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Spontaneous magnetization and effective interactions in QGP at high temperature

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In quark-gluon plasma (QGP), at higher deconfinement temperatures $T \geq T_d$ the spontaneous generation of color magnetic fields, $b^3(T), b^8(T) \neq 0$ (3, 8 are color indexes), and usual magnetic field $b(T) \neq 0$ happens. Simultaneously, the Polyakov loop and/or algebraically related to it $A_0(T)$ condensate, which is solution to Yang-Mills imaginary time equations, are also created.
Usually, in analytic quantum field theory these effects are investigated independently of each other within the effective potentials having different mathematical structures.
The common generation of these condensates was detected in lattice Monte Carlo simulations.

Recently, with the new type two-loop effective potential, which generalizes the known integral representation for the Bernoulli polynomials and takes into consideration the magnetic background, this effect has been derived analytically.
The corresponding effective potential $W(T, b^3, A_0)$ was investigated either in SU(2) gluodynamics or full QCD. The gauge fixing independence of it was proved within the Nielsen identity approach. The values of magnetic field strengths at different temperatures were calculated and the mechanism of stabilizing fields due to $A_0(T)$ condensate has been discovered. In the present review, we describe this important phenomenon in more details, as well as a number of specific effects happening due to vacuum polarization at this background. They could serve as the signals of the QGP creation in the heavy ion collision experiments.

Key words: spontaneous magnetization, high temperature, asymptotic freedom, effective potential, A_0 condensate, effective charge, effective vertexes.

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