HELIX MULTIPLE SCATTERING ERROR

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github issue 126

CURRENT CODE

- org.lcsim.recon.tracking.seedtracker.FastCheck ►ThreePointHelixCheck
  triplet-finding for track seeds

  - For each of the 3 hits, calculates contribution to *z error* ◄── lcsim z (hps y)

```java
if (hit instanceof HelicalTrack3DHit)
    dztot += _nsig * ((HelicalTrack3DHit) hit).dz();
else {
    zfirst = false;
    if (hit instanceof HelicalTrack2DHit)
        dztot += ((HelicalTrack2DHit) hit).zlen() / 2.;
    else
        dztot += _nsig * Math.sqrt(hit.getCovMatrix()[5]);
}
```

  - **Then**
```java
//  Add multiple scattering error here - for now, just set it to 1 mm
dztot += 1.;  dztot += MSerror;
```

  - Compares *total z error* to *(predicted – actual) z position* of middle hit

```java
if (Math.abs(zpred - z[1]) > dztot) return false;
```

MODIFYING MULTIPLE SCATTERING ERROR TERM

$\Theta_{MS} \approx (0.0136 / p) \cdot \sqrt{L} \cdot (1 + 0.038 \ln L)$

    $L \equiv$ sensor thickness, in radiation lengths

    $p \approx b \cdot |R| \cdot \sqrt{(1 + m^2)}$

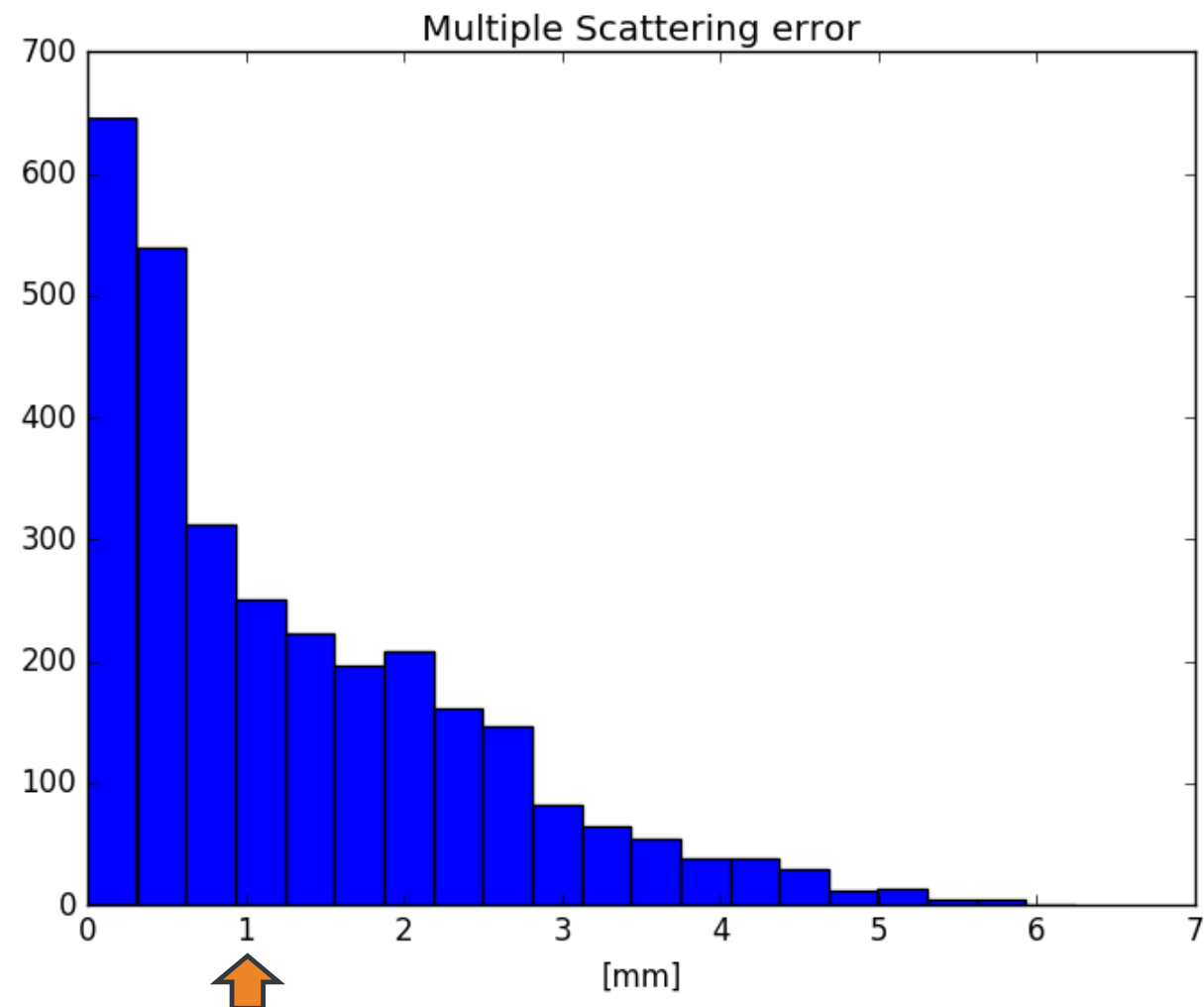 $m \equiv$ helix slope (already calculated)

        $b \equiv$ magnetic field (already an input parameter)

        $R \equiv$ helix radius of curvature (already calculated)

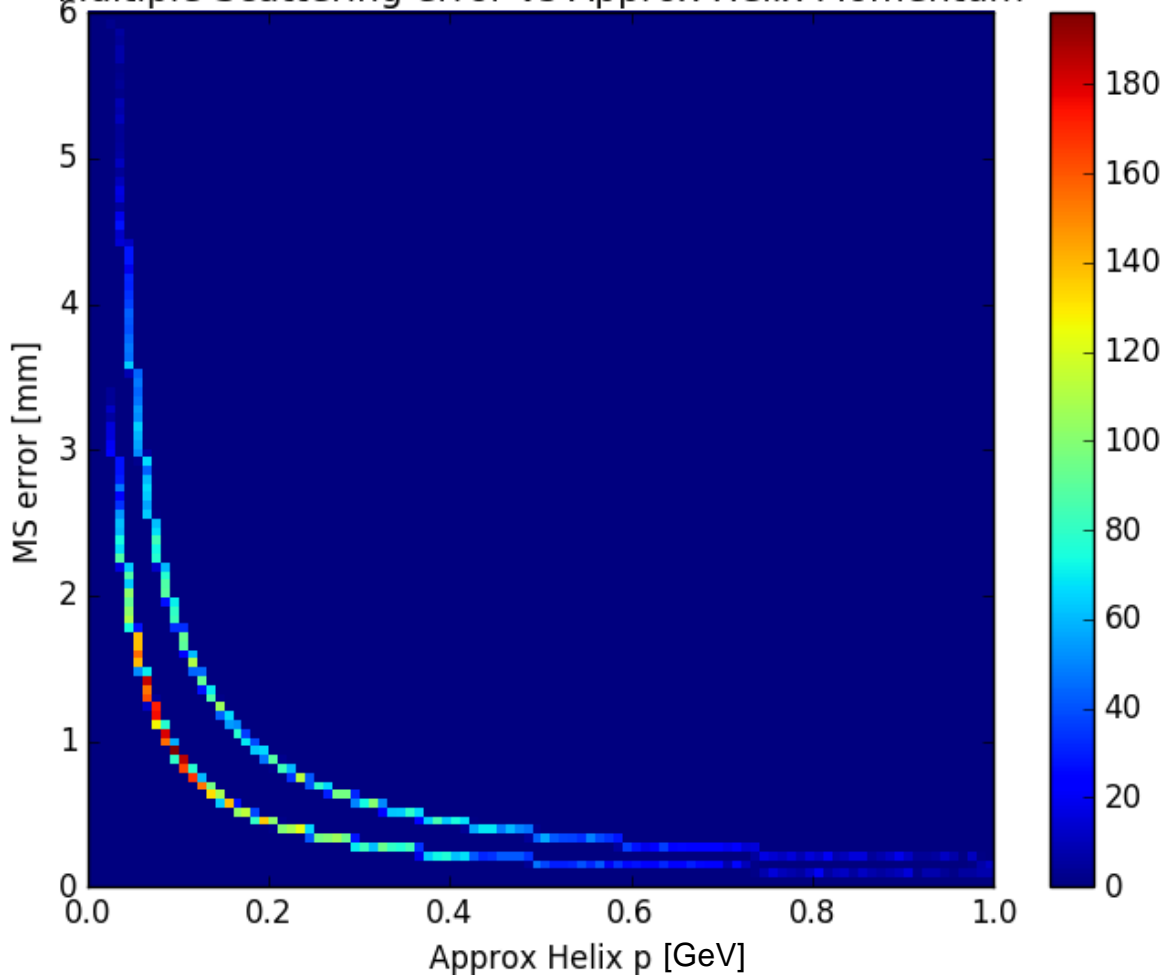$MSerror \approx \Theta_{MS} \sqrt{[(x[0] - x[1])^2 + (x[1] - x[2])^2]}$

    $x[1] \equiv$ LCSim x (HPS z) position of middle hit

MSerror not far from 1 on average ☺

Multiple Scattering error

3

MODIFYING MULTIPLE SCATTERING ERROR TERM

Multiple Scattering error vs Approx Helix Momentum

Why two curves on the plot?
- Different strategies designate different layers for seeding → different layers for the 3 hits in helix candidate
- Spacing between layers determines which of the two curves the candidate falls on
  - 100 mm (1-2-3 strategy): top curve
  - 200 mm (3-4-5 or 4-5-6 strategy): bottom curve

(drawing thanks to Sebouh. I can't draw.)