RUN 5 AmBe data-mc comparison

10-03-2025

Overview

We compare part of the RUN 5 **high gain** data with simulation (low statistics).

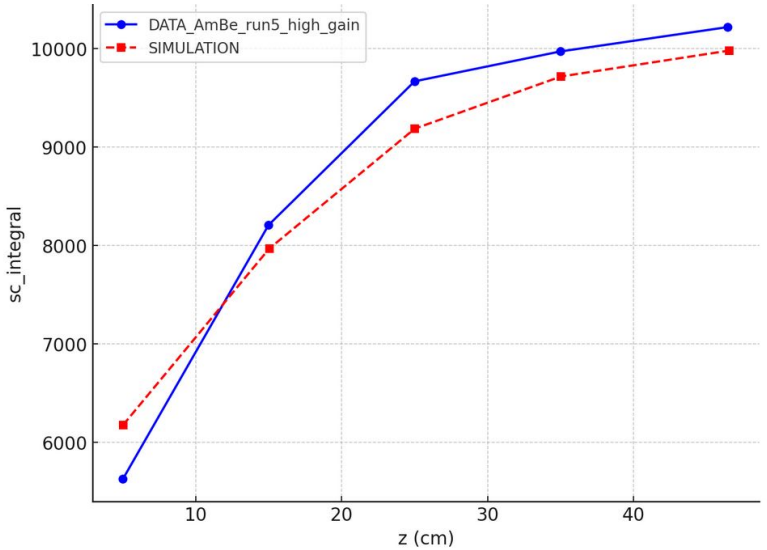
We simulate only AmBe neutrons and then **add real background.**

A simple **normalization** of the simulation and real data is performed in order to be able to compare qualitatively the distributions.

Simulation Workflow

1. **Geant4** simulation Neutrons with AmBe source (geometry implemented by Flaminia) as in presentation 24 feb. 2024 (simulation meeting)

2. **Digitized** ~ 7000 events (neutrons) with best parameters for iron calibration 16 December



3. **Recostruction**: same code version and parameters as in RUN 5 AmBe campaign

Data

- **high gain** (440 V, 800 V/cm) AmBe RUN 5: run 99265 - 99615 (16-7 dic. 2024, ~36 hours data taking, **350 runs**)
- background only (19-20 dic. 2024): run 100031 - 100381 (**350 runs**)

Cuts: keeping only tracks with mean position within a radius of 550 pixels

Note: background only data has a ~15% higher LY than AmBe data

Normalization: why 350 runs?

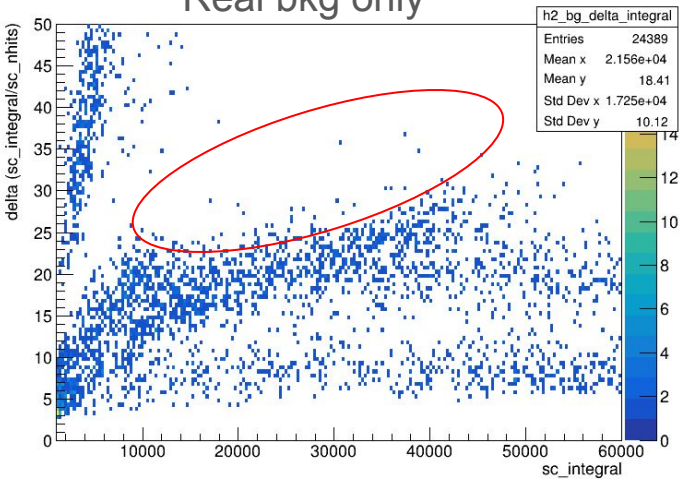
The number of runs was chosen assuming that the difference between AmBe data and bakcground-only data is due to neutrons only:

- Simulation AmBe only: 1716 reconstructed clusters
- Background data only: 24389 reconstructed clusters
- **Simulation AmBe+ real background**: **26105** reconstructed clusters
- **Real AmBe Data: 26543** reconstructed tracks

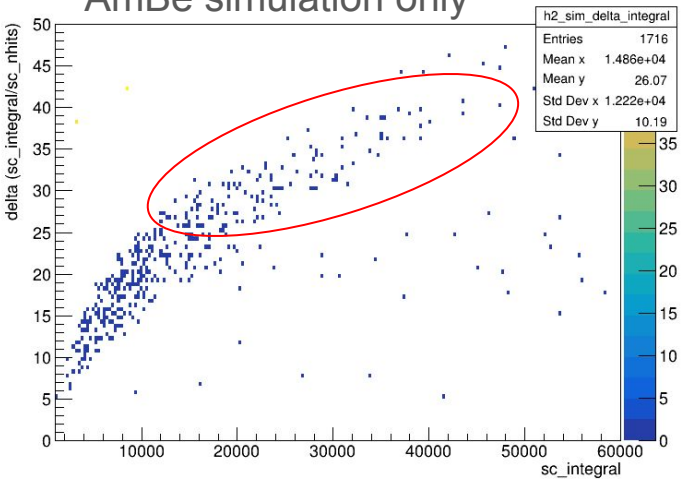
if these two numbers are similar, we can compare the distributions directly

Future steps: It'll be necessary to properly normalize the distributions (geometry efficiency, dead time…)

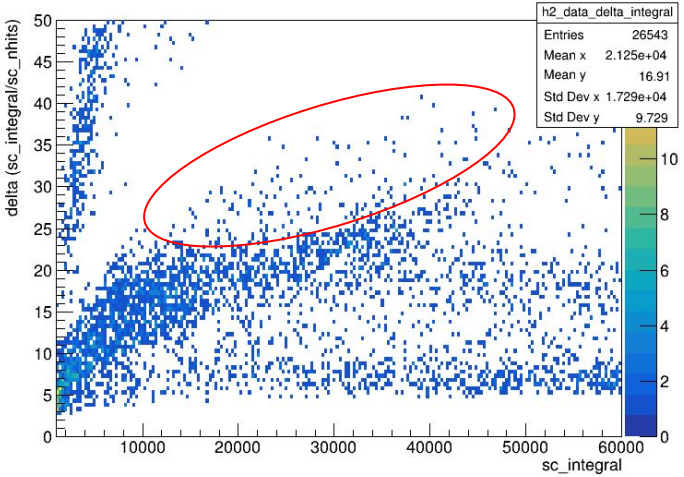
Real bkg only



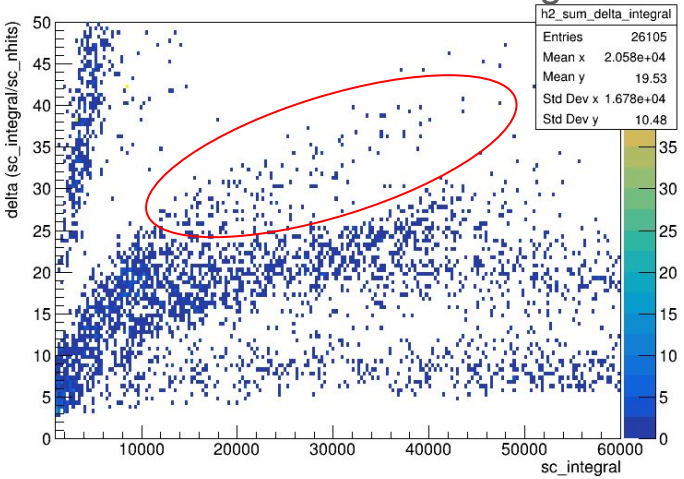
AmBe simulation only



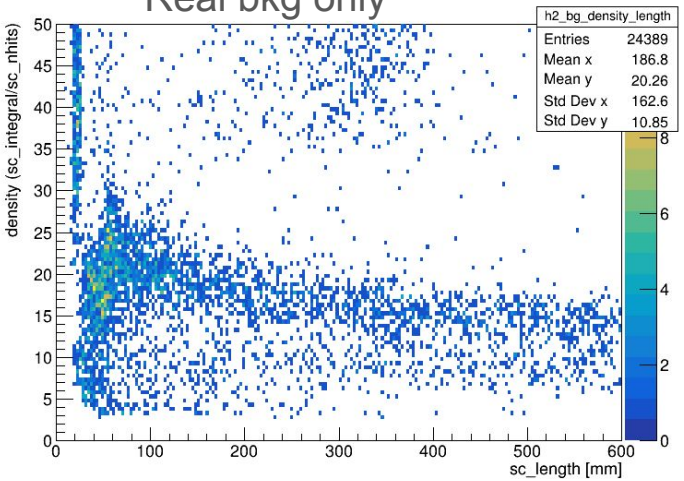
AmBe data



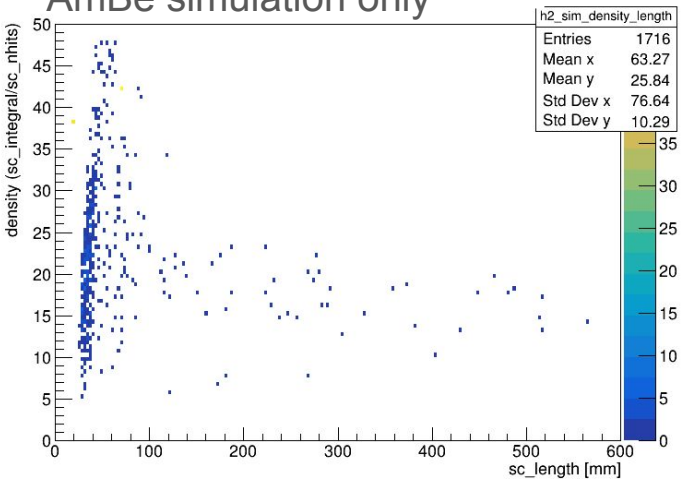
AmBe simulation + real bkg



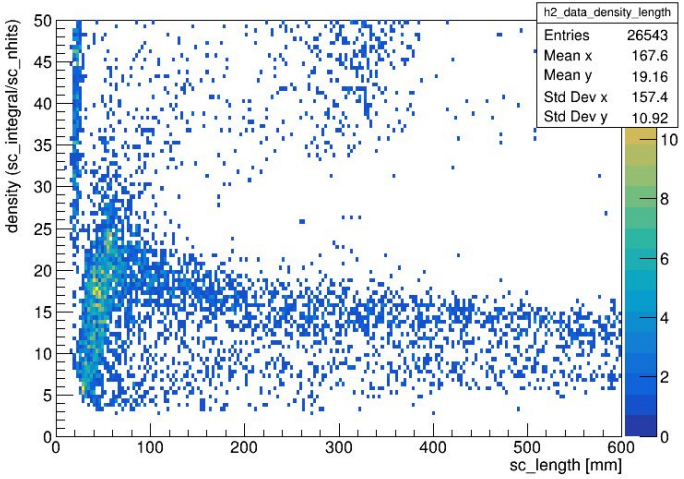
Real bkg only



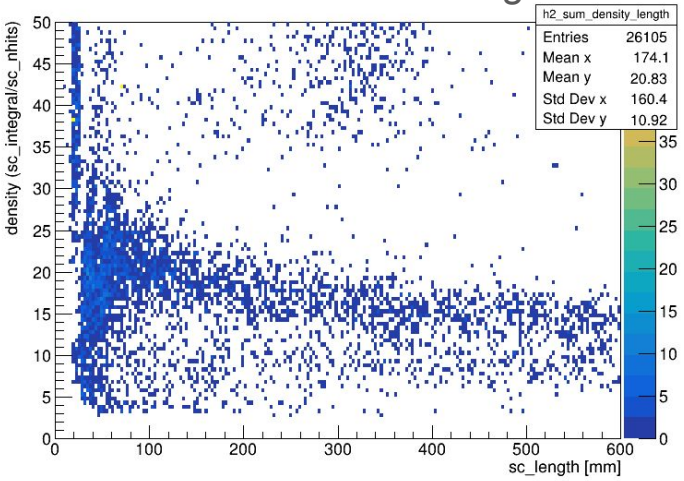
AmBe simulation only

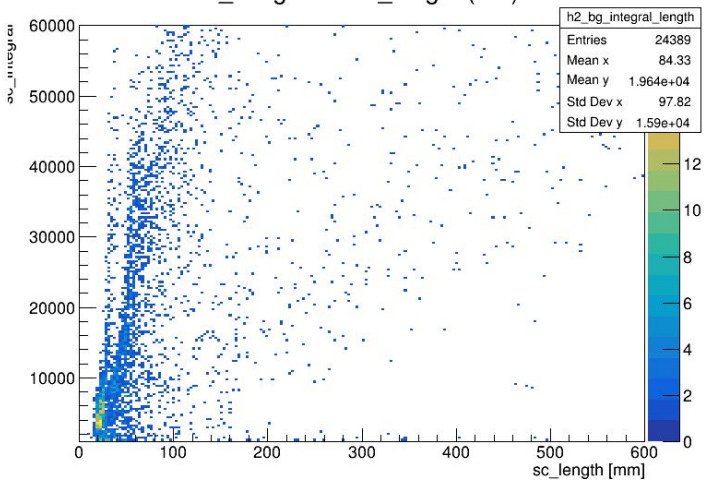


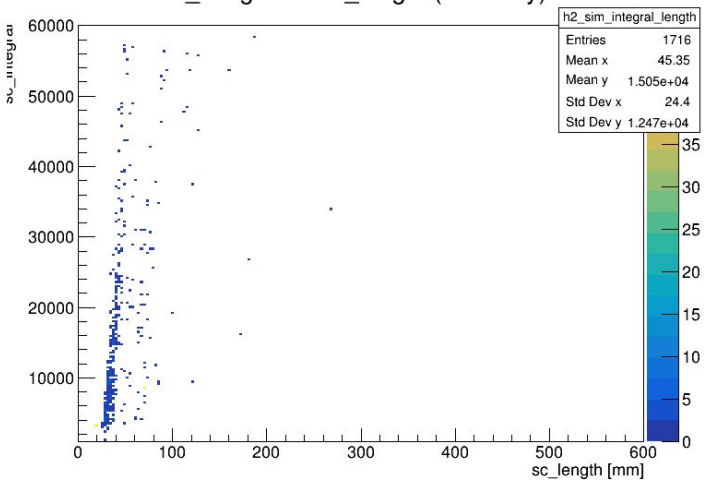
AmBe data

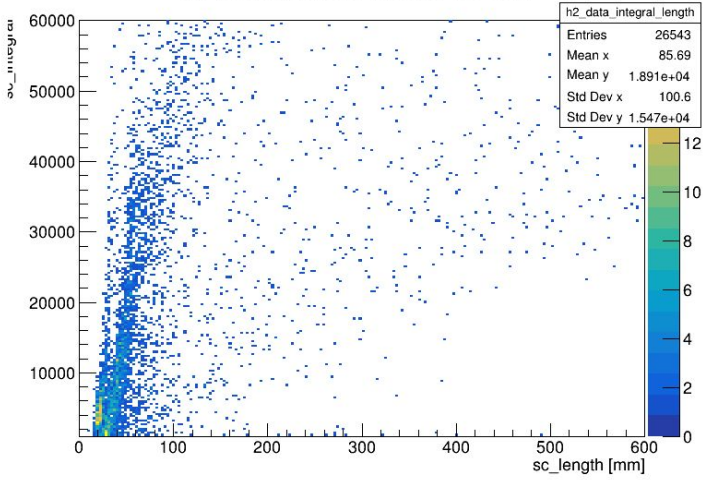


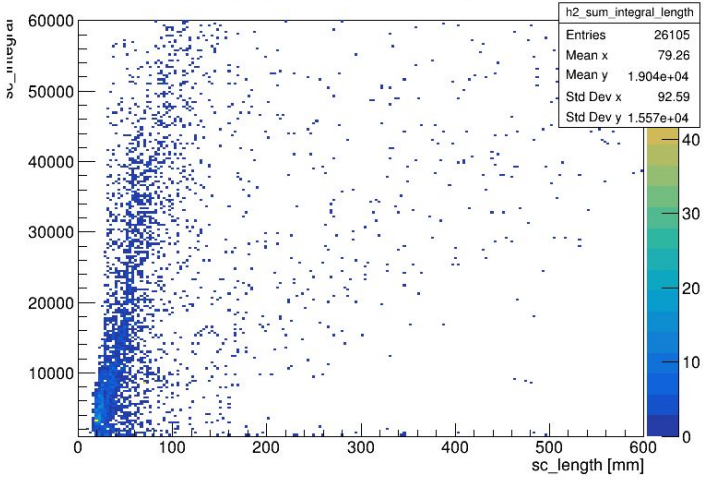
AmBe simulation + real bkg




sc_integral vs sc_length (BG)
h2_bg_integral_length
Entries 24389
Mean x 84.33
Mean y 1.964e+04
Std Dev x 97.82
Std Dev y 1.59e+04
sc_integral
sc_length [mm]

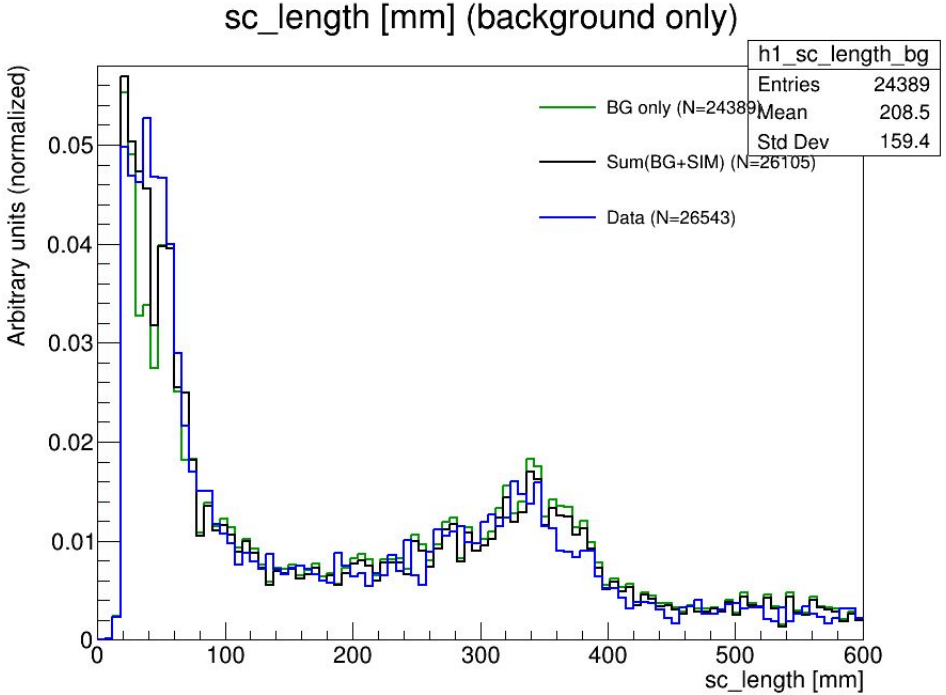

sc_integral vs sc_length (SIM only)
h2_sim_integral_length
Entries 1716
Mean x 45.35
Mean y 1.505e+04
Std Dev x 24.4
Std Dev y 1.247e+04
sc_integral
sc_length [mm]

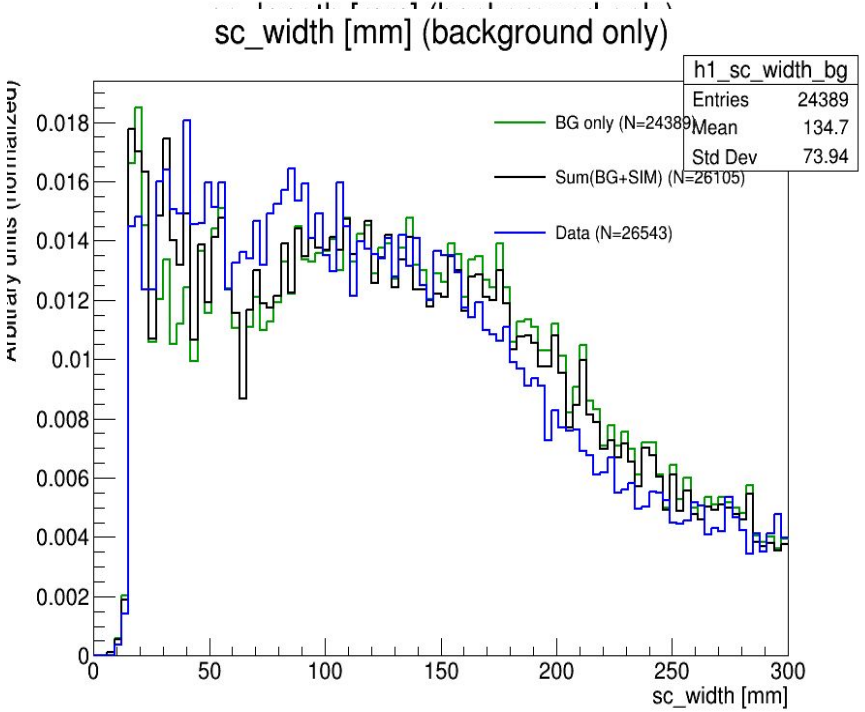

sc_integral vs sc_length (DATA)
h2_data_integral_length
Entries 26543
Mean x 85.69
Mean y 1.891e+04
Std Dev x 100.6
Std Dev y 1.547e+04
sc_integral
sc_length [mm]

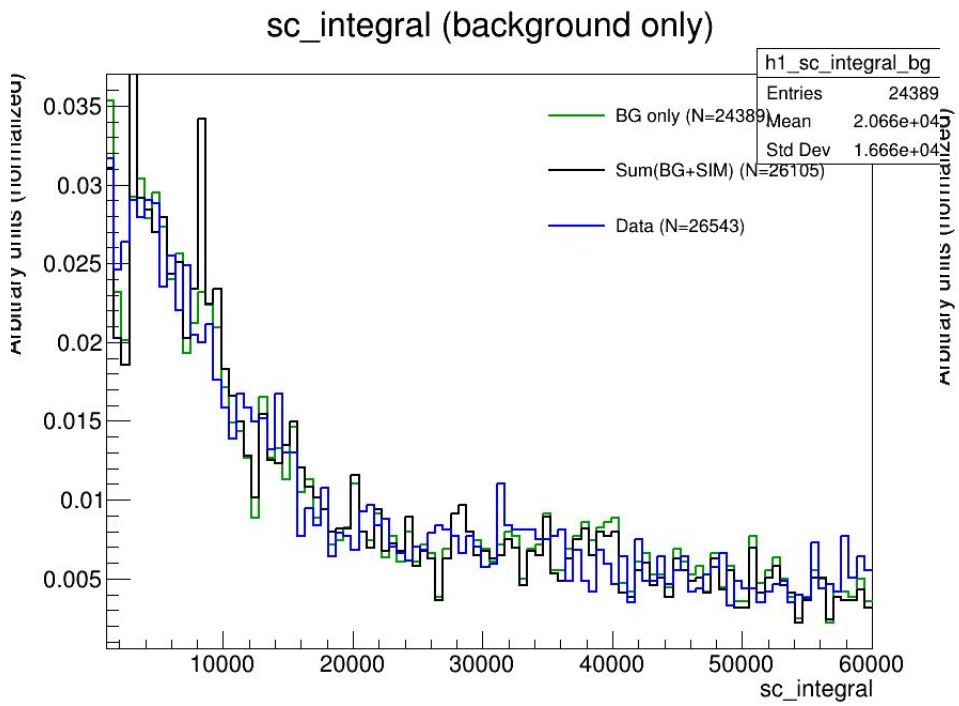

sc_integral vs sc_length (SUM)
h2_sum_integral_length
Entries 26105
Mean x 79.26
Mean y 1.904e+04
Std Dev x 92.59
Std Dev y 1.557e+04
sc_integral
sc_length [mm]

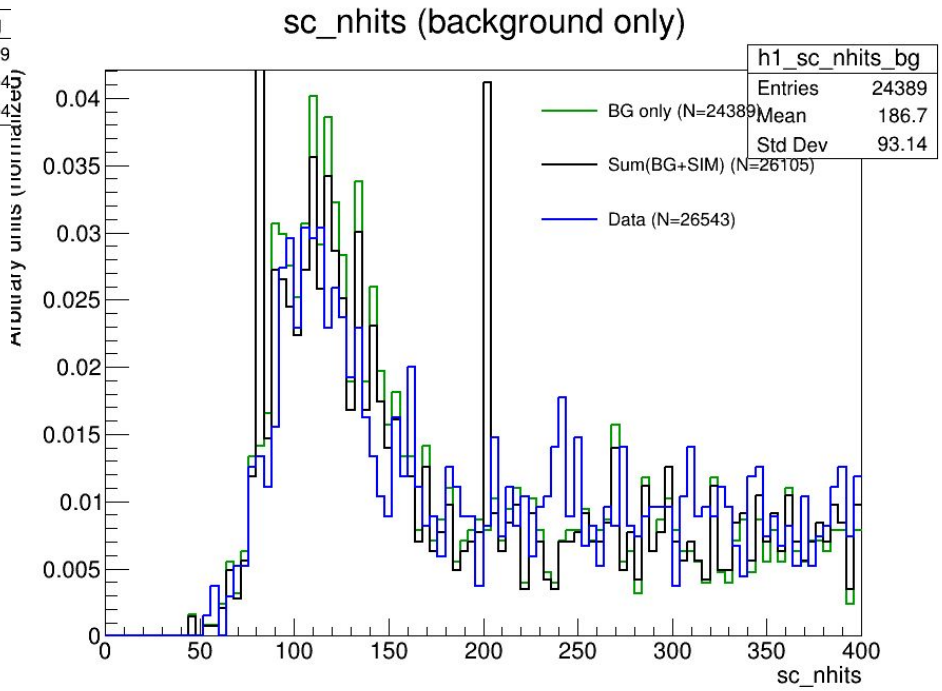
Conclusions

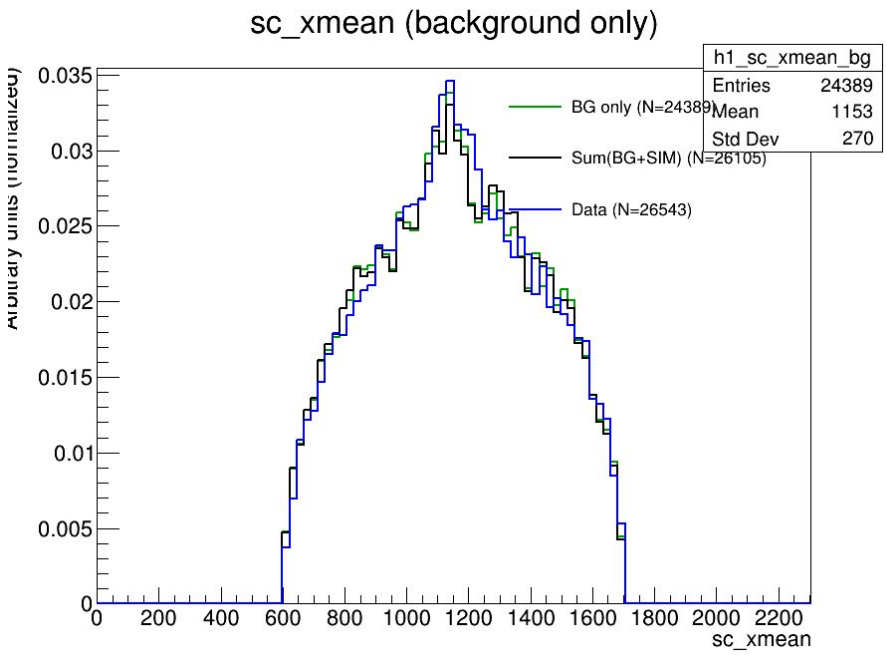
- Preliminary comparison seems promising
- Need to increase statistics and properly normalize
- Need to look at low-gain data too.

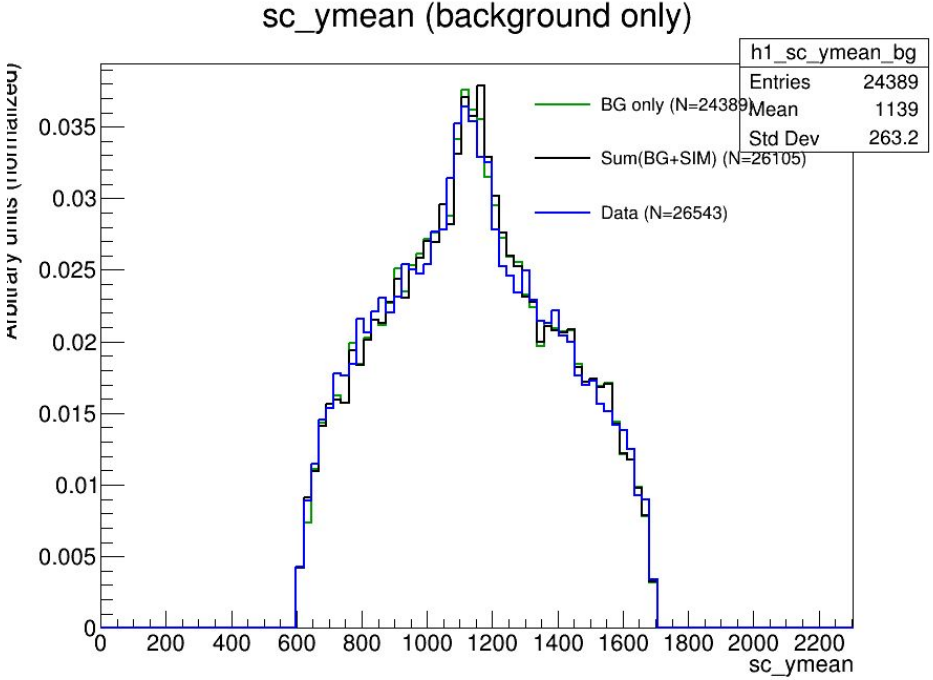

sc_length [mm] (background only)
h1_sc_length_bg
Entries 24389
Mean 208.5
Std Dev 159.4
BG only (N=24389)
Sum(BG+SIM) (N=26105)
Data (N=26543)
Arbitrary units (normalized)
sc_length [mm]

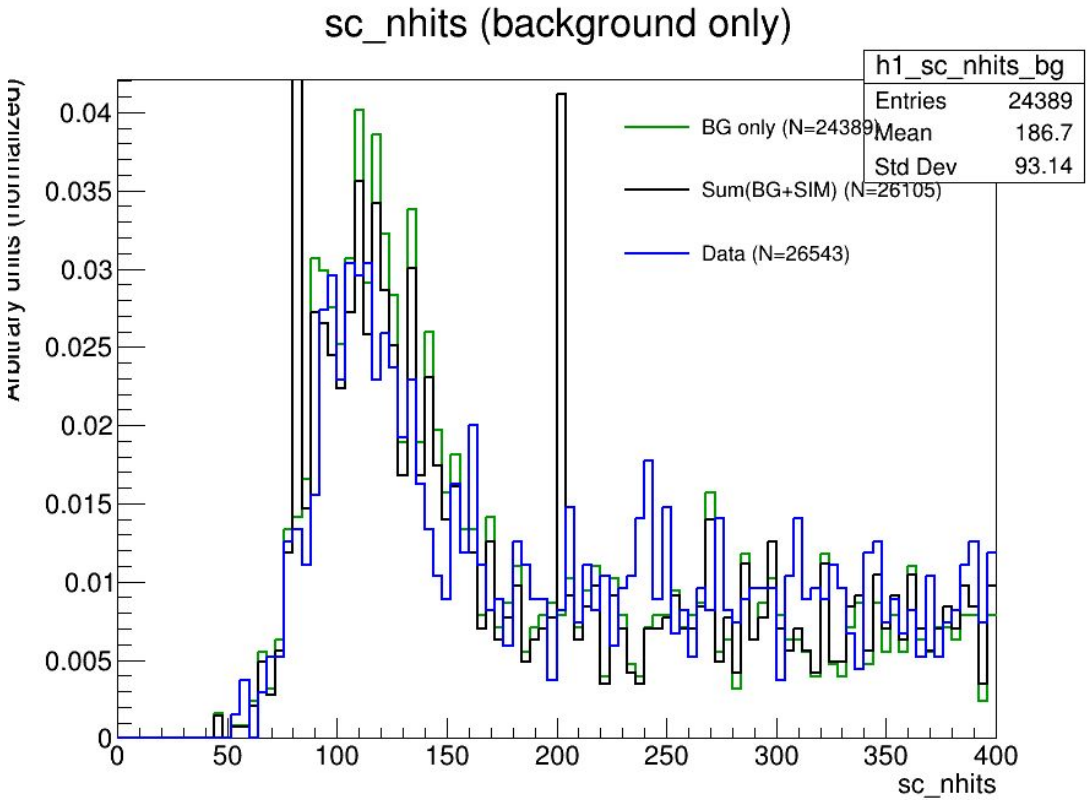

sc_width [mm] (background only)
h1_sc_width_bg
Entries 24389
Mean 134.7
Std Dev 73.94
BG only (N=24389)
Sum(BG+SIM) (N=26105)
Data (N=26543)
sc_width [mm]


sc_integral (background only)
h1_sc_integral_bg
Entries 24389
Mean 2.066e+04
Std Dev 1.666e+04
BG only (N=24389)
Sum(BG+SIM) (N=26105)
Data (N=26543)
Arbitrary units (normalized)
sc_integral


sc_nhits (background only)
h1_sc_nhits_bg
Entries 24389
Mean 186.7
Std Dev 93.14
BG only (N=24389)
Sum(BG+SIM) (N=26105)
Data (N=26543)
Arbitrary units (normalized)
sc_nhits


sc_xmean (background only)
h1_sc_xmean_bg
Entries 24389
Mean 1153
Std Dev 270
BG only (N=24389)
Sum(BG+SIM) (N=26105)
Data (N=26543)
Arbitrary units (normalized)
sc_xmean


sc_ymean (background only)
h1_sc_ymean_bg
Entries 24389
Mean 1139
Std Dev 263.2
BG only (N=24389)
Sum(BG+SIM) (N=26105)
Data (N=26543)
Arbitrary units (normalized)
sc_ymean


sc_nhits (background only)
h1_sc_nhits_bg
Entries 24389
Mean 186.7
Std Dev 93.14
BG only (N=24389)
Sum(BG+SIM) (N=26105)
Data (N=26543)
Arbitrary Units (Normalized)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0
50
100
150
200
250
300
350
400
sc_nhits