Phase structure of the Quark-Meson model

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I. INTRODUCTION

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II. 2 FLAVOR QUARK MESON MODEL

The effective action of the quark-meson model reads

$$\Gamma_k[\Phi] = \int_x \{ Z_{q,k}\bar{q}(\gamma_\mu\partial_\mu - \gamma_0\mu)q + \frac{1}{2}Z_{\phi,k}(\partial_\mu\phi)^2$$

$$+ k_k\bar{q}(T^0\sigma + i\gamma_5 T \cdot \pi)q + V_k(\rho) - c\sigma \} \tag{1}$$

$\rho = \frac{1}{2}\phi^2$

$$\bar{m}_\pi = \frac{V_k'(\rho)}{k^2 Z_{\phi,k}} \tag{2}$$

$$\bar{m}_\sigma = \frac{V_k'(\rho) + 2\rho V_k''(\rho)}{k^2 Z_{\phi,k}} \tag{3}$$

$$\bar{m}_q = \frac{h_k^2\rho}{2k^2 Z_{q,k}^2} \tag{4}$$

with the Wetterich equation

$$\partial_t V_k(\rho) = \frac{k^4}{4\pi^2}\{(N_f^2 - 1)l_0^B(m_{\pi,k}, \eta_{\phi,k}; T)$$

$$+ l_0^B(m_{\sigma,k}, \eta_{\phi,k}; T)$$

$$- 4N_c N_f l_0^F(m_{q,k}, \eta_{q,k}; T, \mu)\} \tag{5}$$

here $l_0^{B/F}$ are threshold functions which are defined as

$$l_0^B(\bar{m}_{\phi,k}^2, \eta_{\phi,k}) = \frac{2}{3}\frac{1}{\sqrt{1 + \bar{m}_{\phi,k}^2}}\left(1 - \frac{\eta_{\phi,k}}{5}\right)$$

$$\left(\frac{1}{2} + n_B(\bar{m}_{\phi,k}^2, T)\right) \tag{6}$$

$$l_0^F(\bar{m}_{q,k}^2, \eta_{q,k}) = \frac{1}{3}\frac{1}{\sqrt{1 + \bar{m}_{q,k}^2}}\left(1 - \frac{\eta_{q,k}}{4}\right)$$

$$\left(1 - n_F(E - \mu) - n_F(E + \mu)\right) \tag{7}$$

$$\eta_{\phi,k} = \frac{1}{6\pi^2}\left\{\frac{4}{k^2}\rho(V_k'(\rho))^2 \right. \tag{8}$$

III. RESULTS

A. phase diagram at chiral limit

IV. SUMMARY AND DISCUSSIONS

In this work, we have studied

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