Extreme hydro workshop 2021

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T. NUNES – UNIVERSIDADE FEDERAL DE SANTA CATARINA (UFSC)

HOW–TO: GENERATING INITIAL CONDITIONS

RUNNING TRENTO

▸ T$_R$ENTo basic syntax is pretty simple:

```
trento [options] projectile projectile [number-events = 1]
```

▸ 100 Pb-Pb events:

```
trento Pb Pb 100
```

▸ The projectiles are the only required options!

Symbol	Name	No. nucleons	Deformed
p	proton	1	—
d	deuteron	2	—
Cu	copper	63	no
Cu2	copper	63	yes
Xe	xenon	129	no
Xe2	xenon	129	yes
Au	gold	197	no
Au2	gold	197	yes
Pb	lead	208	no
U, U2, U3	uranium	238	yes

source: http://qcd.phy.duke.edu/trento

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RUNNING TRENTO – PHYSICAL AND GRID OPTIONS

```
-p, --reduced-thickness FLOAT
-k, --fluctuation FLOAT
-w, --nucleon-width FLOAT
-v, --constit-width FLOAT
-m, --constit-number INT
-d, --nucleon-min-dist FLOAT
-x, --cross-section FLOAT
-n, --normalization FLOAT
--b-min FLOAT
--b-max FLOAT
--random-seed POSITIVE_INT
```

```
--grid-max FLOAT
--grid-step FLOAT
```

Full description of parameters can be found at:

http://qcd.phy.duke.edu/trento/usage.html

RUNNING TRENTO: THE CALL

▸ T$_R$ENTo can be run as an one-liner:

```
trento -p 0.007 -k 1.187 -w 0.956 -d 1.27 -x 6.28 -n 286.23 --grid-max 14 --grid-step 0.1 --b-min 0.0 --b-max 5.0 Pb Pb —number-events=100
```

▸ Or via a config file:

```
trento -c PbPb2p76.cfg
```

PbPb2p76.cfg

```
# specify the projectile option twice
    projectile = Pb
    projectile = Pb
    number-events = 1000
    output = PbPb
    reduced-thickness = 0
    fluctuation = 1
    nucleon-width = 0.5
    cross-section = 6.4
    normalization = 1
    # leave commented out for min-bias
    # b-min =
    # b-max =
    grid-max = 10
    grid-step = 0.2
```

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RUNNING TRENTO – OUTPUT OPTIONS

▸ By default, density profiles are **NOT** saved to disk! It prints to screen:

```
event_number impact_param npart mult e2 e3 e4 e5
```

```
tnunes@jarvis:~$ trento -p 0.007 -k 1.187 -w 0.956 -d 1.27 -x 6.28 -n 286.23 --grid-max 14 --grid-step 0.1 --b-min 0.0 --b-max 5.0 Pb Pb --number-events=100
0    4.2678577894   352   4.1224830826e+04   0.1087150034   0.0144513217   0.0171865246   0.0926349482
1    2.7336610459   393   5.1511066586e+04   0.0539875570   0.0525495066   0.1580413037   0.1007890957
2    1.0737418521   408   5.5376246305e+04   0.0669947541   0.0881691448   0.0811887261   0.0706540792
3    4.5427897566   352   4.5899872586e+04   0.2106628414   0.0512769564   0.1403483977   0.0537733054
4    2.2357988638   394   5.1426304970e+04   0.1139660120   0.0867976788   0.0786343227   0.0667930377
5    2.6557764060   399   5.5158761289e+04   0.1003622580   0.0777164901   0.0577741196   0.1467021601
6    3.6129307740   362   4.6183304196e+04   0.1321684758   0.0762034768   0.1730019359   0.0520646533
7    4.2344612510   342   4.6803142749e+04   0.1824557888   0.0495063353   0.1346367332   0.0959473422
8    3.7847116867   379   4.3693427803e+04   0.0959076063   0.0540635814   0.0900269048   0.0532920447
9    3.0070544810   381   4.9662748798e+04   0.0541776650   0.0273823754   0.0742753463   0.0454066103
10   2.7995531244   389   5.0241607501e+04   0.0936972644   0.0883913455   0.0688669414   0.0584421237
```

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RUNNING TRENTO – OUTPUT OPTIONS

▸ By default, density profiles are **NOT** saved to disk! It prints to screen:

`event_number impact_param npart mult e2 e3 e4 e5`

▸ You can request the grid files to be saved with the option `-o, --output PATH`, in two formats:

    ▸ `--output events` will create a dir called *events* and store *text* grid files on in: `0000.dat, 0001.dat, ...`

    ▸ `--output events.hdf5` will store *hdf5* grids in a file events.hdf5 with dataset names `event_0000, event_0001, ...`

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RUNNING TRENTO – GRID OUTPUTS

▶ Sample grid text file:

```
# event 400
# b     = 5.55242991
# npart = 300
# mult  = 32467.82459
# e2    = 0.155278784
# e3    = 0.08082345005
# e4    = 0.1813832727
# e5    = 0.09054335272
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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```

▶ These files can be used directly as inputs for MUSIC or piped to KoMPoST.

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RUNNING KOMPOST: INTERFACE WITH TRENTO

▸ KoMPoST is run in two steps: interface with T_RENTo and proper execution.

▸ The first step is done with the `trento2kompost.py` script:

  ▸ 1. reads the density profile from TRENTo

  ▸ 2. uses the EOS to convert an entropy profile to an energy profile

  ▸ 3. writes the new profile in the format expected by Kompost

  ▸ 4. generates an input file for Kompost

▸ Inside this script you must specify: `trento_tmp_dir`, `grid_size` , `dx` and `trentoRenorm` ;

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RUNNING KOMPOST: THE SAMPLE FILE

▸ The interface script also reads a sample input file:

```
[KoMPoST_IO]
tIn = 0.2;
tOut = 1.2;
inputfile = examples/trento/dummy.txt
OutputFileTag = test_output/EnergyMomentumTensor.dat
#
[KoMPoSTParameters]
EtaOverS = 0.16
EtaOverSTemperatureScale = 0.1
# 0 for free-streaming, 1 for "KoMPoST" EKT evolution
EVOLUTION_MODE=0
# 0 or 1
ENERGY_PERTURBATIONS=1
# 0 or 1
MOMENTUM_PERTURBATIONS=1
[EventInput]
```

Edit those!

RUNNING KOMPOST: RUNNING THE INTERFACE

▸ The interface can be invoked with:

▸ ```
./trento2kompost.py EVENTNO
```

▸ Where EVENTNO is the number of the event to be interfaced

▸ Example: `./trento2kompost.py 1234`

kompost_setup_1234.ini

1234.dat ⟶ trento2kompost.py

trento_initial_condition_in_kompost_format_1234.txt

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# RUNNING KOMPOST: RUNNING THE INTERFACE

```
[KoMPoST_IO]
tIn = 0.2;
tOut = 1.2;
inputfile = /storage3/tnunes/runs/PbPb_2p76/Kompost-FS-newCalib2/ICs_run2toKompost/trento_initial_condition_in_kompost_format_468.txt
OutputFileTag = test_output/EnergyMomentumTensor.dat
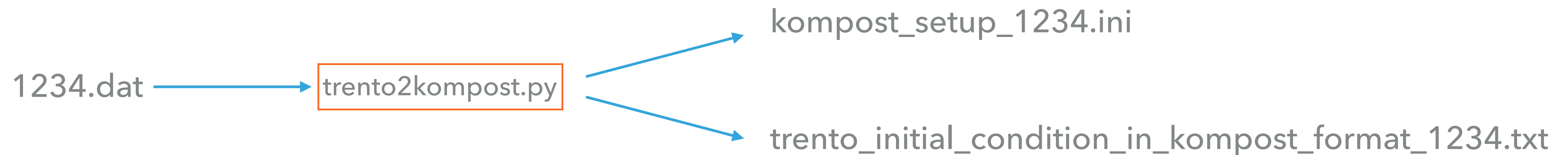
[KoMPoSTParameters]
EtaOverS = 0.081
EtaOverSTemperatureScale = 0.1
EVOLUTION_MODE = 0
ENERGY_PERTURBATIONS = 1
MOMENTUM_PERTURBATIONS = 1

[EventInput]
afm = 0.1
Ns = 280
xSTART = 0
xEND = 279
ySTART = 0
yEND = 279
```

kompost_setup_1234.ini

```
117 80 1e-16 5e-17 5e-17 0 0 0 0 0 0
118 80 0.0010283339305081616 0.00051417 0.00051417 0 0 0 0 0 0
119 80 0.0010582703921070066 0.000529135 0.000529135 0 0 0 0 0 0
120 80 0.0010730612157048183 0.000536531 0.000536531 0 0 0 0 0 0
121 80 0.0010722117787790362 0.000536106 0.000536106 0 0 0 0 0 0
122 80 0.0010557663213598845 0.000527883 0.000527883 0 0 0 0 0 0
123 80 0.0010242513492899603 0.000512126 0.000512126 0 0 0 0 0 0
124 80 1e-16 5e-17 5e-17 0 0 0 0 0 0
125 80 1e-16 5e-17 5e-17 0 0 0 0 0 0
126 80 1e-16 5e-17 5e-17 0 0 0 0 0 0
```

trento_initial_condition_in_kompost_format_1234.txt

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RUNNING KOMPOST: PROPER

▸ You are now able to run Kompost:

    ▸ 1. Navigate (create) an execution dir for you Kompost run;

    ▸ 2. Inside this dir, build a soft link to the EKT dir in the original Kompost dir;

    ▸ 3. Use the runKompost.sh script (or create your own version):

        ▸ ./runKompost.sh 1234

```bash
#!/usr/bin/env bash

export OMP_NUM_THREADS=1

BINDIR="/home/tnunes/kompost/KoMPoST-github"
KPSTINTERFACEDIR="/storage3/tnunes/runs/pPb_502/run2/FS_0to1p2_n14000/ICs_toKompost"
ICNO=$1

mkdir output_$1
cd output_$1
ln -s  /home/tnunes/kompost/KoMPoST-github/EKT EKT
time $BINDIR/KoMPoST.exe $KPSTINTERFACEDIR/kompost_setup_$ICNO.ini
```

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RUNNING KOMPOST: THE OUTPUT

▶ Inside the output folder (one per event), there are several files:

```
EKT                                                        EnergyMomentumTensor.dat.txt
EnergyMomentumTensor.dat.background.txt                    EnergyResponse_FS_X.txt
EnergyMomentumTensor.dat.input.txt                         EnergyResponse_KoMPoST_X.txt
EnergyMomentumTensor.dat.music_init_flowNonLinear_pimunuTransverse.txt        MomentumResponse_FS_X.txt
EnergyMomentumTensor.dat.music_init_flowNonLinear_pimunuTransverse_pimunuNS.txt   MomentumResponse_KoMPoST_X.txt
```

This is the one to be used as initial condition for MUSIC.

REFERENCES

▸ TRENTo source and manual : http://qcd.phy.duke.edu/trento/

▸ TRENTo original article: https://inspirehep.net/literature/1334386

▸ KoMPoST source: https://github.com/KMPST/KoMPoST

▸ KoMPoST original articles: https://inspirehep.net/literature/1671785 and https://inspirehep.net/literature/1671494

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