Summary of my studies

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We live in Hadoron phase now, in fact usually, quarks are not observed as a sole state. But in the high temperature and density state, like in the early universe, a phase transition of quarks from a confined-phase to an unconfined-phase may occur. Hence quarks and gluons may exist as a plasma in such a case. In Brookhaven National Laboratory, they try to generate Quark-Gluon Plasma (QGP) by making high temperature and density nuclear matter. Thus, recently the study of QGP advanced from both theory and experiments.

An important quantity in QGP is ground pressure. Now calculation of pressure in QGP has done up to sixth order, by perturbative expansion. QGP is treated by Quantum Chromo Dynamics (QCD). Coupling constant g in QCD is selected to parameter of expansion, and this calculation uses the $\overline{\mathrm{MS}}$ scheme in various renormalization schemes. The result of calculation does not converge up to sixth order, in fact, instability appears in proportion as increase of the order. By the way, Lattice Montecarlo simulation is one of the most available analysis of QCD, the above perturbative results also does not agree with lattice data. The method of resolution about this problem is still not established.

On the other hand, quantum field theory has infinite degrees of freedom. Thus, we face out many divergences in perturbative calculations. We can not adopt divergent quantities as a physical quantities. In general, divergence has been cut out by the renormalization. But the method of renormalization is not unique, consequently we should select one of the renormalization scheme. The result of the calculation which has renormalized is dependent of renormalization scheme we selected. A problem appears in here, "What renormalization scheme is the most reliable, in the perturbative calculation up to several order?" About this problem, in 1981 P.M.Stevenson suggested Principle of Minimal Sensitivity (PMS). PMS argue that the physical quantities which is calculated is actually independent from renormalization schemes.

My idea is that applying the PMS to the perturbative problems of the pressure in QGP, and improve the result of calculation. Before now, we apply the PMS pressure up to sixth order. Our result is somewhat punched-up compared with the result above the $\overline{\mathrm{MS}}$ scheme as respects to fit with the lattice data. As well, I trying about convergence issue of the pressure. Improvement as this is very challenging because the PMS is principle of renormalization scheme independent about

physical quantity. Hence I wonder that other physical quantities are improved by the PMS about the analogic above problems.