



THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

SEMINAR ON APPLIED MATHEMATICS

Efficient Particle Method for Multiscale Photon Transport

By

Dr. Weiming LI

Institute of Applied Physics and Computational Mathematics

Abstract

This talk discusses our work based on the unified gas-kinetic particle (UGKP) method and unified gas-kinetic wave-particle (UGKWP) method for the photon transport process. The photon transport is a typical multiscale process governed by the nonlinear radiative transfer equations (RTE). The flow regime of photon transport varies from the ballistic regime to the diffusive regime with respect to optical depth. The UGKP and UGKWP method are asymptotic preserving (AP) and regime adaptive schemes. We apply both methods to nonlinear gray radiative transfer equations. The teleportation error is significantly reduced, and the computational efficiency is remarkably improved in the diffusive regime. Additionally, we propose improvements to computing the multiscale flux and the closure of the particle distribution function for the UGKWP method. Numerical oscillations are effectively suppressed at sharp opacity transitions without the need of increased particle flux. We will also discuss our extension of the UGKP and UGKWP method to multi-frequency radiative transfer equations. We consider both the standard multigroup treatment, and also considers the alternative of solving the frequency space in a non-discretized way. The high computational cost of calculating excessive scattering events can be saved, especially in the optically thick regime. Numerical results demonstrate the accuracy and efficiency of the proposed methods in capturing multiscale photon transport.

Date : 10 June 2026 (Wednesday)

Time : 3:00p.m.-4:00p.m.

Venue : Room 4503 (Lift 25 & 26)

All are Welcome!