

**Spent particles beam
background simulation
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KEK**

- **Simulation description**
- **Results for Belle**
- **Comparison to Beast**
- **Plans**

Generation Process :

Sample the particle from a beam profile at beginning of swim.

Special
Program

Input parameters : Emittance ϵ
 α, β, η

Swim the particle through magnetic elements until a point where it scatters.

DECAY
TURTLE

Then at that point reset the four-momentum and resume swimming.

Input parameters : Cross-sections of Physics process

When the particle reaches the BELLE Detector (Far end of QCS), input the four momenta into Geant.

Geant simulates the showers.

BELLE
GEANT

User gets the hit info and makes his/her calculations for radiation damage/trigger rate.

Calculation of Physics Process :

Inputs : Type of Residual Gas : CO

Temperature : 298 K

Gas pressure : 1 nano-torr, *input vacuum profile*

Swim Length : ~~48.7~~ m Electron Ring

~~19.4~~ m Positron Ring

150



$$\frac{d\sigma}{d\theta} = \int_{\theta=0.001}^{\theta=\pi} \frac{\text{Constant}}{\theta^3}$$

θ = minimum angle of scattering

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150

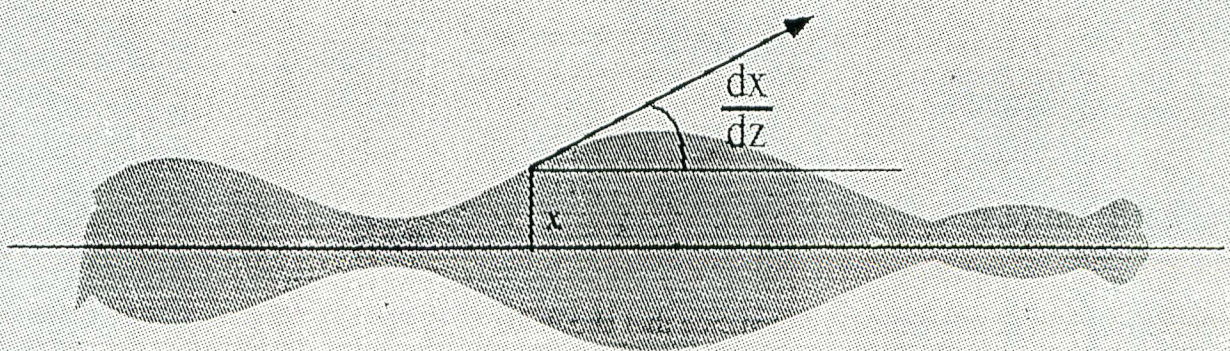
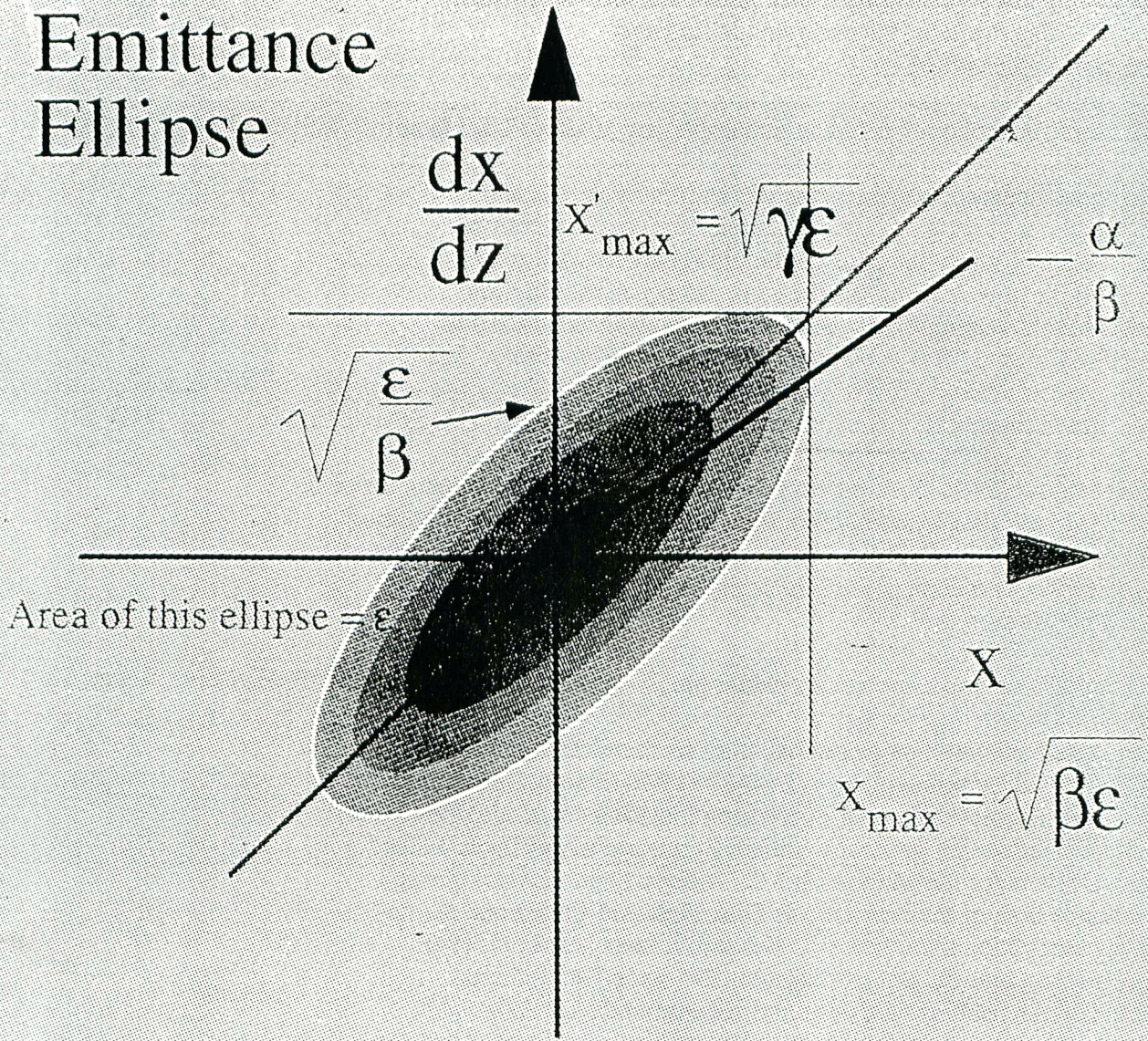


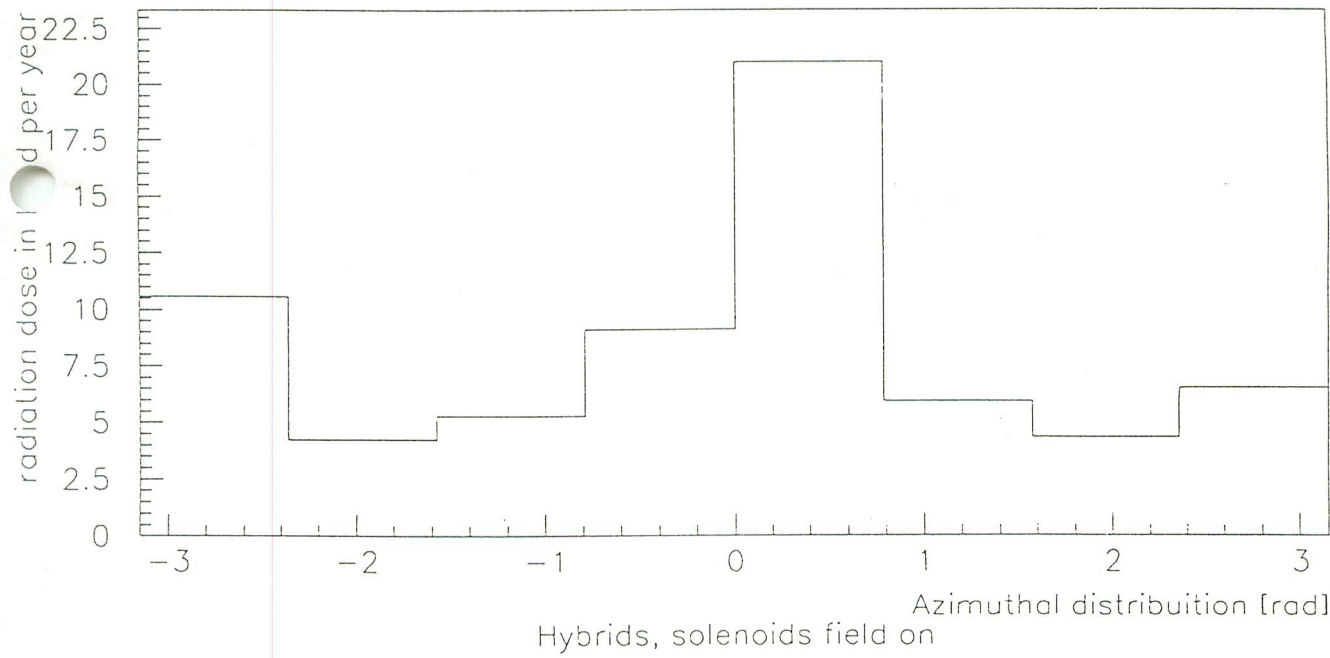
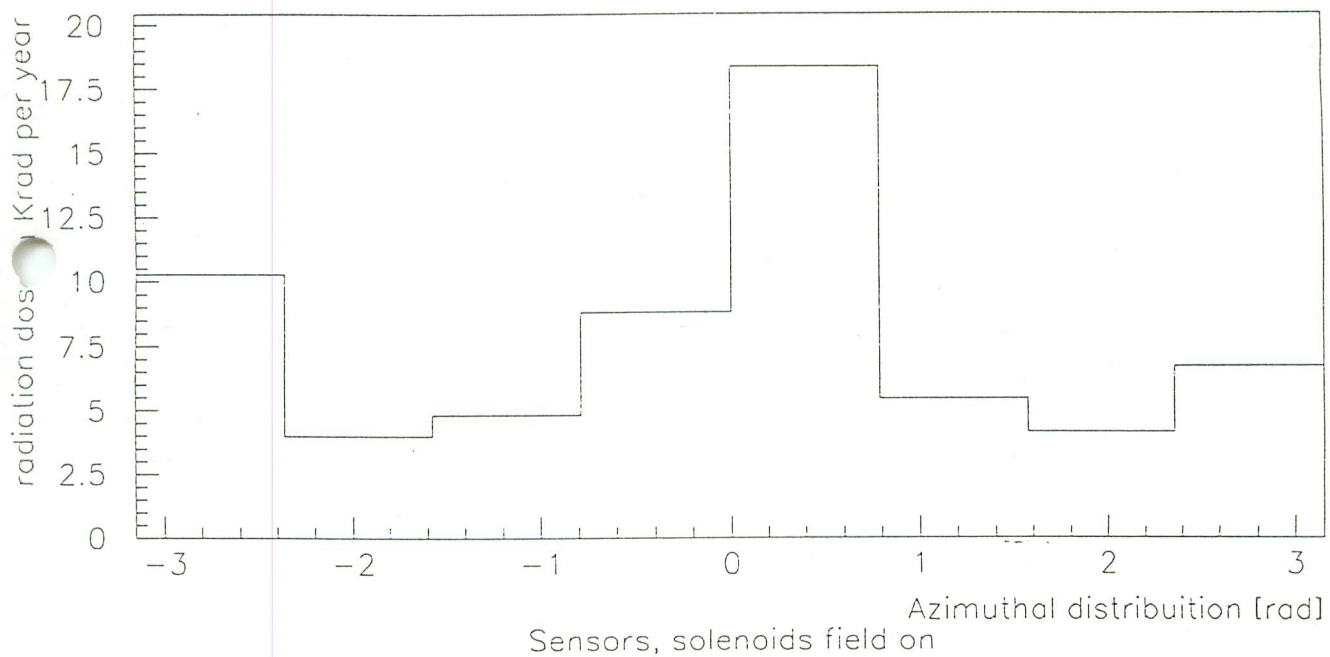
$$\frac{d\sigma}{d\omega} = \int_{\omega=0.05^* \text{ BeamEnergy}}^{\omega=\text{BeamEnergy}} \frac{\text{Constant}}{\omega}$$

$$\omega = \frac{\text{Photon energy}}{\text{Beam Energy}}$$

Beam Sampling :

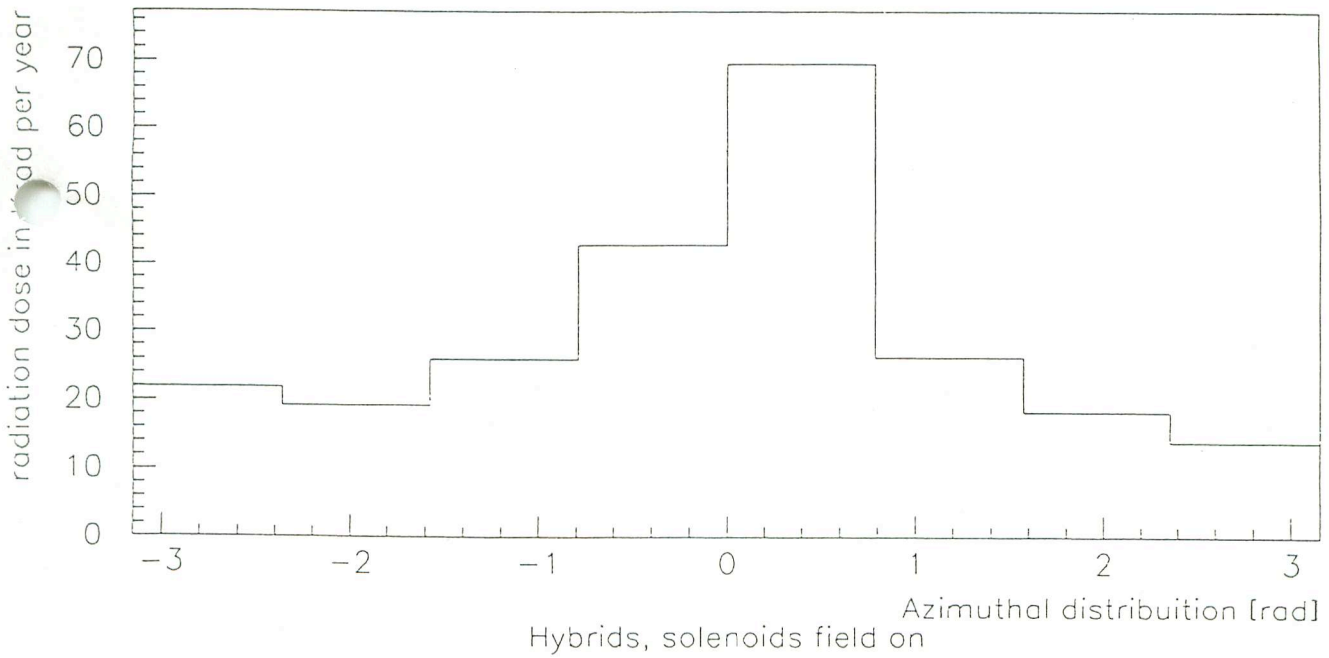
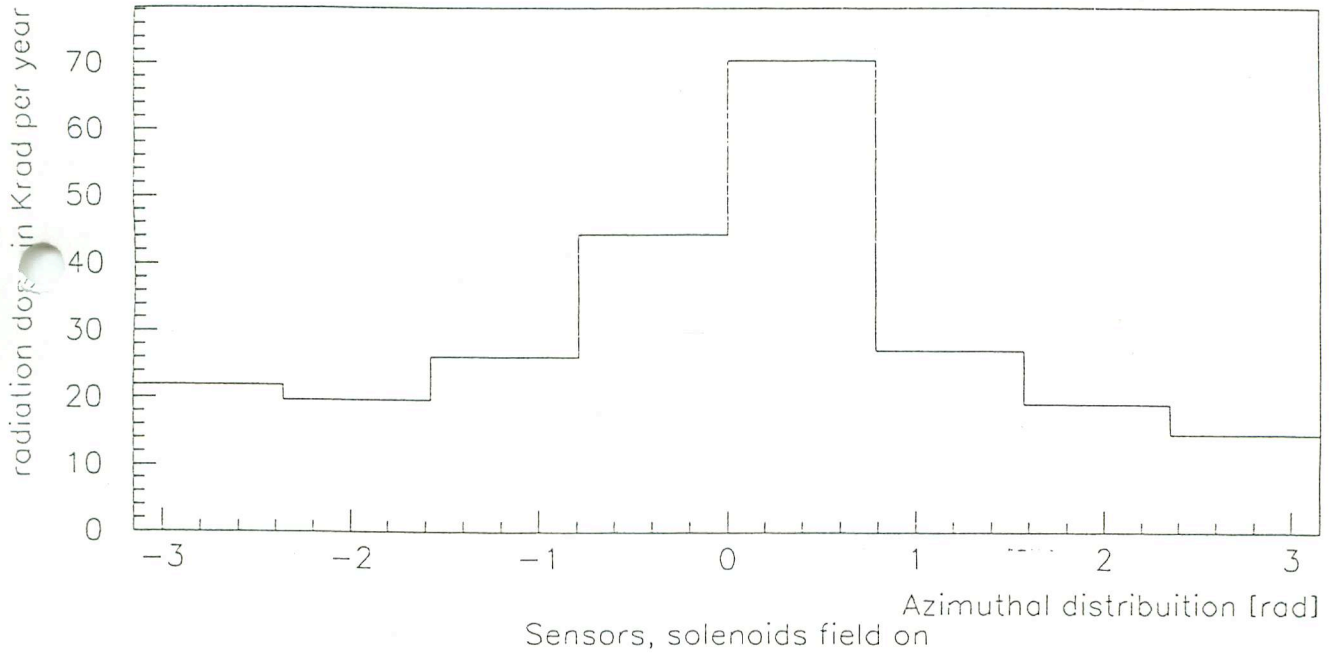
Emittance
Ellipse





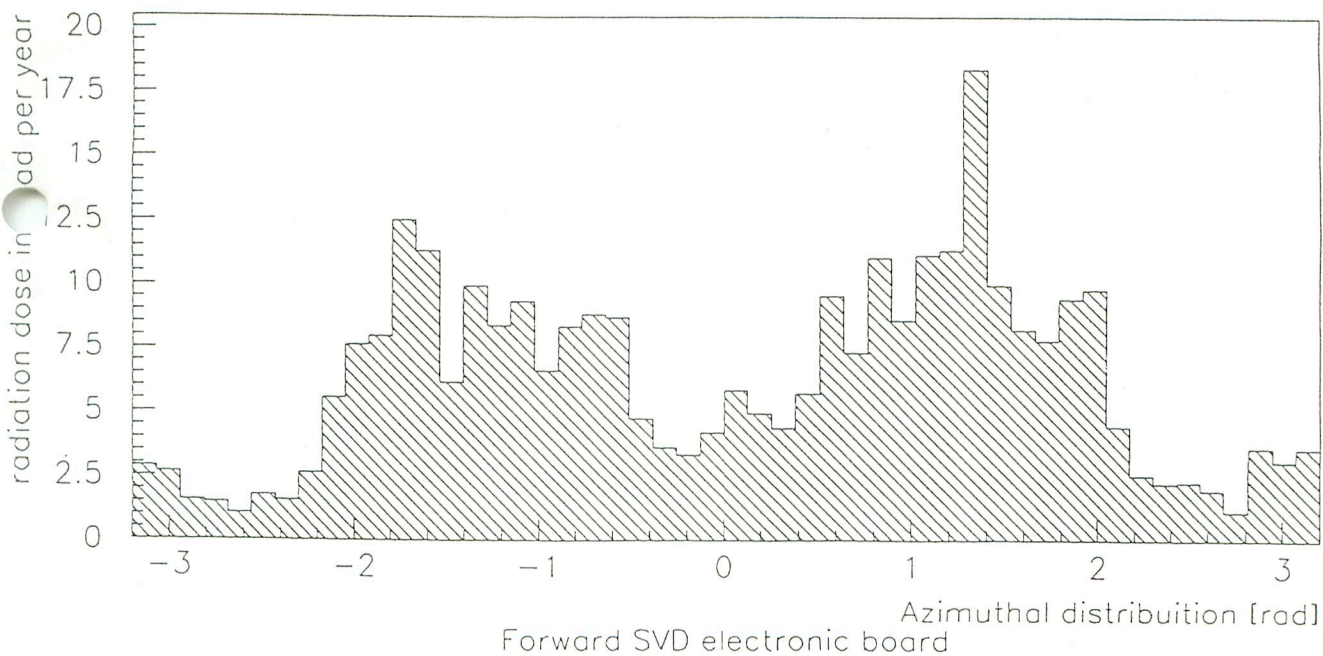
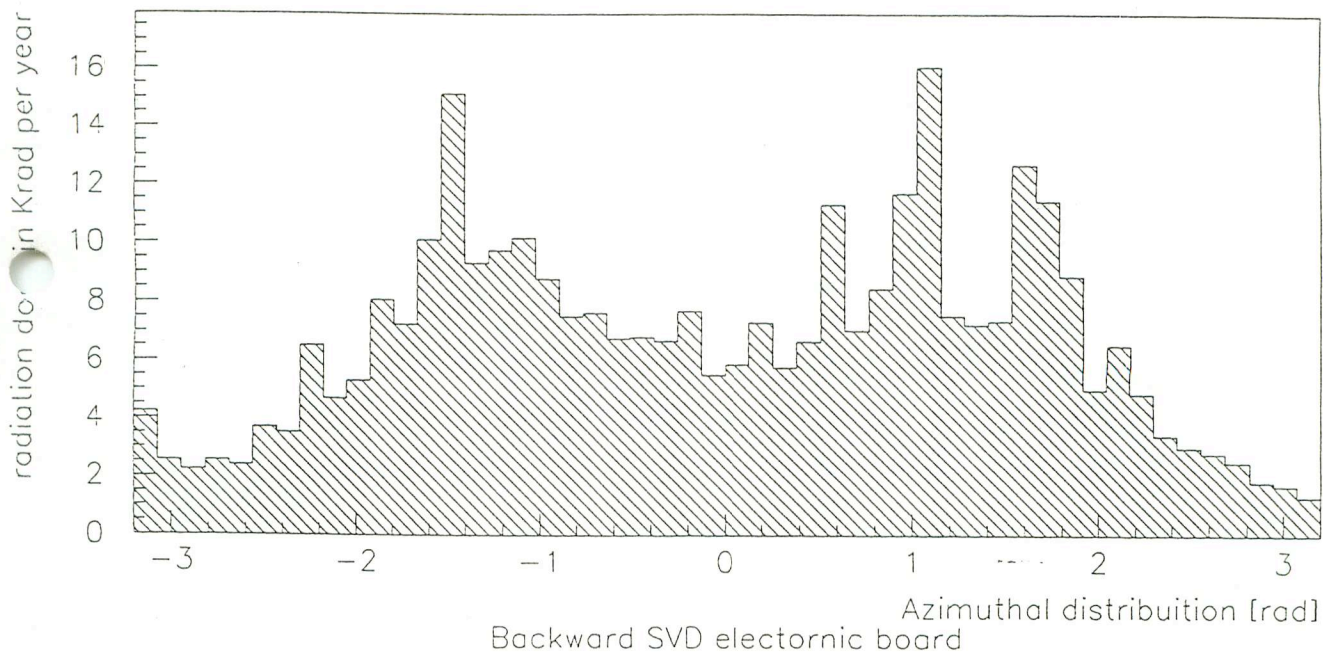
No Masks

98/12/06 15.11

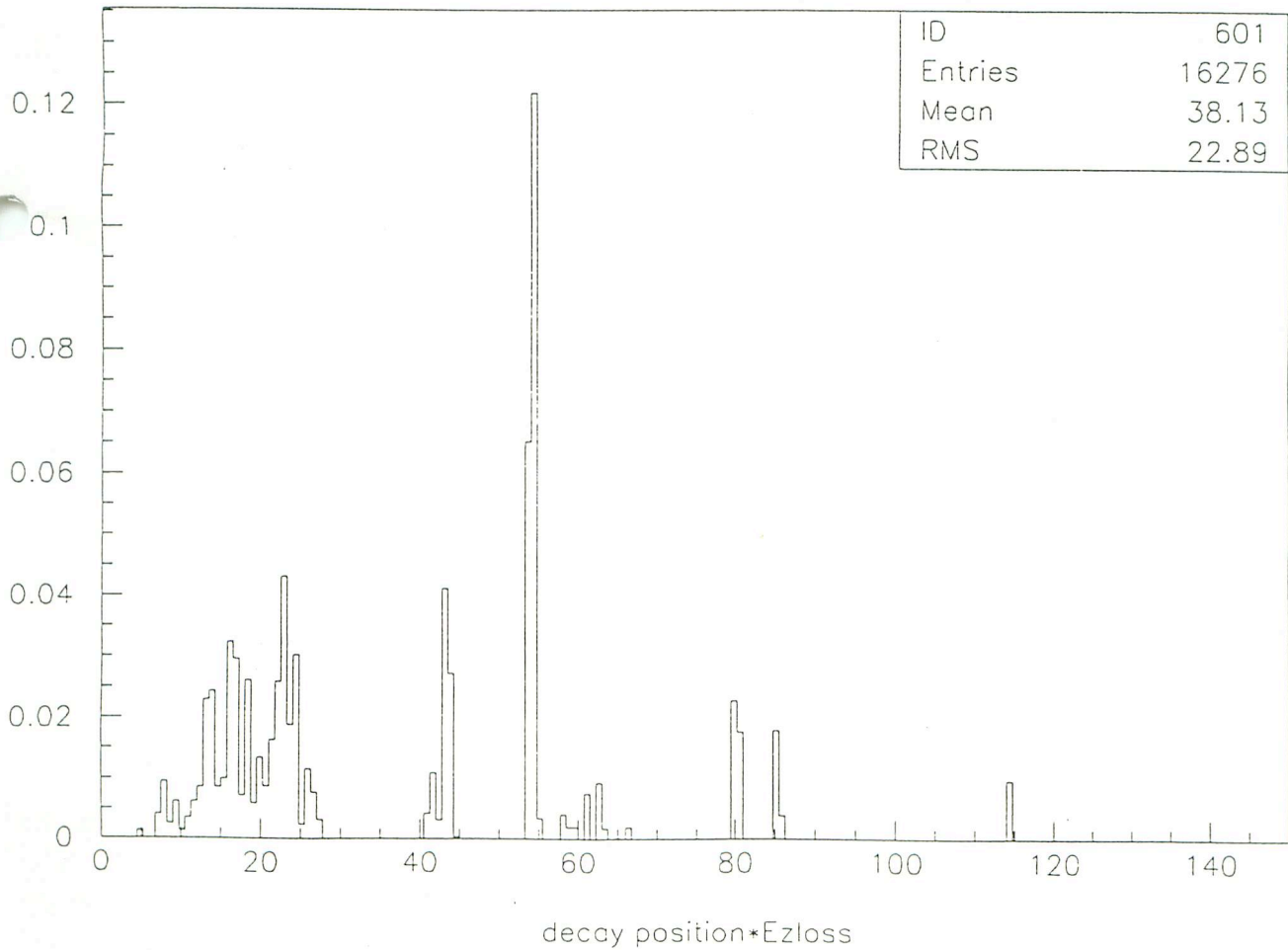
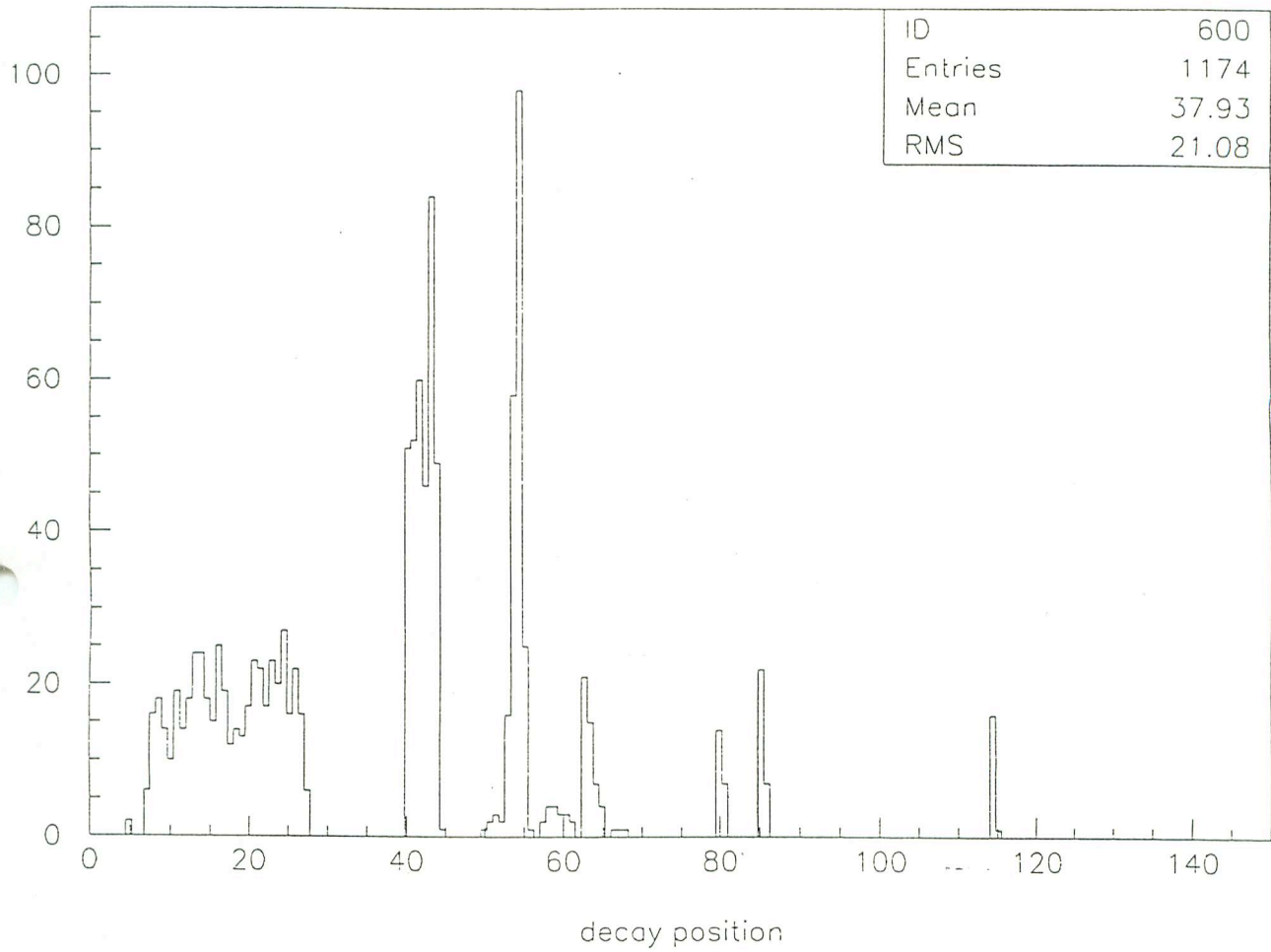


Injection

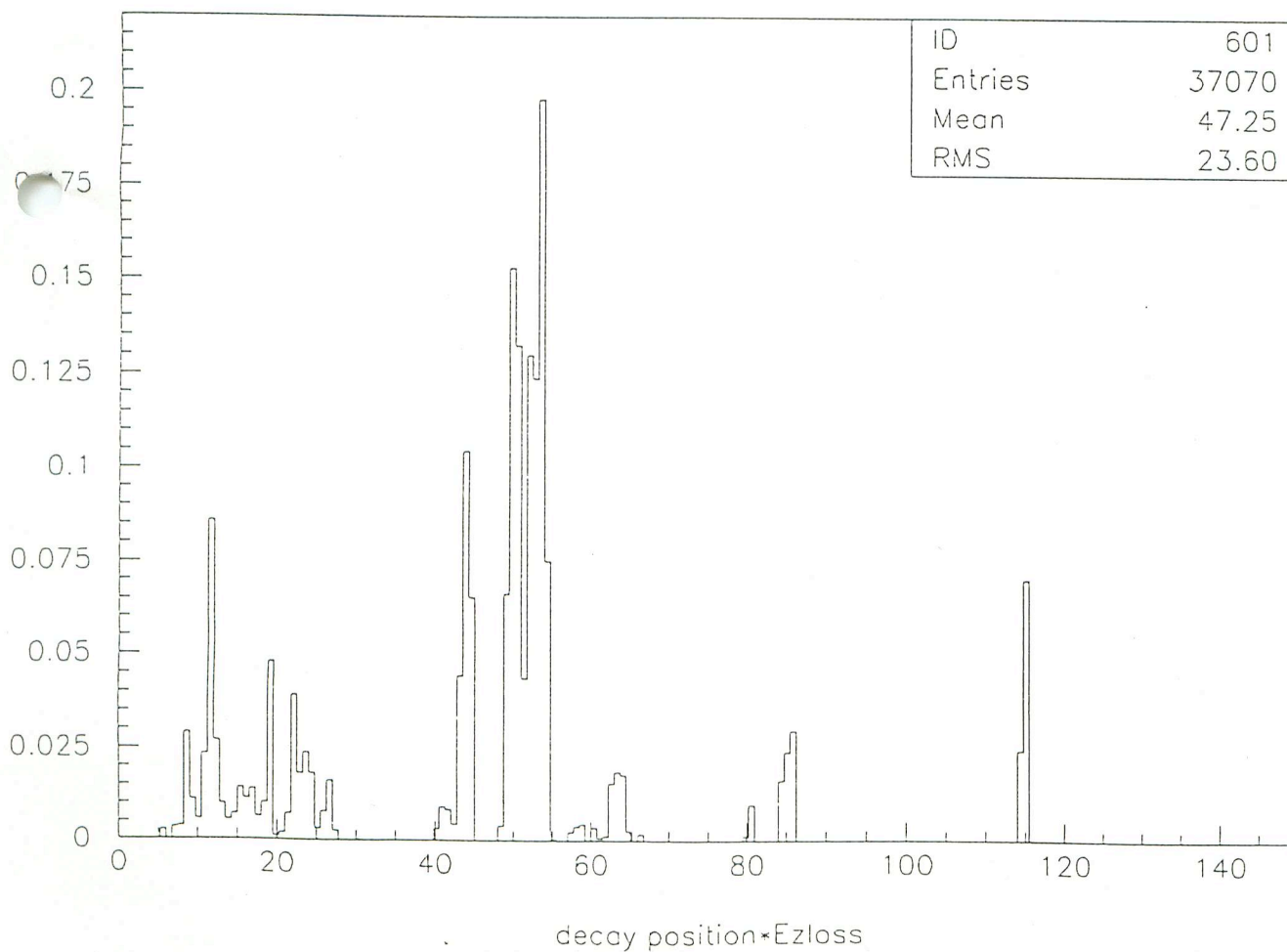
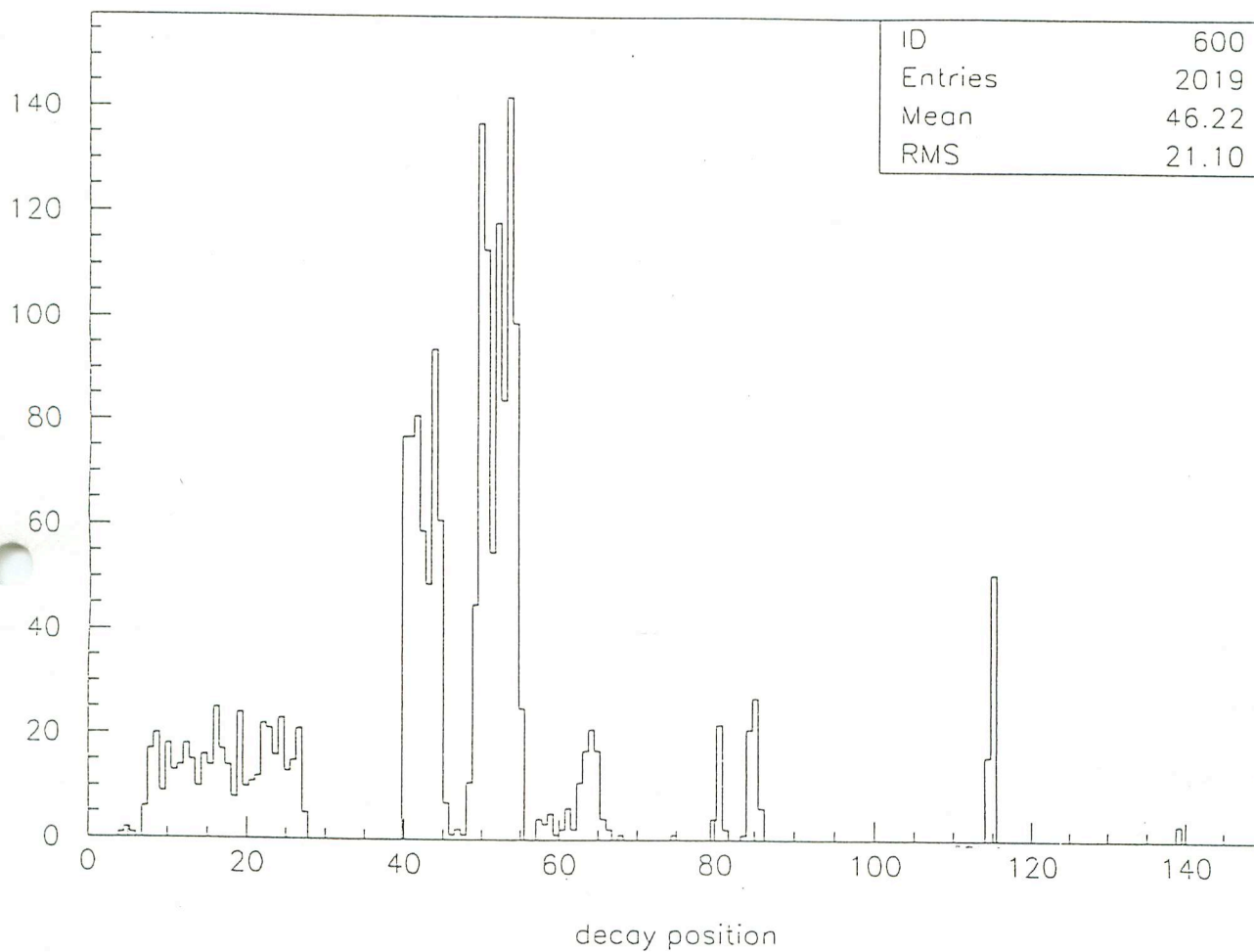
99/03/05 11.38



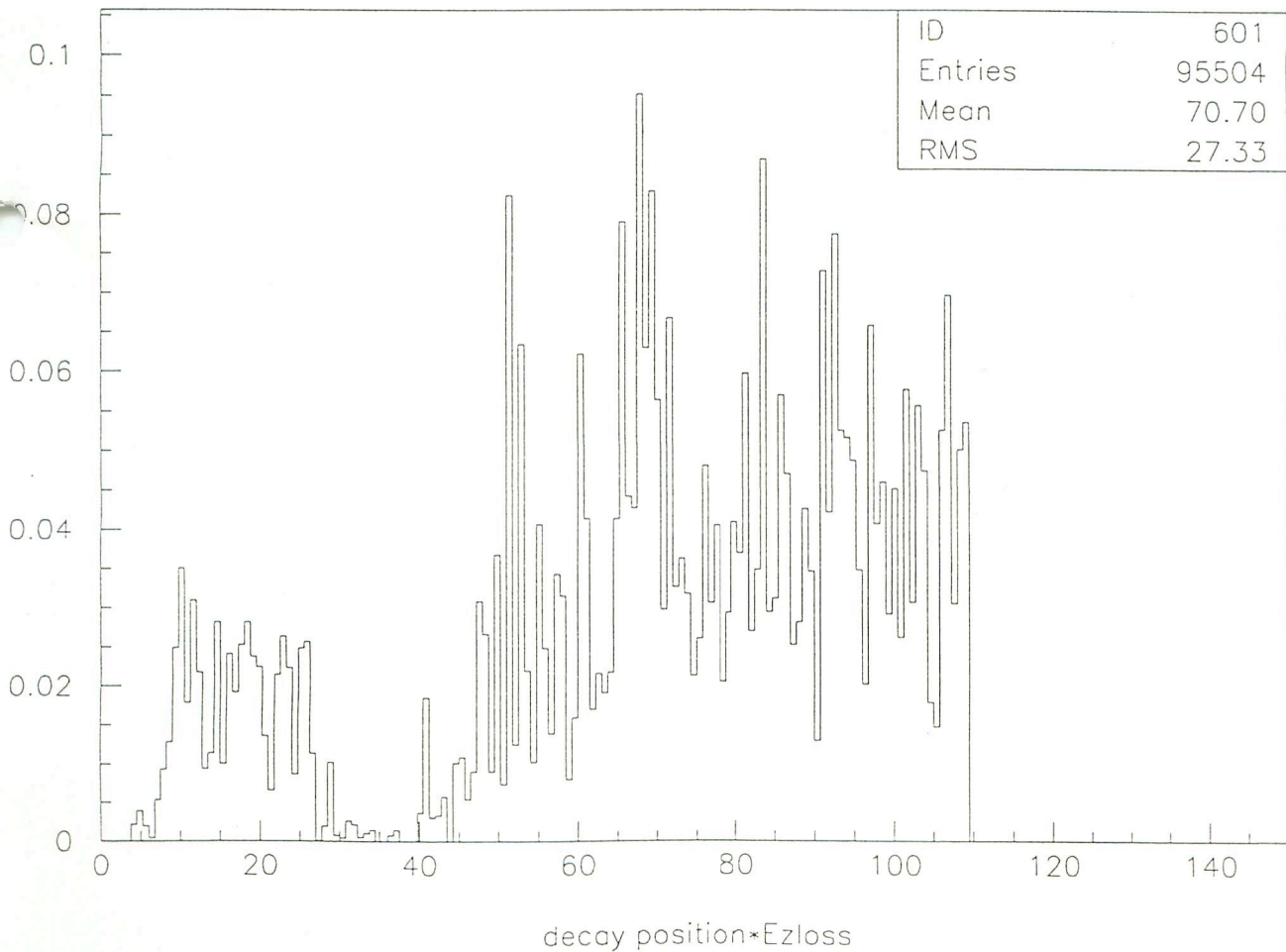
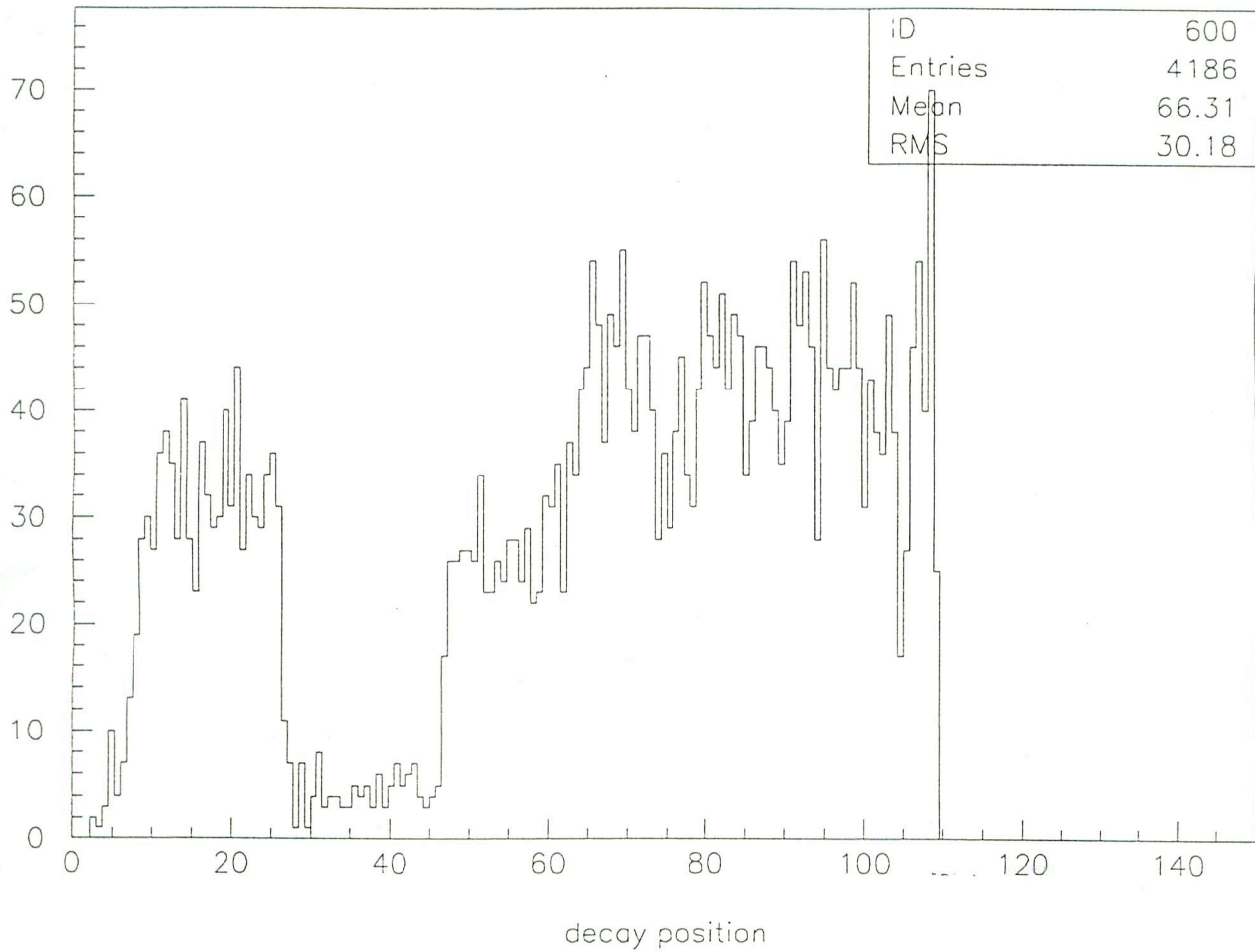
LER Bremsstrahlung



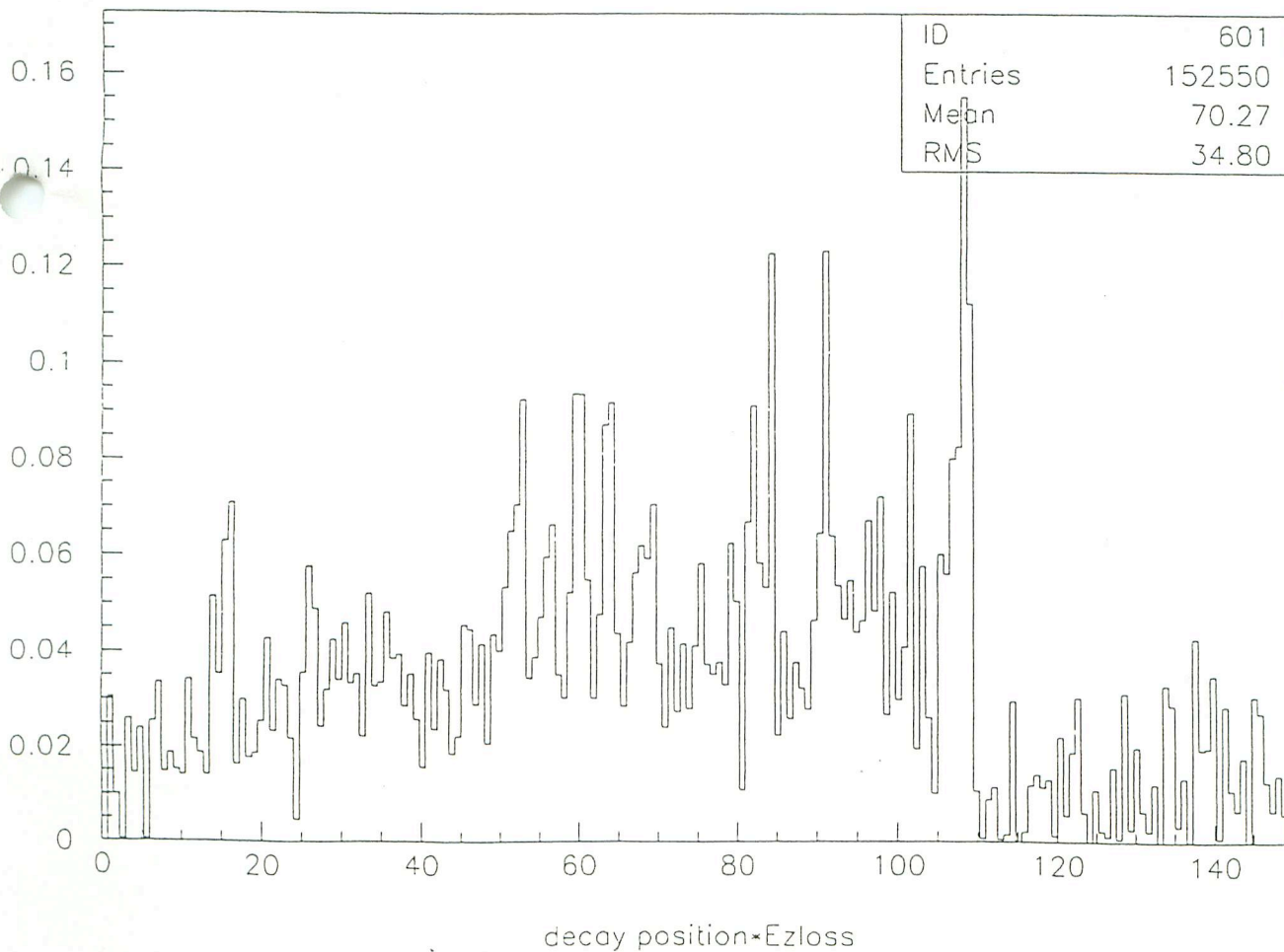
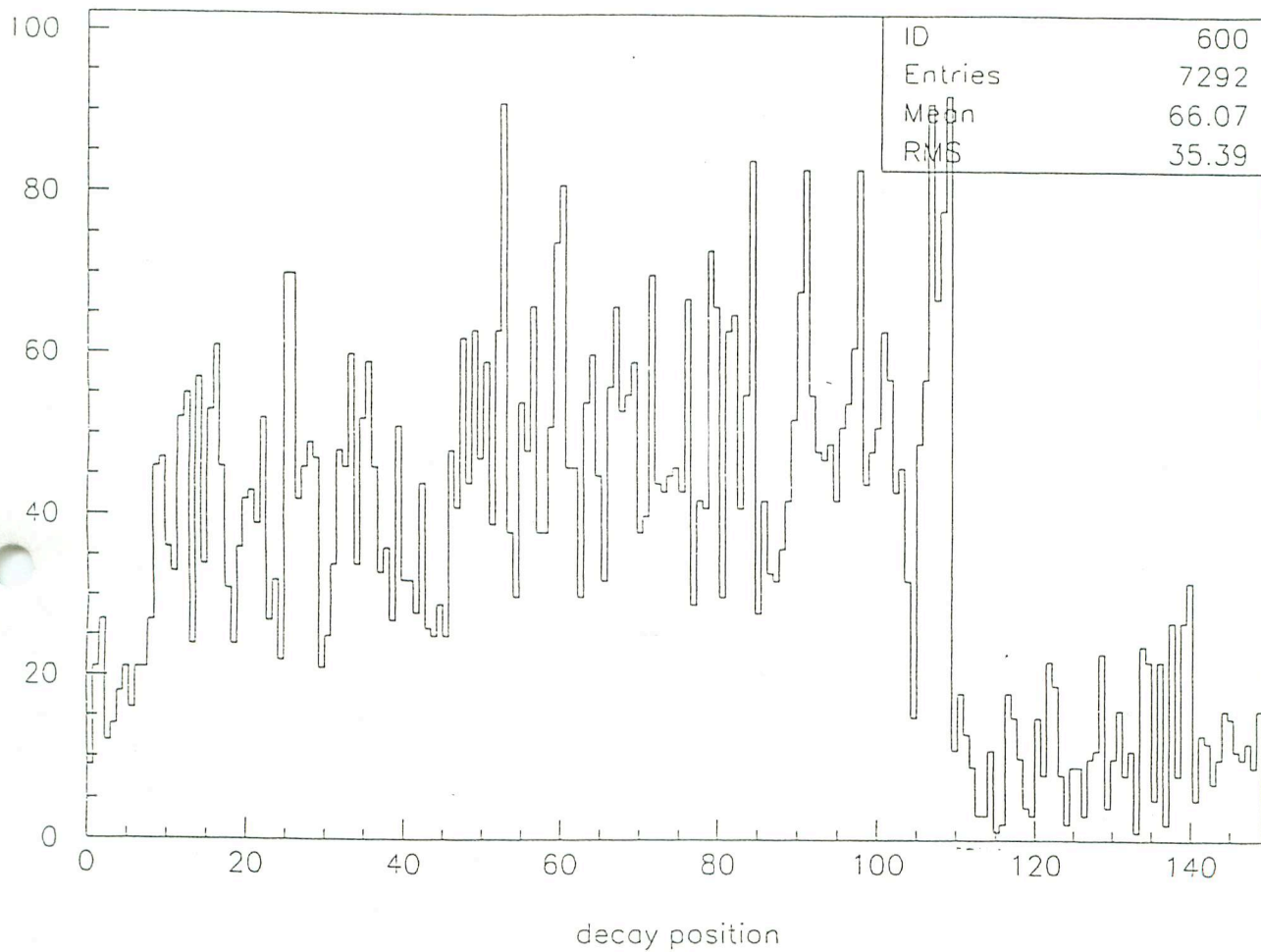
LER Bremsstrahlung (no masks)



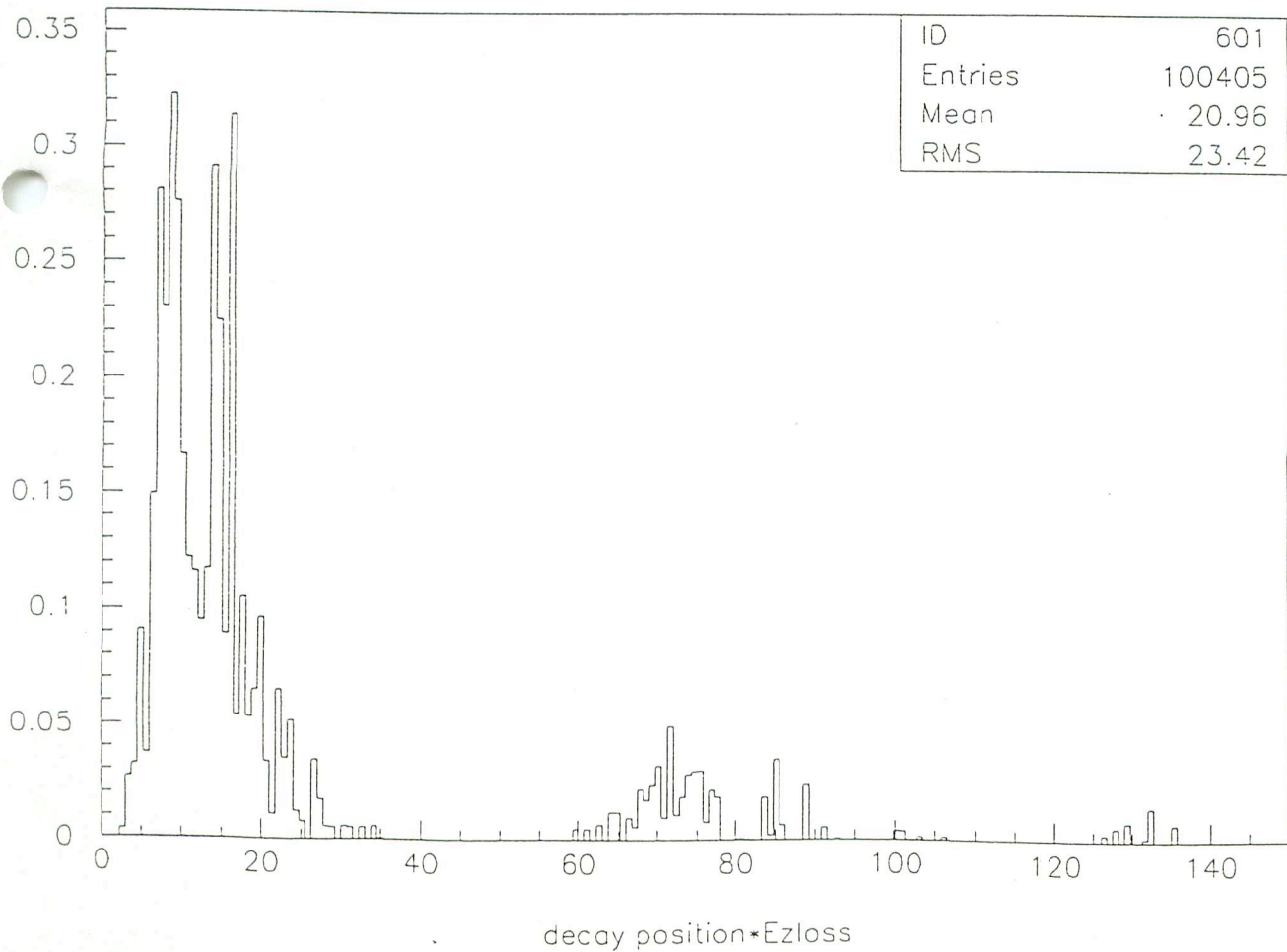
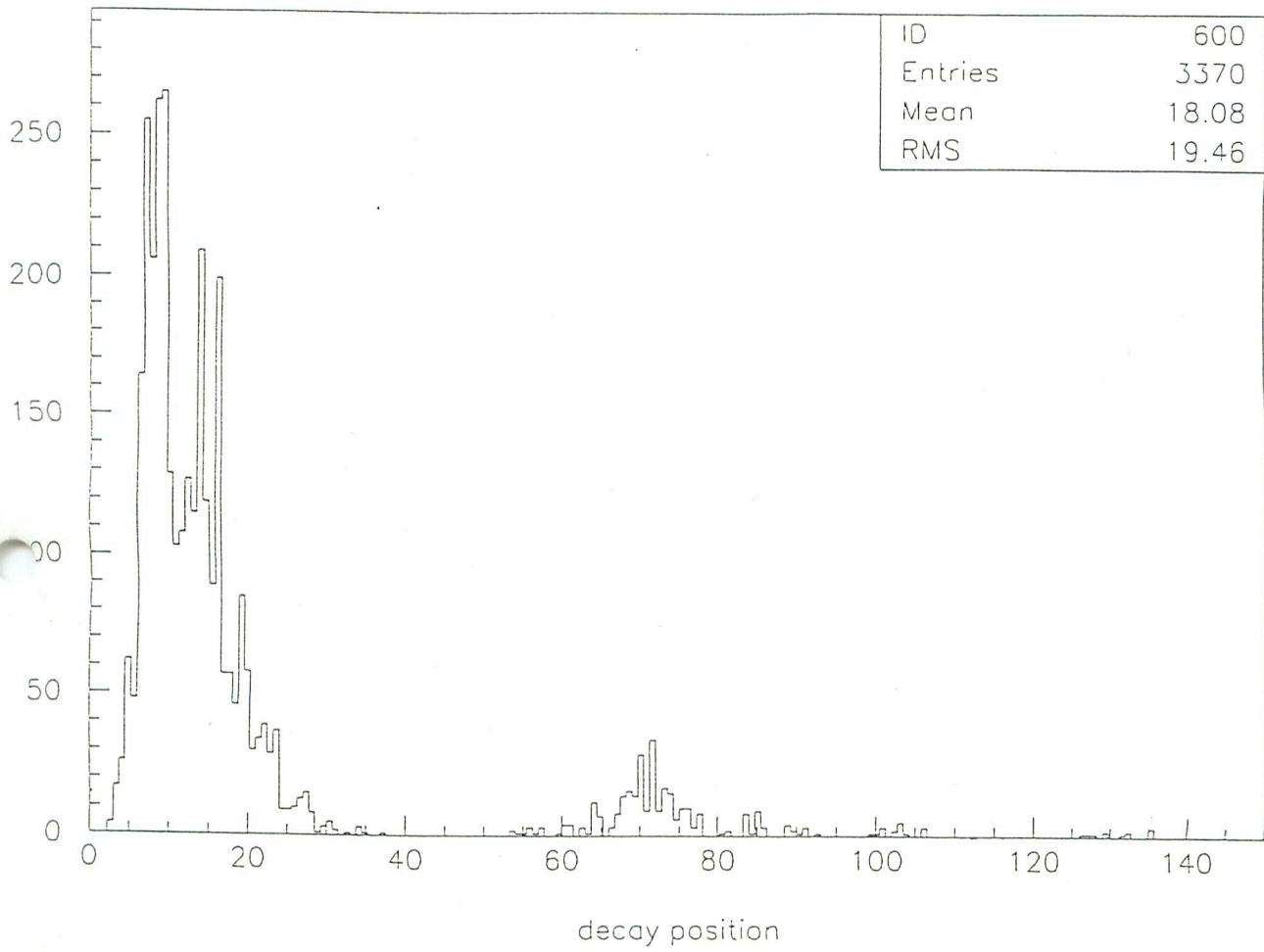
HER Bremsstrahlung



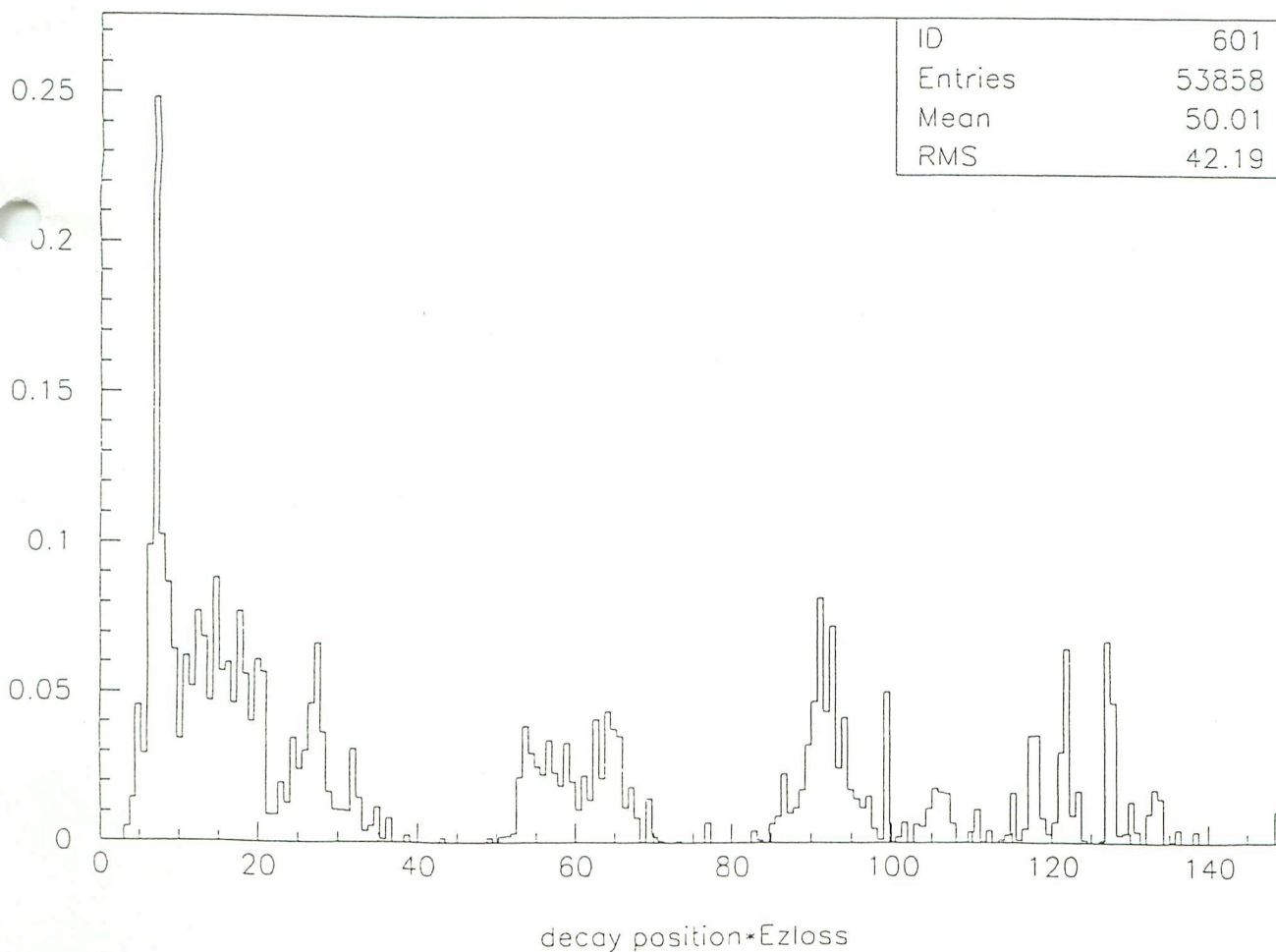
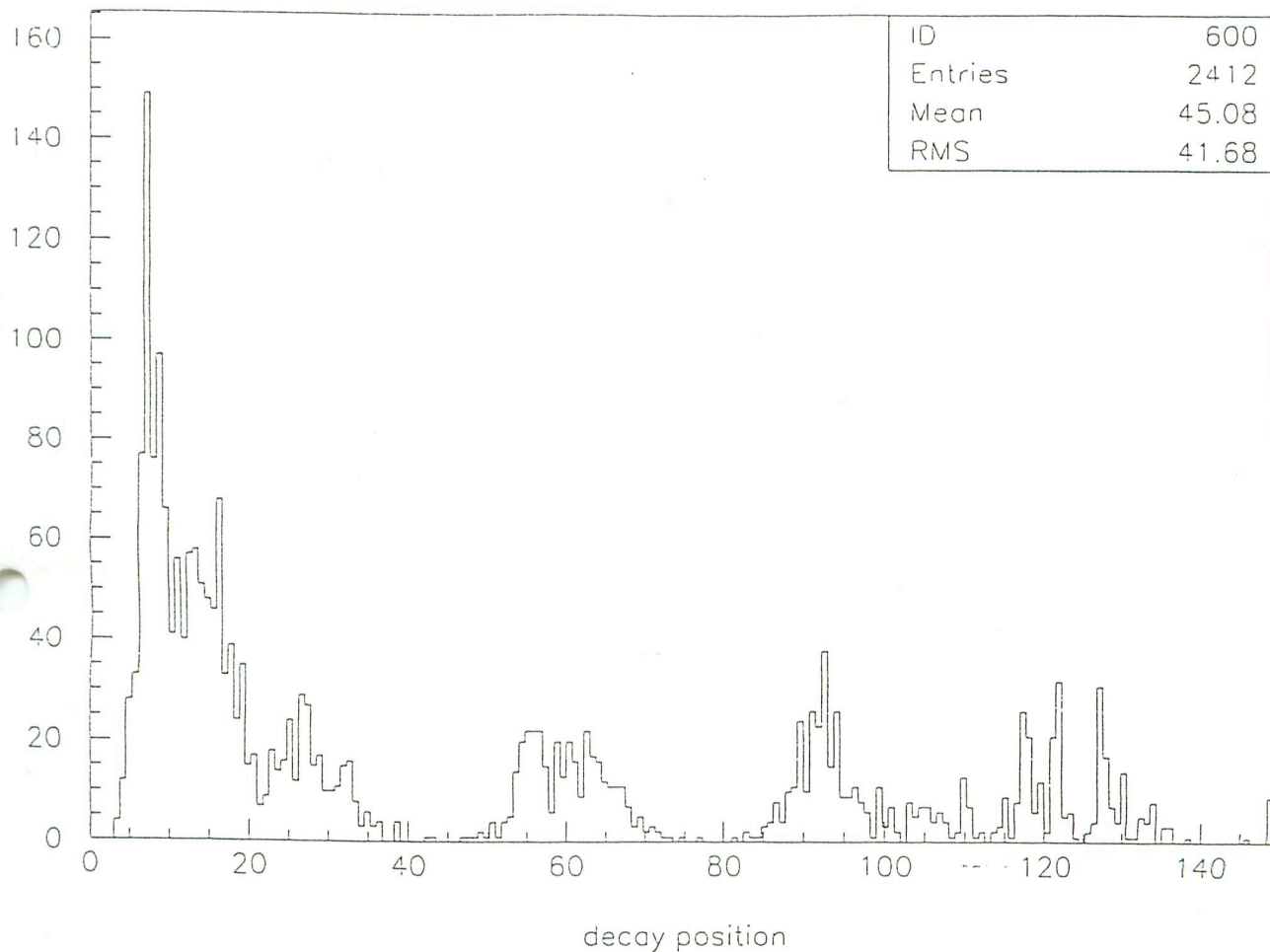
HER Bremsstrahlung (no masks)



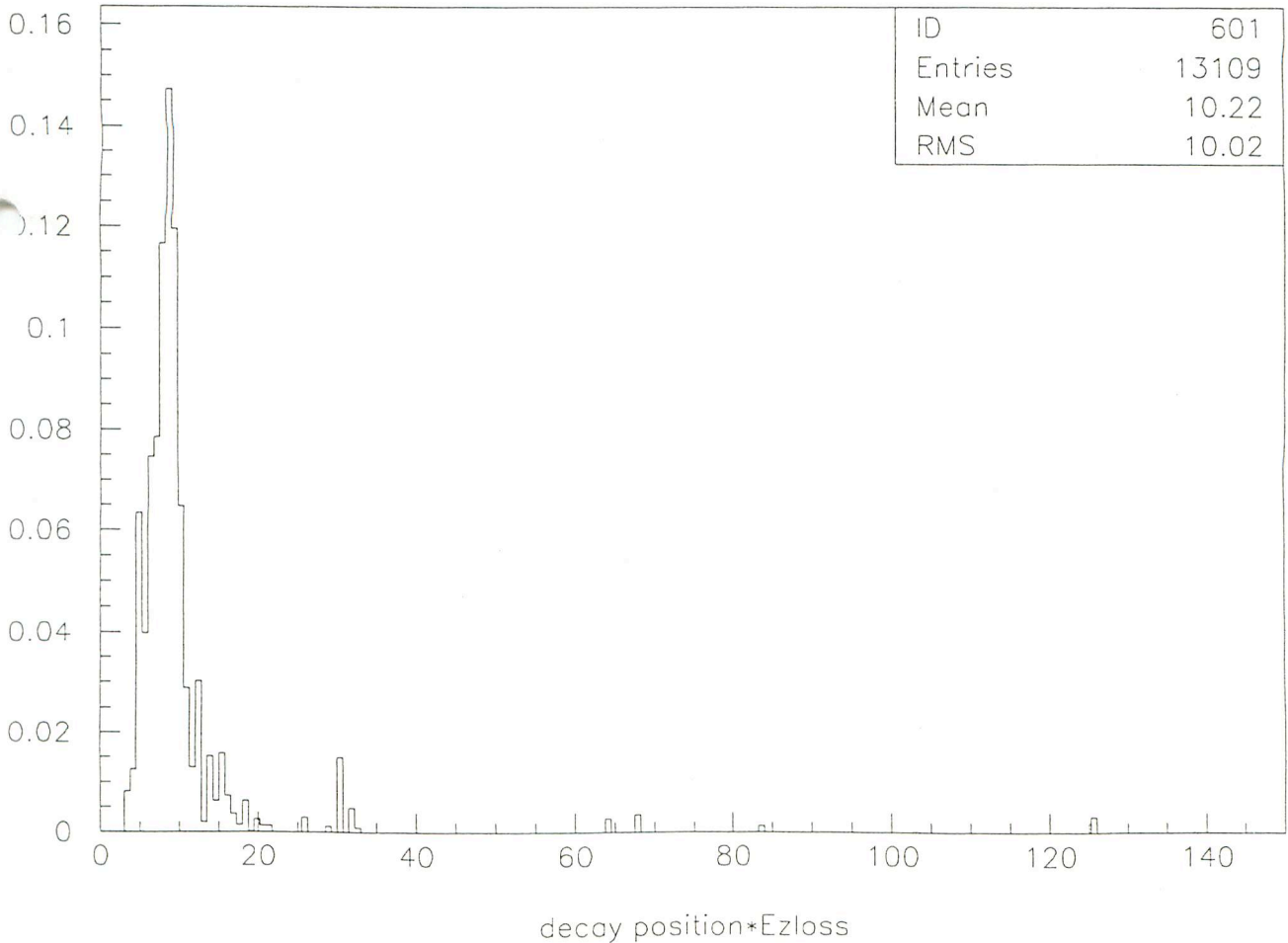
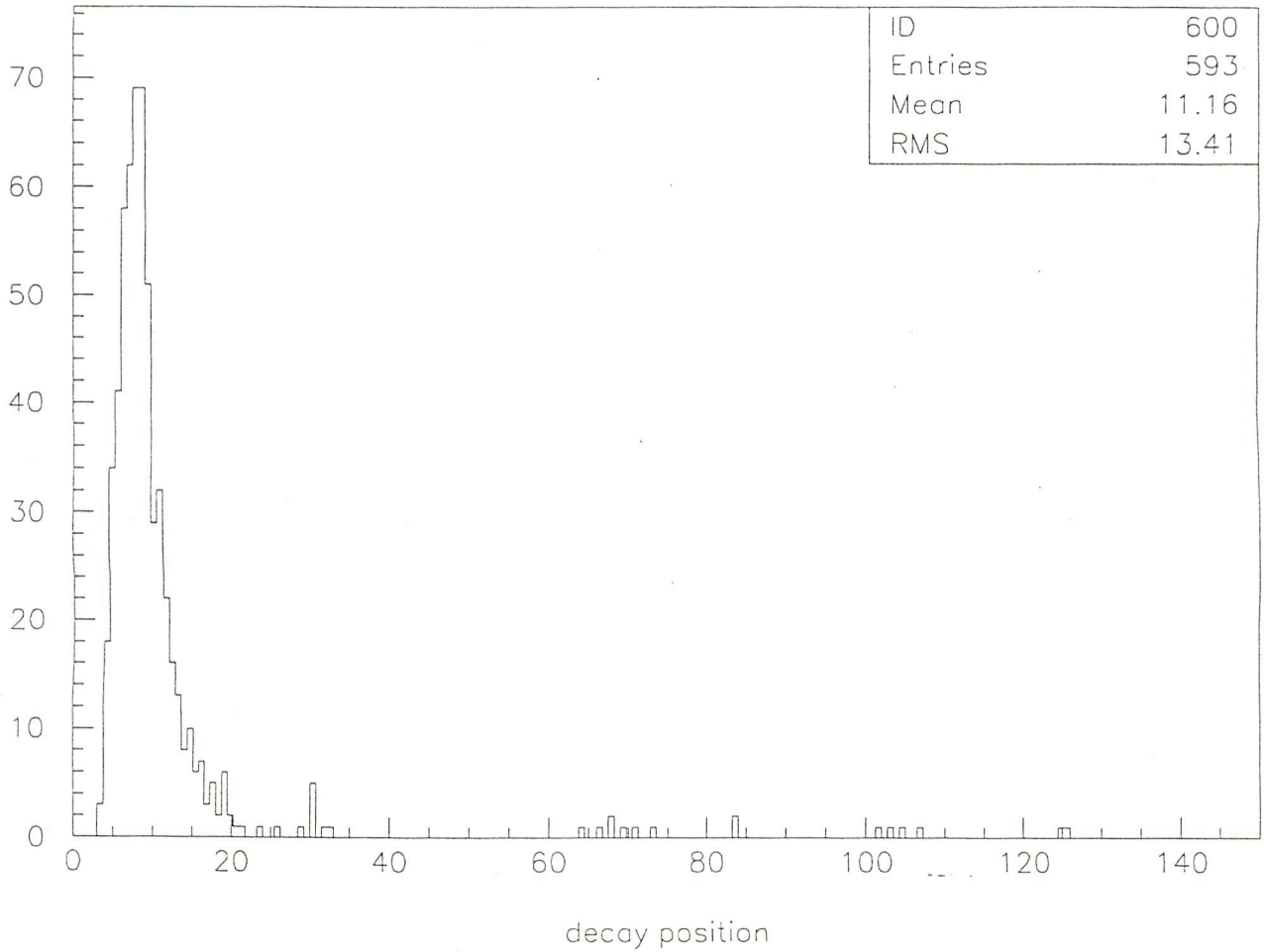
HER Coulomb scatt.



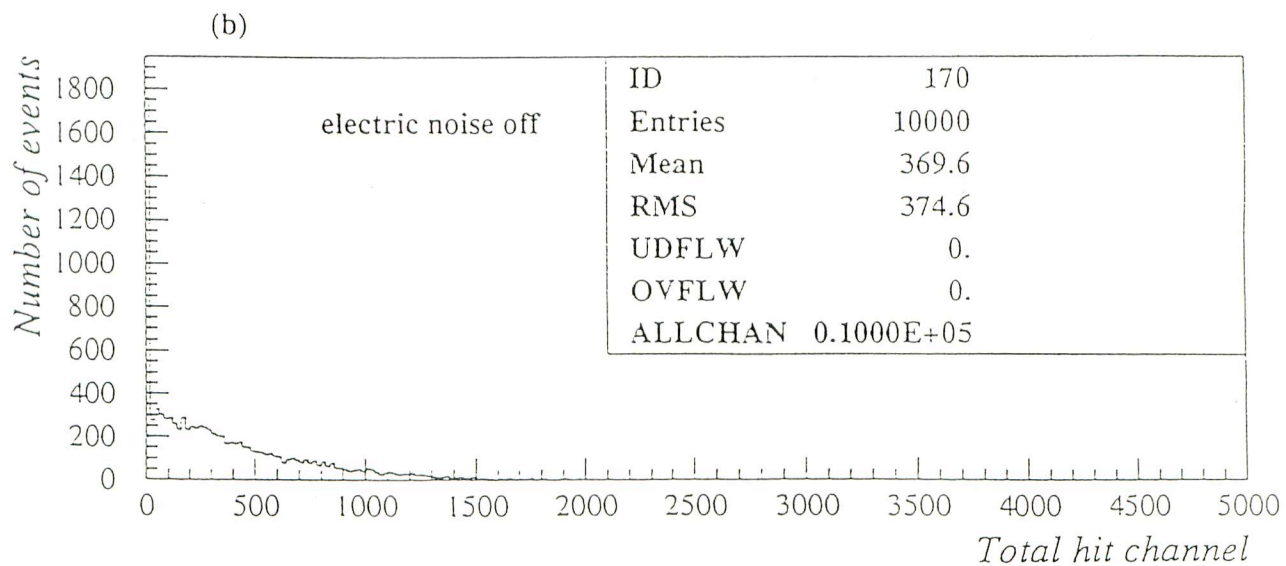
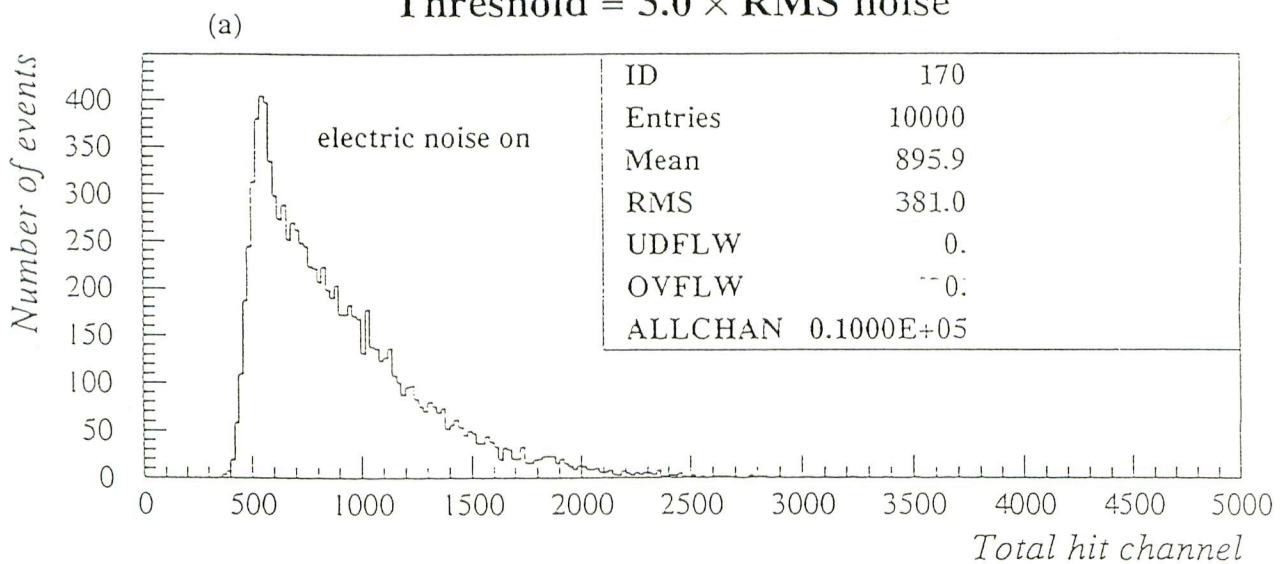
LER Coulomb scatt. (no masks)

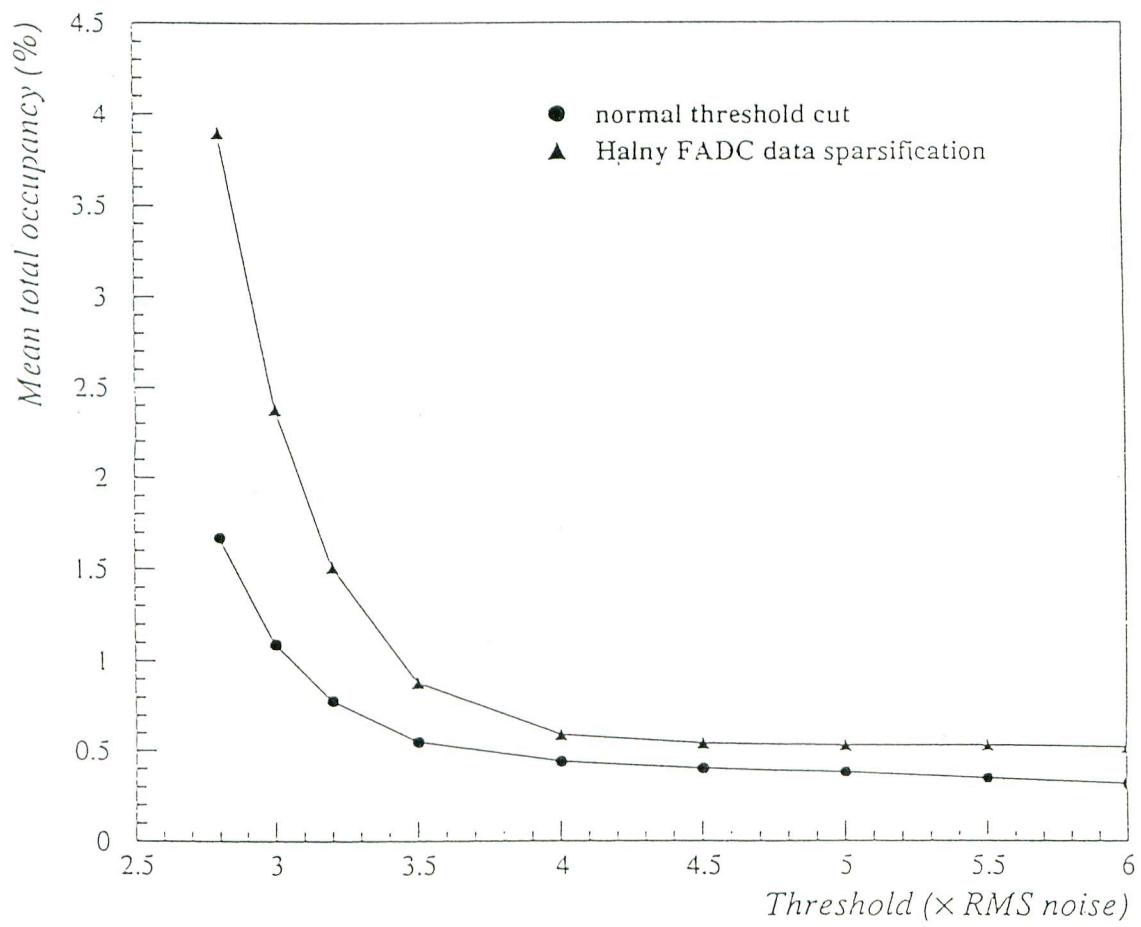


LER Coulomb scatt.



Threshold = $3.0 \times \text{RMS noise}$



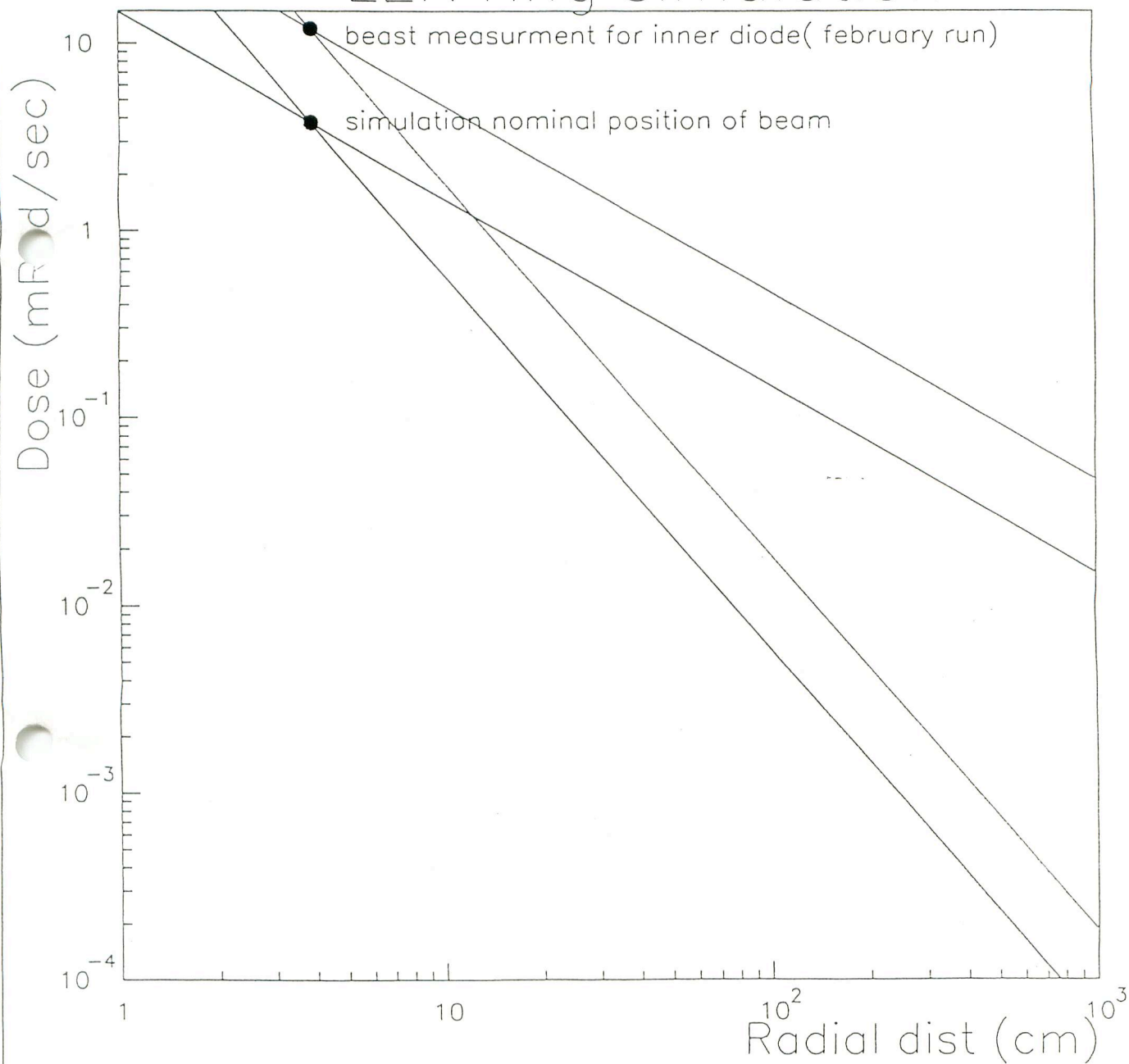


BELLE results

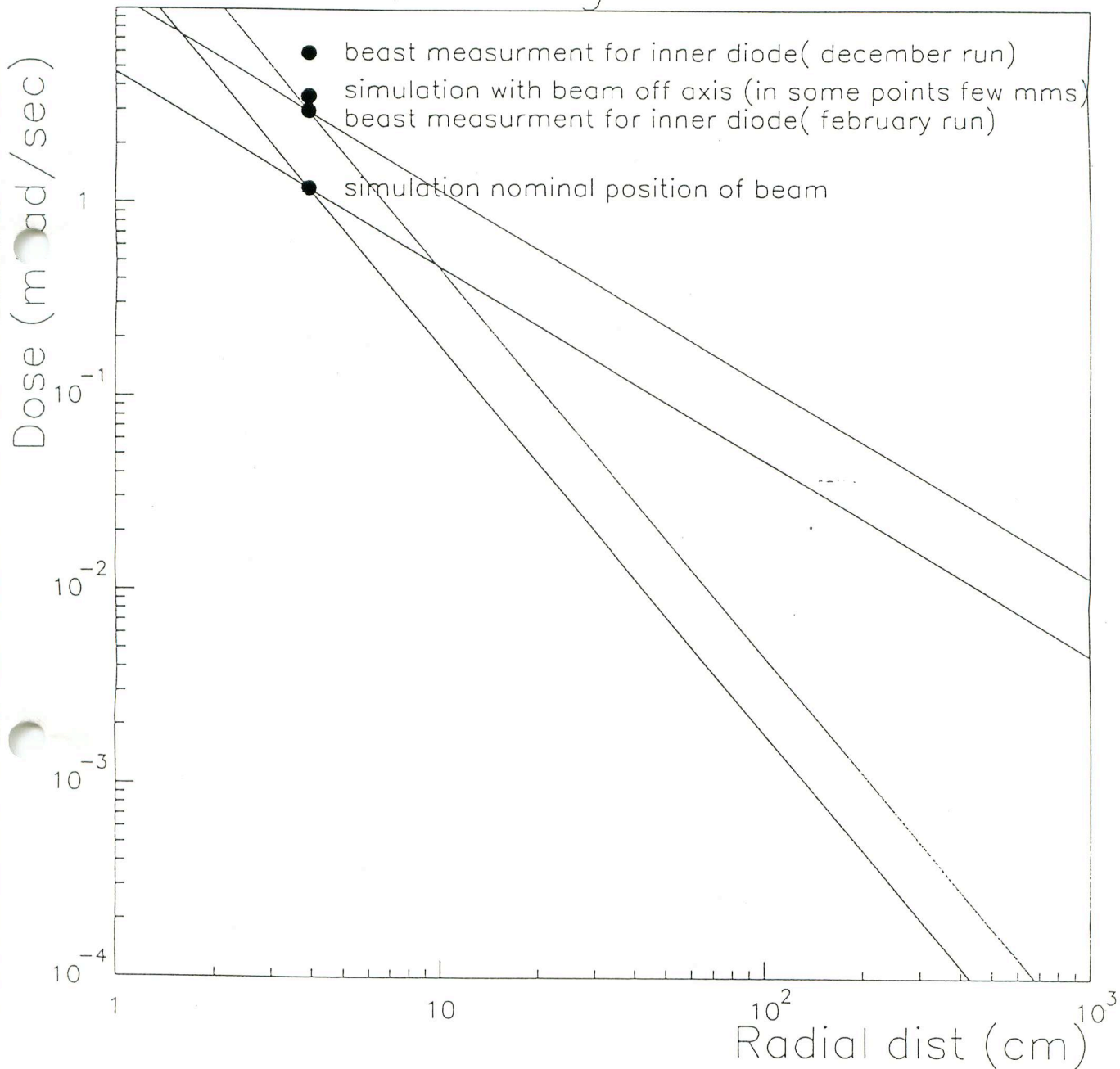
For nominal background

- **SVD radiation dose ~25 Krad /year.**
- **SVD occupancy around 1 % (depend on sparcification program).**
- **Pile-up effect small in average 150 e+ per channel.**
- **Trigger rate from CDC r/phi trigger (two charged tracks) 250Hz.**
- **Estimation of TOF trigger rate (with looser criteria than the real trigger logic) ~4KHz.**
- **Radiation dose acceptable for 10 years of CSI running.**

LER ring simulation



HER ring simulation



BEAST results

- **Simulation gives 3 times lower doses.**
- **Azimuthal distribution even during the "beast dedicated" run consistent with much higher emittance of the beam.**
- **Front back ratio in sandwich diode problem.**

Translation to BELLE

- **SVD dose form steady running up to 200 Krad/year**
- **Maximum occupancy for horizontal modules up to 10%.**
- **Trigger ...**

Plans

- Real vacuum profile.
- Extension of incoming swim lengths, if necessary (right now 270 m).
- Moveable mask effect studies.
- Occupancy and sparcification in BEAST SVD ladder.
- Pile-up effect in CSI.