ATLAS Fast Physics Monitoring

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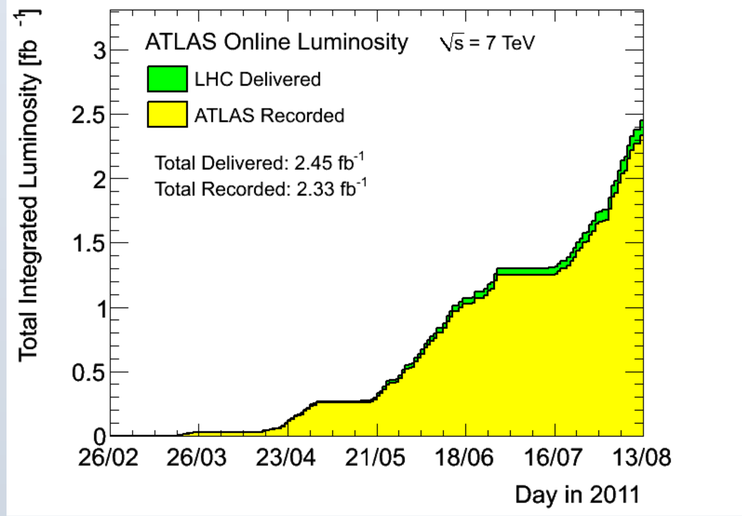
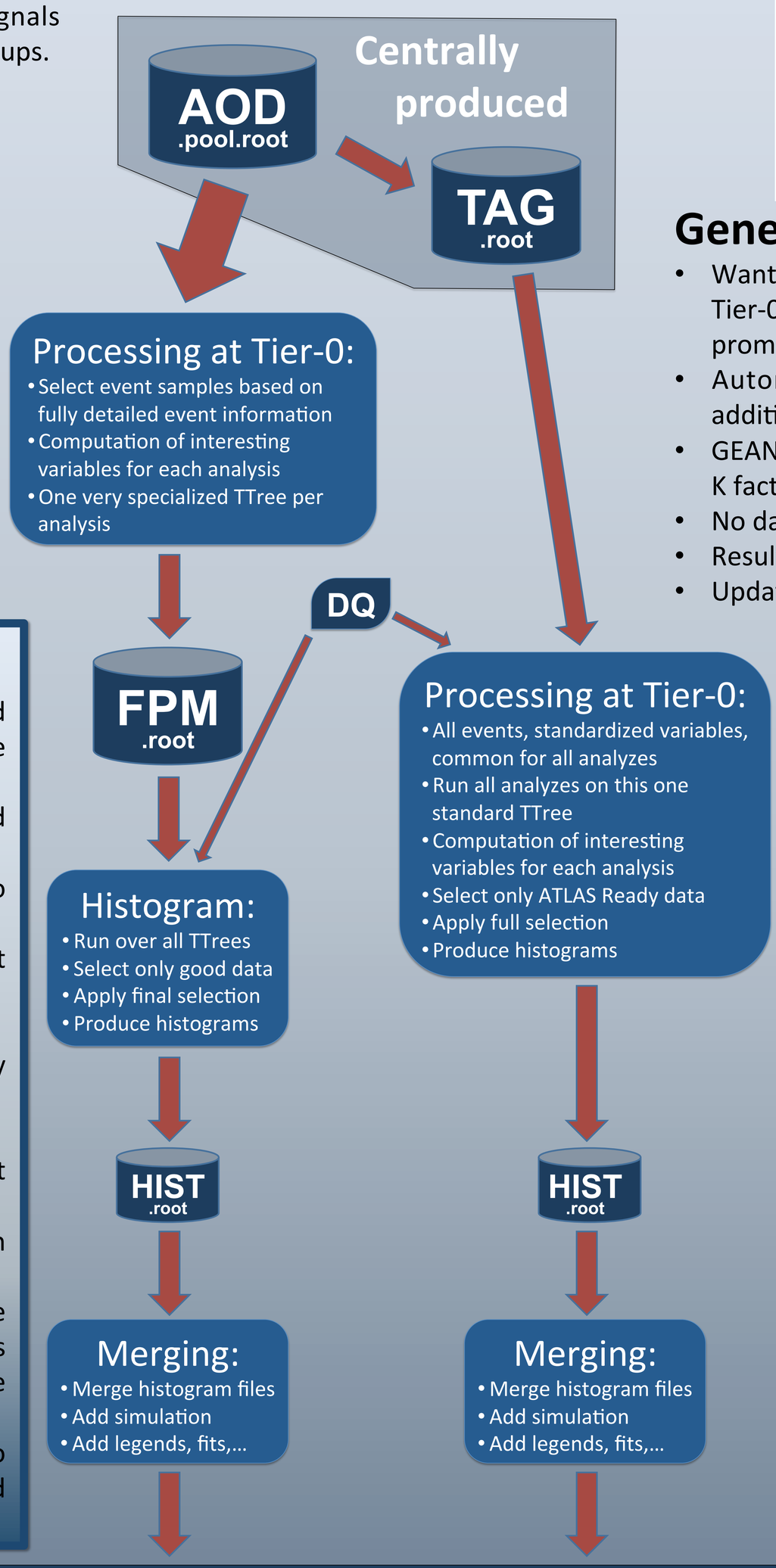
The ATLAS experiment at the LHC is recording data from proton-proton collisions with 7 TeV center-of-mass energy since spring 2010. The integrated luminosity has grown nearly exponentially since then and continues to rise fast. The ATLAS collaboration has set up a framework to automatically run over the rapidly growing dataset and produce performance and physics plots for the most interesting analyses. The system is designed to give fast feedback. The histograms are produced within hours of data reconstruction (2-3 days after data taking). Hints of potentially interesting physics signals obtained this way are followed up by physics groups.



Idea:

- In general, physics analyses are performed on a somewhat fixed dataset
- LHC currently delivers up to 0.4 fb^{-1} of data per week
- Interesting to monitor many topologies and final states as quickly as possible in an unbiased way
- If some problems or something interesting seen, notify experts from relevant detector, performance, and physics groups to follow up with more detailed studies
- Complement data quality monitoring as problems may look like “new physics” signals



General considerations:

- Want results as quickly as possible, thus, run at Tier-0 (no waiting for grid export) right after prompt reconstruction
- Automatized software framework for easy addition of signatures and very frequent running
- GEANT4 simulated events are taken as-is, *i.e.*, no K factors or smearing corrections
- No data-driven background estimations
- Results are shown on ATLAS internal web pages
- Update plots at least every night

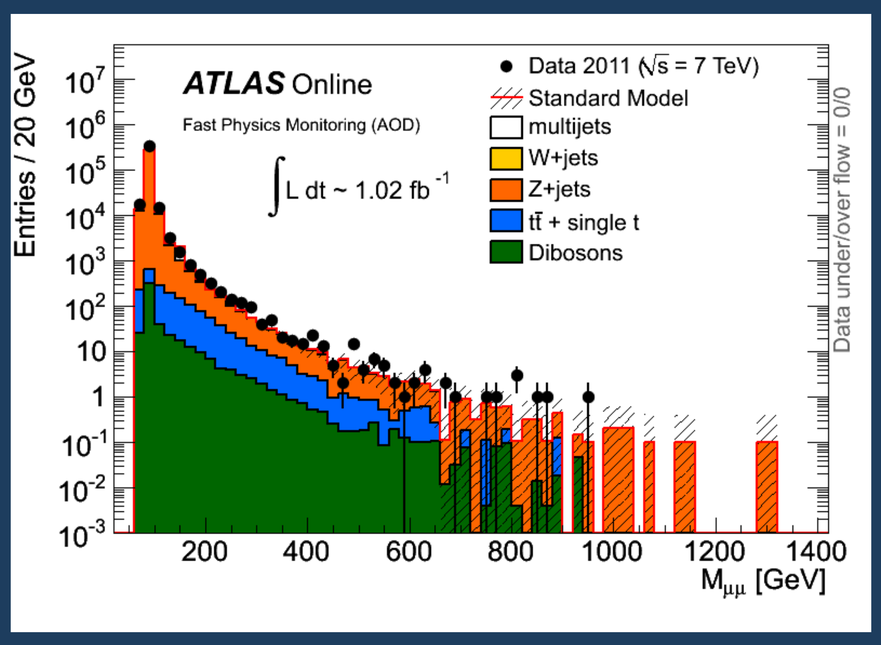
AOD[1] based monitoring:

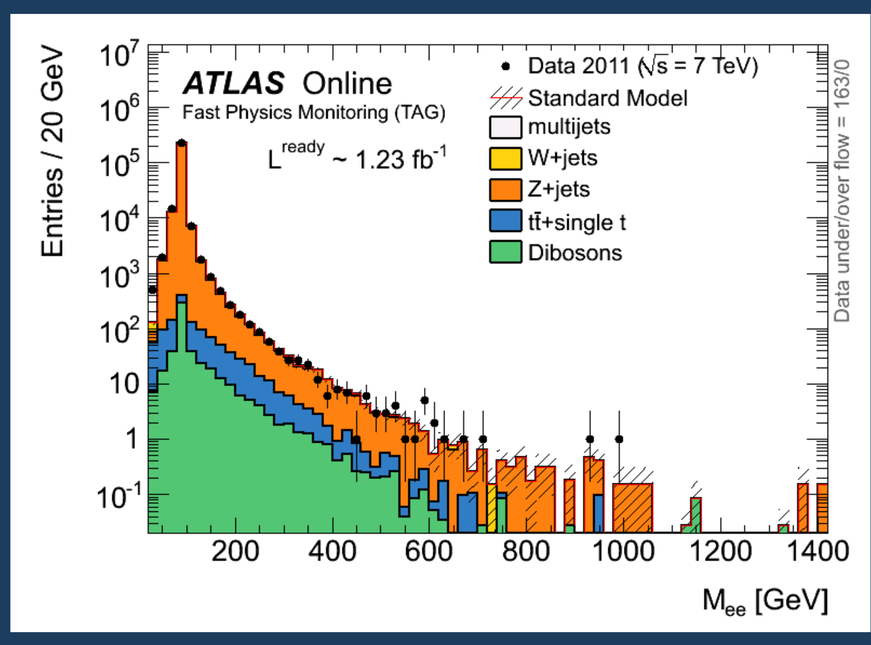
- Analysis of each signature is performed directly on AOD using the full power of the ATLAS software framework Athena
- Full event information is available, detailed studies can be performed
- Keep selection criteria generally identical to corresponding analysis in the physics group
- Keep CPU load somewhat limited as to not affect the Tier-0 reconstruction
- ROOT file contains one TTree per signature
- Use custom PyROOT framework to apply final selection and produce histograms
- Use signature-specific data quality criteria
- Calculate integrated luminosities with best known calibration
- Histograms are merged and overlaid with histograms from GEANT4 simulated events
- Full chain from ROOT files containing the analysis TTrees to display of final histograms on web pages can be done in less than one hour for all 2011 data
- Run at least once every night to automatically include newest data and newest data quality

TAG[1] based monitoring:

- TAG files are an integral part of the ATLAS computing model.
- Always produced from AOD at Tier-0.
- Contain limited information of highest-p_T physics objects in basic ROOT files
- Use C++ framework to perform analysis of all signatures in one pass on TAG files using CERN batch farm
- Use all data when all subdetectors are operational
- Final histograms are merged and overlaid with histograms from GEANT4 simulated events
- Bookkeeping and steering of the entire chain by python-based framework
- Full chain from TAG files to display of final histograms on web pages done in less than one hour for all of 2011 data
- In some cases, fully detailed or high-multiplicity studies are not possible due to limited content of TAG files

Web display:





Glossary:

- **AOD**: Standard object-based file for physics analysis
- **TAG**: Very small plain ROOT file with very limited content
- **Tier-0**: The central grid computing facility use for full data reconstruction

References:

- **[1]** Duckeck G et al. (ATLAS), “LHC computing Grid. Technical design report” (2005), CERN-LHCC-2005-022