ACTS in FASER

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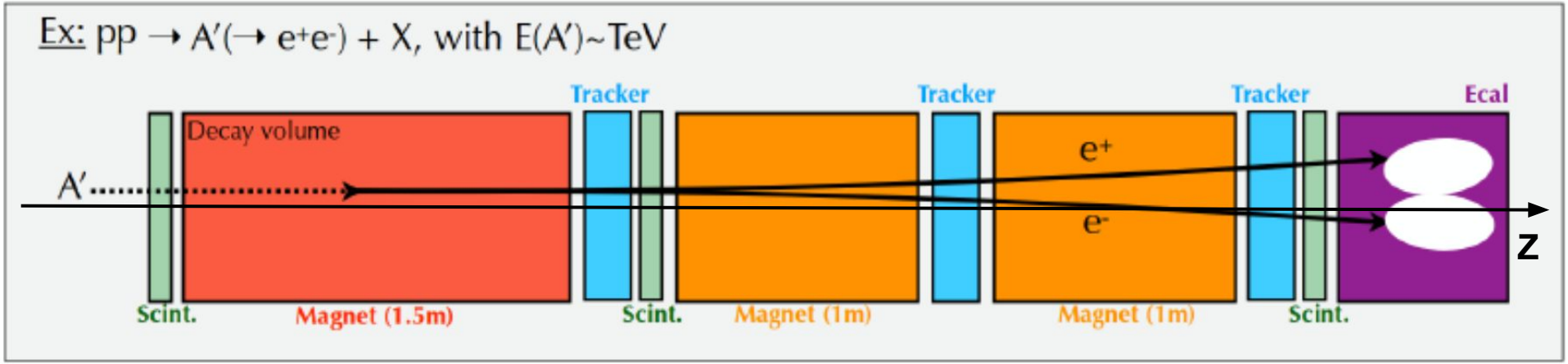
2020/12/01

FASER



- Located in forward region of ATLAS
  - Theta is almost 0
- Three tracker stations:
  - Each stations has 3 layers
    - Each layer has 8 SCT (same with ATLAS) modules

In ACTS

- Surface
  - Build of jacobian

```
79    // Optimized trigonometry on the propagation direction
80    const double x = direction(0);  // == cos(phi) * sin(theta)
81    const double y = direction(1);  // == sin(phi) * sin(theta)
82    const double z = direction(2);  // == cos(theta)
83    // can be turned into cosine/sine
84    const double cosTheta = z;
85    const double sinTheta = sqrt(x * x + y * y);
86    const double invSinTheta = 1. / sinTheta;
87    const double cosPhi = x * invSinTheta;
88    const double sinPhi = y * invSinTheta;
```

In FASER, the theta could be 0. 1/sinTheta could be problematic.

Use x,y,z to get phi and directions?

```
98    // Directional and momentum elements for reference frame surface
99    jacToLocal(eBoundPhi, eFreeDir0) = -sinPhi * invSinTheta;
100   jacToLocal(eBoundPhi, eFreeDir1) = cosPhi * invSinTheta;
101   jacToLocal(eBoundTheta, eFreeDir0) = cosPhi * cosTheta;
102   jacToLocal(eBoundTheta, eFreeDir1) = sinPhi * cosTheta;
103   jacToLocal(eBoundTheta, eFreeDir2) = -sinTheta;
```

In ACTS

- Propagator/PointwiseMaterialInteraction

```
32        const auto theta0 =
33            computeMultipleScatteringTheta0(slab, pdg, mass, qOverP, q);
34        // sigmaPhi = theta0 / sin(theta)
35        const auto sigmaPhi = theta0 * (dir.norm() / VectorHelpers::perp(dir));
36        variancePhi = sigmaPhi * sigmaPhi;
37        // sigmaTheta = theta0
38        varianceTheta = theta0 * theta0;
```

The denominator could be 0

Add a line ?
if (perp(dir)==0)
sigmaPhi= some number

For discussion

- Different with the detectors in collider, FASER has measurements in forward region where theta could be 0.
  - It’s not easy to change the coordinate system
- The sintheta appears in the denominator in some calculations (Thanks Xiaocong), problematic in FASER
  - Could be solved by adding some code to deal with theta=0 case
  - Is there any concerns ?