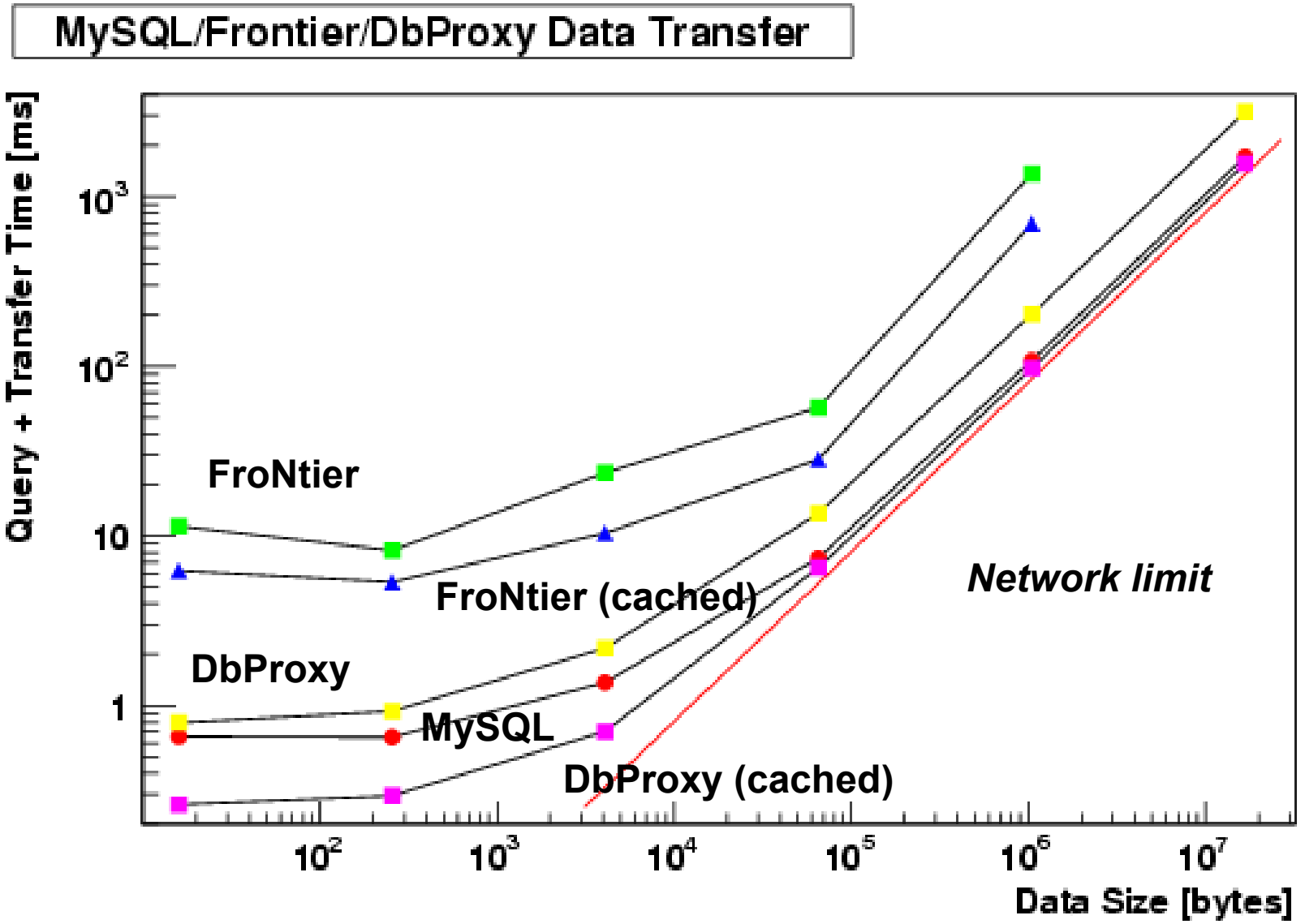
Large Scale Tests

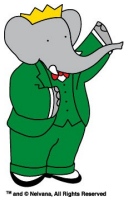


- Goals
  - Determine most efficient technology for accessing the DB from the HLT
    - Speed, reliability, fault tolerance
  - Benchmark existing options
    - FroNtier (DB -> HTTP caching facility, used by CDF/D0)
    - Multi-tiered DB, or Replicas (Oracle, MySQL -> SQLite)
    - Custom-built DB proxy (developed at SLAC)
  - Introduce Framework for collecting/analyzing timing info
  - Develop/run/support medium scale tests at SLAC

Data Access Times

A. Perazzo





Online Testbed at SLAC

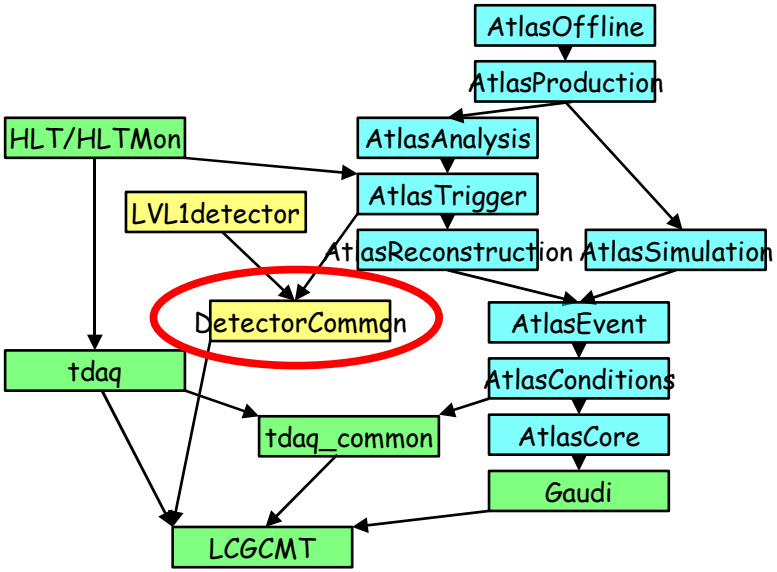
S. Luitz

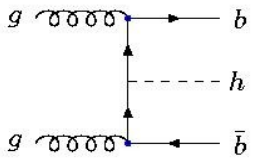
- *BaBar* decided to replace its Level 3 farm at the end of August
  - 50 dual-CPU 1.4 GHz, 1 GB RAM, 18+2*73 GB disk, two on-board 1 Gbit ethernet ports
- Will be set up as a testbed for ATLAS HLT together with
  - 48+ port switch, Oracle server (2 x 1.5 GHz UltraSparc IIIi, 2 GB RAM, 500 GB Sun T3 Fiber Channel disk array)
  - Perform medium scale benchmarks
  - Use to develop alternative proxy/caching strategies

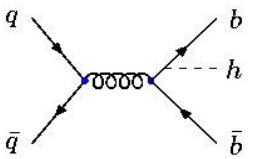
Release Organization

S. Gowdy

- Online/Offline Integration
  - ATLAS Online Software now being added as Projects
  - Taking on new Project "DetectorCommon", initially for LVL1/HLT, but could be used for other subsystems also
    - Holds configuration DB and related software
  - Providing release tools and "Librarian"



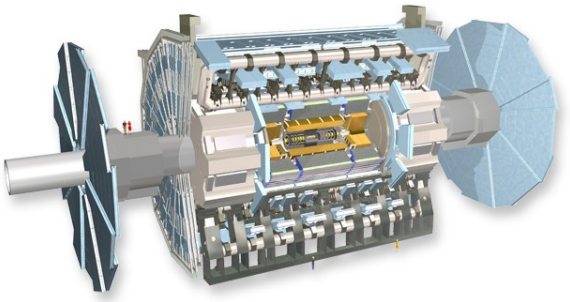




b-Tagging at the HLT

- Example scenario (already alluded to in Su Dong's talk)
  - At large tan β, MSSM Higgs production via *bbH/A* is enhanced, while decay to *tt*, *WW*, *ZZ* is suppressed
    - *bbH*(*bb*) is an important channel to preserve this signature
  - *b*-Tagging of the four jets in the EF (using offline algorithms) is now progressing
  - It would be important to attempt *b*-Tagging already at LVL2
    - But processing limitations are challenging
    - Mastering this will combine pixel expertise with expertise in fast trigger algorithms, performant code, *b*-tagging

Conclusions



- With the ATLAS High Level Trigger, the SLAC group has found a central, extremely critical, and yet still open (i.e. in need) area for contributions
- HLT is an ideal match to the unique expertise SLAC is bringing to the experiment
- Our involvement is already noticeable before our membership is approved
- In the future, HLT work will benefit from coherency with the pixel effort (e.g. *b*-tagging at LVL2)
- We are very excited about this opportunity and are taking on some significant responsibilities