Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

An Unconditionally Energy-Stable Scheme for Incompressible Flows with Outflow/Open Boundaries[1] SUCHUAN DONG, XIAOYU LIU, Purdue University — We present an unconditionally energy-stable scheme for simulating incompressible flows on domains with outflow/open boundaries. The scheme combines the generalized Positive Auxiliary Variable (gPAV) approach and a rotational velocity correction type strategy, and the adoption of the auxiliary variable simplifies the numerical treatment for the open boundary conditions. The scheme admits a discrete energy stability property, irrespective of the time step sizes. Within each time step the scheme entails the computation of two velocity fields and two pressure fields, by solving an individual de-coupled Helmholtz (including Poisson) type equation with a constant pre-computable coefficient matrix for each of these field variables. The auxiliary variable, being a scalar number, is given by a well-defined explicit formula within a time step, which ensures the positivity of its computed values. We present numerical results with several flows involving outflow/open boundaries in regimes where the backflow instability becomes severe to demonstrate the performance of the method and its stability at large time step sizes.

[1]This work was partially supported by NSF

Suchuan Dong
Purdue University

Date submitted: 31 Jul 2019 Electronic form version 1.4