



Contribution ID: 32

Type: **Poster Only**

## Observing Partial Order of the Random Hydrogen Network in Ice Ih

In the condensed phase, water ice contains a well-ordered lattice of Oxygen atoms that hosts a disordered network of Hydrogen atoms. At ambient pressure, water ice (Ih phase) has a hexagonal crystal structure, reflected geometrically in the 6-fold symmetry of snowflakes. The transition from ice Ih to ice XI, the most stable phase, is expected to occur at time-scales of  $\sim 10,000$  years. The hydrogen atoms in *pure* water ice have not been observed to order at low temperatures under ambient pressure. The predominant theory of ice assumes that the Hydrogen dipole moment dominates interactions. We observe hidden strings of 1D order within the disordered manifold of hydrogen atoms, revealed via optical phonons within a large multi-dimensional neutron scattering dataset. Our analysis shows that nearest-neighbor intermolecular interactions drive partial ordering, rather than dipole interactions, and hints at a mechanism for ice Ih's transition into ordered ice XI that may extend to other disordered phases. These empirical insights have broader implications for non-periodic systems exhibiting local-symmetry, while enhancing our knowledge of lattice dynamics of this most intriguing material.

### Topical Area

Emerging research and multimodal techniques

**Authors:** Dr CHEN, Tianran (University of Tennessee, Knoxville); Dr TENNANT, David (University of Tennessee, Knoxville)

**Co-authors:** OWNBY, Isaac (University of Tennessee, Knoxville); Dr BANERJEE, Arnab (Oak Ridge National Laboratory); Dr SAMARAKOON, Anjana (Oak Ridge National Laboratory); Dr MORRIS, Johnathan (Xavier University); Dr YE, Feng (Oak Ridge National Laboratory); Dr ABERNATHY, Douglas (Oak Ridge National Laboratory); Dr MORGAN, Zachary (Oak Ridge National Laboratory); Dr KLEMKE, Bastian (Helmholtz Center for Materials and Energy - Berlin); Dr SIEMENSMEYER, Konrad (Helmholtz Center for Materials and Energy - Berlin); LANIER, Joseph (Xavier University)

**Presenter:** OWNBY, Isaac (University of Tennessee, Knoxville)