# Computing Issues:

- new software
- linux cost and performance
- linux optimization
- babar software
- suggestions

**KWFIT**:

- kinematic fitter program from Paul Avery (CLEO)
- has more options than Telesis and good documentation (See Ms. Shen)
- FORTRAN, runs on LINUX

**EvtGen:**

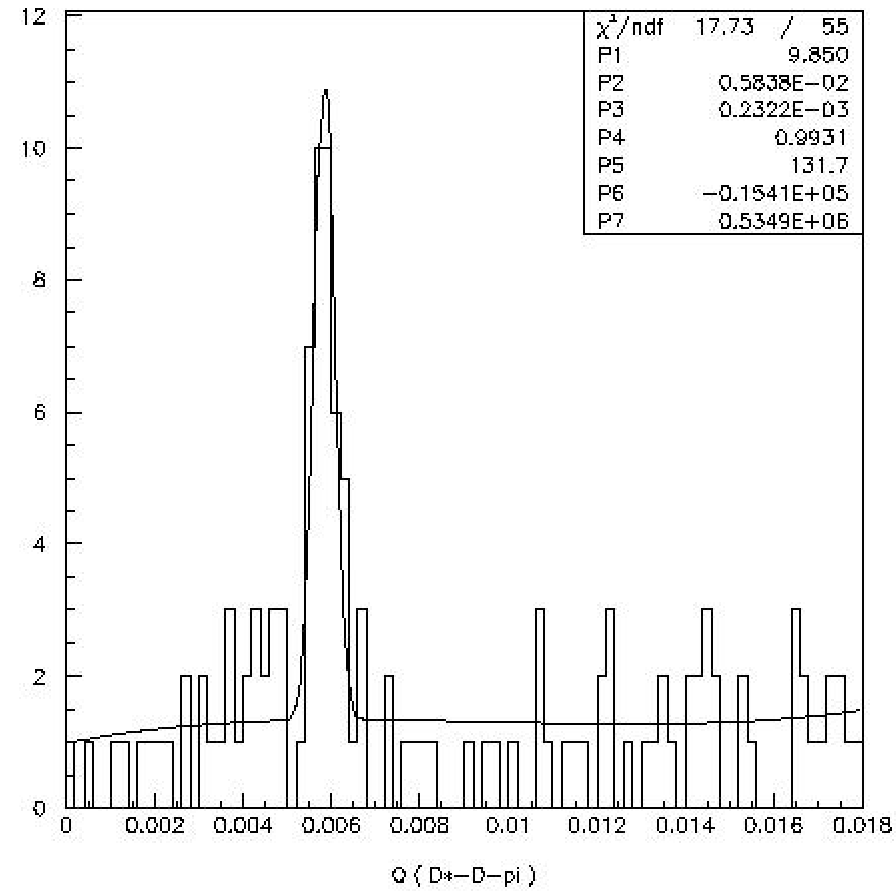
- physics events generator from Anders Ryd (CLEO)
- include helicity amplitudes
- C++ ( but written like FORTRAN )

# Ntuple Analysis with Data: Refitted D* signal: run ~7000 reprocessed with SVT calibrations in 8.2.5

D0 mass is constrained
D0 vertex is fit
slow pion is fit to D0 vertex

Q mean = 5.83 KeV
Q resolution = .232 KeV

PDG value is 5.827 KeV



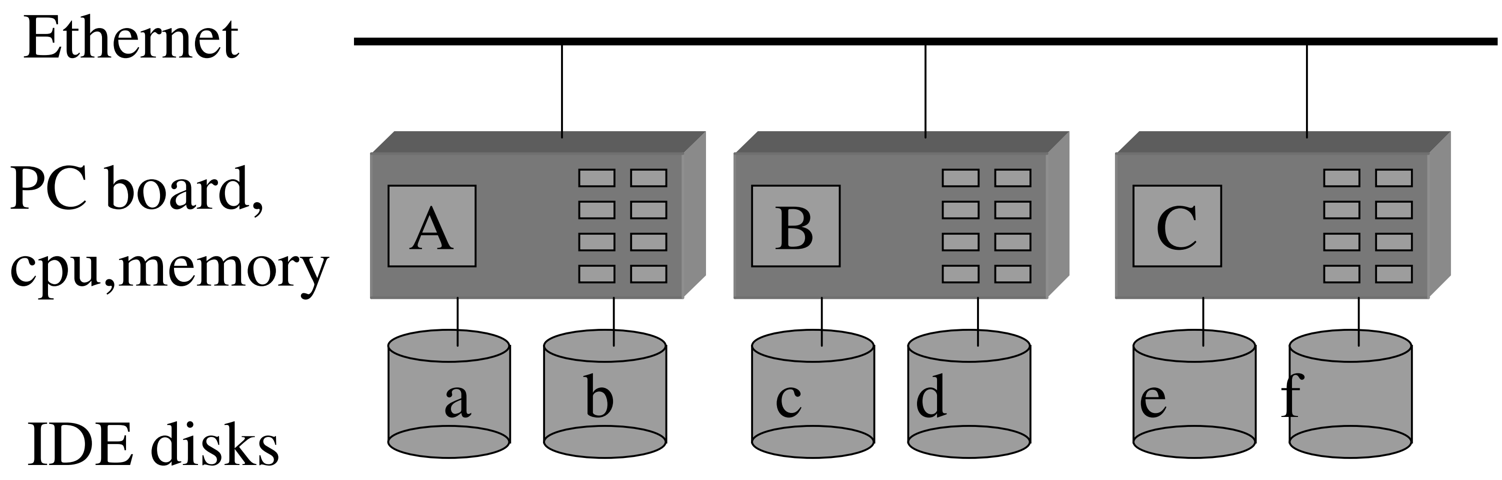

Q = M(D*) - 1.8646 - .139

## LINUX: Costs and Performance

- COSTS
    - LINUX board + CPU (400-450mhz, ~$200), ~$400
    - LINUX board + dual CPU, ~$600
    - PC-100 memory, ~$230/256mb
    - IDE disk drives
        - 27 Gb = $230, 40 Gb = $330
    - Redhat, CERNLIB, StarOffice software is FREE
    - free GNU compiler includes optimization

    - TOTAL cost of system is ~$2K
        - ~$1000 ( motherboard,cpu,memory)
        - 100 GB disk, ~$1000

# POSSIBLE CONFIGURATION




Remark: If processor A reads local disks a or b, the speed is very fast. If processor A reads NFS mounted disk c or d, the speed is much slower.

**LINUX Performance:**

- BES code (at CSU) was converted several years ago
  - floating point number processor is exactly the same (LINUX/HP).
  - Exactly same result (all digits same) on both machines
  - 400 mhz Pentium was 3 times faster than HP735/99.

- BaBar ntuples study at CSU:
  - BaBar trklst stored in ntuple was ~4kb/event
  - 9 Gb of BaBar ntuple on local disk on LINUX box
  - compiled PAW program
    - Event speed 1000 hz to read entire event
    - Event speed 3500 hz to read partial event
      - read only special flag or tag word(s) to select good events

## Conversion of BES software to LINUX

- most problems were non-standard FORTRAN statements
    - data statements

- One tricky problem with random number sequence, ran7
    - consider statement,  if(x.lt.y .and. ran7.gt.0.5 ) then …
    - on one machine, both  x.lt.y   and  ran7.gt.0.5 were executed
    - on another machine, if x.lt.y was false, ran7.gt.0.5 was not executed
    - So random sequence for ran7 was different on different machines

**BES Comparisons:**

- BES will get ~50 million J/ψ events, compress DST is ~1-2 kb/event
    - => 50 million events => 50 - 100 Gb data size
    - if stored on $2000 LINUX system with 100 Gb local disk
        - Read entire data in <50,000 seconds or <14 hours
        - Partial Read entire in <4 hours
    - in principle,  dual Pentium processor, can have two jobs running at same speed reading local disk. ( not yet tested on ntuples )

**Optimization:**

- Depends on particular job
    - compilation/linking requires libraries on local disk
    - reading DST requires moderate CPU and fast I/O
    - monte carlo/reconstruction requires fast CPU and moderate I/O

- Disk Drive
    - disk speed, 5400/7200/10000 rpm
    - DMA (direct memory access) or ultra DMA (Redhat 6 supports)

- Faster CPU
    - Celeron very cheap, but has small memory cache
    - Pentium II/III, 400-450 mhz, ~$200, +500 mhz very expensive
    - Xeon is very very expensive (supports 4-processor board)
- Multiple Processors per board
    - dual pentium boards are cheap, should get ~2x performance
        - Redhat 6 supports SMP (symmetric multiple processor)
        - each disk must have separate IDE card.

**More Optimization**:

- RAID disk drives:
    - for large disk arrays, RAID allows recovery if one disk fails
    - LINUX supports soft RAID ( speed ?)
    - Hard RAID PC adapter cards for multiple SCSI drives, ~$500.
    - Commercial Prices: SUN 200Gb RAID is $14K or $70/Gb.
    - Probably users disk files should be on RAID
    - Large Data Files should not use RAID but tape backup

- TAPE
    - most HEP groups use 4/8mm tapes
        - DLT7000 tape drive is $4000, tapes store 30-50 Gb
    - New system ADR Onstream tape available on PC( windows)
        - 30 Gb tape drive is $200 (linux support available)
        - 70 Gb tape drive is $1000, reads at 14Gb/hour

**More Optimization:**

- Local area Network:
    - 100 megabit, 100BaseT is becoming common in US
    - 1000 megabit or Gigabit ethernet available
        - fiber optic cables
        - interface cards are expensive ~$800, but prices dropping
        - note Pentium boards bus speed is only 100 megabyte/s
    - Router Switches
        - 100 megabit ethernet with 3-4 gigabit backplane ~$2-3K

- Wide Area Network:
    - IHEP connection to outside is very poor,
        - 128kbit/s to KEK
        - 2 hours to ftp 1.5mb file from SLAC
    - ColoradoStateU connection is a typical US university
        - 155mbit/s to internet
        - 1 hour to ftp 2 Gb file from SLAC

**BaBar:**

- BaBar will produce 3 inv.femtobarn data by Dec 23. (~20M events)
- BaBar online does partial processing at 100hz as data is taken
- Full reconstruction on hadronic events within a couple weeks is performed on ~200 SUN ULTRASPARC 5 workstations
- BaBar Software is in C++
    - many powerful physics software tools developed
- Objectivity Database has problems
    - very slow, micro DST speed is <30hz, usually a few hz
    - database files large, cannot transport small event sample because run condition information database is too large
- Temporary solution around Objectivity is ROOT
    - micro DST data stored in ROOT files
    - ROOT programs can read BaBar ROOT files
    - ROOT files load C++ data structures so software tools can be used

**Suggestions for BES**

- Start C++ programming
  - FORTRAN is a dead language, all HEP groups moving to C++
  - all students learn C++ in school, all industry jobs want C++
  - BUT avoid too complicated data structures in beginning.
  - Try using ROOT ( = PAW in C++ )

- Develop Batch LINUX farm for J/ψ run
  - develop local expertise to assemble PC's from scratch
  - setup disk servers, understand how to load balance your needs

- Consider new cheaper Tape drive solutions
  - tape backup of data
  - allows easy transfer to US groups