Hyperbolic Heat Conduction Under Coronal Conditions

PHSX 567 Astrophysical Plasma Physics
Final Project Proposal
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1 Focus

An accurate treatment of heat conduction is important for models of the solar atmosphere due to its role in coronal heating. Unfortunately, the parabolic behavior of the heat conduction term can impose a prohibitive time-step constraint (under coronal conditions) for explicit finite-difference solvers, used to numerically evaluate the equations of (magneto)hydrodynamics. Recently, Rempel 2017 used a hyperbolic form of heat conduction to alleviate the time-step constraint in a comprehensive model of the solar atmosphere. We propose to test the efficacy of this method on the post-flare loop model developed by Longcope 2014 and answer the question: **Can we quantify the error between the hyperbolic and parabolic forms of heat conduction under coronal conditions as a function of time-step size?**

2 Method

We propose to answer the above question by first implementing an explicit finite-difference solution of the post-flare loop model detailed in Longcope 2014. We will then modify the Longcope 2014 model with the hyperbolic heat conduction treatment as described by Rempel 2017. We will produce the appropriate plots to describe the difference between the parabolic and hyperbolic forms of the heat conduction term as a function of time-step size.

3 Aspect

Heat conduction is term in the energy equation, which is described in Section 1E.2 of the class notes. Coronal loops can be thought of as one-dimensional atmospheres, and we can model them using the hydrodynamics equations, described in Section 2C of the class notes.

References

Longcope, D. W. (2014). "A Simple Model of Chromospheric Evaporation and Condensation Driven Conductively in a Solar Flare". In: *ApJ* 795, 10, p. 10. DOI: `10.1088/0004-637X/795/1/10`. arXiv: `1409.1886 [astro-ph.SR]`. URL: `http://adsabs.harvard.edu/abs/2014ApJ...795...10L`.

Rempel, M. (2017). "Extension of the MURaM Radiative MHD Code for Coronal Simulations". In: *ApJ* 834, 10. Provided by the SAO/NASA Astrophysics Data System, p. 10. DOI: `10.3847/1538-4357/834/1/10`. arXiv: `1609.09818 [astro-ph.SR]`. URL: `http://adsabs.harvard.edu/abs/2017ApJ...834...10R`.