

数学与系统科学研究院  
计算数学所网络学术报告

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报告题目：

**High order bound preserving  
methods for compressible  
multi-species flow with chemical  
reactions**

邀请人： 刘勇 博士

报告时间：2021 年 11 月 25 日 (周四)

上午 10:00-11:00

报告工具：腾讯会议 (ID: 376 775 451)

会议链接：

<https://meeting.tencent.com/dm/iKV4Jv5wKeXP>

## Abstract:

In this talk, we develop third-order conservative sign-preserving and steady-state preserving time integrations and seek their applications in multispecies and multireaction chemical reactive flows. In this problem, the density and pressure are nonnegative, and the mass fraction should be between 0 and 1. There are four main difficulties in constructing high-order bound-preserving techniques for multispecies and multireaction detonations. First of all, most of the bound-preserving techniques available are based on Euler forward time integration. Therefore, for problems with stiff source, the time step will be significantly limited. Secondly, the mass fraction does not satisfy a maximum principle and hence it is not easy to preserve the upper bound 1. Thirdly, in most of the previous works for gaseous denotation, the algorithm relies on second-order Strang splitting methods where the flux and stiff source terms can be solved separately, and the extension to high-order time discretization seems to be complicated. Finally, most of the previous ODE solvers for stiff problems cannot preserve the total mass and the positivity of the numerical approximations at the same time. In this work, we will construct third order conservative sign-preserving Runge-Kutta and multistep methods to overcome all these difficulties. The time integrations do not depend on the Strang splitting, i.e. we do not split the flux and the stiff source terms. Moreover, the time discretization can handle the stiff source with large time step and preserves the steady-state. Numerical experiments will be given to demonstrate the good performance of the bound-preserving technique and the stability of the scheme for problems with stiff source terms.

## 报告人简介:

杜洁，清华大学丘成桐数学科学中心助理教授，博士生导师。2010 年进入中国科学技术大学数学科学学院攻读博士学位，期间多次前往香港大学担任研究助理。2014 年作为国家公派联合培养博士研究生前往布朗大学数学系学习。2015 年进入香港中文大学数学系做博士后。2017 年就职于清华大学。多年来从事偏微分方程高精度数值算法及计算流体力学的研究，并在应用层面研究交通流问题的建模和数值模拟。于数值计算及其应用方向的主流杂志上已发表了 20 余篇学术论文，其中包括应用数学类著名杂志 *SIAM Journal on Scientific Computing* 和 *Journal of Computational Physics* 以及工程类顶级期刊 *Transportation Research Part B* 等。

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