DCC dynamics with the SU(3) linear sigma model[*]

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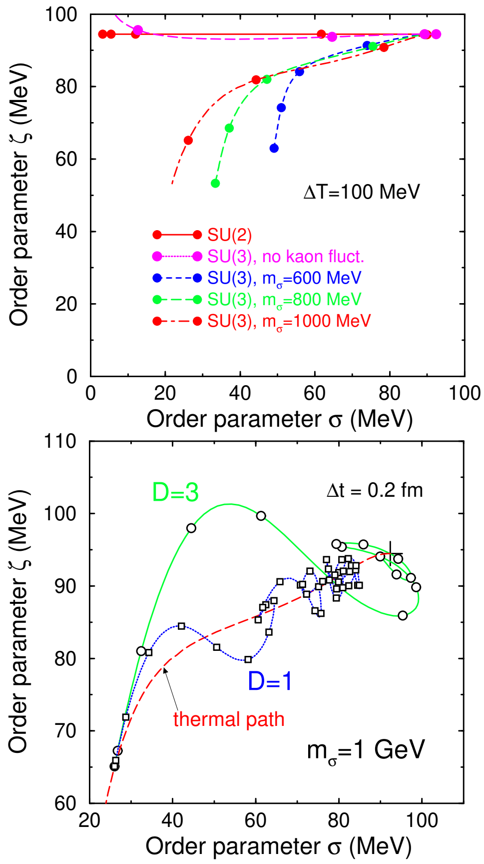
The SU(3) extension of the linear sigma model has been employed to elucidate the effect of including strangeness on the formation of disoriented chiral condensates. By means of a Hartree factorization, approximate dispersion relations for the 18 scalar and pseudoscalar meson species were derived. Their self-consistent solution makes it possible to trace out the thermal path of the two order parameters (top figure) as well as delineate the region of instability within which spontaneous pair creation becomes possible. The results depend significantly on the employed sigma mass, with the highest values yielding the largest regions of instability. The inclusion of strangeness has significant effects once the temperature exceeds the mass of the strange quark. Indeed, the crossover towards chiral symmetry is being pushed to higher temperatures, even for the non-strange order parameter σ.

An approximate solution of the equations of motion for the order parameters in scenarios emulating uniform scaling expansions show that even with a rapid quench only the pionic modes grow unstable (the kaon field fluctuations are important for the dynamics and can not be neglected). Nevertheless, the rapid and oscillatory relaxation of the order parameters (bottom figure) leads to enhanced production of both pions and (to a lesser degree) kaons.

We have pointed out that the neutral fraction R_K of kaon emitted by a single DCC domain has a constant distribution, $P_K(R_K) = 1$ which is qualitatively as anomalous as the inverse square-root distribution $P_\pi(R_\pi) = 1/2\sqrt{R_\pi}$ governing the neutral fraction of DCC pions. Relative to this latter distribution, the kaon distribution $P_K(R_K)$ may be more amenable to measurement by suitable event-by-event analysis due to the fact that K_S^0 decays into charged pions.



Top: The thermal path of the two order parameters σnd ζ. The solid dots are plotted in temperature steps of 100 MeV. All paths start from the vacuum point at the upper right corner and the points for T=100 MeV are still very close to the vacuum point. *Bottom:* The dynamical path of the order parameter (σ,ζ) as a result of a uniform pseudo-expansion in one and three dimensions, starting from thermal equilibrium at T=400 MeV. Time steps with $\Delta\tau$=0.2 fm are indicated. The thermal path is shown for comparison and the cross indicates the location of the vacuum, $(\sigma_{\rm vac}, \zeta_{\rm vac})$, towards which all trajectories converge.

The partial restoration of chiral symmetry enhances the K/π and η/π equilibrium ratios by factors of 2-3. If the expansion is sufficiently fast, this effect may provide an observable signal.

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