ELSEVIER

11 July 1996

PHYSICS LETTERS B

Physics Letters B 380 (1996) 491–492

Erratum

Effective chiral lagrangian from QCD at nonzero chemical potential [Phys. Lett. B 355 (1995) 288] ⋆

R.F. Alvarez-Estrada, A. Gómez Nicola

1) The derivation of Eq. (20) in the paper was performed based on the Seeley-de Witt coefficients H_n calculated in Ref. [18]. After the publication of our paper, new information on the H_n coefficients has appeared in Ref. [24] below, where the full expressions for H_4 and H_5 are obtained, the results being also in agreement with Ref. [25] below. In particular, there are terms in H_5, which are not calculated in [18], that contribute to the lowest order μ_B-dependent gluonic corrections proportional to the gluon condensate. In addition, there is a term in H_6 that also contributes to those corrections, namely, that proportional to $\hat{E}^4 G_{\mu\nu} G_{\mu\nu}$ (see our paper for the notation). The coefficient of the latter term has not been calculated as yet, to our knowledge, but it can be determined using the following recursion relation [18]:

$$H_{n-1} = -\frac{\delta}{\delta \hat{E}(x)} \tilde{H}_n$$

where $\tilde{H}_n$ is obtained from H_n by neglecting total derivatives and identifying cyclic permutations, so that the $\tilde{H}_n$ are the relevant coefficients for the effective action. Then, taking $\hat{E}$ independent of x, the only surviving terms in $\tilde{H}_n$ are precisely those of the form we are interested in, that is, $\hat{E}^{n-2}\hat{R}^2$. If we denote by α_n the coefficient of this term in $\tilde{H}_n$, the above recursion relation gives $\alpha_n = -(n-1)\alpha_{n+1}$ and, hence, we can obtain α_6 from the value of α_5 in [24], yielding $\alpha_6 = 1/288$. It can be checked that the above method works when applied to α_n with $n \leq 5$. Then, we have recalculated the μ_B-dependent corrections and we have found that the coefficients proportional to μ_B^2 cancel. Thus, Eq. (20) in our paper should be replaced simply by:

$$\Gamma_G = \frac{1}{32} \frac{\langle \alpha/\pi G^a_{\mu\nu} G^a_{\mu\nu} \rangle}{M^4} \left(\frac{M^2}{3} D_\mu U D_\mu U^\dagger \right) \qquad (20)$$

2) We shall comment about the μ_B-dependent C-violating terms, namely, those proportional to the Levi-Civita tensor ϵ_{ijk} in Eq. (16) of our paper. We remark that the sum of those terms can be cast as:

$$\mu \int d^4x \, \mathrm{tr} \left(J_0^B[U] + J_0^{\mathrm{CS}}[l_\mu] - J_0^{\mathrm{CS}}[r_\mu] \right)$$

where J_μ^B is the topological baryon number current as given in Eq. (18) and J_μ^{CS} is the Chern-Simons current:

$$J_\mu^{\mathrm{CS}}[A] = \frac{1}{8\pi^2} \epsilon_{\mu\nu\alpha\beta} \mathrm{tr} \left[A_\nu \partial_\alpha A_\beta + \frac{2}{3} A_\nu A_\alpha A_\beta \right]$$

Then, leaving aside $J_0^B[U]$, already discussed in the paper, our effective action also contains Chern-Simons terms for the external vector and axial-vector fields. The above topological structure can be understood by noticing that the true conserved current in the full quantum theory is $J_\mu^B - J_\mu^{\mathrm{CS}}[r_\mu] + J_\mu^{\mathrm{CS}}[l_\mu]$, as a consequence of the anomaly in the baryon number current in the fermionic theory.

⋆ SSDI of original article: 0370-2693(95)00734-2.

PII S0370-2693(96)00629-6

3) Finally, we would like to correct some misprints. In the paragraph just after Eq. (2), it reads "... as usual, $q_{\frac{L}{R}} = \frac{1\pm\gamma_5}{2}q$." and it should read "... as usual, $q_{\frac{L}{R}} = \frac{1\mp\gamma_5}{2}q$.". The symbols G_r, $G_r^{(n)}$, $G_r^{(0)}$, $G_r^{(2)}$, $G_r^{(3)}$, $G_r^{(4)}$, $G_{\mu\nu}$, $G_{\mu\alpha}$, $G_{\alpha\beta}$ and G_r^c appearing in Eqs. (12), (13) and (16), as well as in the paragraph just after Eq. (15), should be replaced by Γ_r, $\Gamma_r^{(n)}$, $\Gamma_r^{(0)}$, $\Gamma_r^{(2)}$, $\Gamma_r^{(3)}$, $\Gamma_r^{(4)}$, $\Gamma_{\mu\nu}$, $\Gamma_{\mu\alpha}$, $\Gamma_{\alpha\beta}$ and Γ_r^c. In the paragraph just after Eq. (15) it reads "... as they stand when μ_B 3 0 ..." and it should read "... as they stand when $\mu_B \neq 0$...". The second μ_B-dependent term in Eq. (16) reads $\mu_B/8\pi^2(D_iUU^\dagger F_{i0}^R - U^\dagger D_iUF_{i0}^L)$ and it should read $\mu_B/24\pi^2(D_iUU^\dagger F_{i0}^R - U^\dagger D_iUF_{i0}^L)$.

The following two references should be added to those in the paper:

[24] A.A. Bel'kov, A.V. Lanyov and A. Schaale, Talk given at the International Workshop on Software Engineering and Artificial Intelligence for High Energy and Nuclear Physics (AIHENP95), Pisa, Italy, 3-8 April 1995. Preprint JINR E2-95-238, hep-ph/9506237.

[25] A.E.M. Van de Ven, Nucl. Phys. B 250 (1985) 593.