The Hong Kong University of Science and Technology

Department of Mathematics

MPhil THESIS EXAMINATION

Kinetic Model and Multiscale Simulation Method of Radiation Plasma System

By

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ABSTRACT

A simplified kinetic model is constructed for the coupled evolution of radiation, electrons, and ions in a radiation plasma system. Gas-kinetic scheme (GKS) is developed for the hydrodynamic electron and ion and the unified gas-kinetic scheme (UGKS) is for the non-equilibrium radiative transfer. The UGKS accurately captures multiscale photon transport from the free streaming to diffusive transport across opacities. This approach enables the scheme to model equilibrium plasma with non-equilibrium radiation transport. In the second approach, a full kinetic model for the radiation plasma system is solved by the unified gas-kinetic scheme(UGKS) for resolving both equilibrium and non-equilibrium phenomenons among radiation, electrons, and ions, as well as their interactions. The two approaches are both validated through several test cases, including radiative transfer in kinetic and diffusion regimes, shock structure for multispecies, Marshak wave, Radiative shock, 3T (three-temperature) double lax shock tube problem, two-dimensional Sedov blast wave, and two-dimensional Tophat based problem. These tests demonstrate the current scheme's capability in handling diverse radiation plasma scenarios.

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Thesis Examination Committee

Chairman	:	**Prof. Yang XIANG, MATH /HKUST**
Thesis Supervisor	:	**Prof. Kun XU, MATH/HKUST**
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(Open to all faculty and students)

The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).