GEANT 3 Step Settings

II. Target STEmax

TWIST Techincal Note 84

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Abstract

Effects of the size of the parameter $STEmax$, the maximum allowed step size in the target, were investigated. The position of a pencil positron beam generated at the target centre was found to differ by no more than $6\mu m$ near the end of the half stack for $5\mu m < STEmax < 500\mu m$, while its kinetic energy differed by no more than $3keV$. Bigger differences are seen in the shapes of the kinetic energy and position distributions for $STEmax = 1\mu m$.

1 Introduction

In the TWIST target where the density is relatively very high the energy loss in one step can be quite large compared to the rest of the detector. To avoid possible systematic effects the step sizes are set seperately for the target region. In this note the effects of varying $STEmax$, the step size length parameter, in the target region are investigated.

A pencil positron beam was tracked starting at a position of $(0,0,0)cm$ (at the centre of the target) and various distributions were plotted at $(0,0,51)cm$ (near the end of the half-stack). These distributions include the x and y position of the beam as well as its kinetic energy. A pure aluminum target (with no graphite layer) of thickness $125\mu m$ was used in this simulation. The value of $TmaxFD$ was set to $5°$.

2 Effects of STEmax

Only energy loss (including delta ray production and bremsstrahlung) was turned on and a million positron tracks were simulated at $\theta = 70°$ and KE=$40MeV$ with $STEmax$ set to values in the range [1,500]μm. The table below shows the means for various distributions after the beam traversed a distance of $51.0cm$ in z. Figure 1 shows the change in beam position as $STEmax$ is changed and the corresponding percentage change in CPU time.

Figure 2 shows the kinetic energy distributions at $z = 51cm$ for various values of $STEmax$. The maximum difference in the rising edge is $\sim 3keV$. Figures 3 and 4 show the x and y distributions of the beam and reflect a maximum difference of $\sim 6\mu m$.

	$\langle x\rangle(cm)$	$\langle y\rangle(cm)$	CPU(msec)	% CPU increase
$500\mu m$	3.232	-1.651	13.5	0%
$100\mu m$	3.227	-1.650	13.5	0%
$50\mu m$	3.232	-1.654	13.6	0.7%
$10\mu m$	3.228	-1.649	13.7	1.5%
$5\mu m$	3.234	-1.655	13.8	2.2%
$1\mu m$	3.233	-1.655	15.1	15.1%

Table 1: The first two columns are the mean x and y position of the positron beam at $z = 51.0cm$. The last two columns are the CPU time per event and the relative increase in CPU time as $STEmax$ is made smaller. The positron beam was simulated with a kinetic energy of $40MeV$ and a θ angle of $70°$.

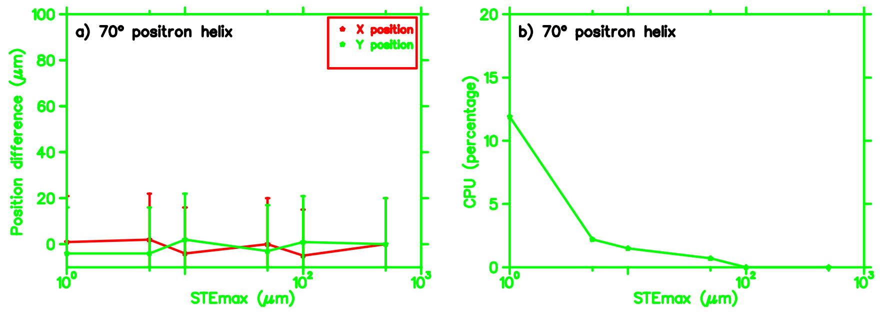

Figure 1: 1a) difference in the mean x (red) position and $STEmax = 500\mu m$) for various values of $STEmax$; the green curve is the same for y. The positron beam was generated with a kinetic energy of $40MeV$ and a θ angle of $70°$. 1b) percentage CPU increase as $STEmax$ is lowered from the $STEmax = 500\mu m$.

3 Conclusions

No significant dependence on the target $STEmax$ is observed, likely as a result of other parameters limiting the step size when $STEmax$ is large (ex. TmaxFD, dEemax). For a positron beam simulated at $KE = 40MeV$ and $\theta = 70°$, a difference of less than $6\mu m$ in the mean beam position is observed for $5\mu m < STEmax < 500\mu m$. For the same $STEmax$ range the kinetic energy differed by no more than $4keV$. The increase in cpu time was found to be small (2.2%) as $STEmax$ is reduced from $500\mu m$ to $5\mu m$. Bigger differnces were observed at $STEmax = 1\mu m$. This might either be due to $STEmax$ becoming the step-limiting parameter more often, or due to rounding errors as a result of single precision in GEANT 3. The current default value of $10\mu m$ for $STEmax$ in the target is appropriate for the TWIST simulation.

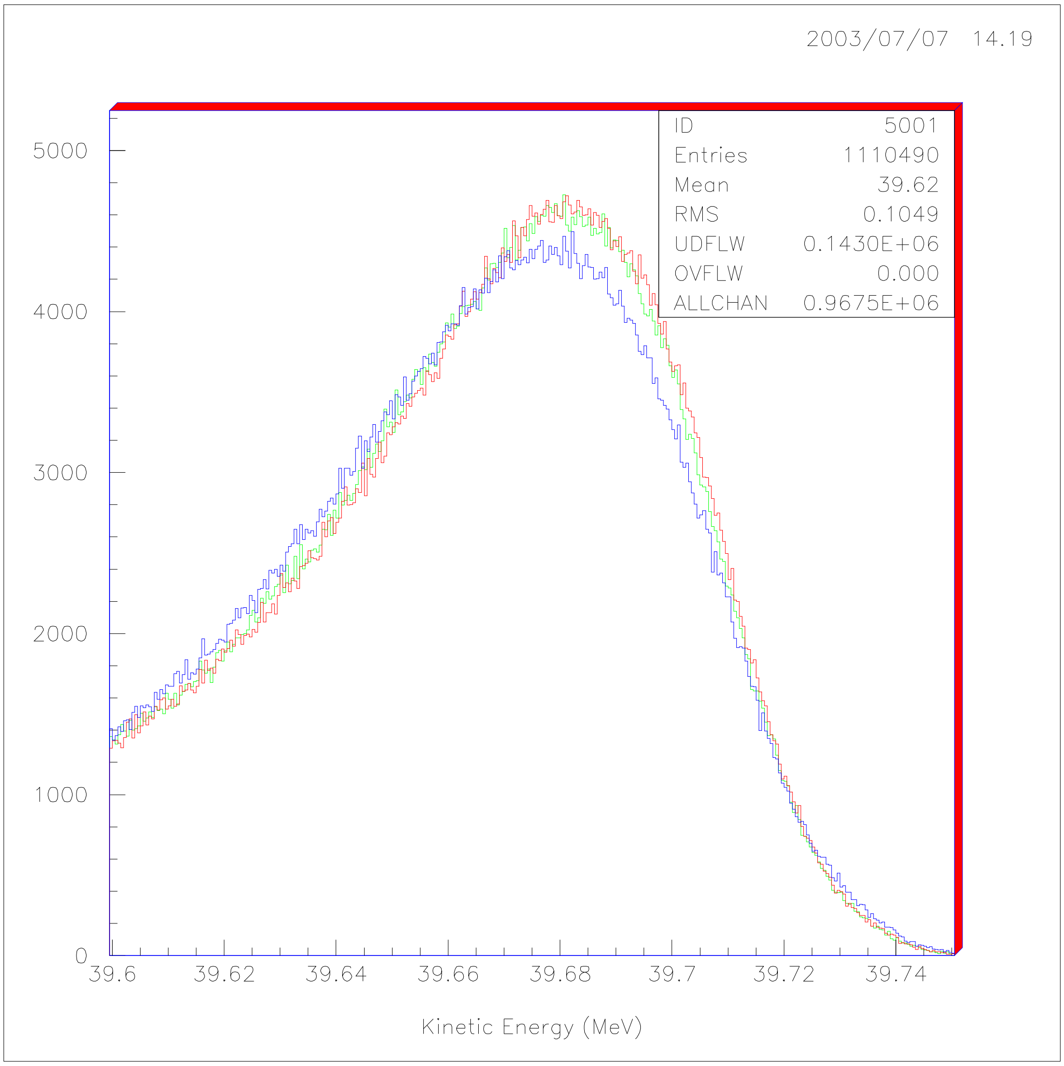

Figure 2: Kinetic energy of the positron beam at $51.0cm$ for $STEmax = 1$ (blue), 10 (green), and 100 (red) μm.

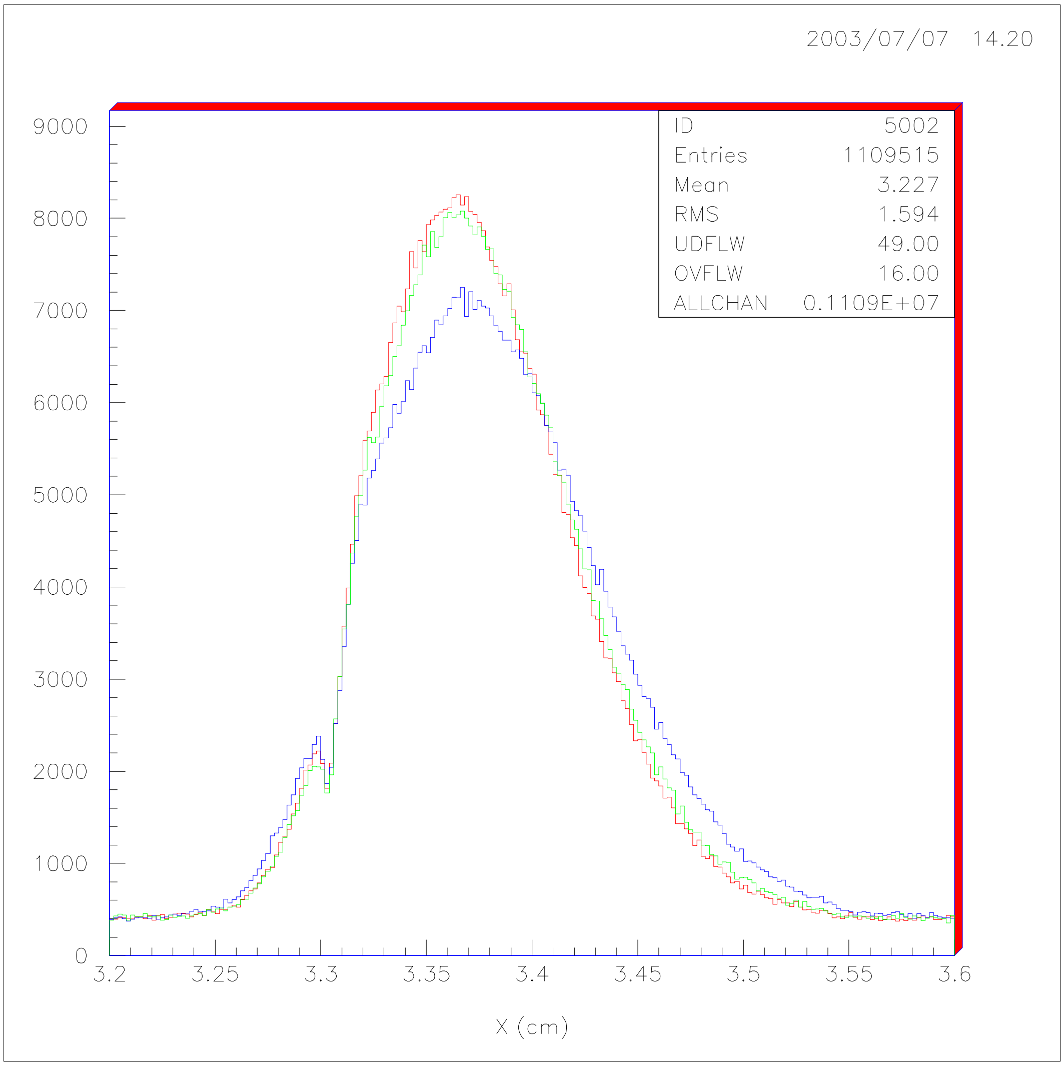

Figure 3: X position of the positron beam at $51.0cm$ for $STEmax = 1$ (blue), 10 (green), and 100 (red) μm.

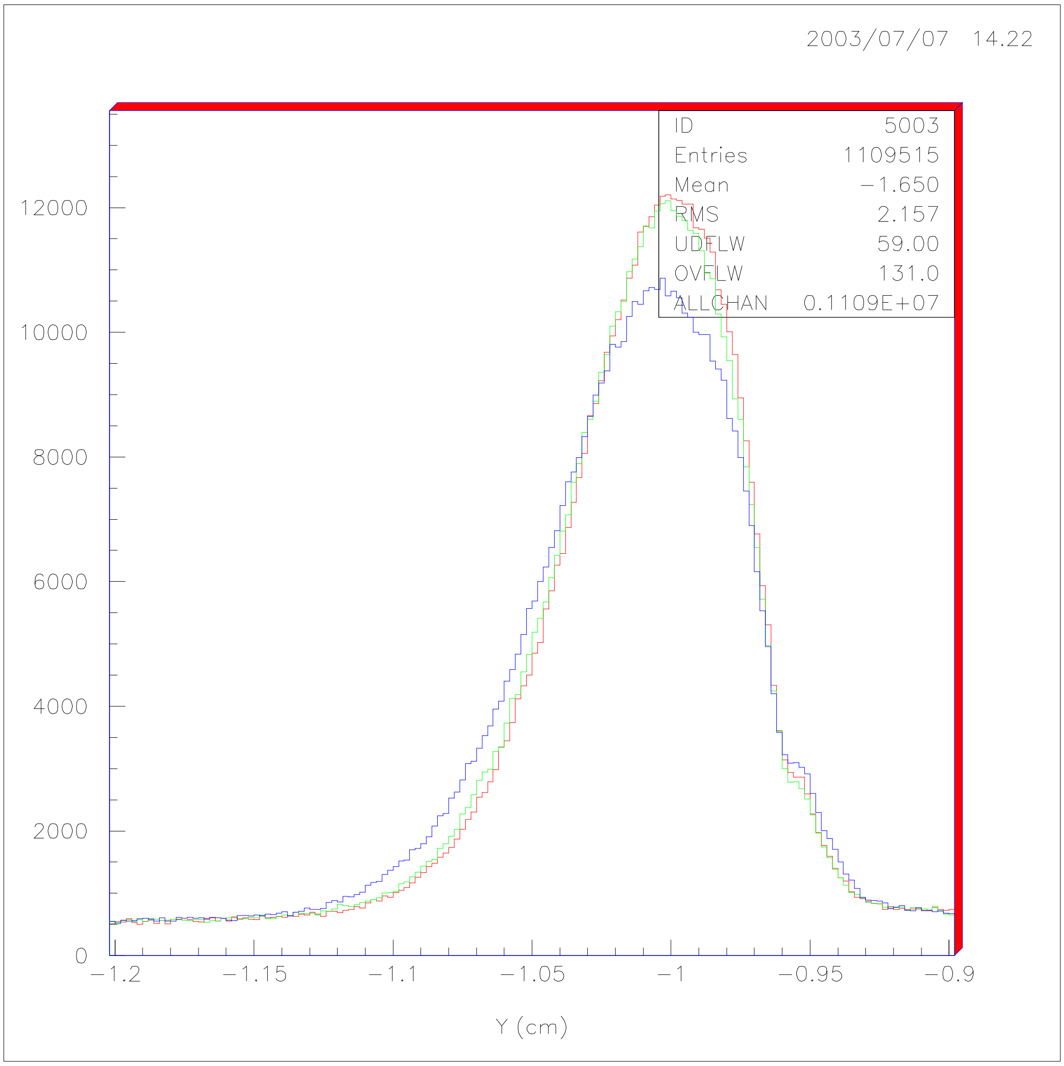

Figure 4: Y position of the positron beam at $51.0cm$ for $STEmax = 1$ (blue), 10 (green), and 100(red) μm.