UPC-electrons in PIXEL

S. Margetis, J. Thomas, F. Videbaek, Y. Fisyak, J. Bouchet

- Full GEANT simulation with *Starlight*
  - Generation of UPC pairs using Starlight
  - Generation of full rapidity/eta (-6 to +6)
  - Full diamond coverage (σ_Z=20cm here)
  - UPGR15 geometry - CDR
  - Hit densities due to spirals included
  - Impact on D0 efficiency estimated

Directory with codes/kumacs/plots/scripts/history here:
/star/institutions/ksu/margetis/hft/starlight/run

Kai Schweda 5/5/2005

	HFT
Inner radius:	1.3 cm
Outer radius:	5.0 cm
Magnetic field:	0.5 T
p_T - cut-off:	1.0 MeV/c
UPC X-section*:	34 k barn
Visible X-section:	3.460 k barn
Luminosity:	10^{27} cm-^{2}s^{-1}
Rate:	3.46 x10^6

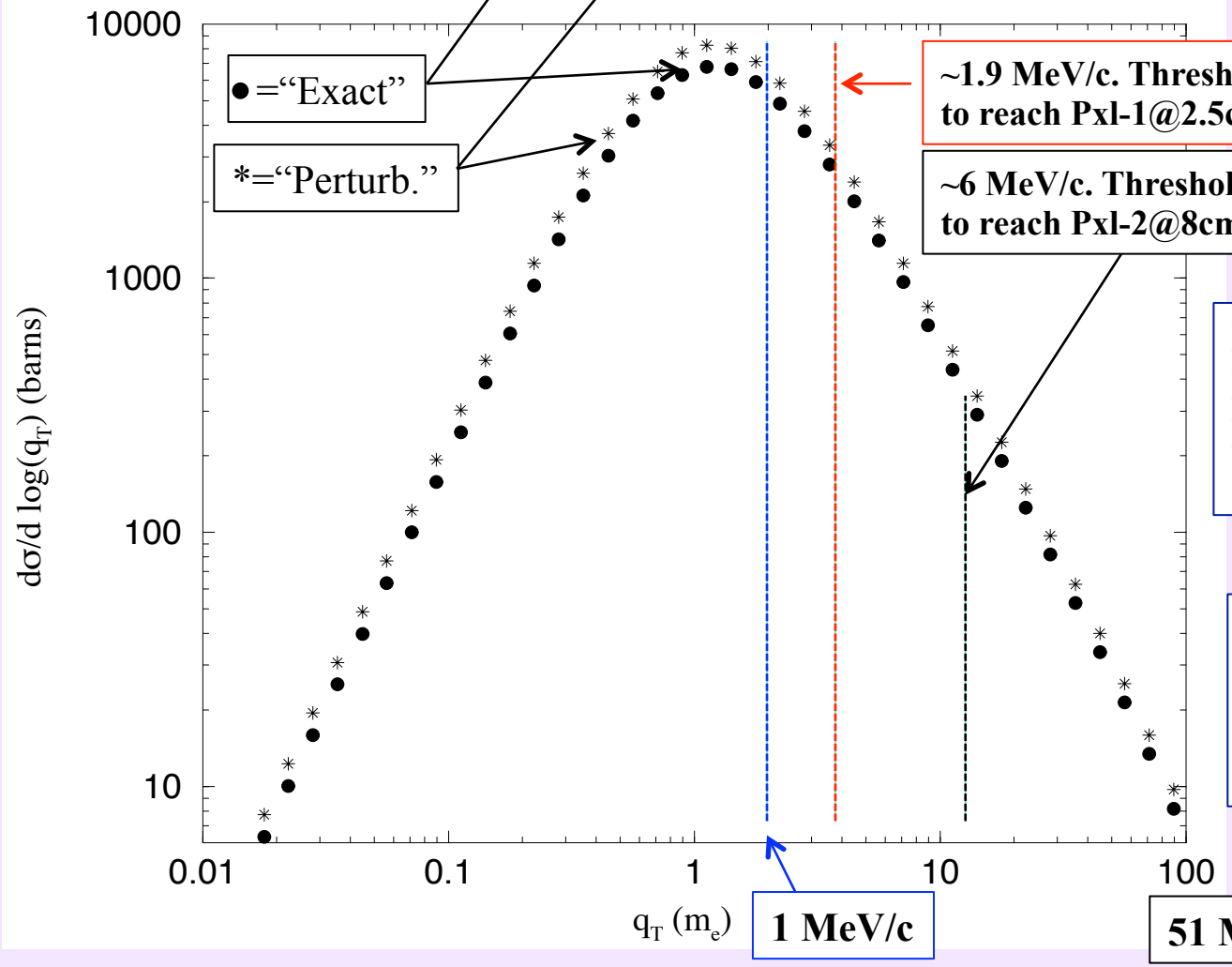
	UPC	Hadronic Au + Au
Integration time:	4 ms	4 ms
Hit density, inner layer:	57 cm^{-2}	58 cm^{-2}
Hit density, outer layer:	6 cm^{-2}	14 cm^{-2}

*QED calculations: A.J. Baltz, nucl-th/0409044.

*QED calculations: A.J. Baltz, nucl-th/0409044v3

Au + Au	Computer Evaluation	28,600	34,600	-6,000 (+220)
$\gamma = 100$	Racah Formula		34,200	
	Hencken, Trautmann, Baur		34,000	
	Lee-Milstein	34,100	42,500	-8,400 (+290)

Perturb=Exact*1.21



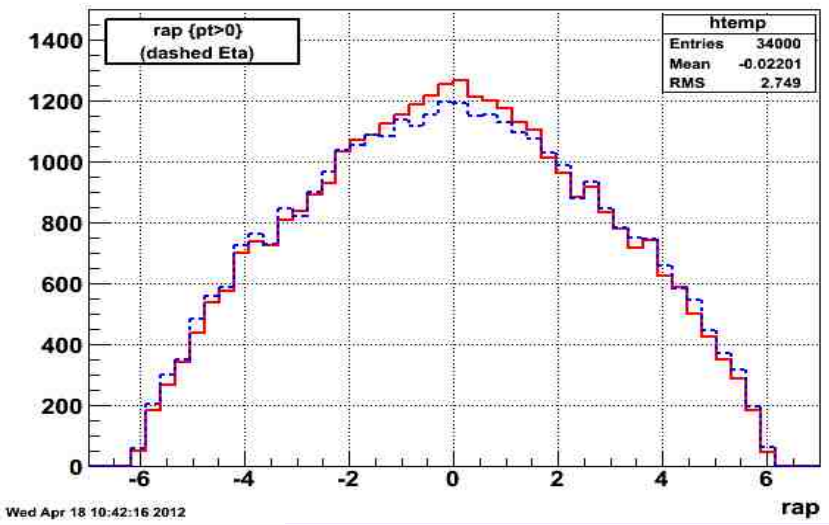
Pxl-1 x-section ~4(5)Kbarn
Kai ~3.5Kbarn
Pxl-2 x-section ~350 (420) barn
1MeV cut σ ~ 8 (9.7) Kbarn

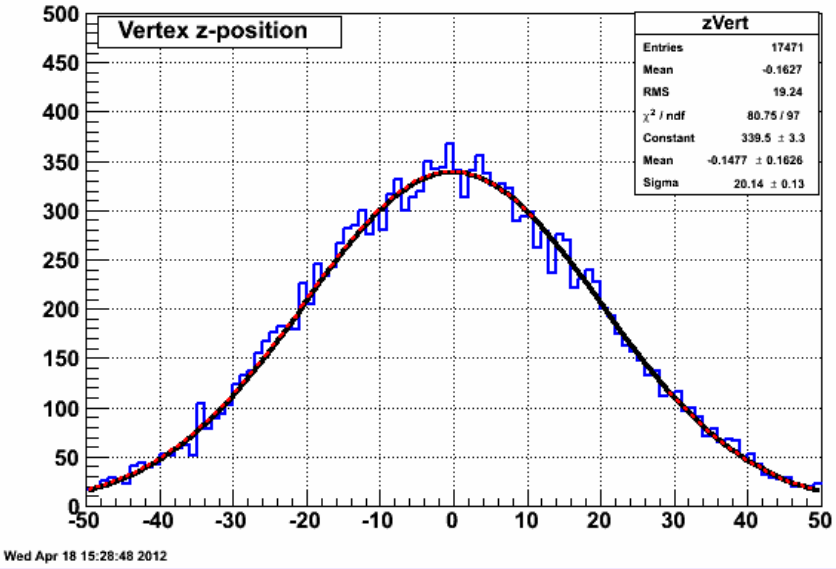
Using 4Kbarn, Event rate is (for $L=80*10^{26}$) Rate=32MHz and (for 0.2ms integr. time) gives PileUp=$6.4*10^3$ Events

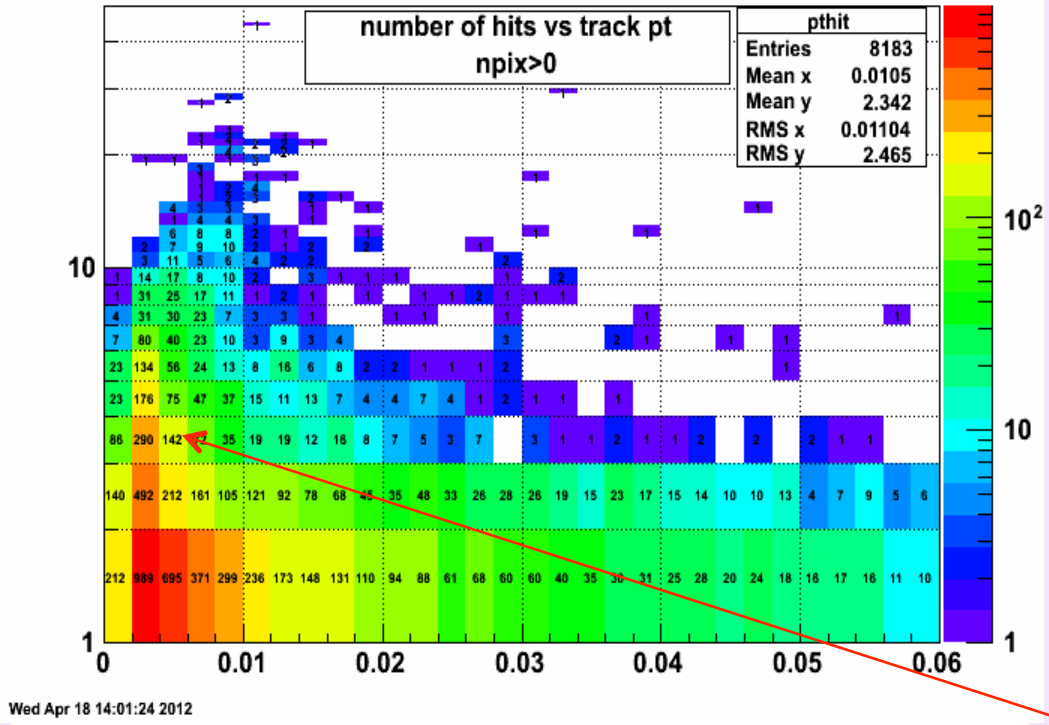
- For 4Kbarn (and L=80*10^{26}) Rate=32MHz and (for 0.2ms) gives PileUp=6.4*10^3 Events
- **For Starsim (~1 MeV E^{γ}_{cm} cut) and 10.6 Kbarn x-section PileUp= 17 Kevnts**

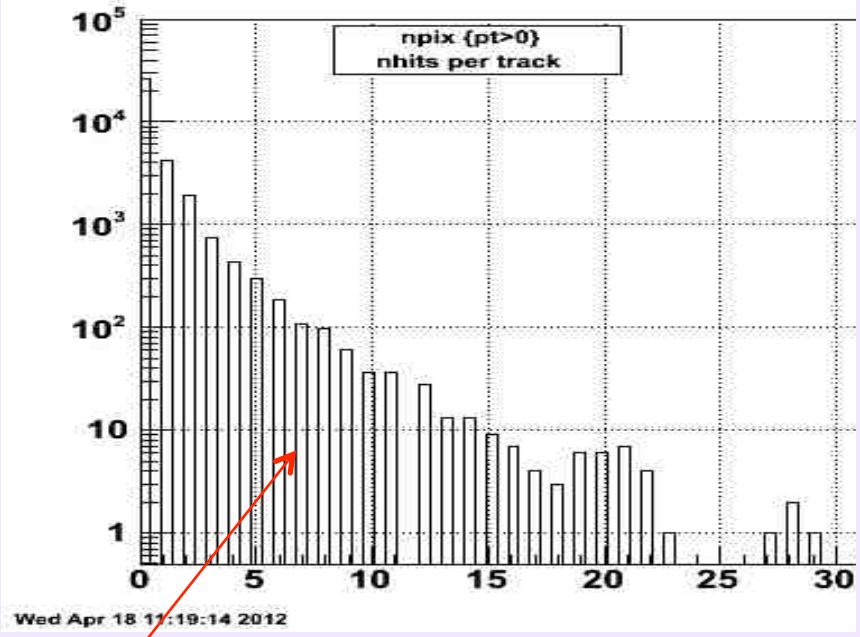
detp geom upgr15

```
BEAM_1_Z  79       # Z of projectile
BEAM_1_A  197      # A of projectile
BEAM_2_Z  79       # Z of target
BEAM_2_A  197      # A of target
BEAM_GAMMA  108.4  # Gamma of the colliding ions
W_MAX  1.0         # Max value of w
W_MIN  0.001       # Min value of w, γ+γ cm energy
RAP_MAX  6.        # max y
CUT_PT  0          # Cut in pT? (0  no, 1  yes)
CUT_ETA  1         # Cut in pseudorapidity? (0  no, 1  yes)
ETA_MIN  -6.       # Minimum pseudorapidity
ETA_MAX  6.        # Maximum pseudorapidity
PROD_MODE  1       # gg or gP switch (1  2-photon )
PROD_PID  11   # Channel of interest e+ + e-  pairs
BREAKUP_MODE  4    # Nuclear breakup 4=leave intact
INTERFERENCE  0    # Interference (0  off, 1  on)

gkine -9 0
gfile o [outfile]

gvertex 0.32  0.09 -0.1
gspread 0.055 0.02 20.0
```

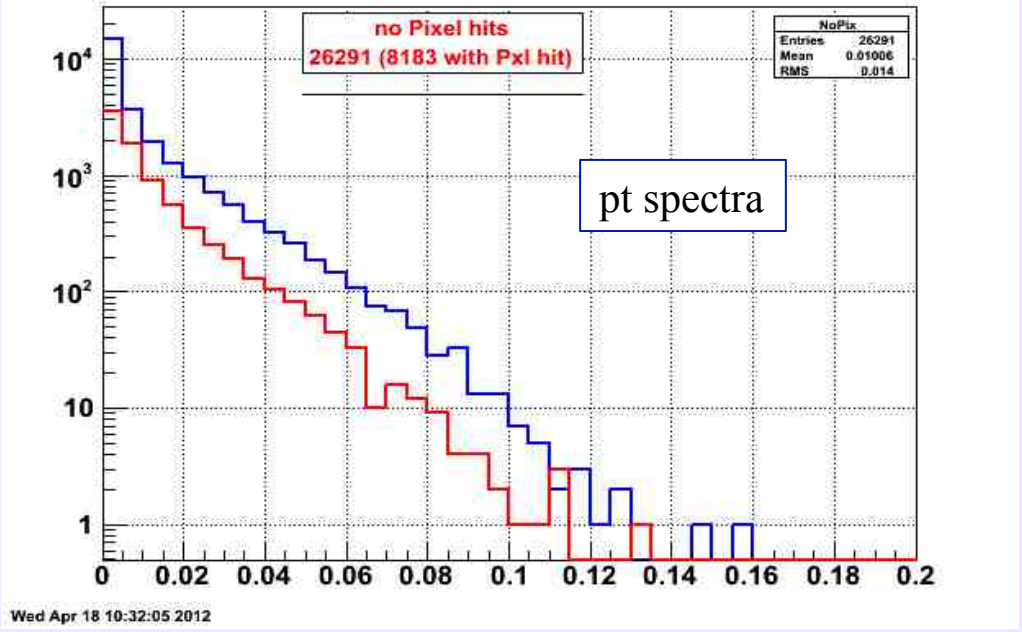




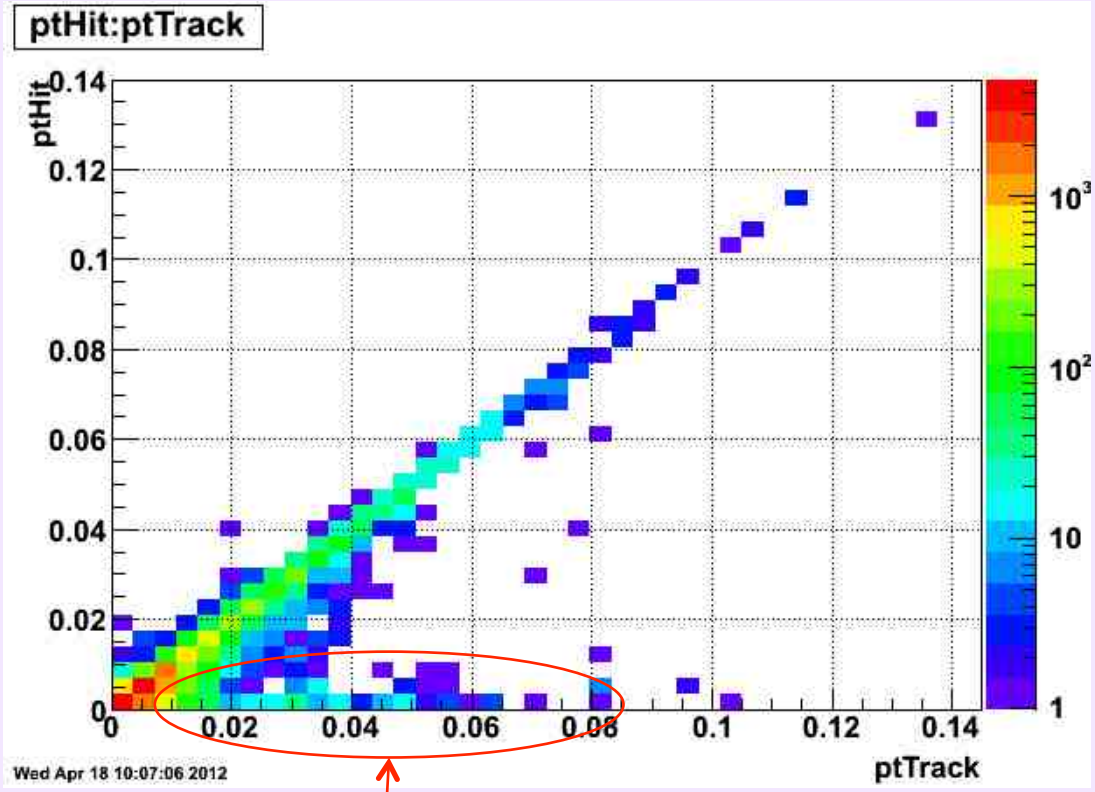




SPIRALS @ low pt



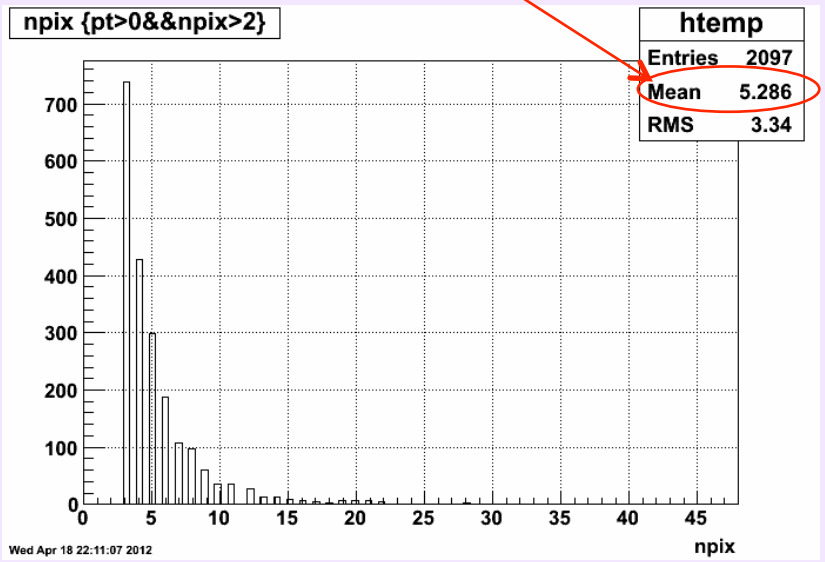
Tracks with:
Zero Hits = 26 K
One Hit = 4 K
Two Hits = 2 K
>2 Hits = 2 K

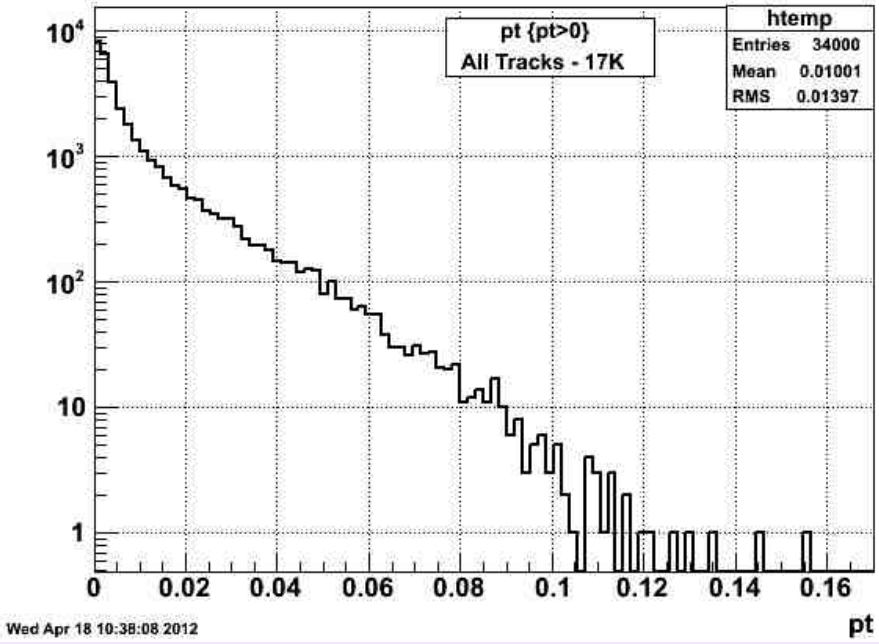


Track Pt as recorded at Hit Position vs the parent track Pt

Important
Average number of Hits per Spiraling Track = 5.3

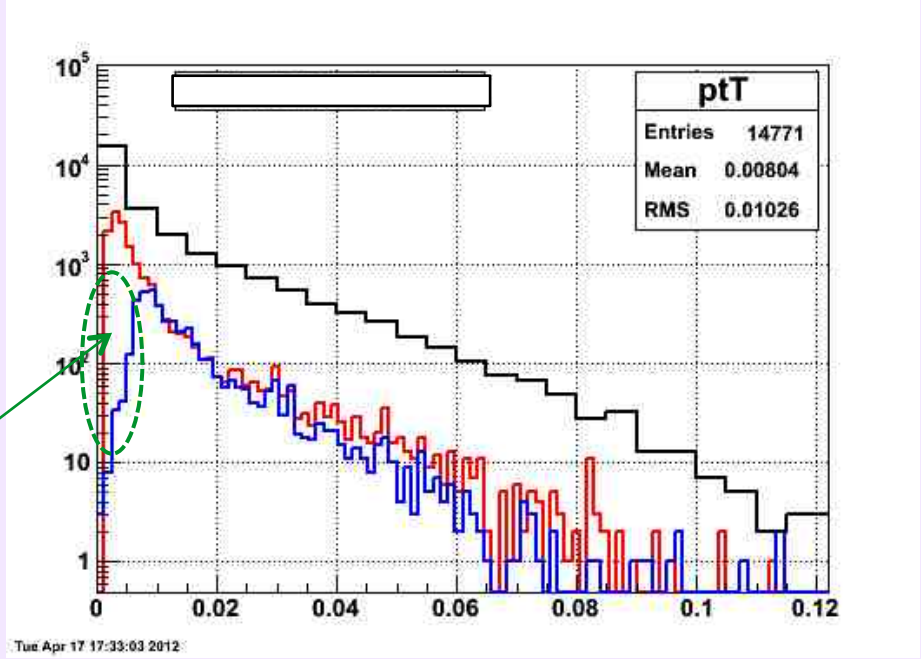
SPIRALS tend to have much lower pt than original track

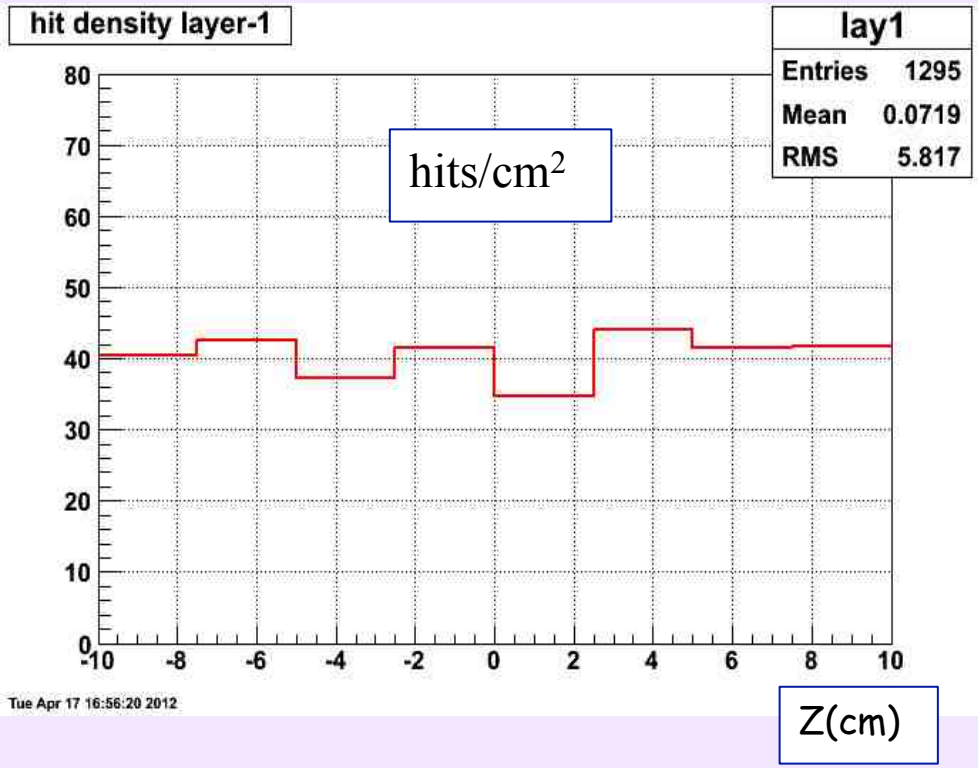


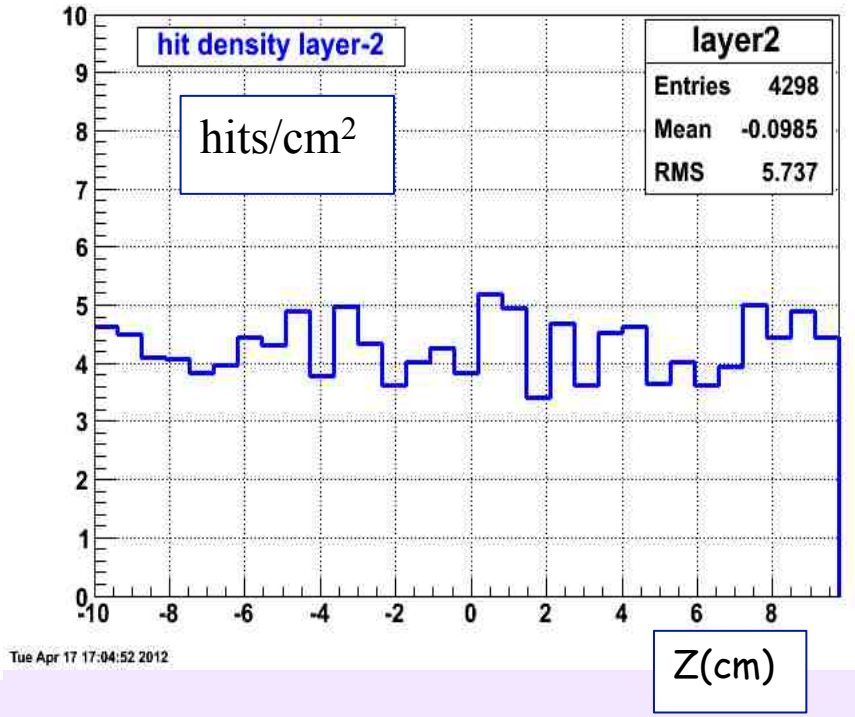


- This spectrum is compatible with others (full rapidity). Very low pt region depends on cuts used.
- It also agrees with Theory one (a few slides up)
- There are some higher pt tails if one allows for nuclear breakup

Layer-2 harder to reach than Layer-1





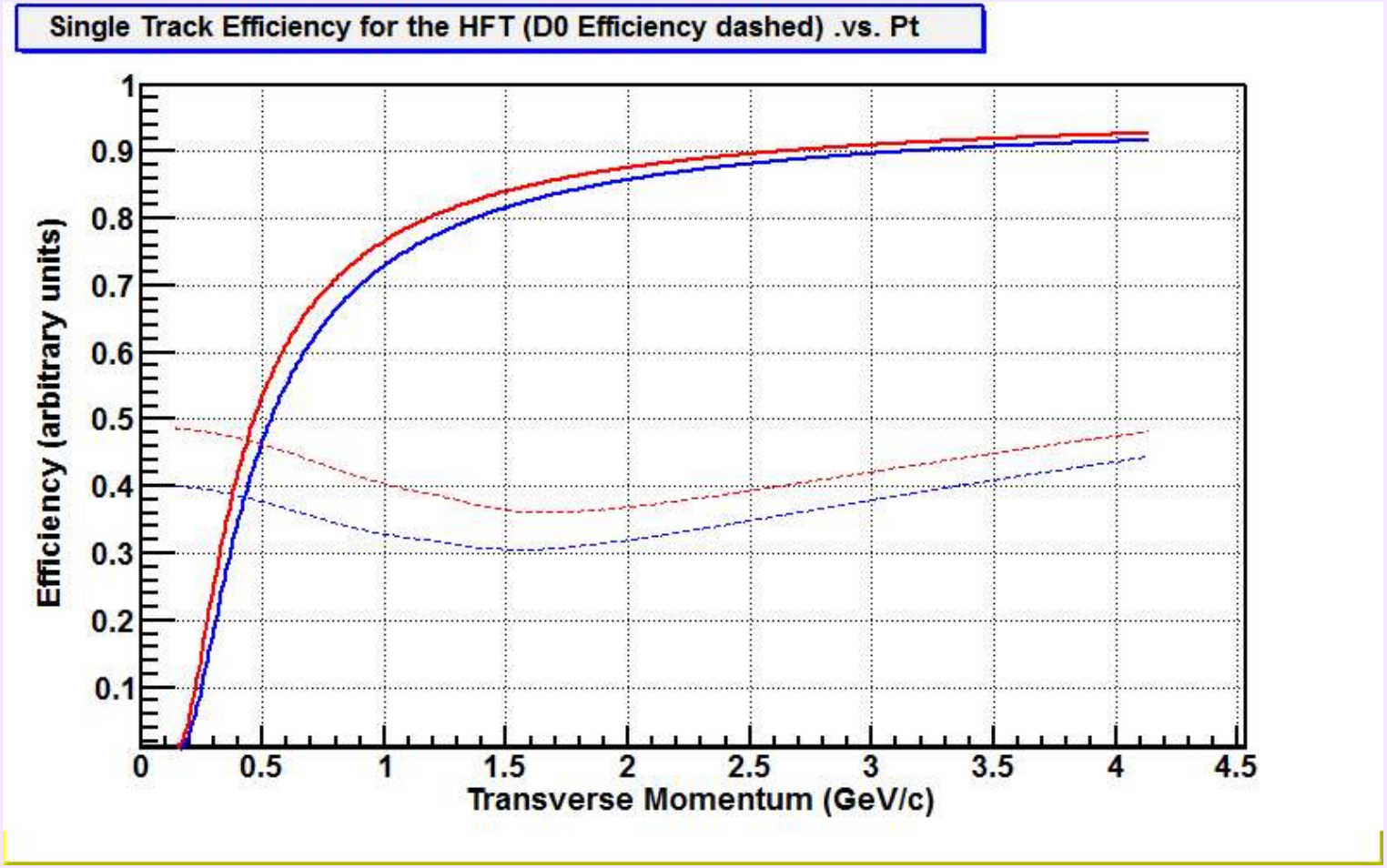


Au+Au Luminosity (RHIC-II)	80 x 10^{26} $cm^{-2}s^{-1}$
dn/dη (Central)	700
dn/dη (MinBias)	170
MinBias cross section	10 barns
MinBias collision rate (RHIC-II)	80 kHz
Interaction diamond size, σ	15 cm
Integration time for Pixel Chips	200 μsec

	PIXEL-1 Inner Layer	PIXEL-2 Outer Layer
Radius	2.5 cm	7.0 cm
Central collision hit density	17.8 cm^{-2}	2.3 cm^{-2}
Integrated MinBias collisions (pileup)	23.5 cm^{-2}	5.2 cm^{-2}
UPC electrons	19.9 cm^{-2}	0.8 cm^{-2}
Totals	**61.2 cm^{-2}**	**8.3 cm^{-2}**

Full simulations show a factor of 2 more hits in layer-1 and 5 in layer-2
If I use the same sigma=15 they will go up

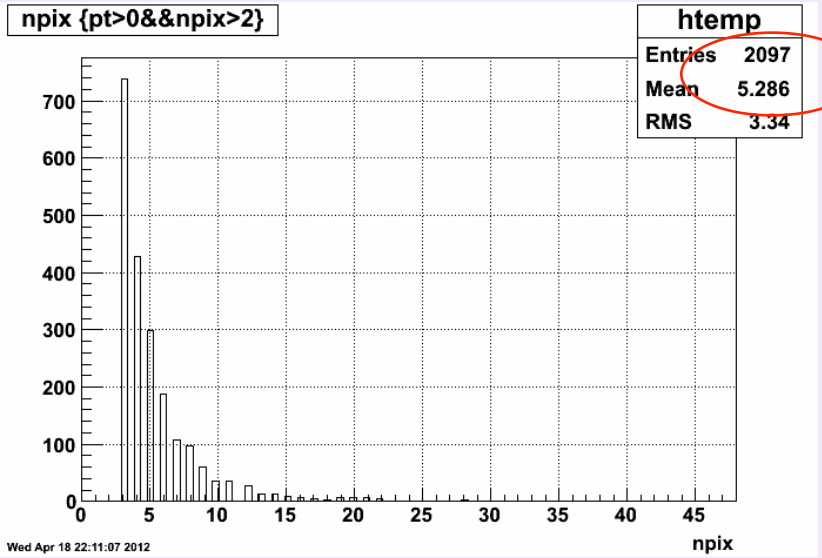
Bottom line: Effect on D0 efficiency



Red= Using HFT-proposal numbers
Blue= Using this results

An Extreme Test - Set CUTELE and DCUTE to 10 KeV instead of 1 MeV

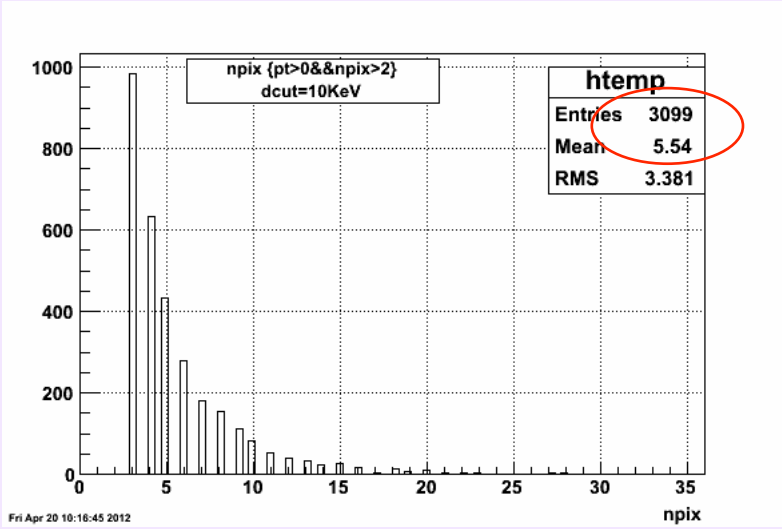
1 MeV



Tracks with:
Zero Hits = 26 K
One Hit = 4.2 K
Two Hits = 1.9 K
>2 Hits = 2.1 K

Total # of Hits = 19.1 K

10 KeV

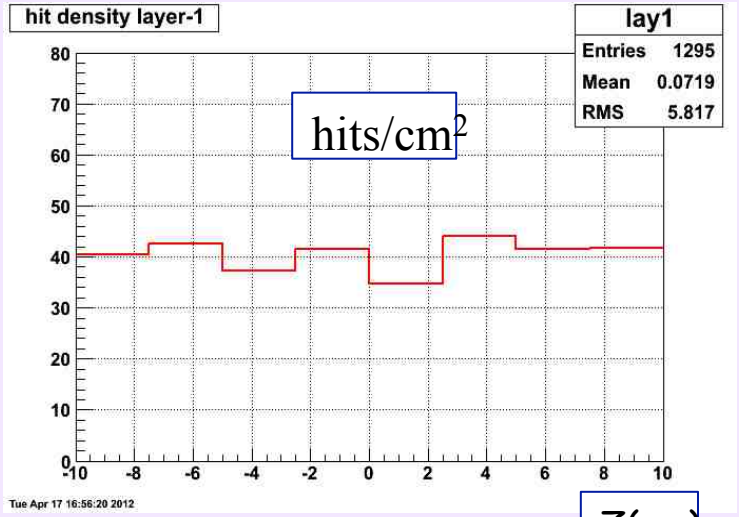


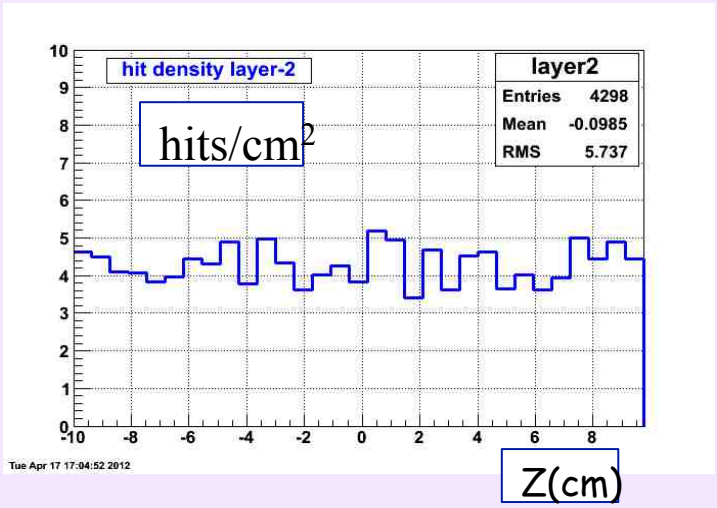
Tracks with:
Zero Hits = 26 K
One Hit = 3.5 K
Two Hits = 1.6 K
>2 Hits = 3.1 K

Total # of Hits = 23.9 K

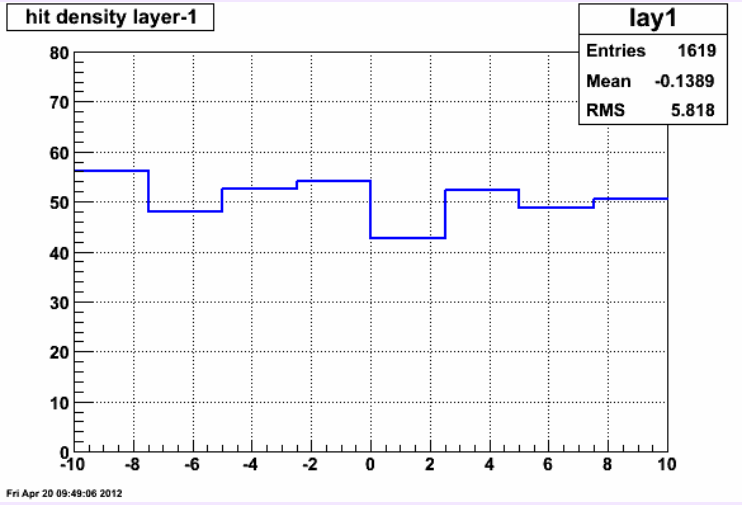
An Extreme Test – Set CUTELE and DCUTE to 10 KeV instead of 1 MeV

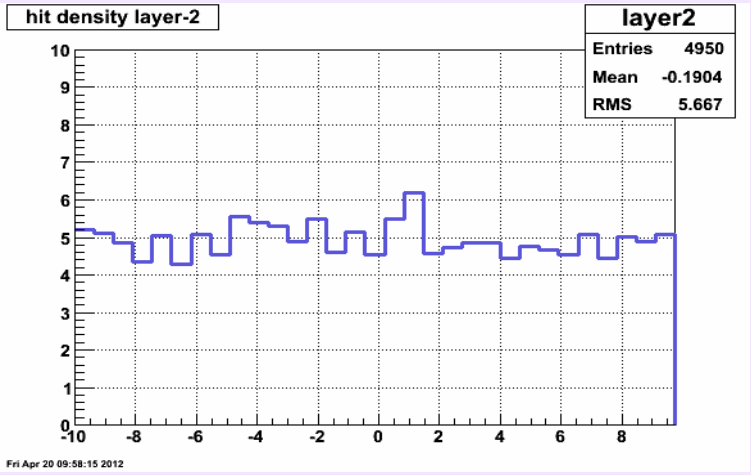
1 MeV





10 KeV





Summary

- We get **many** hits from spiraling
  - Out of 19.1 Khits (total), about 2097 Tr * (5.3<hits/Tr>-2) =6.9Khits
  - hard to estimate exactly or which layer but doable (will check)
- We get contributions from tracks with large z_{vertex} if y is right
- We estimate a higher UPC –electron background in both layers
  - factors 2 [5] higher than CDO in layer-1[2]
  - extreme scenarios do not affect density dramatically (upto 25% increase)
  - simulation shows a different radial dependence than CDO
- Impact on DO efficiency visible