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Decoherence and von Neumann entropy production of classical Yang-Mills fields in relativistic heavy ion collisions

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In the early stage of relativistic heavy-ion collisions, coherent and anisotropic classical Yang-Mills field emerges.
This field, referred to as glasma, has several instabilities from the anisotropy, so small fluctuations in glasma grow exponentially.
Glasma is also known to have chaoticity, which make the field configuration complex and produces the entropy.
Instability and chaoticity of glasma rapidly drive the pressure isotropization and are expected to cause thermalization.
In this work, we compare the time scale of the entropy production and the pressure isotropization in the classical Yang-Mills field.
We regard the classical field as a coherent state, and evaluate the quantum entropy (von Neuman entropy) obtained by ignoring the off-diagonal density matrix elements, namely decoherence.
We find that the growth of fluctuations cause entropy production and pressure isotropization in the same time scale.
We also discuss how the classical Yang-Mills field loses coherence as a result of time average of the density matrix.

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Theory

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