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An analysis of the nucleon spectral function in the nuclear medium from QCD sum rule

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The QCD sum rule method is a powerful tool for studying hadron properties directly from QCD.
In this method, the correlation function of an interpolating field operator coupled to the hadron of interest, which can be calculated in the deep Euclidean region by the operator product expansion (OPE), is related to the hadronic spectral function. The non-perturbative contributions in the correlation function are expressed by vacuum condensates such as the chiral condensate.
In the traditional analysis, it is necessary to assume some specific functional form, such as the “pole + continuum”-ansatz, for the spectral function.
On the other hand, our approach with the help of the Maximum Entropy Method (MEM) is able to extract the spectral function without assuming a specific form.
The method has been successfully applied to the rho meson sum rule [1] and the nucleon sum rule [2] in vacuum.

We have applied this analysis method of QCD sum rules to the spectral function of the nucleon and its negative parity excited states in vacuum [3]. We construct the parity projected nucleon sum rules including the first order \alpha_{s} corrections by using a phase-rotated Gaussian kernel.
Both the positive and negative parity spectral function of the nucleon are extracted after the MEM is applied to the sum rule.
We find that the difference between the positive and negative parity spectral function is mainly caused by the chiral condensate.

Applying this method to the analyses in nuclear medium, the mass modification of both the positive and negative parity states can be examined.
An investigation of the nucleon spectral function in nuclear medium is now in progress.

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[3] K. Ohtani, P. Gubler and M. Oka, Phys. Rev. D 87, 034027 (2013).

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