Update on MR426 (merged)

Resolve "Cascade: Problems with Multiple Scattering (in combination with tracking)"

General C8 call 13.10.2022

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Modules that were changed

1. Track Writer
2. Longitudinal Profile Writer
3. Energy Loss Writer
4. Observation Plane
5. BetheBlochPDG
6. PROPOSAL
7. Particle Cut
8. Switch Process Sequence
9. Process Sequence

* the changes were made in the level of .doContinuous(), where 1 “step” object is now being used instead of 2 (i.e particle & track separately)

** unit tests have been adjusted to work with the new “step” interface

Writers

- Track Writer

Writes kinetic energy, particle weight, position & time at start & end of the track

- Energy Loss Writer

Writes energy lost throughout the track

- Longitudinal Profile Writer

Writes grammage in bins between start & end of the track

Observation Plane

```
this->write(step.getParticlePre().getPID(), energy, displacement.dot(xAxis_),
            displacement.dot(yAxis_), 0_m, step.getTimePost(), weight);
```

Writes particle, kinetic energy, displacement from particle, time & weight at end of the track

BetheBlochPDG

```
  step.add_dEkin(dE);

// also send to output
TOutput::write(step.getPositionPre(), step.getPositionPost(), step.getParticlePre().getPID(), -dE);
return ProcessReturn::Ok;
```

Tracks energy loss dE along the track and position at start & end of the track and the energy lost at this track

PROPOSAL

Here 2 methods needed changing: **.scatter()** & **.doContinuous()**

```
inline void ContinuousProcess<TOutput>::scatter(Step<TParticle>& step, HEPEnergyType const& loss, GrammageType const& grammage)
```

```
// update particle direction after continuous loss caused by multiple
// scattering
DirectionVector dU_{particle_dir.getCoordinateSystem(),
                    {final_direction.GetX(), final_direction.GetY(), final_direction.GetZ()}};
DirectionVector diff_dir_ = dU_ - particle_dir;
step.add_dU(diff_dir_);
```

```
inline ProcessReturn ContinuousProcess<TOutput>::doContinuous(Step<TParticle>& step, bool const)
```

```
// if the particle has a charge take multiple scattering into account
if (step.getParticlePre().getChargeNumber() != 0) scatter(step, dE, dX);
step.add_dEkin(-dE); // on the stack, this is just kinetic energy, E-m

// also send to output
TOutput::write(step.getPositionPre(), step.getPositionPost(), step.getParticlePre().getPID(), dE);
```

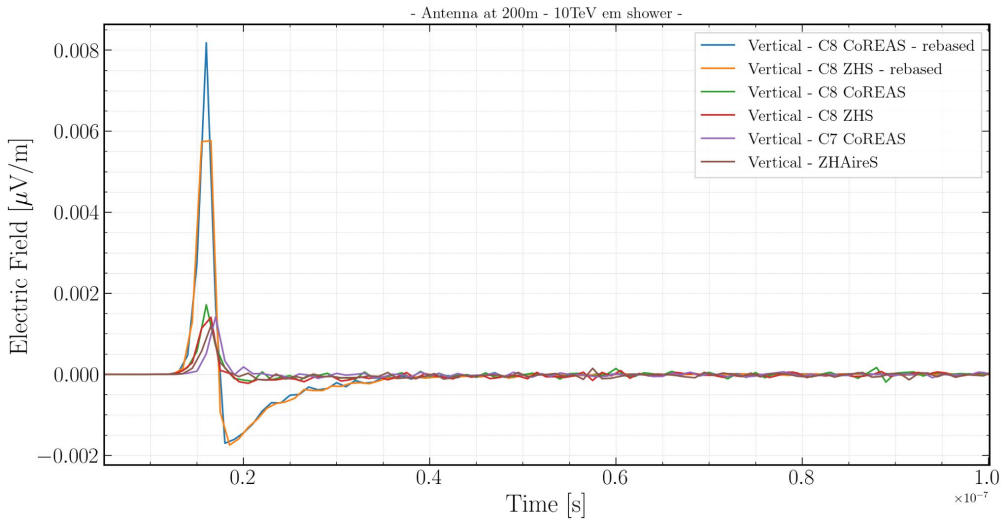
where: `auto dE = E_i_total - E_f_total;`

Particle Cut

```
if (checkCutParticle(step.getParticlePre().getPID(), step.getEkinPost(), step.getTimePost()))
  this->write(step.getPositionPost(), step.getParticlePre().getPID(), step.getEkinPost());
```

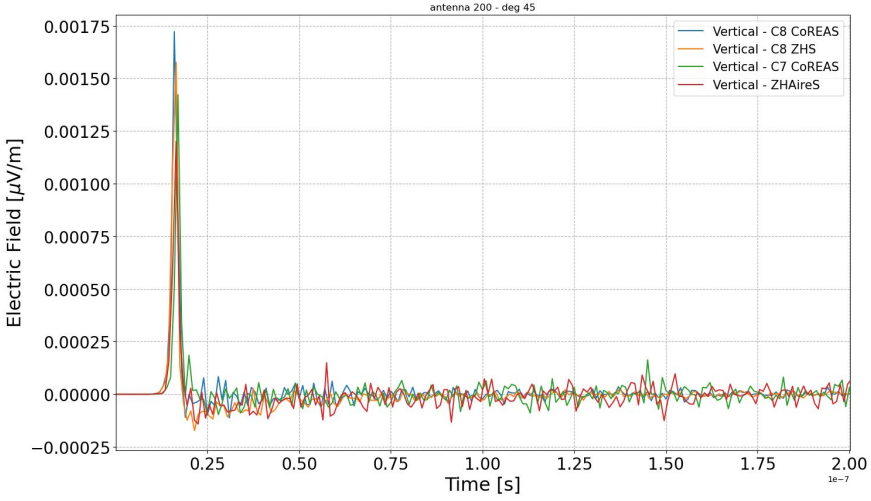
Particle Cut checks energy and time at the end of the track and if the values exceeds the cut values then the particle is discarded

Known issues before this MR on radio



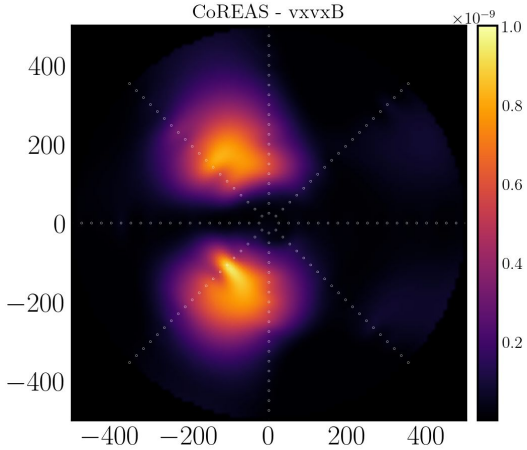
⇐ • Amplitude was off!

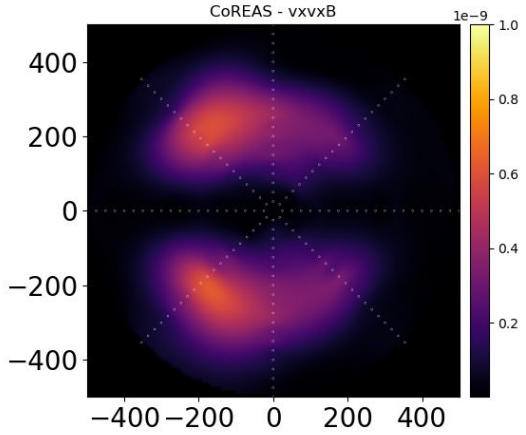
• Amplitude is now fixed! ⇒

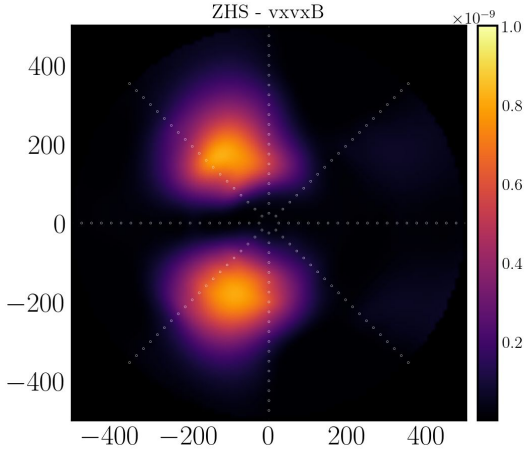


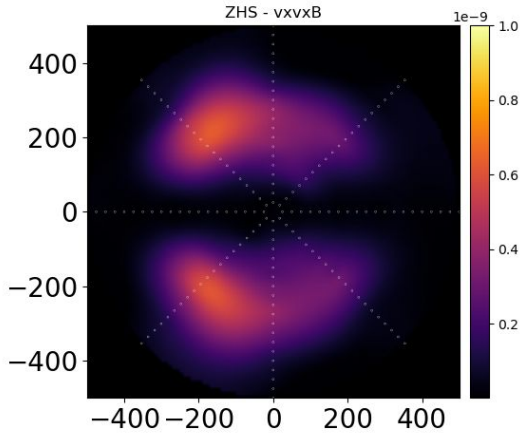
* in the plots it is west polarization - not vertical

Known issues before this MR on radio









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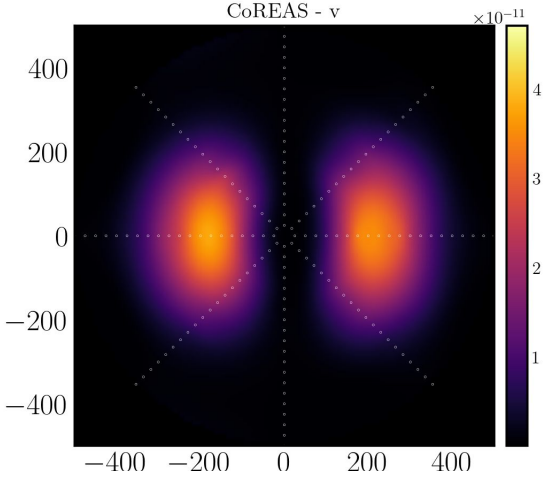

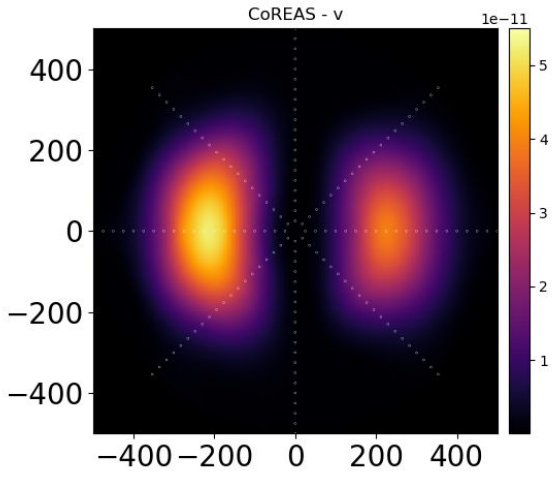

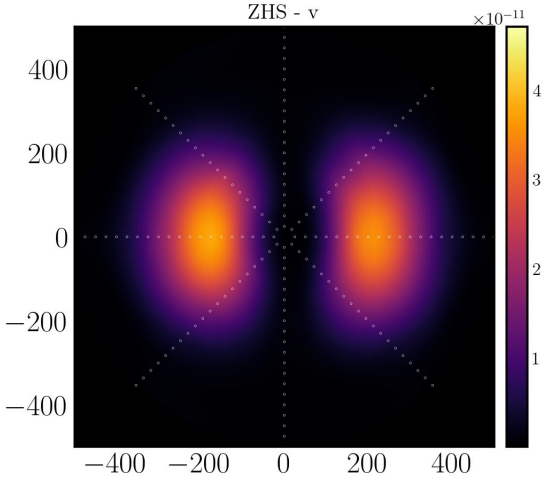

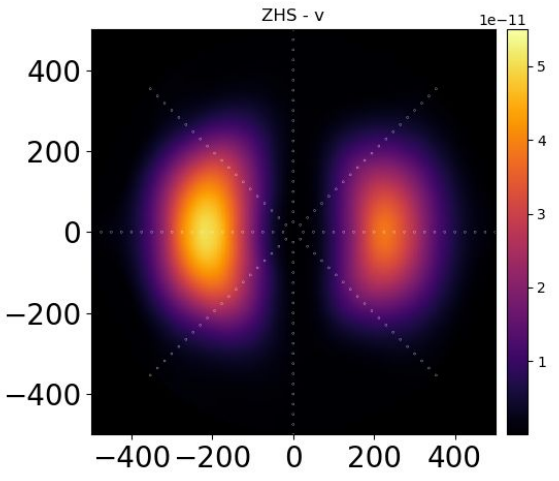

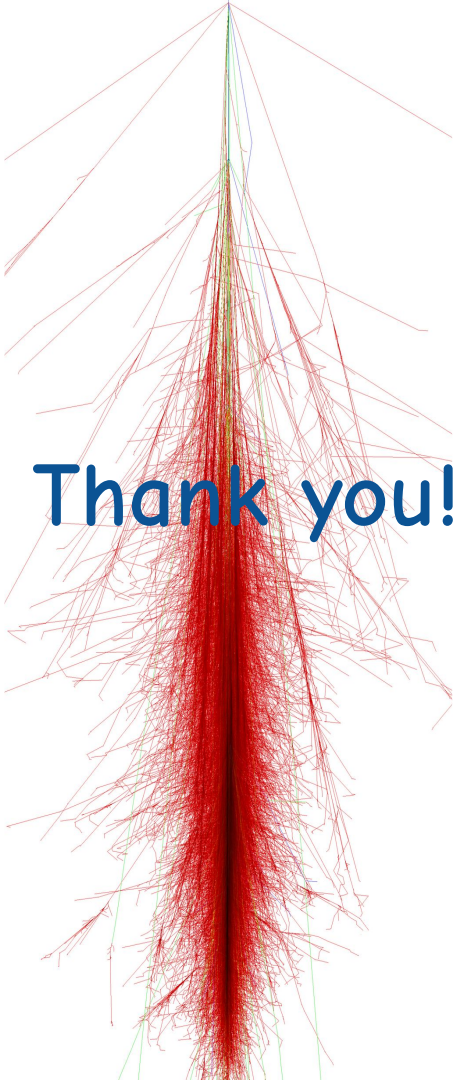

Thank you!