

## Structure-Preserving Numerical Methods for Plasma Simulations

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**摘要:** We introduce structure-preserving numerical methods for models in plasma simulations including Poisson-Nernst-Planck (PNP) equations and Vlasov-Maxwell/Poisson equations. In the first part, we discuss an idea of designing numerical methods based on the Maxwell-Ampère Nernst-Planck equations which is equivalent to the PNP. In the second part, we construct curl-free basis functions for the Vlasov-Ampère equations which is equivalent to the Vlasov-Poisson equations. The scheme with energy conservation is designed, together with an asymptotic-preserving preconditioner such that the scheme can simulate systems at the quasi-neutral limit. In the third part, an energy-conserving scheme is proposed for the Vlasov-Maxwell system based on the asymptotic-preserving scheme at the quasi-neutral limit characterized by the Debye length, where the electric field is calculated through a generalized Ohm law. The Boris correlation and an additional Lagrange multiplier are introduced to achieve both the Gauss-law satisfying and the energy conservation. Classical benchmarks including the Landau damping, two-streaming instability and bump-on-tail instability are present to show the necessity of energy conservation and the attractive performance of the new algorithms

**个人简介:** 徐振礼，上海交通大学教授，分别于2001、2003和2007年从中国科学技术大学获得本科、硕士和博士学位。曾任美国北卡罗莱纳大学夏洛特分校博士后，德国斯图加特大学洪堡学者。2010年加入上海交通大学任特别研究员，2016年晋升正教授，2019-2021年任数学科学学院副院长，2021年起任教务处副处长。2010年获得教育部新世纪优秀人才计划，2012年入选中组部青年拔尖人才计划。担任AAMM、CMS和MCA等杂志编委。研究方向为快速算法和高性能计算、多体现象的建模和分析、分子动力学算法和偏微分方程的数值方法等等。

**邀请人:** 姜海燕

**时间:** 2023年6月28日 10:00-11:00

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