Light FCP Study
FCP simulation

Chengming Liu

20230413

DAMPE MOST Group Meeting

Outline

- Motivation
- Method
- Results
- Summary

Motivation

FCP should not be constrained to be heavy lepton

- Shower can happen
- Mass may be light
- Charge may be arbitrary value

Search for relativistic fractionally charged particles in space

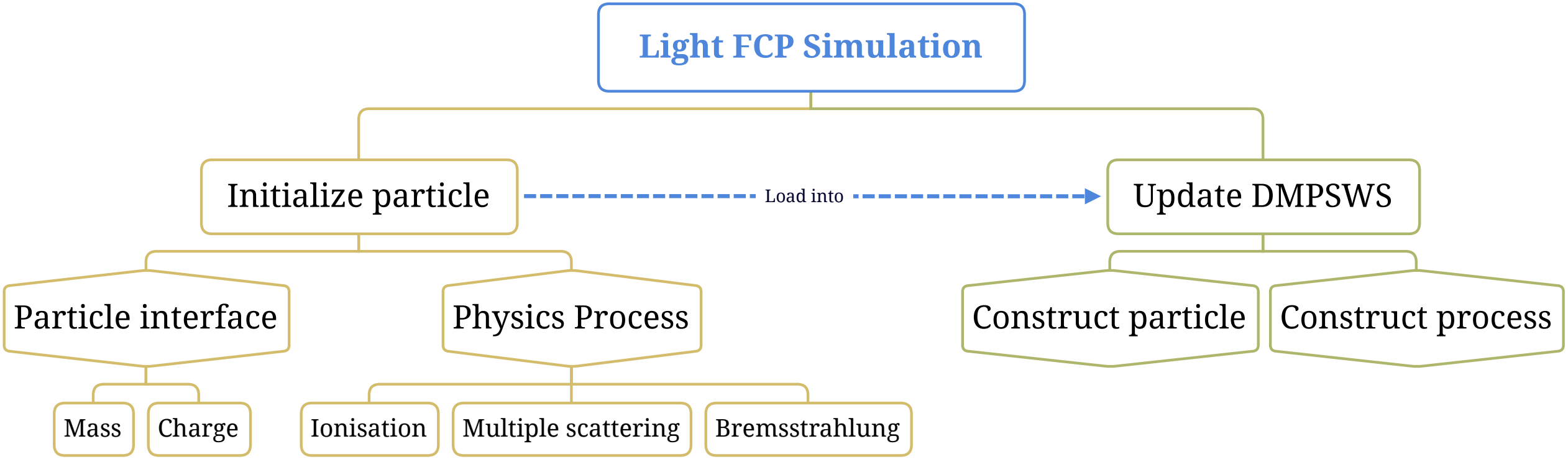
DAMPE Collaboration

Phys. Rev. D **106**, 063026 – Published 29 September 2022

Based on the dataset accumulated by DAMPE, the mass-, energy-dependent spectrum are supposed to be released

Method

- Create light-FCP model in DAMPSW



Geant4 source code modification

- The G4e processes are more appropriate for the light FCP

➢ Modify the model of the G4e

➢ Use electron mass and charge to check the simulation result

LFCPBremsstrahlungRelModel::ComputeDEDXPerVolume()

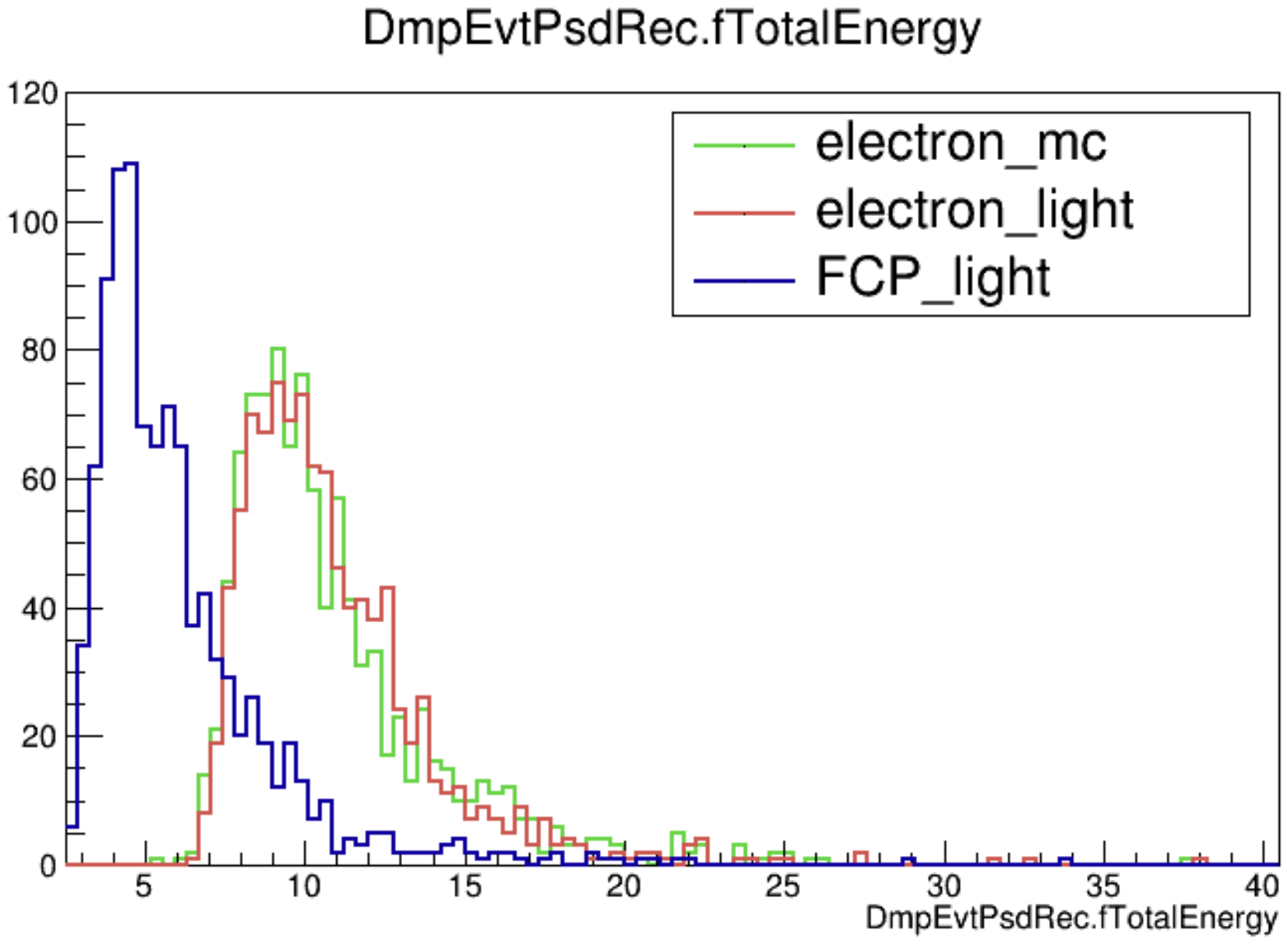
```
//============modified by lcm ================
  dedx                 += theAtomNumDensVector[ie]*zet*zet*ComputeBremLoss(tmax)
  *fPrimaryParticleChr*fPrimaryParticleChr/fPrimaryParticleMass/fPrimaryParticleMass
  *electron_mass_c2*electron_mass_c2;
//============modified by lcm ================
```

The energy deposition of Electron at PSD

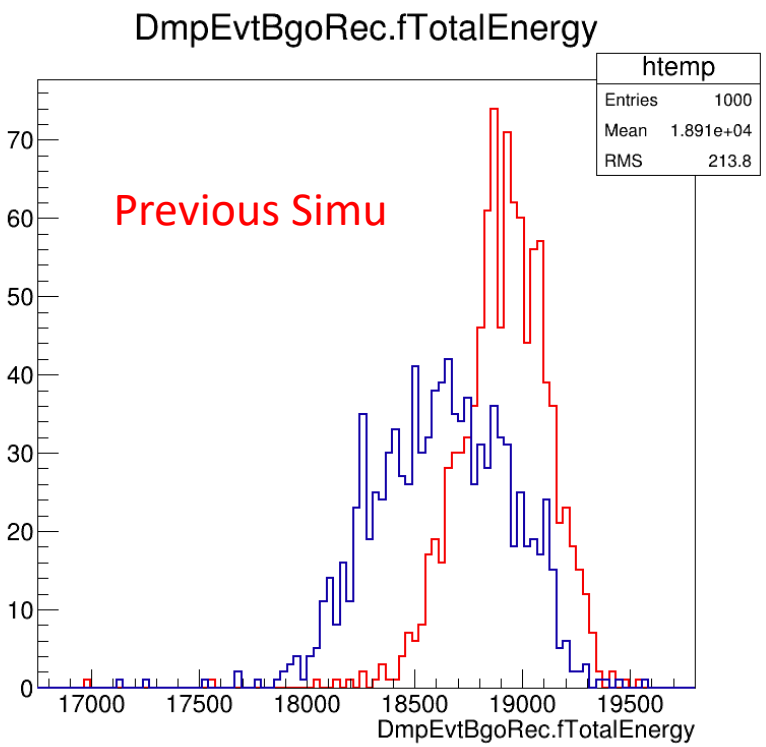
Test simulation

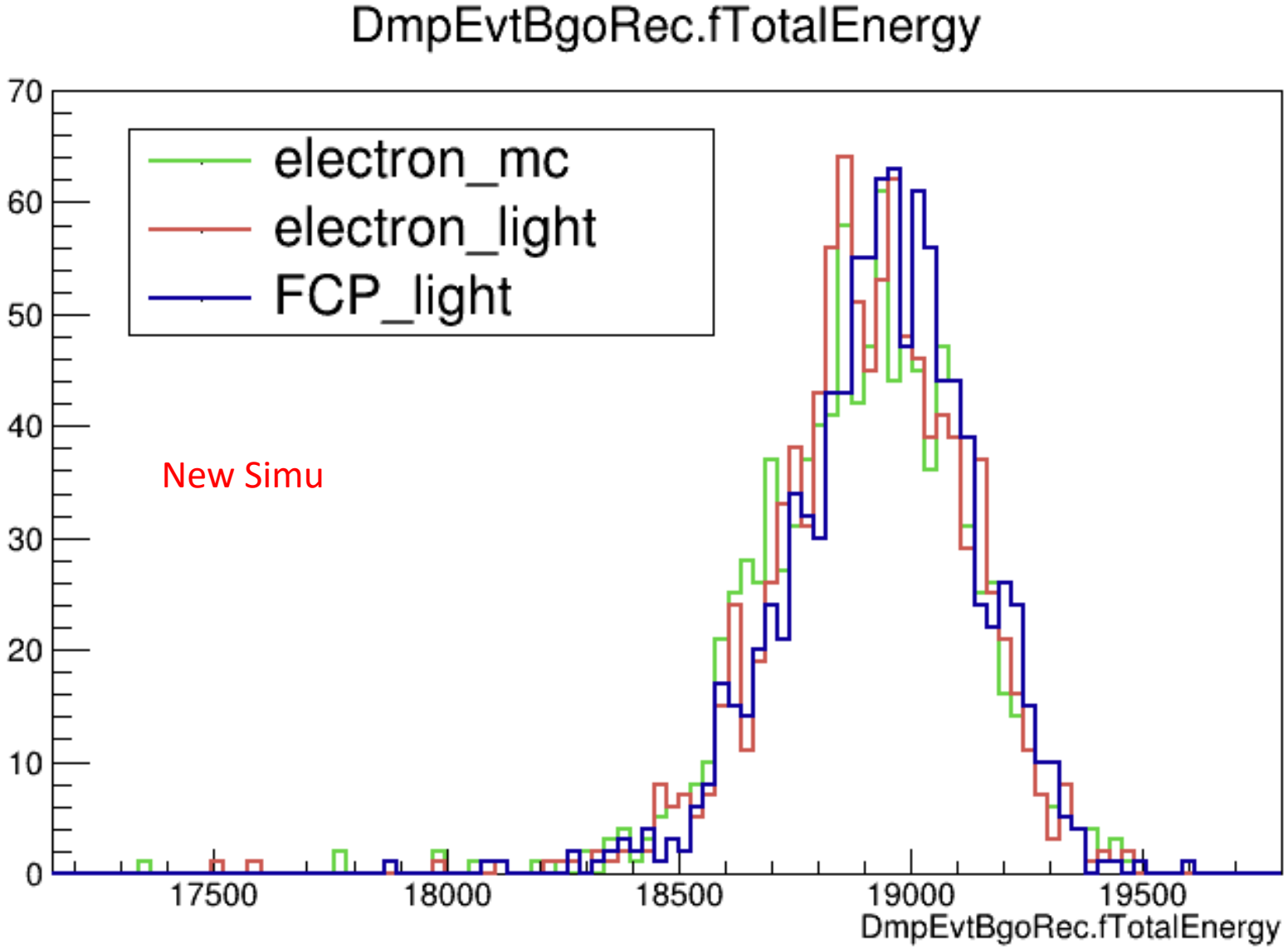
Point source

Kinetic energy: 20 GeV



The energy deposition of Electron at BGO





Backup

```
lightfcp$ tree
.
├── include
|   ├── LFCPBetheBlochModel.hh
|   ├── LFCPBremsstrahlung.hh
|   ├── LFCPBremsstrahlungRelModel.hh
|   ├── LFCPElement.hh
|   ├── LFCPElementPhysics.hh
|   ├── LFCPElementPhysicsMessenger.hh
|   ├── LFCPIonisation.hh
|   ├── LFCPMultipleScattering.hh
|   ├── LFCPPairProduction.hh
|   └── LFCPPairProductionModel.hh
└── src
    ├── LFCPBetheBlochModel.cc
    ├── LFCPBremsstrahlung.cc
    ├── LFCPBremsstrahlungRelModel.cc
    ├── LFCPElement.cc
    ├── LFCPElementPhysics.cc
    ├── LFCPElementPhysicsMessenger.cc
    ├── LFCPIonisation.cc
    ├── LFCPMultipleScattering.cc
    ├── LFCPPairProduction.cc
    └── LFCPPairProductionModel.cc
```

Effective acceptance