Beam Envelope Studies Update

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Beam Simulator:

❖ Full Documentation: GitHub
  ➢ Requirements
    ■ Python 3.x
    ■ ROOT (Python bindings must be available, e.g., import ROOT should work)

❖ Features:
  ➢ Generate synthetic particle events with randomized momenta and vertices
  ➢ Save events in HepMC v3 ASCII format
  ➢ Parse and visualize vertex and momentum distributions using ROOT for testing
  ➢ Fit distributions
  ➢ Interactive plotting interface
  ➢ Customizable to different kinematic ranges and particle types, this generated event file can be used in beam envelope studies

❖ Generated hepmc file can be used in conjunction w. ddsim or other simulations provided geometry

Running Procedure:

❖ python3 envelope_b.py
  ➢ Generates an output .hepmc file

Optionally the following parameters can be adjusted…

within def __init__ :

_self.min_mom = 3.0 # Lower limit of momentum - 3 G/eV_

_self.max_mom = 10.0 # Upper limit of momentum - 10 G/eV_

_self.square_side = 300.0 # Limits vertex region_

within def main():

_output_file = "flat_particle_ascii.hepmc" # Edit name of output file_

_n_events = 10000 # Edit the number of events_

  ➢ The number of events should additionally be reflected in _def __init__ (self, output_file, n_events=10000):_

```
Options:
1. Pion
2. Kaon
3. Proton
4. Mixed Generation
5. Deuteron (D2 nucleus)
6. Alpha (He4 nucleus)
Enter your choice: 4
Wrote 10000 events to flat_particle_ascii.hepmc

Plot Options:
1. Unfitted Distributions
2. Fitted Distributions
0. Exit
Enter your choice: 0
Exiting...
```

{Demo}

Application/Next Steps:

❖ The program provides the initial events to be used in upcoming beam envelope study, where the program output can be used in a full simulation to see how the beam evolves with fields and other variables.

❖ Moving forward:
  ➢ Refining details regarding kinematics and momentum
  ➢ QOL improvements/comments to delineate editable sections
  ➢ Introducing physics parameters to begin beam envelope studies