Comment on "Scaling Hypothesis for the Spectral Densities in the O(3) Nonlinear Sigma Model"

In a recent paper [1], we reported the results of a Monte Carlo study which show that for $p/m < 100$ the continuum limit of the lattice O(3) σ model agrees as well with the S-matrix prediction [2] as with the continuum limit of the dodecahedron spin model. In the latter model the massive high temperature phase must terminate at some finite inverse temperature β. It is well known that asymptotic freedom requires the current two-point function to diverge for $p/m \to \infty$ [3]. However, in another recent paper, we proved that the current two-point function is bounded at finite β, due to reflection positivity and a Ward identity.

Consequently, unless the observed agreement between the O(3) and dodecahedron spin model is accidental and disappears at larger values of p/m, the Balog and Niedermaier scaling hypothesis [4] for the spectral densities in the O(3) nonlinear σ model, predicting a logarithmic increase of the current two-point function with p/m, cannot be correct. Moreover, since the spin two-point function should behave as $(p/m)^{\eta-2}$ for large p/m, the behavior of the odd- and even-particle number spectral densities $\rho^{(n)}(\mu)$ must be quite different.

This different behavior is shown both by our Monte Carlo data and by the Balog-Niedermaier prediction itself, if one looks at it on a logarithmic scale (see Figs. 1 and 2): While for the odd case (spin) the data start growing faster than logarithmically, they grow more slowly than $\ln(p/m)$ for the even case (current). This behavior gives support to our scenario of a powerlike increase in the odd and boundedness in the even sector. Incidentally, for the odd case, the logarithmic slope of the S-matrix result [2] at $p/m = 100$ is already 0.143 and growing; this is larger than the prediction $4/3\pi^2$ in [2] (the long version of their Letter [4]) for the asymptotic slope.

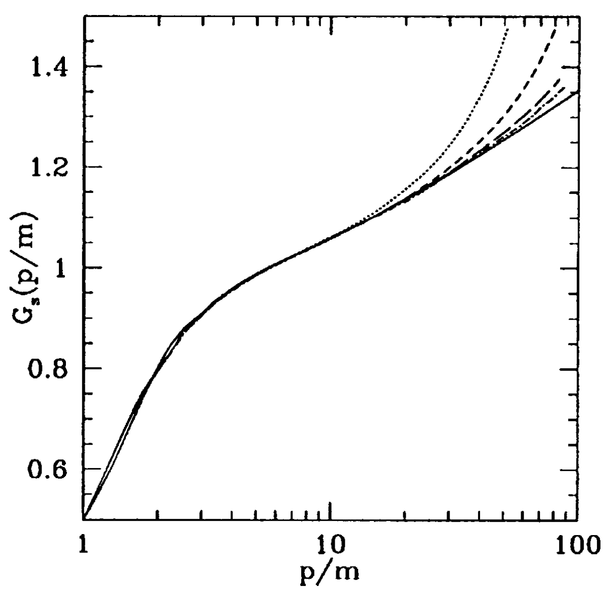

FIG. 1. Monte Carlo data and the Balog-Niedermaier prediction (solid line) for the spin two-point function.

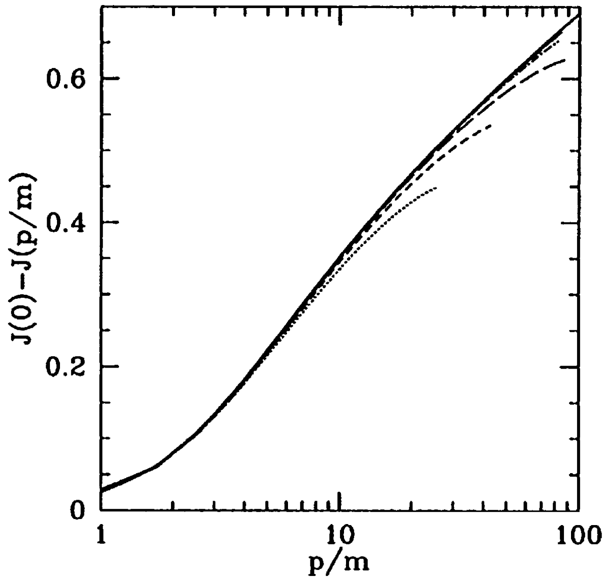

FIG. 2. Monte Carlo data and the Balog-Niedermaier prediction (solid line) for the current two-point function.

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