# Status on LDT runs

01/11/2021

# Last week's update

Regarding to the investigation of difference on ($\Delta$Pt/Pt)

<u>List of major changes</u>

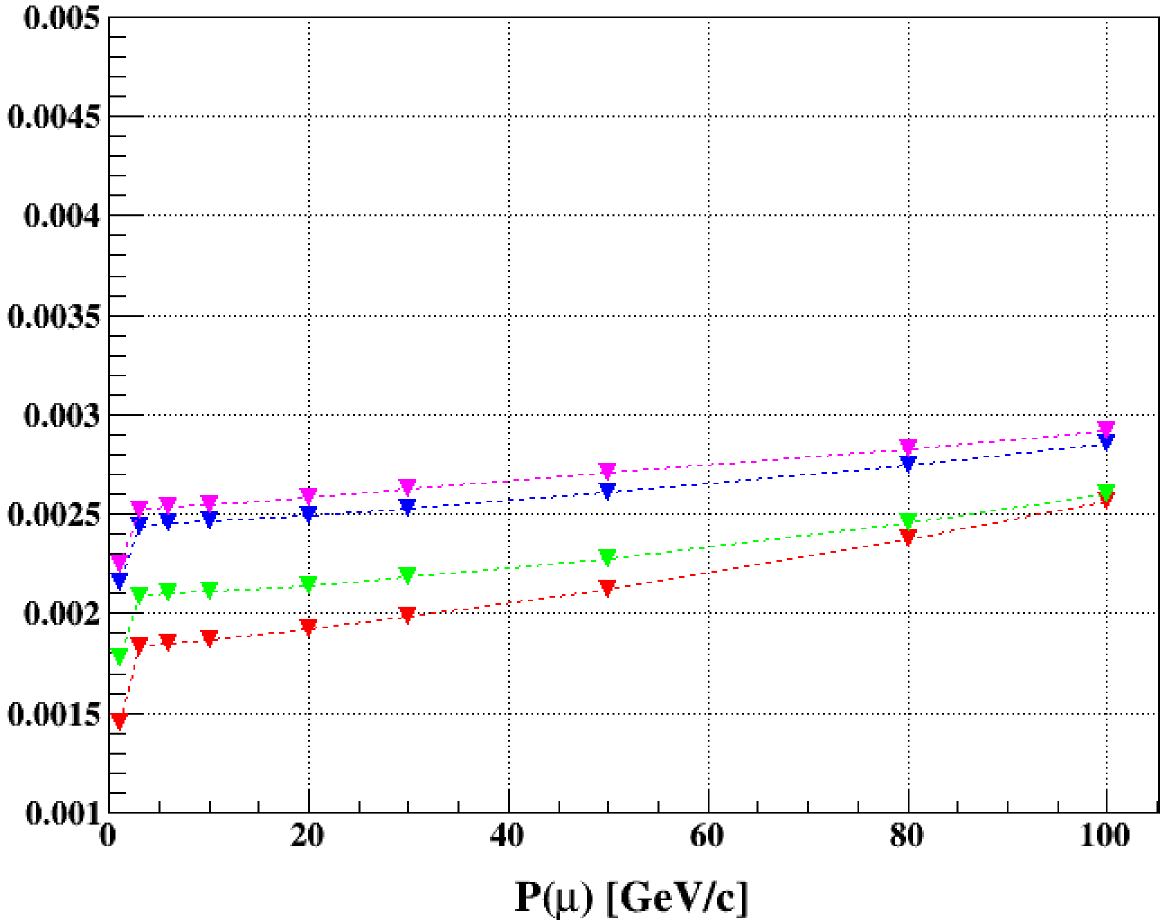
-- Measurement axes & resolution for SITs

-- position of SITs ( information provided by LingHui)

# Update configuration - 1

- SIT stereo angle = 90°
- SIT hit : both axes active (“-1”) per layer
- SIT sigma: 7μm/250μm

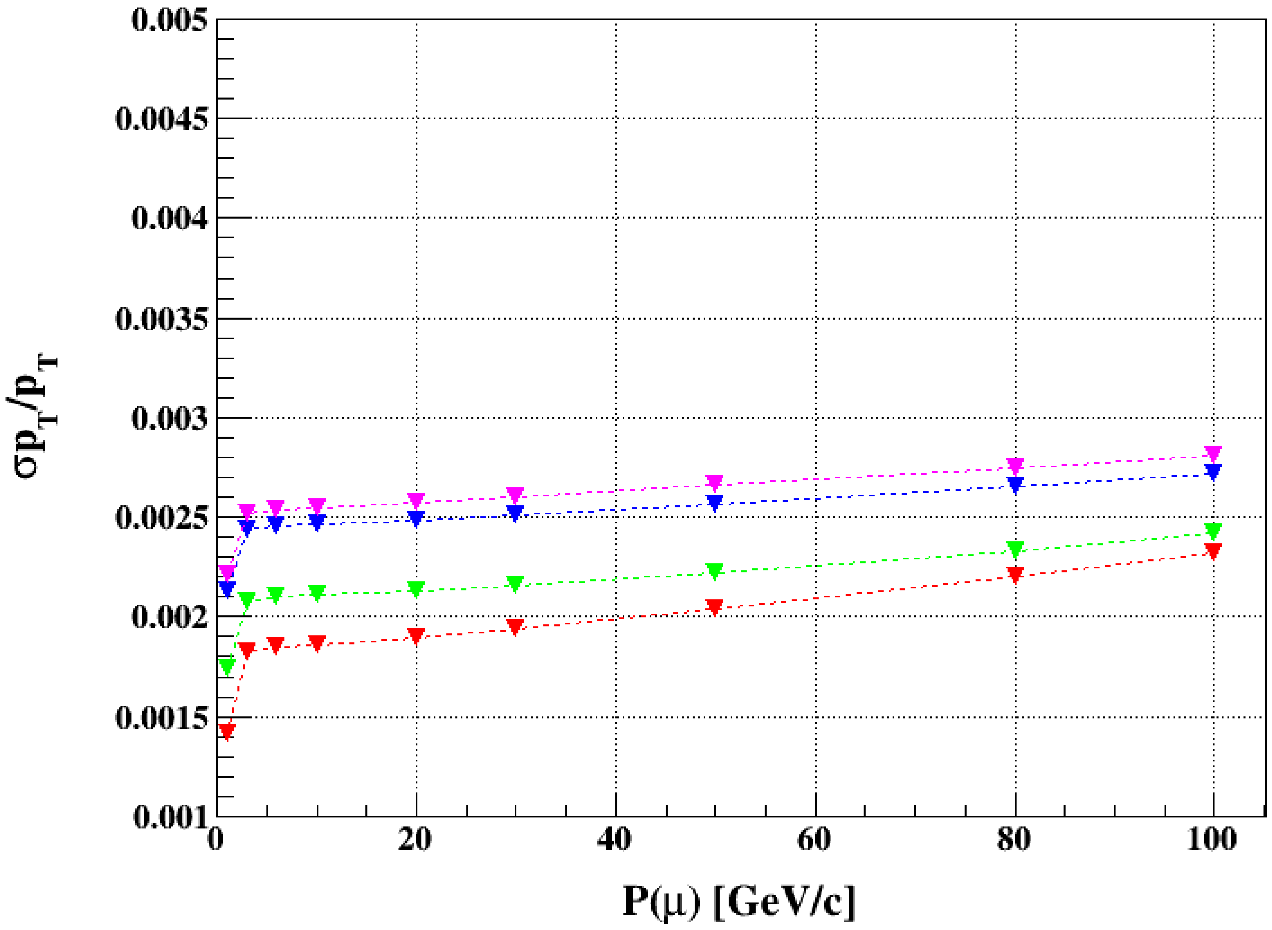
```
Silicon Inner Tracker (SIT)

Number of layers                :   12
Description (optional)          :   |-------------------------------------------
Names of the layers (opt.)      :   SIT1,       XSIT1,      XSIT2,      SI
Radii [mm]                      :   152.9,      153.1,      154.4,      15
Upper limit in z [mm]           :   371.0,      371.0,      371.0,      37
Lower limit in z [mm]           :   -371.0,     -371.0,     -371.0,     -3
Efficiency RPhi                 :   1.00,       0,          0,          1.
Efficiency 2nd coord. (eg. z):      -1,
Stereo angle alpha [Rad]        :   pi/2,
Thickness [rad. lengths]        :   0.00213,    0.00468,    0.00468,    0.
error distribution              :   0
0 normal-sigma(RPhi) [1e-6m]    :   7
          sigma(z)   [1e-6m]    :   250
1 uniform-d(RPhi) [1e-6m]       :
          d(z)       [1e-6m]    :

```



# Update configuration - 2

- SIT stereo angle = 90°
- SIT hit :  both axes active (“-1”) per layer
- SIT sigma:  5μm/250μm

```
Silicon Inner Tracker (SIT)

Number of layers              :   12
Description (optional)        :   |------------------------------------
Names of the layers (opt.)    :   SIT1,         XSIT1,        XSIT2,
Radii [mm]                    :   152.9,        153.1,        154.4,
Upper limit in z [mm]         :   371.0,        371.0,        371.0,
Lower limit in z [mm]         :   -371.0,       -371.0,       -371.0,
Efficiency RPhi               :   1.00,         0,            0,
Efficiency 2nd coord. (eg. z):   -1,
Stereo angle alpha [Rad]      :   pi/2,
Thickness [rad. lengths]      :   0.00213,      0.00468,      0.00468,
error distribution            :   0
0 normal-sigma(RPhi) [1e-6m] :   5
            sigma(z)     [1e-6m] :   250
1 uniform-d(RPhi) [1e-6m]    :
            d(z)      [1e-6m]    :
```



# Update configuration - 3

- SIT stereo angle = 90°

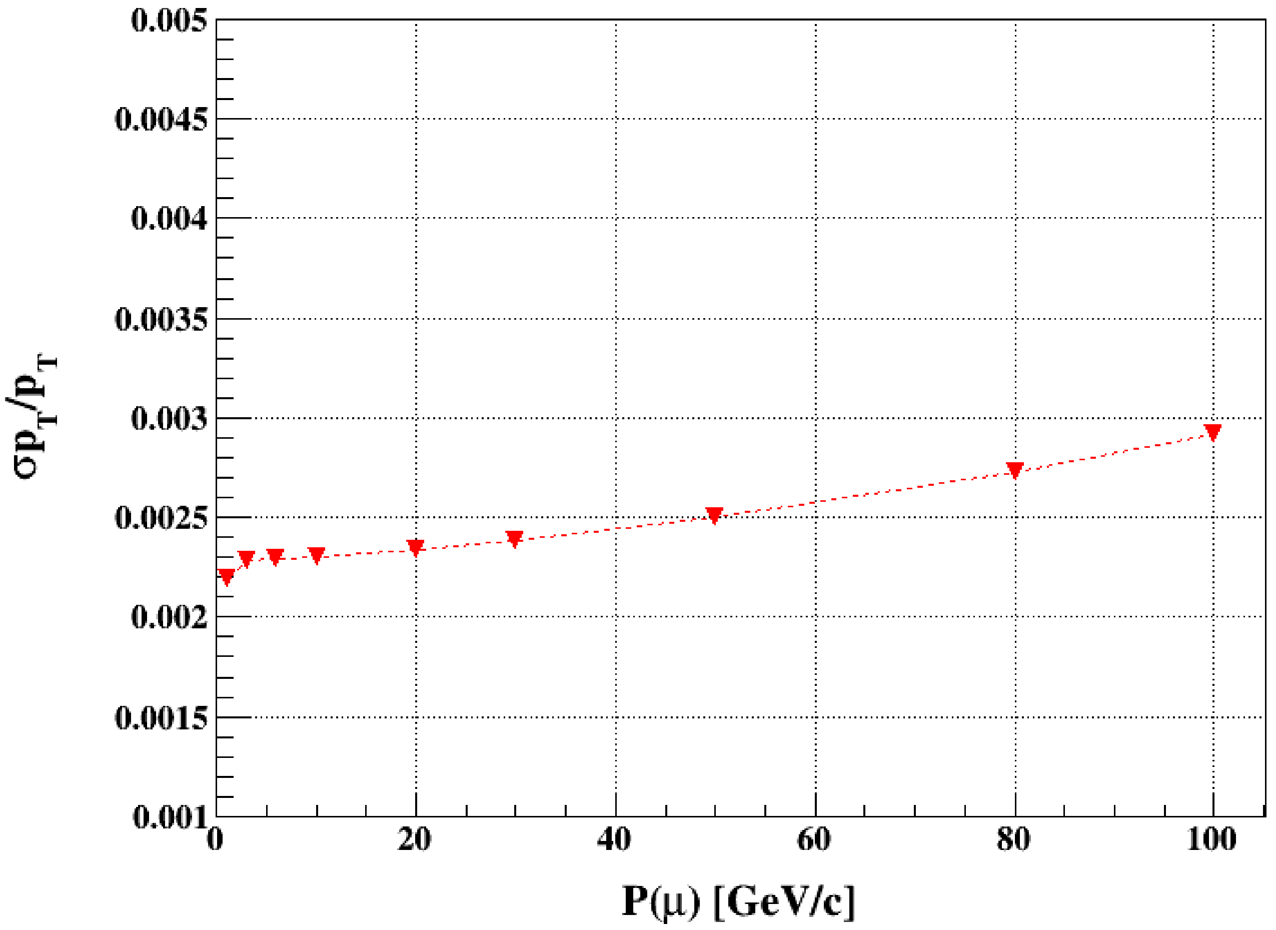
- SIT hit : both axes active ("-1") per layer

- layer6 : SIT1 , layer7 : SIT2
- layer8 : SIT3 , layer9 : SIT4
- layer10 : SET1 , layer11 : SET2

-- sensor/support material are kept as the same

-- VXD settings are updated according to the table

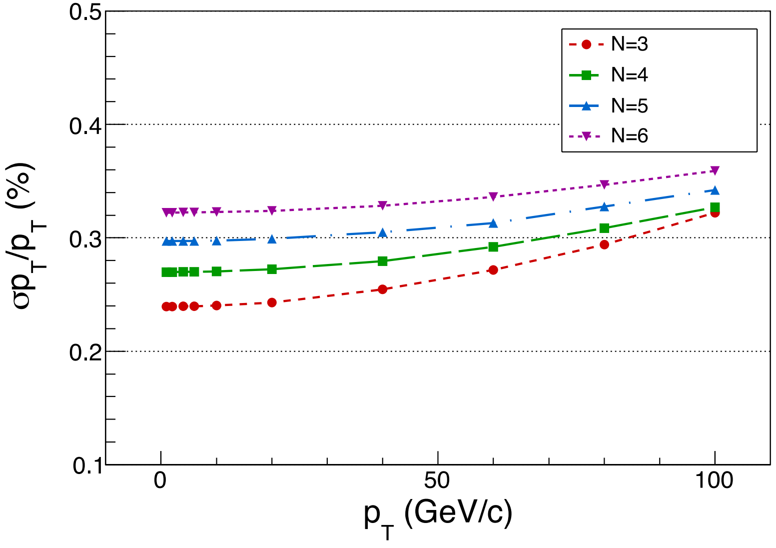
| layer | Radius(mm) | xy-Reso(mm) | z-Reso(mm) |
|---|---|---|---|
| 0 | 17 | 0.0028 | 0.0028 |
| 1 | 19 | 0.006 | 0.006 |
| 2 | 37 | 0.0036 | 0.0036 |
| 3 | 39 | 0.0036 | 0.0036 |
| 4 | 57 | 0.0036 | 0.0036 |
| 5 | 59 | 0.0036 | 0.0036 |
| 6 | 152 | 0.005 | 0.25 |
| 7 | 418.349 | 0.005 | 0.25 |
| 8 | 678.604 | 0.005 | 0.25 |
| 9 | 970.9 | 0.005 | 0.25 |
| 10 | 1230.57 | 0.005 | 0.25 |
| 11 | 1500 | 0.005 | 0.25 |



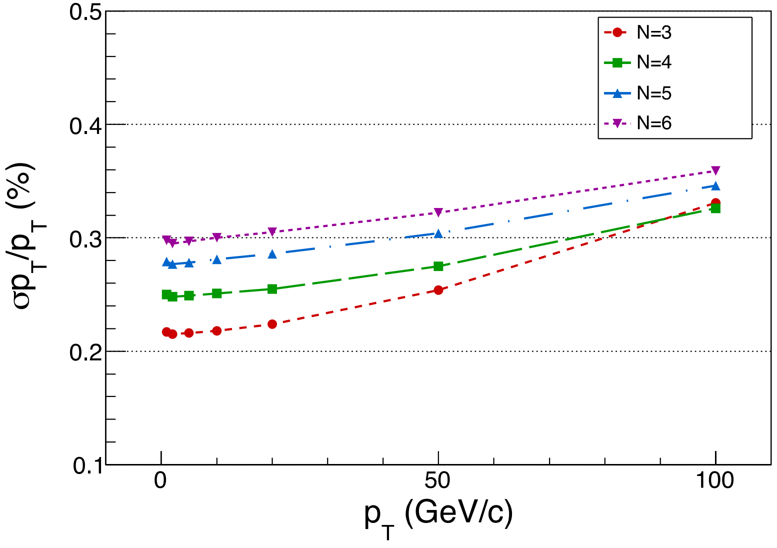
```
Number of layers              :   14
Description (optional)        :   |-Beamt.-|-----------------------------------Vertex detector-----------------------------------
Names of the layers (opt.)    :   XBT,      VTX1,      XVTX1,     XVTX2,     VTX2,      VTX3,      XVTX3,     XVTX4,     VTX4,     VTX5,
Radii [mm]                    :   14.5,     17.0,      17.05,     18,        19,        37.0,      37.05,     38,        39,       57.0,
Upper limit in z [mm]         :   4225,     62.5,      62.5,      62.5,      62.5,      125,       125,       125,       125,      125,
Lower limit in z [mm]         :   -4225,    -62.5,     -62.5,     -62.5,     -62.5,     -125,      -125,      -125,      -125,     -125,
Efficiency RPhi               :   0,        0.99,      0,         0,         0.99,      0.99,      0,         0,         0.99,     0.99,
Efficiency 2nd coord. (eg. z) :   -1
Stereo angle alpha [Rad]      :   pi/2
Thickness [rad. lengths]      :   0.0014,   0.00053,   0.00098,   0.00098,   0.00053,   0.00053,   0.00098,   0.00098,   0.00053,  0.00053,
error distribution            :   0
0 normal-sigma(RPhi) [1e-6m]  :             2.8,                 6,                   3.6,                 3.6,                 3.6,
           sigma(z)   [1e-6m] :             2.8,                 6,                   3.6,                 3.6,                 3.6,
1 uniform-d(RPhi) [1e-6m]     :
           d(z)     [1e-6m]   :

Silicon Inner Tracker (SIT)

Number of layers              :   12
Description (optional)        :   |-----------------------------------------Inner tracker-----------------------------------------
Names of the layers (opt.)    :   SIT1,       XSIT1,      XSIT2,      SIT2,       SIT3,       XSIT3,      XSIT4,      SIT4,
Radii [mm]                    :   152.0,      152.2,      418.549,    418.349,    678.604,    678.804,    971.1,      970.9,
Upper limit in z [mm]         :   371.0,      371.0,      371.0,      371.0,      2350,       2350,       2350,       2350,
Lower limit in z [mm]         :   -371.0,     -371.0,     -371.0,     -371.0,     -2350,      -2350,      -2350,      -2350,
Efficiency RPhi               :   1.00,       0,          0,          1.00,       1.00,       0,          0,          1.00,
Efficiency 2nd coord. (eg. z) :   -1,
Stereo angle alpha [Rad]      :   pi/2,
Thickness [rad. lengths]      :   0.00213,    0.00468,    0.00468,    0.00213,    0.00213,    0.00468,    0.00468,    0.00213,
error distribution            :   0
0 normal-sigma(RPhi) [1e-6m]  :   5
           sigma(z)   [1e-6m] :   250
1 uniform-d(RPhi) [1e-6m]     :
           d(z)     [1e-6m]   :
```

```
Number of layers              :   4
Description (optional)        :   |TPC outer wall|--------------External Tracker----------------------
Names of the layers (opt.)    :   SET1,       XSET1,      XSET2,      SET2,
Radii [mm]                    :   1230.57,    1230.77,    1500.2,     1500.0,
Upper limit in z [mm]         :   2300,       2300,       2300,       2300,
Lower limit in z [mm]         :   -2300,      -2300,      -2300,      -2300,
Efficiency RPhi               :   1.00,       0,          0,          1.00,
Efficiency 2nd coord. (eg. z) :   -1,
Stereo angle alpha [Rad]      :   pi/2,
Thickness [rad. lengths]      :   0.00213,    0.00468,    0.00468,    0.00213,
error distribution            :   0
0 normal-sigma(RPhi) [1e-6m]  :   5,
           sigma(z)   [1e-6m] :   250,
1 uniform-d(RPhi) [1e-6m]     :
```

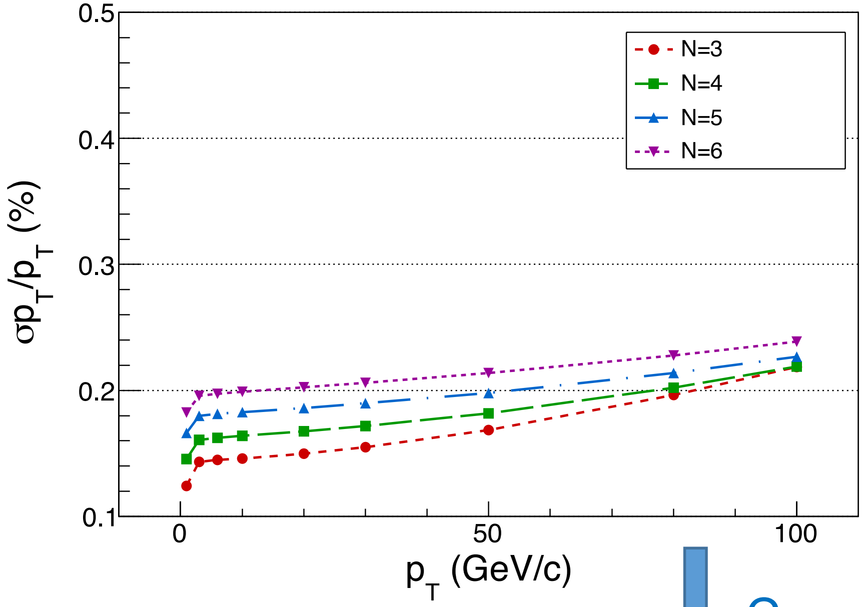
## FST

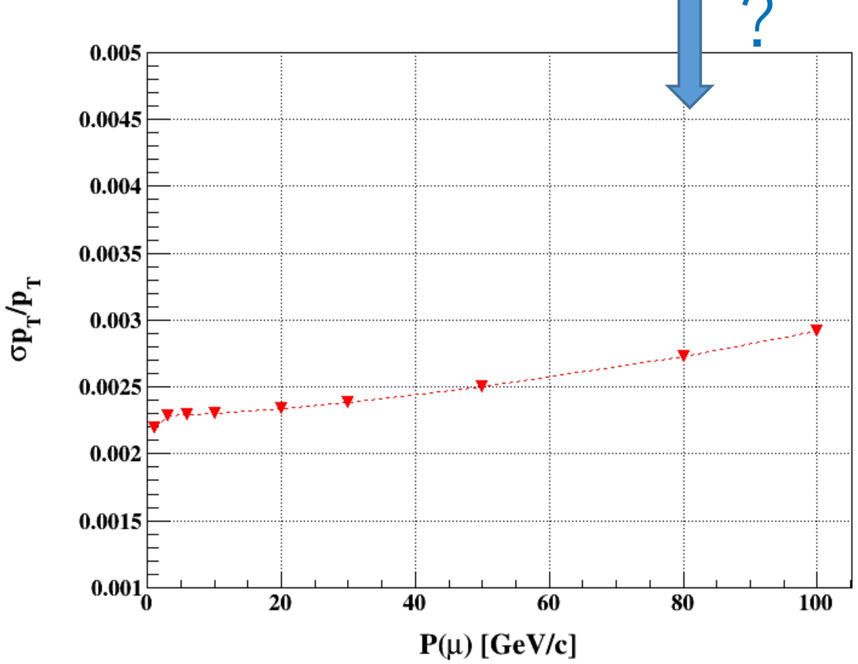



## tkLayout




## LDT



# Particle simulation part in the LDT（“Simulation.m”)

***From last slide***

if MS option is set

MS effect

random number (for direction)

Change direction

```
znow=param_start(2);% current z position
bprop=0;
fprop=0;
maxzmax=max(zpos.bmax);
minzmin=min(zpos.bmin);

for k=2:(FLayer+BLayer)     % loop over all layers, terminated by break statement
    if Flags.MulSca
        pT=convf*Bz/parami(5); % Transv. momentum computed from curvature
        p=pT/sin(parami(3));    % absolute Momentum

        if reftype(k-1) X=bXlen(bnow)/(sin(parami(3))*cos(parami(4)));
        else            X=fXlen(fnow)/abs(cos(parami(3)));  end
        sigms=0.0136*sqrt((Mass^2+p^2)/p^4)*sqrt(X)*(1+0.038*log(X));
        % s.d. of projected multiple scattering angle
        Xstore(k-1)=X;  varMS_store(k-1)=sigms^2;

        ran=(randn(1,2).*[1 1/sin(parami(3))])*sigms; %changes in direction
        if parami(3)>pi/2 ran(1)=-ran(1); end


        parami(3)=parami(3)+ran(1); % Kick in theta
        parami(4)=parami(4)+ran(2); % Kick in phi (beta)
        pT=p*sin(parami(3));         % recompute pt with new theta
        parami(5)=convf*Bz/pT;       % Curvature from transverse momentum

        if k==2 pstartMS=parami; end

```

# further details, is under investigation

# It is set as

```
for k=2:(FLayer+BLayer)      % loop over all layers, terminated by break statement
    if Flags.MulSca
        pT=convf*Bz/parami(5); % Transv. momentum computed from curvature
        p=pT/sin(parami(3));    % absolute Momentum

        if reftype(k-1) X=bXlen(bnow)/(sin(parami(3))*cos(parami(4)));
        else            X=fXlen(fnow)/abs(cos(parami(3)));   end
%         sigms=0.0136*sqrt((Mass^2+p^2)/p^4)*sqrt(X)*(1+0.038*log(X));
        sigms=0.0177*sqrt((Mass^2+p^2)/p^4)*sqrt(X)*(1+0.038*log(X));
        % s.d. of projected multiple scattering angle
        Xstore(k-1)=X;  varMS_store(k-1)=sigms^2;
```

# reftrack.m

```
%
% REFTRACK computes the reference track (the expansion points for the
% Kalman filter), the H matrices, the error matrices, the derivative
% matrices and the variances of multiple scattering for every layer hit
% according to the simulation.
% The reference track is the completely undisturbed extrapolation of the
% start parameters through the whole detector, without kinks due to
% multiple scattering.
```

This term was un-changed last week

```
% prepare variances of multiple scattering
if Flags.MulSca~=0
    b=reftype(1:size(paramr,1)); % first radiation length of barrel layers
    if sum(b)~=0
      X(b)=bXlen(refindex(b))./(sin(paramr(b,3)).*cos(paramr(b,4)))';
      % Effective thickness of scatterer incl. beta (all layers)
    end
    f=~b;   % now radiation length of forward layers
    if sum(f)~=0
      X(f)=fXlen(refindex(f))./abs(cos(paramr(f,3)))';
    end

    sigMS=0.0136*sqrt((Mass^2+pr^2)/pr^4)*sqrt(X).*(1+0.038*log(X));
          % s.d. of projected multiple scattering angle
    varMS=sigMS.^2;
else
    varMS=NaN;
end % if Flags.MulSca~=0
```

# Measurement Axis

## 3.1 Input of barrel region, magnetic field and vertex position

As the entire detector is assumed to have cylindrical symmetry, the detector layers in the barrel region are cylinder surfaces, defined by their radii and their extensions in the $z$-direction. Each detector layer is a priori assumed to be a double-sided strip layer: the first coordinate measured is the azimuthal arc $R\Phi$, the second one is a helix with arbitrary stereo angle $\alpha$; for $\alpha = \pi/2$ it measures $z$. Since inefficiencies are included, a single-sided layer can be modeled by giving one coordinate zero efficiency. Setting the efficiency of the second coordinate to $-1$ forces both coordinates to fire at the same time (strict correlation). Pixel layers can be modeled by giving the coordinates the corresponding pixel distances, the stereo angle $\alpha = \pi/2$, and strict correlation of the efficiency.

*LDT User Guide*

The code also looks like as explained above, the first coordinate should be Rphi

# Definition of dPt/Pt ?

-- under confirmation --

-- description about pull/residual ,,

at inner side of beamtube ?
at first dector layer ?

-- a bit confusing and need to follow carefully.

```
function [rms,hist]=mcrms(Radius,MC_res,res_true,param_start,param_fit,MCpullhi

% function rms
% Called by LDT_main
% Main program: LIC_Detector_Toy
%
% Input:    MC_res      Array of residuals at the inner side of the
%                       beamtube, for every track and every coordinate
%           res_true    Residuals between the true simulated parameters and
%                       the fitted parameters at the inner side of the
%                       beamtube, for every track and coordinate
%                       (Phi,z,theta,beta,kappa)
%           param_start Simulated start parameters at inner side of
%                       beamtube, for every track
%           Radius      Radius of beamtube
%           MCpullhit   Logical array, which indicates the tracks for those
%                       Monte-Carlo pulls can be computed
% Output:   hist        arrays for histogramming MC-pulls
%           rms         rms values of hist
%                       rms(1) => RPhi
%                       rms(2) => z
%                       rms(3) => theta
%                       rms(4) => phi
%                       rms(5) => dpt/pt
%                       rms(5) => dpt/pt^2
%
%  RMS calculates the pull quantities at the inner side of the
%  beamtube and and delta p_t/(p_t) and delta p_t/(p_t)^2

```