Kalman Filtering Tests II

Outline

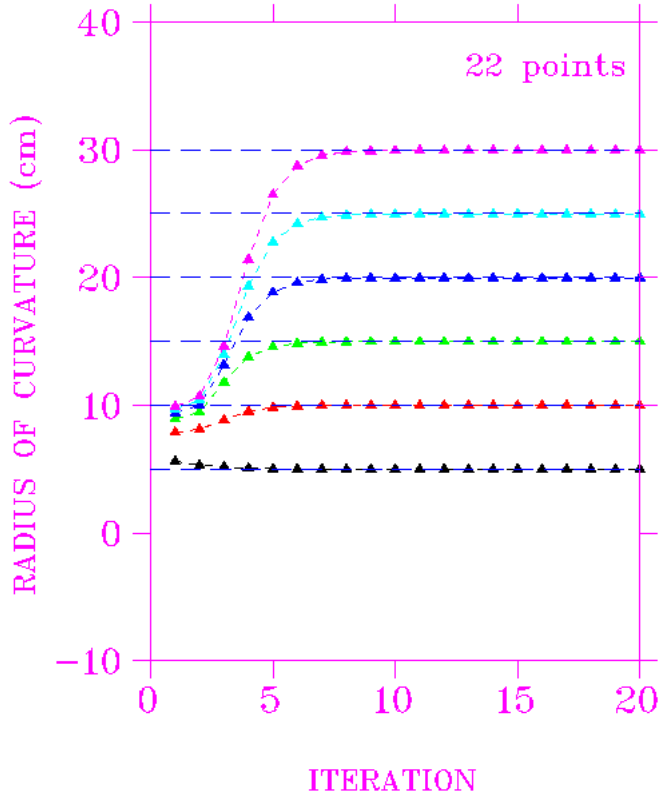
- Kalman filtering with actual detector spacing and resolution.
  - Helices generated over a range of the radius of curvature (R).
  - Helices generated over a range of the dip angle (λ).
- A more realistic “positron” spectrum distribution.
- Reconstructed “positron” parameters at σ=100 μm gaussian smearing.
  - Energy.
  - angle.
  - (u,v) origin.
- Positron parameters resolution at E = 45 MeV.
  - As a function of angle.
  - As a function of smearing.

KF Performance

Actual Detector Spacing & Resolution

(1) Sensitivity to R

- Generated helix parameters:
  - $\phi_0 = 45^0$
  - $u_0 = +5$ cm
  - $v_0 = -5$ cm
  - $\lambda = 60^0$
  - $\sigma = 100\ \mu m$
- Fit starting parameters:
  - $\phi_0 = 0^0$
  - $u_0 = 0$ cm
  - $v_0 = 0$ cm
  - $\lambda = 40^0$
  - R = 15 cm

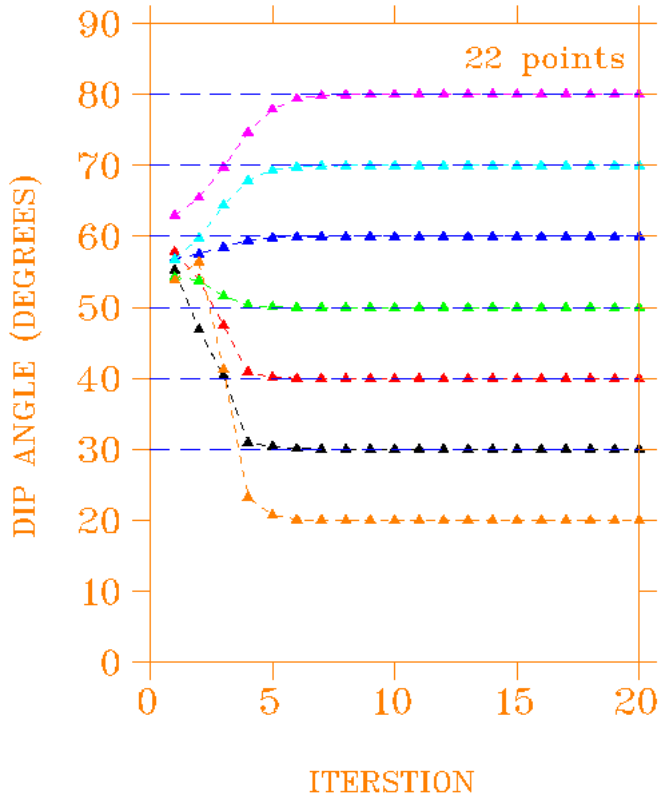


KF Performance

Actual Detector Spacing & Resolution

(1) Sensitivity to λ

- Generated helix parameters:
  - $\phi_0 = 45^0$
  - $u_0 = +5$ cm
  - $v_0 = -5$ cm
  - R = 5 cm
  - $\sigma = 100\ \mu m$
- Fit starting parameters:
  - $\phi_0 = 0^0$
  - $u_0 = 0$ cm
  - $v_0 = 0$ cm
  - R= 15 cm
  - $\lambda = 40^0$



Energy and Angle Convergence

Generated helix parameters:

u_0 = -2.09 cm

v_0 = 1.65 cm

E = 60MeV

θ = 20^0

σ = 100 μm

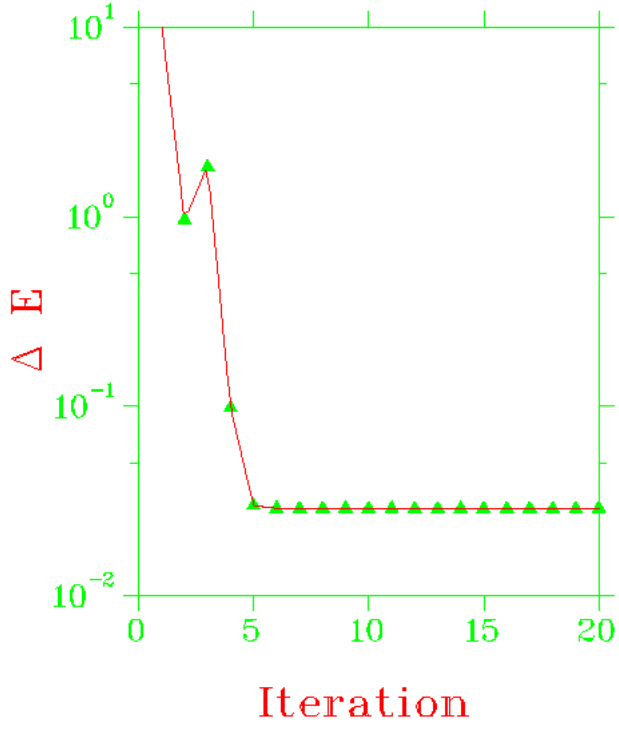
Fit starting parameters:

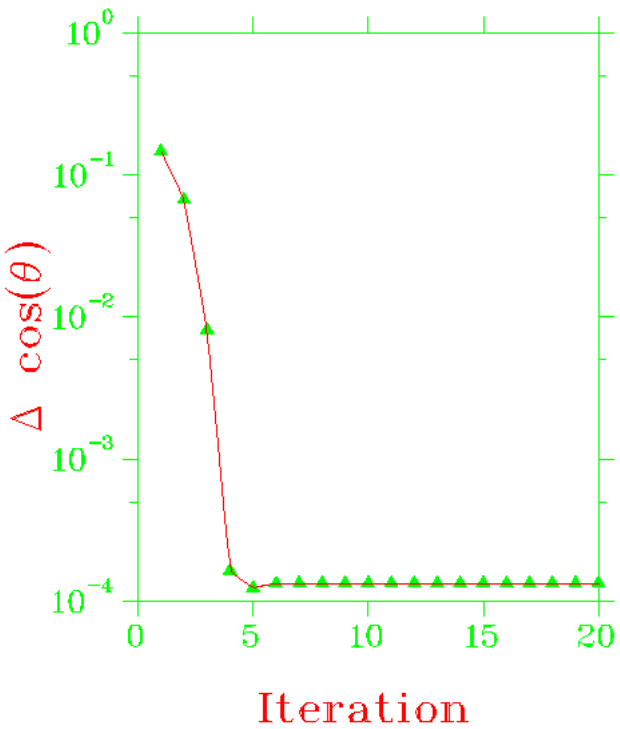
u_0 = 0.0 cm

v_0 = 0.0 cm

E = 71 MeV

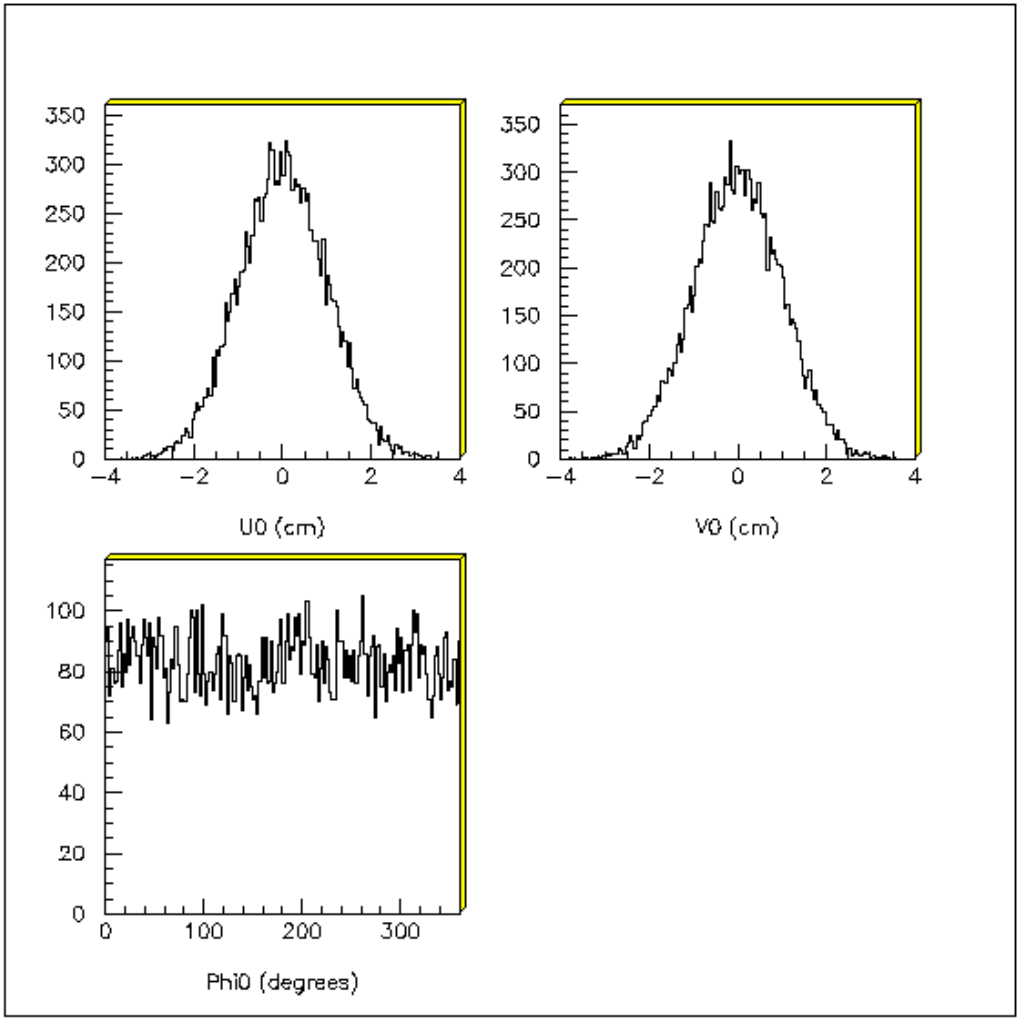
θ = 38^0





Generated Distribution

- **Gaussian in u_0 and v_0**
  σ = 1 cm
- Isotropic in ϕ



Reconstructed Origin Coordinates

High Resolution

- Generated Values:

  R = 3.12 (cm)

  E = 60 MeV

  θ = 20^0

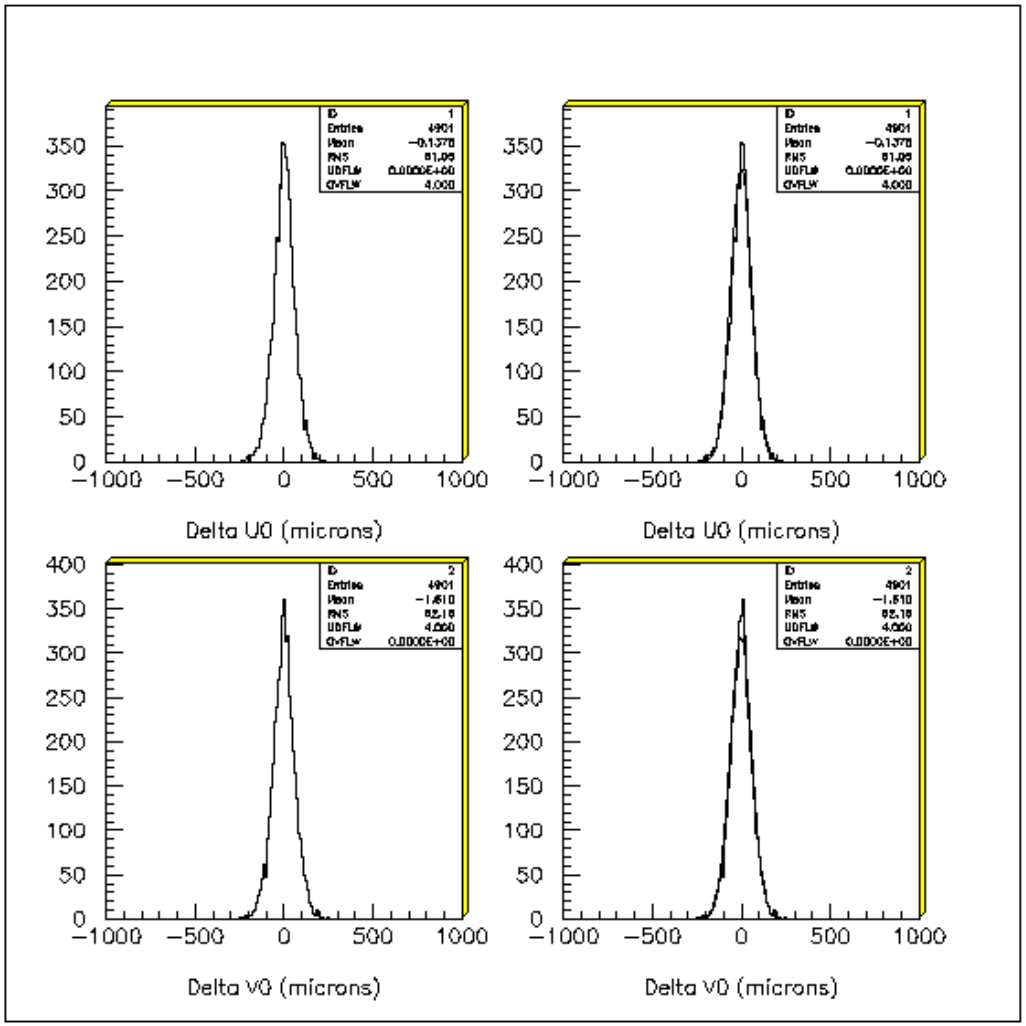
  σ = 100 μm

- Fit Results:

  Successfully reconstructed events: 90%.

  σ_{u0} = 60 μm

  σ_{v0} = 61 μm



Reconstructed Energy and Angle

High Resolution

- Generated Values:

  R = 3.12 cm

  E = 60 MeV

  $\theta = 20^0$

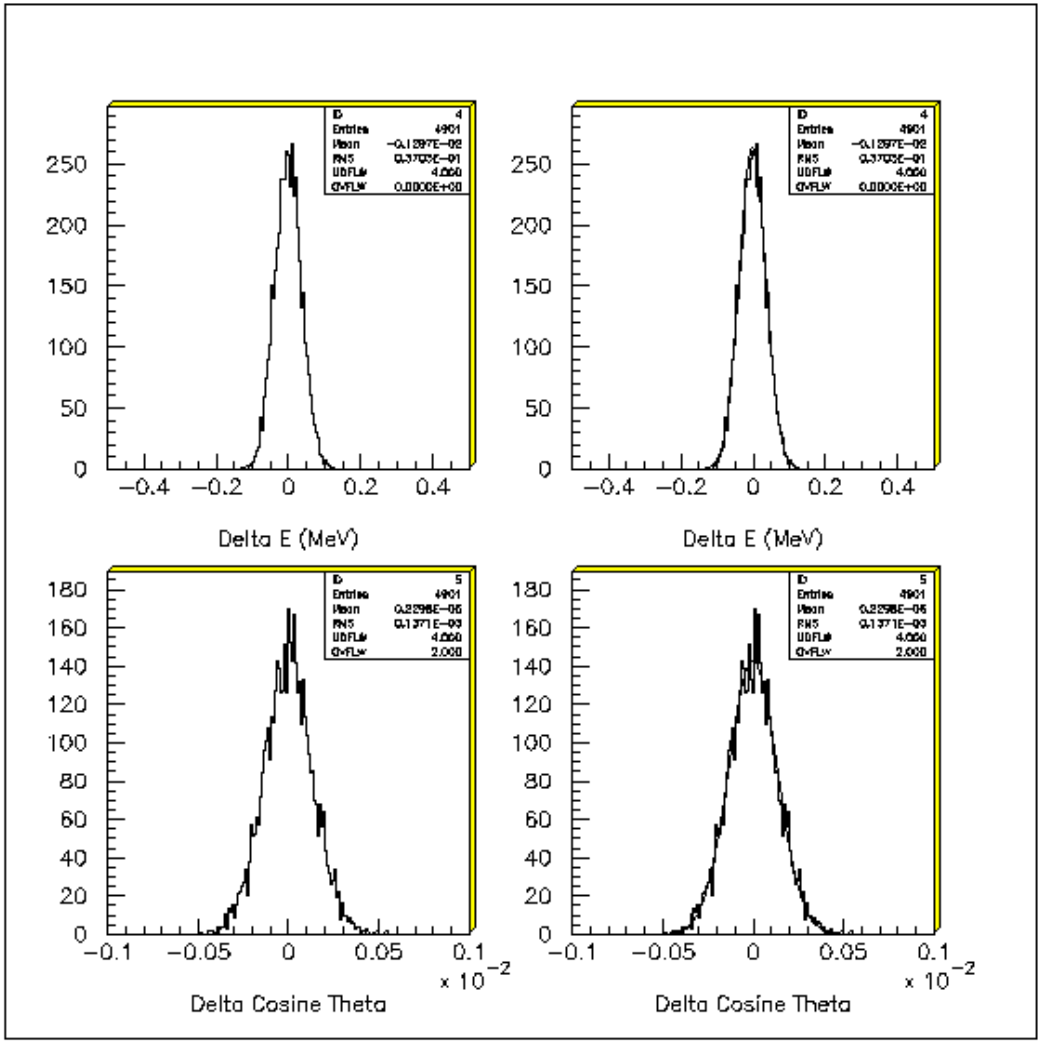
  $\sigma = 100\ \mu m$

- Fit Results:

  Successfully reconstructed events: 90%.

  $\sigma_E = 0.037$ MeV

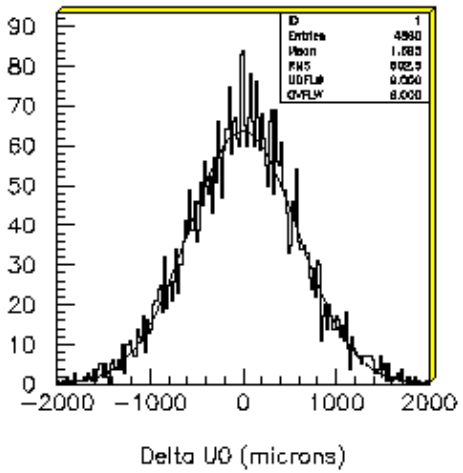
  $\sigma_{\cos\theta} = 1.4 \times 10^{-4}$

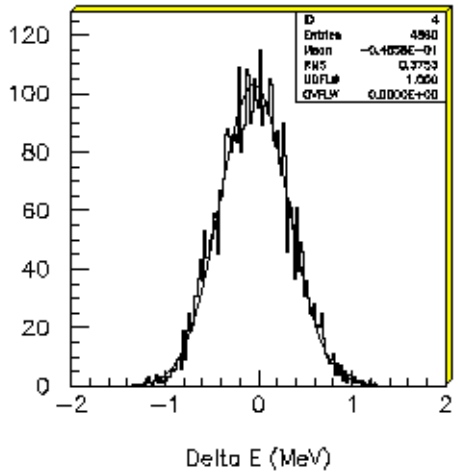


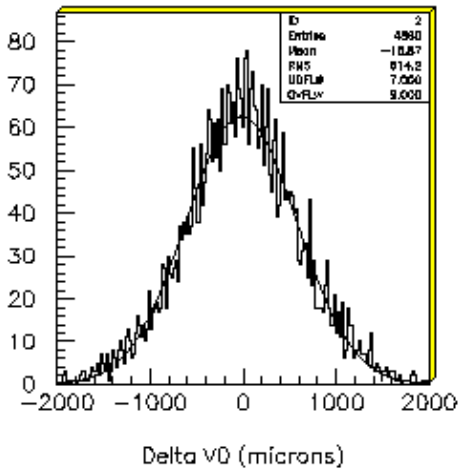
Reconstructed Parameters

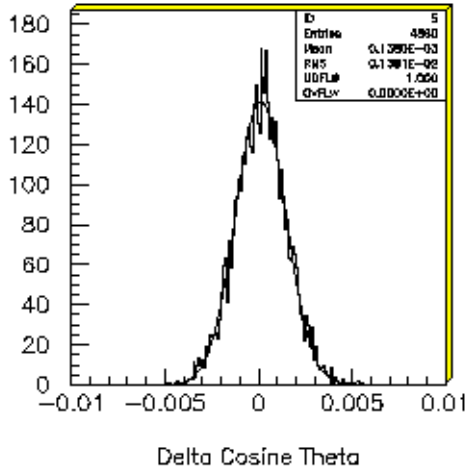
Low Resolution

- Generated Values:
  - **R = 3.12 cm**
  - **E = 60 MeV**
  - **$\theta = 20^0$**
  - **$\sigma = 1000\ \mu m$**
- Fit Results:
  - **Successfully reconstructed events: 86%.**
  - **$\sigma_{u0} = 588\ \mu m$**
  - **$\sigma_{v0} = 596\ \mu m$**
  - **$\sigma_E = 0.368$ MeV**
  - **$\sigma_{cos\theta} = 1.34 \times 10^{-3}$**



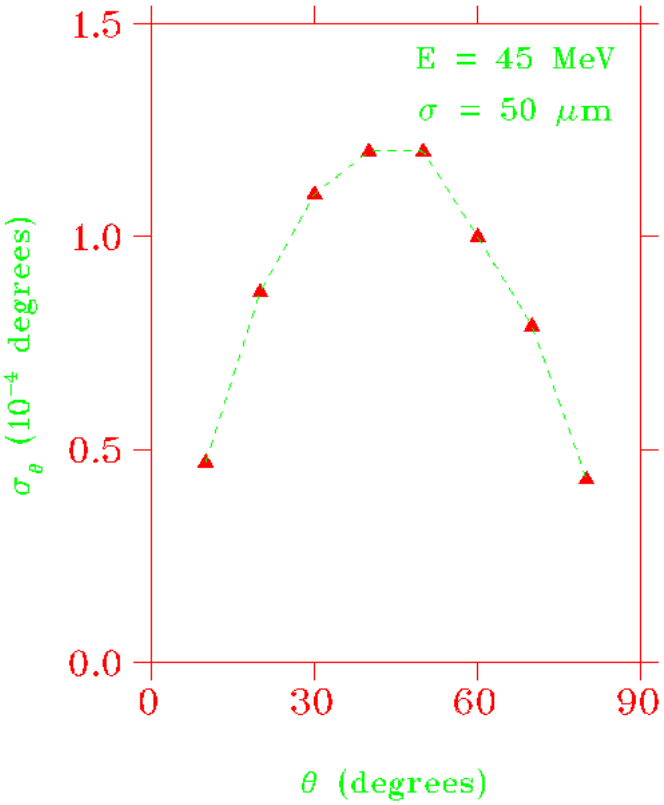


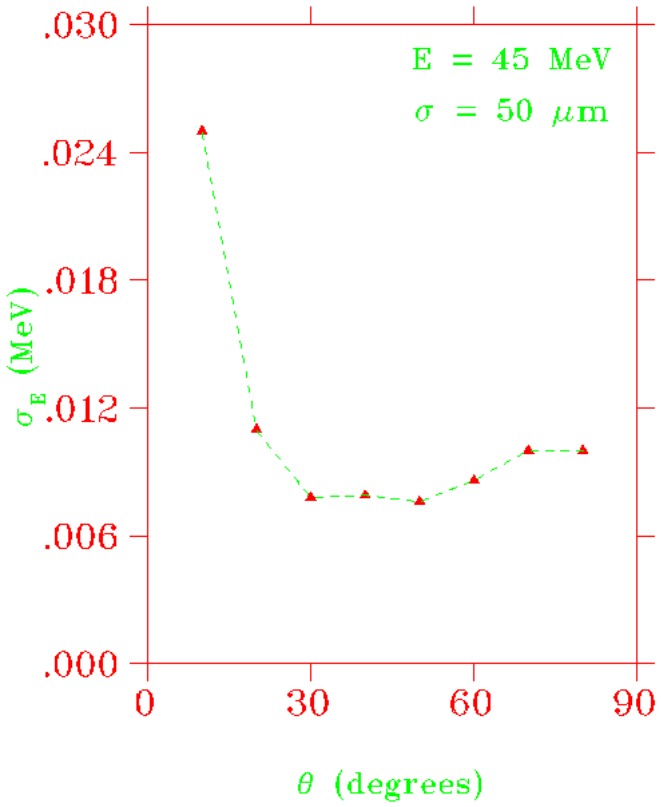




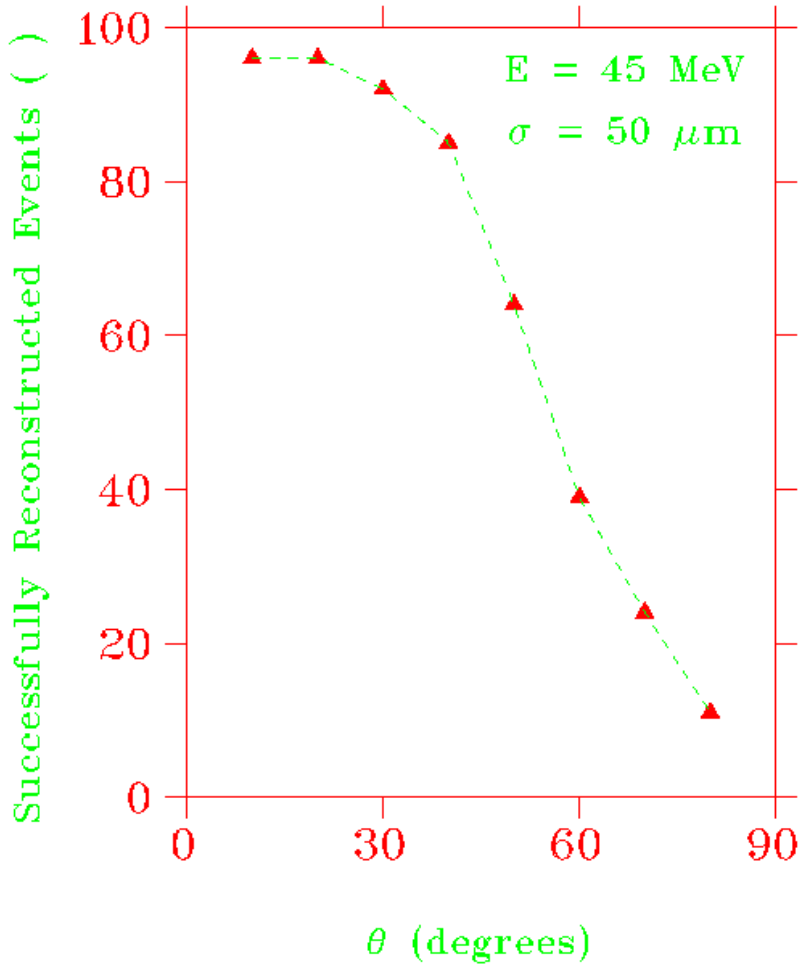
Resolutions as a Function of θ

σ_{u0} = 30 μm
σ_{v0} = 30 μm





Percentage of Successfully Reconstructed Events



Conclusions

- Performance of KF with actual detector spacing. — Works fine!
- Performance of KF with Gaussian smearing of measurements. — Works fine!
- Resolutions with smearing similar to chamber res.: — Good Resolutions.
  - energy, angle, and origin coordinates.
- Are there any failure modes? — Yes. Very sensitive to choice of (C_p).
- Works at a smearing level similar to wire spacing? — Yes. Fails at the same rate as with high resolution