BaBar Online Detector Control

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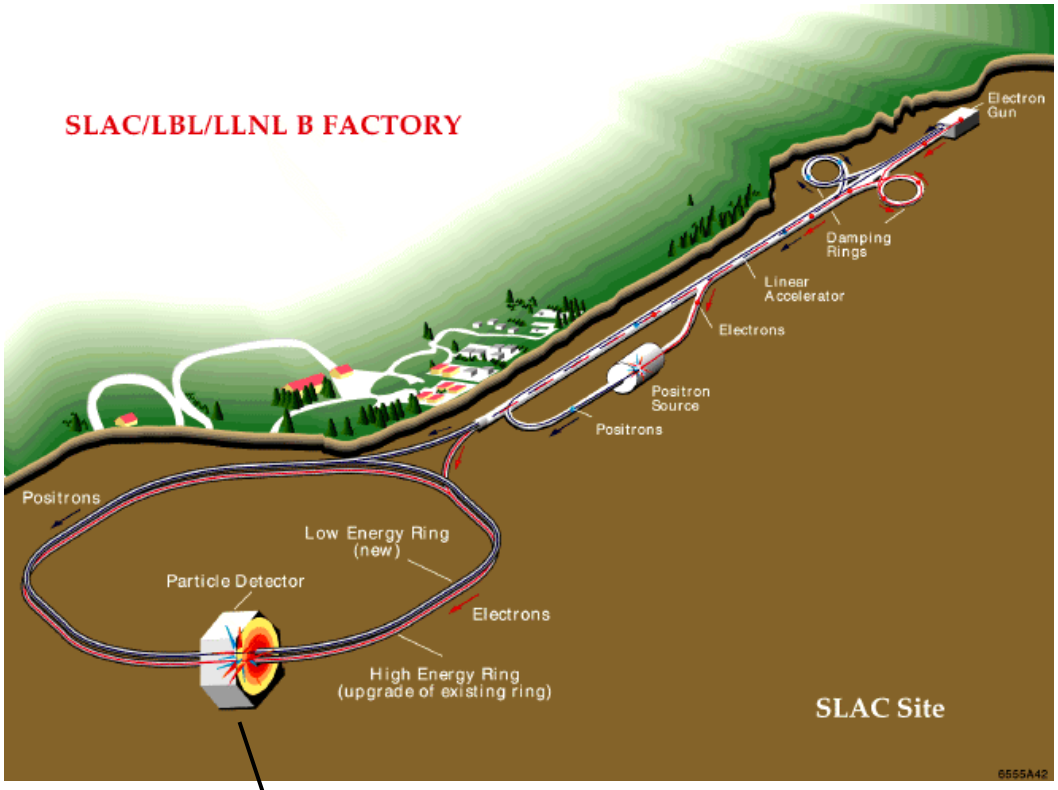
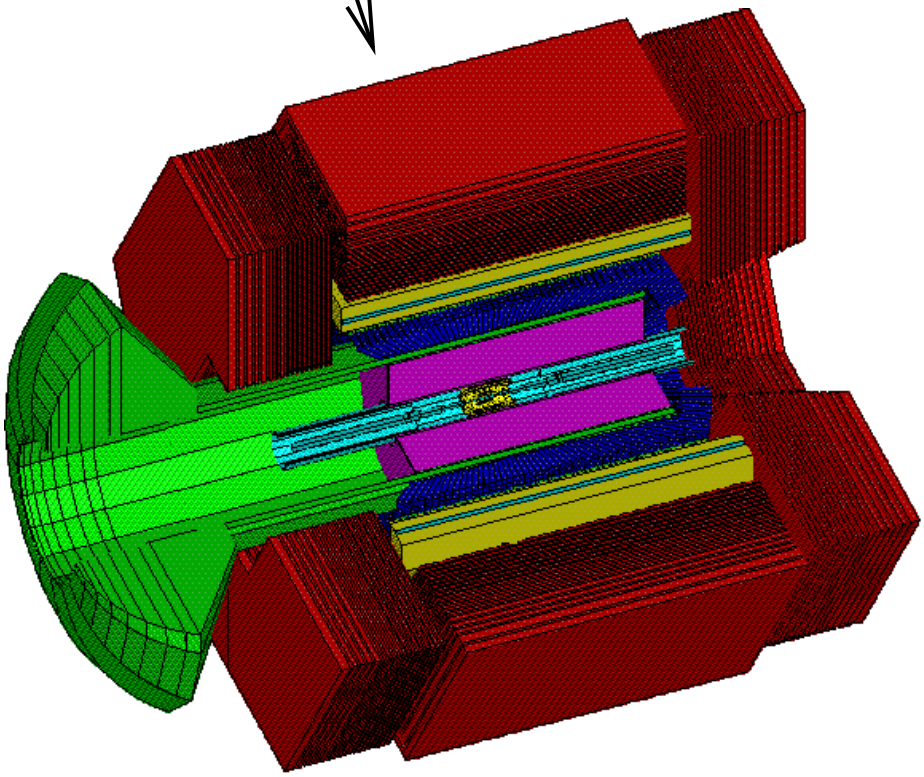
Outline:

- Overview
- EPICS hardware/software
- Interaction with PEP-II
- Interface to the Online System
- Use of Objectivity databases
- Operational experience





Beams:

9.0 GeV e-
3.1 GeV e+

Luminosity:

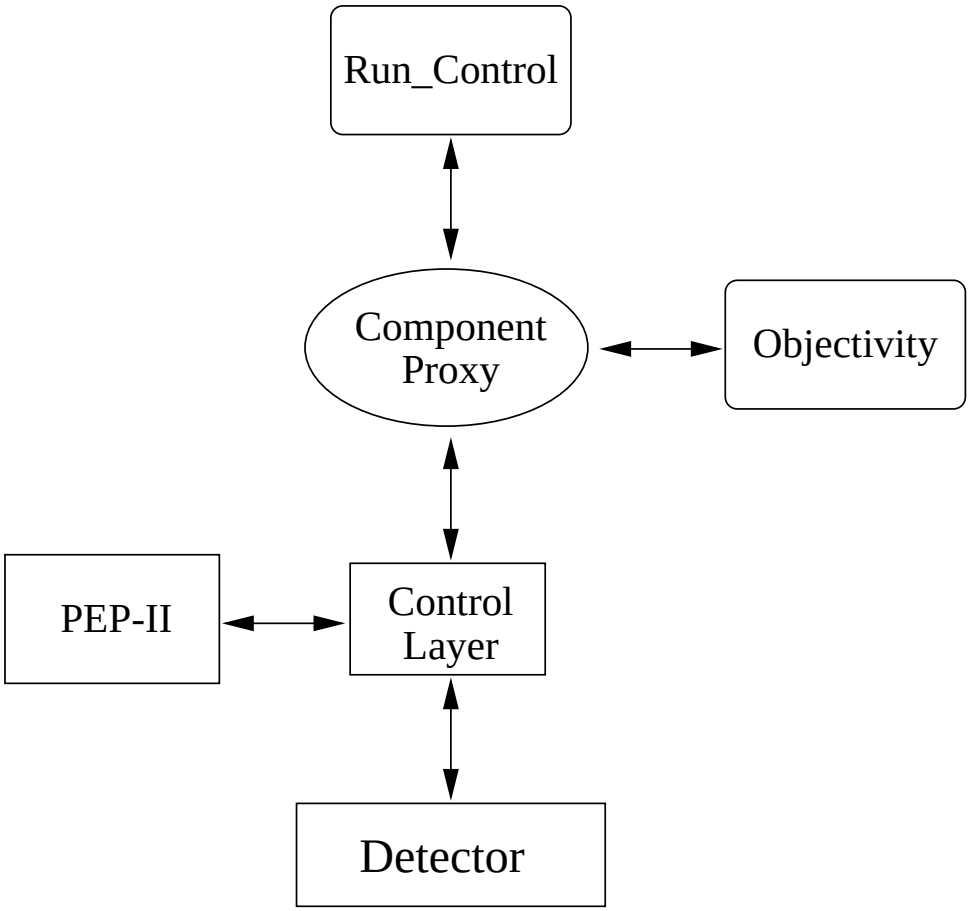
3x10^33

Data:

30fb-1/yr

Overview of Detector Control System

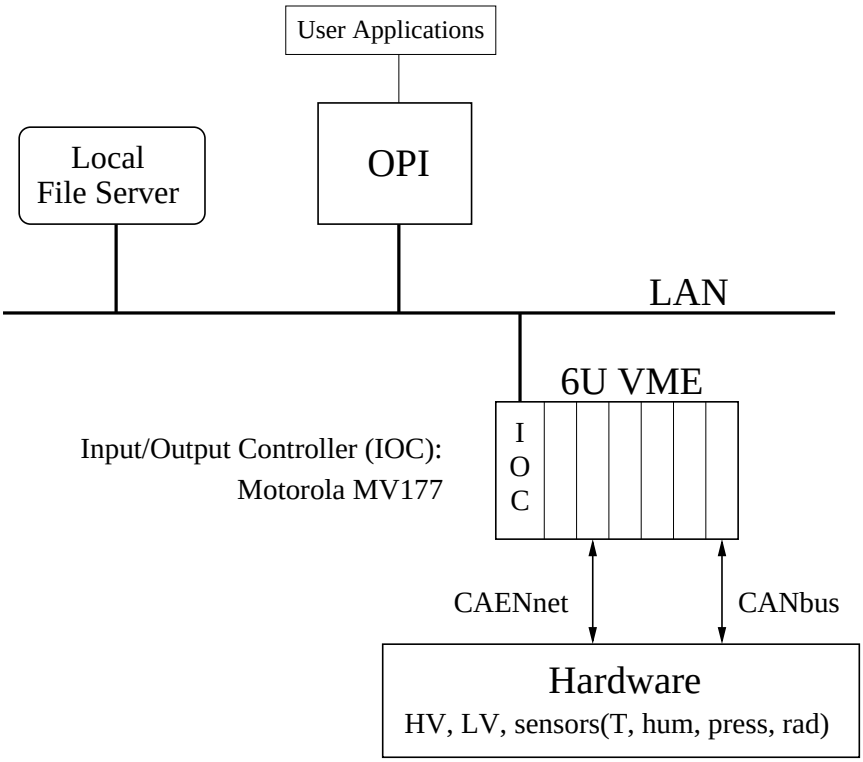
- Responsibilities of the Detector Control system:
  - Safe and reliable operation of BaBar detector
  - Report status of detector to the Online system and PEP-II
  - Configure the detector for physics datataking
  - Archive ambient data

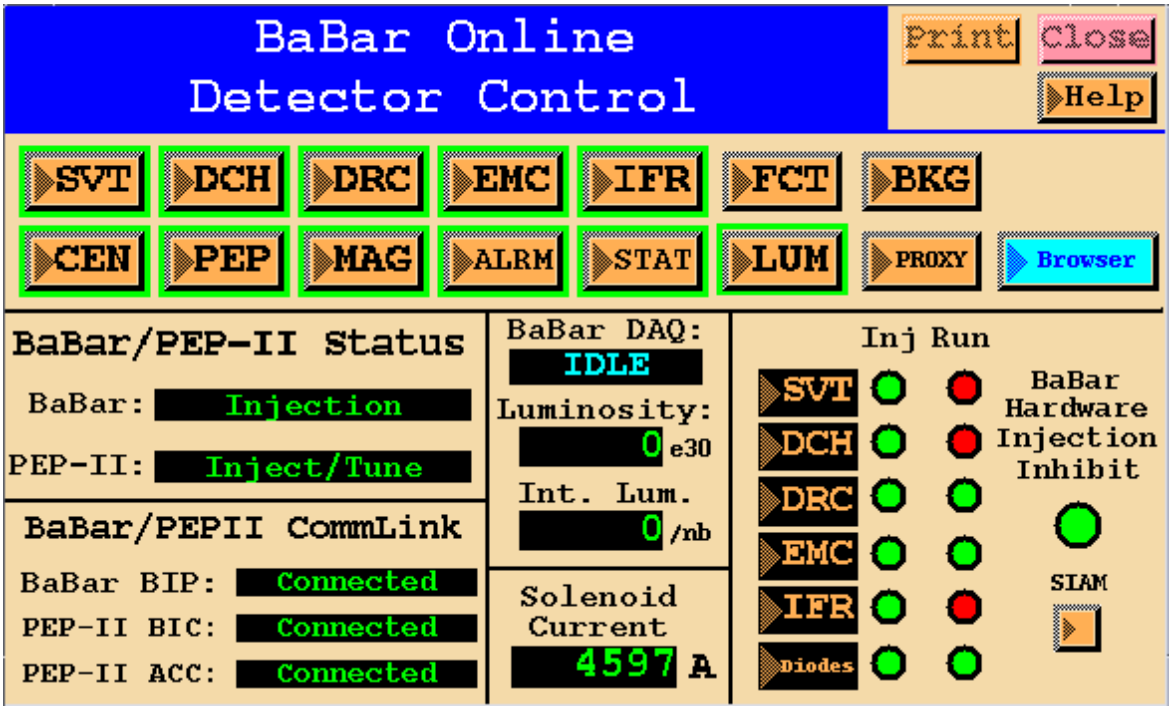


Control Level

- Control level implemented in EPICS
  - 15 IOCs serving $\sim 10^5$ channels
  - Common hardware components

    (CAEN, CANbus, VSAM, SIAM)
- Channel Access over LAN with local file server
- Operator Interface (OPI):
  - Display Manager
  - Alarm Handler
  - StripTool




BaBar Online
Detector Control
Print
Close
Help
SVT
DCH
DRC
EMC
IFR
FCT
BKG
CEN
PEP
MAG
ALRM
STAT
LUM
PROXY
Browser
BaBar/PEP-II Status
BaBar: Injection
PEP-II: Inject/Tune
BaBar/PEPII CommLink
BaBar BIP: Connected
PEP-II BIC: Connected
PEP-II ACC: Connected
BaBar DAQ:
IDLE
Luminosity:
0 e30
Int. Lum.
0 /nb
Solenoid Current
4597 A
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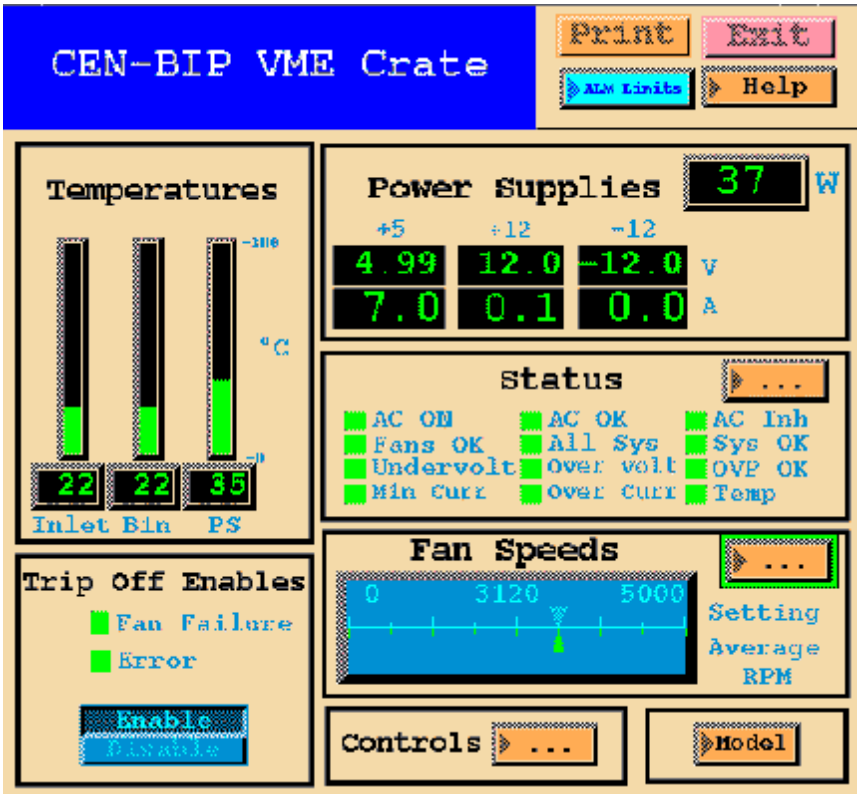
BaBar Hardware Injection Inhibit
SIAM


CEN-BIP VME Crate
Print
Exit
ALM Limits
Help
Temperatures
°C
22
22
35
Inlet Bin PS
Power Supplies
37
W
+5
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0.1
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A
Status
AC ON
AC OK
AC Inh
Fans OK
All Sys
Sys OK
Undervolt
Over volt
OVP OK
Min Curr
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Setting
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Fan Failure
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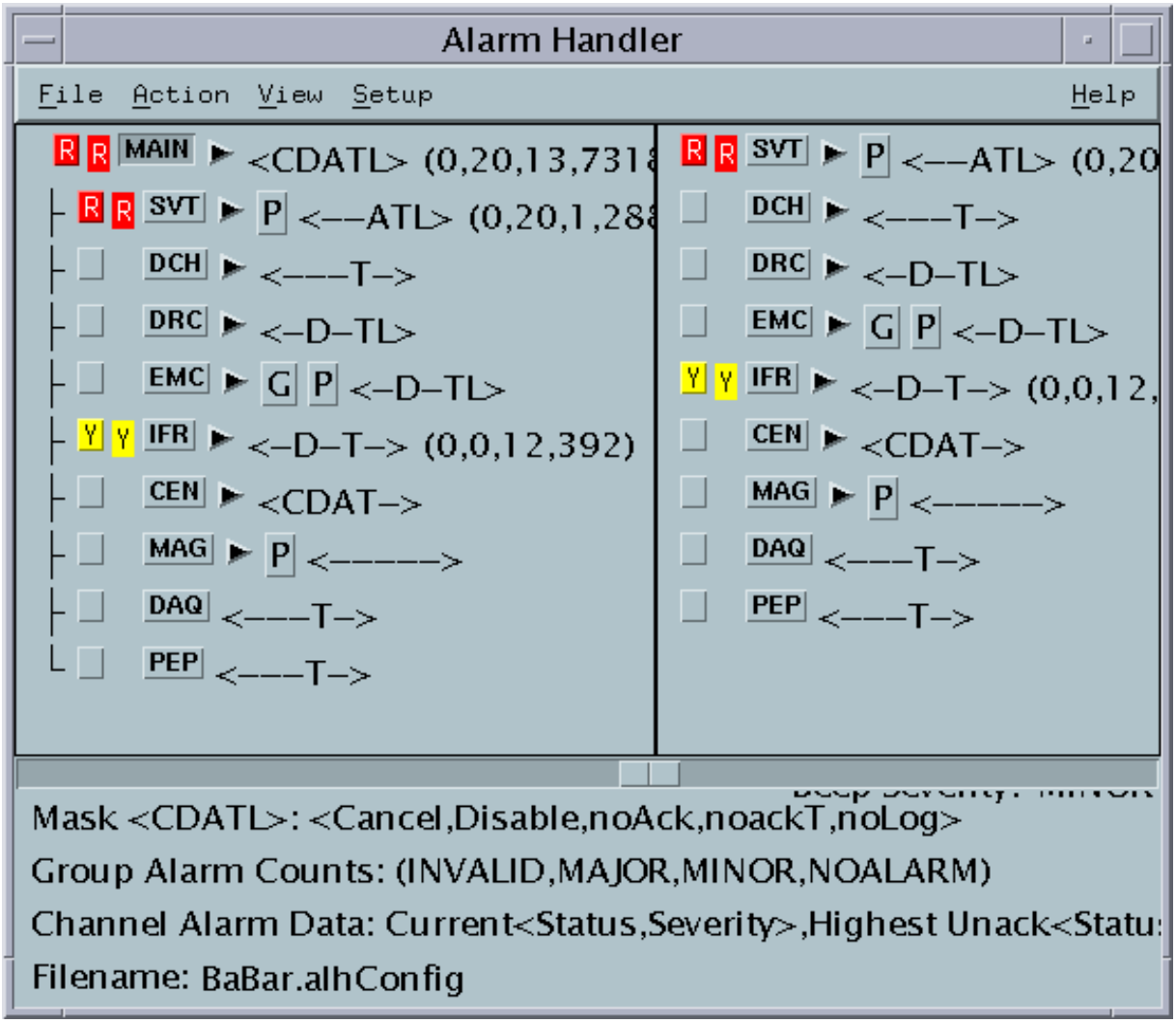
Controls
Model

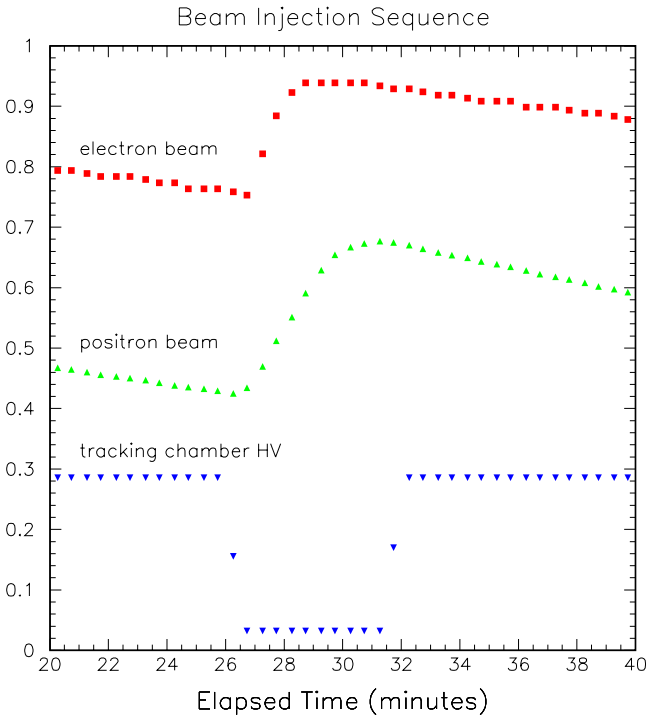

Alarm Handler
File Action View Setup Help
R R MAIN ▶ <CDATL> (0,20,13,7318
R R SVT ▶ P <--ATL> (0,20,1,288
DCH ▶ <---T->
DRC ▶ <-D-TL>
EMC ▶ G P <-D-TL>
Y Y IFR ▶ <-D-T-> (0,0,12,392)
CEN ▶ <CDAT->
MAG ▶ P <----->
DAQ <---T->
PEP <---T->
R R SVT ▶ P <--ATL> (0,20
DCH ▶ <---T->
DRC ▶ <-D-TL>
EMC ▶ G P <-D-TL>
Y Y IFR ▶ <-D-T-> (0,0,12,
CEN ▶ <CDAT->
MAG ▶ P <----->
DAQ <---T->
PEP <---T->
Mask <CDATL>: <Cancel,Disable,noAck,noackT,noLog>
Group Alarm Counts: (INVALID,MAJOR,MINOR,NOALARM)
Channel Alarm Data: Current<Status,Severity>,Highest Unack<Statu
Filename: BaBar.alhConfig

Interaction with PEP-II

- Positron beam lifetime $\sim$ 1 hour
- Design parameter – injection downtime $<\sim$ 6 minutes
- BaBar must be safe for injection:
  - silicon tracker bias voltage off
  - drift chamber and muon detector high voltage at safe (no gain) level

$\Rightarrow$ Close communication between BaBar and PEP-II essential

- IOC-to-IOC link over dedicated network connection
- EPICS sequencers handle injection "handshake"



Interface to the Online System

- EPICS implemented primarily in C
- BaBar software implemented in C++

$\Rightarrow$ Need C++ interface to Online system

- Component Proxy Design:
  - Abstraction of BaBar hardware in terms of C++ objects
  - Communicates with Run_Control, configures detector, and archives data
  - Each instance defined by a set of EPICS channels (configured in ascii file)
  - Status of hardware component summarized by a "RUNNABLE" flag
  - Communication with EPICS implemented in the Common Device (CDEV) framework

- BaBar runs 27 component proxies on two Sun Ultra 10 workstations with 0.75GB of combined memory

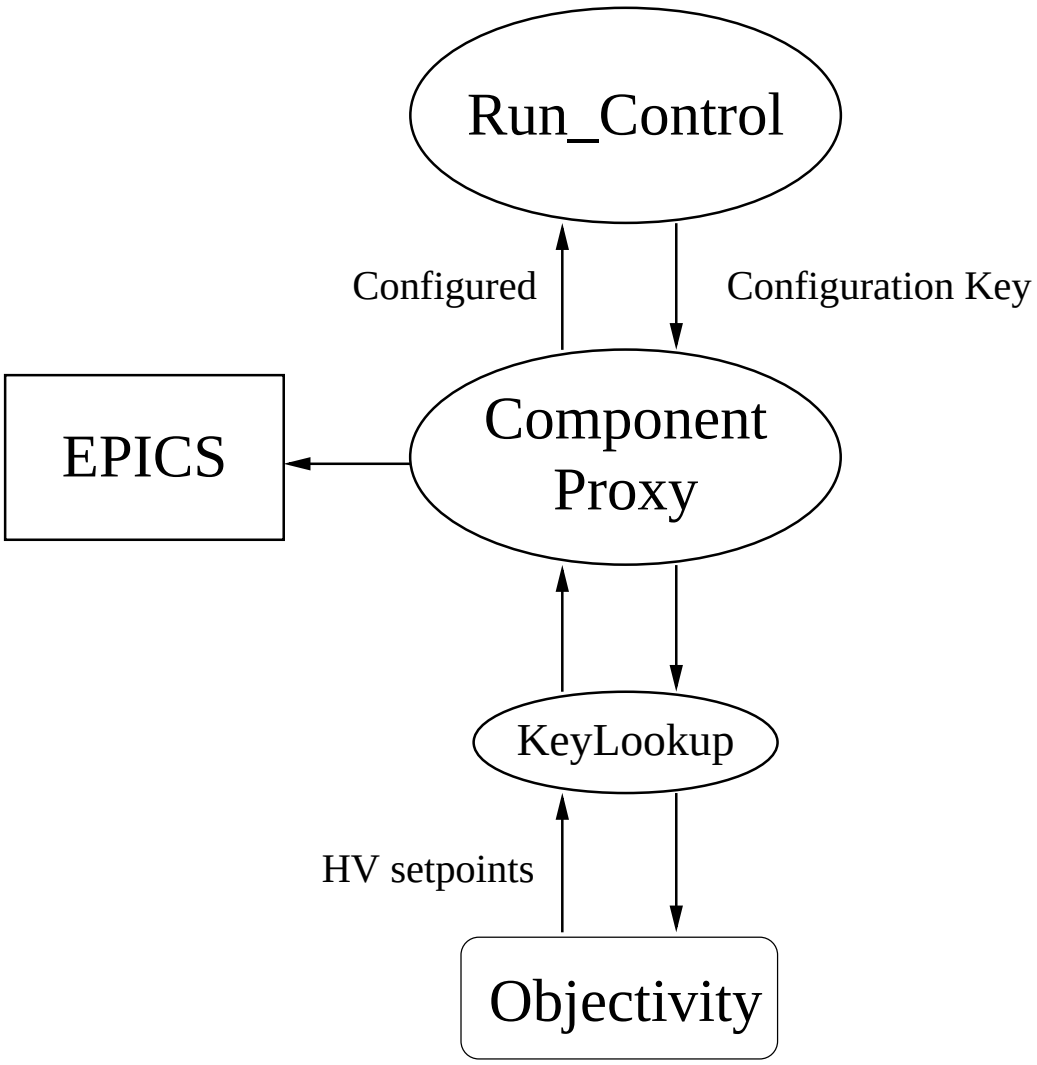
Interaction with Run_Control

- BaBar Run_Control modeled on the DELPHI design:
  - Real-world system described in terms of finite state machines (SMI)
  - Communication via DIM protocal
- Component proxy spawns a coprocess to communicate with SMI object
- Relevant state transitions:
  Initialize, Configure, Begin, Pause, End
  - Cannot begin run until each proxy is "RUNNABLE"
  - Datataking is paused if component loses its runnable status
  - Response time for HV trips $\sim$ 1 second

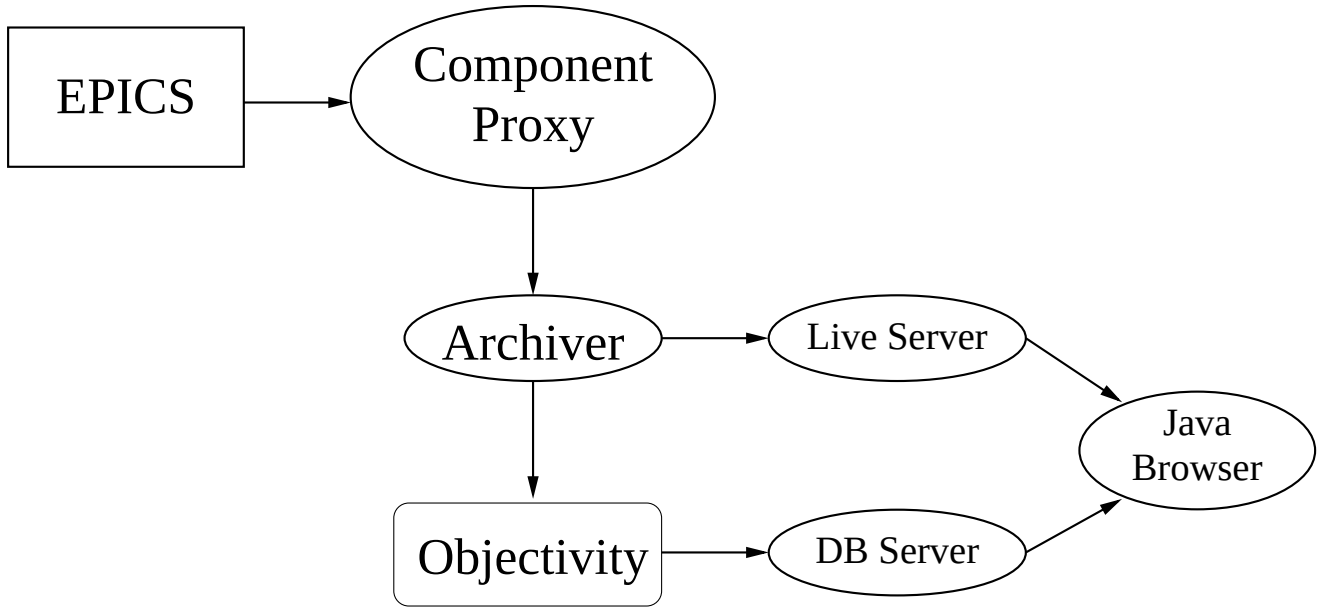
Use of Objectivity Database

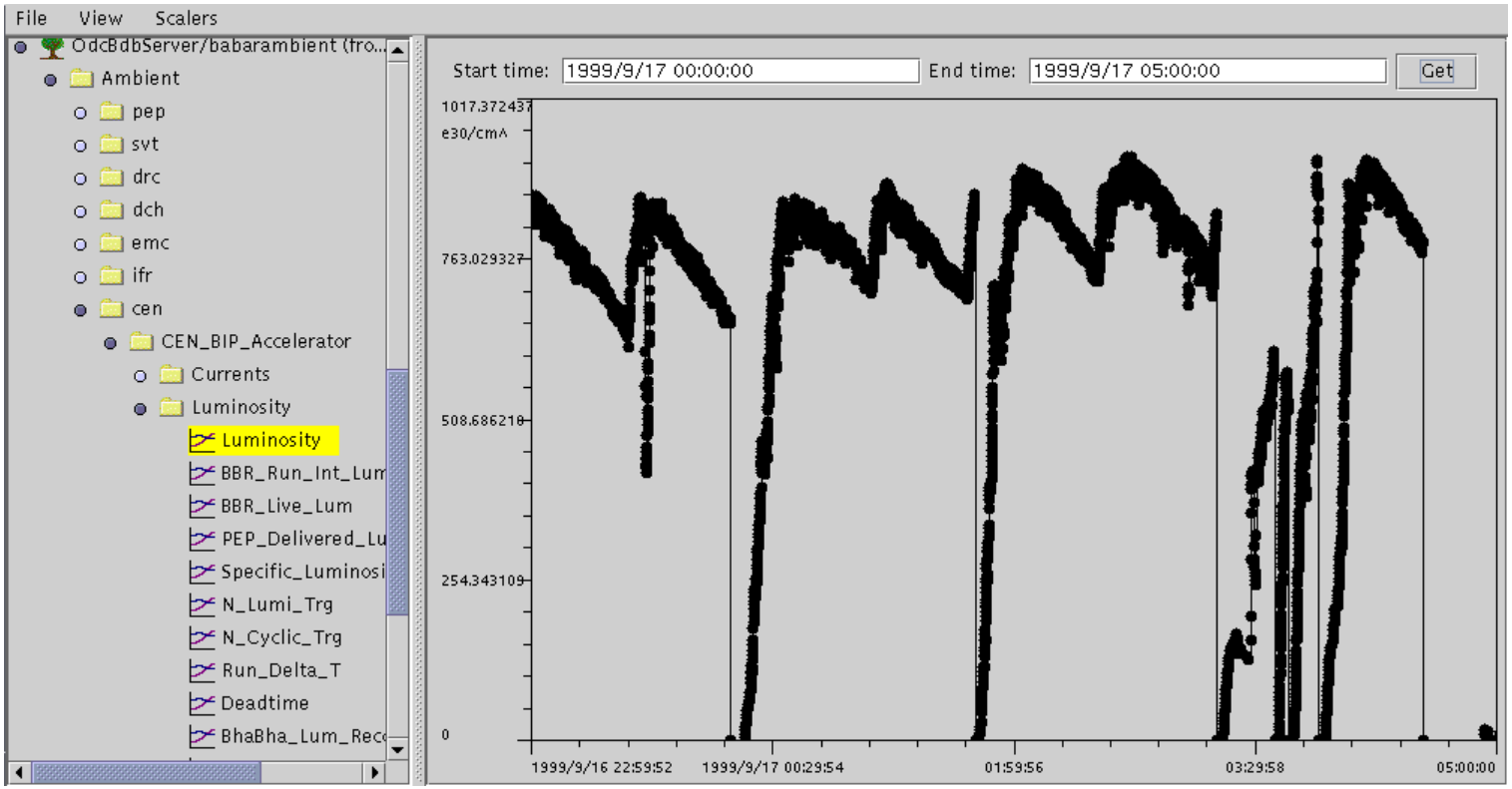
- BaBar uses Objectivity to store event, conditions, configuration, and ambient data
  - common tools for database access
  - access to conditions data during offline reconstruction
  - maximizes limited human resources
- See talk on BaBar databases by G. Zioulas for more details

- Detector Configuration:
  - Run_Control CONFIGURE transition initiates "KeyLookup" process



- Archiving ambient data:
  - Each component proxy monitors a set of EPICS channels and transfers data to an archiver coprocess
  - The archiver accumulates data in a cache before writing it to the Ambient database
  - Data written every 60 minutes to reduce database activity
  - Total archiving rate $\sim$ 2MB/hr (17.5GB/yr)
- Java browser retrieves data from "live" server or database server using CORBA




File
View
Scalers
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Ambient
pep
svt
drc
dch
emc
ifr
cen
CEN_BIP_Accelerator
Currents
Luminosity
Luminosity
BBR_Run_Int_Lum
BBR_Live_Lum
PEP_Delivered_Lu
Specific_Luminosi
N_Lumi_Trg
N_Cyclic_Trg
Run_Delta_T
Deadtime
BhaBha_Lum_Rec
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1999/9/17 00:00:00
End time:
1999/9/17 05:00:00
Get
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508.686218
254.343109
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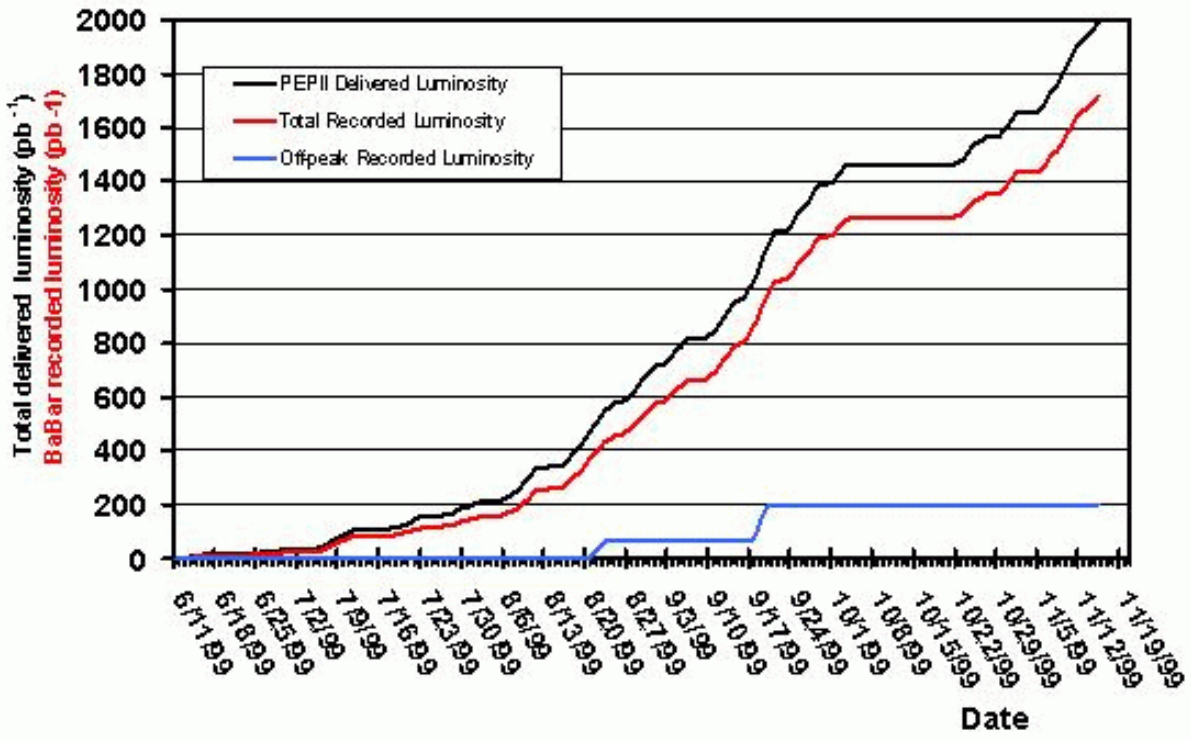
1999/9/16 22:59:52
1999/9/17 00:29:54
01:59:56
03:29:58
05:00:00

Operational Experience

- EPICS hardware/software is very robust
  - $\sim 10^5$ channels served by 15 IOCs to > 300 clients (average load)
  - injection handshake works well
- Problems/delays commissioning component proxy:
  - Objectivity reliability issues delayed testing of configuration/archiving features
  - Database update-lock contention among Online processes contributed to significant downtime during initial running period (largely avoided now)
  - Component proxy performance suffers from limited computing resources
- But...

BaBar Recorded Luminosity (BaBar L3)



Monday, November 15, 1999 I. Adam & L.Lanceri