論文の内容の要旨

Chiral symmetry and vacuum structure in rotating relativistic systems (回転する相対論的システムにおけるカイラル対称性と真空構造)

氏名　　豆田 和也

Rotation is an intriguing subject, not only from the academic viewpoint but also in the practical investigation of quantum matter. For Quantum Chromodynamics (QCD), the rotational effect is much crucial because rapid rotation actually exists in quark-hadron systems: rotating hot matter created in non-central relativistic heavy-ion collisions and rotating neutron stars. In this thesis, we analyze the QCD thermodynamics in rotating systems. First, we briefly review the relativistic scalar theory in a rotating frame. Then we find that for rotating systems the boundary condition plays a quite important role to correctly define the low-energy structure. Next we argue the thermodynamics of rotating fermionic matter. We prove that the rotational effect is invisible in the vacuum as long as the boundary condition is properly taken into account. In other words, rotation affects macroscopic quantities only if there is other external source, e.g. temperature, magnetic field. We show that in such environments, the rotational effect on the chiral symmetry breaking is quite similar to the finite-density effect. Especially for a magnetized rotating system, we discover that the interplay between magnetic field and rotation leads to the "rotational magnetic inhibition"; chiral symmetry for rotating fermions is restored by magnetic field. This is a novel phenomenon analogous to the inverse magnetic catalysis in a finite-density magnetized system. Finally, we qualitatively discuss that this phenomenon plays a crucial role to determine the chiral structure in the realistic systems.