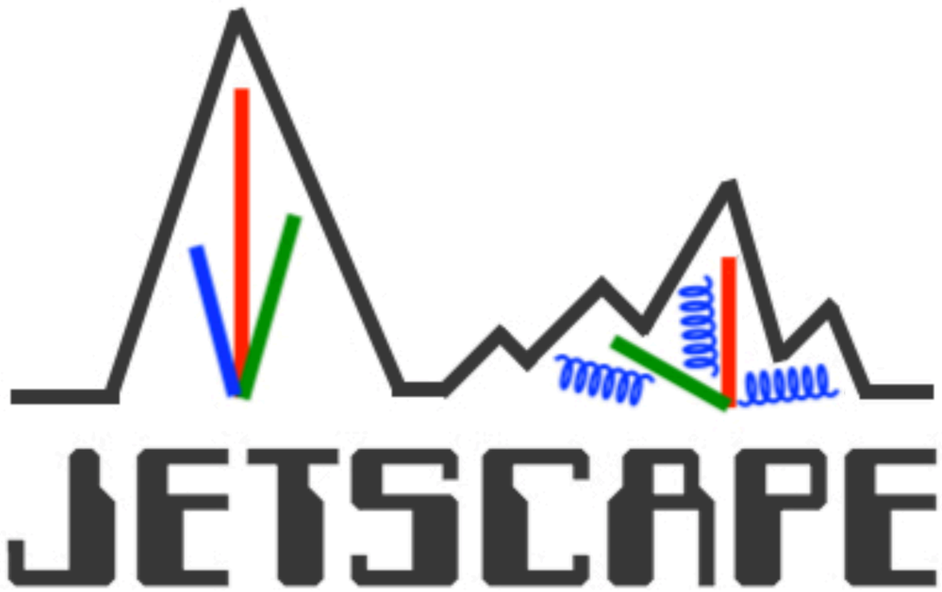
Simulations with JETSCAPE (PHYS)



Texas A&M University, January 10th 2019

JETSCAPE
Winter School 2019

pp

Simulation for pp collisions with JETSCAPE

- **Settings in simulations for pp collisions**
  - Use PythiaBrickTest.cc and generate 100 events with $\hat{p}_{\mathrm{T}}^{\mathrm{min}} = 110\,\mathrm{GeV},\ \hat{p}_{\mathrm{T}}^{\mathrm{max}} = 120\,\mathrm{GeV}$
  - MATTER vacuum shower down to $Q = 1\,\mathrm{GeV}$
  - Initial hard partons generated by Pythia (MPI, ISR: ON)
  - Colorless Hadronization

- **Work flow**
  - Edit PythiaBrickTest.cc
  - cmake ..
  - make
  - Edit jetscape_init.xml
  - ./PythiaBrickTest

Edit PythiaBrickTest.cc (pp)

- Set Event Number

```
78  ··Show();¬
79  ¬
80  ··auto·jetscape·=·make_shared<JetScape>("./jetscape_init.xml",100);¬
81  ··jetscape->SetId("primary");¬
82  ¬
83  ··//·Initial·conditions·and·hydro¬
```

- Set Colorless Hadronization Module

```
115 ··auto·hadro·=·make_shared<Hadronization>·();¬
116 ··auto·hadroModule·=·make_shared<ColoredHadronization>·();¬
117 ··//hadro->Add(hadroModule);¬
118 ··auto·colorless·=·make_shared<ColorlessHadronization>·();¬
119 ··hadro->Add(colorless);¬
120 ··hadroMgr->Add(hadro);¬
```

Edit jetscape_init.xml (pp)

- Check setting of PythiaGun

```
59  ····<!--·Pythia·Gun·-->¬
60  ····<!--·Sensible·defaults·are·set·in·the·class.·ptHat·etc.·get·their·own·field·-->¬
61  ····<PythiaGun>¬
62  ····· <name>PythiaGun</name>¬
63  ····· <pTHatMin>110</pTHatMin>¬
64  ····· <pTHatMax>120</pTHatMax>¬
65  ····· <eCM>2760</eCM>¬
66  ····· <!--·You·can·add·any·number·of·additional·lines·to·initialize·pythia·here·-->¬
67  ····· <!--·Note·that·if·the·tag·exists·it·cannot·be·empty·(tinyxml·produces·a·segfault)·-->¬
68  ····· <!--·<LinesToRead>·-->¬
69  ····· <!--·» HardQCD:all·=·on·-->¬
70  ····· <!--·</LinesToRead>·-->¬
71  ····</PythiaGun>·····¬
```

- Set “in-vacuum” in MATTER

```
83  ····<Matter>¬
84  ····· <name>Matter</name>¬
85  ····· <Q0> 1.0 </Q0>¬
86  ····· <T0> 0.16 </T0>¬
87  ····· <vir_factor> 0.25 </vir_factor>¬
88  ····· <in_vac> 1 </in_vac>¬
89  ····· <recoil_on> 0 </recoil_on>¬
90  ····· <broadening_on> 0 </broadening_on>¬
91  ····· <brick_med> 0 </brick_med>¬
92  ····· <brick_length> 0.0 </brick_length>¬
93  ····· <hydro_Tc> 0.16 </hydro_Tc>¬
94  ····· <qhat0> 3.0 </qhat0>¬
95  ····· <alphas> 0.25 </alphas>¬
96  ····</Matter>¬
```

Output

- **test_out.dat**

  - all the information of simulations

- **FinalStateHadrons and FinalStatePartons**

  - examples of analysis code

  - generate a list of final state hadrons/partons from test_out.dat

  -> JetscapeFinalStateHadrons.txt/JetscapeFinalStatePartons.txt

JETSCAPE
Winter School 2019

PbPb

Preparation

- **Get a table used in LBT jet energy loss module**

  - Go to external_packages

  % ./get_lbtTab.sh

- **Get hydro profile used in this session**

  - Go to example

  % ./get_hydroSample.sh

  or

  % source get_hydroSample.sh

Simulations for PbPb

- **Settings in simulations for PbPb at 2.76 TeV**

  - Use hydroJetTest.cc and generate 100 events with $\hat{p}_{\mathrm{T}}^{\mathrm{min}} = 110\,\mathrm{GeV},\ \hat{p}_{\mathrm{T}}^{\mathrm{max}} = 120\,\mathrm{GeV}$

Jet

- MATTER+LBT

- Recoil:ON, $\alpha_s = 0.25$

- Virtuality separation scale: $Q_0 = 2\,\mathrm{GeV}$

- Initial condition from TRENTo+Pythia (MPI, ISR: ON)

Moreland, Bernhard, Bass(14)

- Colorless Hadronization

QGP fluid

- 2+1D, event-averaged (data table)

- TRENTo initial condition+free-streaming

Liu, Shen, Heinz(15)

- VISHNU (viscous hydro calculation)

Shen, Qiu, Song, Bernhard, Bass, Heinz(16)

Simulations for PbPb

- **Work flow**

  - Edit hydroJetTest.cc
  - make
  - Edit jetscape_init.xml
  - ./hydroJetTest

Edit hydroJetTest.cc (PbPb)

- Set Event Number

```
      //If you want to suppress it: use SetVerboseLevel(0) or max SetVerboseLevel(
          or 10
82    JetScapeLogger::Instance()->SetVerboseLevel(0);
83
84    Show();
85
86    auto jetscape = make_shared<JetScape>("./jetscape_init.xml", 100);
87    // auto jetscape = make_shared<JetScape>("./jetscape_init_pythiagun.xml",5);
88    jetscape->SetId("primary");
89    jetscape->SetReuseHydro (true);
90    jetscape->SetNReuseHydro (100);
91
92    auto jlossmanager = make_shared<JetEnergyLossManager> ();
```

- Add LBT

```
142   // Switching Q2 (or whatever variable used
143   // hardcoded at 5 to be changed to xml)
144   jloss->Add(matter);
145   jloss->Add(lbt);  // go to 3rd party and ./get_lbtTab before adding this
          module
146   //jloss->Add(martini);
147   //jloss->Add(adscft);
148
149   jlossmanager->Add(jloss);
```

- Set Colorless Hadronization Module

```
155   //hadro->Add(hadroModule);
156   hadro->Add(colorless);
157   hadroMgr->Add(hadro);
158   jetscape->Add(hadroMgr);
159
```

Edit jetscape_init.xml (PbPb)

- MATTER

```
82  ¬
83  ····<Matter>¬
84  ····· <name>Matter</name>¬
85  ····· <Q0> 2.0 </Q0> <!-- must be the same as Q0 in Lbt -->¬
86  ····· <T0> 0.16 </T0> <!-- must be the same as hydro_Tc in Lbt -->¬
87  ····· <vir_factor> 0.25 </vir_factor>¬
88  ····· <in_vac> 0 </in_vac> <!-- 0: in-medium -->¬
89  ····· <recoil_on> 1 </recoil_on> <!-- 1: recoil on -->¬
90  ····· <broadening_on> 0 </broadening_on>¬
91  ····· <brick_med> 0 </brick_med>¬
92  ····· <brick_length> 0.0 </brick_length>¬
93  ····· <hydro_Tc> 0.15 </hydro_Tc> <!-- must be smaller in  -->¬
94  ····· <qhat0> -3.0 </qhat0> <!-- set negative value  -->¬
95  ····· <alphas> 0.25 </alphas> <!-- should be the same value as alphas in Lbt  -->¬
96  ····</Matter>¬
```

- LBT

```
98  ····<Lbt>¬
99  ····· <name> Lbt </name>¬
100 ····· <Q0> 2.0 </Q0> <!-- must be the same as Q0 in Matter -->¬
101 ····· <in_vac> 0 </in_vac>¬
102 ····· <only_leading> 0 </only_leading>¬
103 ····· <hydro_Tc> 0.16 </hydro_Tc> <!-- must be the same as T0 in Matter -->¬
104 ····· <alphas> 0.25 </alphas> <!-- should be the same value as alphas in Matter  -->¬
105 ····</Lbt>¬
```

Details of XML (MATTER)

MATTER `<Matter>`.

`<Q0>`: the virtuality of a parton to switch from MATTER to the transport energy loss module in [GeV].

`<T0>`: the temperature to switch from the transport energy loss module to MATTER in [GeV]. The value must be the same as that in `<hydro_Tc>` in the transport energy loss module.

`<vir_factor>`: the factor to be multiplied by the p_{T} of the initial parton in MATTER to obtain the maximum virtuality of the parton.

`<in_vac>`: the flag to turn off and on the medium effect in MATTER (`1`: in vacuum, `0`: in medium)

`<recoil_on>`: the flag to turn on and off the recoils in MATTER (`1`: on, `0`: off)

`<broadening_on>`: the flag to turn on and off the broadening effect in MATTER (`1`: on, `0`: off). If `<recoil_on>` is `1` (recoil is on), the broadening effect is automatically turned off regardless of this flag's setting.

`<brick_med>`: the flag to use the static uniform medium (brick) in MATTER (`1`: yes, `0`: no).

`<brick_length>`: the length of the brick in [fm].

`<hydro_Tc>`: the temperature below which the medium effect is turned off in MATTER in [GeV].

`<qhat0>`: the value of $\hat{q}_0$ in MATTER in [GeV^2/fm]. If a negative value is set here, α_{s} is used to calculate $\hat{q}$.

`<alphas>`: the value of α_{s} in MATTER. To use the value of α_{s} being set here, set the value in `<qhat0>` to a negative value.

Details of XML (LBT)

LBT `<Lbt>`.

`<Q0>`: the virtuality of a parton to switch from MATTER to LBT in [GeV].

`<in_vac>`: the flag to turn off and on the medium effect in LBT (`1`: in vacuum, `0`: in medium).

`<only_leading>`: the flag to turn off the tracking of any radiated partons and recoils in LBT (`1`: track only the partons received from MATTER, `0`: track all the partons in jet).

`<hydro_Tc>`: the temperature below which the medium effect is turned off in LBT in [GeV]. The value must be the same as that in `<T0>` in MATTER.

`<alphas>`: the value of α_s in LBT.