The BTEV ECAL Requirements for High Quality Reconstruction of Neutral Particles

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Presented at FrontierScience-2002, Frascati, Italy, October 6-11, 2002

Important B decay modes

$B^0 \to ((\rho\pi)^0) \to \pi^+\pi^-\pi^0$, ${B_s}^0 \to \psi\eta$ and $\psi\eta'$, $B^0 \to K^*\gamma$ and $\rho^0\gamma$

ECAL Requirements

- **excellent energy resolution**
- **excellent position resolution**
- **compact shower size**
- **fast signal**
- **radiation hardness**
- **refined reconstruction tools**

Technology

- **Lead Tungstate ($PbWO_4$)**
- **Photomultiplier Tubes**

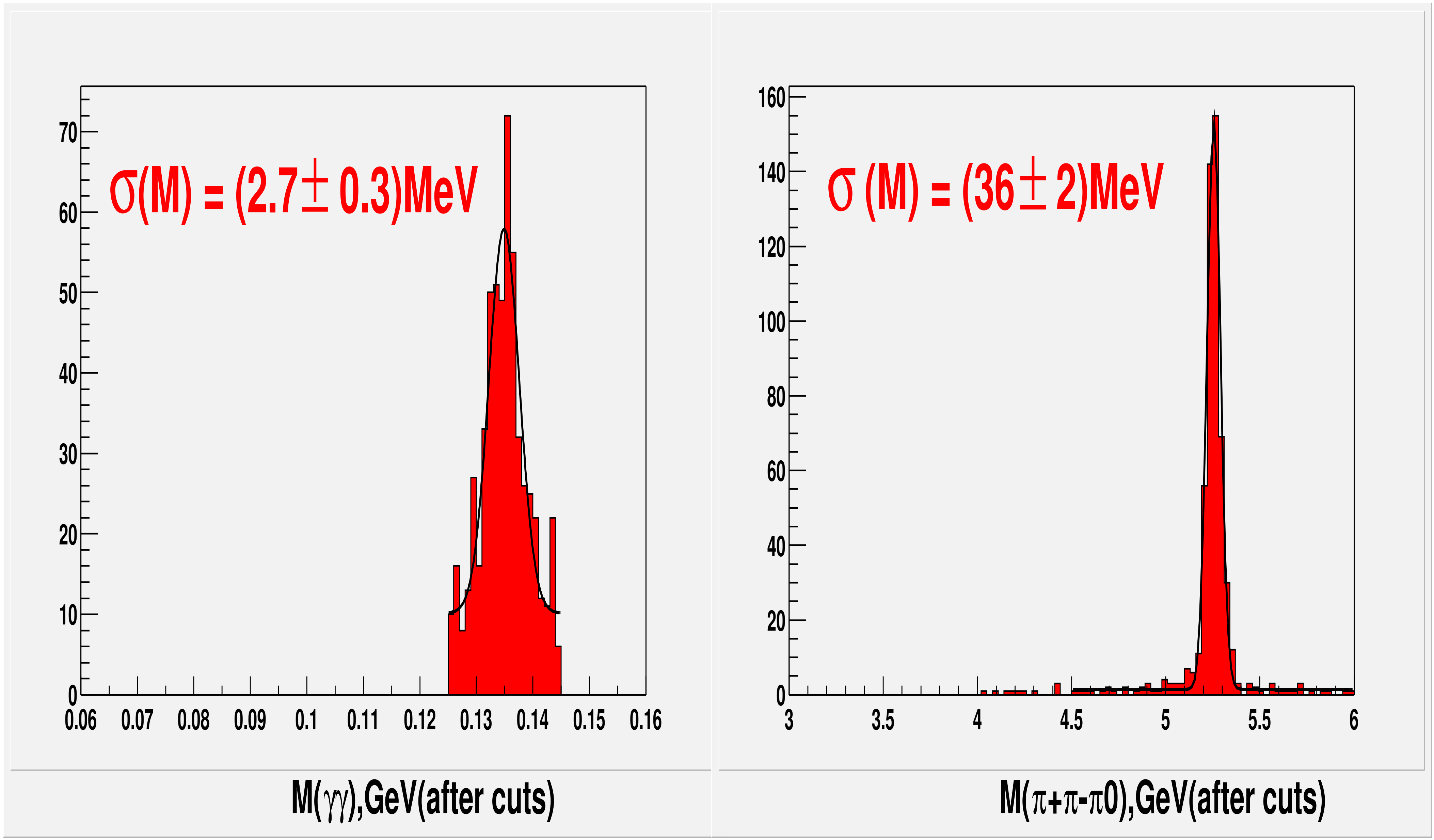
Expected Resolution

- $\sigma(E)/E = \mathbf{1.7\%}\ /\sqrt{E} \oplus \mathbf{0.55\%}$
- $\sigma(x) = \mathbf{3500}\mu m/\sqrt{E} \oplus \mathbf{200}\mu m$

ECAL Geometry

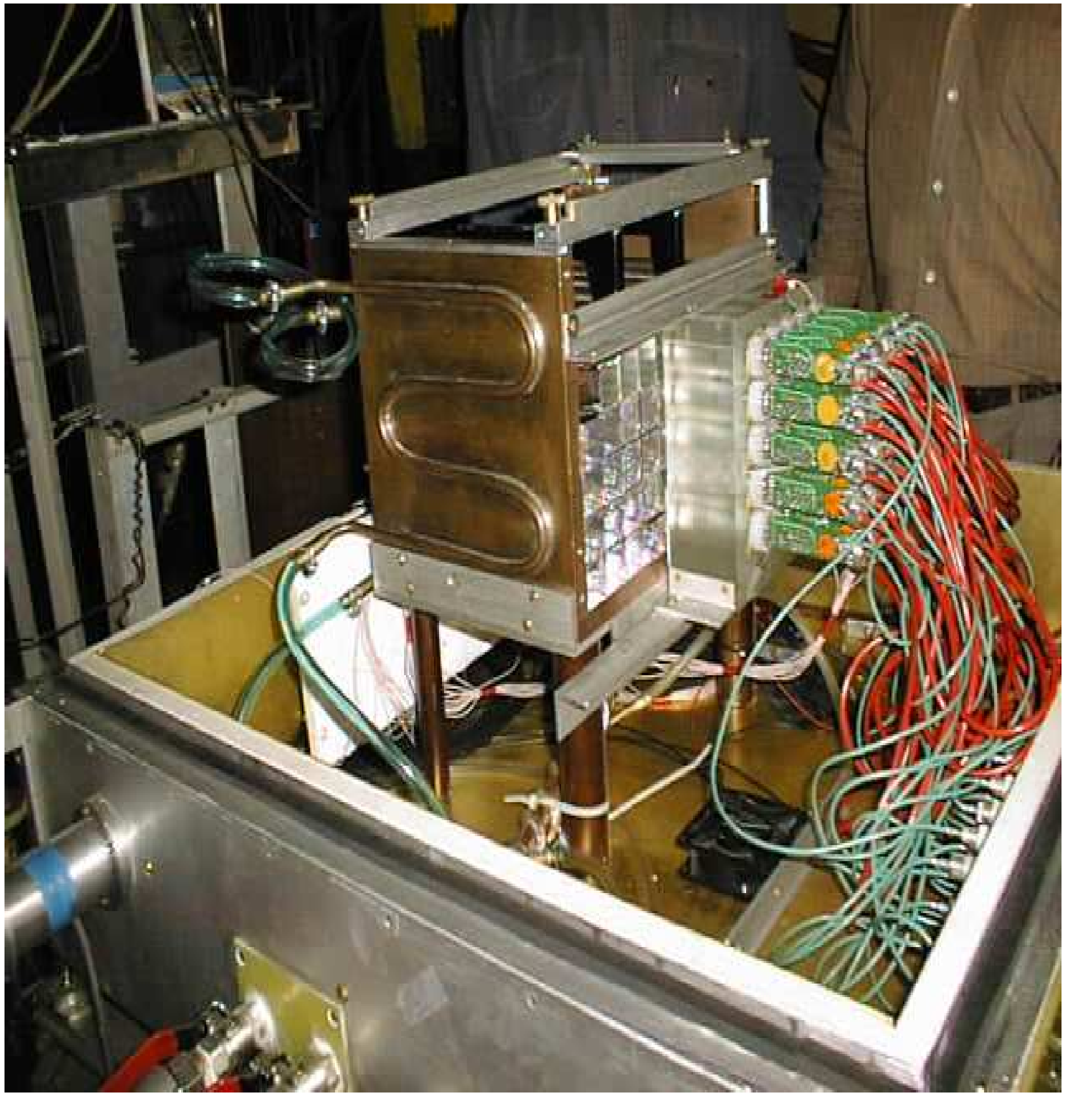
- **tapered crystals pointing at the interaction region**
- **coverage 10÷160cm from beam-line (~210$mrad$)**
- **smaller than 300$mrad$ acceptance for tracking system**
- **~20% signal loss for most final states**
- **γ reconstruction efficiency ~15÷80% (depends on radius)**
- **π^0 reconstruction efficiency ~8÷30% (depends on radius)**

$B^0 \to (\rho\pi)^0$, Geant3 MC + BTeV Reconstruction Tools



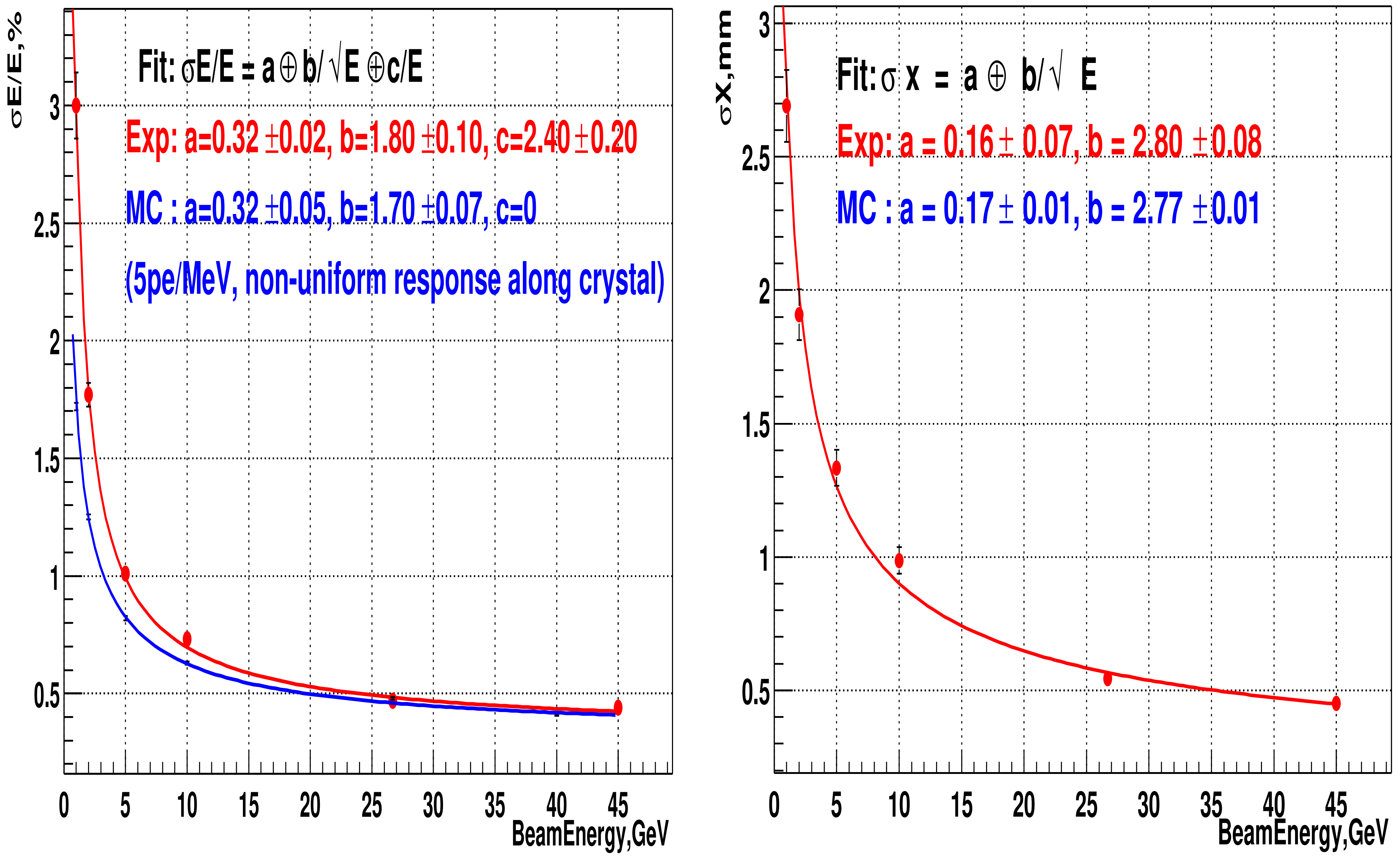
BTeV/ECAL Test Beam Program at IHEP(Russia)

- runs April-01, November/December-01, April-02;
- run December-02 in preparation

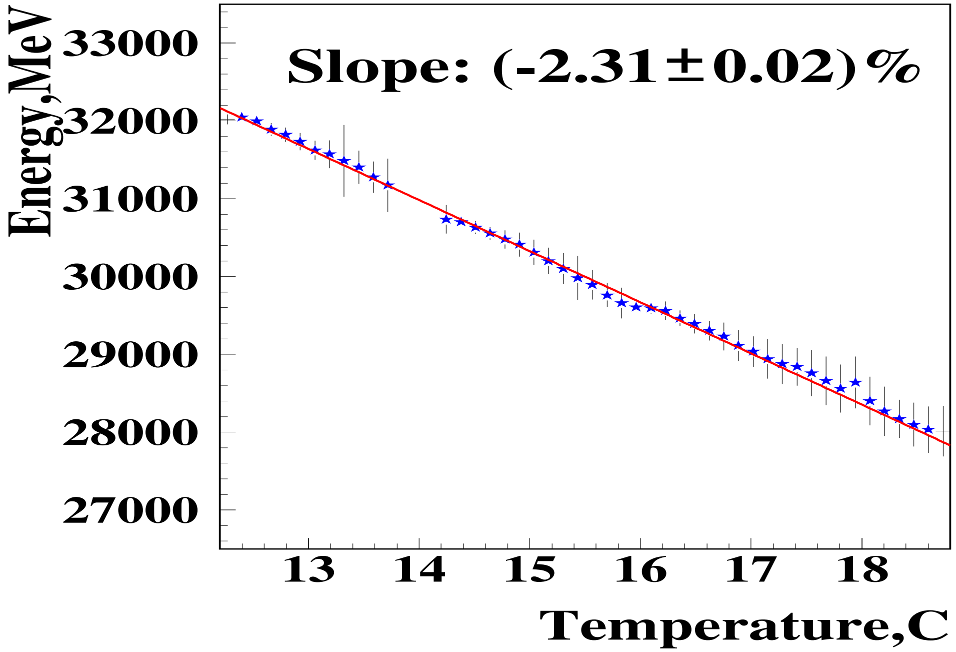


- dedicated 2B channel at U70
- 5x5 array of $PbWO_4$ crystals
- each crystal 27x27x220mm^2
  (BTeV will use tapered crystals)
- tyvek wrapping
  (to enhance light output)
- PMTs 10-stage Hamamatsu
  (BTeV will use 6-stage PMTs)
- beam with momentum tagging
- trigger (scint.counters)
- thermal insulation
  (+ temperature control)
- monitoring system (blue, green, yellow, and red LED)
- α- and PIN-monitoring of LEDs
- dedicated irradiation facility

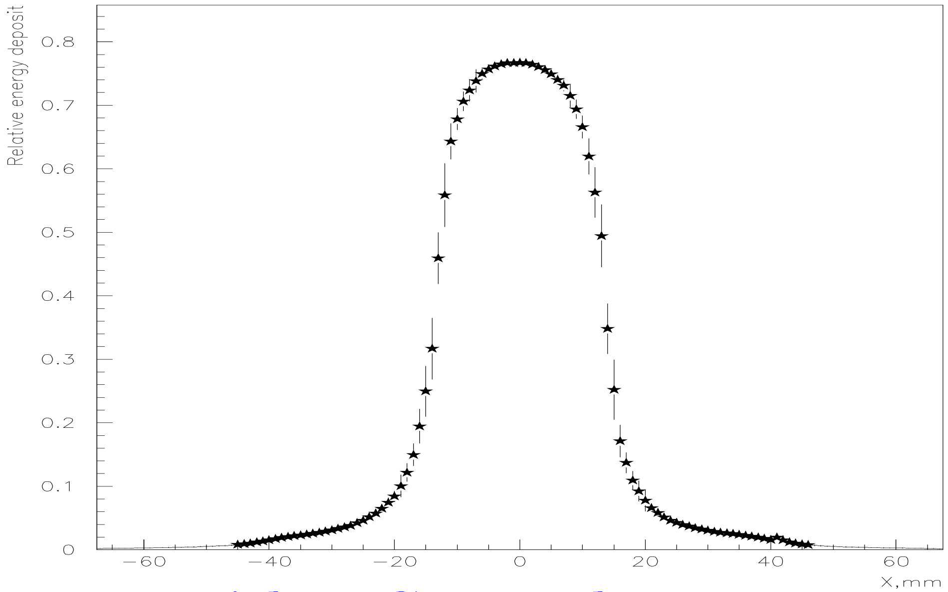
Energy and Position Resolution



LY vs Temperature

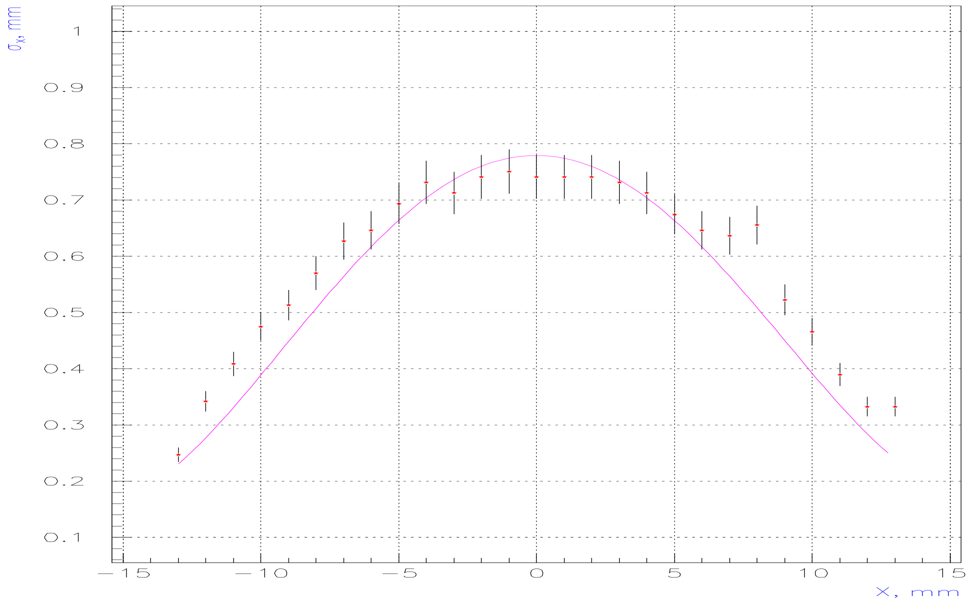


EM Shower Lateral Profile

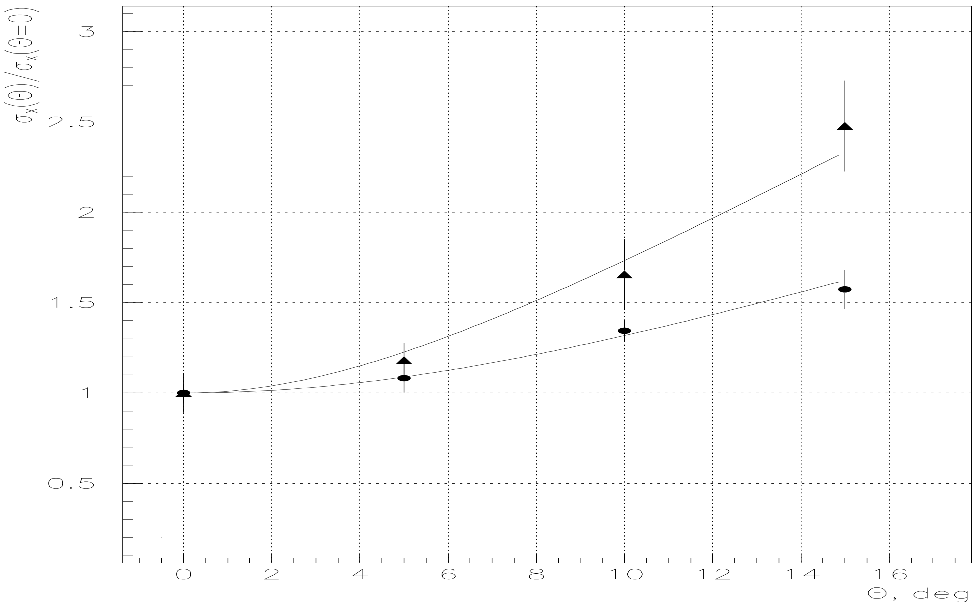


scan with 45GeV e^- beam, 1mm step

Position Resolution vs X

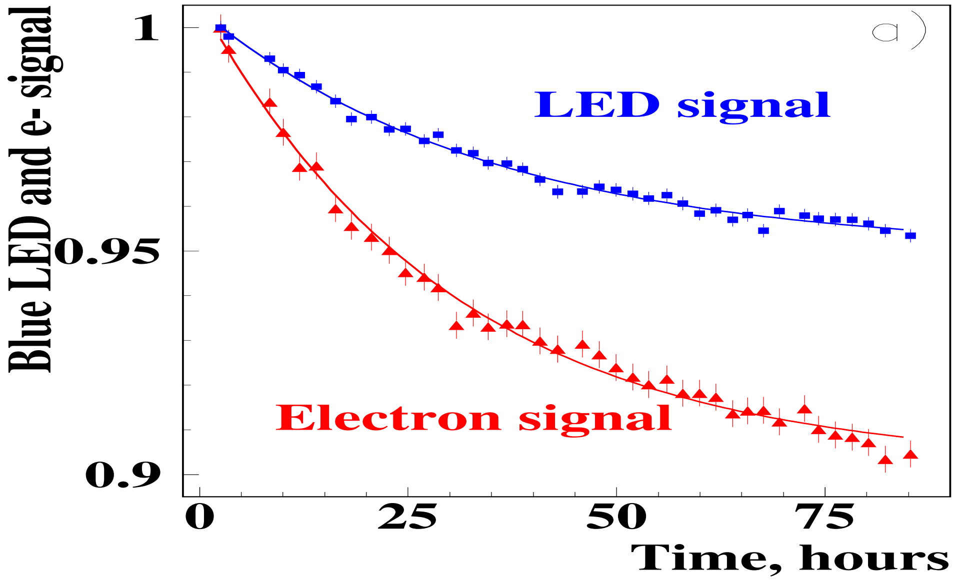


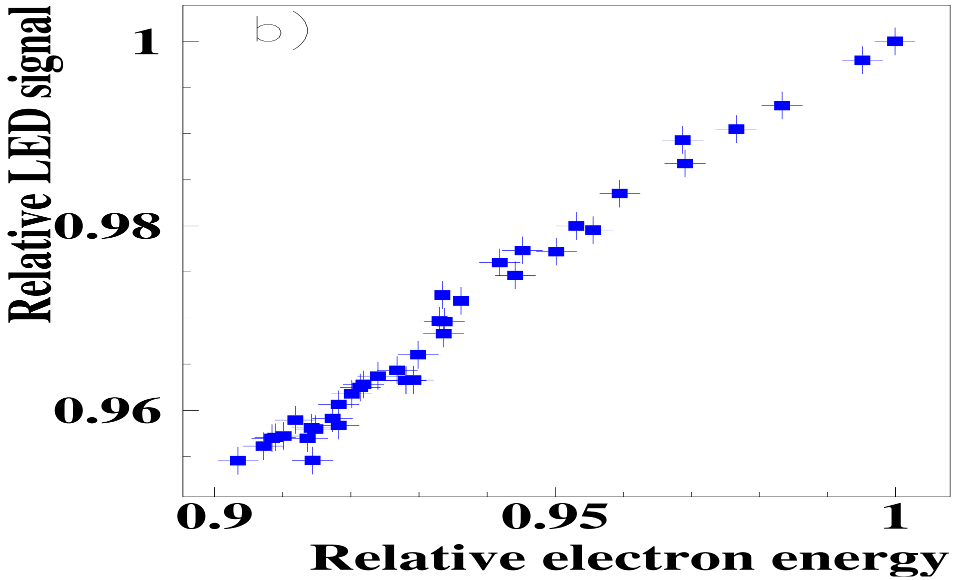
Position Resolution vs α



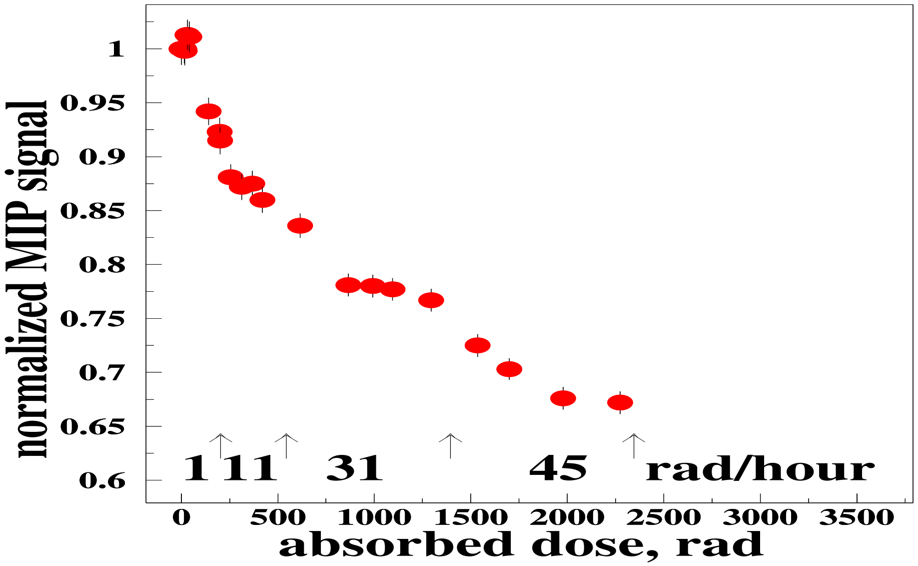
Irradiation with Beam - Moderate Dose Rate

26.7GeV e^-, dose rate $8 \div 25$rad/hr

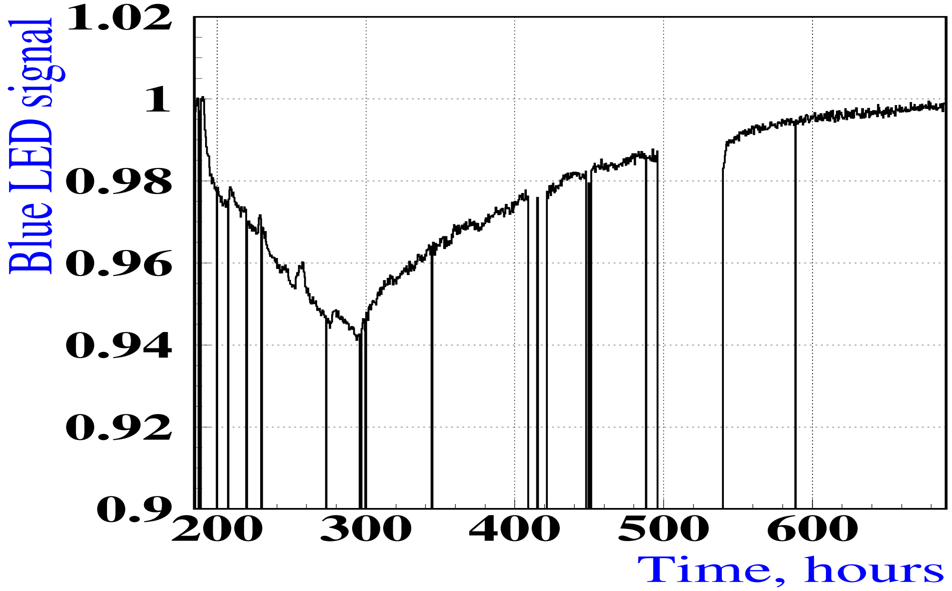




40GeV π^-, dose rate $1 \div 60$rad/hr

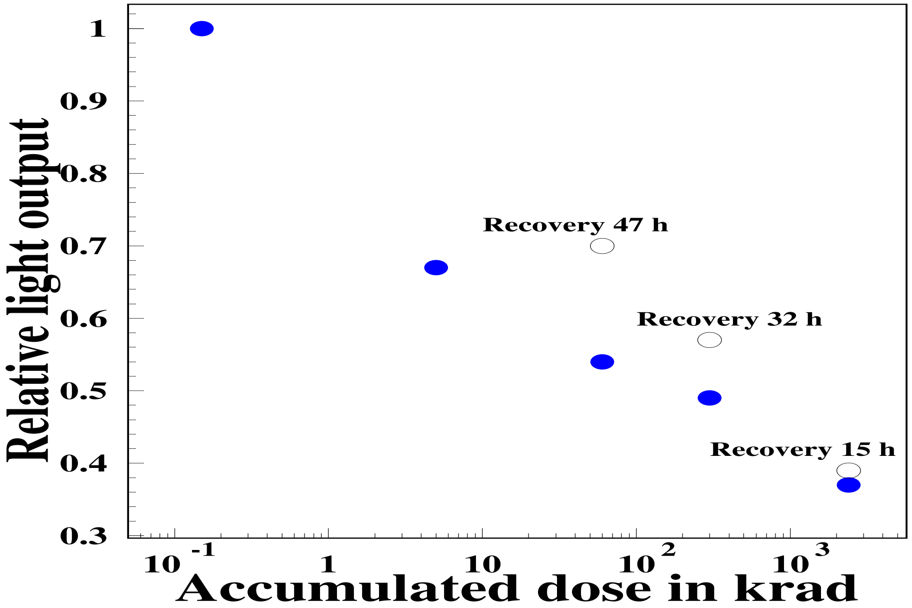


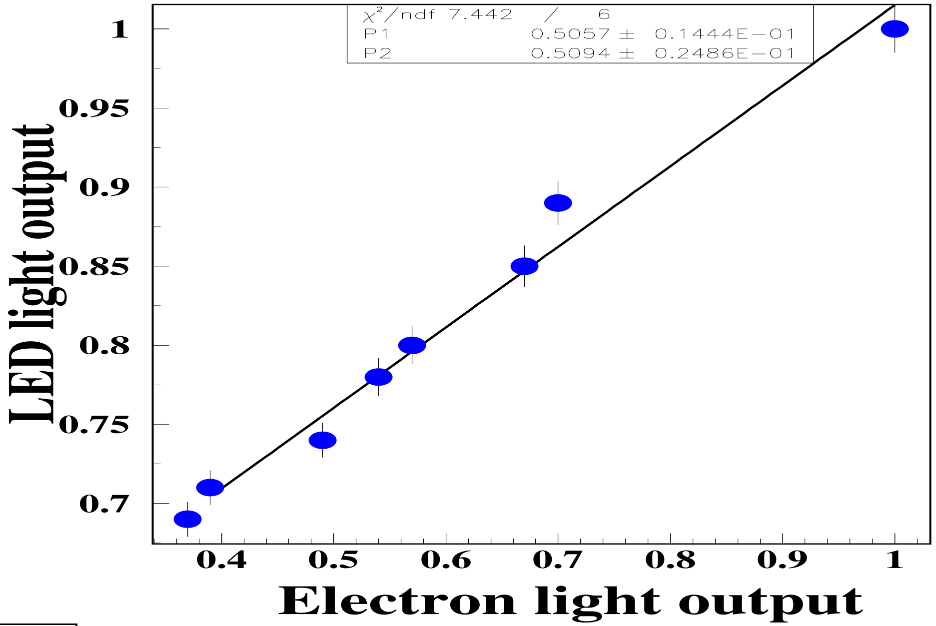
Crystals Recovery



Super-Intensive Irradiation

- dose rates 0.5÷100krad/hr
- accumulated doses 0.35÷3100krad
- particles spectra similar to those expected in BTEV





Summary

- BTeV ECAL requirements met :
  - measured resolutions agree with expectations
  - stochastic term (1.8±0.1)% measured in energy resolution is so far best result for $PbWO_4$
- BTeV can live with effect of irradiation of $PbWO4$ (continuous calibration needed)
- BTeV ECAL is capable of CLEO/BaBar/Belle-like performance; unprecedented in hadron machine