The 2-loop self energies and spectral functions in the O(4) sigma model at finite temperature

Tetsuo NISHIKAWA[a] Osamu MORIMATSU[a] and Yoshimasa HIDAKA[b]
[a] *High energy accelerator research organization, Tsukuba, Ibaraki, Japan*
[b] *University of Tokyo, Hongo, Bunkyo-ku, Tokyo, Japan*

In ref.[1] the spectral functions in the O(4) linear sigma model at finite temperature was studied in the 1-loop order employing optimized perturbation theory, and threshold enhancement of the spectral functions at finite temperature was found. We extend the calculation including 2-loop self energy diagrams in order to study the effect of thermal widths of π in the process $\sigma \to \pi\pi$, which is not taken into account in the 1-loop order. First, we analyzed the structure of the imaginary part of the diagrams. One of the remarkable points is that the 2-loop self energies have imaginary parts at arbitrary energy of the initial σ. Secondly, we numerically evaluated the so called sunset diagram (Fig.1 (a)) as a first step. Fig.2 shows the spectral functions including the sunset and 1-loop diagrams. At T =ffD 180MeV, where $\sigma \to \pi\pi$ is kinematically forbidden, σ has a width of the order of 10MeV due to the induced decay . At lower temperatures, the contribution of the sunset diagram turns out to be small. Therefore, it is crucial to see the effects of the three diagrams depicted in Fig.1 (b)$\sim$(d), since in these diagrams an intermediate pion decays into sigma induced by thermal pion ($\pi\pi \to \sigma$) . Numerical evaluations of these diagrams are now in progress.

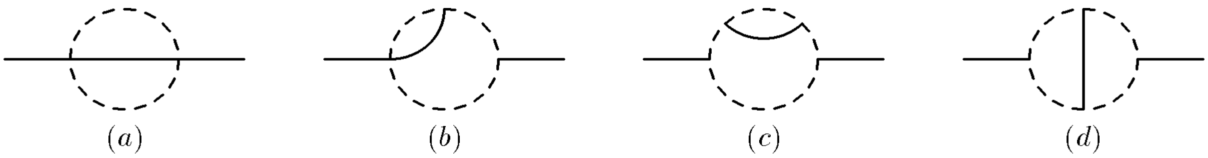

Figure 1: 2-loop self energy diagrams. Solid and dashed lines are σ and π respectively.

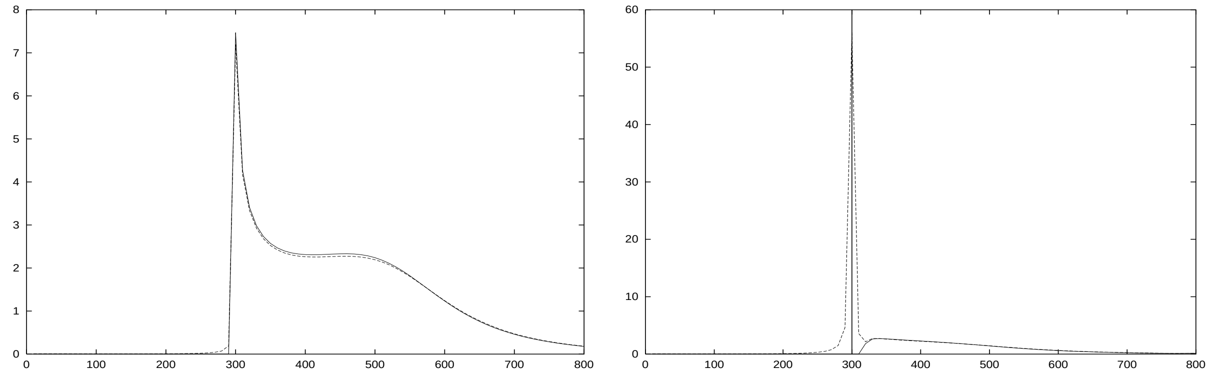

Figure 2: σ spectral function at T =ffD 145MeV (left panel) and T =ffD 180MeV (right panel). Horizontal axis is the energy of σ (MeV). Solid lines corresponds to the spectral function to 1-loop [1] and dashed to that including 1-loop self energy and the sunset diagram.

References

[1] Chiku and Hatsuda, Phys. Rev.**D58** (1998) 76001.