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Surprises for the chemical freeze-out line from the new data in proton-proton and nucleus-nucleus collisions

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New results of the NA61/SHINE and HADES collaborations, as well as the updated data from NA49, and the existing data from other collaborations are analyzed within the transport models and the hadron resonance gas (HRG) statistical model. The chemical freeze-out parameters in $p+p$ interactions and central $A+A$ collisions are found and compared with each other in the $\sqrt{s_{NN}}$ = 3.2–17.3 GeV energy range.

The chemical freeze-out temperatures in $p+p$ interactions are found to be larger than the corresponding temperatures in central $A+A$ collisions. The temperature in $p+p$ slowly grows with energy from 130 to 175 MeV, in contrast to $A+A$ temperature, which increases very fast from zero and saturates at $T_{\rm A+A} \simeq 156$ MeV. This value is lower than predicted by chemical freeze-out line in HRG previously, but is very close to the temperature found in HRG in $A+A$ at the LHC.

The largest difference $T_{\rm p+p} - T_{\rm A+A} \simeq 60$ MeV is at low energies. These temperatures are very close $T_{\rm p+p} \simeq T_{\rm A+A}$ at $\sqrt{s_{NN}} = 6.3 - 7.7$ GeV, and then the difference grows again reaching 20 MeV at the highest SPS energy. The radius $R_{\rm A+A}$ increases with collision energy, while $R_{\rm p+p}$ is approximately constant. More data at low energies are needed. The minimal requirements to the set of measured particles are obtained, see arXiv:1512.08025 for details.

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