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# A positive decomposition of the entropy production for the ellipsoidal BGK model

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## Abstract

The BGK model is widely used in place of the Boltzmann equation since it reproduces various qualitative properties of the Boltzmann equation at much lower computational cost. But it's well known that the BGK approximation of the Navier Stokes equation does not give the correct Prandtl number, which is defined as the ratio between the viscosity and the thermal conductivity. In an effort to cook up a variant of the BGK model that gives the correct Prandtl number, Holway introduced the ellipsoidal BGK model (ES-BGK model) where the collision operator of the Boltzmann equation is replaced by a relaxation operator involving a non-isotropic Gaussian designed to match the Prandtl number of the Navier-Stokes equation [1]. In this talk, we consider the entropy dissipation structure of the ES-BGK model. More precisely, we show that the entropy production functional of ES-BGK model is decomposed into two sub-production terms, one of which shares similar structure with the original BGK entropy production functional, whereas the other involves a novel positivity structure of its own interest. As an application of this newly revealed structure, we prove the existence of weak solutions for the ES-BGK model with fixed collision frequency. [1] Holway, L.H.: Kinetic theory of shock structure using an ellipsoidal distribution function. *Rarefied Gas Dynamics*, Vol. I

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