

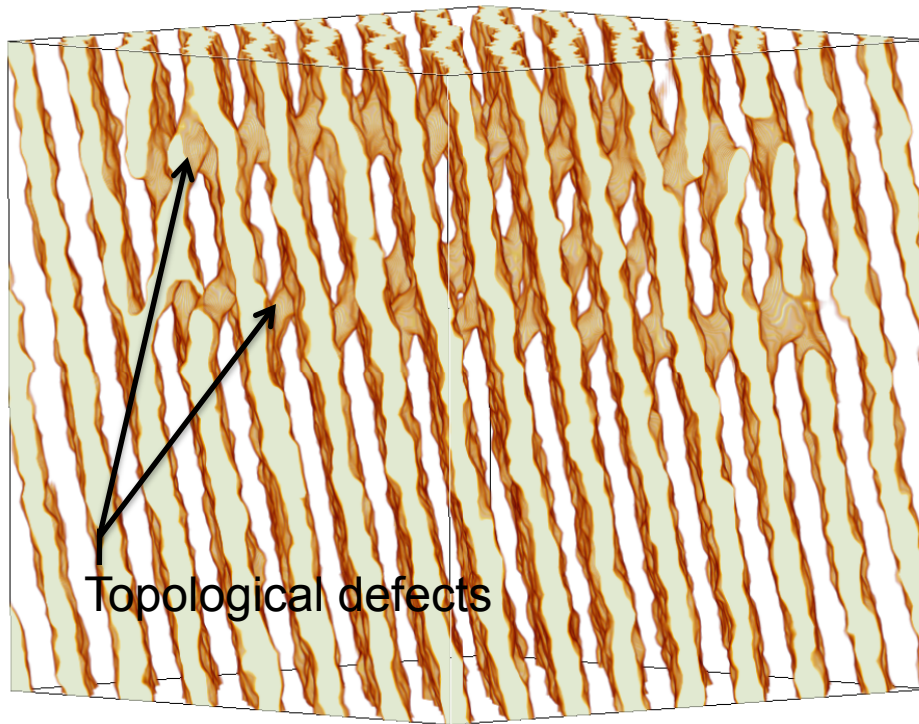
Defects in Nuclear Pasta and Crust Cooling of Neutron Stars

Objectives

- Use large scale GPU computing to perform detailed molecular dynamics (MD) simulations of large regions of the neutron star crust, including complex nuclear pasta phases, to determine a variety of transport properties.

Impact

- Newly discovered topological defects in nuclear pasta phases can impact radio and X-ray observations of neutron stars.
- Popular Space.com article by C. Choi: [Cosmic 'Nuclear Pasta' May Be Stranger Than Originally Thought](#)



Accomplishments

- MD simulations with up to 409,600 nucleons led to discovery of new long-lived topological defects that reduce electron mean free path and decrease both electrical and thermal conductivities of neutron star crust.
- This is found to change the crust cooling rate 3 to 10 years after the end of an accretion episode in a Low mass X-ray binary (LMXB) and could lead to magnetic field decay in isolated neutron stars.
- Code IUMD scales well to at least 512 GPUs, now being ported to more GPUs on TITAN.