

Benchmarking the JETSCAPE 1.0 event generator in p+p collisions

R.J. Fries and JETSCAPE Collaborators

The last year has seen rapid progress in the development of the JETSCAPE event generator. In the previous report we have discussed the release v1.0 of the JETSCAPE software package [1,2]. JETSCAPE stands for *Jet Energy-loss Tomography with a Statistically and Computationally Advanced Program Envelope*. It is a collaboration funded with \$3.6M through the *Software Infrastructure for Sustained Innovation* (SI2) program of the U.S. National Science Foundation. It involves theoretical and experimental physicists, computer scientists, and statisticians. R. J. Fries has been a PI on the proposal and is representing Texas A&M University in this multi-institutional effort.

Texas A&M was involved in the development and benchmark testing of the PP19 tune of JETSCAPE 1.0 intended to describe several important observables in p+p collisions. Results from p+p collisions are a critically important baseline to interpret results in collisions of nuclei. Often ratios of results in A+A and p+p, with suitable normalization, so called nuclear modification factors, are presented. It is therefore important to establish that the JETSCAPE event generator can describe measured observables in p+p to a degree comparable to established event generators.

In Ref. [3] we describe the PP19 tune in detail. We calculate single inclusive differential jet cross sections, single inclusive charged hadron cross sections, dijet mass cross sections, jet shape observables and jet fragmentation functions at three different center of mass energies, 200 GeV, 2.76 TeV and 7 TeV. We compare to calculations with default PYTHIA 8 [4] and to data from the Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC). As an example we show in Fig. 1 the inclusive

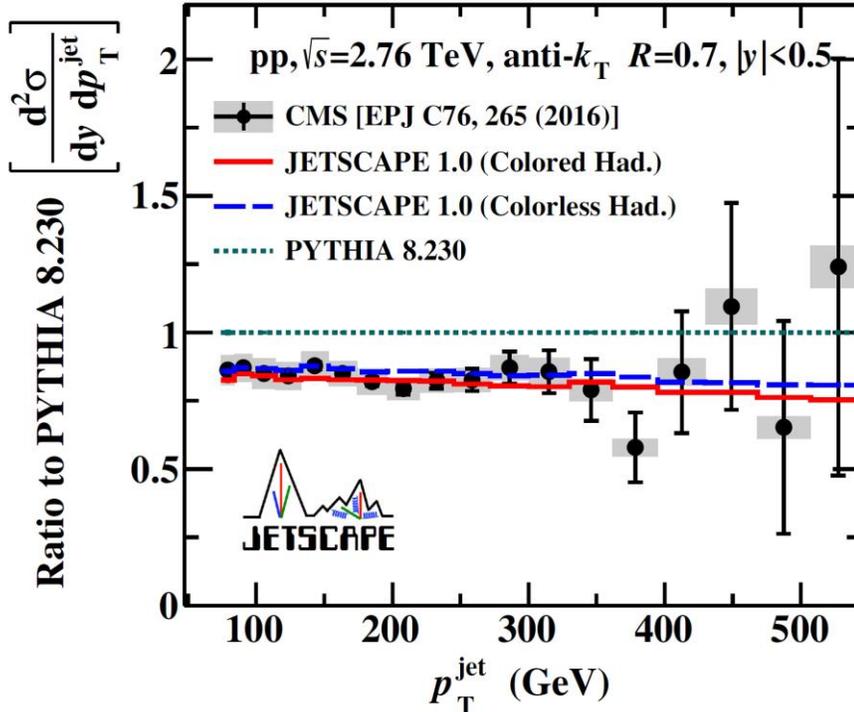


FIG. 1. One example from Ref. [3]: JETSCAPE results with both Colored and Colorless Hadronization and data from the CMS experiment [4] are compared to PYTHIA 8. The calculation was done at 2.76 TeV collision energy for jets with radius $R=0.7$.

cross section of jets (defined by the anti- k_t algorithm) with radius $R=0.7$ at center of mass energy 2.76 TeV. The ratio of JETSCAPE results with two different hadronization options (Colorless and Colored Hadronization), and of data from CMS [4] is taken with respect to a calculation with default PYTHIA 8.

Overall we find that JETSCAPE is describing data on a level comparable to PYTHIA 8. Deviations from data increase at lower momentum and for smaller jet cone sizes, as expected. JETSCAPE does particularly well with single inclusive jet cross sections and jet shape observables. With the p+p baseline established JETSCAPE is ready to be employed in nuclear collisions.

[1] <https://github.com/JETSCAPE>

[2] J. Putschke *et al.* (JETSCAPE Collaboration), arXiv:1903.07706.

[3] A. Kumar *et al.* (JETSCAPE Collaboration), (in preparation).

[4] T. Sjostrand *et al.*, *Comput. Phys. Commun.* **191**, 159 (2015)

[5] V. Khachatryan *et al.* (CMS Collaboration), *Eur. Phys. J. C* **76**, 265 (2016).