PHENIX COMPUTING MODEL

- RCF structure & how our activities fit in
- analysis flow
- some contraints
- data model - under construction!
- Mock Data Challenge

Caution:
non buzzword compliant slides

PHENIX Computing model?

RCF configuration

- Managed Data Server (MDS)
  - controlled by HPSS
    - High Performance Software System
  - controls data storage on disk & tape robot
- Central Reconstruction Server
  - Farm of processors running LINUX
    - PHENIX gets a dedicated set
  - Use multiple processors in parallel, sending whole events to each one
  - Batch system, but analyze one file with multiple processors
- Central Analysis Server
  - Processor farm
  - Larger server machine(s) for I/O bandwidth
    - partitioned among experiments

RCF architecture

Reconstruction server

Basic steps

- Reconstruct tracks, PID clusters, associate
  - make first estimate of PID done by groups led by Melynda, Jeff
  - output is DST
- Data mining done by physics working groups
  - subsets of DSTs (data duplicated)
  - milliDSTs 100's of GB in size
  - made by physics working groups
- Analysis done by subsets of physics working groups (topical)
  - make particle information
    - optimized for particular physics analysis
  - create exportable microDSTs (10-100 GB)
    - made and used by subsets of physics groups
- Physics analysis done by individuals
  - take microDSTs to make physics plots
  - apply MC efficiency, acceptance corrections
  - background subtractions
  - can be done at home institutions

overview

raw data

- Packets of data inside frames
- event builder assembles frames to events
- format finalized -> Phenix Raw Data Format
- software to write PRDF from simulated events exists
- integration & demonstration underway

Reconstruction

- Runs in Central Reconstruction Server
  - production mode allows ~1 pass per event
    - more will be possible in year 1
- make DST's
  - content documented by Jeff
  - reconstruction returns STAF tables
  - logical, physical structure being designed
    - single stream for MDC, then multiple streams
  - store in Objectivity (data base) ultimately
    - in PRDF for Mock Data Challenge
  - size for central Au + Au ~800 kB per event
- fill Tag Data Base for later event selection

Tape mount limitation

- for MDC PHENIX gets 1 tape drive
- for Day-1 we get ~6 tape drives
  - 2 tied up recording data from PHENIX ("sinking data")
  - 2 used for reconstruction (running flat out)
    - perhaps 1 is enough at the beginning?
  - 1 writes DSTs
  - 1 available for data mining, analysis passes
- Drive costs $85K

PHENIX data model

- Logical structure to respect resource limitations
  - Tape mounts
  - I/O bandwidth
  - Disk storage (“online” or fast access)
  - CPU time

- Must define access to raw data
  - can not replay many raw data tapes
    - can’t copy into Objectivity data base
  - Copy 0.1% or 0.01% of raw data to DST?
    - would allow cross checks over entire data set

- DST streams need to be designed

Possible Logical Data Model

Data Mining

- Select subset of DST data to copy into mDST
- Interplay with multiple DST streams
  - should contain fewer events than DST
    - step to select rare events
  - may also discard subset of event data
- Use Tag data base filled during reconstruction
  - may do computation also
  - resource limitations need to be analyzed
- Organized at physics working group level
  - group agrees on mDST contents
  - each collaborator does NOT make their own
  - cooperation of groups would improve efficiency

Analysis

- Runs in Central Analysis Server
  - not limited to single pass
  - number of times we can touch mDST
    - depends on their size

- Take mDSTs and make microDSTs
  - uDSTs have physics quantities
  - online disk resident (PHENIX has 15 TB on Day-1)
  - may be histograms and/or event data
  - store ROOT structures
  - expect to make multiple uDSTs in each working group

- Visualization and manipulation use ROOT

- Writing analysis code a service done by physics working groups

Physics analysis

- differentiated from previous step by being more specific
  - input is microDST, output is physics plot
  - done by individuals or small subsets of working groups
- done using ROOT
- bring in Monte Carlo corrections, events
  - MC is run at CC-J, elsewhere
- results reported back to physics working group & collaboration
  - does this code go in the repository?
  - reproducibility, quality control
    - physics working group is responsible

Calibration

- plan needs to be defined
- general approach
    - some/much calibration in counting room
        - before data disappears from local disk
        - strip out calibration events early
    - other calibs require reconstructed tracks
        - e.g. alignment
        - incorporate somehow into reconstruction pass
    - separate raw data into streams?
        - specify requirements
        - understand limitations (D. Morrison knows)
        - frequency of different operations
- need help from collaboration to specify - small task force?
- raw data streaming also a potential option
    - pros/cons to separate muon events early

To be defined

- Calibration strategy
  - what in counting room, what in CRS
- Logical data model
- Connectivity/duplication of raw data to DST
- Boundary between DST and mDST production
  - how best to use separate DST streams?
- How much computation during Data Mining?
- Organize/monitor repository code for analysis
  - a service which falls along physics working group boundaries
  - need to decide how we coordinate analysis

Mock Data Challenge

- will happen in September
- reconstruct 100K events (multiple times) to test CRS
- write single DST stream in PRDF
    - will also test Objectivity and Grand Challenge software
    - tune content by iteration with analysis groups
- we get ONE tape drive
- analyze DST to exercise CAS
    - done by physics working groups
    - access data by “carousel” first
        - make limited test of GC package
    - need to revisit goals
        - priorities
        - plan/action items

MDC preparation status

- 100K events generation underway
  - will be done in time
  - software to translate to PRDF underway
- Reconstruction software underway
  - expect to be ready
- Tag data base being defined
- Data base access development underway
  - keep this as goal for MDC?
- Analysis plans to be defined here

Physics goals for MDC

- CENTRAL ARMS (priority ordered list)
  1) dN/deta from MVD
  2a) Et distribution from EMCAL
  2b) pt distribution from charged tracks
  3) reconstruct pi0 in EMCAL
  4) find admixed single photons in EMCAL
  5) identify electron candidates using track+EMCAL & RICH
- MUON ARMS
  make J/psi distribution in Au + Au events
- SPIN
  Analyze sample of 1M p-p collisions or peripheral Au + Au
  reconstruct pi0 and J/psi

From Physics Groups?

- Global Event
  - dN/deta, Et
- Hadrons
  - pt distribution from charged tracks
- Thermal photons and pairs
  - pi0 spectrum, find admixed single photons
- Hard Scattering
  - Select events with high pt pi0 & charged tracks
  - pi0, charged pt distribution to ~6 GeV/c
- Light Vector Mesons
  - find electron candidates: track+EMCAL+RICH
  - pair mass distribution using 2 arms
- Heavy Flavor
  - reconstruct J/psi -> muon pairs
  - reconstruct J/psi -> electron pairs
    - collaborate with Light Vector Meson group
- Spin
  - reconstruct pi0, J/psi in p+p collisions

Required for MDC

- completion of tasks underway by end of August
- translation pass: PISA events to raw data tapes
- plans from physics working groups
  - identify milestones: no surprises in September!
- infrastructure from core offline group
  - connect to CRS queues; bookkeeping
  - data carousel to access DSTs
  - software to put/fetch DST to Objectivity
  - strategy for testing GC software
- coding standards, tools, class libraries, etc. for analysis?

A proposal

- PHENIX “seminar” after MDC
  - report physics performance results
    - provide enough time for details
  - provide feedback to reconstruction
    - DST contents, structure
    - scope of reconstruction
    - refine tag database
- input to refine computing model
- show off time for our first analyses of fake data

Grand Challenge

- consortium of experimenters
- develop efficient and effective data access
  - handle large (Petabyte) data sets
  - automate collection of events in response to queries
  - automate/minimize number of tape stages
- software demonstration at RCF underway in July