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# Effect of baryon-antibaryon annihilation on thermal model fit to extract chemical freeze-out parameters

Hadron yields obtained from elementary collisions up to heavy-ions have been successfully described by thermal models with a few parameters such as temperature and baryon chemical potential [1, 2].
However, the LHC/ALICE experiment has recently found that the proton and antiproton yields are a factor of 2 too low compared to thermal description [3]. This has been shown to arise from baryon-antibaryon ($B\bar{B}$) annihilations which can still be appreciable after chemical freeze-out because of their large cross-sections while the reverse reactions of multi-particles fusing into a $B\bar{B}$ pair cannot be sustained [4]. In this study, we include the $B\bar{B}$ annihilation effect
into the thermal model [5] by introducing one more parameter for the out-of-equilibrium annihilation loss of the protons. We use the quark model description for the annihilation losses of the other (anti-)baryons. We assume annihilation of a $B\bar{B}$ pair produces a certain number of mesons (default 5 pions and kaons depending on the strangeness content) [4, 6]. We fit both heavy-ion data ($\sqrt{s}_{\rm NN}=$ 6.27 GeV to 2.76 TeV) and proton-proton collision data ($\sqrt{s}_{\rm NN}=$ 200, 900, and 7000 GeV) at SPS, RHIC and LHC energies. We obtain new chemical freeze-out parameters with significantly improved fit quality in comparison to the default thermal model.
We find that the baryon loss increases with increasing collision energy while the antibaryon loss decreases. We further find a significant increase in the chemical freeze-out temperature compared to the default fit, potentially provoking a rethink of the nuclear phase diagram.

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## Preferred Track

Baryon-Rich QCD Matter and Astrophysics

## Collaboration

Not applicable

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