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Thermalization and Transport Phenomena in Oxygen-Oxygen Collisions at √(s_NN)=7 TeV: A Color String Percolation Model Approach

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The investigation of the QCD phase transition and the Quark-Gluon Plasma (QGP) formation in high-energy nuclear collisions continues to be a central focus in modern nuclear physics. While traditionally associated with heavy-ion collisions, recent studies suggest that QGP-like droplets may also emerge in high-multiplicity proton-proton (pp) events. Motivated by these findings, the present study investigates Oxygen-Oxygen (O+O) collisions at √(s_NN)=7 TeV, a promising and upcoming system at the Large Hadron Collider (LHC). Because of the nuclear stability and doubly magic configuration, oxygen-16 is considered an ideal probe for studying QCD-related phenomena in small systems. In this study, we employ the Color String Percolation Model (CSPM) to analyze thermodynamic observables from O+O events simulated using the A Multi-Phase Transport (AMPT) model. We extracted several key thermodynamic and transport parameters, including the initial percolation temperature (T(ξ)), energy density (ε), the shear viscosity to entropy density ratio (η/s), etc. These observables provide critical insight into the evolution of medium and collective behavior in small collision systems. The results are benchmarked against Lattice QCD (LQCD) predictions using nuclear density profiles such as Woods-Saxon and harmonic oscillator. The role of α-clustering in oxygen nuclei is also investigated for its influence on collective behavior. This study offers new insights into QGP-like behavior and thermalization in small systems, strengthening the role of CSPM in interpreting the dynamics of hot QCD matter at LHC energies.

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