# Belle Outlook

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# Efficiency of Data Taking

- Data taking (~70 min), Injection (~2 min for $e^-$, ~6 min for $e^+$, ~ 2min for linac mode switch)
  - Continuous LER injection scheme eliminates 8 min loss. Scheme basically works. Try from March.

- ~10% of running time is given to off-resonance run (60 MeV below).
  - 13% out of total 16% sys error for $Br(B \to \pi l \nu)$ comes from continuum statistics. But....

- Accepted luminosity/delivered luminosity ~89%
  - Run start-stop procedure ~4% (mostly HV ramp-up and down)
  - DAQ deadtime ~ 3.5% at present ~250$Hz$ trigger rate.
    ~10% at 500$Hz$ (future upgrade item)
  - HV trip and CDC current-limiter ~1.5%
  - Others ~2%

# Detector Performance and Physics Results

- Uncertainties of reconstruction efficiency $\sim 2\%$ for track and $\sim 2\%$ for $\gamma$
  - $Br(B \to X_S\gamma)$: $\pm 4.7\%$ ($\pm 5.3\%$) from tracking ($\gamma$)/ $\pm 12.4\%$ total sys error
  - CDC alignment, fine tuning of MC, calibration data samples such as $\eta \to \pi^+\pi^-\pi^0/\eta \to \gamma\gamma$, $D^0 \to K^-\pi^+/D^0 \to K^-\pi^+\pi^0$, $D^{*0} \to D^0\gamma$, $\cdots$.

- Uncertainty of vertex reconstruction
  - $\sin 2\phi 1_1$ fit: $\pm 0.04$/ $\pm 0.06$ total sys error
  - Fine tuning of tracking, vertexing, and matching.

- Slow pion efficiency:
  - $D^{*+}D^{*-}$ yield: Belle/BaBar $\sim 0.4$
  - SVD2.0 (4 layers compared with present 3) should significantly improve.

- $\pi^0$ detection efficiency
  - $J/\psi K_S(\pi^0\pi^0)$ yield: Belle/BaBar $\sim$0.67
    (Belle has more materials in front of CsI)
  - Improvement on cluster-finding (combining TOF information?)

- Uncertainly of $K/\pi$ separation
  - $y_{CP} \equiv \tau(D^0 \to K^-\pi^+)/\tau(D^0 \to K^-K^+) - 1$: $\pm$0.5%/ $\pm$0.7% total sys error
  - $Br(B \to K\pi/\pi\pi)$ and $Br(B \to D^{(*)}K/D^{(*)}\pi)$ are dominated by $\Delta E$ shapes now. But contribution from $K/\pi$ uncertainly will become significant in future.

- Hadron shower simulation
  - GEANT3(Fluka) gives $\sim$10% more pion fake rate. Reconstruction efficiency for $J/\psi K_L$ is $\sim \times 2$ larger in MC.
  - No real harm. Just nuisance, especially, as we use KLM for "neutrino reconstruction".
  - GEANT4(Fluka) better(?). No plan to change.

# SVD2.0

## (Only major hardware upgrade in immediate future)

- Installation in summer 2002 or summer 2003.
  Decision will come very soon. (present SVD should be OK until spring 2003)
- Beampipe radius: from 20mm to 15mm
- Sensors: from 3 layers to 4 layers (local tracking becomes possible)
- SVD-CDC boundary: from 80mm to 100mm
- CDC: from 3 cathode-strip layers to 2 small-cell layers
- Impact parameter $\sigma(z)$: from 36$\mu$ to 24$\mu$
- Radiation hardness of electronics: good up to 5 Mrad
  Should be OK up to 1700$fb^{-1}$ if our experience, $dose \propto$ 3.1 $krad/fb^{-1}$, persists.

# Detector Upgrade for $\times 10$ beam current

- Vertexing
  - Occupancy for inner layers will become untorelable. We will learn a lot more from SVD2.0
  - Very important to go for better resolution and try to use vertexing for reducing continuum background.
  - Possible configuration

    1 cm beampipe + 2 layers of rad-hard pixel + 3 layers of strip

- Central tracking
  - Our experience shows the drift chamber works above $r = 150$mm even at $\sim \times 10$ beam current.
  - Must shorten readout time:

    smaller cells, faster drift-velocity gas (pure methane is a candidate), flash ADC instead of Q-to-T.

- Particle Identification
  - Present system (dE/dx + aerogel + TOF) should work, except TOF dead-time will reach $\sim$3%.
  - We should improve $K/\pi$ separation performance and reduce material in front of CsI.
  - R&D continues for a new system consisting:

    Time of Propagation RICH counter (TOP counter) for barrel + proximity focusing aerogel RICH for endcap.
- Electromagnetic Calorimetry
  - Keep existing CsI(Tl) crystals and front-end electronics (cost consideration).
  - Try to cope with pileup noise and fake clusters by improving back-end electronics ( pipeline readout and wave form recording)
  - After above improvements, extrapolation from present measurements gives:

    Degradation of energy resolution is $\times$2 in barrel,
    $N_\gamma$/event ($E_\gamma >$ 72MeV) increases by $\sim \times$5-100,
  - Integrated radiation dose of 1krad reduces light output by 5 $\sim$ 10% at 3000$fb^{-1}$.
  - These degradations are tolerable.

- KLM
  - No problem for barrel. Endcap needs shielding against beam background.
- Data Acquisition System
  - 6 k$Hz$ trigger rate, 100 kbyte/event data size.
  - Must go to pipeline readout.