The JETSCAPE collaboration: v1.0 Release

R.J. Fries and JETSCAPE Collaborators

In the last reporting period the JETSCAPE collaboration reached its first milestone with the release of v1.0 of their software package [1], see Fig. 1. 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.

The primary goal of the JETSCAPE Collaboration is to design and deploy an overarching software framework that can be used by the entire community of heavy-ion theorists and experimentalists to program, simulate and study complete collision events that can reproduce every aspect of high-energy heavy-ion collisions. The first version of the framework code already covers a lot of ground. It contains code for initial state generation in the soft (TRENTO) and hard sector (PYTHIA). It can run viscous fluid dynamic simulations including freeze-out (MUSIC) for the soft particle sector. It includes four different final state shower Monte Carlo codes for jets: MATTER, MARTINI, LBT and HYBRID [2]. The default hadronization is PYTHIA string fragmentation. The JETSCAPE framework manages the codes and contains a sophisticated scheduler to call and hand over data between modules.

One of the new physics aspects, not possible with single existing generators, is that jet shower Monte Carlo codes can be called in their intended region of applicability and partons can be handed over smoothly between them depending on their energy, virtuality and ambient medium temperature. For example, high virtuality partons are by default handled by MATTER, while low virtuality, high energy partons can be propagated by both LBT and MARTINI. HYBRID is the default choice for low virtuality, low energy partons. This new parton-by-parton interleaving of energy loss mechanisms has first been described by the JETSCAPE collaboration in the previous reporting period [3].

Improvements are on the way for updates to be released soon. This includes hybrid hadronization to replace pure string hadronization with the goal to achieve a realistic description of in-medium hadronization effects, hadronic transport for the final state, event-by-event color glass initial state Monte Carlo, jet feedback on the medium including concurrent running of jet Monte Carlos and fluid dynamics, GPU acceleration, and statistical tools for data analysis.

At the same time efforts are on the way by the collaboration to benchmark the JETSCAPE 1.0 framework. Of particular importance are baseline results for p+p collisions, which have been coordinated at Texas A&M. JETSCAPE 1.0 does very well describing jet cross sections, large momentum hadron spectra, jet shapes and jet fragmentation functions in p+p collisions.

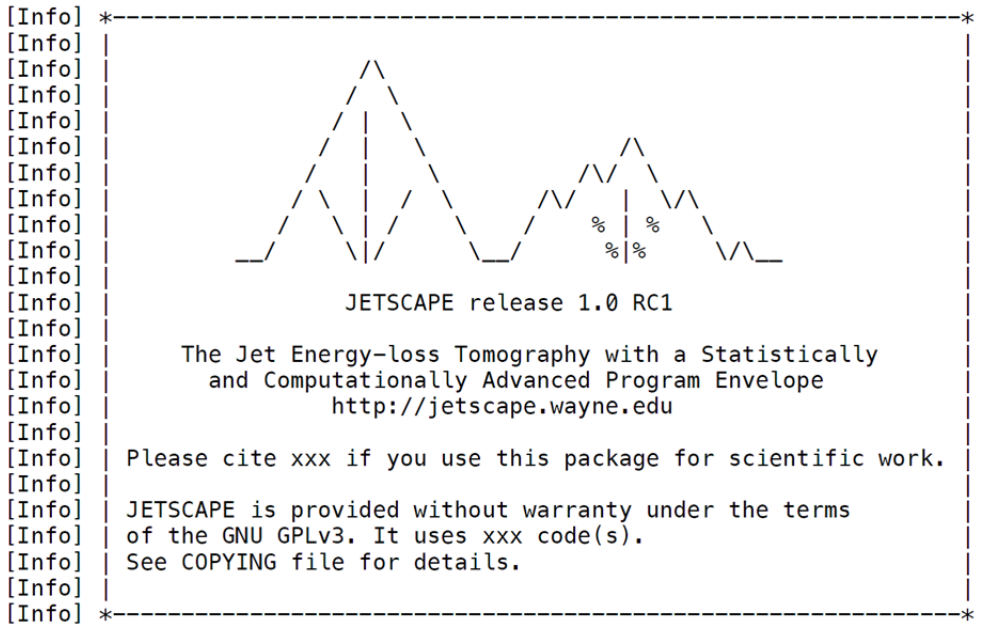

FIG. 1. The first release of the JETSCAPE code is now available on GITHUB.

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

[2] J. Putschke *et al.* [JETSCAPE Collaboration], *The JETSCAPE User Manual*, to be published.

[3] S. Cao *et al.* [JETSCAPE Collaboration], Phys. Rev. C **96**, 024909 (2017).