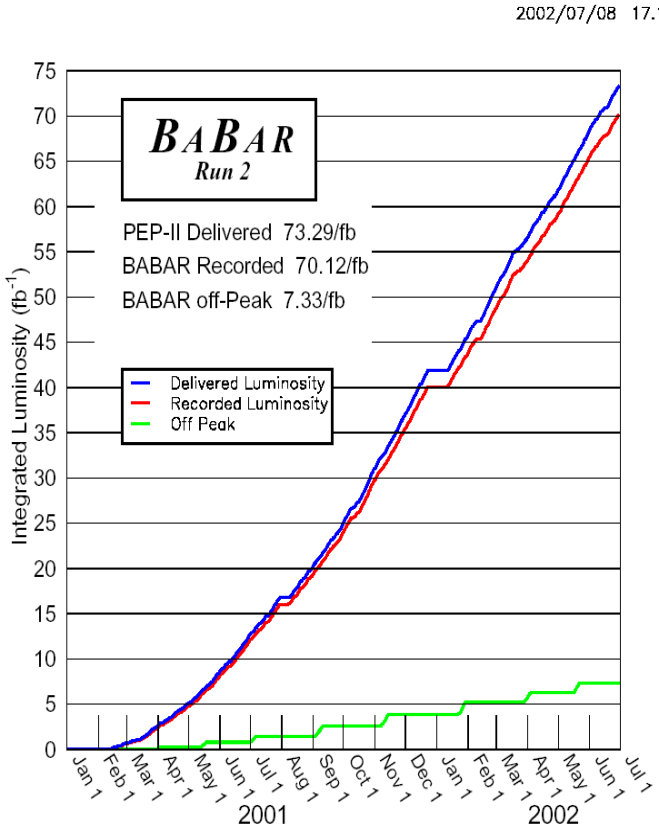
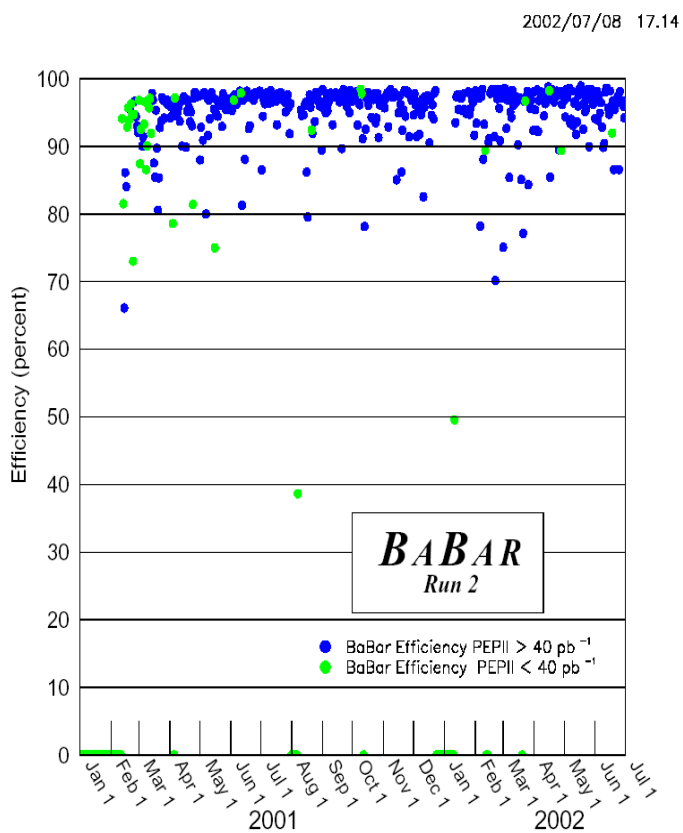
Detector Report

- Run 2 & 2002 Shutdown Work
  - SVT, DCH, DIRC, EMC, IFR
  - Online LINUX farm
- Run 3 Progress
- Upgrades

Run 2

- Run 1(10/99) + Run 2 delivered/recorded: 98.6/93.8
- Run 2 efficiency ~97%
- Bellows heating limits luminosity

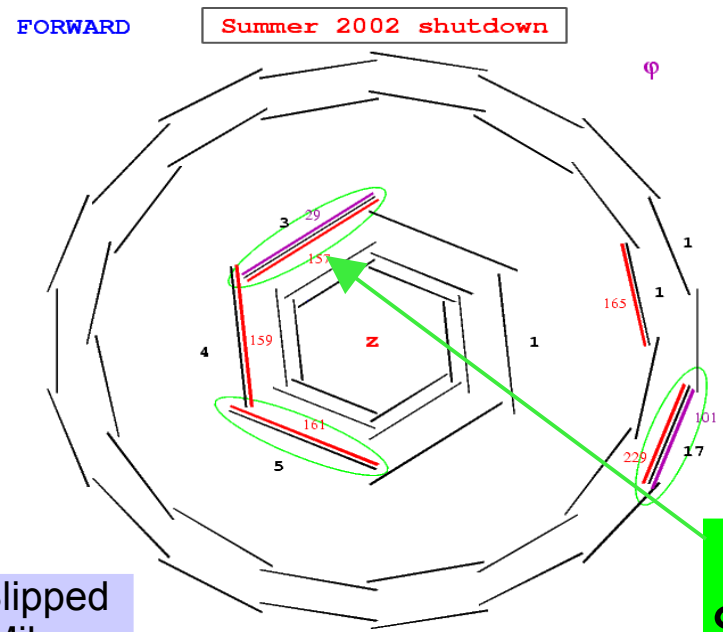


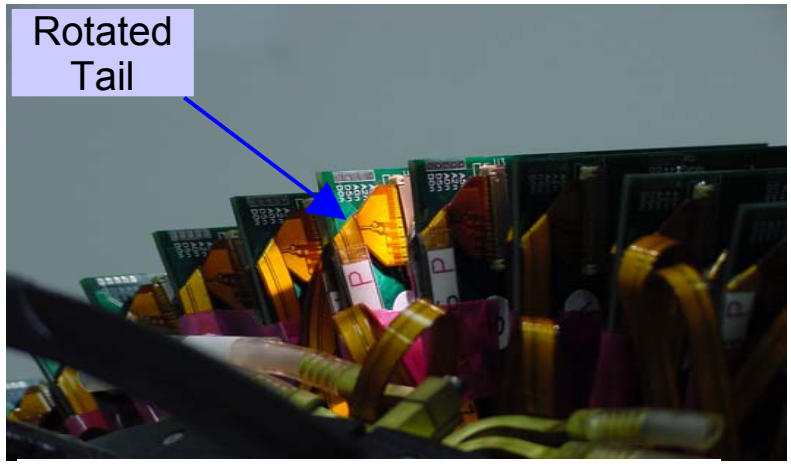


SVT

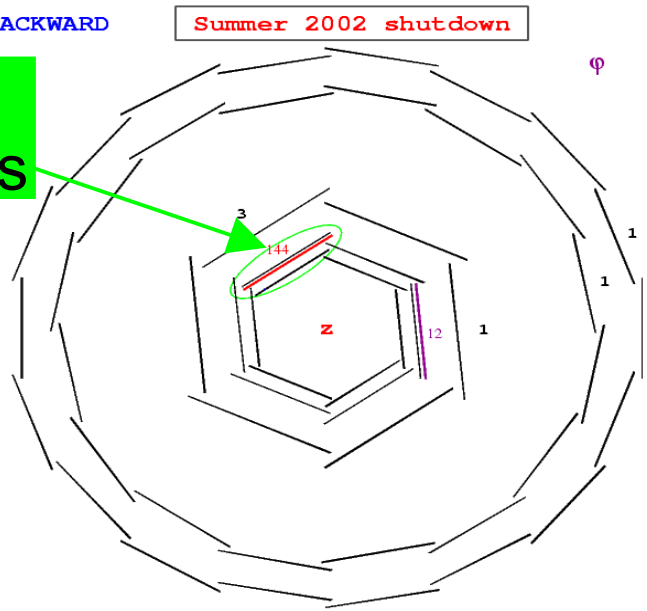
- Support tube extraction for bellows cooling work requires SVT removal from the ST. Recover readout sections where possible: it is too early for ladder replacement (rad damage).
- Many electrical tests and visual inspections were done.
  - Fix 5 of 9 readout sections (208 in system).
  - Better secure matching card connections.
  - Re-terminate the backward cables.

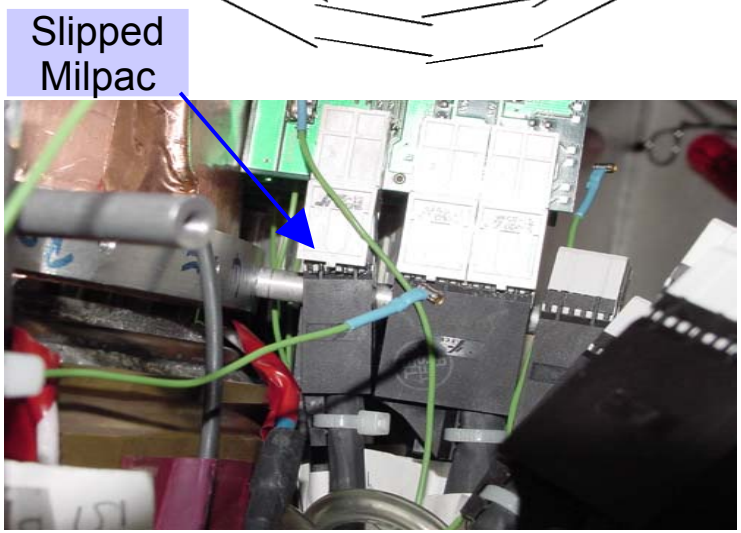
SVT





Fixed Sections



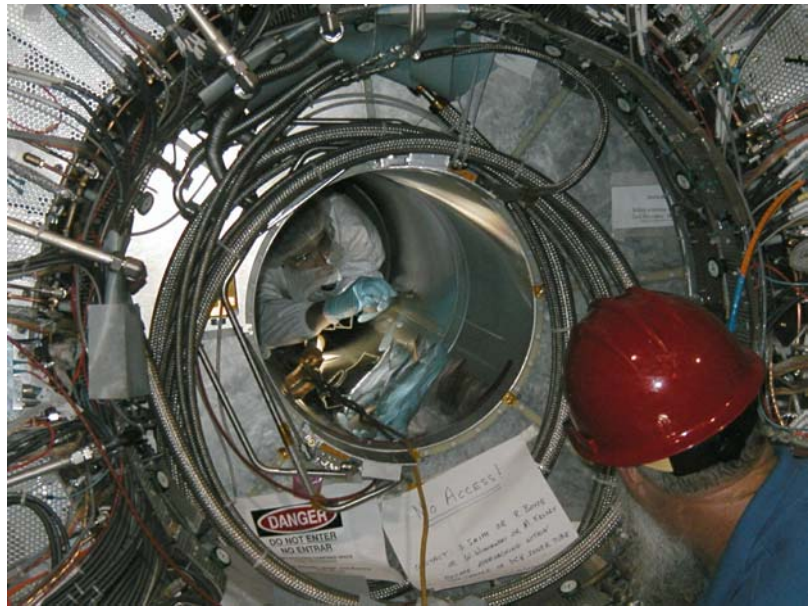


SVT

- SVT
  - improve IP sealing and install humidity control system
- SVTRAD
  - upgrade electronics: calibrate in empty buckets
  - test diamond diode (aft)
  - machine: quartz & CsI pairs under aft cone (B1)
- **Spares**
  - Work completed on SVT spare modules at Pisa, UCSB! (end CY02) Install 2005

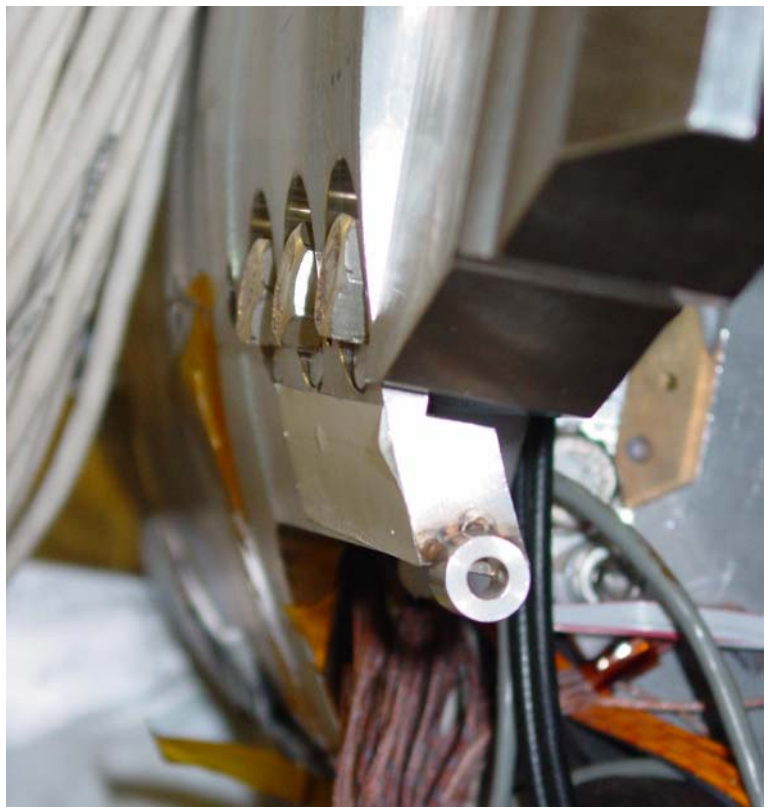
DCH

- Shutdown expected to be uneventful: cut & add connectors to cables at raft (successful); other minor work
- Support Tube hits inner cylinder during removal & cracks it.
  - No environmental contamination
  - Cylinder still ~7x structural load

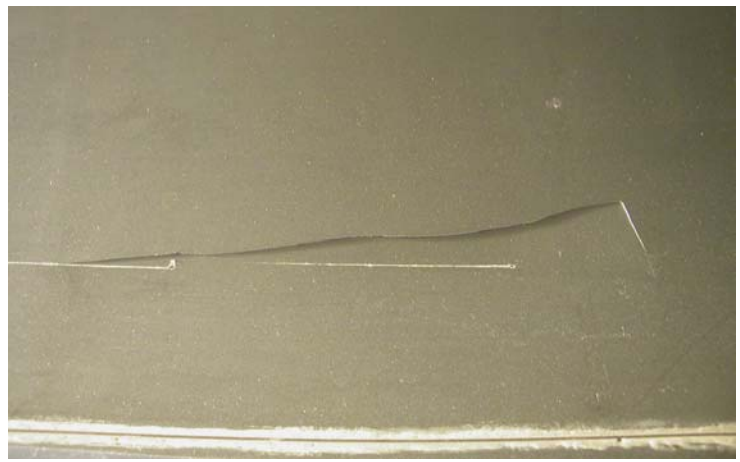


DCH

- damage source

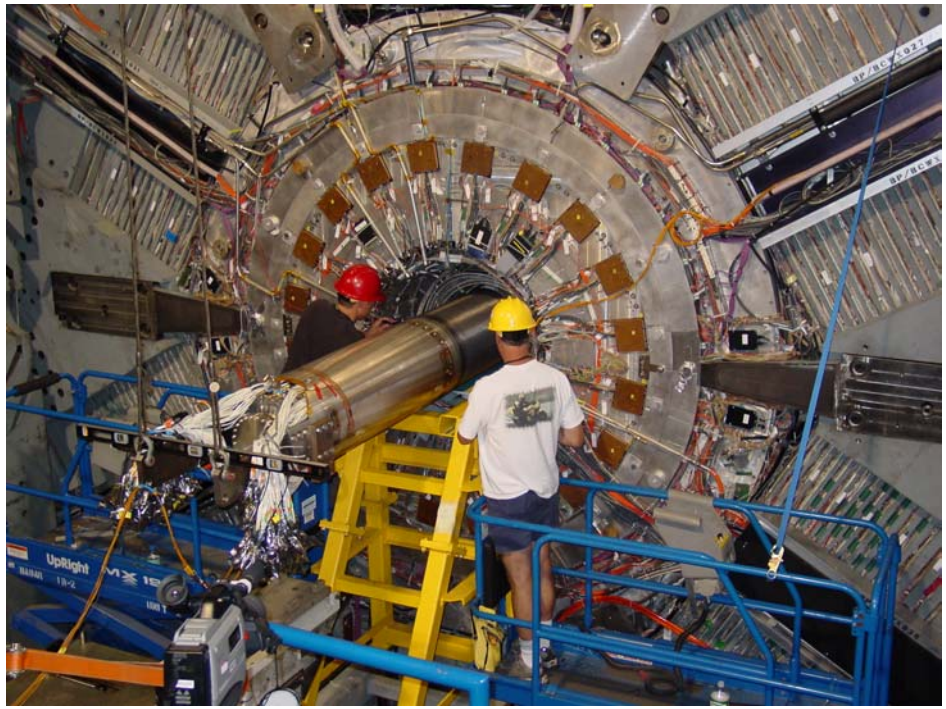


- before & after fill



DCH Damage and Repair

- Repair Crack
  - Fill with epoxy
  - Cover with Al
  - Helium tight
  - Ground & bag
  - No damage to wires
  - 5mm clearance to ST



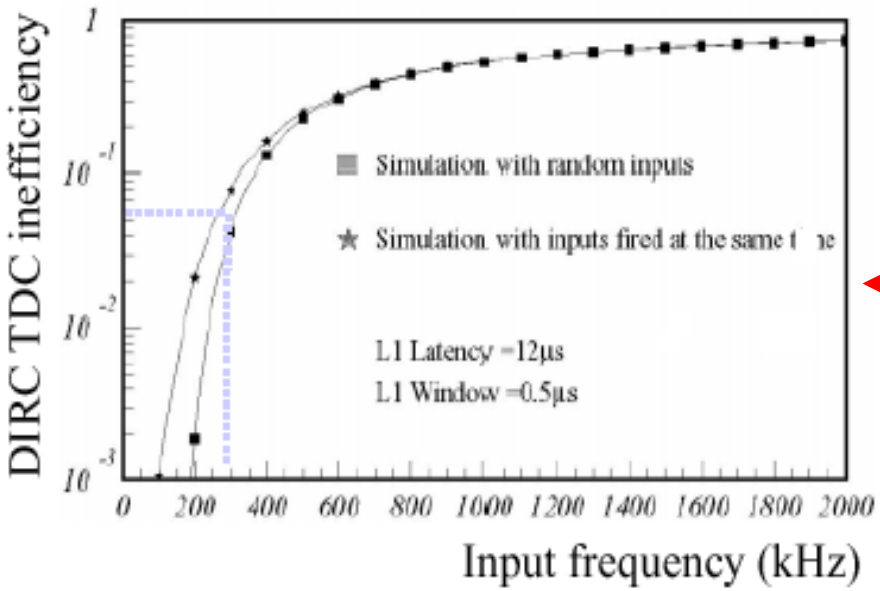
Support Tube Installation

- DIOM repairs
- Decision: No new DCH

DIRC shutdown main activity: TDC upgrade (I)

Issue: background rate versus luminosity:

→ expectation: rate (kHz) ~ 530 at $L=4.10^{34}$ cm^2/s



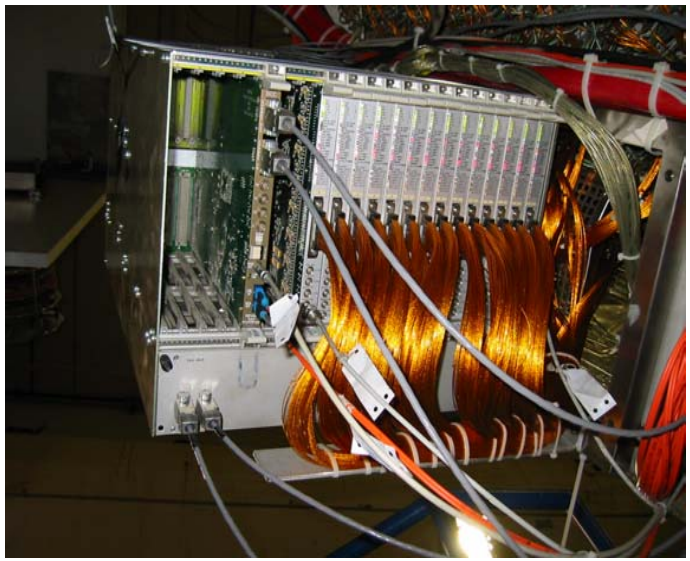
← high inefficiency with initial design

⇒ New TDC design to allow small dead time up to 1 MHz rates

- Binning=520ps, full scale=32us
- Simultaneous Read and Write operations
- Counting inefficiency < 1% @1MHz
- Minimum time between 2 consecutive L1: 2.2 us

DIRC TDC upgrade (II)

TDC chips: 12 (sectors) × 14 (Front End Boards) × 4 (chips)=672



Sector crate

Front end board

Boards: - removed and sent to external company for chips exchange
- re-coded and tested in test bench at SLAC
- re-installed in detector

↳ fully tested with calibration data: OK

→ TDC upgrade successful !

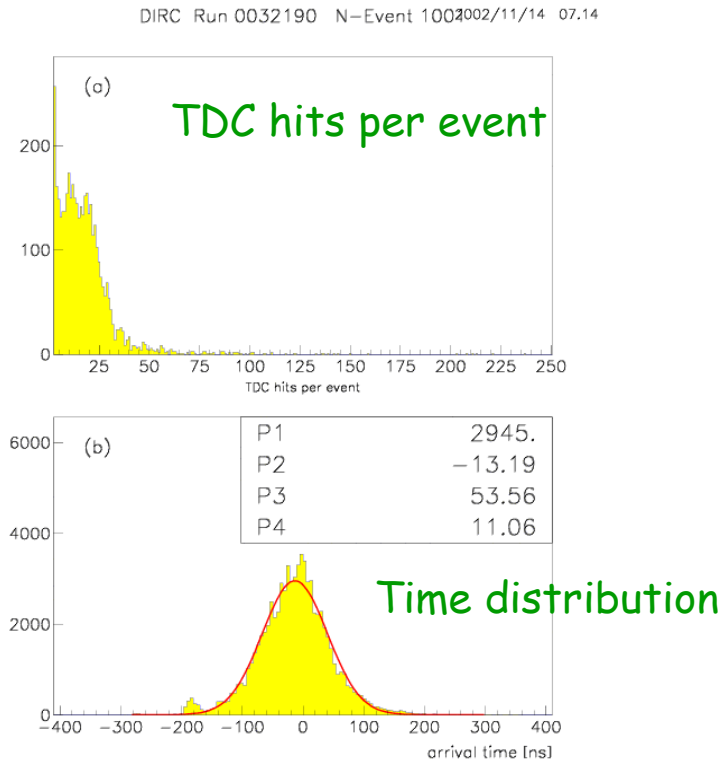
DIRC TDC upgrade (III)

Timing distribution

Chips sent to SLAC: September 18th 2002

Chips exchanged by company: October 2th 2002

Boards re-installed and fully tested in detector: October 11th 2002



DIRC cosmic data

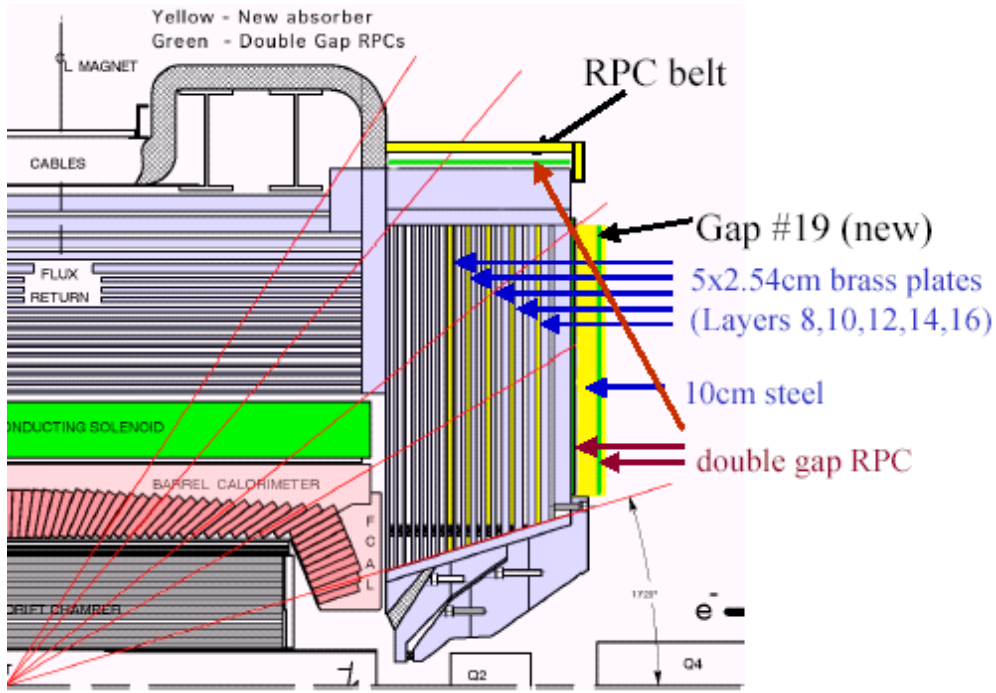
Both distributions look good

EMC

- routine repairs
  - ADBs, TRBs, GMBs, RMBs, replace rate-limit diode/crystal packages, improve LV PS cooling
- cross-talk studies
  - add to measurements taken last downtime with more extensive set: 1 EC and 8 Barrel minicrates (high gain, low gain, short shaping, long shaping time)
  - confirm pattern of cross-talk; check implementation
- background PIN diodes replaced (calibrated)
- neutron generator fails

IFR

- Endcap Upgrade
  - goal: improve pion contamination for tightly identified muons from 2.3% to <1%
  - replace dying RPCs with chambers which have been carefully Q/C'd
  - replace 5 layers in door with 1" brass; add two double layers in place of old layer 18, with added 4" steel….
  - Requires removal of electronics racks, cables, gas lines, old layer 18 & its steel, door flux bars and comb plates



IFR

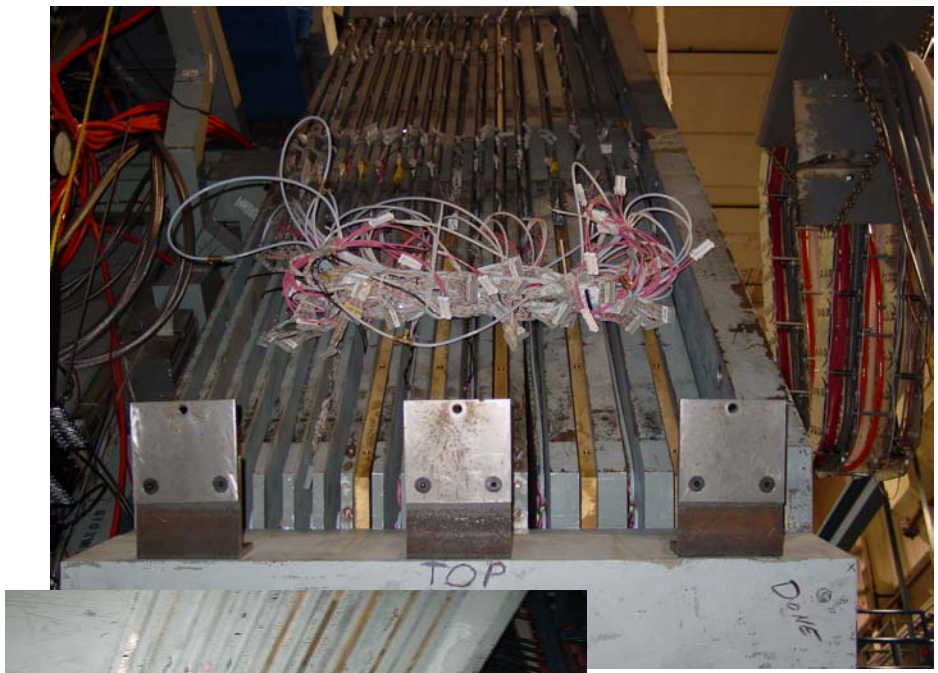
- Endcap RPCs
  - all chambers received and tested (in CEH)
  - chambers prepped and cables dressed for insertion into slots
  - double layers assembled into steel (layers 13-16, gaps 18-19)

IFR

- Front end electronics
  - racks stripped of cables
  - re-installed new and re-routed cables
  - mini-crates tested and repaired
  - trigger fanout connections

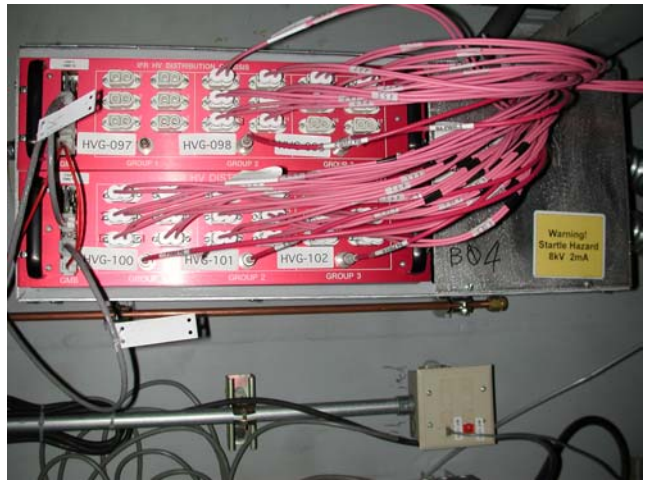
IFR

- installation chambers as well as brass proceeded faster than expected
  - brass requires some machining; layer 13; bend sheet
  - chamber replaced for high current after installation
  - chambers repaired: broken gas lines



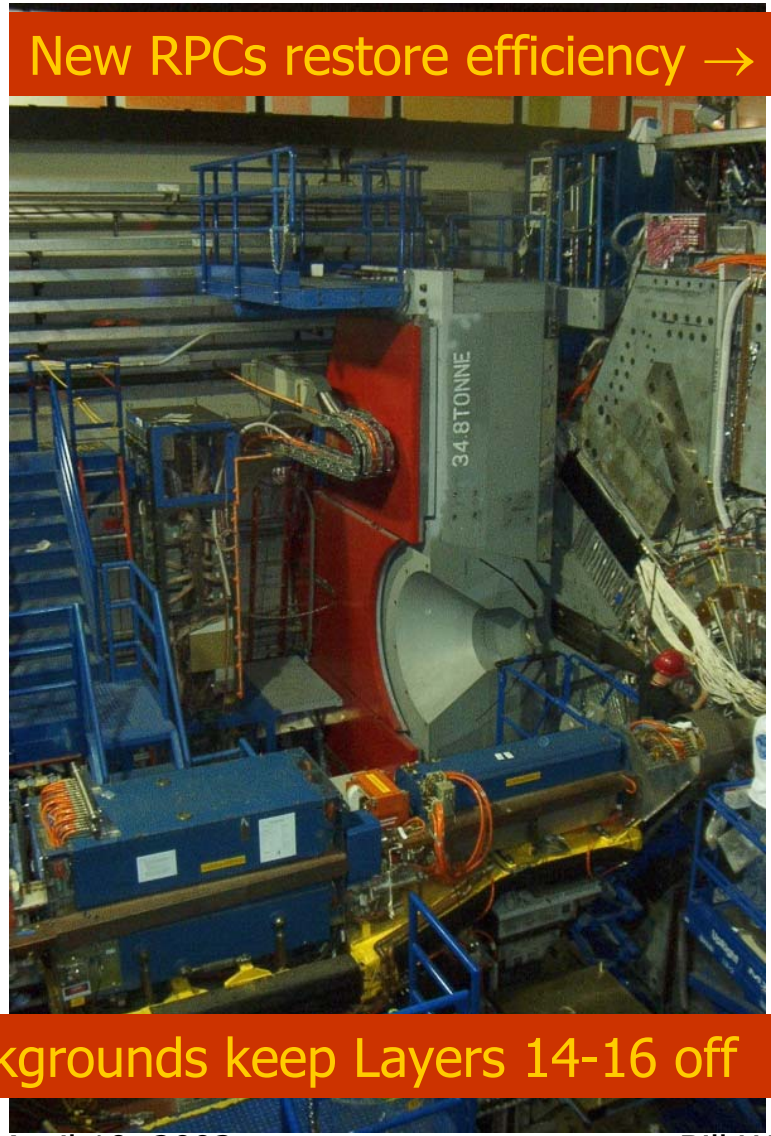
IFR

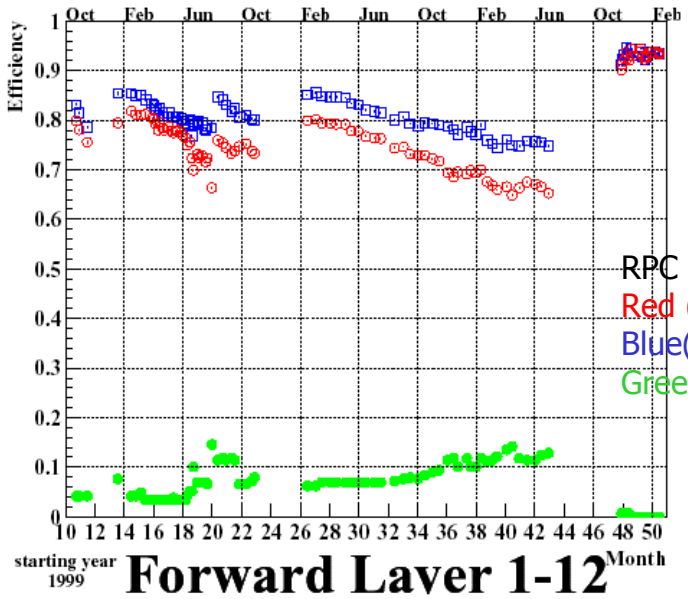
- Barrel
  - HV (EC too)
    - HV distribution system completely revamped
    - full barrel rung out: chambers recovered
  - Gas (EC too)
    - distribution upgrade
  - FEC repair
    - Recovery to level of start of RUN 2
  - Remediation: no cure



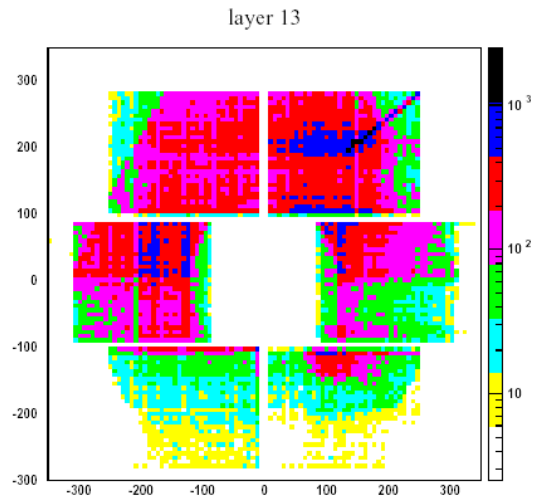
IFR

New RPCs restore efficiency →





RPC efficiency
Red (all)
Blue(eff>10%
Green(eff<10%)



Backgrounds keep Layers 14-16 off →

Run 3 Progress

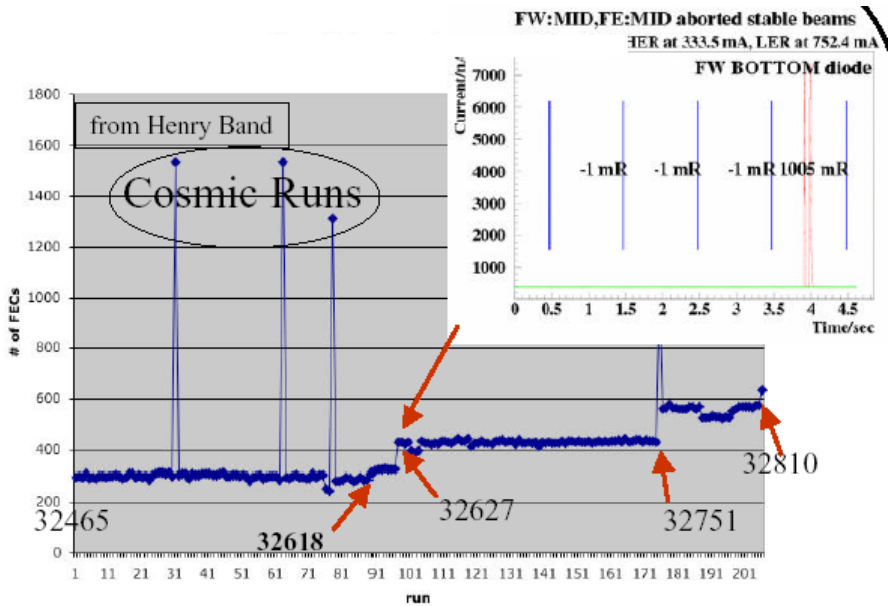
- Pre-Run:
  - All systems 'ready' for data taking: 4 Nov.
  - System debug for 10 days
  - Magnet on 9 Nov. : full detector cosmic runs
- First beams 15 Nov.
- Early shifters are 'experts'
  - Former run coordinators, system managers, subsystem operations managers, etc. lined up for the first month of data taking; this eased startup problems.
- Scrubbing machine ~2 weeks
- Perform Y(3s) scan during scrubbing (3 shifts) to establish an accurate energy scale and width

PEP σ_{energy} 4.5+/-0.1 MeV

Run 3 Progress (II)

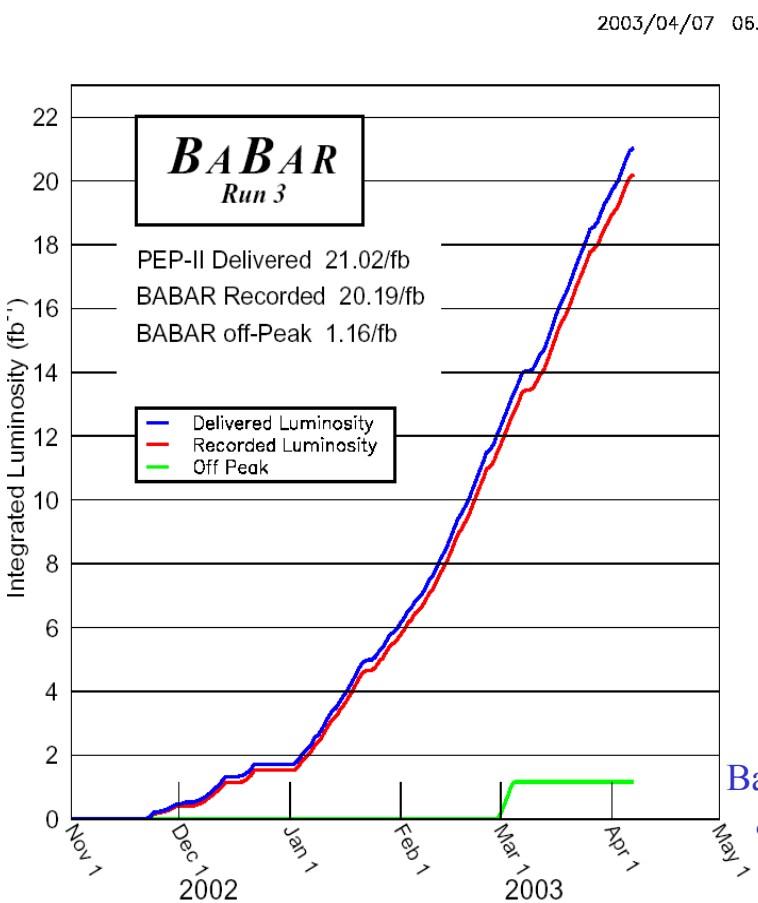
- Kickers
  - Problems with abort kicker interaction with single beam dumper: no effect on BaBar. Problem with injection kicker: kills ~240 IFR FECs. 60 repaired during ROD. 216 fixed during Holiday Shutdown.

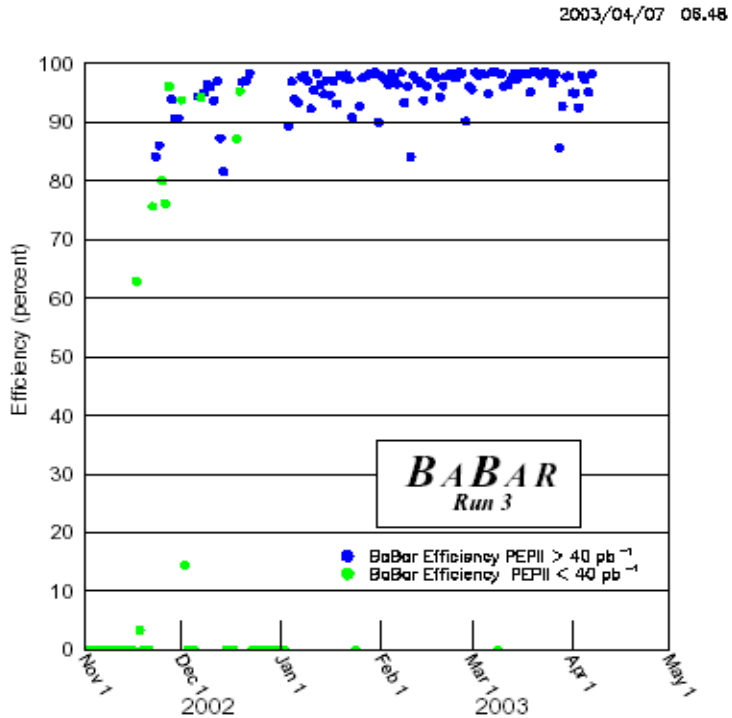
includes all sources (electronics, HV, gas, etc)



Run 3 Progress (III)

- Luminosity: PEPII records fall this year!
  - Best lum, shift, day, week, month for PEPII





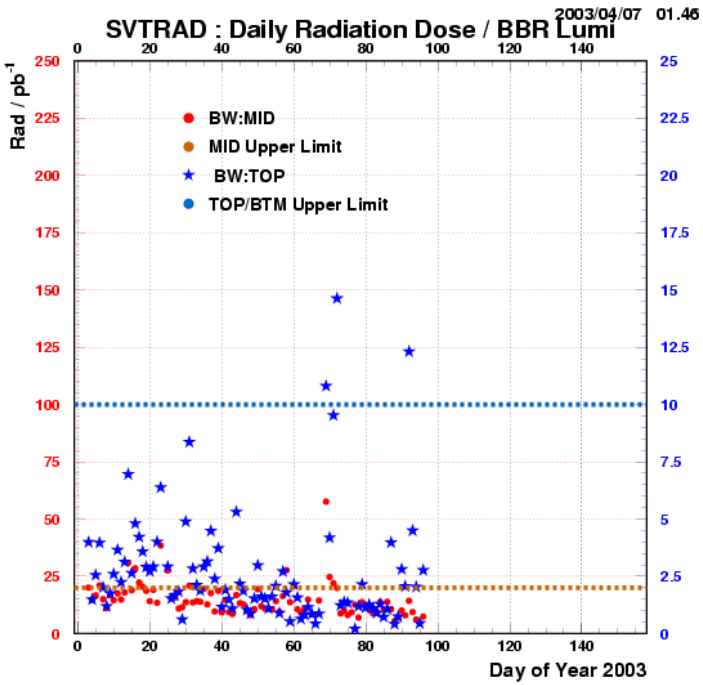
BaBar shift efficiency = DAQ on / PEP stable beams & low bckgds. Data collection efficiency is high.

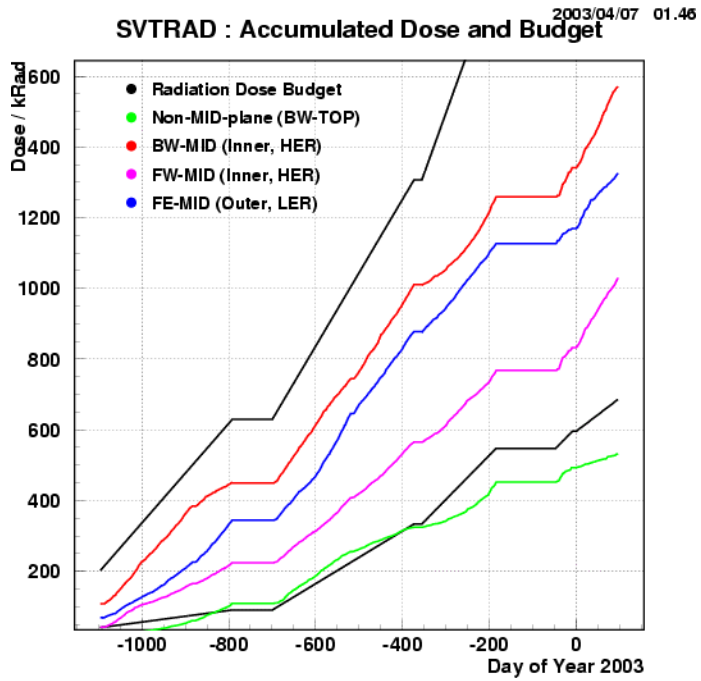
Run 3 Progress (IV)

- SVT: Data looks good.
  - Dataflow problems solved.
- DCH: Data looks good.
  - Timing problem due to crate reorganization fixed.
- DIRC: Data looks good.
- EMC: Data looks good.
  - Minor chiller problems
  - Neutron Generator patched: needs replacement
- IFR: data looks ok; caveat: backgrounds
- Trigger: ~1kHz at 4.5×10^{33}
  - EMT hot tower problem identified as poor connections: temporary fix with cable re-termination and replacement; long-term: backplane re-work
- Backup Heat-exchanger: Commissioned

Run 3 Progress: Backgrounds

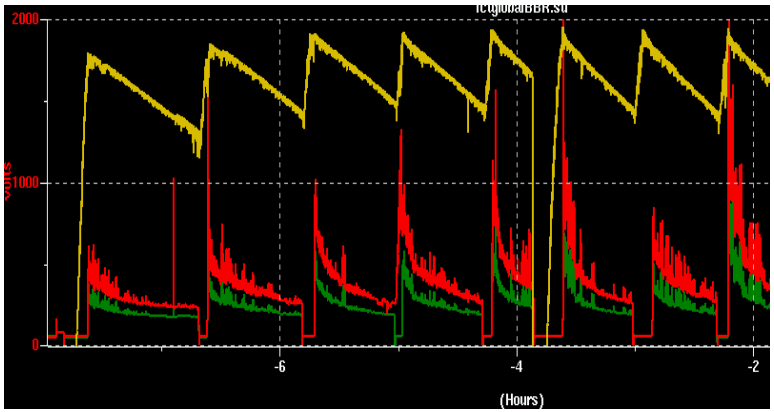
- Backgrounds have been acceptable.
- SVT radiation aborts & budget

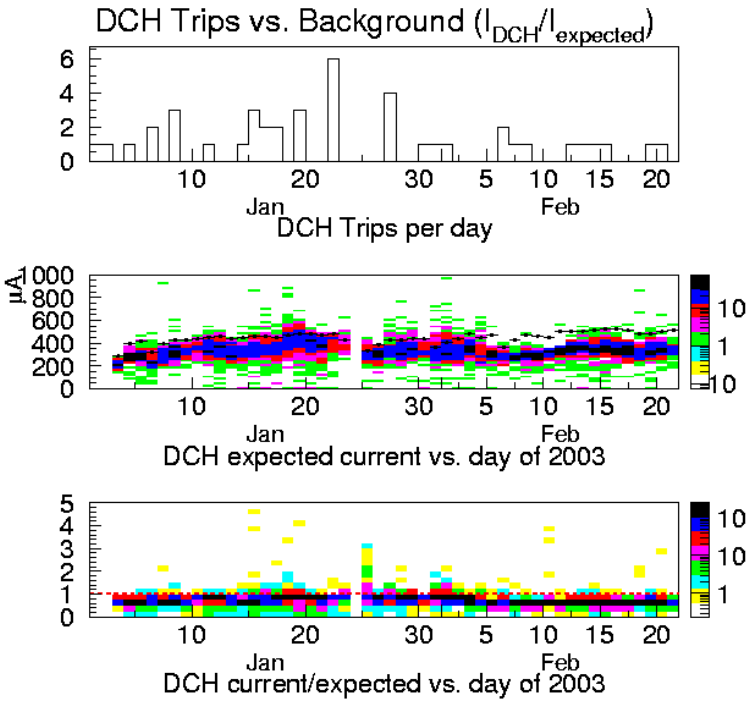




Run 3 Progress: Backgrounds

- DCH ----------→





- IFR
  - Layer 13 Pain (when backgrounds high)
  - LER limits layers in forward endcap: turn on 13 or 14; low rate sections of outer pair of layers: test with SF_6

Level 1 Trigger Upgrade

ZPD prototype (9U VME):
XilinX Vertex II 3000/4000 FPGAs.
120MHz databus & internal logic.

Need to contain L1 rate to <3 Khz at future high luminosity running to avoid DAQ bottleneck in DCH front-end data shipping.

The upgrade task:

24 Track segment finders (TSF)
8 Z-Pt-Discriminators (ZPD)
- **Interface boards of 3 types**

All boards in late prototype phase.

Final Design Review this week.

Commissioning before end of run.

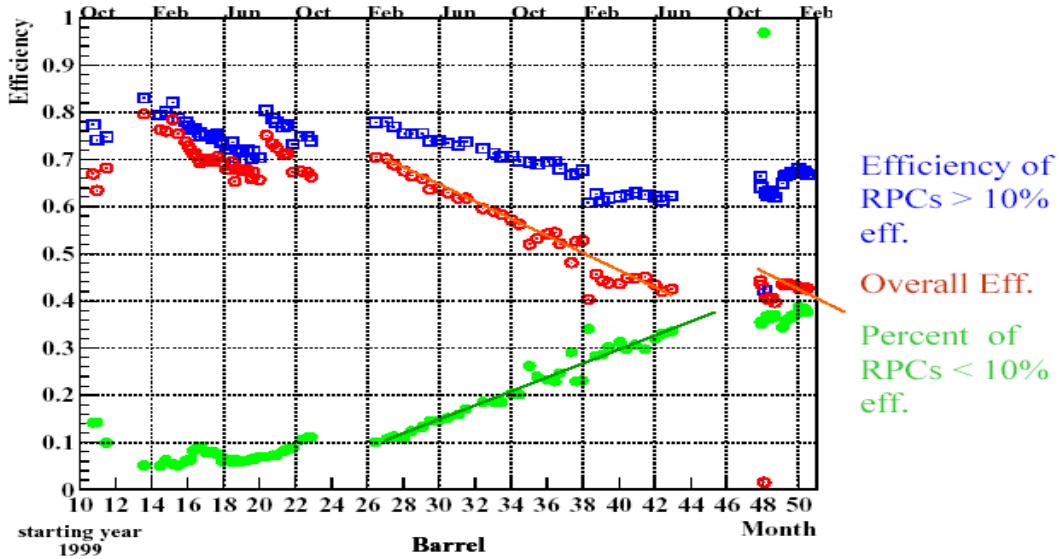
(will run new system in parallel to exisitng system initially with DCH trigger fiber signal splitting).

DCH Electronics Upgrade

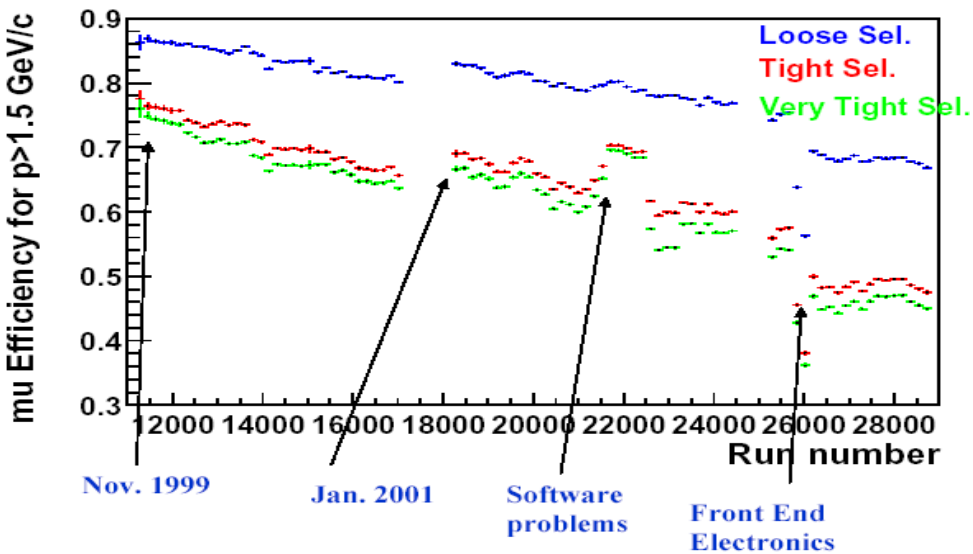
- Drift Chamber DAQ may limit the L1 trigger rate to about 4 kHz. Dead-time will be ~3-8% at 2×10^{34} cm^{-2} s^{-1}, ~15-30% at double this luminosity if nothing is done to the trigger or DCH read-out.
  - Read-out changes for DCH would require engineering studies and design to begin early in FY04 in order to be ready for an FY05 installation.

IFR Barrel Upgrade

Many RPCs die since 1999. Fraction effectively dead is now almost 40%



Muon selectors losing efficiency



IFR Barrel Upgrade

- Barrel RPCs have been dying since 1999.
- Physics is affected.
- Remediation efforts have not been successful.
- Need to address the problem now that the Endcap Upgrade is done.
- In late September a Working Committee was formed.

IFR Barrel Upgrade

- Working Committee consisting of proponents, consultants and the review committee :
  - review committee: Hearty & Ratcliff(chairs); Forti, Karyotakis, Nash, Richman, Roe, Spaan, Va'vra
  - proponents: Band, Calabrese, Ferroni, Hitlin, Lu, Schindler
  - consultants: Cavoto, Krebs, Lange
- Must last for the lifetime of the detector (end of the decade).

IFR Barrel Upgrade

- Elements of Charge:
  - decision for IFC (Jan 03)
  - advise on improvements to muon identification, in particular pion rejection
  - consider K_l identification/veto vs. mu id/pi rejection: priorities
  - backgrounds for luminosity up to $4x10^{34}$
  - progress in engineering; destructive removal?
  - use old electronics? Engineering?
  - comment on cost estimates, schedule, manpower, development path, reviews
- candidate technologies
  - RPCs; Limited Streamer Tubes; Scintillator with APDs

IFR Barrel Upgrade

- RPCs
  - can two gaps fit in one layer?
  - electronics for avalanche mode; on-chamber for streamer too?
  - oiling without coating spacers?
  - new factory?
- LSTs
  - experience at LEP and HERA positive.
  - how much electronics development needed?
  - thin enough for double layer in gap?
- Scintillator
  - extruded plastic with wavelength shifter fibers (MINOS) read out with APDs both ends: enough photons?
  - reliability of APDs?
  - electronics development?

IFR Barrel Upgrade

- Two workshops were held: mid-November & before the December collaboration meeting.
- Weekly phone meetings between September and December.
- Decision reached at the December Collaboration meeting.

IFR Barrel Upgrade

II. Recommendations:

- In order to optimize the physics output for the next decade, BaBar should proceed with an upgrade to the Barrel IFR as soon as practical. This upgrade should include the following elements:
    1. Removal of existing RPC Chambers.
    2. Placement of 2.2 cm thick brass slabs into at least 5 slots (or 6 slots if possible pending a final optimization of material placement and load restrictions).
    3. Installation of detectors into the other 12-13 slots.
- The detection system for the barrel upgrade should be double-gap LST chambers of 2.2 cm thickness. Pre-production double gap prototypes should be fabricated and thoroughly tested by May 1, 2003, and their performance reviewed immediately thereafter.
- An ongoing internal review process is encouraged to provide timely review of technical, cost, schedule, and management issues associated with the upgrade.
- The fabrication and installation of the Barrel upgrade should be optimized with respect to running schedules and other downtime needs of PEP-II and BaBar so as to minimize the impact on the integrated luminosity.

IFR Barrel Upgrade

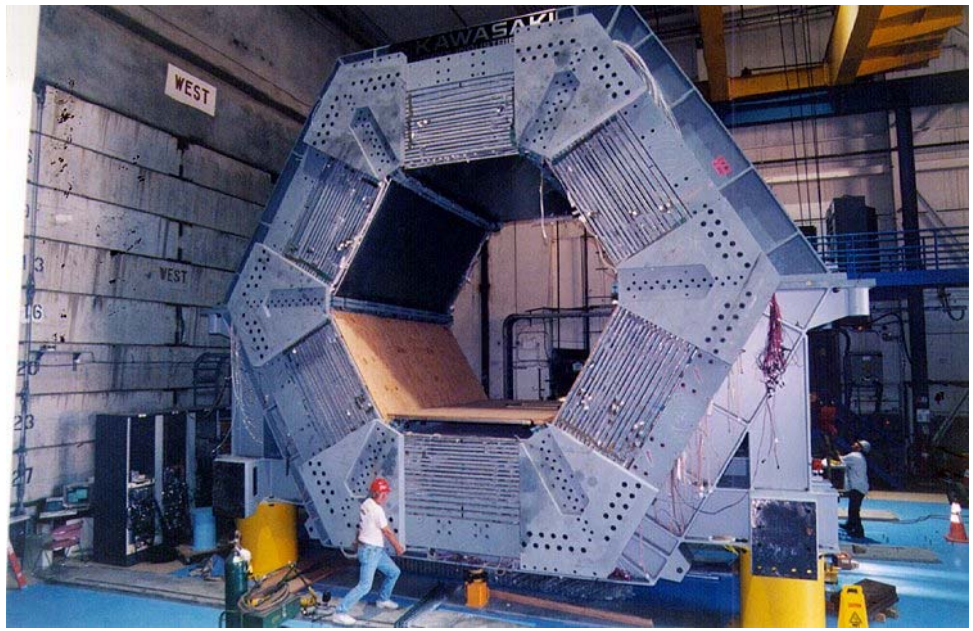
- IFR barrel expected timeline
  - 2004
    - Replace 2 sextants (probably top and bottom). This needs 3 months. The normal summer shutdown is 2 months.
  - 2005
    - Replace balance of barrel IFR sextants. SVT ladder replacement and IP work would take place in parallel. This requires 6 months (4 months if IFR work decoupled).

IFR Barrel Upgrade: Progress (I)

- Oversight Committee functioning. Standing Committee. Meeting ~6 weeks. First meeting at February Collab Mtg. Interim review this week.
- Detailed project plans will be prepped for the end of May (collaboration meeting). Present to EPAC in June, INFN in late June, IFC at the end of June.
  - WBS draft prepared for detector elements (rounds Feb, Mar)
  - WBS draft for installation, tooling, absorber along with manpower estimates and cost estimates; schedule in works
  - Institutional responsibilities in negotiation
  - Steering Committee with two points-of-contact: Stew Smith & Roberto Calabrese
- Mech. engineering has begun (earthquake issues, FEAs). Installation tooling & platforms in design.
  - Goal to test corner block removal, RPC layer removal in 2003

IFR Barrel Upgrade: Mechanics

- IFR Barrel



layer 18 & 19 inaccessibility
corner blocks

IFR Barrel Upgrade: Progress (II)

- Prototype Studies (Ferrara and Princeton)
- Strip performance studies (Ferrara and Princeton)
- Aging Tests (Princeton)
  - No effect at 0.1coul/cm (worst dose expected by 2010)
  - 7% gain loss at 0.3 coul/cm
- Gas & Wire tests (Princeton)
- Discussions leading up to prototype order from pol.hi.tech
- Workshop Jan 10/11 in Princeton.
  - 18 Attendees including 5 engineers
  - Discussed concepts and details of design, construction, assembly, electronics, high voltage, shipping, installation; prototype orders.
  - Began work on schedule, assignment of responsibilities
- Extended sessions at February Collaboration Meeting
- Workshop March 17/18 in Rome.
  - Visit to pol.hi.tech. site
  - Tube size discussions, prototype status, project planning

Summary

- Run 2, ~1.5 years, ends with over 70/fb recorded.
- The summer shutdown work was successfully completed on schedule.
- Run 3 has started. The detector is producing good data. The post-holiday turn-on of PEPII has been very good. The Trigger Upgrade is proceeding.
- The IFR Barrel Upgrade Working Committee labored intensely in the Fall. LSTs were chosen. Good technical progress has been made since then. Project planning is in the works. Install in 2004 and 2005 shutdowns.