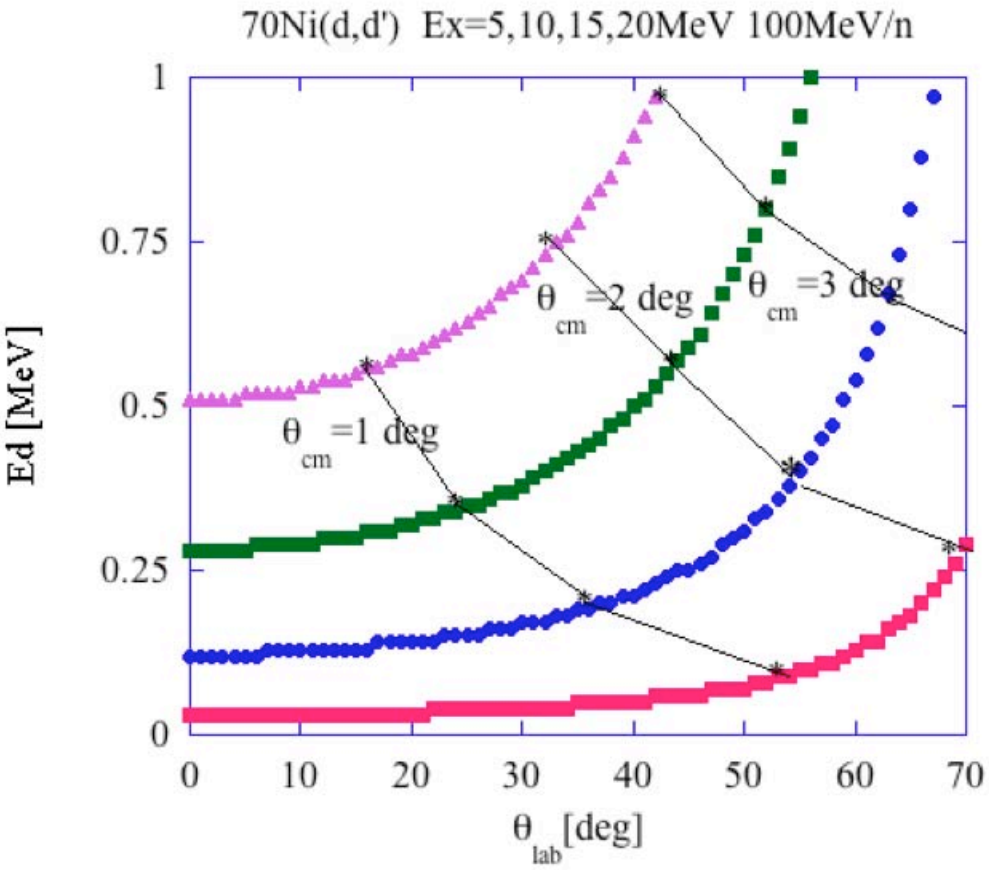
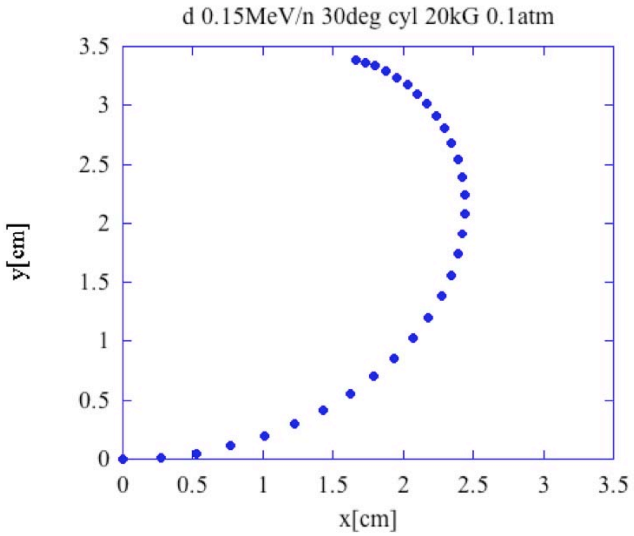
# Some simulations for the AT-TPC mainly at low E

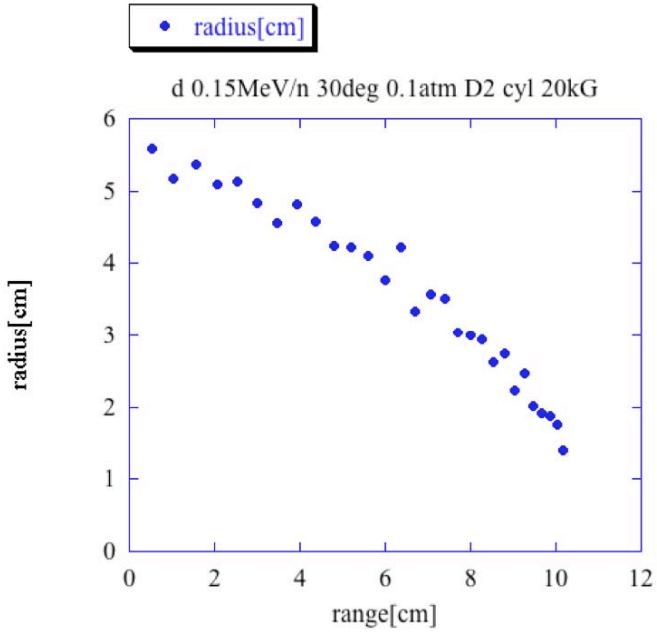
W.Mittig

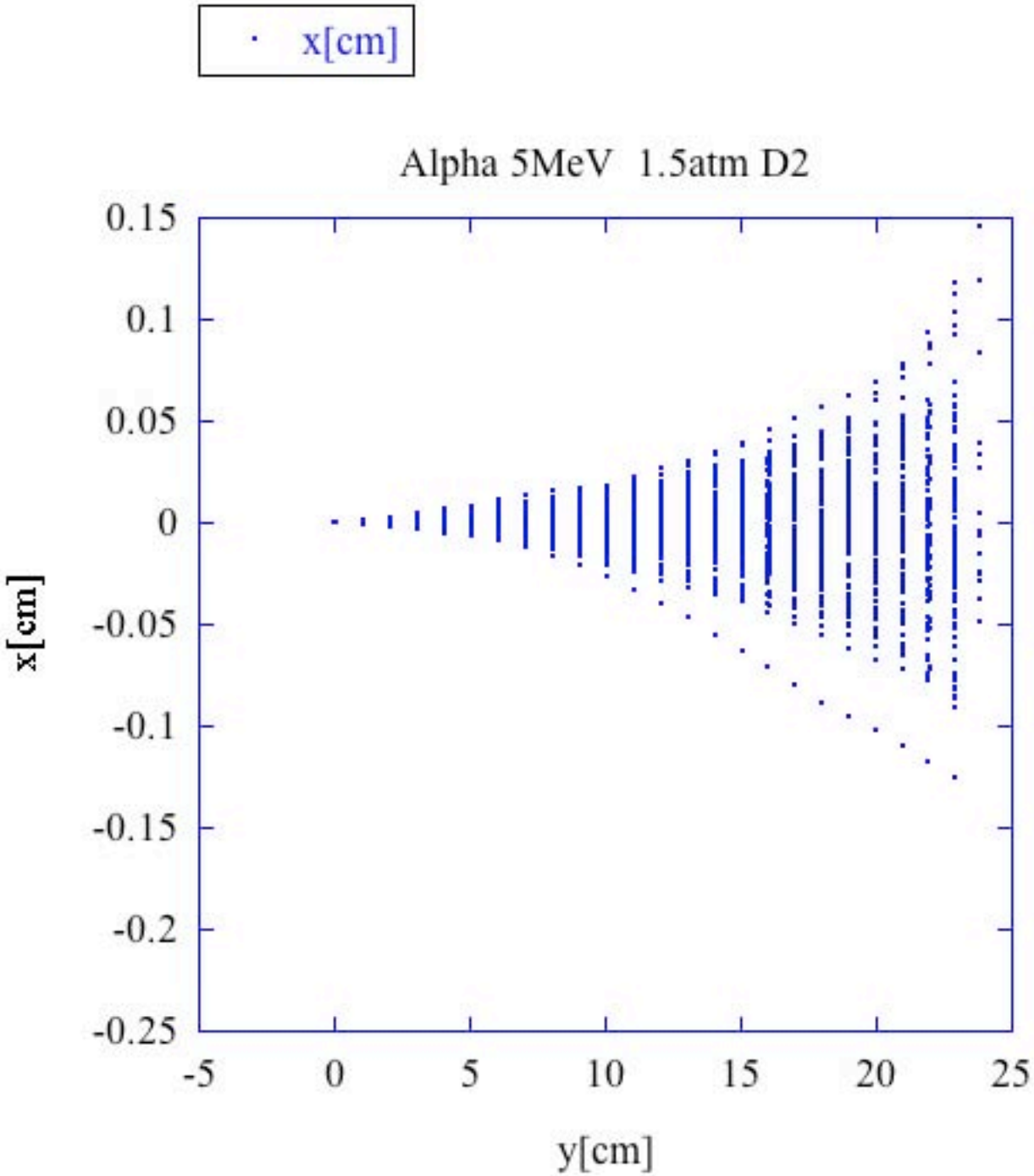
MSU-NSCL

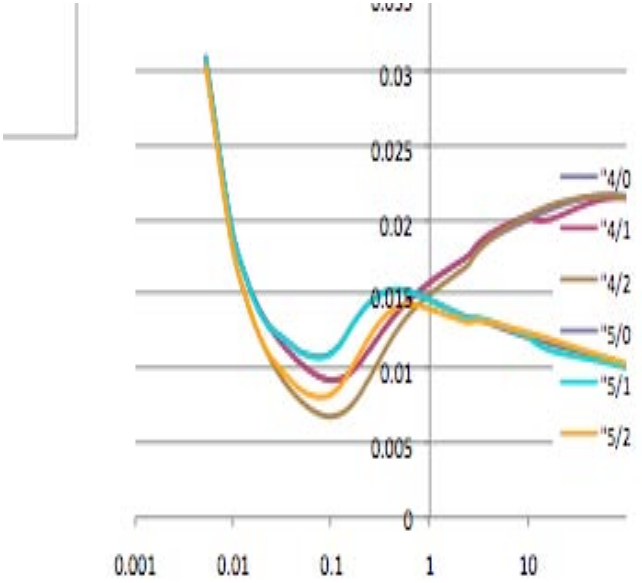
Get meeting Caen 10-12 march 2009


70Ni(d,d') Ex=5,10,15,20MeV 100MeV/n
Ed [MeV]
θ lab [deg]
θ cm =1 deg
θ cm =2 deg
θ cm =3 deg
0
0.25
0.5
0.75
1
0
10
20
30
40
50
60
70

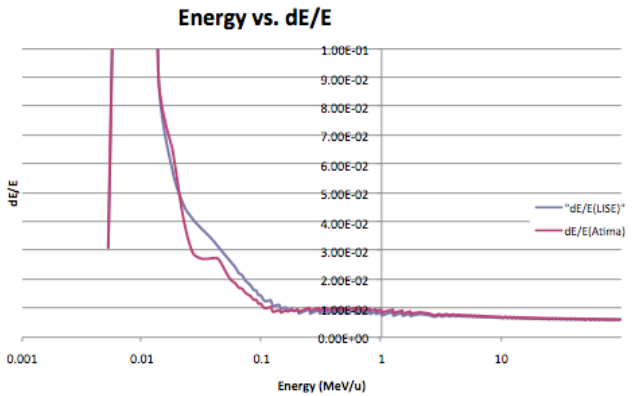

d 0.15MeV/n 30deg cyl 20kG 0.1atm
y[cm]
x[cm]
0
0.5
1
1.5
2
2.5
3
3.5


radius[cm]
d 0.15MeV/n 30deg 0.1atm D2 cyl 20kG
radius[cm]
range[cm]
0
1
2
3
4
5
6
0
2
4
6
8
10
12

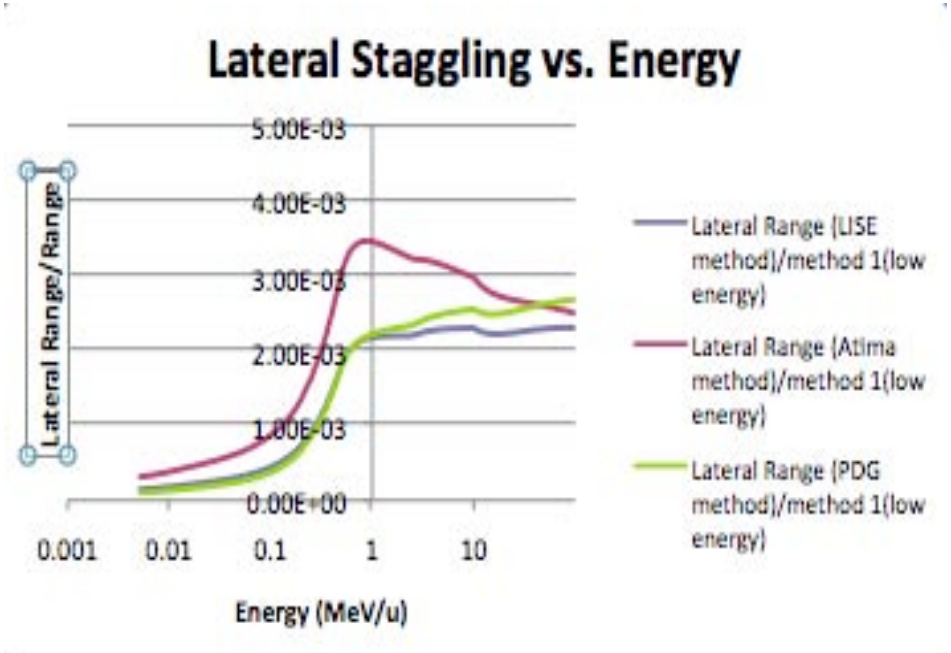

x[cm]
Alpha 5MeV 1.5atm D2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
x[cm]
-5
0
5
10
15
20
25
y[cm]

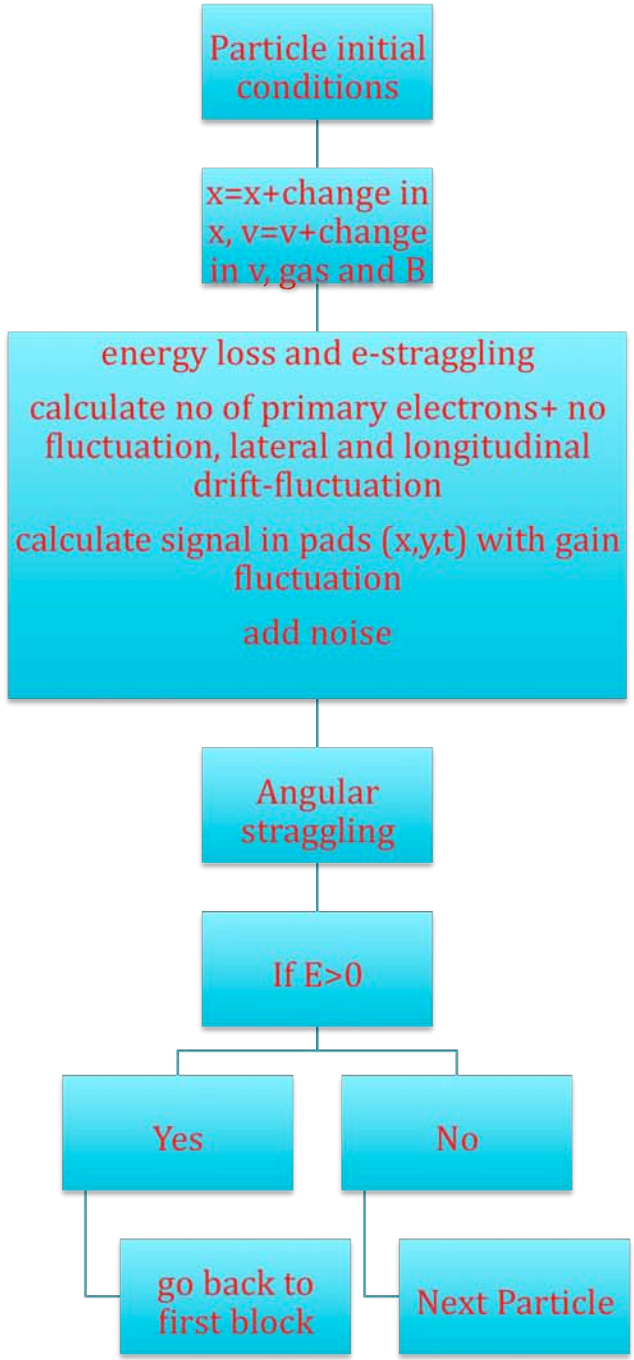



This is dR/R as a function energy[MeV] for Lise and Atima; the fine structure are different formula of range, the somewhat divergent curves at higher energy are for lise (upper ones) and Atima (lower ones). So one can conclude that above 100keV, the ratio is 0.015+-0.005.
From this one can plot dE/E, if E is determined by the range:




K.Tylor+O.Tarasov




Particle initial conditions
x=x+change in x, v=v+change in v, gas and B
energy loss and e-straggling
calculate no of primary electrons+ no fluctuation, lateral and longitudinal drift-fluctuation
calculate signal in pads (x,y,t) with gain fluctuation
add noise
Angular straggling
If E>0
Yes
No
go back to first block
Next Particle

K.Tyler-WM

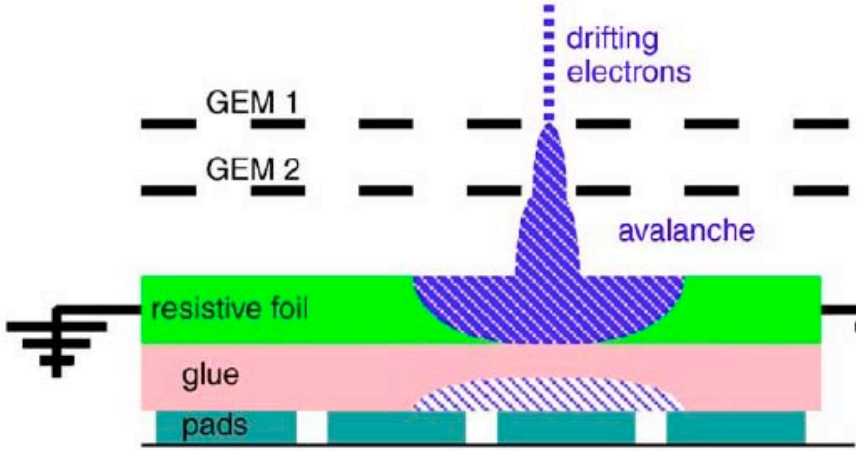



Fig. 1. Schematic of a double GEM test cell designed for dispersion studies.

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# Simulating the charge dispersion phenomena in Micro Pattern Gas Detectors with a resistive anode

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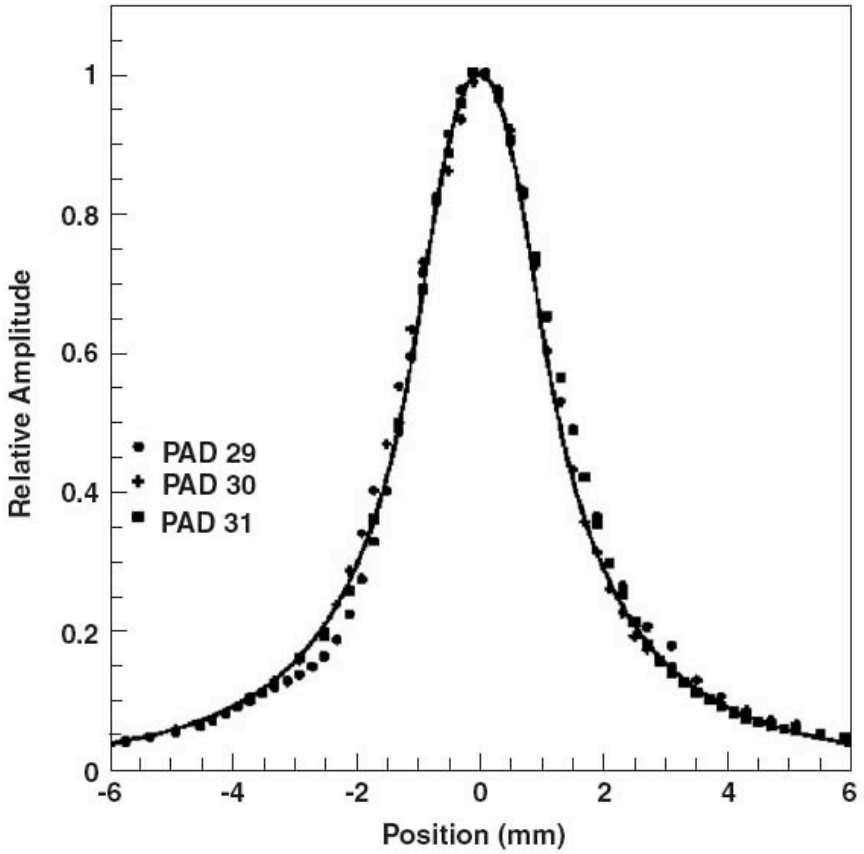
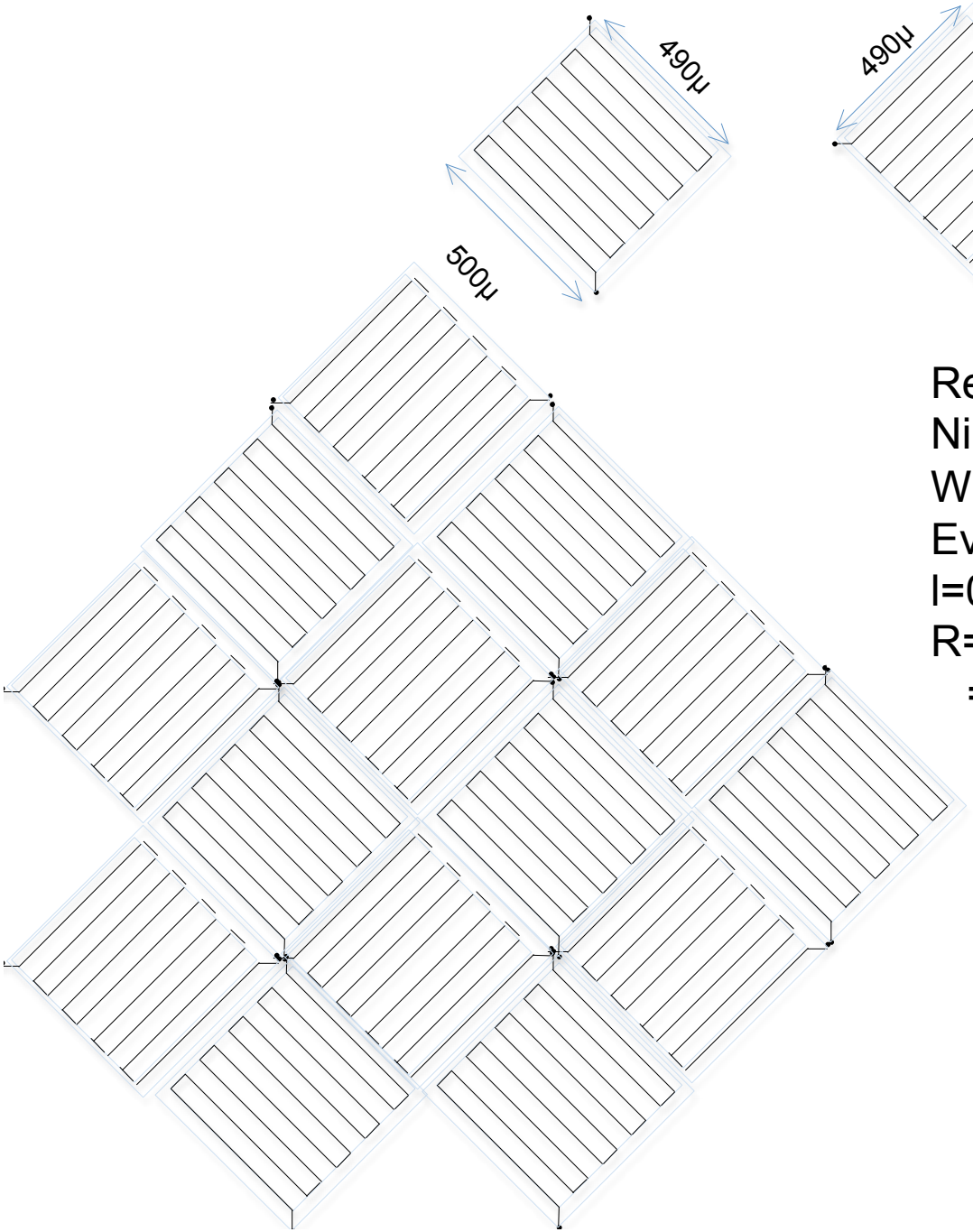
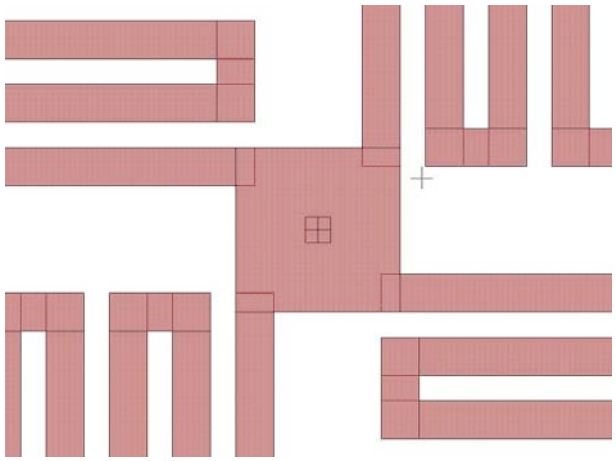
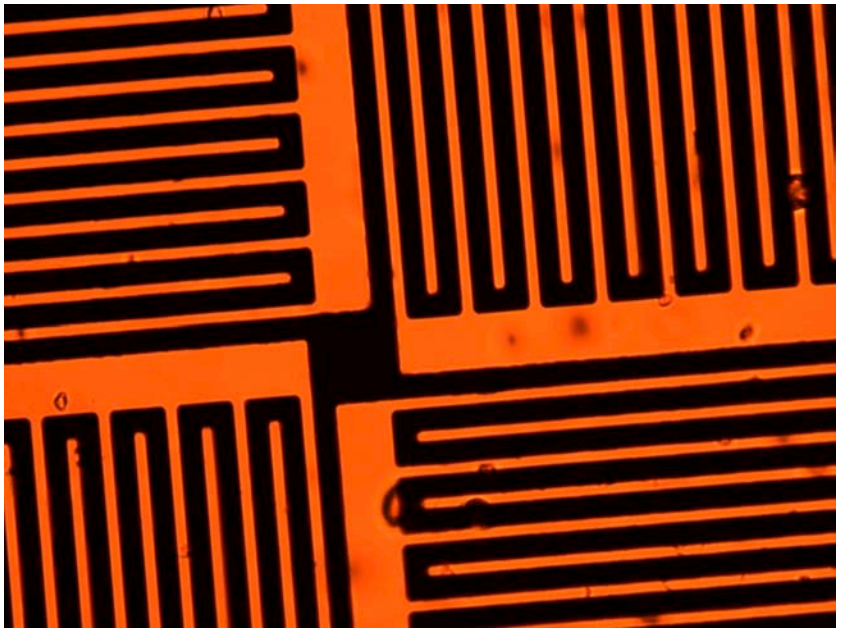


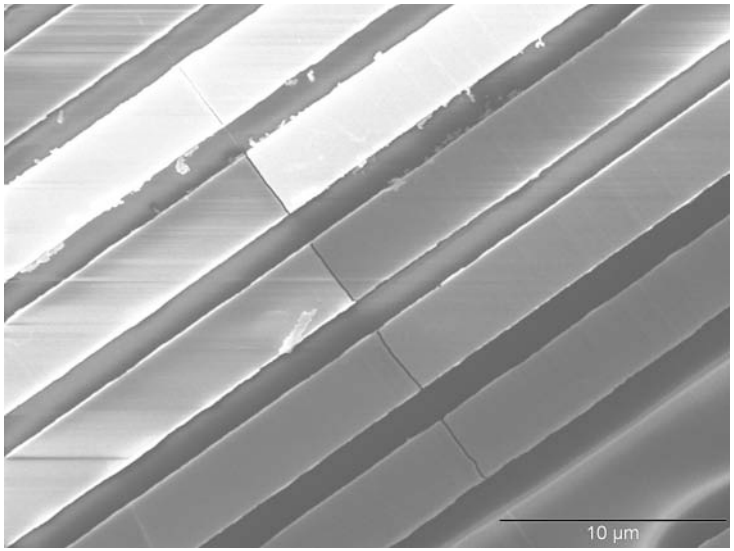

Fig. 4. Simulated pad response functions (PRF) compared to the measured PRFs for pads 29–31. The pad layout is shown in Fig. 5(a). The differences between the simulation and the measured PRFs are attributed to local variations in the system RC constant. Nevertheless, the simulated PRF is in good agreement with the data.



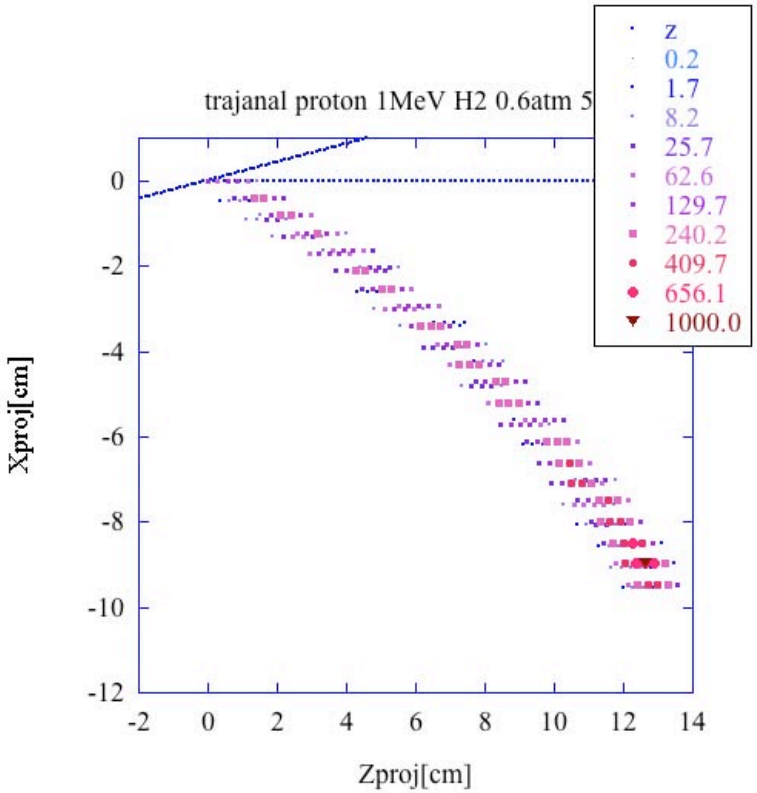

Resistance calculation:
NiCr $1.08 \cdot 10^{-6} \Omega m$
With 3µ strips 0.1µ thick,
Every 5µ length l
l=0.49mm*.49/0.005=49mm
$R=1.08 \cdot 10^{-6} \Omega m * 0.049m)/(3 \cdot 10^{-6} * 0.1 * 10^{-6})$
$=180k\Omega$







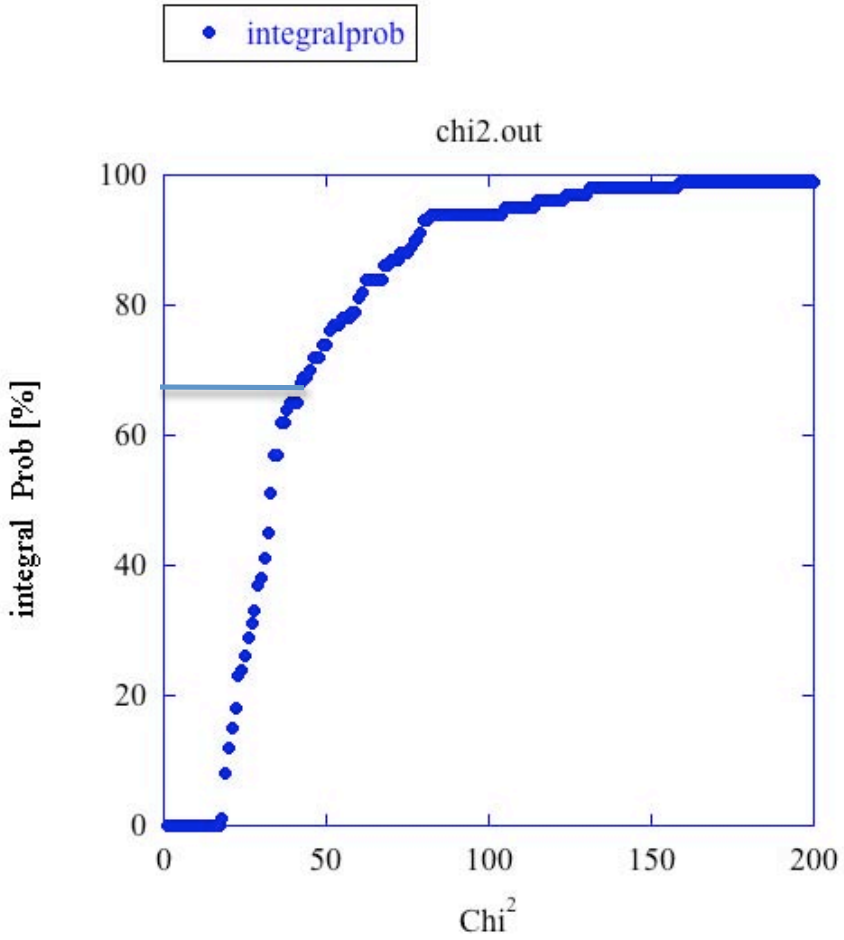

J.Yurkon + WM

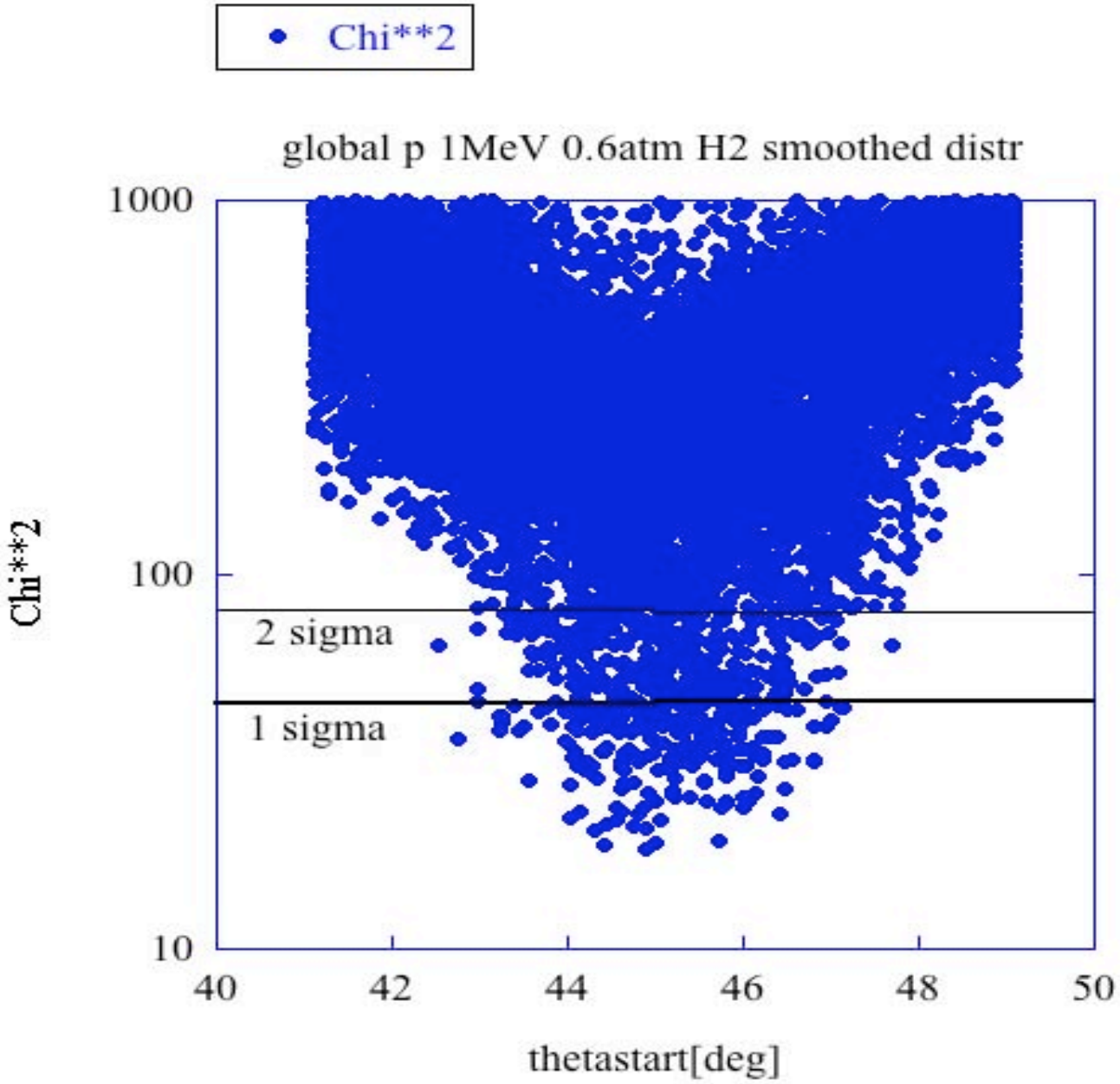


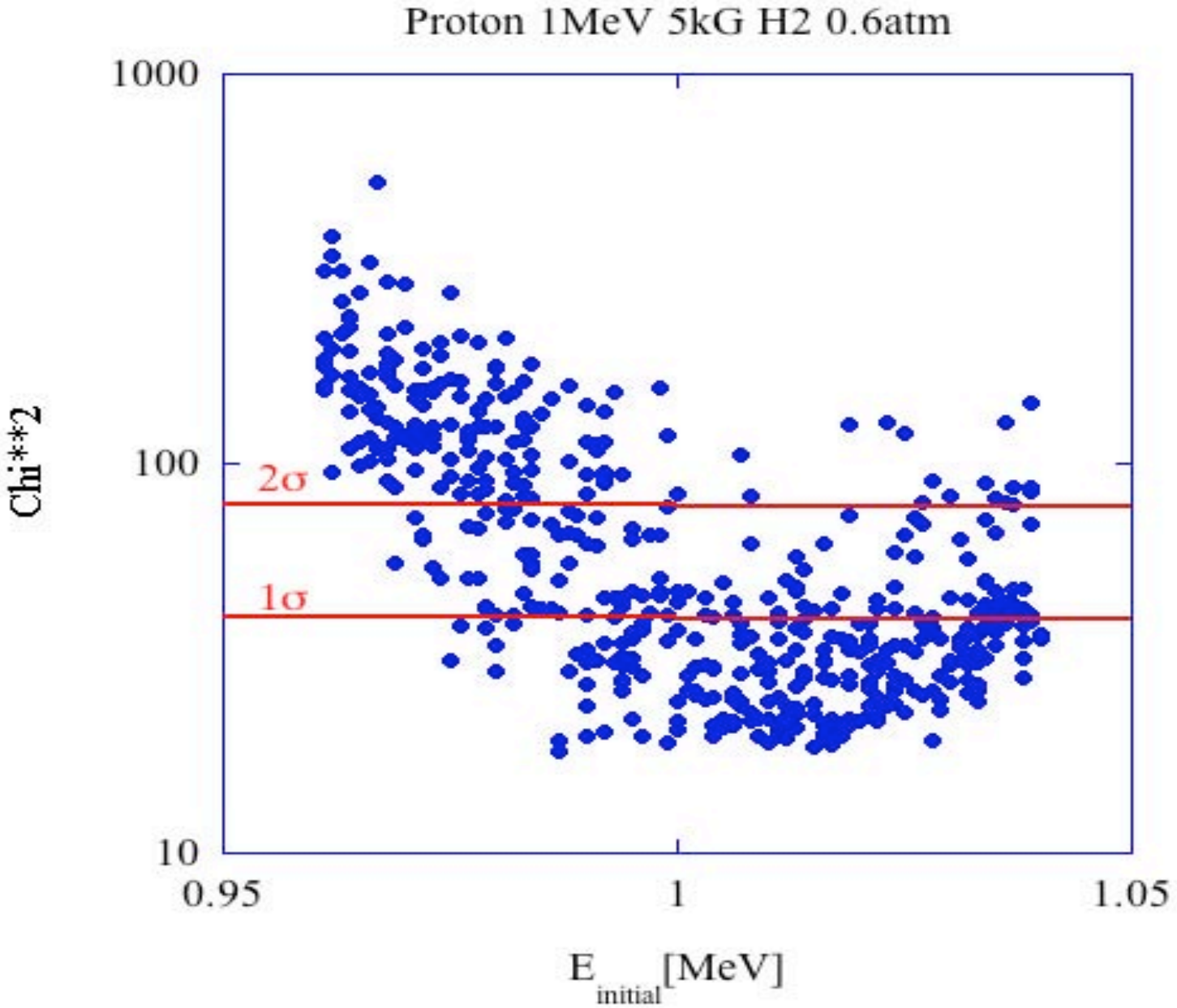

To get a quantitative estimate of the resolution that may be achieved, for a given experimental condition and a given padstructure, the following procedure is adopted:

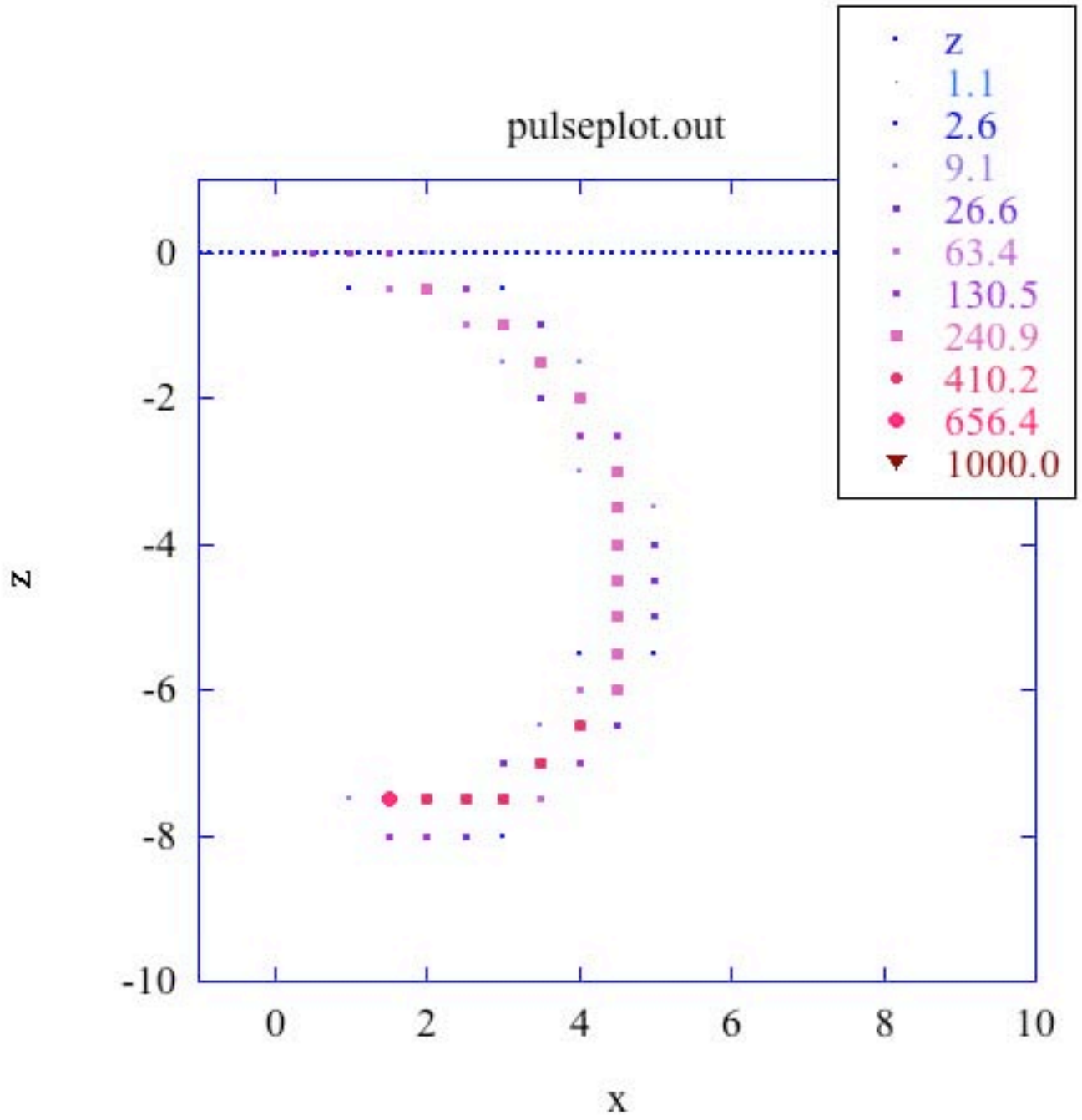
1) about 100 trajectories with fixed initial conditions are calculated
2) the mean value of signal in the 3-dim x,y,z space (digitalized following padstructue and time buckets)
3) the chi2 defined as the deviation of the signal for an individual trajectory with varying initial conditions from the mean value

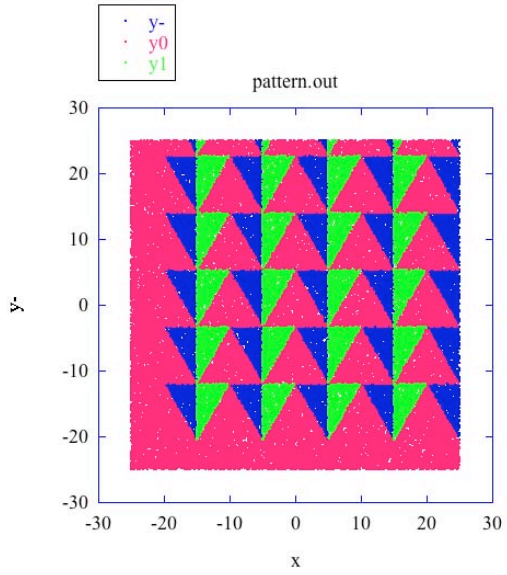
```
            do i=1,128
            do j=1,128
            do k=1,128
                  if (pulsemeannor(i,j,k).gt.threshold.and.
     $                pulsemeanev(i,j,k,nev).gt.threshold) then
                     npad=npad+1
          dev2=(pulsemeannor(i,j,k)-pulsemeanev(i,j,k,nev))**2
c         estimation of fluctuation just by electron statistics, noise  and
gain
          snelec=pulsemeanev(i,j,k,nev)/gain(i,j) !number of primary electrons
          dsnelec=sqrt(snelec)*gain(i,j) !fluctuation valid if >>1
          dpulse=dgain*pulsemeanev(i,j,k,nev)/(gain(i,j))  !fluctuation due to
gain
          sig2=snoise**2+dsnelec**2+ dpulse**2
          dev2=dev2/sig2   !normalisation taking into account these three
contributions
          chi2=chi2+dev2
                        else
                        endif
            enddo
            enddo
            enddo
            chi2=chi2/float(npad)
```

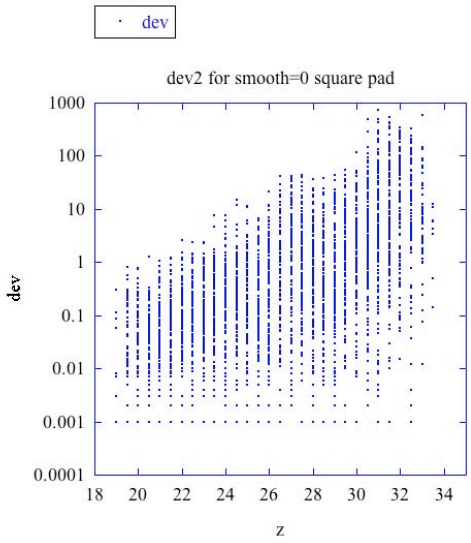

integralprob
chi2.out
integral Prob [%]
100
80
60
40
20
0
0
50
100
150
200
Chi2

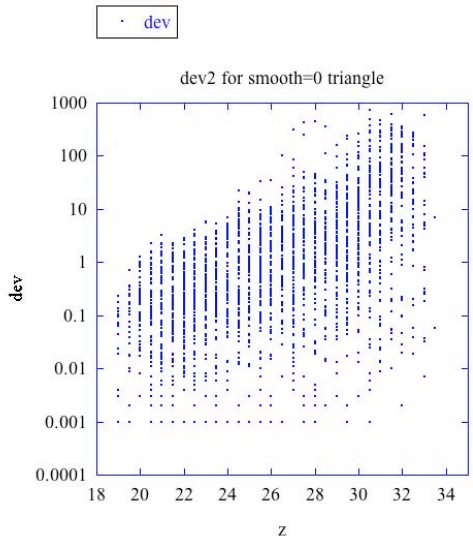

Chi**2
global p 1MeV 0.6atm H2 smoothed distr
1000
100
10
Chi**2
2 sigma
1 sigma
40
42
44
46
48
50
thetastart[deg]

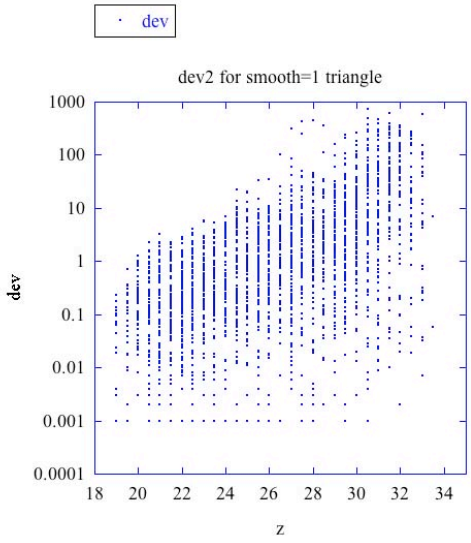

Proton 1MeV 5kG H2 0.6atm
1000
100
10
Chi**2
2σ
1σ
0.95
1
1.05
E initial [MeV]

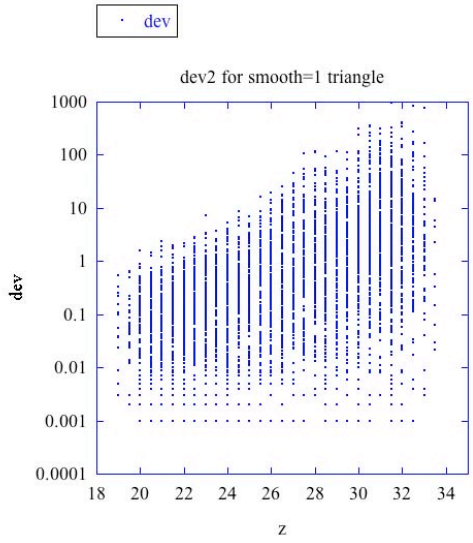

pulseplot.out
z
1.1
2.6
9.1
26.6
63.4
130.5
240.9
410.2
656.4
1000.0
0
-2
-4
-6
-8
-10
z
0
2
4
6
8
10
x

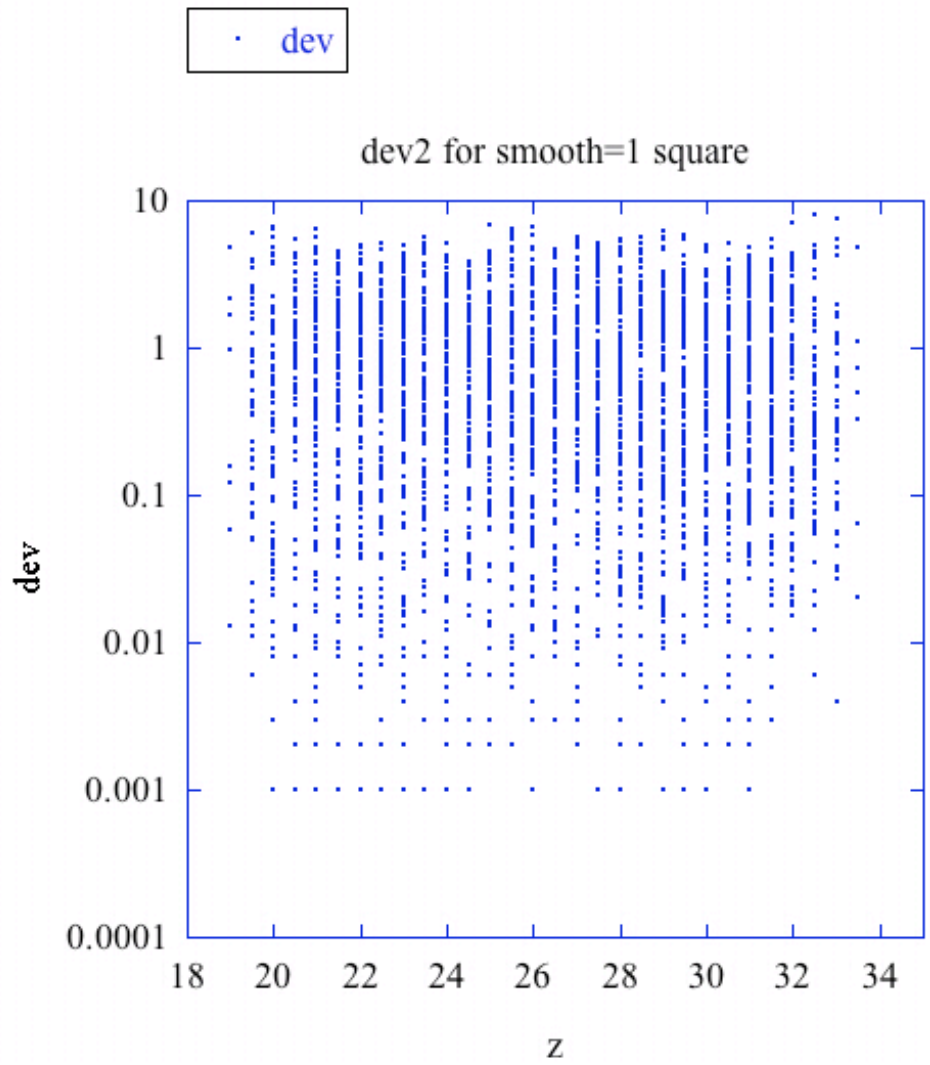

y-
y0
y1
pattern.out
y-
x
30
20
10
0
-10
-20
-30
-30 -20 -10 0 10 20 30

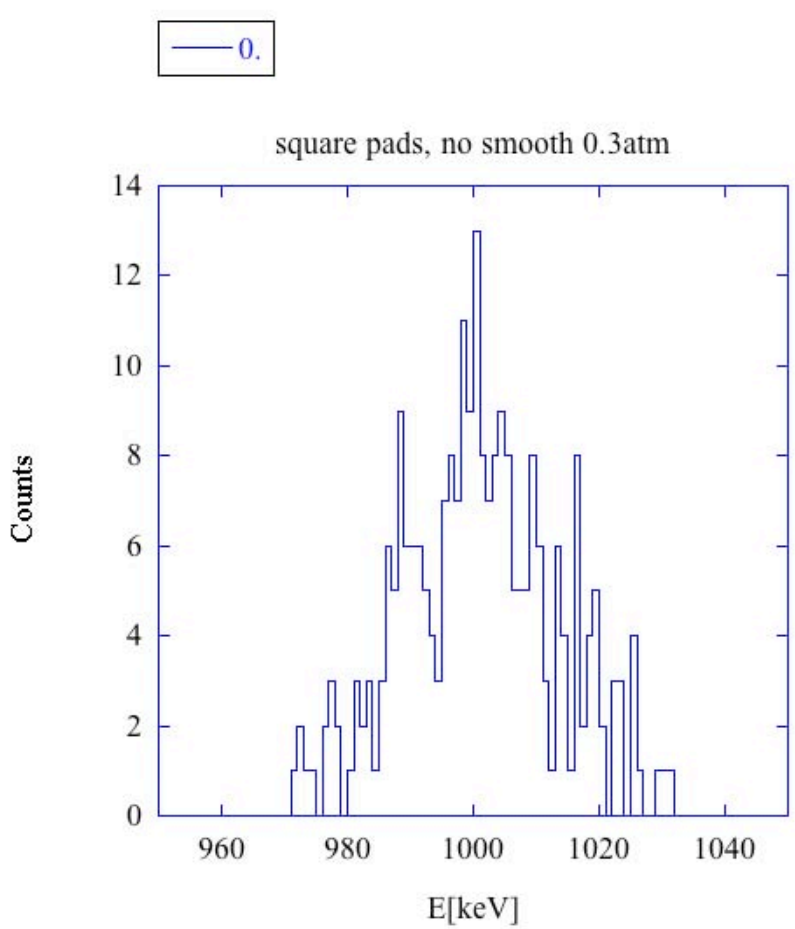

dev
dev2 for smooth=0 square pad
dev
z
1000
100
10
1
0.1
0.01
0.001
0.0001
18 20 22 24 26 28 30 32 34

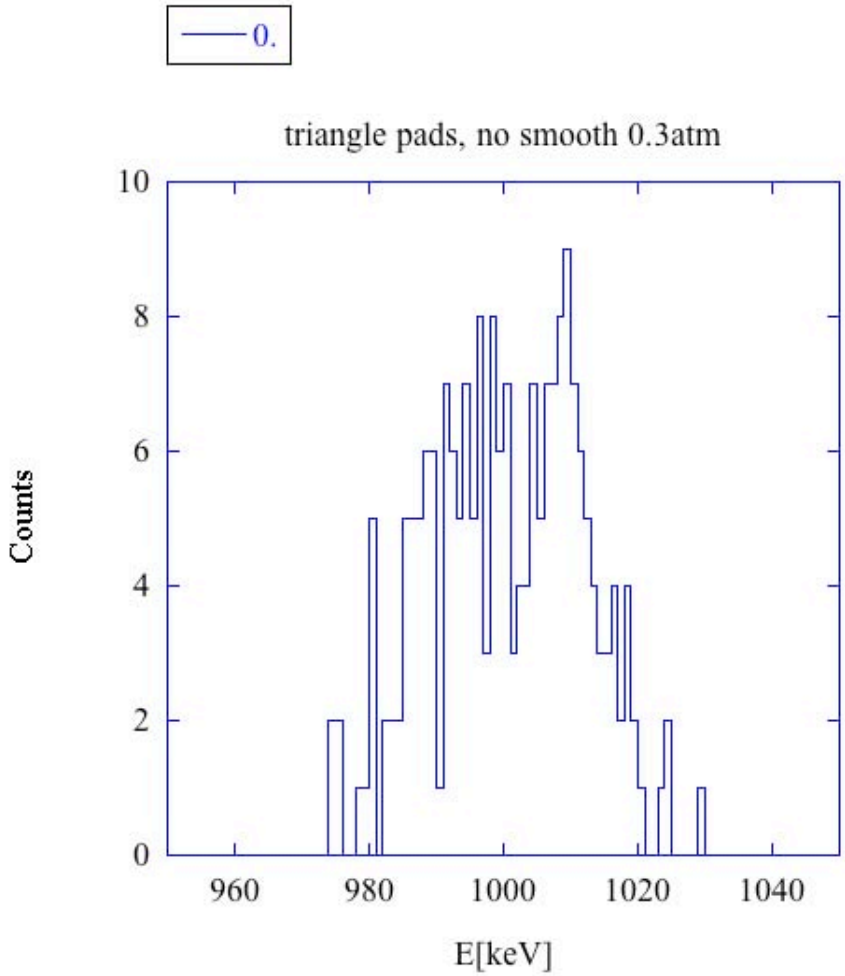

dev
dev2 for smooth=0 triangle
dev
z
1000
100
10
1
0.1
0.01
0.001
0.0001
18 20 22 24 26 28 30 32 34

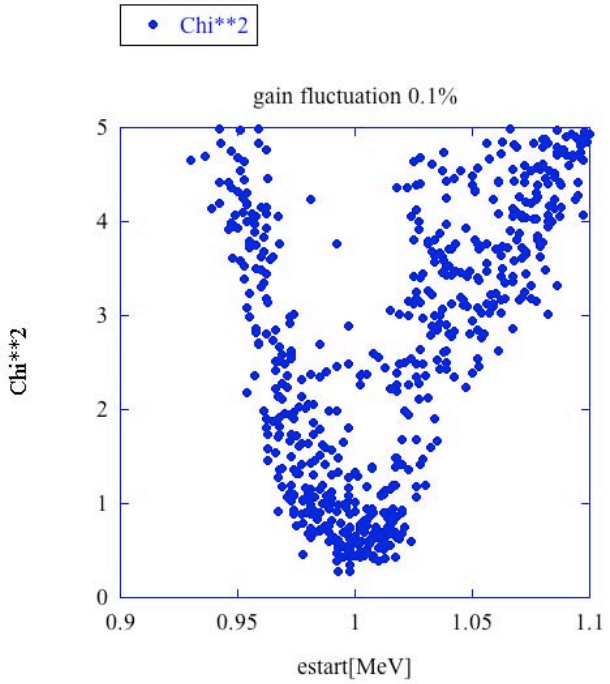

dev
dev2 for smooth=1 triangle
dev
z
1000
100
10
1
0.1
0.01
0.001
0.0001
18 20 22 24 26 28 30 32 34

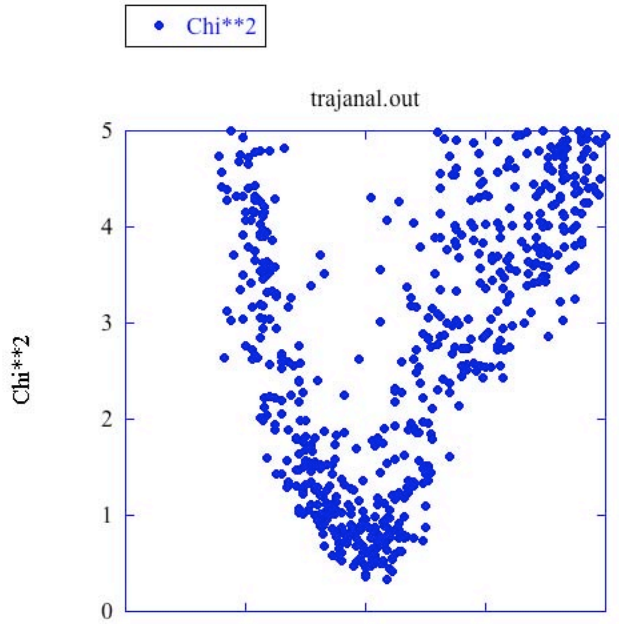

dev
dev2 for smooth=1 triangle
dev
z
1000
100
10
1
0.1
0.01
0.001
0.0001
18 20 22 24 26 28 30 32 34

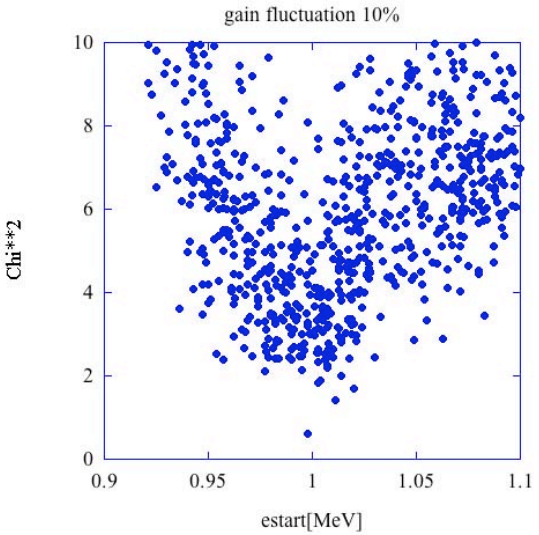

dev
dev2 for smooth=1 square
10
1
0.1
0.01
0.001
0.0001
dev
18
20
22
24
26
28
30
32
34
z

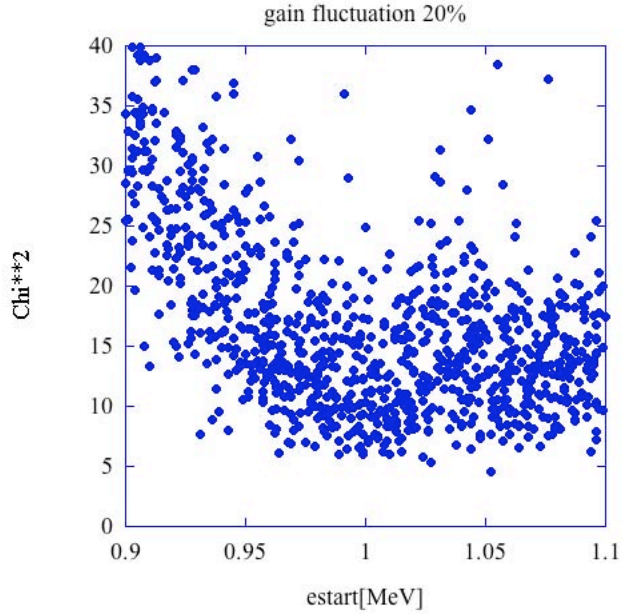

0.
square pads, no smooth 0.3atm
Counts
E[keV]
0
2
4
6
8
10
12
14
960
980
1000
1020
1040

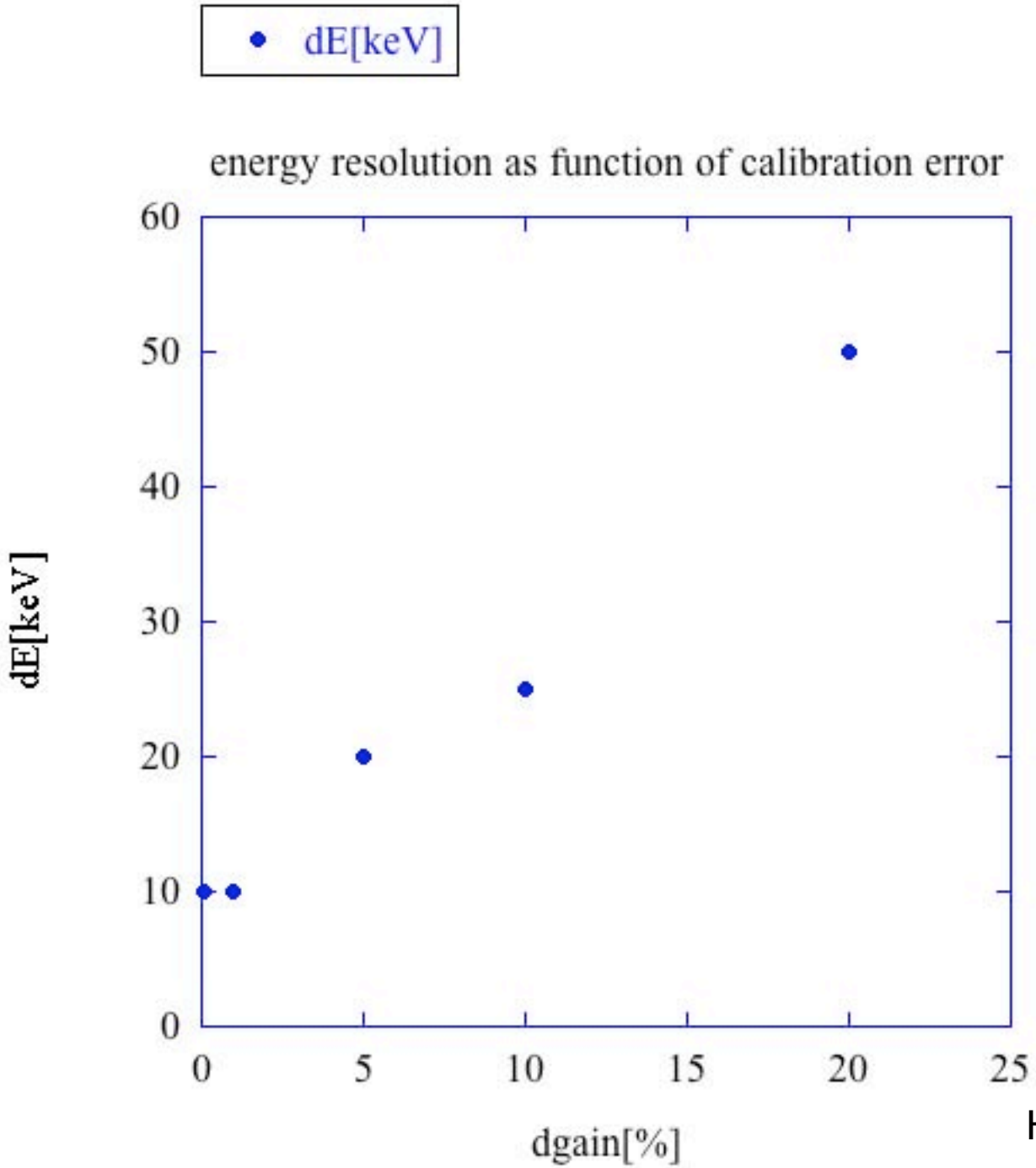

0.
triangle pads, no smooth 0.3atm
Counts
E[keV]
0
2
4
6
8
10
960
980
1000
1020
1040


Chi**2
gain fluctuation 0.1%
Chi**2
estart[MeV]
0
1
2
3
4
5
0.9
0.95
1
1.05
1.1


Chi**2
trajanal.out
Chi**2
0
1
2
3
4
5


gain fluctuation 10%
Chi**2
estart[MeV]
0
2
4
6
8
10
0.9
0.95
1
1.05
1.1


gain fluctuation 20%
Chi**2
estart[MeV]
0
5
10
15
20
25
30
35
40
0.9
0.95
1
1.05
1.1


dE[keV]
energy resolution as function of calibration error
dE[keV]
60
50
40
30
20
10
0
0
5
10
15
20
25
dgain[%]

H.WANG+WM