Prediction for global properties in O+O collisions at $\sqrt{s_{NN}} = 7$ TeV using AMPT model

D. Behera[1], N. Mallick[1], S. Tripathy[2], S Prasad[1], A. N. Mishra[3] and R Sahoo[1]
1. Indian Institute of Technology Indore, India, 2. INFN- sezione di Bologna, Italy
3. Wigner Research Center for Physics, 29-33 Konkoly-Thege Mikl\'os Str., H-1121 Budapest, Hungary
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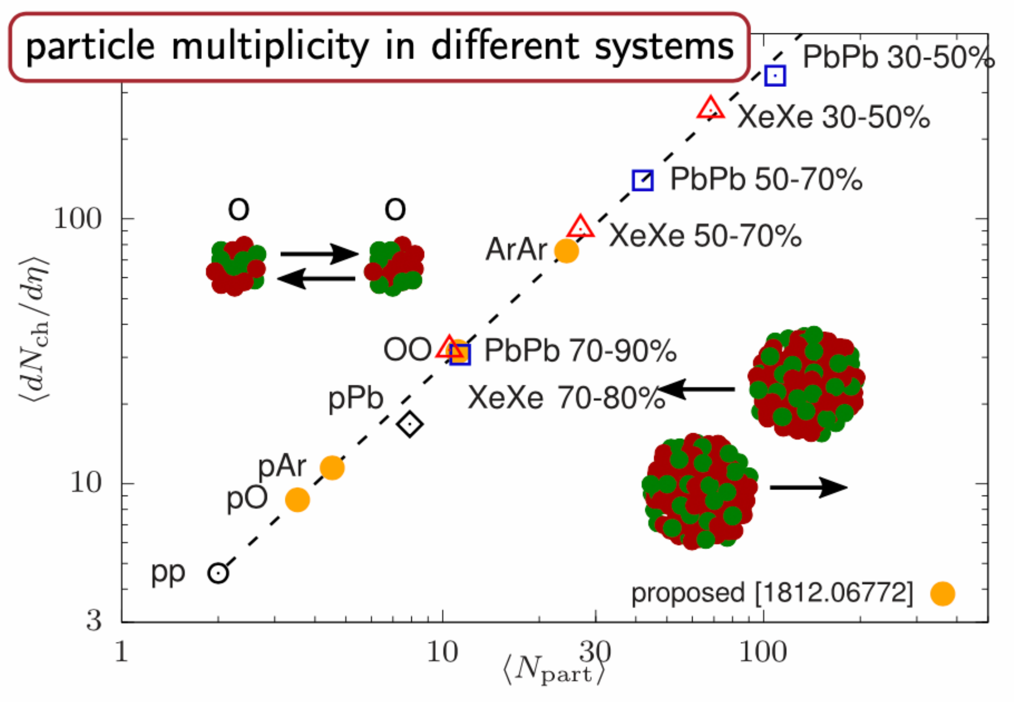
1. Physics Motivation

- LHC, CERN plans for a day of Oxygen+Oxygen collisions in RUN 3
- Special interest to Oxygen as
  1. Investigate the origin of small system collectivity
  2. Probe possibility of α-cluster structure

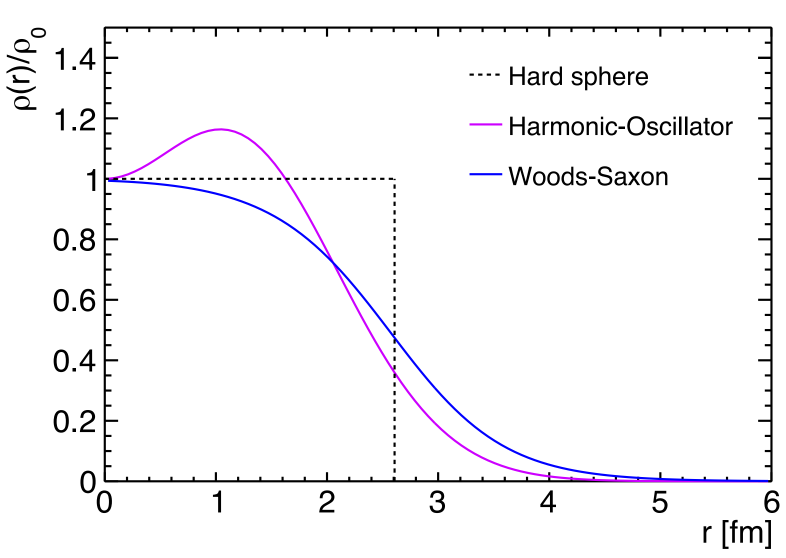


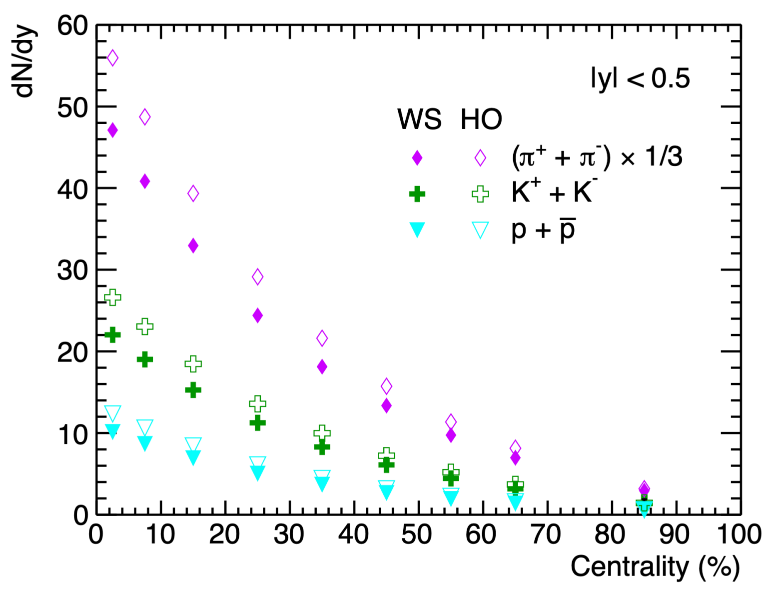
Z. Citron, A. Dainese et al, arXiv:1812.06772

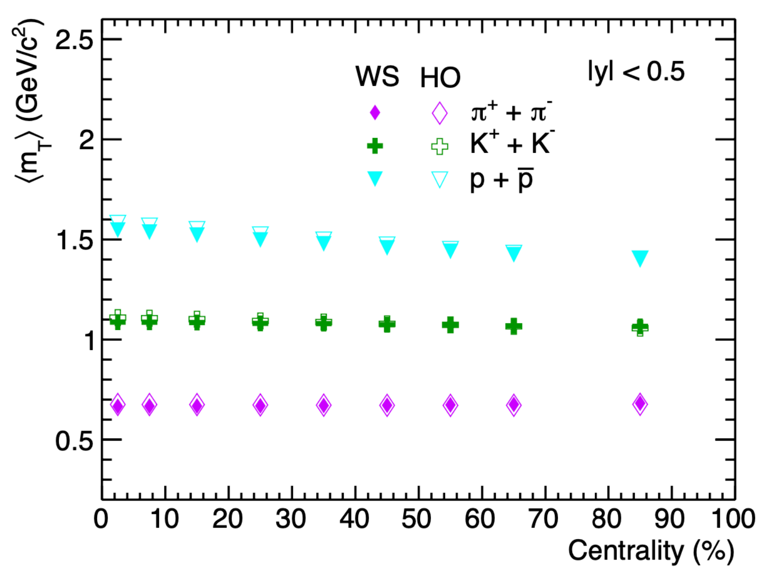
2. Bjorken Energy Density

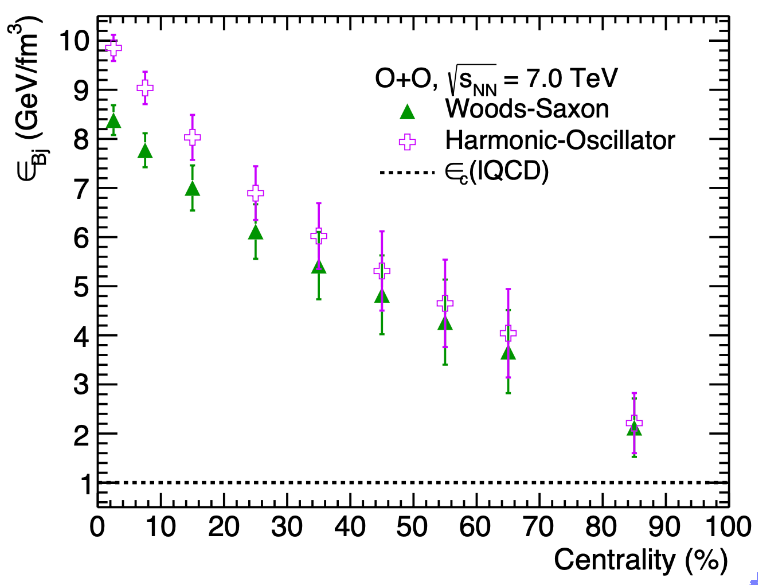
- Initial energy density is the key variable for studying the formation of Quark-Gluon Plasma (QGP) in heavy-ion collisions
- The Bjorken energy density (ϵ_{Bj}) [1]:

$$\epsilon_{Bj} \approx \frac{3}{2} \times \left(\langle m_T \rangle \frac{dN}{dy} \right)_{\pi^{\pm}} + 2 \times \left(\langle m_T \rangle \frac{dN}{dy} \right)_{K^{\pm},p,\bar{p}}$$





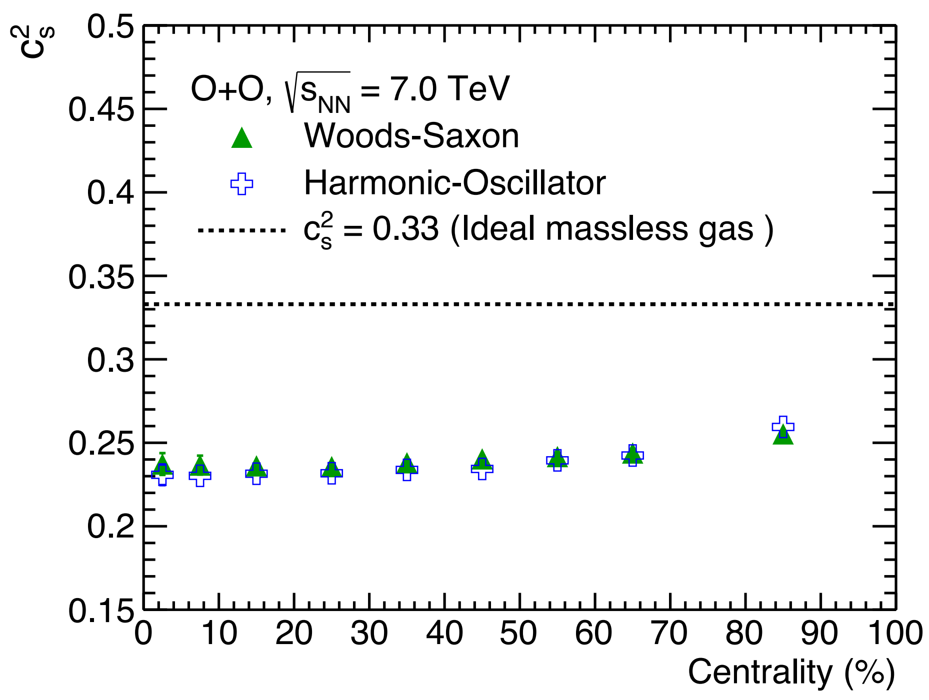




3. Squared Speed of Sound

- A Double Gaussian function: $A_1 e^{\frac{-x^2}{2\sigma_1^2}} - A_2 e^{\frac{-x^2}{2\sigma_2^2}}$ is used to describe pseudorapidity spectra
- Landau hydrodynamic model [2]: c_s^2 is related to width of rapidity distribution function

$$\sigma_y^2 = \frac{8}{3} \frac{c_s^2}{1 - c_s^2} \ln\left(\frac{\sqrt{s_{NN}}}{2m_p} \right)$$



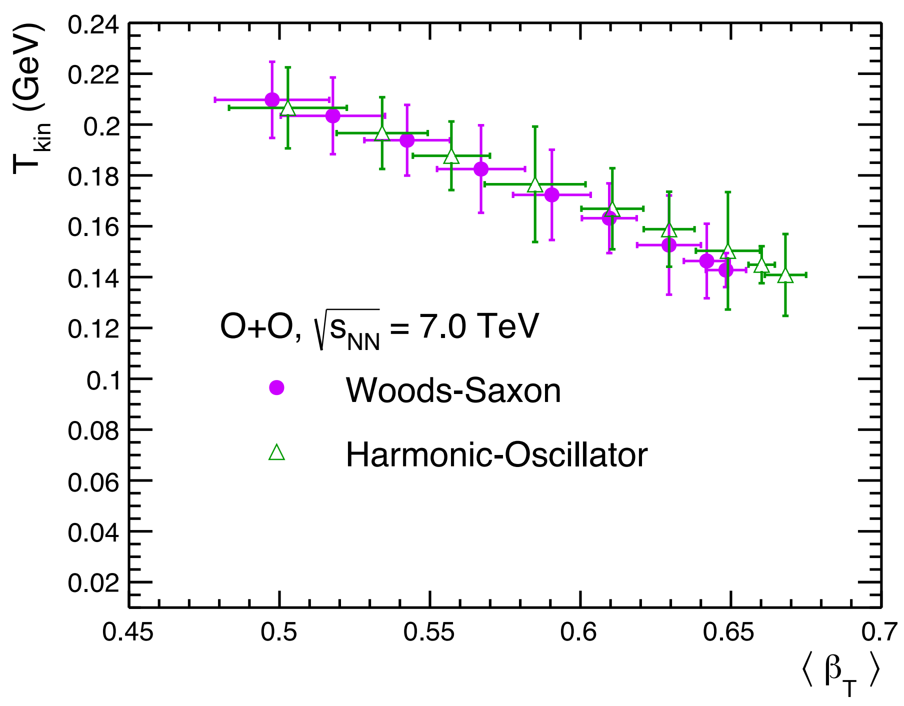
- Within uncertainty, c_s^2 is found to be similar as a function of centrality

4. Kinetic free-out parameters

- Boltzmann-Gibbs blast-wave (BGBW) function:

$$\frac{d^2N}{dp_T dy} = D \int_0^{R_0} m_T r dr K_1\left(\frac{m_T \cosh \rho}{T_{kin}} \right) I_0\left(\frac{p_T \sinh \rho}{T_{kin}} \right)$$

- Fitting ranges in p_T-spectra [3]: Pion = (0.5 - 1.0) GeV/c
  Kaon = (0.2 - 1.5) GeV/c
  Proton = (0.3 - 3.0) GeV/c



- T_{kin} is less for most central collision system while peripheral system has larger value

5. Summary

- We report Bjorken energy density, squared of speed of sound and kinetic freeze-out parameters
- Bjorken energy is higher for centra collision system
- Kinetic freeze-out temperature (T_{kin}) and average traverse flow ($\langle \beta_T \rangle$) is similar within uncertainty for both nuclear density profiles

References

[1] D. Behera, N. Mallick, S. Tripathy, S. Prasad, A.N. Mishra, and R. Sahoo, arXiv:2110.04016 [hep-ph]
[2] L. D. Landau, Izv. Akad. Nauk Ser. Fiz. 17, 51 (1953)
[3] S. Acharya et al. [ALICE Collaboration], Phys. Rev. C 101, 044907 (2020)