Digitization of TPC in Marlin

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Flow of TPC Digitization

- Loop over all the pad row based sim hits
  - Calc. the angles(phi,theta) relative to the pad, height of pad
    1. Use momentum of the particle to calculate the angles relative to the pad
    2. From the hits use triplets of hits to fit a circle and calculate theta and phi relative to the pad
    3. If the hit has no record of it MCParticle, just set nominal values theta=phi=90
  - Calculate Point Resolutions according to Ron's Formula
    - tpcRPhiRes,tpcZRes,PadIndex
    - Create a tpc voxel hit for this simhit and store it for this tpc pad row
  - If lowPt collection, shift the hit in r-phi to the nearest pad-row centre
    - set the resolutions to the pads to digital like values:
      - tpcRPhiRes = padWidth; tpcZRes = _binningZ
    - create a tpc voxel hit for this simhit and store it for this tpc pad row
- Loop over the tpc rows containing hits and check for merged hits
  - look to see if the two hit occupy the same pad in phi or if not whether they are within the r-phi double hit resolution
  - Merged hits smear with gaussian use resolution padWidth and binningZ
- Write to TrackerHit
  - Position(smear with gaussian), energy deposite, CovMatrix, link to the Raw SimTrackerHit

Point resolution fomula

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Calculate Point Resolutions according to Ron's Formula

sigma_{RPhi}^2 = sigma_0^2 + Cd^2/N_{eff} * L_{drift}

sigma_0^2 = (50micron)^2 + (900micron*sin(phi))^2
Cd^2/N_{eff}} = 25^2/(22/sin(theta)*h/6mm)
Cd = 25 ( microns / cm^(1/2) )
(this is for B=4T, h is the pad height = pad-row pitch in mm,
theta is the polar angle)

sigma_{z}^2 = (400microns)^2 + L_{drift}cm * (80micron/sqrt(cm))^2
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Smear parameters

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double aReso =_pointResoRPhi0*_pointResoRPhi0 + (_pointResoPadPhi*_pointResoPadPhi * sin(padPhi)*sin(padPhi)) ;
double driftLength = gearTPC.getMaxDriftLength() - (fabs(thisPoint.z()));
padheight = padLayout.getPadHeight(padLayout.getNearestPad(thisPoint.perp(),thisPoint.phi()));

double bReso = ( (_diffRPhi * _diffRPhi) / _nEff ) * sin(padTheta) * ( 6.0 / (padheight) )  * ( 4.0 / bField  ) ;

double tpcRPhiRes = sqrt( aReso + bReso * (driftLength / 10.0) ); // driftLength in cm

double tpcZRes  = sqrt(( _pointResoZ0 * _pointResoZ0 )
                     +
                     ( _diffZ * _diffZ ) * (driftLength / 10.0) ); // driftLength in cm
```

Parameters for hit resolusion smear

- Pad Phi Resolution constant in TPC, _pointResoPadPhi=0.9
- R-Phi Resolution constant in TPC, _pointResoRPhi0=0.05
- R-Phi Diffusion Coefficent in TPC, _diffRPhi=0.025
- Number of Effective electrons per pad in TPC, _nEff=22
- TPC Z Resolution Coefficent independent of diffusion, _pointResoZ0=0.4
- Z Diffusion Coefficent in TPC, _diffZ=0.08

Parameters for binning

- Defines spatial slice in Z, _binningZ=5.0
- Defines spatial slice in RP, _binningRPhi=2.0

Parameters for merging

- Defines the minimum distance for two seperable hits in Z, _doubleHitResZ=5.0
- Defines the minimum distance for two seperable hits in Rphi, _doubleHitResRPhi=2.0
- Defines the maximum number of adjacent hits which can be merged,_maxMerge=3