

# Advances in the kinetics of heat and mass transfer in near-continuous complex flows

Aiguo Xu (许爱国)<sup>1,2,3,4,\*</sup>, Dejia Zhang (张德佳)<sup>1,4,5</sup>, Yanbiao Gan (甘延标)<sup>6</sup>

<sup>1</sup> National Key Laboratory of Computational Physics, Institute of Applied Physics and Computational Mathematics, P. O. Box 8009-26, Beijing 100088, China

<sup>2</sup> State Key Laboratory of Explosion Science and Technology, Beijing Institute of Technology, Beijing 100081, China

<sup>3</sup> HEDPS, Center for Applied Physics and Technology, and College of Engineering, Peking University, Beijing 100871, China

<sup>4</sup> State Key Laboratory for GeoMechanics and Deep Underground Engineering, China University of Mining and Technology, Beijing 100083, China

<sup>5</sup> National Key Laboratory of Shock Wave and Detonation Physics, Mianyang 621999, China

<sup>6</sup> Hebei Key Laboratory of Trans-Media Aerial Underwater Vehicle, School of Liberal Arts and Sciences, North China Institute of Aerospace Engineering, Langfang 065000, China

\*Corresponding author. E-mail: Xu\_Aiguo@iapcm.ac.cn

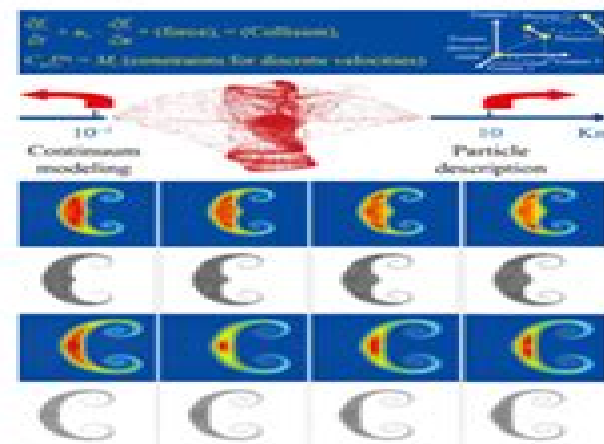
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## ABSTRACT

The study of macro continuous flow has a long history. Simultaneously, the exploration of heat and mass transfer in small systems with a particle number of several hundred or less has gained significant interest in the fields of statistical physics and nonlinear science. However, due to absence of suitable methods, the understanding of mesoscale behavior situated between the aforementioned two scenarios, which challenges the physical function of traditional continuous fluid theory and exceeds the simulation capability of microscopic molecular dynamics method, remains considerably deficient. This greatly restricts the evaluation of effects of mesoscale behavior and impedes the development of corresponding regulation techniques. To access the mesoscale behaviors, there are two ways: from large to small and from small to large. Given the necessity to interface with the prevailing macroscopic continuous modeling currently used in the mechanical engineering community, our study of mesoscale behavior begins from the side closer to the macroscopic continuum, that is from large to small. Focusing on some fundamental challenges encountered in modeling and analysis of near-continuous flows, we review the research progress of discrete Boltzmann method (DBM). The ideas and schemes of DBM in coarse-grained modeling and complex physical field analysis are introduced. The relationships, particularly the differences, between DBM and traditional fluid modeling as well as other kinetic methods are discussed. After verification and validation of the method, some applied researches including the development of various physical functions associated with discrete and non-equilibrium effects are illustrated. Future directions of DBM related studies are indicated.

**Keywords** near-continuous flow, non-equilibrium, kinetics, discrete Boltzmann method, complex physical field analysis



# Recent Advances In Heat Mass Transfer

**CL Gary**



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## **Table of Contents Recent Advances In Heat Mass Transfer**

1. Understanding the eBook Recent Advances In Heat Mass Transfer
  - The Rise of Digital Reading Recent Advances In Heat Mass Transfer
  - Advantages of eBooks Over Traditional Books
2. Identifying Recent Advances In Heat Mass Transfer
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Recent Advances In Heat Mass Transfer
  - User-Friendly Interface
4. Exploring eBook Recommendations from Recent Advances In Heat Mass Transfer
  - Personalized Recommendations

- Recent Advances In Heat Mass Transfer User Reviews and Ratings
- Recent Advances In Heat Mass Transfer and Bestseller Lists
- 5. Accessing Recent Advances In Heat Mass Transfer Free and Paid eBooks
  - Recent Advances In Heat Mass Transfer Public Domain eBooks
  - Recent Advances In Heat Mass Transfer eBook Subscription Services
  - Recent Advances In Heat Mass Transfer Budget-Friendly Options
- 6. Navigating Recent Advances In Heat Mass Transfer eBook Formats
  - ePub, PDF, MOBI, and More
  - Recent Advances In Heat Mass Transfer Compatibility with Devices
  - Recent Advances In Heat Mass Transfer Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Recent Advances In Heat Mass Transfer
  - Highlighting and Note-Taking Recent Advances In Heat Mass Transfer
  - Interactive Elements Recent Advances In Heat Mass Transfer
- 8. Staying Engaged with Recent Advances In Heat Mass Transfer
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Recent Advances In Heat Mass Transfer
- 9. Balancing eBooks and Physical Books Recent Advances In Heat Mass Transfer
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Recent Advances In Heat Mass Transfer
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Recent Advances In Heat Mass Transfer
  - Setting Reading Goals Recent Advances In Heat Mass Transfer
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Recent Advances In Heat Mass Transfer
  - Fact-Checking eBook Content of Recent Advances In Heat Mass Transfer

- Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
- 14. Embracing eBook Trends
  - Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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