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QCD effective potential with strong magnetic fields at zero and finite temperatures SHO OZAKI, TAKASHI ARAI, KEK, KOICHI HATTORI, RIKEN, KAZUNORI ITAKURA, KEK — In this contribution, we will discuss QCD vacuum in strong magnetic fields. As a first step towards understanding the effects of magnetic fields on QCD vacuum properties, we analytically derive the Euler-Heisenberg action for QCD + QED at zero and finite temperatures. From the action, at zero temperature, we found that the chromo-magnetic field prefers to be parallel to the external magnetic field, and thus the QCD vacuum with strong magnetic fields is spatially anisotropic. This result is consistent with recent lattice data. Furthermore, the chromo-magnetic condensate increases with an increasing magnetic field, which supports the "gluonic magnetic catalysis" as observed in current lattice data. Next, we will discuss the effective potential with strong magnetic fields at finite temperatures. In particular, we focus on the influence of the magnetic field on the center symmetry in QCD. The pure Yang-Mills theory has the center symmetry (being spontaneously broken at high temperature), but dynamical quarks explicitly break it. We will show how the magnetic fields affect the explicit symmetry breaking, by using the effective potential for the Polyakov loop. We will also discuss the confinement-deconfinement phase transition in strong magnetic fields in terms of nonperturbative approaches such as functional renormalization group.

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