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The role of the sigma meson in thermal models

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The by now well-established scalar-isoscalar resonance $f_0(500)$ (the σ meson) seems potentially relevant in the evaluation of thermodynamic quantities of a hadronic gas, since its mass is low. However, we recall that its contribution to isospin-averaged observables is, to a surprising accuracy, canceled by the repulsion from the pion-pion scalar-isotensor channel. As a result, in practice one should not incorporate $f_0(500)$ in standard hadronic resonance-gas models for studies of isospin averaged quantities. In our analysis we use the formalism of the virial expansion, which allows one to calculate the thermal properties of an interacting hadron gas in terms of derivatives of the scattering phase shifts, hence in a model-independent way directly from experimentally accessible quantities. A similar cancellation mechanism occurs for the scalar kaonic interactions between the $I=1/2$ channel (containing the alleged $K^*(800)$ or the κ meson) and the $I=3/2$ channel.

Author: Prof. GIACOSA, Francesco (Kielce University)

Co-authors: BEGUN, Viktor (UJK); BRONIOWSKI, Wojciech (IFJ PAN)

Presenter: Prof. GIACOSA, Francesco (Kielce University)

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