Study of Nuclear Modification Factor in O-O collisions at LHC energies using a transport model

Debadatta Behera[1*], Suman Deb[2], Captain R. Singh[1], and Raghunath Sahoo[1]

[1]Department of Physics, Indian Institute of Technology Indore, Simrol, Indore 453552, India

[2]Laboratoire de Physique des 2 infinis Ir`ene Joliot-Curie, Universit´e Paris-Saclay, CNRS-IN2P3, F-91405 Orsay, France

Based On: **Physical Review C 109, 014902 (2024)**

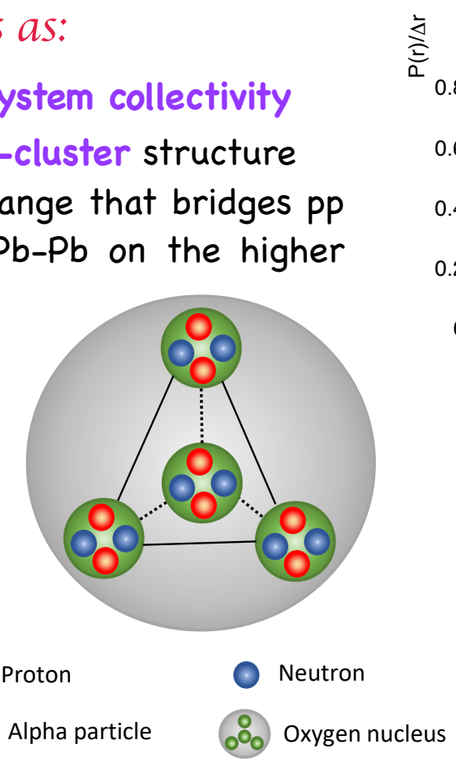
SQM Strasbourg 2024

1. Introduction & Methodology

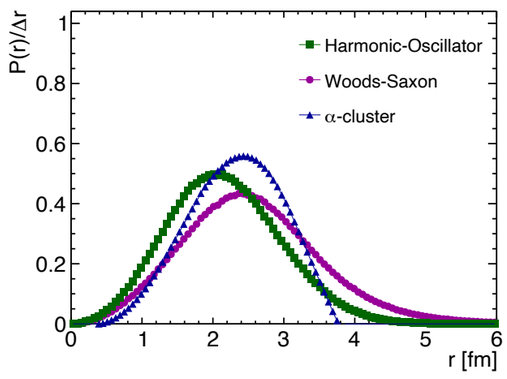
- Upcoming Plan for Oxygen-Oxygen (O-O) collisions in RUN 3 at the LHC
- *Special interest to Oxygen-Oxygen collisions as:*
  1. It may help to investigate the **origin of small system collectivity**
  2. It may help to probe the signatures of exotic **α-cluster** structure
  3. Particle production mechanism in a multiplicity range that bridges pp and p-Pb on the lower side, and Xe-Xe and Pb-Pb on the higher side of the multiplicity

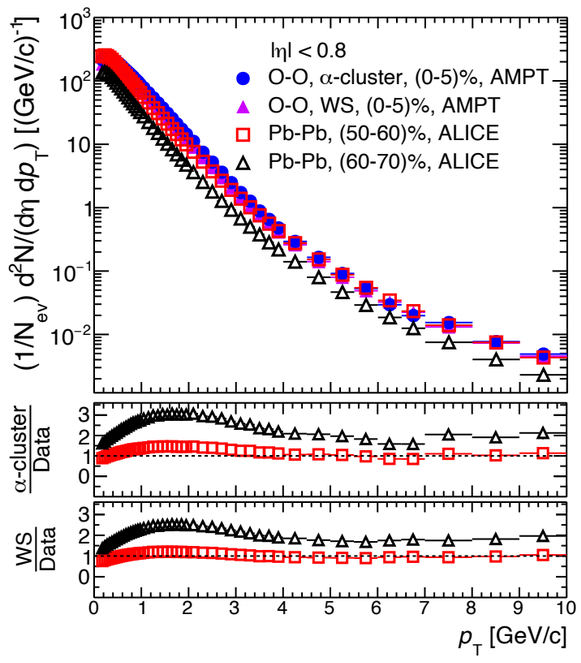
Nuclear modification factor (R_{AA}) for charged hadrons :

$$R_{AA} = \frac{d^2N^{AA}/dp_T d\eta}{\langle N_{coll}\rangle d^2N^{pp}/dp_T d\eta}$$



[α-clustered structure in oxygen nucleus]

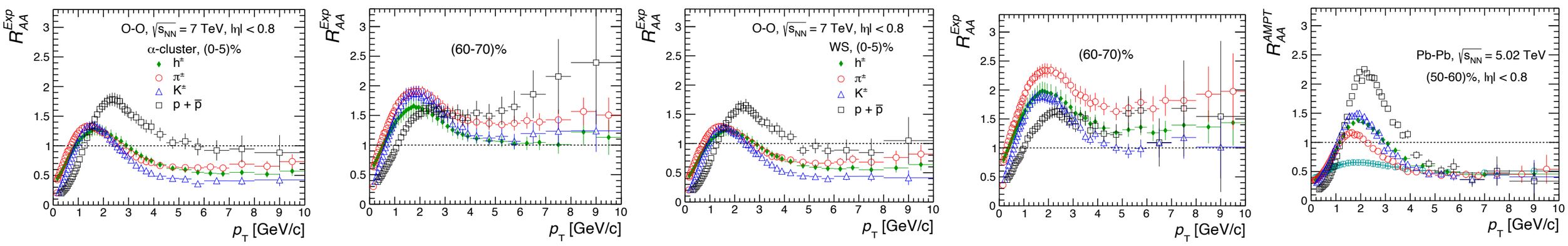




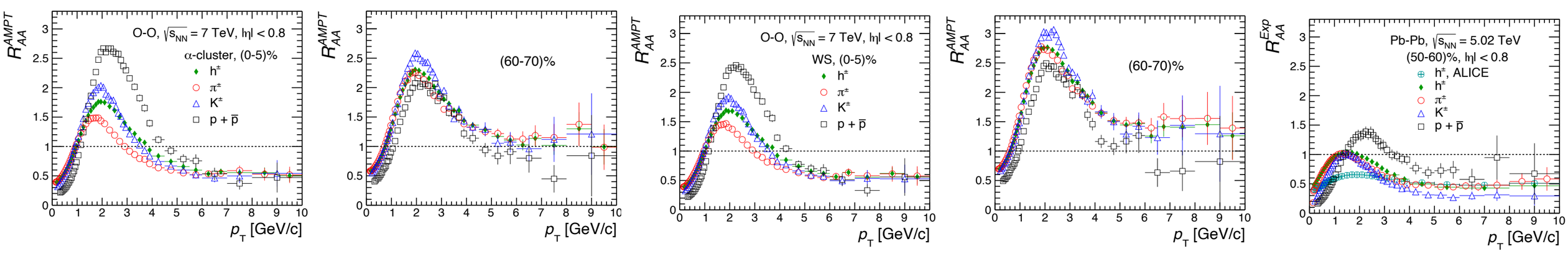
- Investigating R_{AA} in the multiplicity range similar to O-O and Pb-Pb collisions
- The charged-particle multiplicity of O-O collisions corresponding to the **(0-5)%** centrality class approximately agrees with the **(50–60)%** centrality of the Pb-Pb collisions as seen in the above figure

D. Behera, N. Mallick, S. Tripathy, S. Prasad, A. N. Mishra and R. Sahoo, Eur. Phys. J. A 58, 175 (2022).

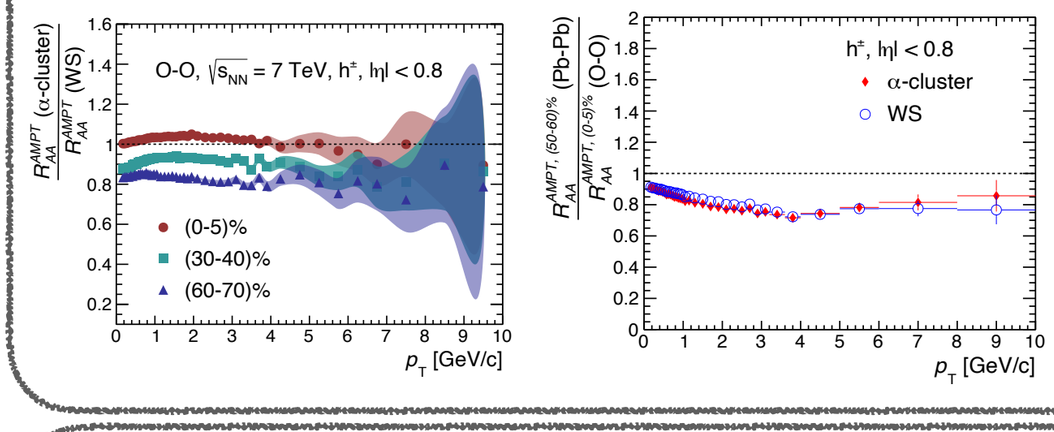
2. Results



- Suppression is more pronounced in most central collisions compared to peripheral collisions
- The difference in species-specific suppression is compatible with a mass ordering towards $p_T < 1.5$ GeV, implicating **radial flow**



- The effect of α-clustered density profiles on particle production is stronger in mid-central and peripheral collisions than in the most central collisions, unlike the Woods-Saxon profile
- Pb-Pb collisions exhibit **60% larger** radius than O−O collisions at a similar multiplicity [Phys. Rev. C 100, 024904 (2019)]



- (50-60)% centrality class of Pb-Pb collisions displays **greater suppression** than the (0-5)% centrality class of O-O collisions
- α-clustered structure creates a compact and denser fireball, particularly in relatively **non-central collisions** in comparison with the Woods-Saxon density profile.

3. Summary

- Nuclear modification factor (R_{AA}) is studied for charged and identified hadrons in the O-O collisions using AMPT
- Behaviour of R_{AA} is studied at similar multiplicity environment between O-O and Pb-Pb collisions
- Density profile study is more effective for mid-central and peripheral collisions as compared to central collisions

[Email: debadatta.behera@cern.ch]