

The JETSCAPE Framework

Lecture

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*RHIC & AGS Annual User's meeting
June 8th 2021*

*We thank James Mulligan and Steffen A. Bass for
their slides, which forms the basis of this talk.
[James Mulligan's talk](#) in JETSCAPE summer school*

Questions

Interact on Slack:

jetscape_tutorial_rhic_aggs_2021

- Ask questions : [# general](#)
- Questions about installation:
[# installation](#)
- School material: [# school_material](#)

Wiki page:

<https://github.com/TianyuDai/JETSC>

[APE-rhic-aggs/wiki](#)

The screenshot displays the Slack interface for the **jetscape_tutorial...** workspace. On the left sidebar, the channel list includes **# general**, **# installation**, **# random**, and an option to **Add channels**. Below these are direct messages with Slackbot and several team members. The main panel shows the **#general** channel with a header indicating 12 members. A message from **jeanfrancois.paquet** at 4:47 AM states, "joined #general along with 8 others." Below this, there are two reaction bubbles: "Hi everyone!" and "Let's try using Slack for...". At the bottom, a text input field is labeled "Send a message to #general" with a rich text editor toolbar.

Questions

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jetscape_tutorial_rhic_aggs_2021

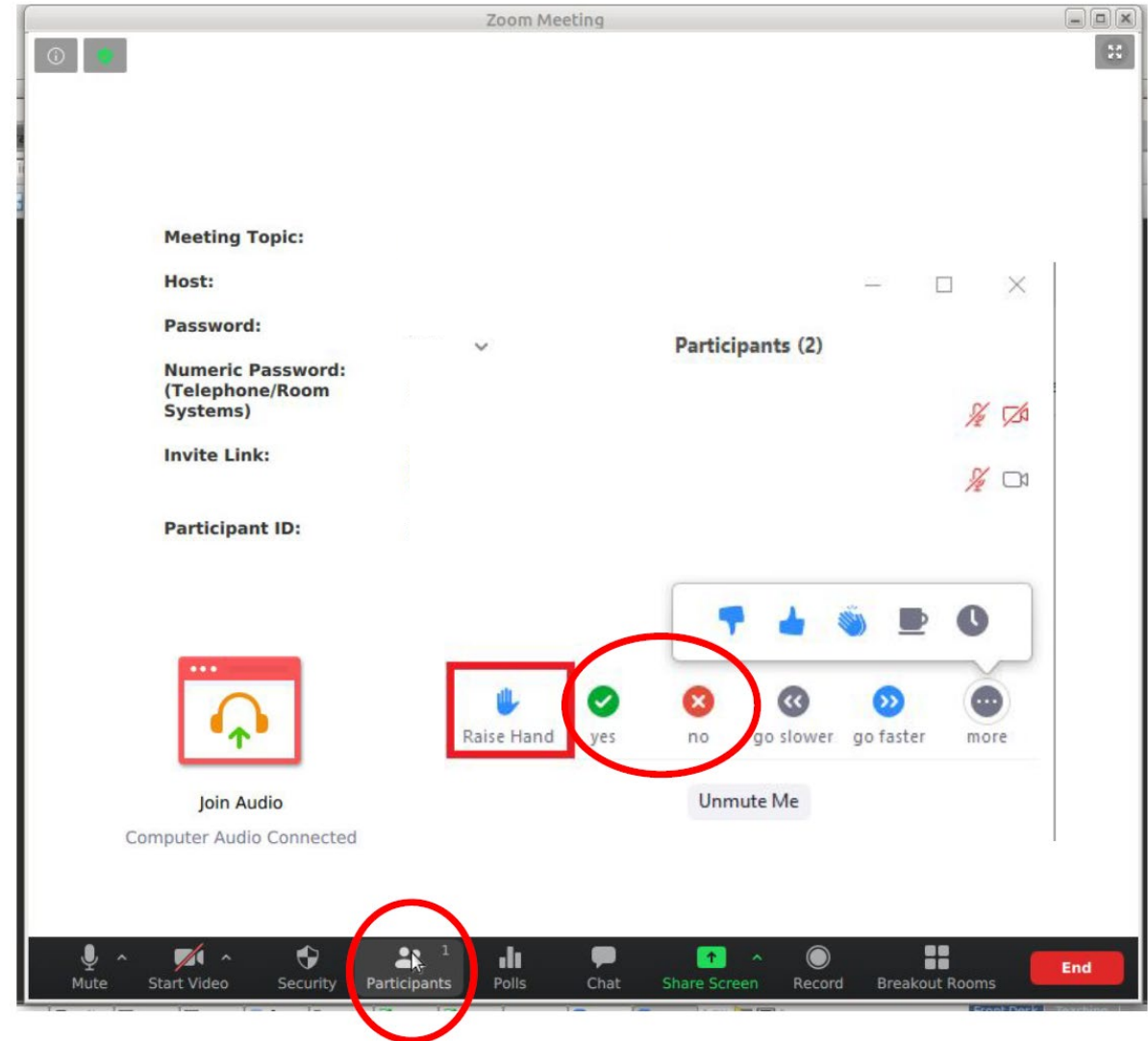
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React on Zoom:



Outline

June 8th:

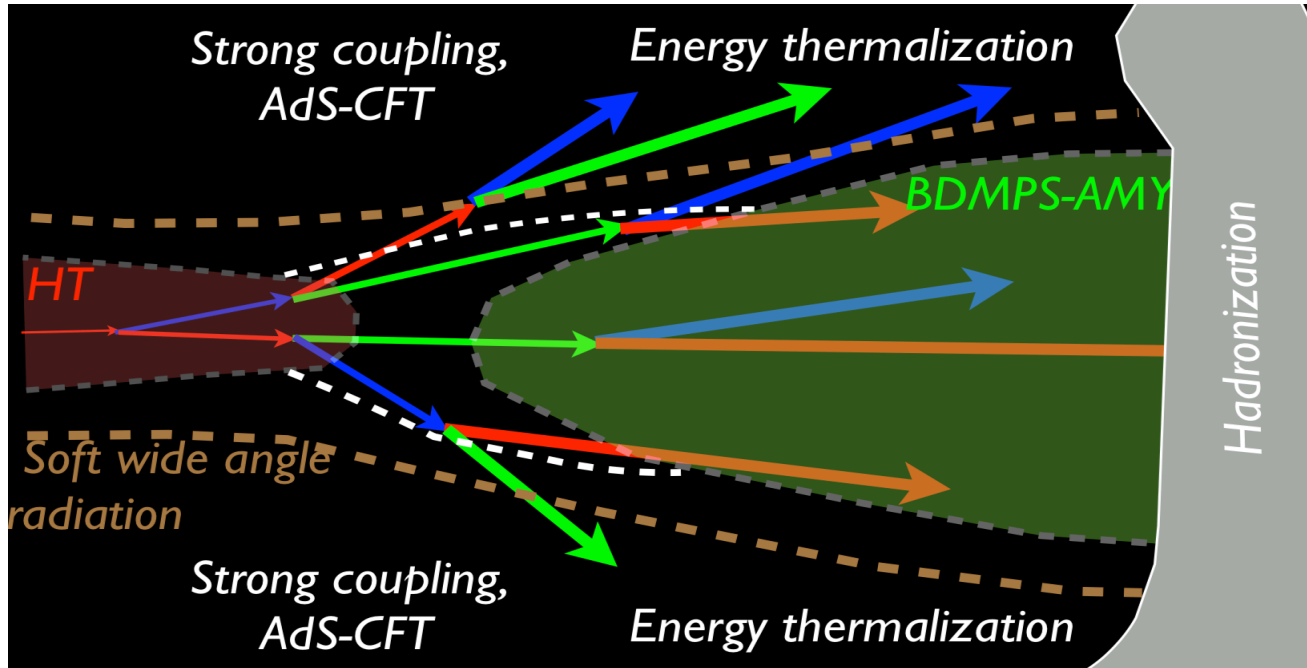
- **Overview of JETSCAPE framework**
- Run JETSCAPE using container
- Configure JETSCAPE
- Calculate parton energy distribution using energy loss module in static medium
- Implement a new module in JETSCAPE*

June 9th:

- Introduction to JETSCAPE with realistic hydrodynamic module
- Run p+p collisions
- Configure JETSCAPE to use realistic hydrodynamic module
- Extend to A+A collisions and calculate RAA

Jetscape: Motivation

Jet Energy Loss Tomography with a **S**tatistically and **C**omputationally **A**dvanced **P**rogram **E**nvelope



- a tool to study energy-loss physics
- large area of research, many different approaches exist
- Collaboration of theoretical and experimental physicists, computer scientists and statisticians

Goal: a state-of-the-art extensive, extensible and modular event generator

The collaboration



COMP

The software development working group

PHYS

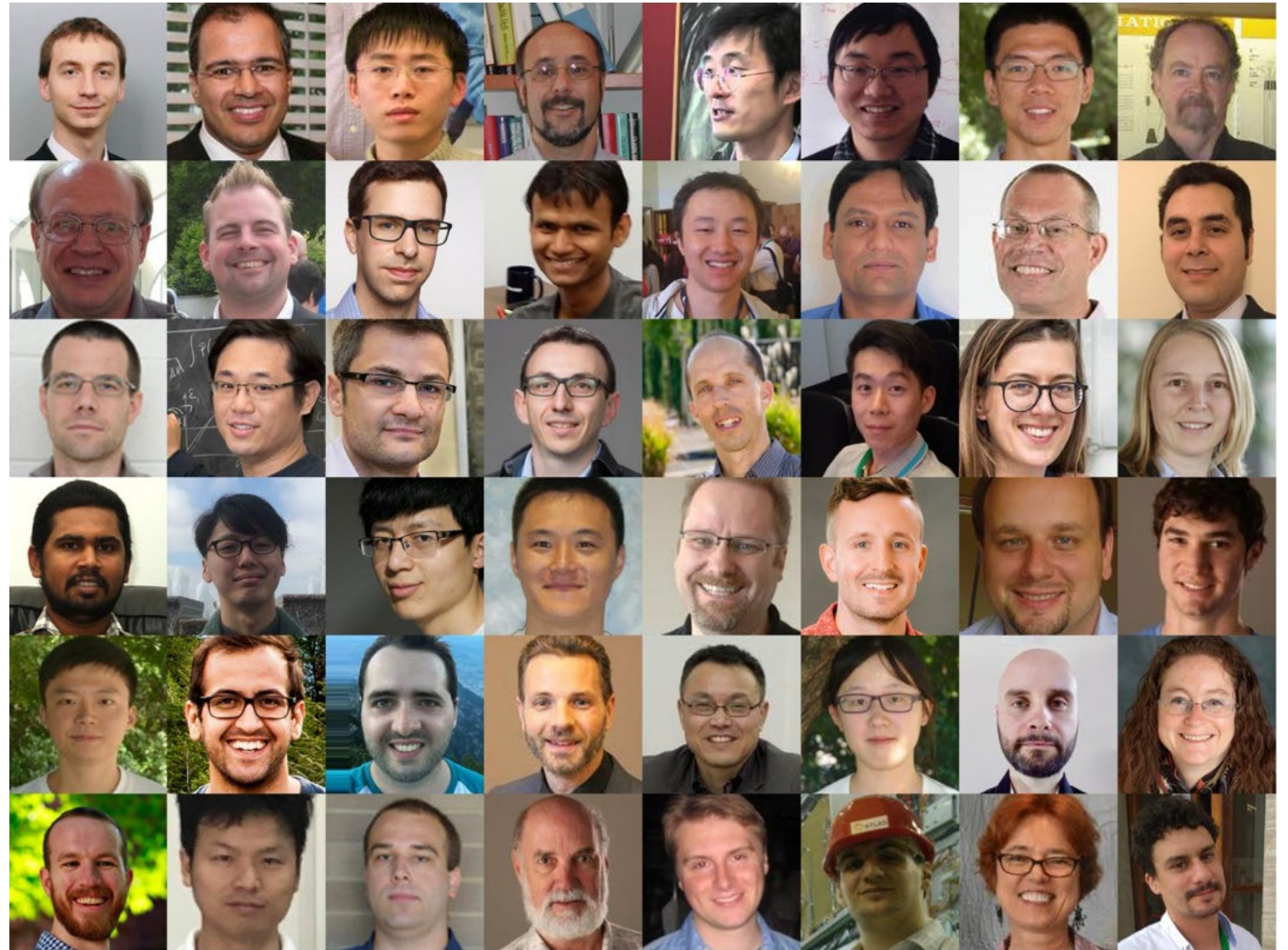
The physics modeling working group

SIMS

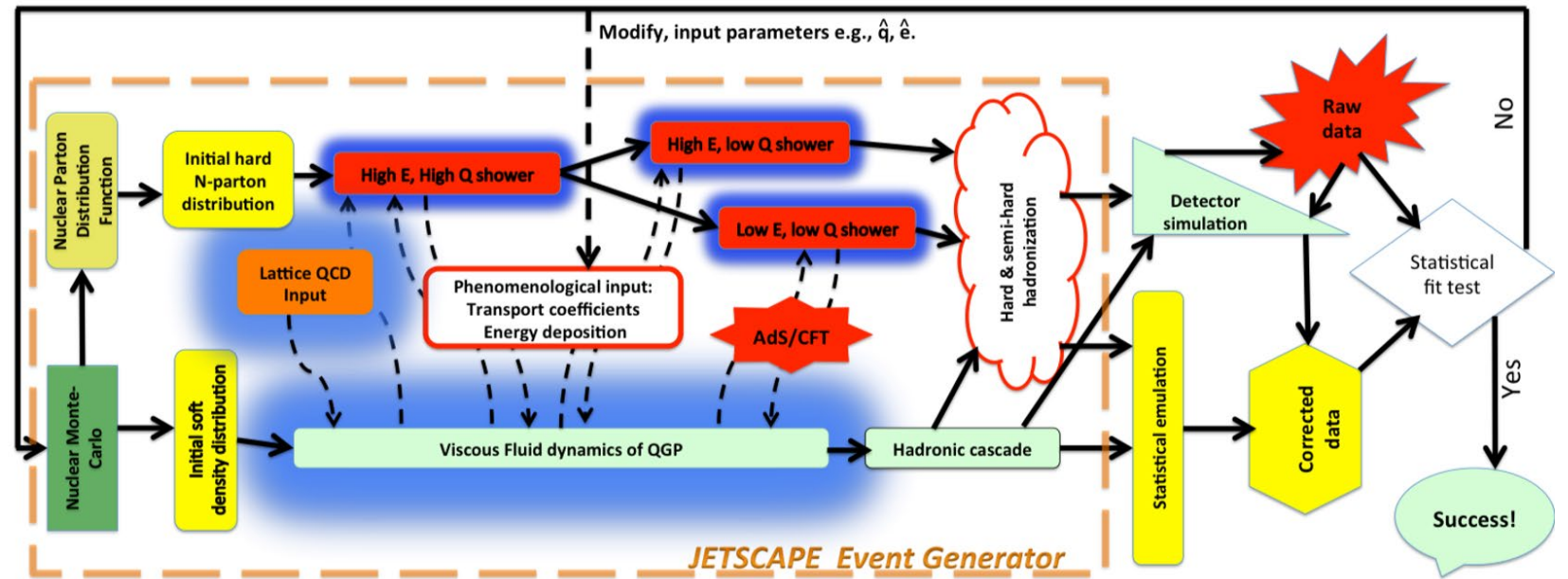
The simulations and distributed computing working group

STAT

The data and statistical analysis working group



JETSCAPE framework



Event generator

A **framework** for general-purpose MC event generators in heavy-ion collisions

<https://github.com/JETSCAPE/JETSCAPE>

Topic for today

Statistical toolkit

Bayesian model-to-data comparison

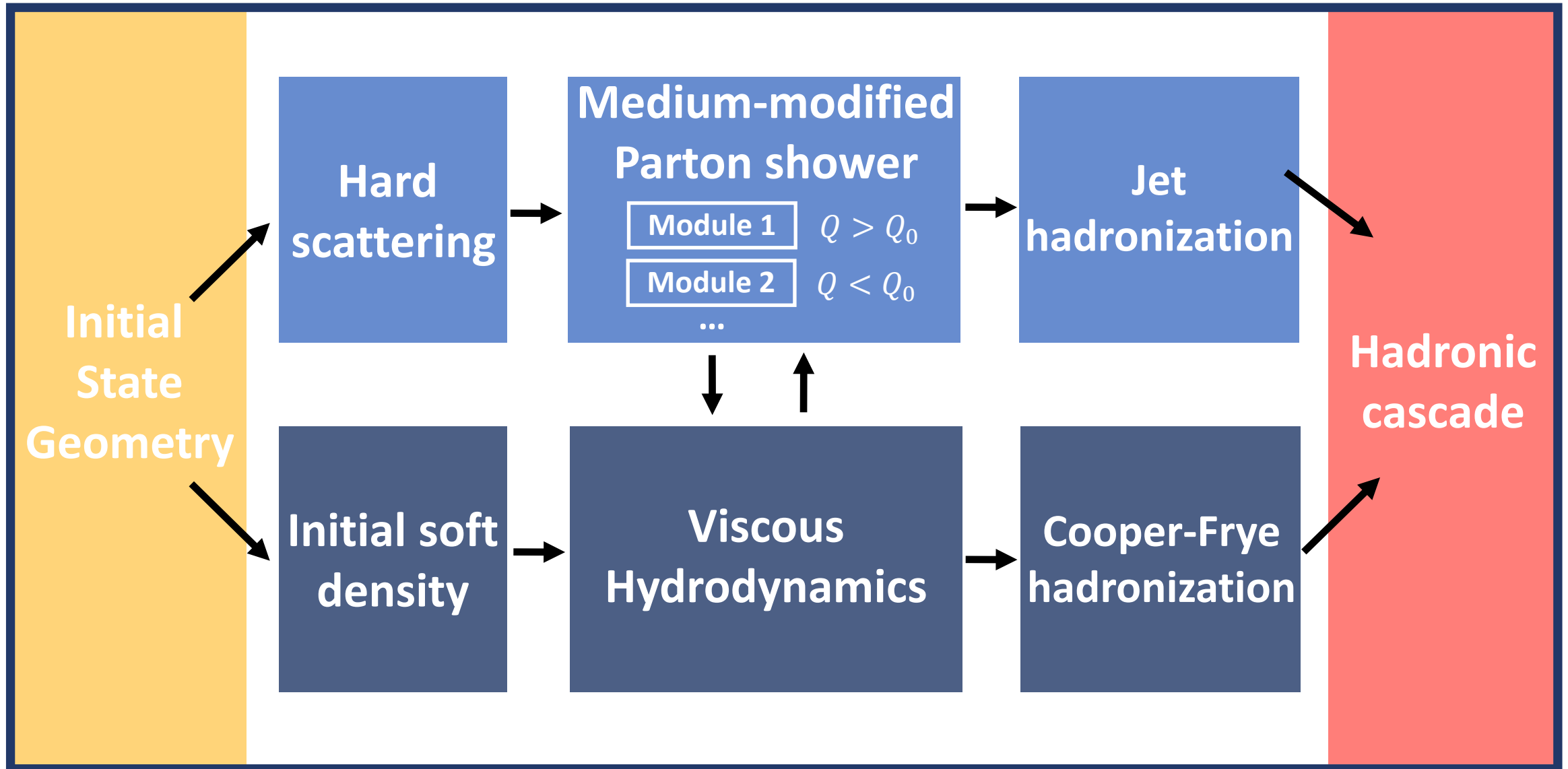
JETSCAPE is not just for jets!
It is a framework for *general-purpose* event generators

1

The JETSCAPE framework is modular

The core framework decides how physics modules can interact with each other — but the modules themselves can be user-contributed

A unified framework has clear benefits when we want to compare models of one particular part of a multi-stage event evolution



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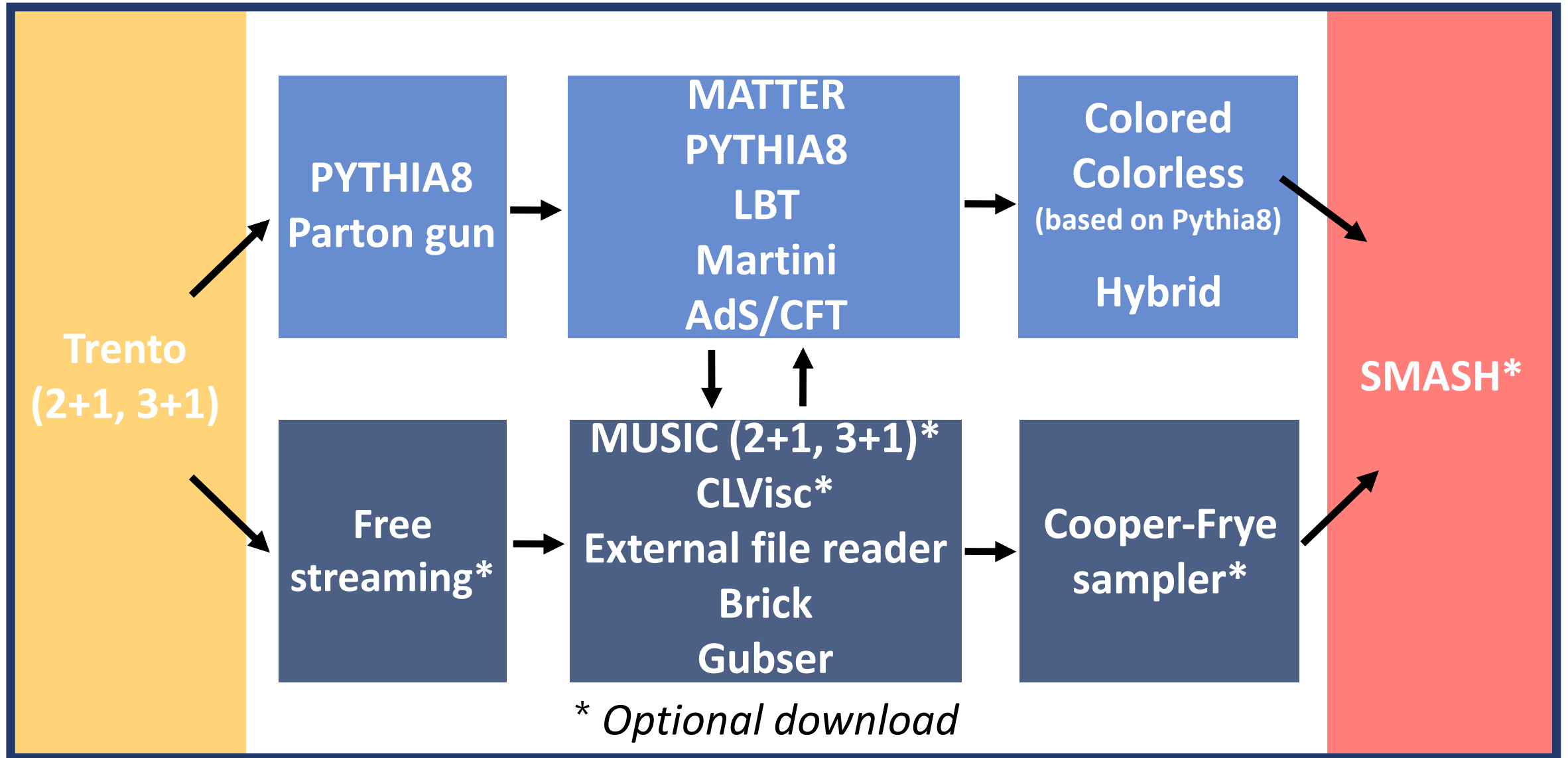
The core framework decides how physics modules can interact with each other — but the modules themselves can be user-contributed

2

Physics modules are open-source

Key improvement in heavy-ion physics — predictions can be checked against many observables simultaneously

A unified framework has clear benefits when we want to compare models of one particular part of a multi-stage event evolution

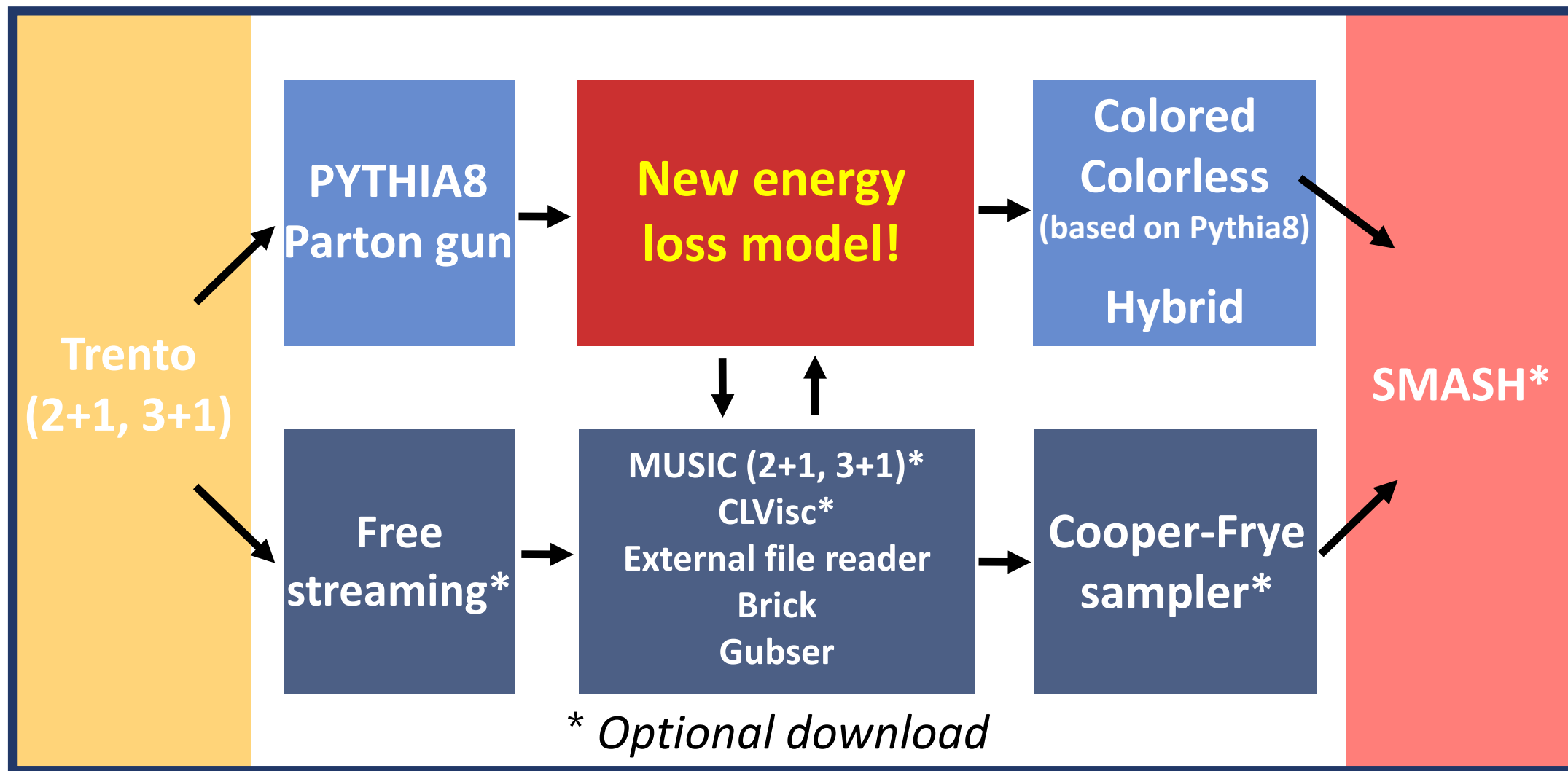


Implementing new energy loss module

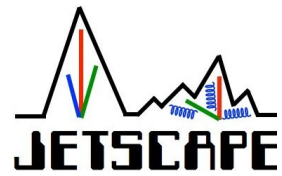
arXiv.org > hep-ph > arXiv:2012.03441

Example: **Parton energy loss in a hard-soft factorized approach**

Tianyu Dai, Jean-François Paquet, Derek Teaney, Steffen A. Bass



The current status



The framework is available and ready for public use

Many recent improvements to user experience


Latest release

v3.3
a33360b

Verified

Compare

JETSCAPE 3.3

 jdmulligan released this on Feb 9 · 1 commit to master since this release

- Add particle writer (#80)
- Add "deploy" docker container with precompiled JETSCAPE -- for testing (#79)

- Use responsibly — it is a framework — you get out the physics you put in
- There is a lot of theoretical work inside — but currently only slices of the theory landscape
- We are at the start of the exciting phase — well-controlled theory comparisons

Recent JETSCAPE results



p+p results

JETSCAPE framework: p+p results

A. Kumar et al. (The JETSCAPE collaboration)

Phys. Rev. C **102**, 054906 – Published 10 November 2020

Parton energy loss

Multistage Monte Carlo simulation of jet modification in a static medium

S. Cao et al. (The JETSCAPE collaboration)

Phys. Rev. C **96**, 024909 – Published 22 August 2017

Systematic comparison to data

Multisystem Bayesian constraints on the transport coefficients of QCD matter

D. Everett et al. (JETSCAPE Collaboration)

Phys. Rev. C **103**, 054904 – Published 14 May 2021

Determining the jet transport coefficient \hat{q} from inclusive hadron suppression measurements using Bayesian parameter estimation

S. Cao et al. (JETSCAPE Collaboration)

arXiv: 2102.11337 – Submitted 22 Feb 2021

Phenomenological constraints on the transport properties of QCD matter with data-driven model averaging

D. Everett et al. (JETSCAPE Collaboration)

arXiv: 2010.03928 – Accepted by Phys. Rev. L, 27 May 2021

Find more: <https://jetscape.org/>