V

QCD, hadronic structure and high temperature

13 Hadronic structure and quantum chromodynamics

13.1 Confined quarks in a cavity

A hadronic particle, according to section 3.1, is a quark-filled bubble, a 'swiss-cheese' hole, in the structured vacuum. The highly excited drop of QGP is indeed much akin to the picture of an individual, colorless hadron, except that it is the thermal pressure that acts against the vacuum pressure, not the quantum pressure. As a first step in a more detailed discussion of the QGP phase, we briefly discuss how this approach allows us to understand properties of individual hadrons.

In the quark-bag model of hadronic structure, colorless qqq baryons or $\bar{q}q$ mesons are embedded in the structured vacuum sea. In a calculational framework proposed by Bogoliubov [78], independent quarks confined by a static Lorentz-scalar potential with infinite walls were considered. This is ensuring permanent 'confinement' of the constituents within a given volume. The interest in this approach grew only after it was understood that the confining potential is not to be derived from quark–quark interactions, but that it arises from the repulsion of colored quarks by the structured QCD vacuum state.

The structure of hadrons emerges on considering a static spherical state in which residual quark–quark interactions are introduced. This MIT-bag model is able to capture most features of the hadron spectrum [92, 93, 99, 151]. Our limited objective is to extract from a study of the hadronic spectrum information about the latent heat of the vacuum $\mathcal{B}$, and the mass of the strange quark $m_{\rm s}$. To accomplish this we will not need to introduce in this book improvements addressing the restoration of translational invariance, and the absence of chiral symmetry; see section 3.3. For further details on chiral symmetry and the bag model, we refer the interested reader to [94, 256, 258].

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