



The VII-th International Conference on the  
**Initial Stages** of High-Energy Nuclear  
Collisions (IS2023), Copenhagen.

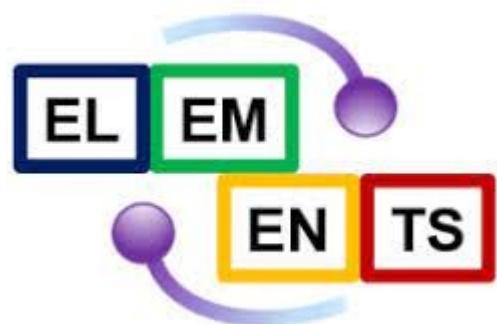
# Extracting initial conditions for hydrodynamics from transport approach

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# SMASH-vHLL-E-hybrid model

A. Schäfer et al.: Eur. J.A 58 (2022) 11, 230

## Initial condition:

extracting hadrons from hadron transport model SMASH at:

$$\tau = \frac{R_p + R_t}{\sqrt{(\sqrt{s_{NN}}/2 m_N)^2 - 1}}$$

J. Weil et al.: Phys.Rev.C 94 (2016) 5, 054905

## Hydrodynamics:

hadrons' energy and momentum and charges are smoothed out:

$$K(r) \propto \exp\left(-\frac{x^2 + y^2}{\sigma_T^2} - \gamma_{eta}^2 \tau_0^2 \frac{\eta^2}{\sigma_\eta^2}\right)$$

3D viscous relativistic hydrodynamics vHLL-E

Iu. Karpenko: Comput.Phys.Commun. 185 (2014) 3016

**Particilization:** Cooper-Frye sampling

**Afterburner:** SMASH

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- designed with BES/SPS energies in mind
- naturally 3D
- $T^{\mu\nu}$  + charges: baryon number + electric charge

## This work:

- modification of how we use these initial conditions in hydro
- Au+Au at 200 GeV, 0-5% centrality

# Particles into hydro

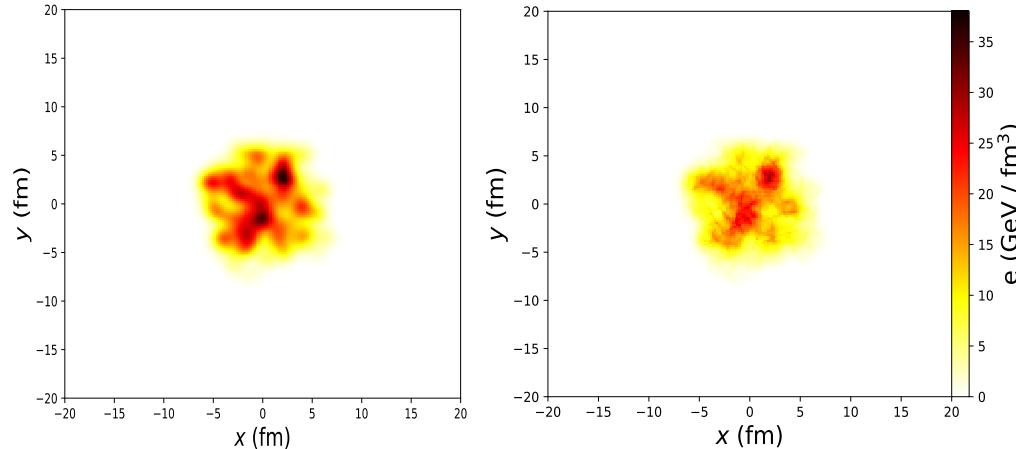
## Change A

- A different smearing kernel: covariant formula

$$K(r) = (2\pi\sigma^2)^{-3/2} \gamma \exp\left(-\frac{\mathbf{r}^2 + (\mathbf{r} \cdot \mathbf{u})^2}{2\sigma^2}\right)$$

D. Oliinychenko et al.: Phys.Rev.C 93 (2016) 3, 034905

- Different fluctuations: will we see it in the flow?



## Change B

- Toy model for minijet energy loss
- Divide the hadrons into soft initial conditions and hard minijets:  $m_T > 2$  GeV
- Energy loss:

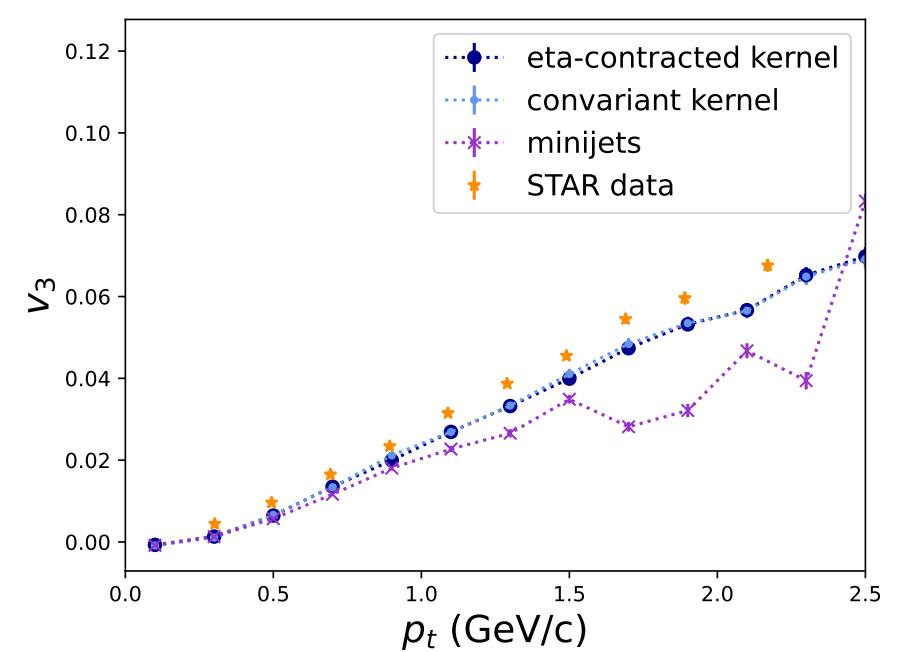
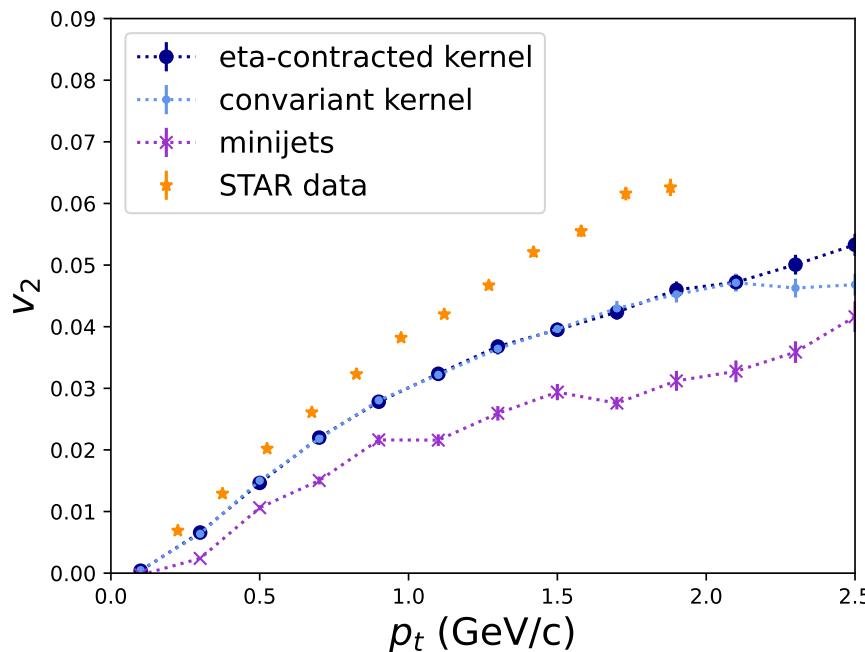
$$\frac{dE}{dx} = -\frac{4}{\pi} E_{init} \frac{x^2}{x_{stop}^2} \frac{1}{\sqrt{x_{stop}^2 - x^2}}$$

- Gaussian sources to hydro

D. Pablos et al.: Phys.Rev.C 106 (2022) 3, 034901

# Azimuthal anisotropies

- Flow comparison:
  - smearing kernel does not influence the energy density geometry – no change in  $v_2$ ,  $v_3$
  - minijets reduce both  $v_2$  and  $v_3$



# Future plans

- Possible observables: longitudinal flow decorrelation,  $v_1$
- Low energies: dynamical initialization  
→ w R.Hirayama, Iu.Karpenko
- High energies: IC comparison (N. Goetz)
- All the codes mentioned are public, look for smash-vhlle-hybrid here:

