Contribution ID: **121** Type: **Contributed poster**

Imaging Large Superfluid Helium Droplets

Monday, June 25, 2018 6:45 PM (15 minutes)

Superfluid helium droplets do not rotate as a solid body; instead, the droplet's rotation is manifested through the presence of quantized vortices. The vortices have a diameter of ~2 Å and their detection remain an outstanding experimental problem. Here, we report on X-ray coherent diffraction imaging of free, single, rotating superfluid ^{4}He droplets (diameter D = 200 - 2000 nm, temperature T = 0.4 K) using the Linac Coherent Light Source at SLAC. The droplets were doped with xenon atoms, which trace the vortex cores and serve as a contrast agent for imaging. The instantaneous positions and shapes of the vortices from the diffraction images were obtained using a phase retrieval algorithm developed in our laboratory at USC. In the first part of this contribution, we present an overview of the observed vortices in droplets of different sizes and shapes. Additionally, we found that doping by a large number of xenon atoms may influence the kinematics of vortices.

In the second part, we report on diffraction patterns collected from very large droplets, D>2000 nm, that are produced from the breakup of a liquid helium jet in vacuum. In contrast to the usual concentric rings in smaller droplets, the diffraction patterns in very large droplets show characteristic lobed structures that resemble surface harmonics. While further analysis is needed, we temporarily assign these unusual intensity distributions to large amplitude shape oscillations in the droplets.

Quantum vortices and shape oscillations are global excitations in superfluid helium droplet, which currently can only be accessed through coherent diffractive imaging at x-ray free electron lasers (XFEL). Accordingly, XFELs emerge as powerful tools for investigating the manifestations of superfluidity in finite sized systems.

Primary authors: TANYAG, Rico Mayro (Max-Born-Institut); Mr PANG, Weiwu (University of Southern California); Dr BACELLAR, Camila (École Polytechnique Federale de Lausanne); Dr BERNANDO, Charles (University of Southern California); Dr BUCHER, Max (LCLS, SLAC); Dr FERGUSON, Ken (LCLS, SLAC); Dr GOMEZ, Luis (University of Southern California); Dr JONES, Curtis (University of Southern California); Mr MAHL, Johannes (Lawrence Berkeley National Laboratory); Mr O'CONNELL, Sean Marcus (University of Southern California); Ms SALADRIGAS, Catherine (Lawrence Berkeley National Laboratory); Dr TOULSON, Benjamin (Lawrence Berkeley National Laboratory); Mr VERMA, Deepak (University of Southern California); Dr WALTER, Peter (SLAC National Accelerator Laboratory); Dr BOSTEDT, Christoph (Argonne National Laboratory); Dr GESSNER, Oliver (Lawrence Berkeley National Laboratory); Prof. VILESOV, Andrey (University of Southern California)

Presenter: TANYAG, Rico Mayro (Max-Born-Institut)

Session Classification: Poster session