The JETSCAPE Collaboration: Updates and C-SCAPE Proposal

R. J. Fries with JETSCAPE Collaborators

In previous versions of this report we have discussed the continuing work of the JETSCAPE collaboration. JETSCAPE is a multi-disciplinary collaboration, supported by NSF, which is tasked to develop a software framework for simulations of high energy nucleus-nucleus and other collisions. Major changes are underway. At the 2024 collaboration meeting, Rainer Fries was voted to be Spokesperson Elect, with a term to start on July 1, 2025. The role of lead institution would at the same time transfer to Texas A&M University, which will enjoy the privilege of leading a network of PIs at elite institutions, including Berkeley, MIT and Duke University. The Spokesperson Elect also had the responsibility to lead the development of the next proposal to the NSF on behalf of JETSCAPE. That proposal, with several new co-investigators, promising a novel C-SCAPE framework was submitted in December 2024.

On the science side, the group at Texas A&M focused on a "vacuum tune" of the latest v3.6 of JETSCAPE for both electron-positron (e^+ e^-) and proton-proton (pp) collisions. The tuning was done using Bayesian calibration on up to six parameters spanning parton showering, string fragmentation, and underlying event generation. Data sets included identified pion and kaon spectra down to 1 GeV in momentum, which differentiates this project from the previous PP2019 tune [1]. Fig. 1 shows preliminary results from the Bayesian calibration for pp collisions at a center-of-mass energy of 2.76 TeV. The posterior

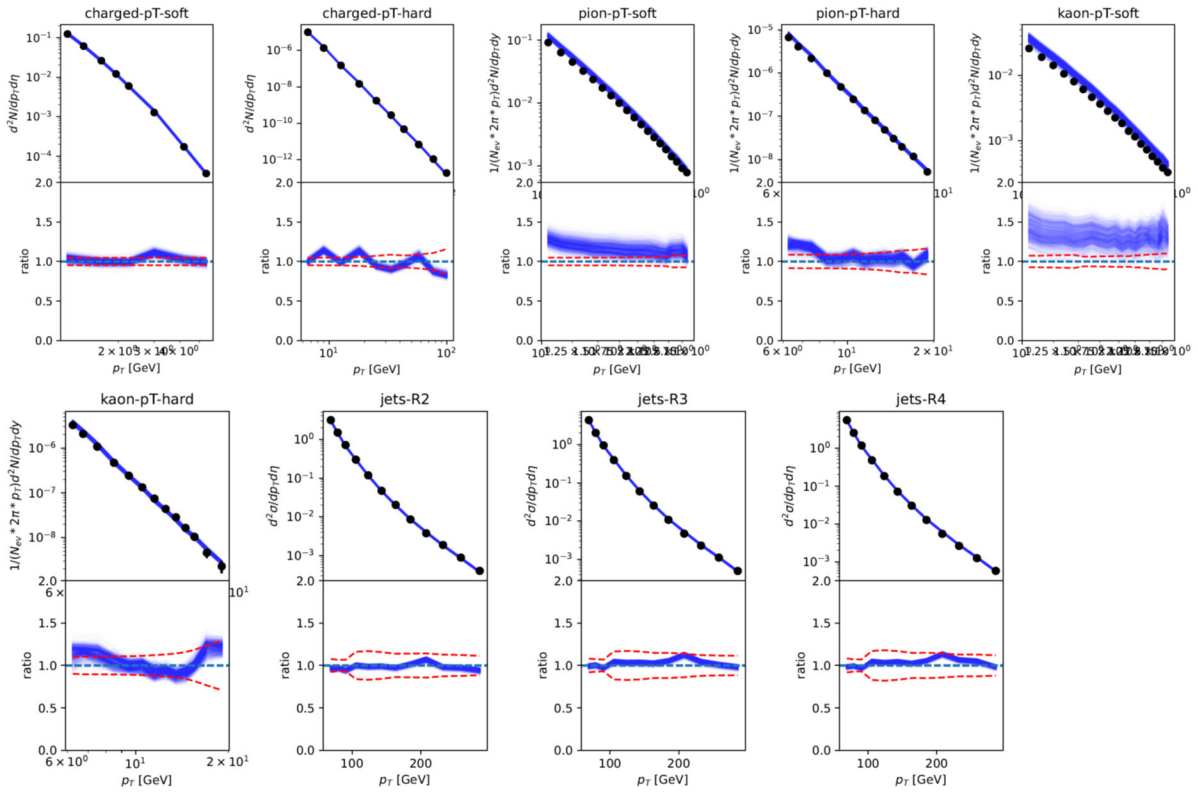

Fig. 1. The spectrum of charged hadrons in e+e- collisions at an energy of 91.2 GeV. Results are shown for hadron decays only in SMASH, and two scenarios with hadronic rescattering in SMASH with hadrons propagating for a proper time of 0.1 or 1 fm/c, respectively. The bottom panel shows the ratio of the latter two result with the decays only case. Hadronic rescattering has an effect even in this very dilute system.

distributions for several data sets used in the calibration are shown together with experimental data. This includes identified pion and hadron spectra (data from ALICE), charge hadron spectra (data from CMS) and jet spectra for different jet radii (data from ATLAS). Hadron data are presented separted in “soft” and “hard” with the cutoff being p_T=6 GeV. Red dashed lines in the ratio plots (bottom panels) indicate experimental uncertainties. Most calculations are fully compatible with experimental data, except soft pions and kaons which show larger deviations. Similar results are obtained for pp collisions at 200 GeV and e^+ e^- collisions at 91.2 GeV.

This work was support by the U.S. National Science Foundation under awards OAC-2004571 and OAC-2514008.

[1] The JETSCAPE 3.6x and XSCAPE 1.2.x packages, https://github.com/JETSCAPE
[2] A. Kumar *et al.*, JETSCAPE framework: p+p results, Phys. Rev. C **102**, 054906 (2020).