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Role of repulsive interactions in the interplay with missing strange resonances

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The standard implementation of the statistical model assumes point-like particles, and accounts for attractive interactions among hadrons through resonance formation.
The classical HRG model has proven to be unable to describe all the available results on fluctuations of B/Q/S conserved charges from lattice calculations, and shows some significant deviations from the latest measurements performed by the ALICE collaboration on particles yields [1].
Motivated by these issues it has been proposed to include in the hadronic spectrum not-yet detected states from the Quark-Model [2]. The presence of extra strange resonances, which fills the gap in the poorly known strange sector, improves the description of some key-observables and at the same time spoils the agreement with other not negligible ones.
Recently the relevance of repulsive channels against some particular mesonic states, i.e. the highly debated sigma and kappa resonances, has been highlighted [3,4], and furthermore it has been shown how repulsive interactions are important to have a consistent description of SU2 and SU3 gauge theories [5].
Repulsive interactions can be modeled within the HRG framework assigning to each particle an effective hard-sphere radius, with the net result that the portion of space occupied by hadrons must be subtracted to the system-volume [6], namely excluded-volume effects.
Although this is a simplicistic assumption, it allows to extract quantitative results on the different hadronic interaction-channels, e.g. the so called proton-anomaly can be interpreted as a difference in the light and strange sectors [7].
We show how the inclusion of repulsive interactions balances the effect of extra higher-mass strange resonances restoring the agreement with higher-order fluctuations of conserved charges, and preserving the improvements for the above mentioned key observables and for experimental particle yields.
Indeed both theoretical calculations and experimental measurements hint consistently for smaller strange states with respect to the light ones with same mass. This result can be phenomenologically justified by the smaller cross sections for the heavier strange hadrons.
Future calculations on higher-order observables related to net-electric charge could further establish the role of repulsive interactions.
Excluded-volume effects could be otherwise relevant to analyze the non-monotonic behavior of the Beam Energy Scan measurements on fluctuations of conserved charges at non-vanishing baryon densities.

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List of tracks

Freeze-out, hadronisation and statistical models

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