

Deep learning for flow observables in ultrarelativistic heavy-ion collisions

Henry Hirvonen

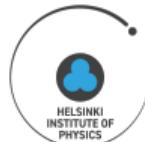
with Harri Niemi, Kari J. Eskola

[arXiv:2303.04517\[hep-ph\]](https://arxiv.org/abs/2303.04517)

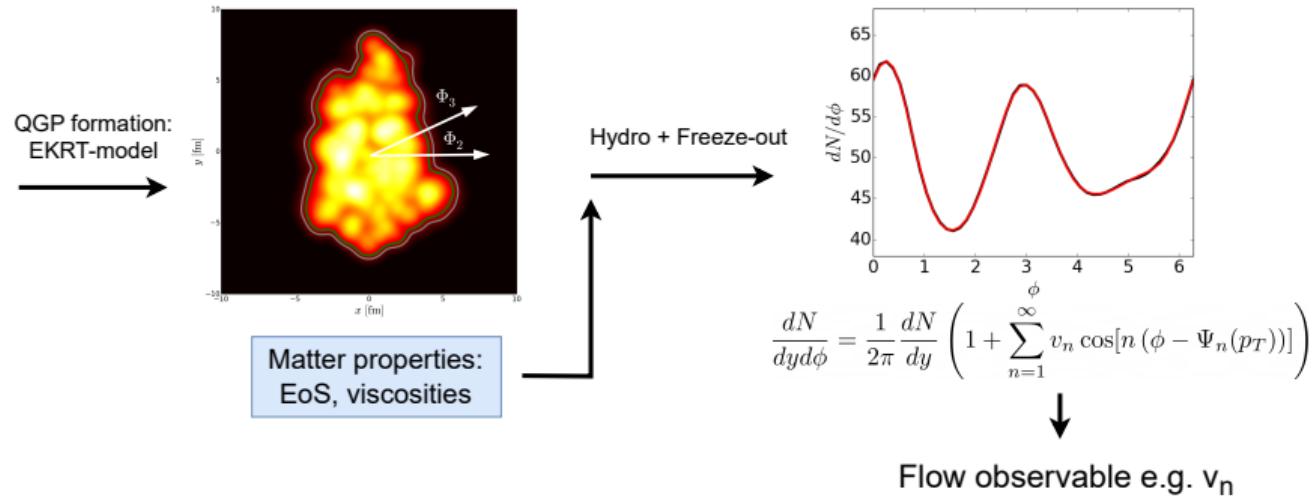
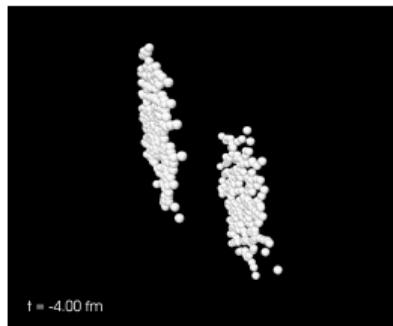
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CoE in Quark Matter
YoctoLHC

Quark Matter 2023, Flash talk, 9.9.2023

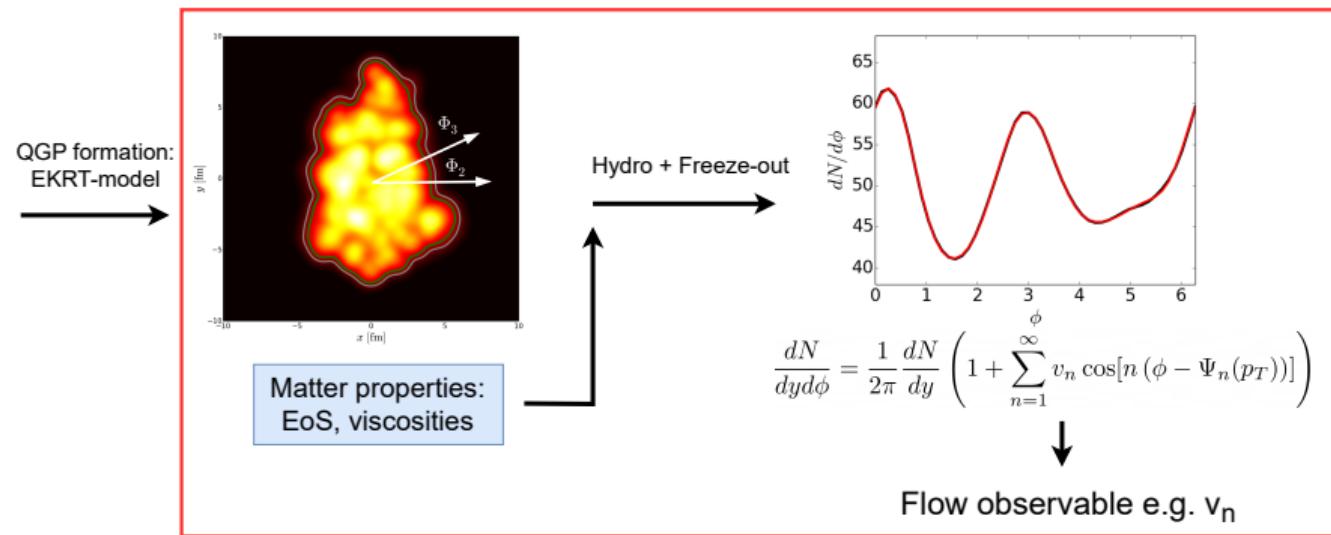
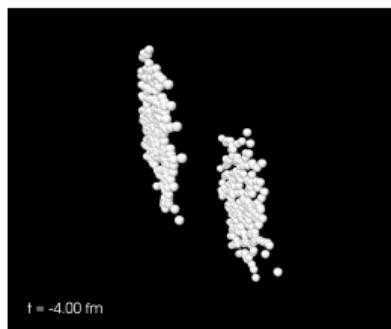


Simulation



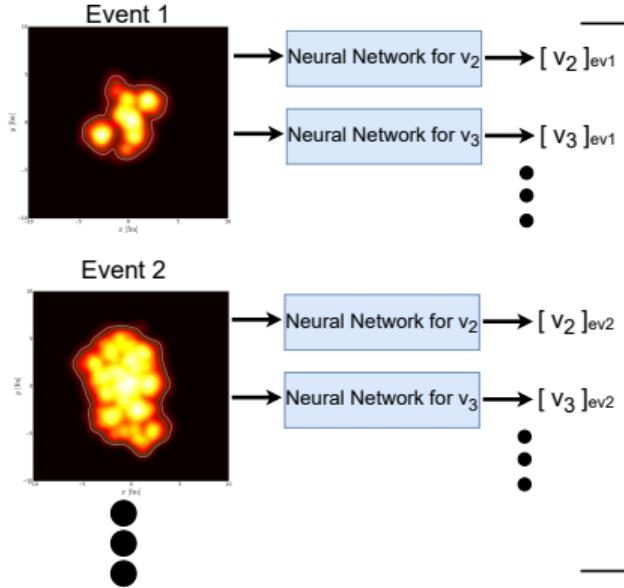
- Simulation needs to be done for $\sim 1M$ different nuclear configurations to get similar statistical errors as in the experiments for multi-particle correlations

Simulation



- Simulation needs to be done for $\sim 1M$ different nuclear configurations to get similar statistical errors as in the experiments for multi-particle correlations
- Computationally expensive part: takes $\sim 30\text{min CPU Core time for each event}$

Neural networks



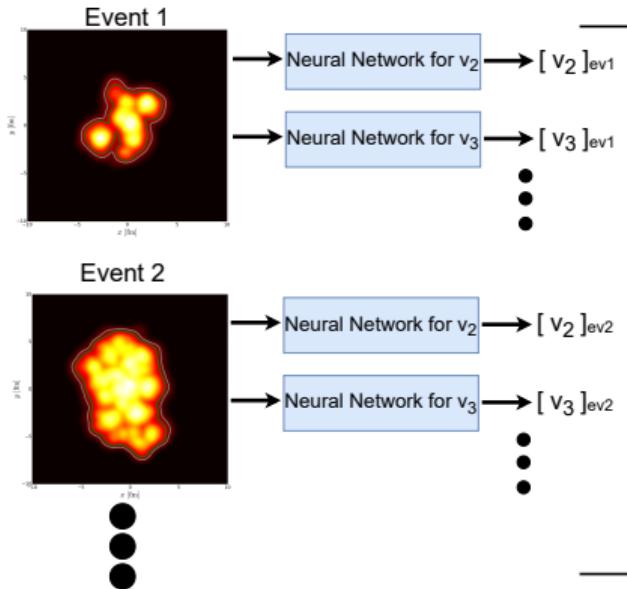
$$v_n\{2\} = \sqrt{\langle [v_n]_{\text{ev}}^2 \rangle}$$

$$\text{NSC}(n, m) = \frac{\langle [v_n]_{\text{ev}}^2 [v_m]_{\text{ev}}^2 \rangle}{\langle [v_n]_{\text{ev}}^2 \rangle \langle [v_m]_{\text{ev}}^2 \rangle} - 1$$

Average over events $\rightarrow v_n\{2\}, \text{NSC}(n,m), \text{etc.}$

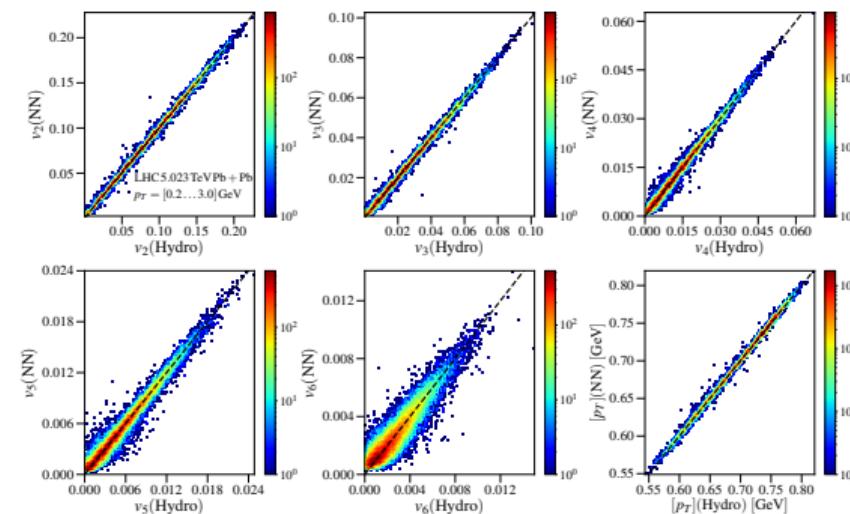
Generating 10M events takes ~ 20 GPU hours

Neural networks



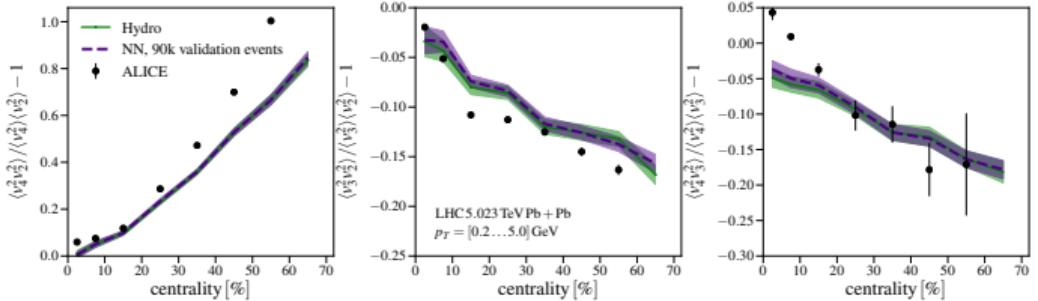
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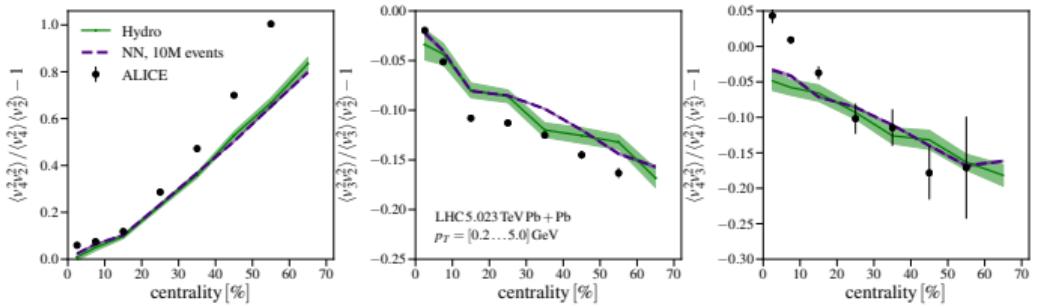


Generating 10M events takes ~ 20 GPU hours

Validation:



Prediction:



Applications:

- Bayesian analysis with multi-particle correlations
- Imaging of nuclear structure
- Studying effects of different initial state models