



Event Selection Services in ATLAS

Jack Cranshaw

Argonne National Laboratory
for the ATLAS TAG Development Team



The ATLAS Data Model

- The expected data taking for a standard LHC year is 10^7 seconds.
- The detector will take data at roughly 200 Hz.
 - Limited by offline data storage, not detector trigger rate. *Could go up!*
 - Does not take into account simulation data which will have comparable size (20-50% of RAW data). We already have roughly 1 PB of data and the LHC has yet to have collisions.
- Multiple stages of processing (RAW 2 MB/ev, ESD 500 MB/ev, AOD 250 kB/ev, DPD 10-100 kB/ev) with multiple versions.
- Extensive calibration systems and data needed.
 - Refinement based on iterative processing and physics results over the course of 1 month to 1 year.
- Metadata key to finding data.
 - Provided by multiple systems at multiple sites in multiple formats.
 - Modulo some scaling and distributed computing problems we can build on previous experimental experience for much on geometry and detector conditions.
 - But providing event-level metadata has rarely been done and never at these scales.



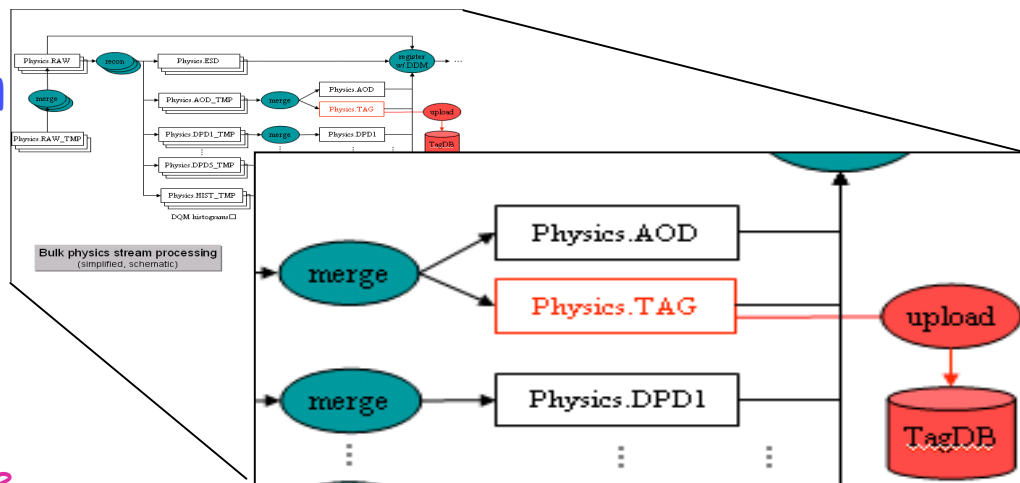
Components Adopted From LCG

- TAG software is built on top of the POOL Collections package (see Andrea's talk).
- ATLAS is the primary user of this software package and contributes much of the development effort.
- Two persistency mechanisms
 - File based: ROOT
 - Schema object, TTree with TAG data, TTree with metadata (for collection/file)
 - Relational Database: CORAL
 - Collection definition tables, TAG data tables, File navigation tables, metadata table for collection metadata.
- This provides a flexible system for
 - TAG creation using grid processes (files).
 - Global TAG selections (relational).
 - Analysis of selected events (file).
- Commissioning of this system is ongoing. ATLAS software challenges have led to the development and implementation of new features in POOL. In general, changes are required at each order of magnitude increase in data volume either because of performance needs or increasing data complexity.



TAG Data Storage and Distribution

- Two things are done with the produced TAG data.
 - It is grouped into file datasets and distributed by the ATLAS Distributed Data Management system.
 - After transfer to CERN, the files are uploaded to an Oracle RAC system at CERN and at Oracle installations at participating Tier 1's (BNL, TRIUMF, ...).
- This is done centrally from CERN by processes writing locally to the CERN database or over the network to the remote databases.
 - In general this requires running several writing processes in parallel, and the system can scale by adding processes
 - More details on the poster **"ATLAS TAGS Database distribution and management"**.





Data Available

- TAG production is done during merging of AOD files during Tier0 reconstruction at CERN or on the grid at Tier1 facilities during reprocessing using a transform provided and maintained by the ATLAS Physics Analysis Tools group.
- Thus far TAG production and processing has been irregular
 - Produced regularly with non-standard content for detector commissioning exercises (10^7 events). Files merged into larger files to cover a full run, but not imported into the database.
 - TAGS from reprocessing will be loaded.
 - Produced for dedicated exercises designed to mimic detector data such as the Full Dress Rehearsal (10^6 events).
 - Produced for some Monte Carlo data, but the power of TAGS are larger when extracting data from heterogeneous samples than from homogeneous samples.



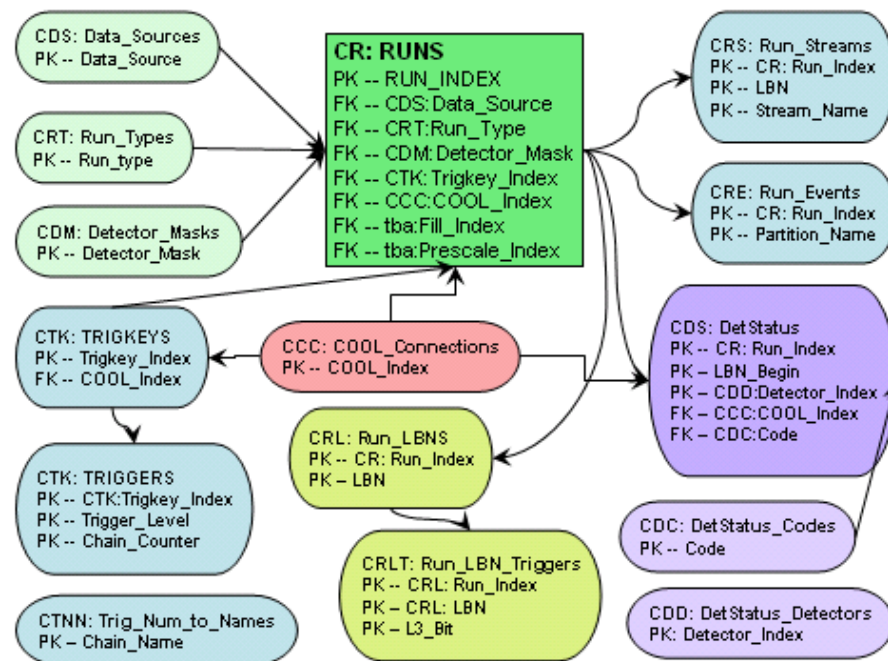
An Integrated Approach to Event Selection

- We have developed an integrated system for doing event selections called the Event Level Selection Service Interface (ELSSI). This is deployed as a web interface which will be described in the following slides.
- As an integrated system it brings together not just the information in the TAG database, but also information on
 - quality conditions,
 - detector status,
 - trigger configuration information,
 - ...
 - Much of this information sits in other database systems or files.
- ELSSI is also grid-aware using the Acacia software (<http://acacia.wiki.sourceforge.net/>) and requires a grid certificate for access
 - Allows a level of security on access.
 - Allows the possibility to submit grid jobs using the user's grid certificate directly from ELSSI.
- While the TAG data is replicated to remote sites, the services are being prototyped at CERN before deploying to other sites.



Non-Event Metadata

- A meaningful event selection in ELSSI requires information on triggers and other "conditions" which change at intervals coarser than event-by-event. For performance reasons, this information is extracted from the sources that it is originally written into, e.g. COOL; and stored in a dedicated schema for use by ELSSI.
- These data are distributed along with the TAG data to sites hosting a relational TAG database.





Supporting Services

- ELSSI requires several supporting services
 - A stable and clonable hardware system with Apache and php installed.
 - Grid authentication for access to database resources and for eventual submission of grid jobs.
 - Extraction of the selected events and their metadata into a format which can be used as input to an athena job. This service is essentially a wrapper around one of the POOL Utilities: CollAppend.
- Along with ELSSI these services are deployed on two machines at CERN, one for development and one for production users. The code is managed in cvs, but is not part of ATLAS software releases.
- An initial test installation of ELSSI + services was deployed to the Midwest Tier2 at UChicago.



CHEP09 - March 23 2009

ELSSI Web Page Overview

ELSSI :: The ATLAS Event Level Selection Service Interface ::

https://voatlas18.cern.ch/tagservices/fdr2_prod_FDR2C_01_00_01/index.htm

ATLAS ▾ Agenda ▾ News ▾ Economist ▾ Yahoo ▾ Google ▾ RSS Feeds ▾ Local Weather Forec... ▾ CHEP 2009

Athenaeum JSP - Log ▾ ELSSI :: The ATLAS Event Leve... ▾

ELSSI^{FDR2}

Recognizes User → Jack Cranshaw 899901, welcome to ELSSI: the ATLAS Event Level Selection Service Interface
Contact hn-atlas-physicsMetadata@cern.ch for support
Built with [GridSite](#)

ELSSI server instance
Extract

Status

Saved Sessions
simple%20test

Session Name:

Selection Criteria

Create query | Review query | Perform query

Temporal cut | Streams | Data Quality | Trigger | Physics attributes

Specify the **Run range** or the **Time period** for your temporal cut by selecting one of the two radio buttons below:

☒ Run range

Specify the run range(s) in the following area. Please use the range format of **lower_runnumber-higher_runnumber** (e.g., 52280-52283) or the runnumber(e.g., 52300) if only a single run is of your interest.
You may enter multiple ranges, but be sure to separate your ranges by a comma (',') if you have more than one(e.g., 52280-52283, 52300):

Enter your run range(s) in the following box (linear ranges only, parentheses will be ignored):

☐ Time period

Specify the beginning date and ending date for each of your time periods. You may type in the dates in the given format, or click on the calendar icon to select the dates. The dates are within the UTC time zone.

Starting Date(mm/dd/yyyy):

Ending Date(mm/dd/yyyy):

You may edit your date ranges in the box below. Please use the range format of **starting_date-ending_date** (e.g., 06/02/2008-06/05/2008) or the date(e.g., 09/10/2008) if only a single date is of your interest.
You may enter multiple ranges, but be sure to separate your ranges by a comma (',') if you have more than one(e.g., 06/02/2008-06/05/2008, 09/10/2008):

Selection Summary
Click on the category names to show the information for that category.

[Run range](#)
[Stream\(s\)](#)
[Data quality](#)
[Triggers](#)
[Physics attributes](#)

Heads up summary

You may select the trigger configuration to display run numbers with run dates under that configuration:

Done



ELSSI Tour: Stream Selection

- Things to note:

- Atlas data is divided into streams based on related triggers.
- The same data is reprocessed multiple times.

Create query Review query Perform query

Temporal cut Streams Data Quality Trigger Physics attributes

Indicate the stream(s) from which you would like to select by clicking in a check-box. Collections of data sets will be displayed according to your selection.
You may select all collections in each single stream, or you can select individual collections of your interest.

Streams	Collections under each stream of "fdr08_run2" runs
<input checked="" type="checkbox"/> Bphys	<div>All Bphys fdr08_run2_physics_Bphys_o3_f47_m26 fdr08_run2_physics_Bphys_o3_f48_m27 fdr08_run2_physics_Bphys_o3_f8_m10</div>
<input checked="" type="checkbox"/> Egamma	<div>All Egamma fdr08_run2_physics_Egamma_o3_f47_m26 fdr08_run2_physics_Egamma_o3_f48_m27 fdr08_run2_physics_Egamma_o3_f8_m10</div>
<input checked="" type="checkbox"/> Jet	<div>All Jet fdr08_run2_physics_Jet_o3_f47_m26 fdr08_run2_physics_Jet_o3_f48_m27 fdr08_run2_physics_Jet_o3_f8_m10</div>
<input checked="" type="checkbox"/> Minbias	<div>All Minbias fdr08_run2_physics_Minbias_o3_f47_m26 fdr08_run2_physics_Minbias_o3_f48_m27 fdr08_run2_physics_Minbias_o3_f8_m10</div>
<input checked="" type="checkbox"/> Muon	<div>All Muon fdr08_run2_physics_Muon_o3_f47_m26 fdr08_run2_physics_Muon_o3_f48_m27 fdr08_run2_physics_Muon_o3_f8_m10</div>

Selected streams:

```
fdr08_run2_physics_Bphys_o3_f48_m27  
fdr08_run2_physics_Egamma_o3_f47_m26  
fdr08_run2_physics_Egamma_o3_f48_m27  
fdr08_run2_physics_Egamma_o3_f8_m10  
fdr08_run2_physics_Jet_o3_f8_m10  
fdr08_run2_physics_Minbias_o3_f48_m27  
fdr08_run2_physics_Muon_o3_f47_m26
```

Restore saved stream selection

Reset



ELSSI Tour: Trigger Selection

Selection Criteria <- Back C

Create query Review query Perform query

Temporal cut Streams Data Quality **Trigger** Physics attributes

- You've selected the trigger configuration with luminosity index(es): 2032, 2033
By default, triggers of all three levels under the selected luminosity index(es) are displayed.
- Set trigger constraints by selecting the Event Filter triggers. The passed Level 2 and Level 1 triggers corresponding to the selected Event Filter trigger will be highlighted.
- Choose to "Show all Level 2/1 triggers" by turning on/off the checkboxes on top of the Level 2 and Level 1 triggers boxes.

Trigger menu of selected configuration(s):

	Event Filter	<input checked="" type="checkbox"/> Show all Level 2 triggers	<input checked="" type="checkbox"/> Show all Level 1 triggers
1. Select Trigger	Luminosity of 10^{32} —	L2_J55	L1_EM18I_XE30
	EF_e20i	L2_J62	L1_EM7I
	EF_e105	L2_J84	L1_EM7I_MU6
	EF_g105	L2_JE220	L1_FJ120
	EF_2e5	L2_JE280	L1_FJ18
	EF_2e15i	L2_JE340	L1_FJ35
	EF_2g20	L2_JE400	L1_FJ70
	EF_2tau35i	L2_MinBiasRandom	L1_J10
	EF_FJ18	L2_MinBiasSpacePoints	L1_J120
	EF_JE220	L2_e105	L1_J18
	EF_JE280	L2_e10i	L1_J23
	EF_JE340	L2_e10i_mu6	L1_J35
	EF_mu10 (prescale=1)	L2_e20i	L1_J42
EF_mu40	L2_e20i_xe20	L1_J5	
EF_mu20	L2_e25_tight	L1_J70	
EF_2mu6	L2_g105	L1_JE220	
EF_te250	L2_g25_L32	L1_JE280	
EF_te360	L2_g25i_L32	L1_JE340	
EF_xe15	L2_g25i_tight_xe30	L1_JE400	
EF_xe20	L2_mu10 (prescale=1)	L1_MU10 (prescale=100)	
2. Toggle Fired/Not Fired	<input checked="" type="radio"/> Trigger Fired <input type="radio"/> Trigger Not Fired		
	EF_2e5=1 OR EF mu10 = 1		



ELSSI Tour: Review/Refine Query

Selection Criteria

<- BackContinue ->Reset

Create queryReview queryPerform query

Your streams are :

fdr08_run2_physics_Bphys_o3_f48_m27
fdr08_run2_physics_Egamma_o3_f47_m26
fdr08_run2_physics_Egamma_o3_f48_m27
fdr08_run2_physics_Egamma_o3_f8_m10
fdr08_run2_physics_Jet_o3_f8_m10
fdr08_run2_physics_Minbias_o3_f48_m27

Your constraints and the resulting query

You may in the following editable areas modify your query *if necessary*, using AND, OR and parenthesis, to form your SQL constraints(e.g., (a=1 OR b=2) AND c=3). Do NOT insert newline carriage return) into each constraint expression.
(Note: The units in TAG database are in MeV instead of GeV.)

Run ranges or time periods (Enter linear ranges only, parentheses will be ignored.)	Physics cuts (Remember to add abs() to your η and P_T cuts as required!)	Trigger constraints
<div>52280-52304</div>	<div>NLooseElectron>2 AND abs(LooseElectronPt2)>100000</div>	<div>EF_2e5=1 OR EF_mu10 = 1</div>

The resulting query:

((RunNumber >= 52280 and RunNumber <= 52304)) and (NLooseElectron>2 AND abs(LooseElectronPt2)>100000) and triggers(EF_2e5=1 OR EF_mu10 = 1)



ELSSI Tour: Perform Query

Your query is: `(NJet>3) and triggers(EF_J120 = 1 or EF_J62 = 1)`

Events selected (total count = 1):

STEAM_NAME	count(*)
fdr08_run2_physics_Jet_o3_f48_m27	1051

Count Display results Retrieve event collection

Display results for your query

Select attributes (use Ctrl to select multiple attributes then Confirm)

- L2PassedTrigMask26
- L2PassedTrigMask27
- L2PassedTrigMask28
- L2PassedTrigMask29
- L2PassedTrigMask3
- L2PassedTrigMask30
- L2PassedTrigMask31
- L2PassedTrigMask4
- L2PassedTrigMask5
- L2PassedTrigMask6
- L2PassedTrigMask7
- L2PassedTrigMask8
- L2PassedTrigMask9
- Level1TriggerType
- LooseElectronEta1
- LooseElectronEta2
- LooseElectronEta3
- LooseElectronEta4
- LooseElectronPhi1
- LooseElectronPhi2

Confirm

RunNumbers with their LumiblockN's where the selected trigger(s) (EF_J62, EF_J120) is(are) active (total count = 36):

Stream_name	RunNumber	LumiblockN	Subtotal
fdr08_run2_physics_Jet_o3_f48_m27	52300	1~6,8,10,12~14,16~17,19~23,25~26,30~36,39~47	36

NJet, LooseElectronPt1 100

Clear

Of the total of 1051 events that satisfied your cuts, only the top 1000 rows will be retrieved for display and purposes.

NJET

LOOSEELECTRONPT1



CHEP09 - March 23 2009



ELSSI Tour: Selection Extraction

Contact hn-atlas-physicsMetadata@cern.ch for support
Built with GridSite

Status

Selection Criteria <-- Back Continue --> Reset Hide Summary

Create query Review query Perform query

Your streams are : fdr08_run2_physics_Bphys_o3_f47_m26

Your query is : (EventNumber<100 and VtxX<10)

Count Display results Retrieve event collection

Retrieve your event collection.

You may now build a list of qualifying events for your query and return these in a ROOT file

Retrieve

(This may take a moment--CMT and ATLAS environments must be initialized, a relational database queried and your results transferred to AFS space)

Reset

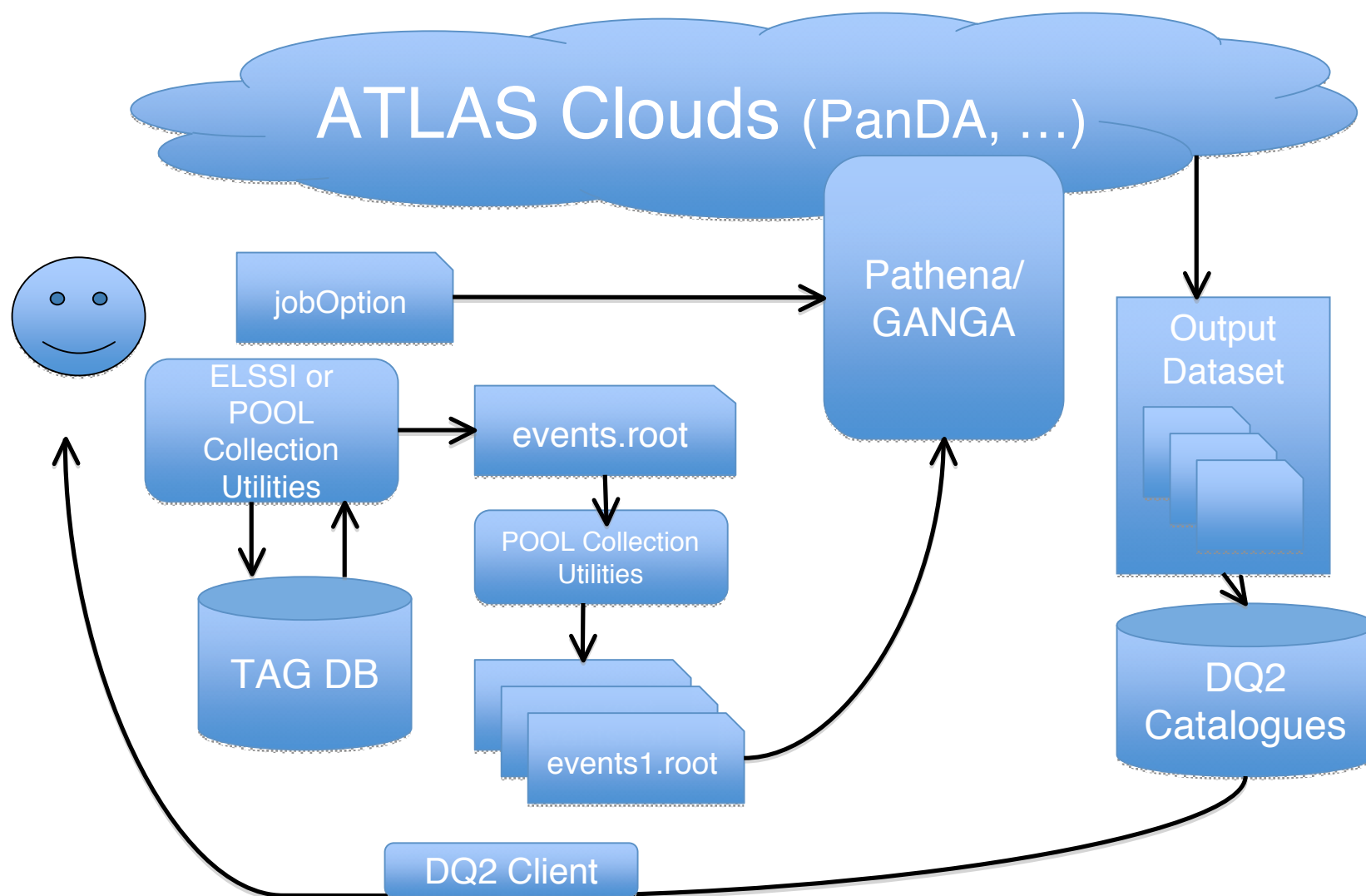
- The final page contains a button which calls the Extract service which returns a hyperlink to an POOL Collection ROOT file (also available on afs).
- With an appropriate catalog (provided by DA/DDM tools), this file can be used as input to an athena job locally or on the grid.

Jack Cranshaw: ATLAS Computing



CHEP09 - March 23 2009

Example: TAG's with Distributed Analysis



Jack Cranshaw: ATLAS Computing



Summary

- ATLAS has developed an event-level metadata system called TAG which is being deployed through a web interface called ELSSI to provide physicists with a tool for doing analysis.
- This tool
 - Uses the POOL Collections package as the basis for storing the data.
 - Data is produced and distributed in ROOT files.
 - It is also stored in relational databases at CERN and participating ATLAS Tier 1 sites for use by ELSSI.
 - In order to support ELSSI event selections, coarser grain (run, lumiblock) data is extracted from other sources (COOL,...) and stored in a set of tables with the TAG data.
 - ELSSI can extract the selected events references and metadata and write them to a file which can then be used as input to an athena job run on the grid.



Future

- Submission of a skimming job to the grid as part of ELSSI
 - Fixed skim of certain data type (AOD,ESD,...). Prototype using delegated grid credentials already demonstrated.
 - User defined job
- More links to outside metadata sources
 - Standalone Run/Lumiblock level browser whose output can be used by ELSSI or athena.
 - Dataset level data in the AMI database.
 - More information on target data storage using DDM tools.
- Expanded collection-level and file-level metadata
 - Can an analysis which uses ELSSI calculate a cross section?
 - Piece-wise infrastructure tested, but need end-to-end validation.
- More flexibility on data presented and awareness of 'schema' evolution or 'schema' compatibilities.
- Deployment of services to other sites
 - Load balancing, cloud hierarchies, failback options, ...
- Further automation and streamlining of the process.