BeAGLE simulations at lower energies

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Motivation

- The previous BeAGLE simulations I ran used an electron beam with an 18 GeV/c momentum on an ion beam with a 110 (GeV/c)/A momentum. The events were generated with a minimum Q^2 of 0.5 GeV^2/c^2.
- I want to test if BeAGLE can simulate events at lower energies. I tested the following settings:
  1. Electron momentum = 10 GeV/c; ^{197}Au momentum = 100 GeV/c/A; $Q^2 > 10$ GeV^2/c^2
  2. Electron momentum = 1 GeV/c; ^{197}Au momentum = 10 GeV/c/A; $Q^2 > 10$ GeV^2/c^2
  3. Electron momentum = 5 GeV/c; ^{197}Au momentum = 0 GeV/c/A; $Q^2 > 1$ GeV^2/c^2

Setting 1: run card

```
* ------------------
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
PROJPAR                                                              ELECTRON
TARPAR         197.0       79.0         3
TAUFOR         10.0        25.0        1.0
FERMI           2          0.62
* random number
FSEED            13          -1          3          3
* output file with the name of fort.xx (xx=21-99)
OUTPUT           92
* energy of interaction
* --------------------
*            momentum of beam1||momentum of beam2
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
MOMENTUM        10.0         100.0
*       decay of pi0  2/0  decay/not decayed
PARDECAY          2
*       treatment of diffractive events
*DIFFRACT         -3           0           0          0
* lepton tagger to sample events with certain kinematics cuts
*               yMin       yMax     Q2Min     Q2Max    theta_Min theta_Max
L-TAG           1e-9       1.00       10.0     20000.0        0.0       6.29
```

Setting 1: run card

```
* ------------------
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
PROJPAR                                                              ELECTRON
TARPAR         197.0       79.0         3
TAUFOR          10.0       25.0       1.0
FERMI            2         0.62
* random number
FSEED             13         -1          3          3
* output file with the name of fort.xx (xx=21-99)
OUTPUT            92
* energy of interaction
* --------------------
*            momentum of beam1||momentum of beam2
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
MOMENTUM        10.0         100.0
*       decay of pi0  2/0  decay/not decayed
PARDECAY           2
*       treatment of diffractive events
*DIFFRACT         -3           0          0          0
* lepton tagger to sample events with certain kinematics cuts
*               yMin       yMax     Q2Min     Q2Max    theta_Min theta_Max
L-TAG           1e-9       1.00       10.0     20000.0        0.0       6.29
```

^{197}Au beam

Setting 1: run card

```
* ------------------
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
PROJPAR                                                              ELECTRON
TARPAR         197.0       79.0         3
TAUFOR         10.0        25.0        1.0
FERMI           2          0.62
* random number
FSEED            13          -1          3           3
* output file with the name of fort.xx (xx=21-99)
OUTPUT           92
* energy of interaction
* --------------------
*            momentum of beam1||momentum of beam2
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
MOMENTUM        10.0          100.0
*       decay of pi0  2/0  decay/not decayed
PARDECAY          2
*       treatment of diffractive events
*DIFFRACT         -3           0           0           0
* lepton tagger to sample events with certain kinematics cuts
*               yMin       yMax     Q2Min     Q2Max    theta_Min theta_Max
L-TAG           1e-9       1.00       10.0     20000.0        0.0       6.29
```

Beam momenta

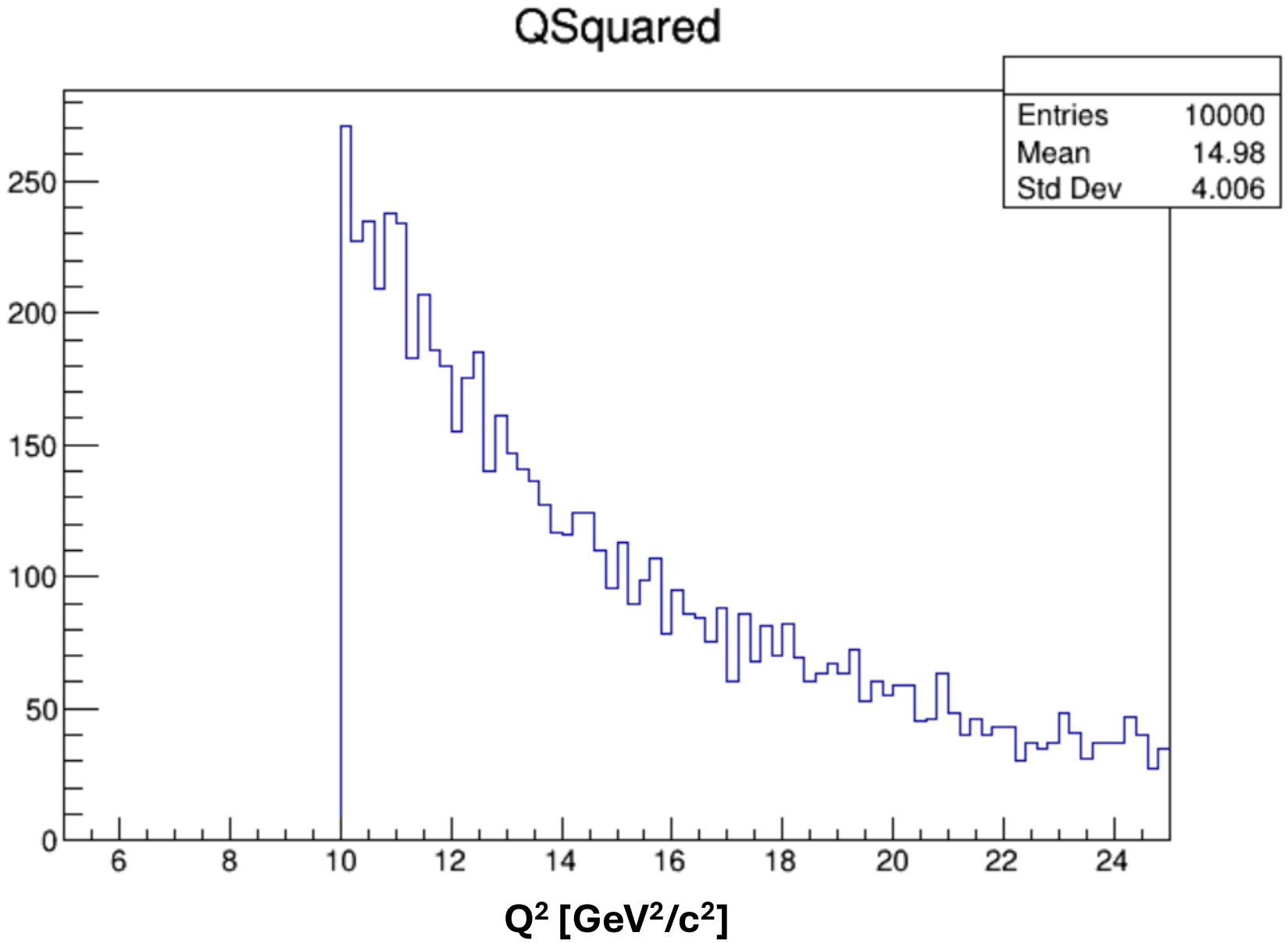
Setting 1: run card

```
* ------------------
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
PROJPAR                                                              ELECTRON
TARPAR         197.0       79.0         3
TAUFOR         10.0        25.0        1.0
FERMI           2          0.62
* random number
FSEED            13          -1          3           3
* output file with the name of fort.xx (xx=21-99)
OUTPUT           92
* energy of interaction
* --------------------
*            momentum of beam1||momentum of beam2
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
MOMENTUM        10.0         100.0
*       decay of pi0  2/0  decay/not decayed
PARDECAY          2
*       treatment of diffractive events
*DIFFRACT         -3           0           0           0
* lepton tagger to sample events with certain kinematics cuts
*               yMin       yMax      Q2Min     Q2Max    theta_Min theta_Max
L-TAG           1e-9       1.00       10.0     20000.0        0.0       6.29
```

Minimum Q^2

Setting 1: Generated Q^2 distribution

Events generate as expected with no error messages.



Setting 2: run card

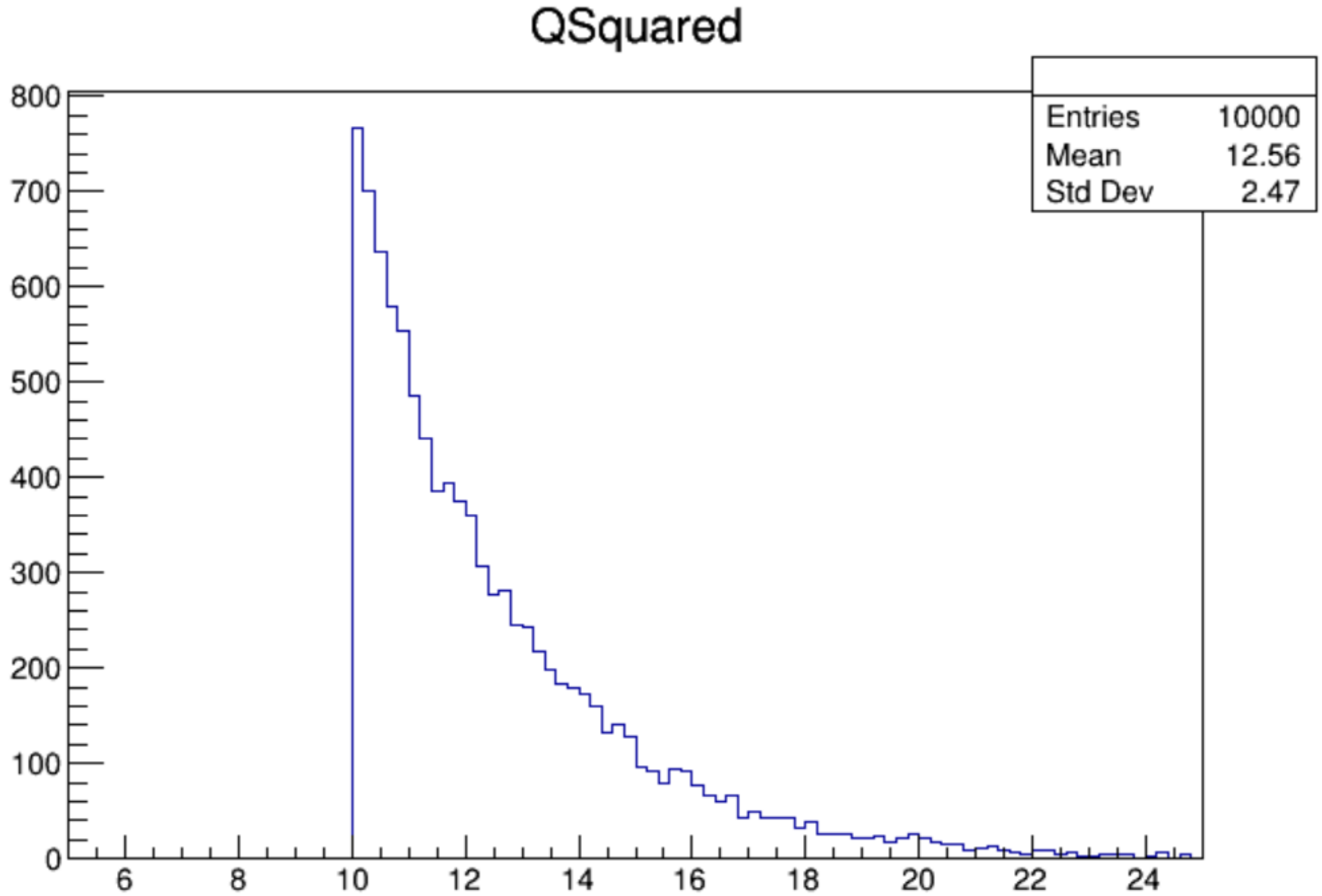
```
* ------------------
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
PROJPAR                                                              ELECTRON
TARPAR         197.0       79.0         3
TAUFOR         10.0        25.0        1.0
FERMI           2          0.62
* random number
FSEED            13          -1          3          3
* output file with the name of fort.xx (xx=21-99)
OUTPUT           92
* energy of interaction
* --------------------
*            momentum of beam1||momentum of beam2
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
MOMENTUM        1.0         10.0
*       decay of pi0  2/0  decay/not decayed
PARDECAY          2
*       treatment of diffractive events
*DIFFRACT         -3           0           0          0
* lepton tagger to sample events with certain kinematics cuts
*               yMin       yMax     Q2Min     Q2Max    theta_Min theta_Max
L-TAG           1e-9       1.00       10.0     20000.0        0.0       6.29
```

Setting 2: run card

```
* ------------------
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
PROJPAR                                                              ELECTRON
TARPAR         197.0       79.0         3
TAUFOR          10.0       25.0       1.0
FERMI              2       0.62
* random number
FSEED             13         -1         3         3
* output file with the name of fort.xx (xx=21-99)
OUTPUT             92
* energy of interaction
* --------------------
*            momentum of beam1||momentum of beam2
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
MOMENTUM         1.0         10.0
*       decay of p10  2/0  decay/not decayed
PARDECAY           2
*       treatment of diffractive events
*DIFFRACT         -3          0          0          0
* lepton tagger to sample events with certain kinematics cuts
*               yMin       yMax      Q2Min     Q2Max    theta_Min theta_Max
L-TAG           1e-9       1.00       10.0     20000.0        0.0       6.29
```

Setting 2: Generated Q^2 distribution

Events generate as expected with no error messages.



Setting 3: run card

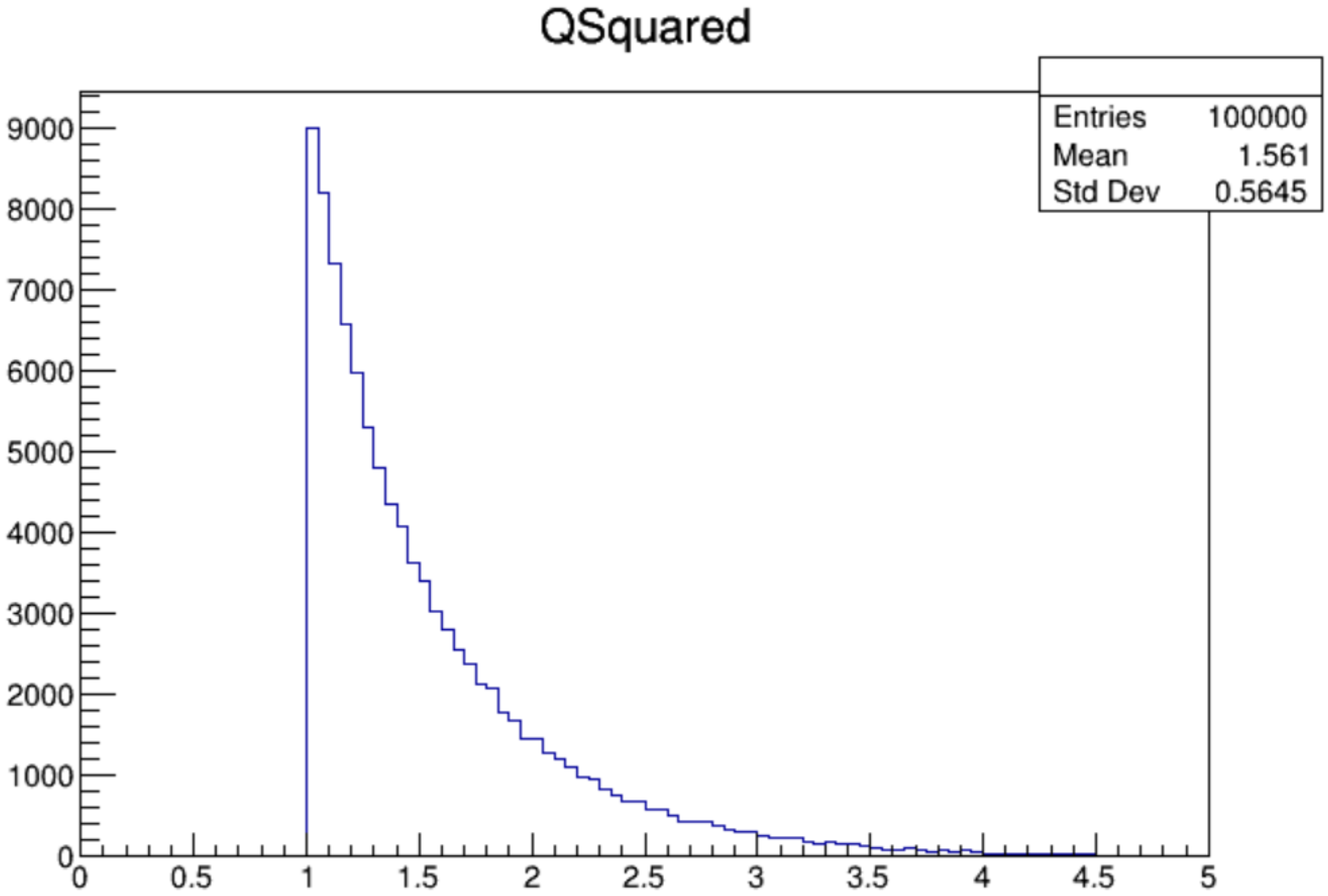
```
* ------------------
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
PROJPAR                                                              ELECTRON
TARPAR         197.0       79.0         3
TAUFOR         10.0        25.0        1.0
FERMI           2          0.62
* random number
FSEED           13          -1          3          3
* output file with the name of fort.xx (xx=21-99)
OUTPUT          92
* energy of interaction
* --------------------
*            momentum of beam1||momentum of beam2
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
MOMENTUM        5.0         0.0
*       decay of pi0  2/0  decay/not decayed
PARDECAY          2
*       treatment of diffractive events
*DIFFRACT        -3          0           0          0
* lepton tagger to sample events with certain kinematics cuts
*               yMin       yMax     Q2Min     Q2Max    theta_Min theta_Max
L-TAG           1e-9       1.00      1.0      20000.0       0.0       6.29
```

Setting 3: run card

```
* ------------------
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
PROJPAR                                                              ELECTRON
TARPAR         197.0       79.0         3
TAUFOR          10.0       25.0       1.0
FERMI              2       0.62
* random number
FSEED             13         -1         3         3
* output file with the name of fort.xx (xx=21-99)
OUTPUT             92
* energy of interaction
* --------------------
*            momentum of beam1||momentum of beam2
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
MOMENTUM         5.0         0.0
*       decay of p10  2/0  decay/not decayed
PARDECAY           2
*       treatment of diffractive events
*DIFFRACT         -3          0          0          0
* lepton tagger to sample events with certain kinematics cuts
*               yMin       yMax      Q2Min      Q2Max    theta_Min theta_Max
L-TAG           1e-9       1.00       1.0     20000.0          0.0      6.29
```

Setting 3 : Generated Q^2 distribution

Events generate as expected with no error messages.



Summary

- BeAGLE can generate events down to lower COM energies without any generation errors.
- What energies do we want to use?