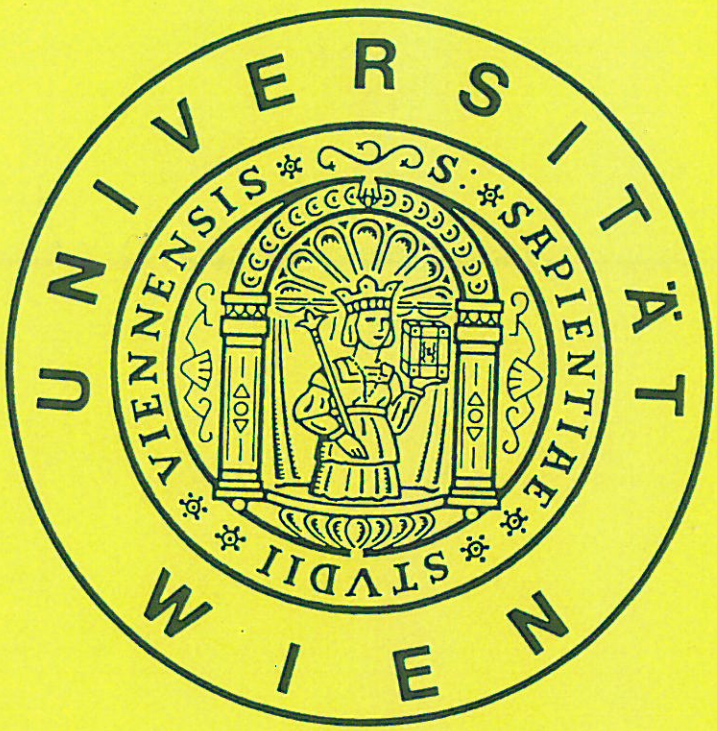

Institut für Radiumforschung und Kernphysik

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ON THE APPLICATION OF THE NONLINEAR CHIRAL σ-MODEL IN HOT AND DENSE MATTER

H. Baier, W. Bentz[2] and C. Matulla

There are several advantages to look upon the linear chiral Lagrangian as the starting point in describing hot and dense matter [1,2]. We follow the approach introduced by Weinberg and Schwinger [3,4]. Starting with the renormalizable linear theory, we redefine the fields using a highly nonlinear transformation of the Weinberg type. To this new representation we add an expression whose shape is motivated by Ref. [5].

$$\mathcal{L} = \overline{N}\left[i\gamma_\mu\partial^\mu - g\phi' + \left(1+\vec{\xi}^2\right)^{-1}\left(\gamma_5\gamma_\mu\vec{\tau}\partial^\mu\vec{\xi} - \gamma_\mu\vec{\tau}\left(\vec{\xi}\times\partial^\mu\vec{\xi}\right)\right)\right]N +$$
$$+ 2^{-1}\left[\left(\partial^\mu\phi'\right)^2 + 4\phi'\left(\partial^\mu\vec{\xi}\right)^2\left(1+\vec{\xi}^2\right)^{-2}\right] -$$
$$- 2^{-1}\mu^2\phi'^2 - 2^{-2}\lambda^2\phi'^4 + \left(1+\vec{\xi}^2\right)^{-1}\left(1-\vec{\xi}^2\right)^2 c\phi' + \delta\alpha c^2\phi'^{-2}$$

N corresponds to the transformed nucleon, ϕ' and $\vec{\xi}$ to the transformed scalar and pseudoscalar fields, respectively.

It is our goal to determine the renormalized effective action in one-loop approximation. Furthermore, we compare the meson propagators of the scalar and the pseudoscalar field in the linear theory with those in the nonlinear representation to discuss their equivalence.

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CHRISTOPH MATULLA

NONLINEAR CHIRAL σ MODEL FOR NUCLEAR MATTER
W. Bentz, C. Matulla and H. Baier
In order to include pionic degrees of freedom in the description of nuclear many-body systems, the chiral σ model in the nonlinear representation is investigated. The renormalizability of the model, which is obtained from the lionear σ model by a field transformation of the Weinberg type, is studied in the context of the equivalence theorem. It is shown that in any expansion scheme which is based on self-consistent mean scalar fields, the non-linear sigma model should be considered as unrenormalizable (even if the sima mass is kept finite), and nem counter terms have to be introduced in each order. The resulting equation of state in the one-loop (Hartree) approximation is calculated, and the corresponding pion-nucleus optical potential is discussed.
Parts of this work were done as a diploma thesis. The full text of this paper was published in Phys. Rev. C **56**, 2280 (1997).

PUBLICATIONS
W. Bentz, C.Matulla and H. Baier
Nonlinear chiral σ model for nuclear matter, Phys. Rev. C **56**, 2280 (1997).

PRESENTATIONS AT MEETINGS AND SEMINARS
W. Bentz, C. Matulla and H. Baier
Das nichtlineare Sigma-Modell fuer nukleare Materie.

APPROVED DIPLOMA AND DOCTORATE THESES
C. Matulla,
Vorarbeiten zur Anwendung einer nichtlinearen chiralen Theorie auf nukleare Materie, diploma thesis, University of Vienna, Austria (1997).