

Belle Detector Commissioning

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for the

Belle Collaboration

200 People

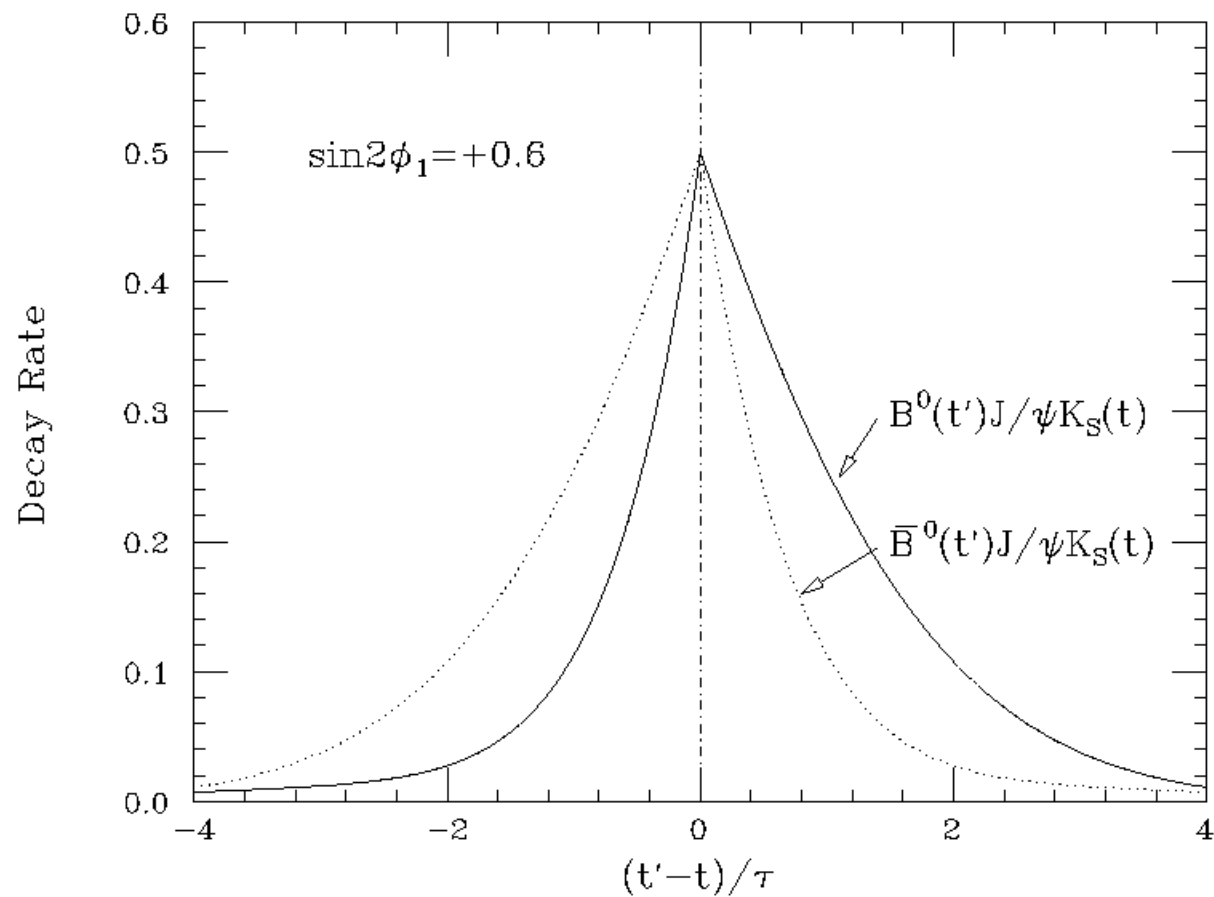
50 Institutions

10 Countries



Physics Motivation

Oh, you've all seen this before...

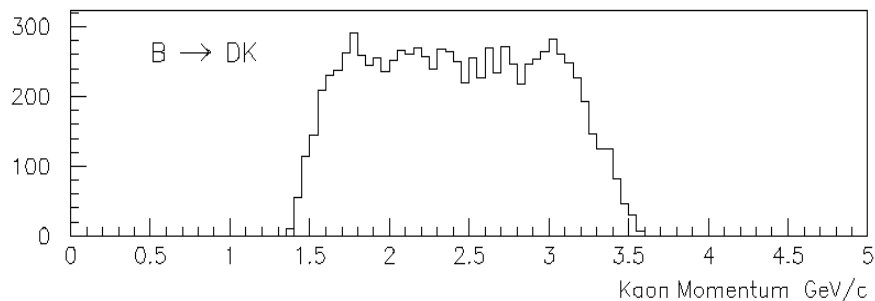
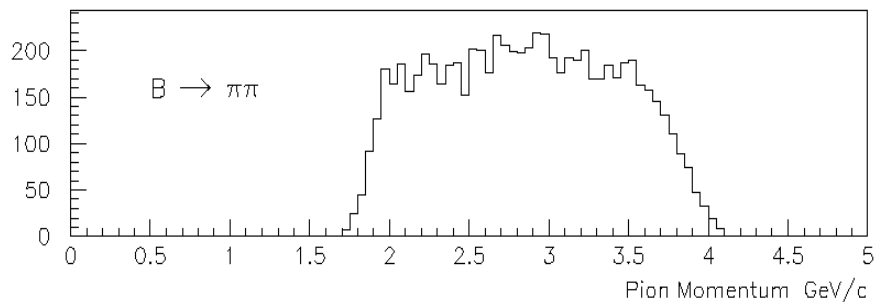
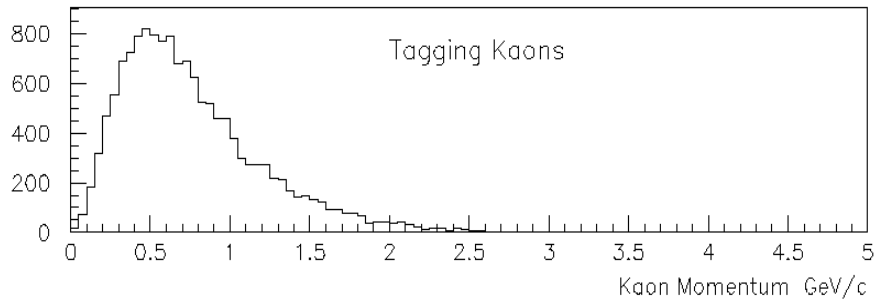


Motivation for Detector Parameters

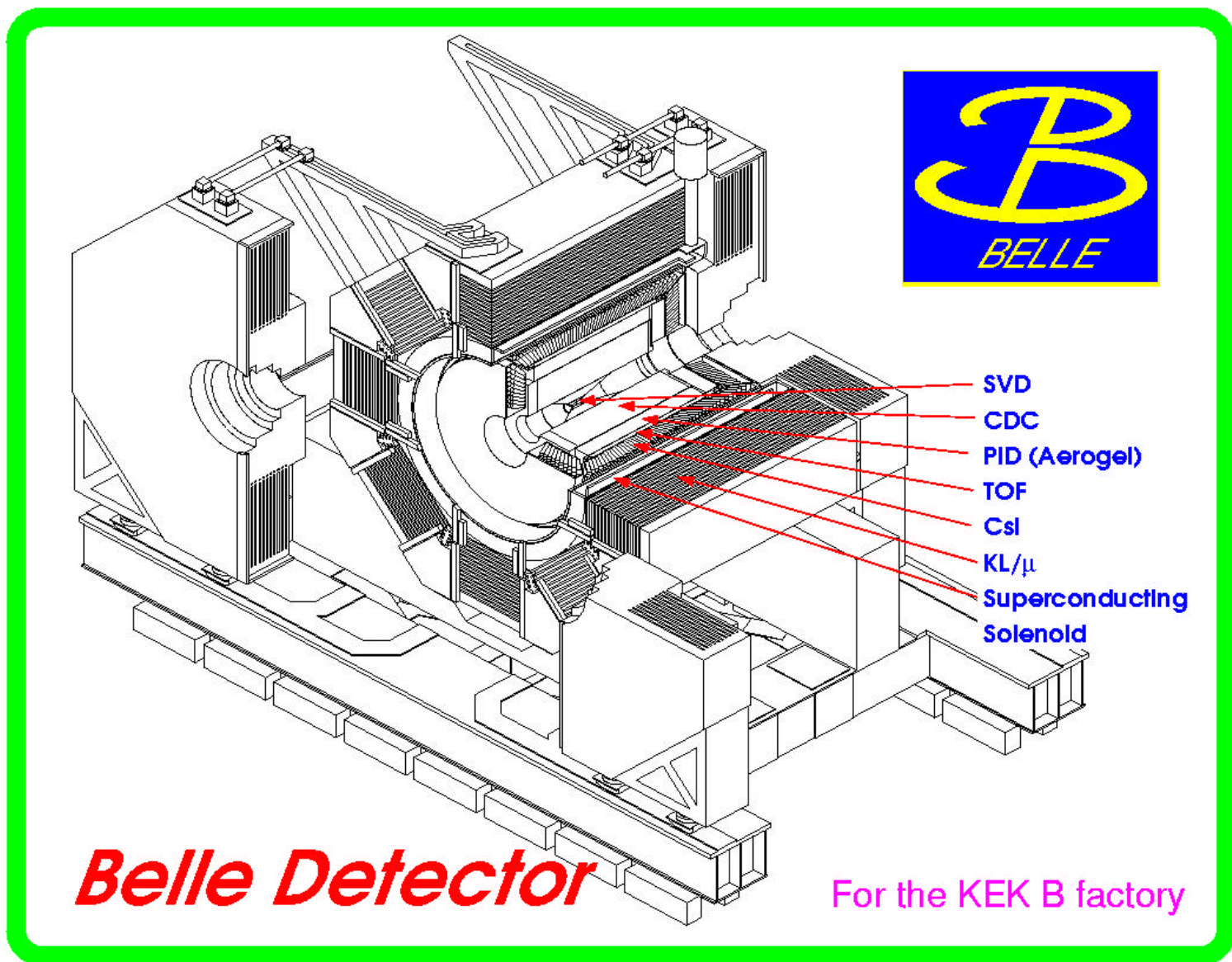
- Vertex Measurement
 - Need to measure decay vertices to $<50\mu\text{m}$ to get proper time distribution.
- Tracking...
 - Would like $\Delta p/p \approx .5\%$ to help distinguish $B \rightarrow \pi\pi$ decays from $B \rightarrow K\pi$ and $B \rightarrow KK$ decays.
 - Provide dE/dx for particle ID.
- EM calorimetry
 - Detect γ 's from slow, asymmetric π^0 's \rightarrow need efficiency down to 20 MeV.
- Hadronic Calorimetry
 - Tag muons.
 - Tag direction of K_L 's from decay $B \rightarrow \psi K_L$.
- Particle ID
 - Tag strangeness to distinguish B decays from B bar decays (low p).
 - Tag π 's to distinguish $B \rightarrow \pi\pi$ decays from $B \rightarrow K\pi$ and $B \rightarrow KK$ decays (high p).

Rely on mature, robust technologies whenever possible!!!

Particle ID needs



Technology	Pros	Cons	Comment
TOF	Simple.	Only for low momentum.	Included in Belle
dE/dx	Proven. Comes for free.	Only for low momentum	Included in Belle.
TMAE based RICH	Proven in SLD and DELPHI	Universally despised.	Rejected.
CSI RICH	Once seemed promising.	No one could build a working prototype.	Rejected.
DIRC	Rugged. Excellent separation.	New. Constraints on detector geometry	Babar choice
Aerogel threshold Cerenkov	Simple.	Barely adequate	Belle choice



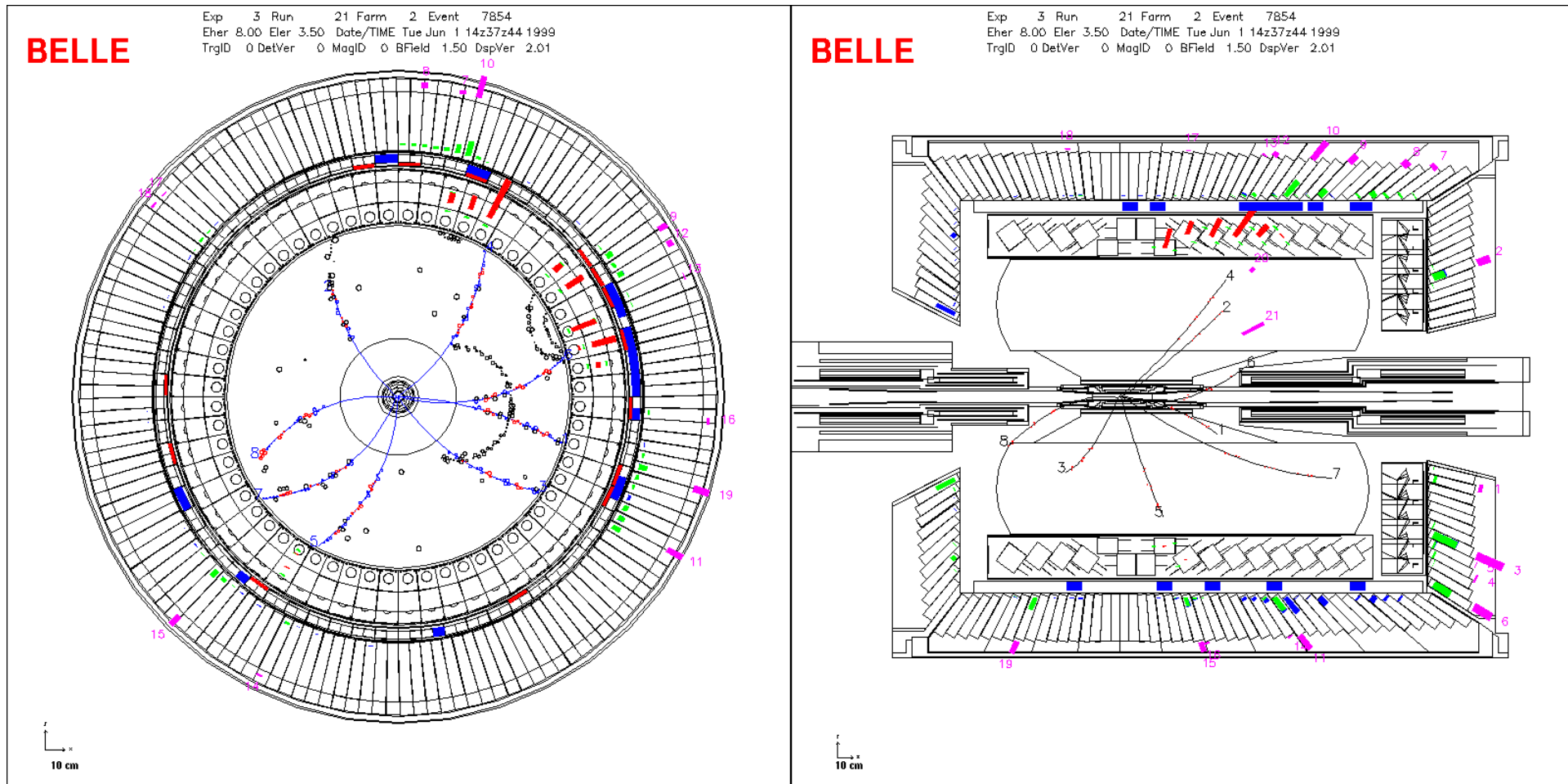
Key Belle Milestones

- Early 1990's - Japanese groups begin working.
- January 1994 - Collaboration forms.
- April 1995 - TDR Submitted.

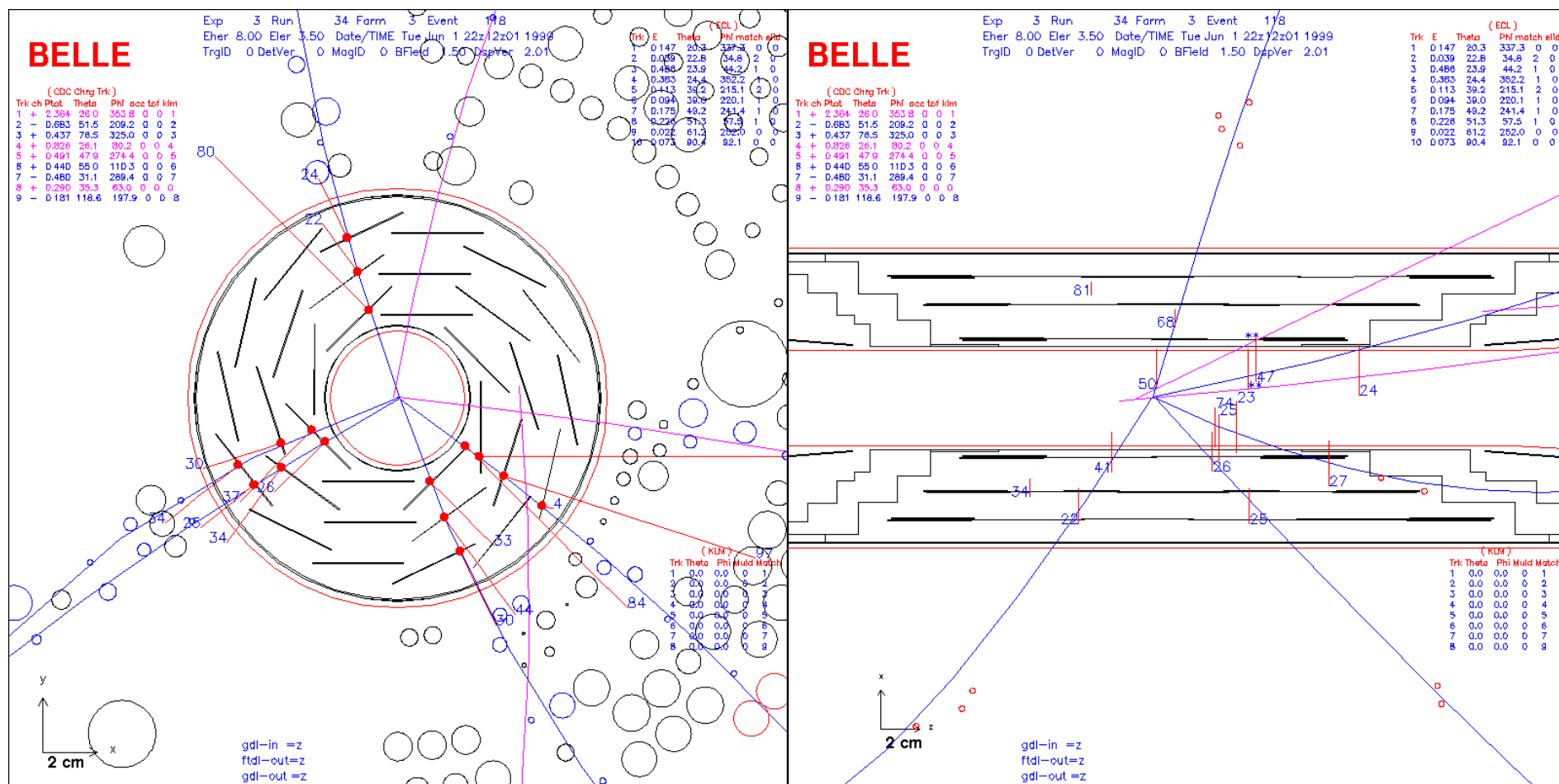
...lots of work by lots of people in lots of places...

- Dec 18, 1998 - Belle detector completed (including SVD)
- Jan 26, 1999 - First cosmic ray with full detector.
- May 1, 1999 - Belle rolled into place.
- June 1, 1999 - **First hadronic event!!!!**

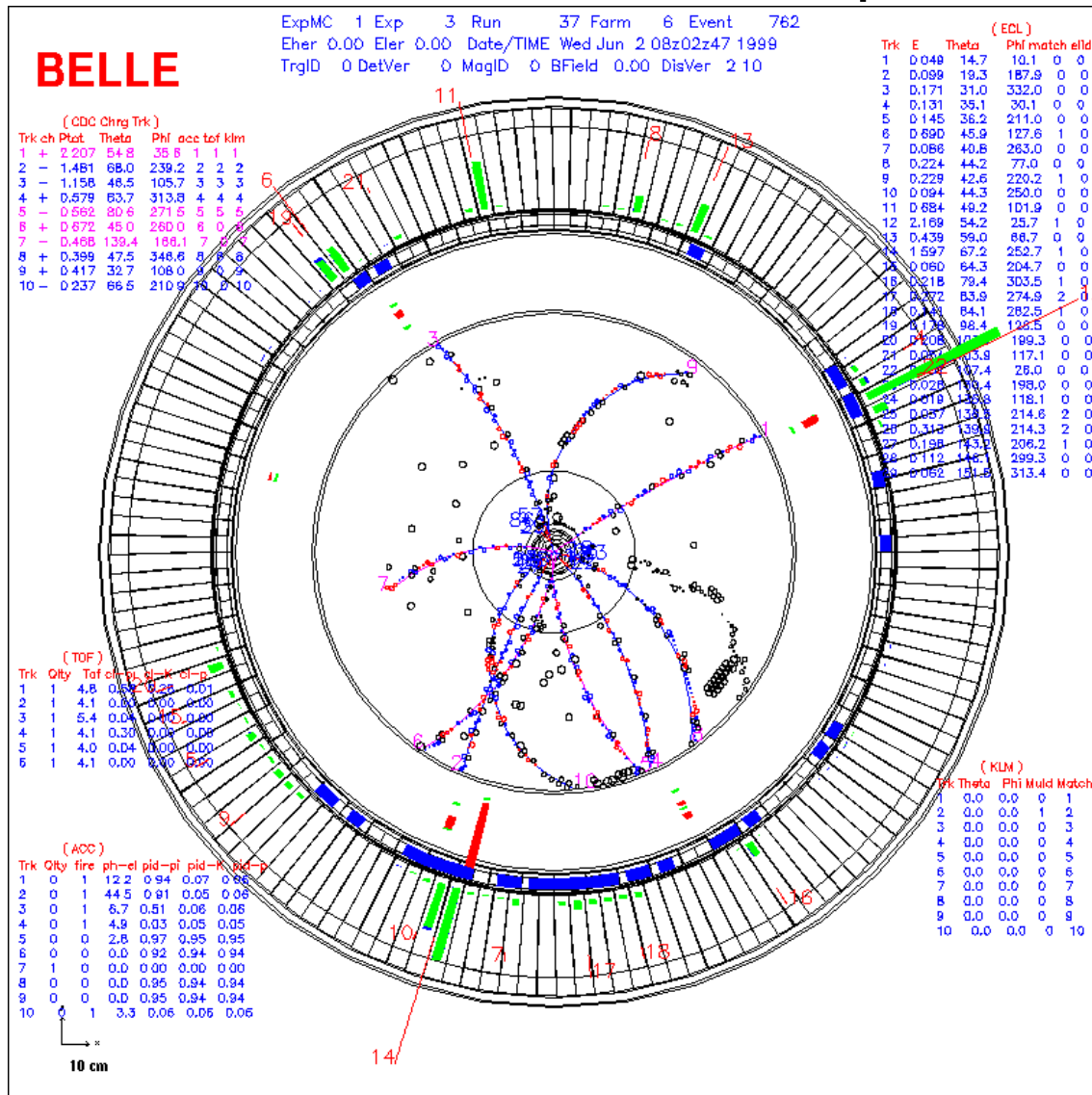
June 1, 1999: Our First Hadronic Event!!



More Fun: SVD Included



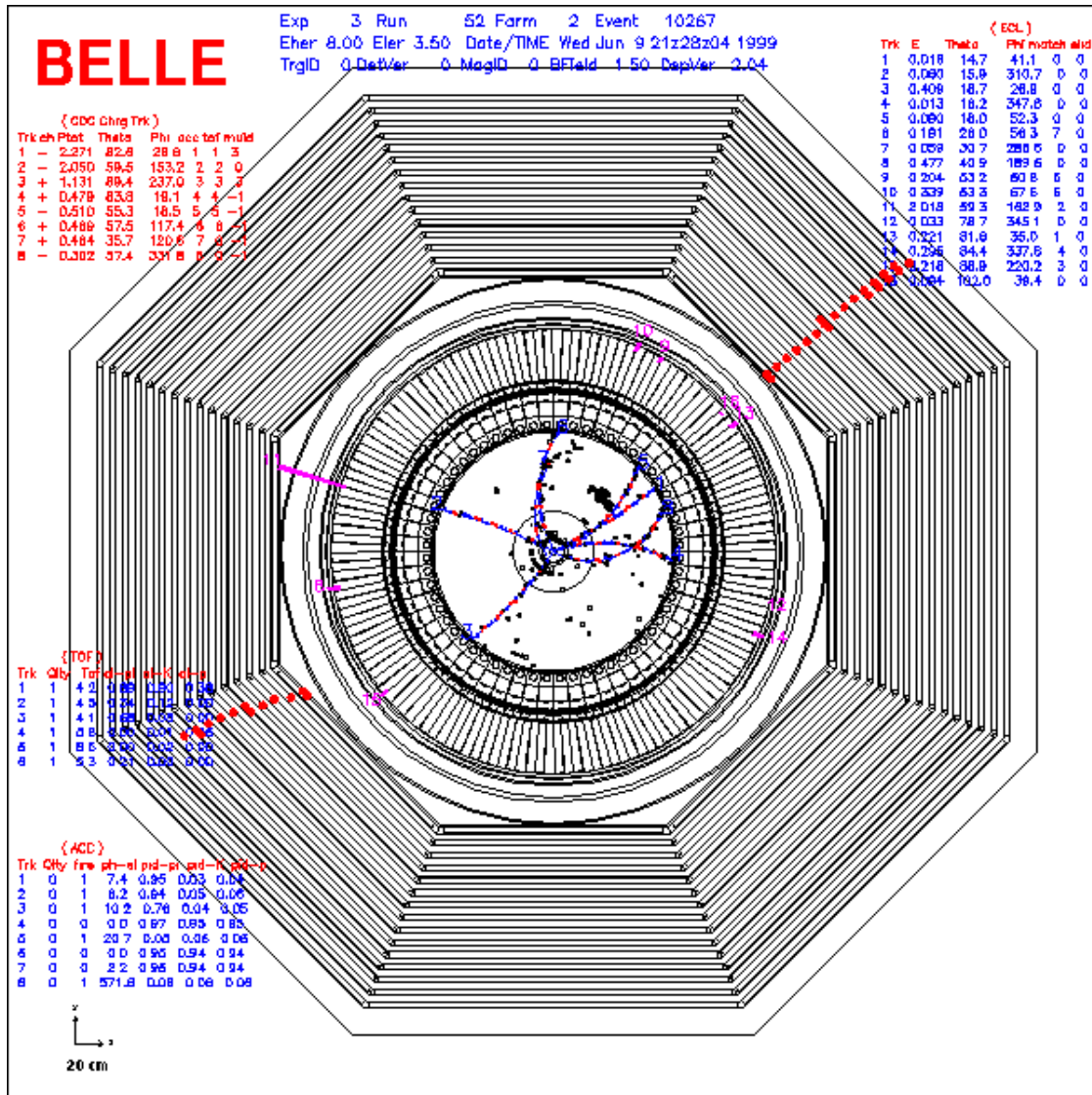
First J/ψ Candidate



• $J/\psi \rightarrow e\bar{e}$

– $M(e\bar{e}) = 3.1 \text{ GeV}$

And the Muon System....



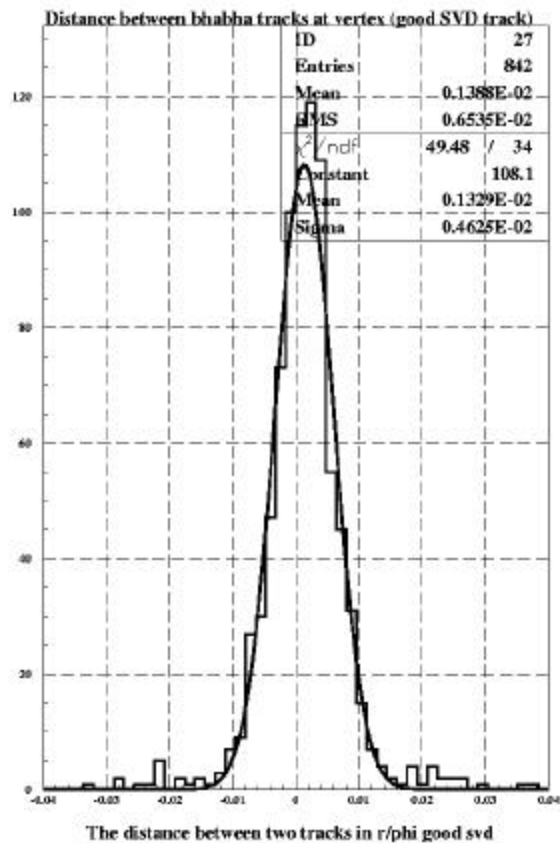
• $J/\psi \rightarrow \mu\mu$

– $M(\mu\mu) = 3.1 \text{ GeV}$

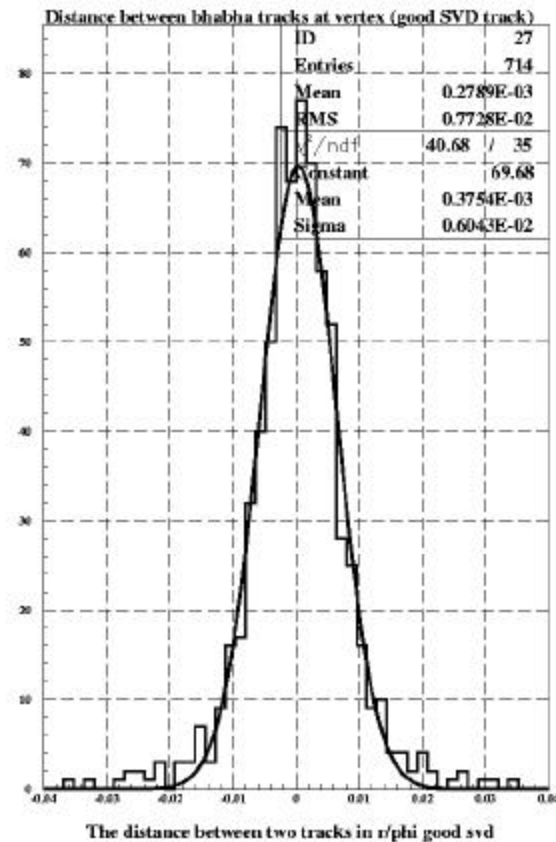
SVD Performance

SVD impact parameter resolution (rphi)

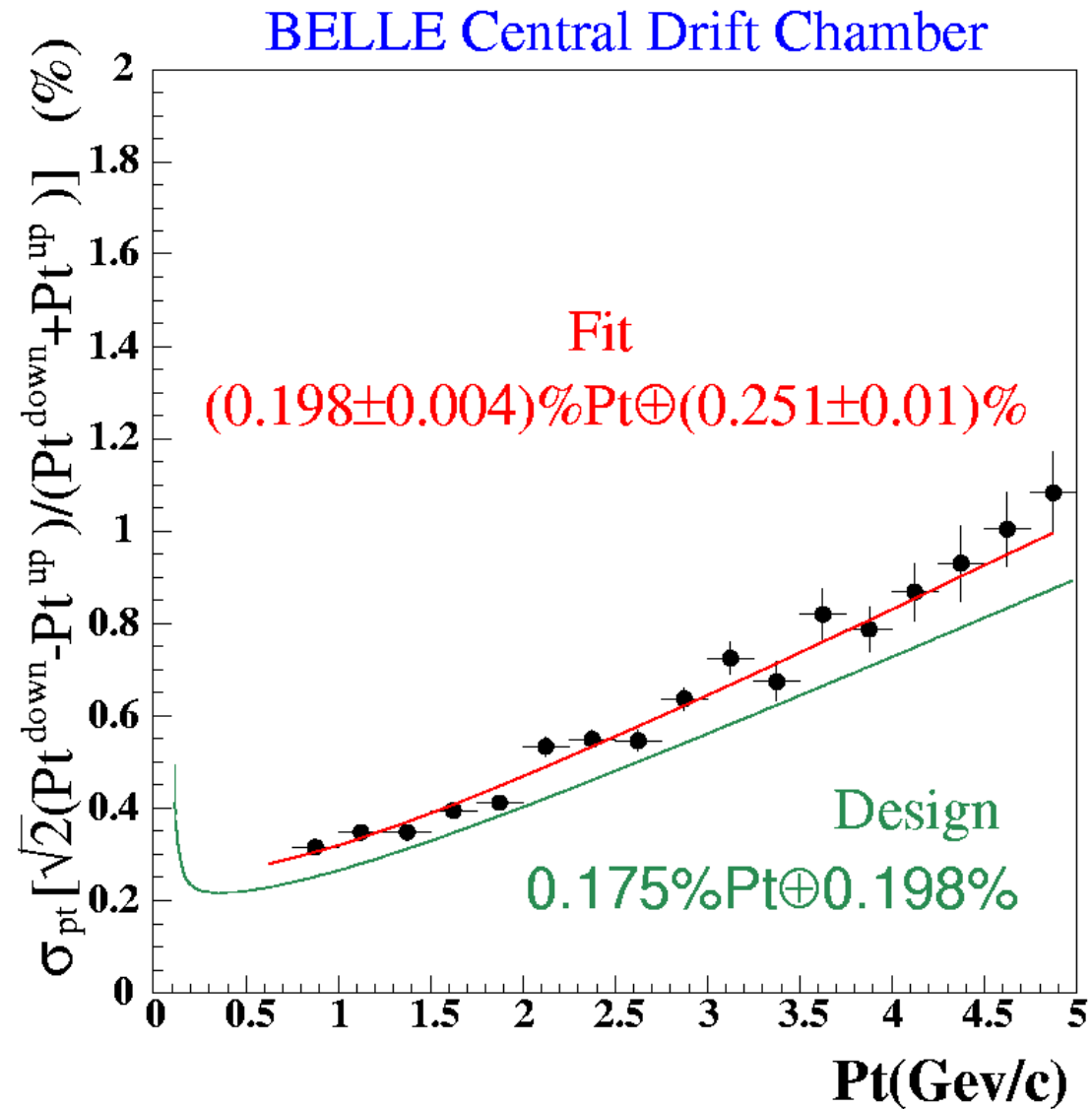
Vertical tracks



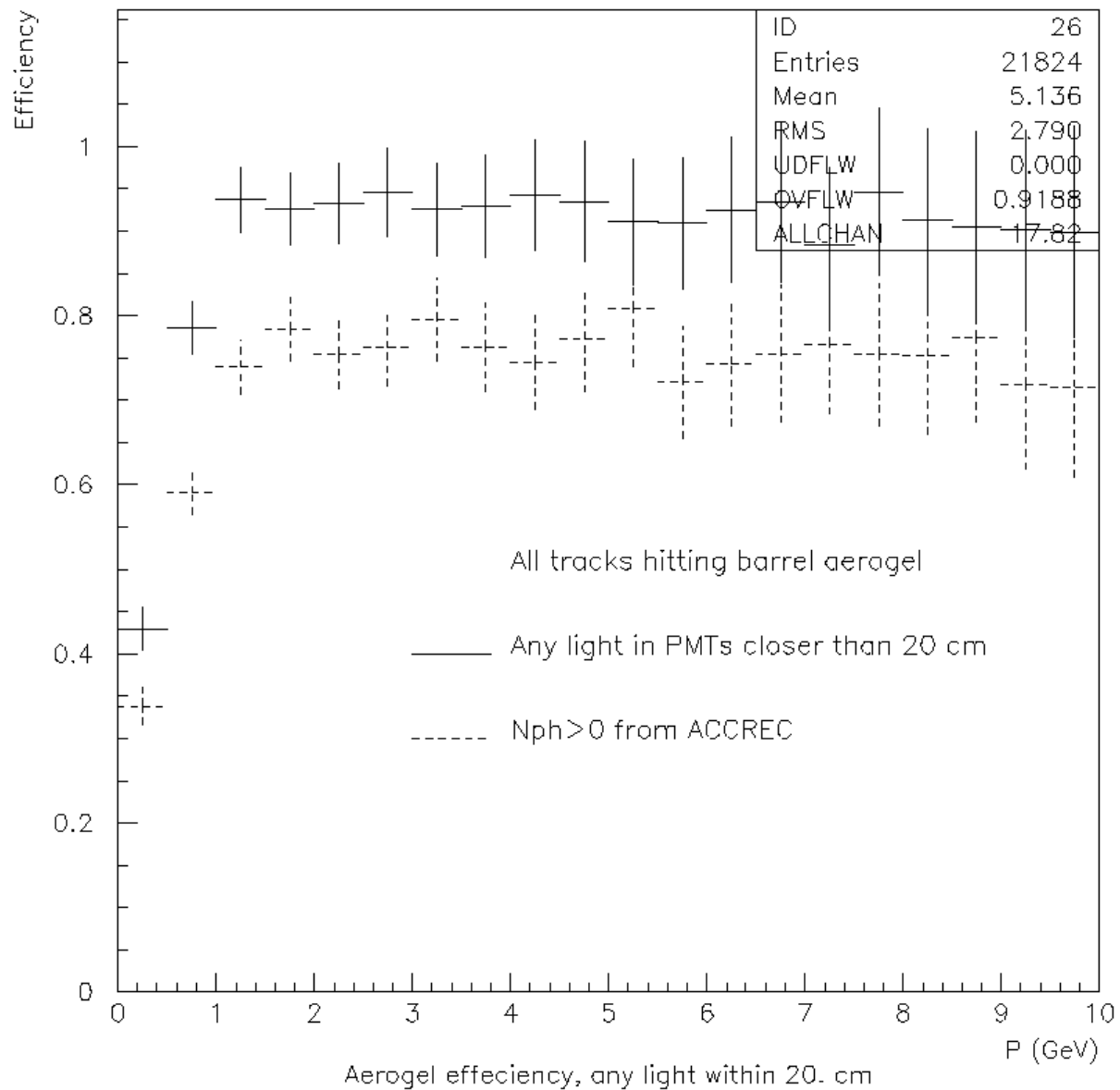
Horizontal tracks



CDC Performance (Cosmic Rays)

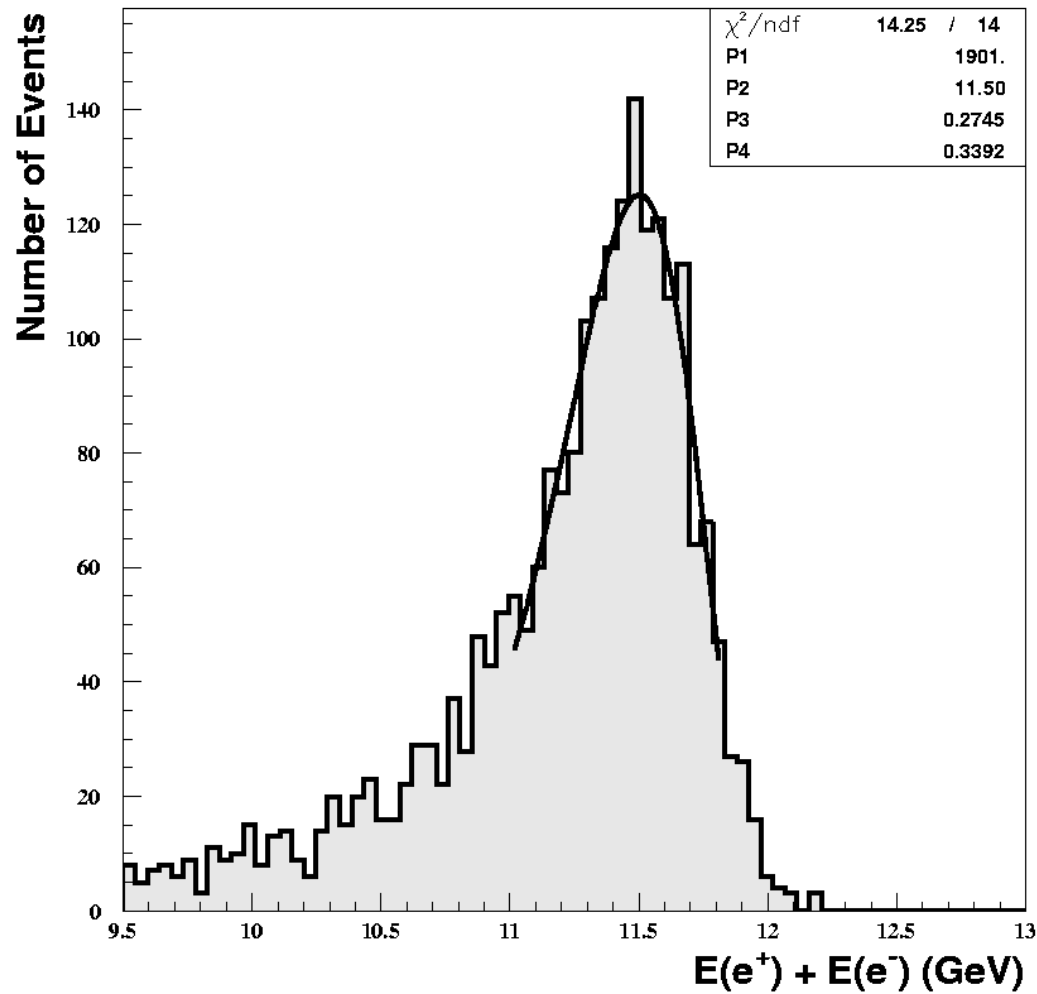


ACC Efficiency



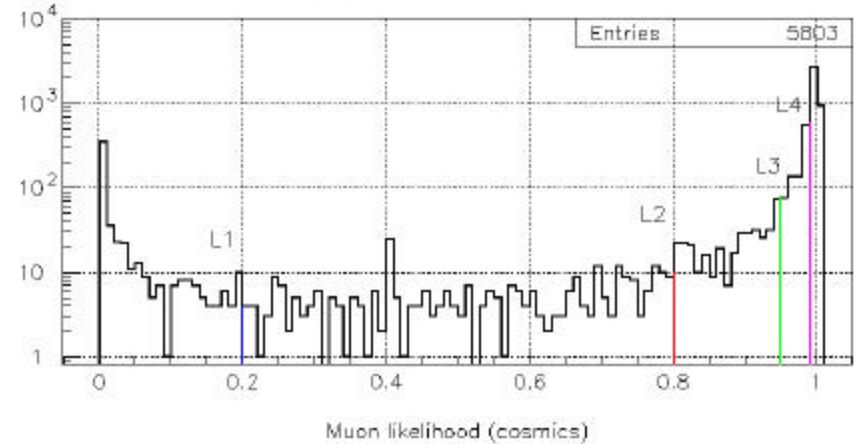
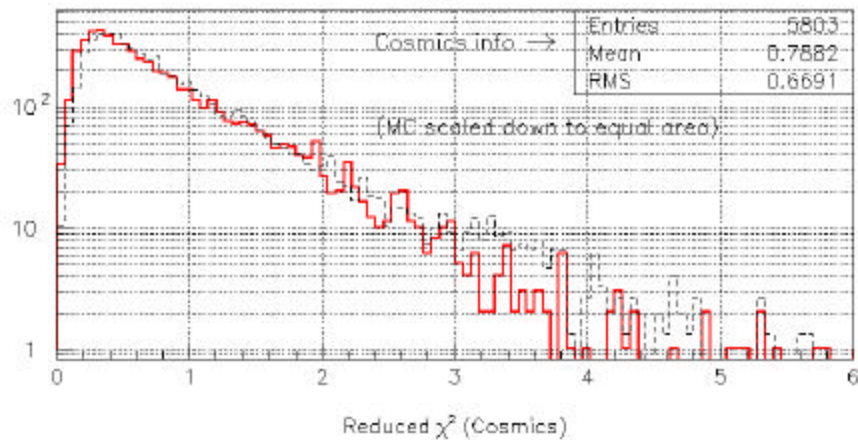
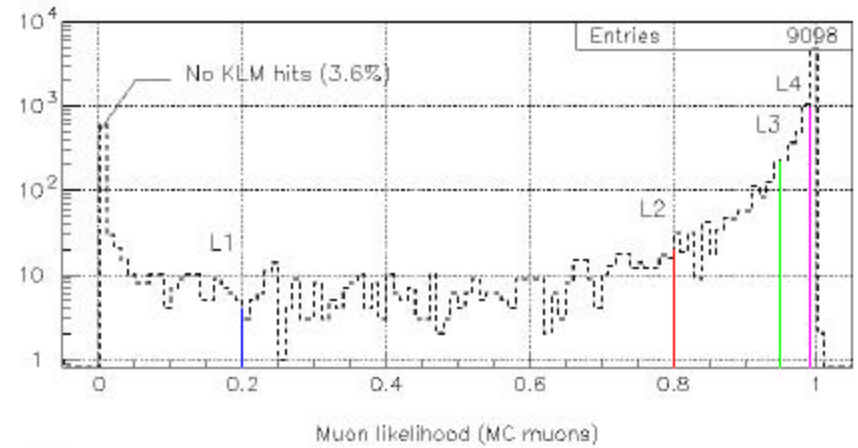
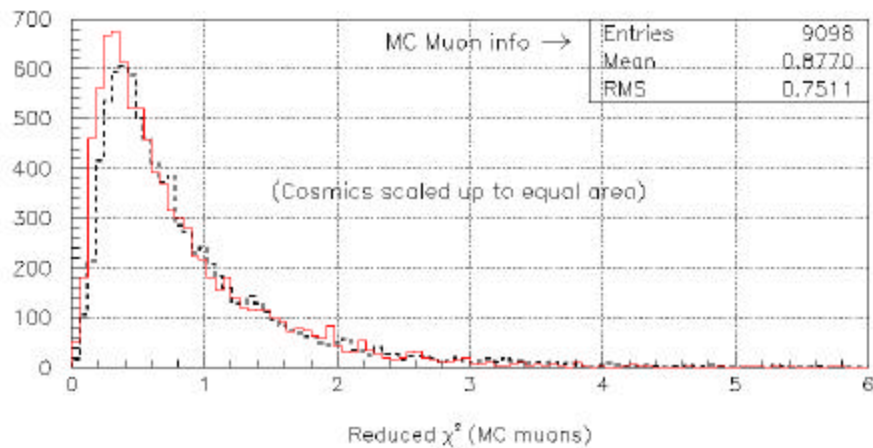
ECAL Performance

Shower Sum for Bhabha



KLM Performance

Cosmics (solid) and MC muons (dashed) (0.5–4.0 GeV/c) 99/06/15 22.47



Conclusions

- KEK-B is **working!**
- The whole Belle detector is **working!**
- The Belle reconstruction and analysis software are **working!**
- If we can just keep air out of the beam pipe, we have an exciting few years ahead.