ELECTROMAGNETIC FIELDS OF MAGNETIZED NEUTRON STARS IN GENERAL RELATIVITY

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We present solutions of Maxwell equations in the internal and external background space-time of magnetized neutron stars. The star is considered isolated and in vacuum, with a dipolar magnetic field.

General relativity introduces corrections related both to the monopole and the dipole parts of the gravitational field. In particular, we show that in the case of infinite electrical conductivity general relativistic corrections due to the dragging of reference frames are present, but only in the expression for the electric field. In the case of finite electrical conductivity, however, corrections due both to the space-time curvature and to the dragging of reference frames are shown to be present in the induction equation. These corrections could be relevant for the evolution of the magnetic fields of pulsars and magnetars. The solutions found reflect a rather general physical configuration and could therefore be used in a variety of astrophysical situations.

INSTANTON VACUUM AND QCD EFFECTIVE ACTION BEYOND CHIRAL LIMIT

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The presence of instantons in QCD vacuum very strongly affects light quark properties, owing consequent generation of quark-quark interactions. This effect leads to the formation of the massive constituent interacting quarks and implies spontaneous breaking of chiral symmetry (SBCS). Instantons play a leading role in the formation of the lightest hadrons and their interactions, while the confinement forces are rather unimportant, probably. The features of light quarks placed into instanton vacuum are concentrated in the fermionic determinant $\Delta_N = \Delta B$ (in the field of N_+ instantons and N_- anti-instantons). The main term of the matrix $B_{ij} - a_{ij}$ is the overlapping matrix element of the quark zero-modes $\Phi_{\pm,0}$ generated by instantons (antiinstantons).The overlapping of the quark zero-modes provides the propagating of the quarks by jumping from one instanton to another one. Another important parameter of B is the current mass m. With typical instanton sizes of $\rho \approx 1/3$ fm and inter-instanton distances of $R \approx 1$ fm, a is of the order of the strange current quark mass, $m_s = 150$ MeV. So, it is very important to take properly into account the current quark mass.

The fermionic determinant Δ_N averaged over instanton/anti-instanton positions, orientations and sizes can be considered as a partition function of light quarks Z_N. Then the properties of the hadrons and their interactions are concentrated in the QCD Effective Action.

The following topics will be discussed:

- the derivation of the action with proper account of current quark masses;
- the test with axial-anomaly low-energy theorems;
- the application of the action to the calculation of various observables.

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