Update on BeAGLE Simulations

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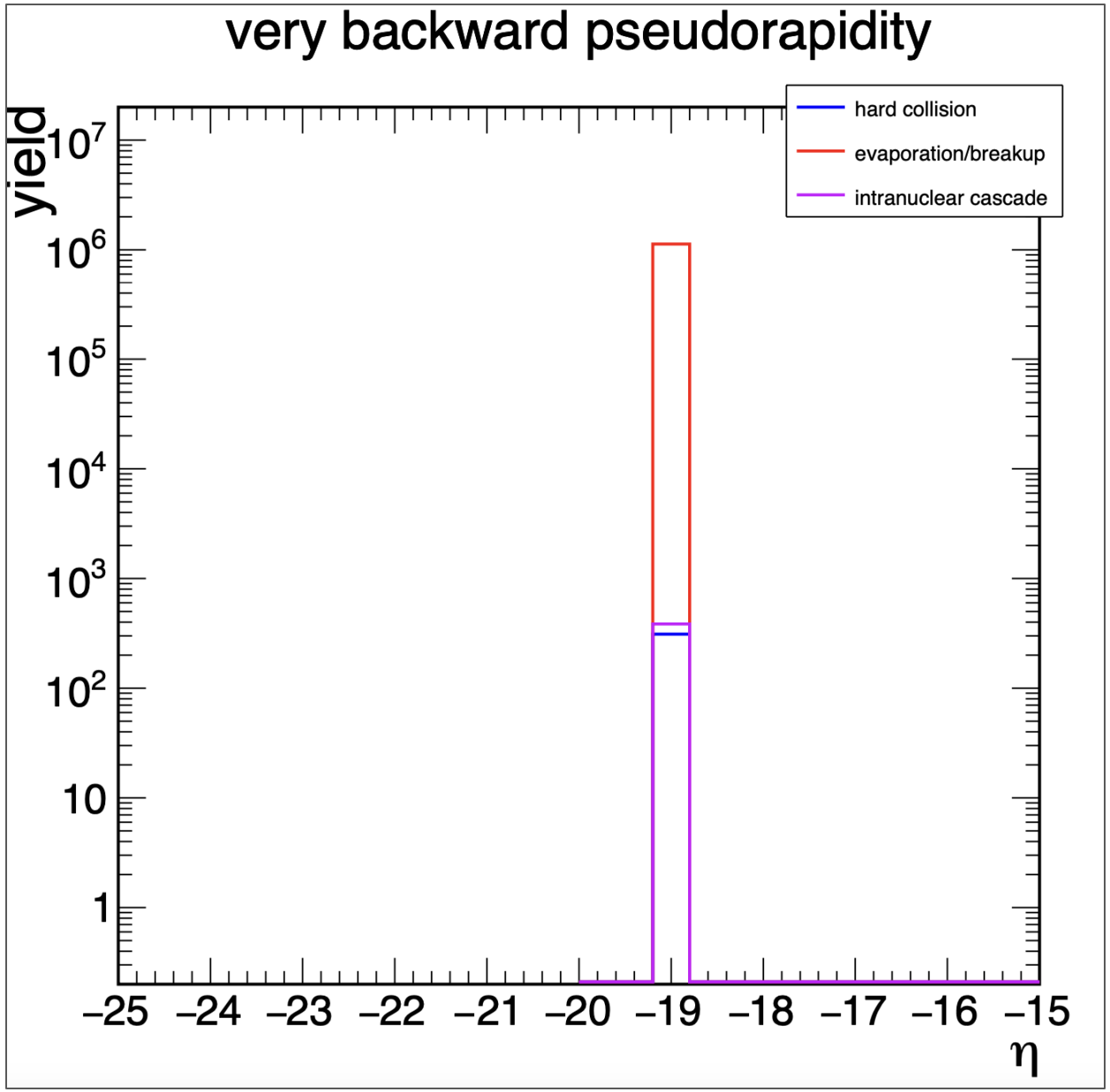
Outline

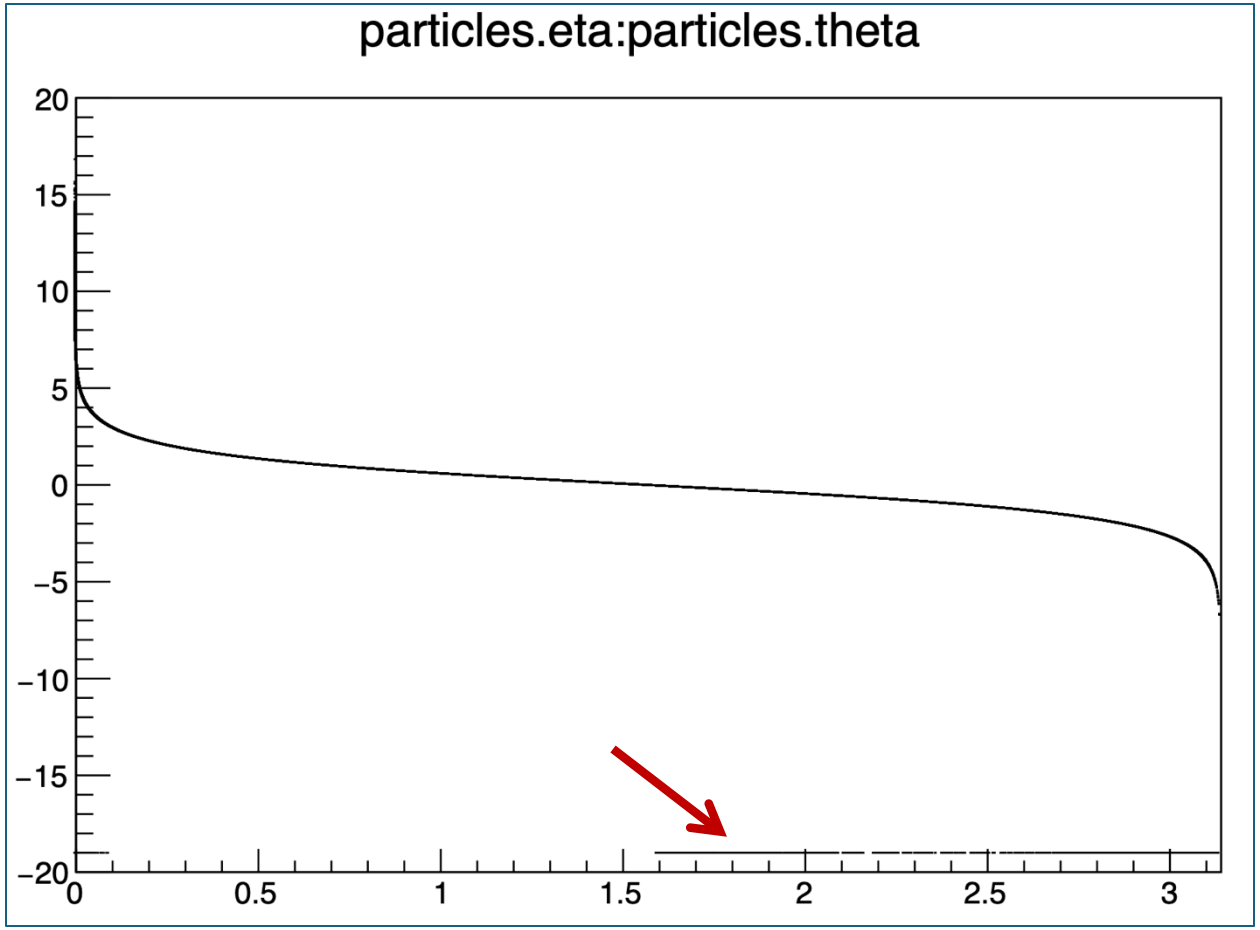
- The eta problem for photons
- Work on addressing the eta problem
- Summary

Photons at η = -19

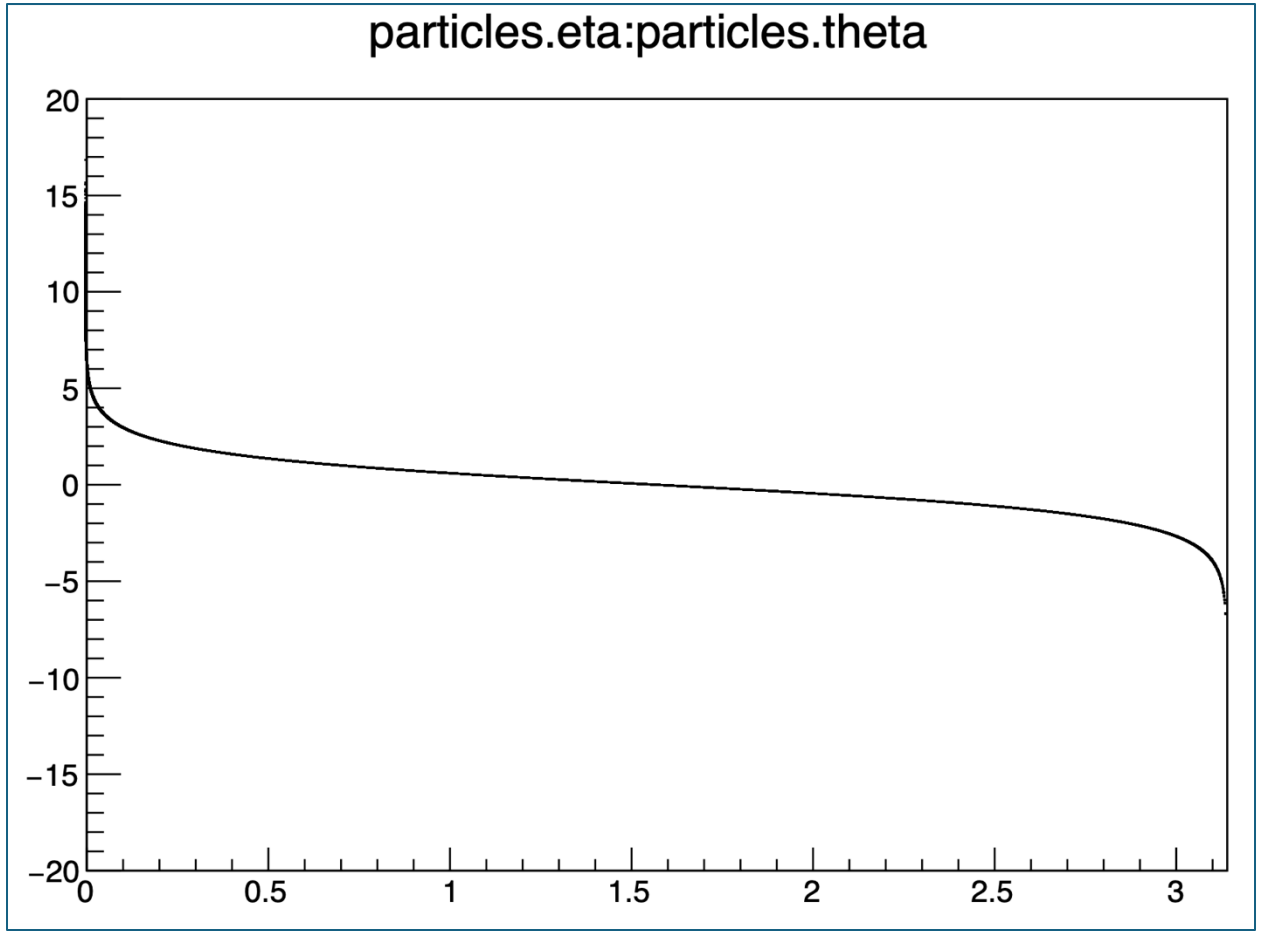


- We see some very backward photons spiking at η = -19
  - Most are the low momentum photons from the evaporation stage
- This spike arises from setting the η = -19 for particles that do not meet some conditions
- Recomputing η for all particles

Comparing results from eic-smear versions

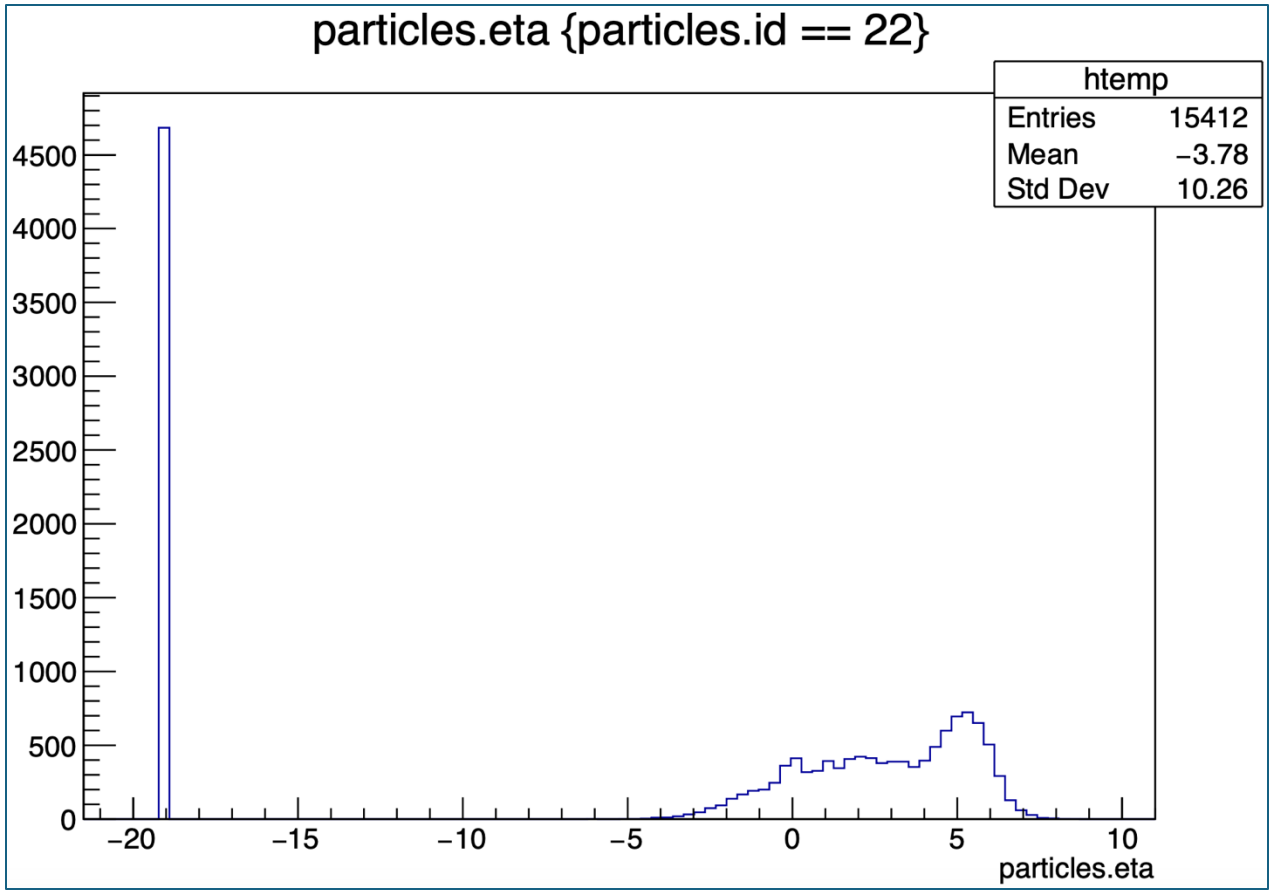


original eic-smear

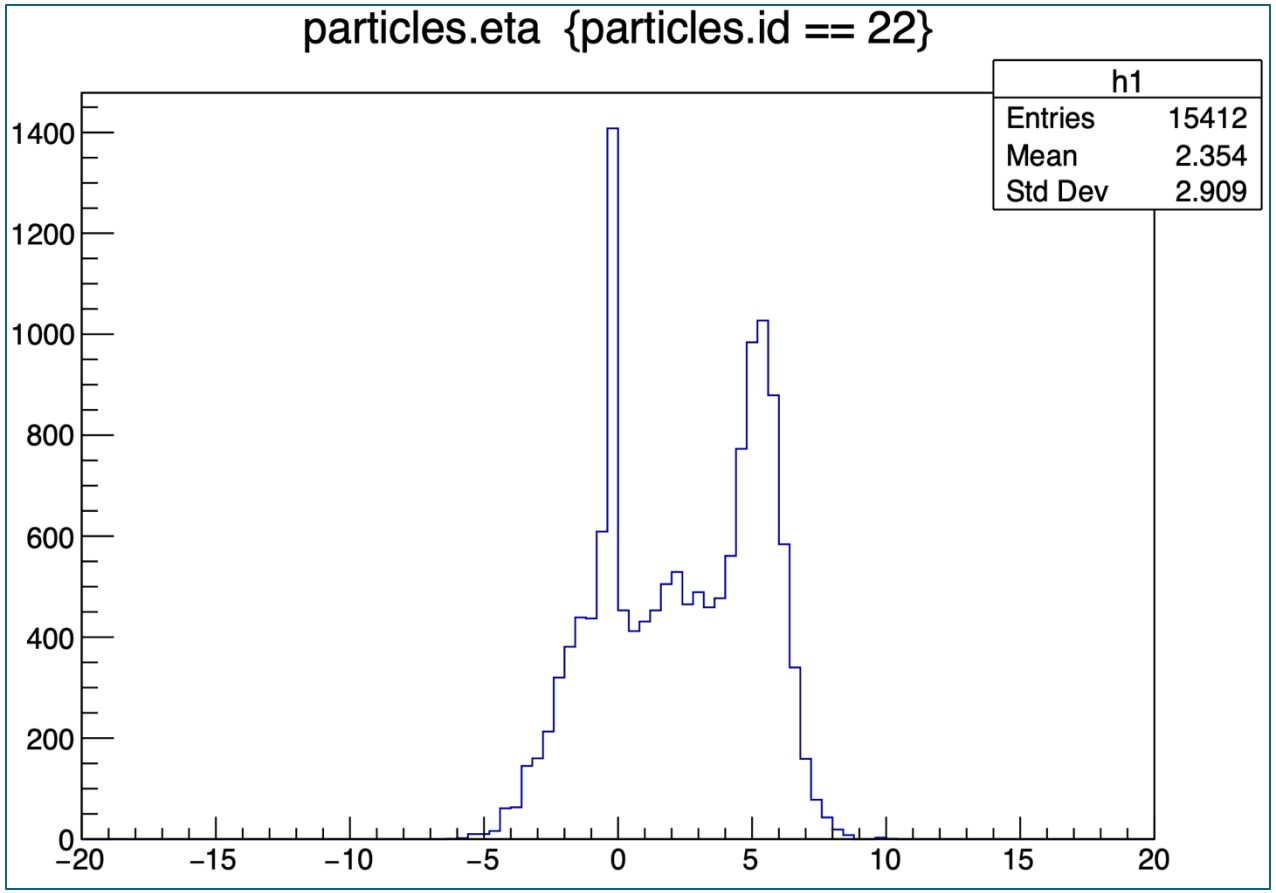


“eta-fixed” eic-smear

Comparing results from eic-smear versions



original eic-smear



“eta-fixed” eic-smear

Photons with energy < 1

Row	Instance	particles	particle	particle	particle
0	4	11	0	0	-19
0	230	1	0.2048709	0.204864	5.4810271
0	231	1	0.3553569	0.355357	-19
0	232	1	0.0051699	0.005164	3.7302162
0	233	1	0.0095809	0.009578	4.4436197
0	234	1	0.0484890	0.048489	-19
0	235	1	0.012507	0.012506	5.3516955
0	236	1	9.100e-05	9.1e-05	-19
0	238	1	0.3272750	-0.253245	-1.029729
0	239	1	0.0190600	0.012802	0.8137730
1	4	11	0	0	-19
1	261	1	0.0661839	0.066165	4.4105401
1	262	1	0.0874470	0.087442	5.2189068
1	263	1	0.0131339	0.013131	4.6273293
1	264	1	0.0018889	0.001889	-19
1	267	1	0.4388580	0.38443	1.3582098
1	268	1	0.3093169	0.28247	1.5464948
2	3	21	0.0145760	-0.05711	-19
2	4	11	0	0	-19
2	205	3	0.0145760	-0.05711	-19
2	229	1	0.3948439	0.394839	6.0586962
2	230	1	0.1719750	0.171962	5.0742569
2	231	1	0.0442080	0.044192	4.3094019
2	232	1	0.0411380	0.041138	-19
2	233	1	0.0074419	0.007442	-19

Type <CR> to continue or q to quit ==> q

Row	Instance	particles	particle	particle	particle
0	4	11	0	0	inf
0	230	1	0.2048709	0.204864	5.4810271
0	231	1	0.3553569	0.355357	6.7828016
0	232	1	0.0051699	0.005164	3.7302162
0	233	1	0.0095809	0.009578	4.4436197
0	234	1	0.0484890	0.048489	6.8315563
0	235	1	0.012507	0.012506	5.3516955
0	236	1	9.100e-05	9.1e-05	5.2040367
0	238	1	0.3272750	-0.253245	-1.029729
0	239	1	0.0190600	0.012802	0.8137730
1	4	11	0	0	inf
1	261	1	0.0661839	0.066165	4.4105401
1	262	1	0.0874470	0.087442	5.2189068
1	263	1	0.0131339	0.013131	4.6273293
1	264	1	0.0018889	0.001889	5.3450603
1	267	1	0.4388580	0.38443	1.3582098
1	268	1	0.3093169	0.28247	1.5464948
2	3	21	0.0145760	-0.05711	-0.046181
2	4	11	0	0	inf
2	205	3	0.0145760	-0.05711	-0.046181
2	229	1	0.3948439	0.394839	6.0586962
2	230	1	0.1719750	0.171962	5.0742569
2	231	1	0.0442080	0.044192	4.3094019
2	232	1	0.0411380	0.041138	7.1606640
2	233	1	0.0074419	0.007442	5.4864177

Type <CR> to continue or q to quit ==> q

Status codes → 1: stable final state particle

3: documentation line describing the collision

21: documentation line describing the collision

Photons with energy < 1

		Status	E	pz	eta
0	4	11	0	0	-19
0	230	1	0.2048709	0.204864	5.4810271
0	231	1	0.3553569	0.355357	-19
0	232	1	0.0051699	0.005164	3.7302162
0	233	1	0.0095809	0.009578	4.4436197
0	234	1	0.0484890	0.048489	-19
0	235	1	0.012507	0.012506	5.3516955
0	236	1	9.100e-05	9.1e-05	-19
0	238	1	0.3272750	-0.253245	-1.029729
0	239	1	0.0190600	0.012802	0.8137730
1	4	11	0	0	-19
1	261	1	0.0661839	0.066165	4.4105401
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1	267	1	0.4388580	0.38443	1.3582098
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2	4	11	0	0	-19
2	205	3	0.0145760	-0.05711	-19
2	229	1	0.3948439	0.394839	6.0586962
2	230	1	0.1719750	0.171962	5.0742569
2	231	1	0.0442080	0.044192	4.3094019
2	232	1	0.0411380	0.041138	-19
2	233	1	0.0074419	0.007442	-19

Type <CR> to continue or q to quit ==> q

		Status	E	pz	eta
0	4	11	0	0	inf
0	230	1	0.2048709	0.204864	5.4810271
0	231	1	0.3553569	0.355357	6.7828016
0	232	1	0.0051699	0.005164	3.7302162
0	233	1	0.0095809	0.009578	4.4436197
0	234	1	0.0484890	0.048489	6.8315563
0	235	1	0.012507	0.012506	5.3516955
0	236	1	9.100e-05	9.1e-05	5.2040367
0	238	1	0.3272750	-0.253245	-1.029729
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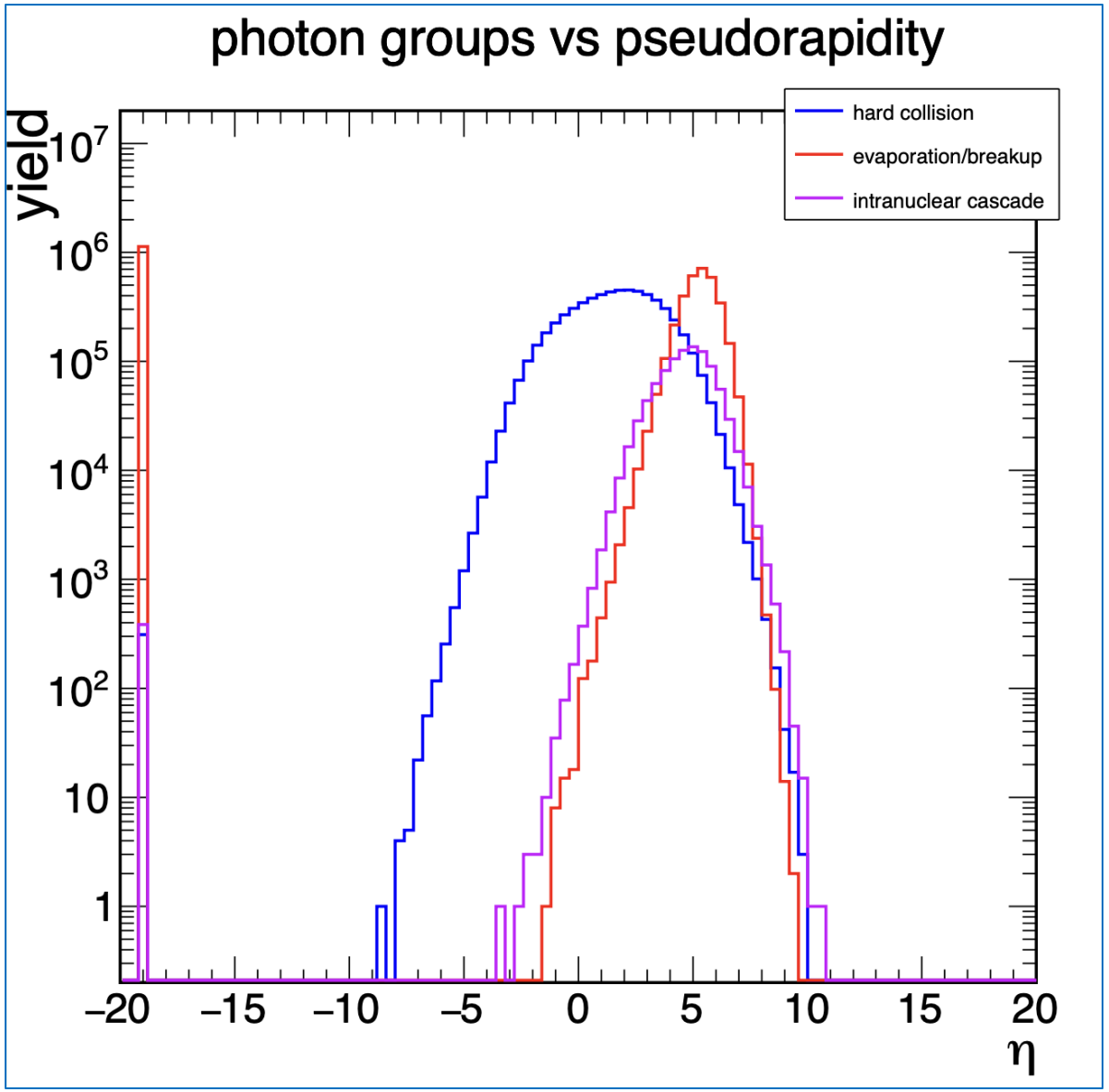
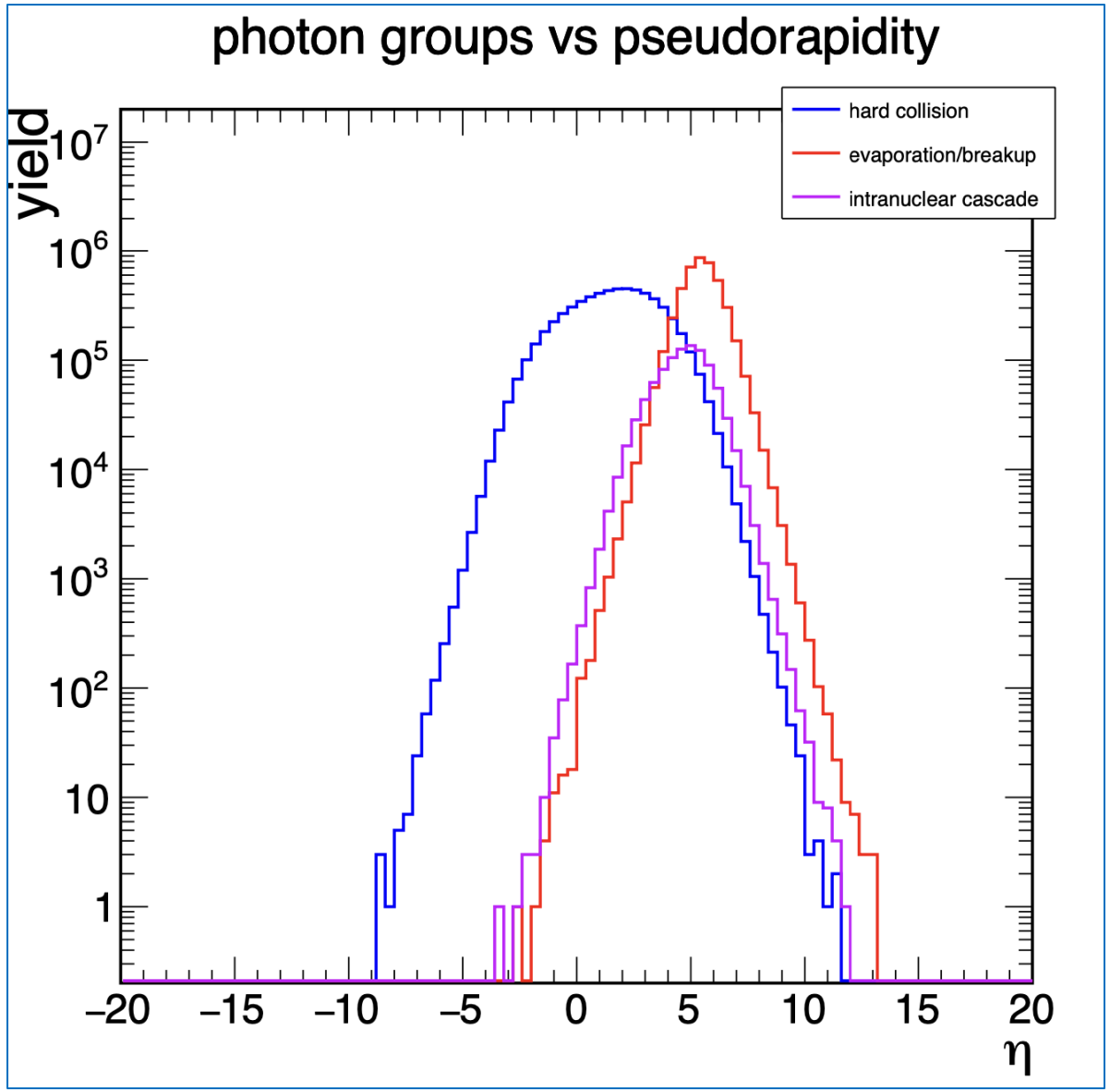
1	263	1	0.0131339	0.013131	4.6273293
1	264	1	0.0018889	0.001889	5.3450603
1	267	1	0.4388580	0.38443	1.3582098
1	268	1	0.3093169	0.28247	1.5464948
2	3	21	0.0145760	-0.05711	-0.046181
2	4	11	0	0	inf
2	205	3	0.0145760	-0.05711	-0.046181
2	229	1	0.3948439	0.394839	6.0586962
2	230	1	0.1719750	0.171962	5.0742569
2	231	1	0.0442080	0.044192	4.3094019
2	232	1	0.0411380	0.041138	7.1606640
2	233	1	0.0074419	0.007442	5.4864177

Type <CR> to continue or q to quit ==> q

Status →	11:	Projectile (γ*) documentation line

Decoupled Photons





Summary

- Computation of pseudorapidity for particles addressed to be calculated using the polar angle for all particles

- Photons previously spiking at $\eta = -19$ redistributed correspondingly with e-A interaction stage

- There are some photons which now have η = infinity
  - Most of these have energy = 0 and status = 11
  - A few have very small energy
  - We are still working to address this issue

Bonus: Changes that were made to eic-smear code

```
135  void ParticleMCbase::ComputeDerivedQuantities() {
136    // Calculate quantities that depend only on the properties already read.
137    pt = sqrt(pow(px, 2.) + pow(py, 2.));
138    p = sqrt(pow(pt, 2.) + pow(pz, 2.));
139    // Rapidity and pseudorapidity
140    Double_t Epluspz = E + pz;
141    Double_t Eminuspz = E - pz;
142    Double_t Ppluspz = p + pz;
143    Double_t Pminuspz = p - pz;
144    if (Eminuspz <= 0.0 || Pminuspz == 0.0 ||
145       Ppluspz == 0.0 || Epluspz <= 0.0) {
146      // Dummy values to avoid zero or infinite arguments in calculations
147      rapidity = -19.;
148      eta = -19.;
149    } else {
150      rapidity = 0.5 * log(Epluspz / Eminuspz);
151      eta = 0.5 * log(Ppluspz / Pminuspz);
152    }  // if
153    theta = atan2(pt, pz);
154    phi = TVector2::Phi_0_2pi(atan2(py, px));
155  }
```

```
136  void ParticleMCbase::ComputeDerivedQuantities() {
137    // Calculate quantities that depend only on the properties already read.
138    pt = sqrt(pow(px, 2.) + pow(py, 2.));
139    p = sqrt(pow(pt, 2.) + pow(pz, 2.));
140    // Rapidity and pseudorapidity
141    Double_t Epluspz = E + pz;
142    Double_t Eminuspz = E - pz;
143    Double_t Ppluspz = p + pz;
144    Double_t Pminuspz = p - pz;
145    if (Eminuspz <= 0.0 || Pminuspz == 0.0 ||
146       Ppluspz == 0.0 || Epluspz <= 0.0) {
147      // (previous) Dummy values to avoid zero or infinite arguments in calculations
148      // calculating pseudorapidity (eta) with the polarangle
149      // leaving rapidity untouched for now
150      rapidity = -19.;
151
152    } else {
153      rapidity = 0.5 * log(Epluspz / Eminuspz);
154      //eta = 0.5 * log(Ppluspz / Pminuspz);
155
156    }  // if
157    theta = atan2(pt, pz);
158    eta = (-1) * log(tan(theta/2));
159    phi = TVector2::Phi_0_2pi(atan2(py, px));
160  }
```

File: ParticleMC.cxx