



Contribution ID: 73

Type: **not specified**

Shear and bulk relaxation times from Kubo formulas

Tuesday, 19 September 2017 15:10 (20 minutes)

The shear and the bulk relaxation times are important ingredients of the second order hydrodynamics whose success in heavy ion phenomenology is unquestioned. In this work, we report two field-theoretical analyses involving the shear and the bulk relaxation time. Unlike viscosities themselves, field theoretical calculations of the relaxation times are hard to come by in literature, especially for the bulk relaxation time. Therefore, first we show, by carefully examining the analytic structure of the stress-energy tensor response functions, how to obtain a Kubo formula involving the bulk relaxation time. Second, by making use of the Kubo formulas involving shear effects we calculate the shear relaxation time within the massless scalar theory.

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Session Classification: Thermalization / Hydrodynamization