CONSTRAINING THE DENSITY DEPENDENCE OF THE SYMMETRY ENERGY USING THE MULTIPLICITY AND AVERAGE P_T RATIOS OF CHARGED PIONS

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The charged pion multiplicity ratio in intermediate energy heavy-ion collisions, a probe of the density dependence of symmetry energy above the saturation point, has been proven in a previous study to be extremely sensitive to the strength of the isovector $\Delta(1232)$ potential in nuclear matter. As there is no current knowledge, either from theory or experiment, about the magnitude of this quantity, the extraction of constraints for the slope of the symmetry energy at saturation by using exclusively the mentioned observable is hindered at present. It is shown that, by including the ratio of average p_T of charged pions $\langle p_T^{(\pi^+)}\rangle/\langle p_T^{(\pi^-)}\rangle$ in the list of fitted observables, the noted problem can be circumvented. A realistic description of this observable requires the accounting for the interaction of pions with the dense nuclear matter environment embodied by the so called S and P-wave pion optical potentials. This is performed within the framework of a QMD transport model that enforces the conservation of the total energy of the system and incorporates information about these potentials gained by the experimental study of pionic atoms and pion-nucleus scattering and also from theoretical hadronic models and chiral perturbation theory. A symmetry energy with a value of the slope parameter $L > 20$ MeV is favored, at 99.7% confidence level, from a comparison with published FOPI experimental data. It is shown that near future experimental measurements of pionic observables (SAMURAI TPC Collaboration) will present the opportunity of extracting a precise constraint for the symmetry energy stiffness.