BaBar Analysis Preservation
(BaBar Data Practices Interview)

For the DASPOS/DPHEP7 Workshop

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on behalf of

The BaBar LTDA group

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Data Description

- The final
  BABAR <u>raw data</u> amounts to 0.7 petabytes,
  with more than
  5 petabytes of processed data
  <u>accumulated from multiple cycles of reprocessing and simulation</u>.

  - The **raw data is in the form of XTC (eXtended Tagged Container) files**

- Raw data from the detector were acquired in units of "runs", defined as periods of operation under stable conditions, bounded to limit the resulting XTC file sizes. Typical runs lasted for 30-60 minutes and contained 10^5–10^6 events accepted by the Level 3 trigger.
  There are over 9 billion physics events.

- **Simulation production was accomplished with ~25 sites producing a total of over 50 billion events**

- The **ROOT file format is used for the processed data**.

Preserved Data

We chose to preserve the last two reprocessings and only these + the raw data are available on the current media.

- The archived simulated data set contains approximately:

  - 7 billion events for specifically requested physics processes, and

  - 20 billion generic events.

- 700 TBytes of raw data

- 822 TBytes (653 TBytes) of reconstructed real (simulated) data

Data Lifecycle

- About 30% of the raw data events pass the background filters

- There is a **collection** of processed events for each raw data run.

- Since a 2GB limit on the file sizes was respected, **a collection frequently has several files**.

- Also, the processed output for both raw and simulated data contains two components, the **MICRO** containing only the final track momenta, energies, and particle identification assessments and the **MINI** with the digitized hits

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Physics Streams

- **The largest type of data are the conglomerate of physics streams**

  - Each event typical ends up in multiple streams

- The physics streams can be either:

  - Type **tag**: which has only filter tag bits

  - Type **pointer**: with tag bits, pointers to events in the raw and simulated processed data files, and user data objects
    (the above two are only useful at sites with the corresponding processed data)

  - Type **deepCopyMicro**: all the above and the micro processed data output (most useful for university like sites)

  - Type **deepCopyMini**: everything (needed for special analysis at remote sites needing hit level information and not have too high a selection rate)

```
#        Name             Components owned (copied)    Components borrowed (pointers back)
# 1. "deepCopyMicro"      tag, aod, cnd, usr, (tru)            esd
# 2. "deepCopyMini"       tag, aod, cnd, usr, (tru), esd       None
# 3. "pointer"            tag, cnd, usr                        aod, (tru) esd
# 4. "tagOnly"            tag                                  aod, cnd, (tru), esd
```

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Data Type Comparison

```
$ BbkUser --dbname bbkr24 --dse_status 1 dse_type components --combine 'components:mini=*E*,micro=*H*B*' dse_id file_id events gbytes
--summary --release 24\*,26\*
```

TYPE	COMPONENTS	#COLL.	#FILES	#EVENTS	#GBYTES
Bkg	HR	188	1089	74899228	1557.8
--- PROCESSED DETECTOR DATA ---					
PR	micro	37004	38973	9129704527	27005.0
PR	mini	37004	53494	9129704527	52981.5
--- PROCESSED DETECTOR DATA PHYSICS STREAMS---					
PRskims	micro	175556	226107	95864657071	122936.4
PRskims	mini	8309	8309	13094834	211.4
--- SIMULATED DATA ---					
SP	micro	213613	213613	27145413000	162747.6
SP	mini	213610	292631	27144817000	232333.6
--- SIMULATED DATA PHYSICS STREAMS ---					
SPskims	micro	579064	769911	213150135705	381890.3

ir2 to pc to er to skim production (Fri Oct 24 09:43:03 2008)
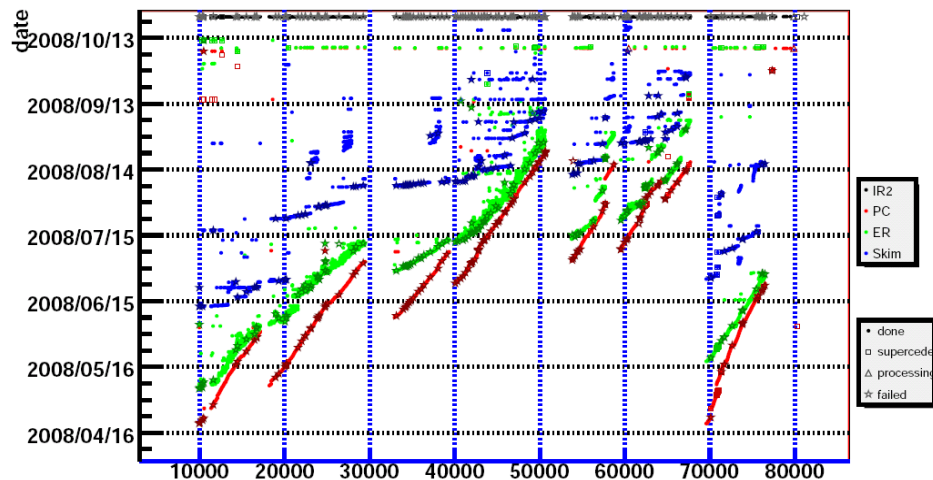
avg. over BBbar, ccbar, uds, tau, μ -pairs and Bhabha events

simulation data	(output KB)/(input event)
micro	5.7
mini	9.7
skims	21.1

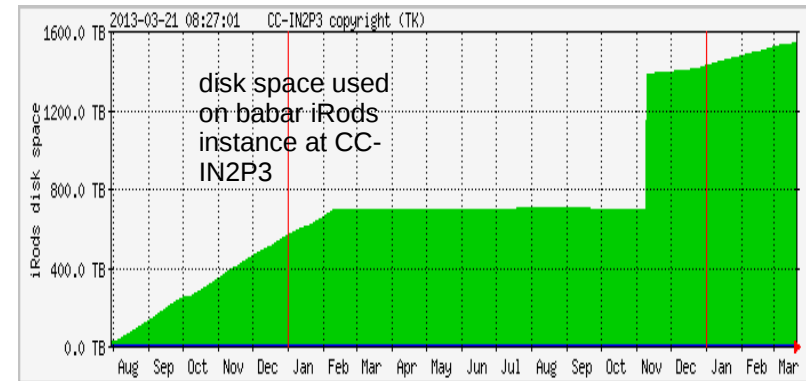| reconstructed detector data	
micro	3.1
mini	7.1
skims	8.9

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Tools

- **Databases**: Oracle and MySQL databases (for collection metadata, run conditions, data quality monitoring, production tracking, publication and presentation tracking, Online: still needed for checking run conditions, generating stats/plots for documentation (ex: the detector paper which is in progress))

    - Migration from Oracle to MySQL

- **Packages for data access:** XROOTD

- **Production and analysis:** g++. g77, glibc, bash, javac, tcsh, ROOT, PERL, PyThon, RooFit, geant4

- **Filesystems:** Disk: AFS, NFS, Tape: HPSS, T10Kb tapes

- **Generators**: EvtGEN(Tauola, KK2F, BHWide, Pythia, babayaga, koralb, photos, gamgam ...)

- **Batch/VM**: LSF (SLAC has been investigating alternatives), LTDA uses PBS/Torque, KSM, KVM

- **OS**: RHEL5,6 (SLAC), SL4,5,6 (LTDA) except RHEL6.4 on frontend machines

All are now rather common tools.
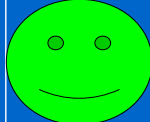
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Data Protection

- **Raw data at SLAC, Padova (*bye-bye*) and ccin2p3**

  - **Many times lost files at SLAC due to tape failures have been recovered from Padova and ccin2p3**

- **Processed data at SLAC is now being copied to ccin2p3**

- **Old media with the next to last processing is stored away in a separate building**

disk space used on babar iRods instance at CC-IN2P3

- **450 TBytes of the most used data is on disk**

- **LTDA has over 1 PB of storage of the most used data**

- **Last two processings of the data + raw data on T10Kb tapes**

- **Until now the DOE has just required preservation of the data for 10 years after being collected but it doesn't specify the required preservation of the useability of the data**

  - **Data preservation plans must be submitted with proposals**

Data Management and Disaster Recovery Maturity Rating
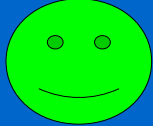
●

1	2	3	4	5
Data management activities focus on the day-to-day	Some awareness of potential risks but few take preventative action	Policies and plans are in place for disaster recovery and long-term sustainability	Disaster recovery plans are accompanied by procedures for implementation Data loss, a break in the research process, or loss of access to data is unlikely	Disaster recovery plans are routinely tested and shown to be effective Succession plans (e.g. an alternative data centre) are in place to safeguard data

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Data Commonality

- Processed data is in **ROOT** format which is very common **BUT** _the BaBar libraries must be present for the files to be truly useable for analysis work_.

- The BaBar Documentation Working Group has and is continuing to develop up-to-date documentation such that **new users can access and use the data with minimal expert help**. Great progress has been made on this.

Data Description Maturity Rating

| 1	2	3	4	5
Metadata is an unfamiliar concept Low engagement with the need to document data	Metadata and data description practices vary by individual	Metadata is well understood and guidance is provided to support the use of standards Data are documented	Data are well labeled, annotated and systematically organized Data can be understood by other researchers	Metadata is routinely created and well managed The exemplary practice advances community standards

Software

- releases of software

  - **Releases validated for publishable physics results are made several times a year** with many minor/test releases in between

    - CVS repository, SRT management, both with Web interfaces

  - Made of **>900 packages**

    - Offline:

      - Generation, simulation, reconstruction, skimming, analysis tools, user analysis code

    - Online:

      - Still included primarily for documentation purposes

  - **Nightly builds** on SL6, SL5 and Solaris10

    - Package experts automatically notified of failures

  - In general, each step must use a release version equal to or greater than that used for the previous step

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Preservation

- The **raw data** is most important because we retain the ability to reproduce all production steps as long as there is funding for the storage and reasonable processing capacity available

  - Each step is less important than the prior step

- Uses of the data beyond the current set of planned analyses:

  - Cross-reference between new/old experiments

  - Checking results with the easier lower lumi conditions

  - education purposes
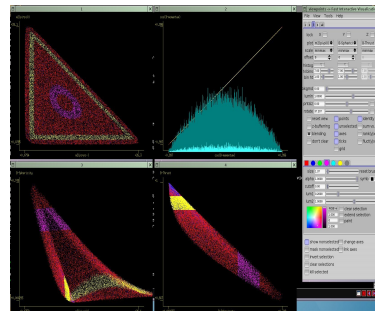
  - there will be new ideas for new analyses of the data

- ***The data is kept accessible and the full useability is retained using the LTD**A*

See Tina's talk for more details!

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Summary

- The **BaBar data is protected by having copies at different sites** and reservation of funds for a future media migration

- The **BaBar data and framework uses common formats and tools**

- The **BaBar data and the ability to use the data have been assured through the efforts of the BaBar LTDA group**.

- *Foresee continued publishable analysis work using the BaBar data by collaborators until at least 2018. The collaboration will remain open to new collaborators.*

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How long ...

- Perhaps they too will be analyzing this data.