

**The Hong Kong Polytechnic University  
Department of Applied Mathematics**

**Colloquium**

**High-order structure-preserving schemes for special relativistic hydrodynamics**

**By**

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**Abstract**

We mainly review two high-order accurate structure-preserving finite difference schemes for the special relativistic hydrodynamics (RHD). The first is the physical-constraints-preserving (PCP) scheme, which preserves the positivity of the rest-mass density and the pressure and the bounds of the fluid velocity and is built on the local Lax-Friedrichs (LxF) splitting, the WENO reconstruction, the PCP flux limiter, and the high-order strong stability preserving time discretization. The key to developing such scheme is to prove the convexity and other properties of the admissible state set and to discover a concave function with respect to the conservative vector. The second is the entropy stable (ES) scheme, whose semi-discrete version satisfies the entropy inequality. The key is to technically construct the affordable entropy conservative (EC) flux of the semi-discrete second-order accurate EC schemes satisfying the semi-discrete entropy equality for the found convex entropy pair. As soon as the EC flux is derived, the dissipation term can be added to give the semi-discrete ES schemes satisfying the semi-discrete entropy inequality. The WENO reconstruction for the scaled entropy variables and the previous time discretization are implemented to obtain the fully-discrete high-order “ES” schemes. The performance of the proposed schemes have been demonstrated by numerical experiments. By the way, we also briefly review other relative works on the structure-preserving schemes for the special RHDs.



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**Date: 12 April 2022 (Tuesday)**

**Time: 10:00-11:00 (Hong Kong Standard Time GMT +8)**

**Venue: Online Talk via Zoom (Meeting ID: 972 2890 2161)**

**Speaker: Prof. Huazhong Tang, Peking University**

**Host: Prof. Zhonghua Qiao, The Hong Kong Polytechnic University**

**Click to join:**

<https://polyu.zoom.us/j/97228902161?pwd=dYt3Z2Rrd1VPNHV0RnF6LzFjYnRFQT09>

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For enrolment, please send your name and email to [wai-yan.moon@polyu.edu.hk](mailto:wai-yan.moon@polyu.edu.hk) on or before 11 April 2022