Contribution ID: **456** Type: **Invited talk in the parallel session**

Ultracold quantum bubbles aboard the International Space Station

Wednesday, 7 July 2021 10:30 (30 minutes)

Exploring the effects of geometry, topology, dimensionality, and interactions on ultracold atomic ensembles has proven to be a continually fruitful line of inquiry. One heretofore unexplored configuration for such ensembles is that of a bubble or shell, where trapped atoms are confined in the vicinity of a spherical or ellipsoidal surface. Such a system could offer new collective modes, topologically-sensitive behavior of quantized vortices, self-interference and shell collapse, as well as the exploration of trapped ultracold systems with mm-scale spatial extent. While techniques for the generation of bubble-shaped traps have been known since 2001, terrestrial gravity has thus far prevented the observation of ultracold shells. With the construction of the NASA Cold Atom Lab (CAL) facility and its subsequent delivery to the International Space Station (ISS) and commissioning as an orbital BEC facility in 2018, experimental schemes requiring a sustained microgravity environment are now possible. I will present recent CAL observations of trapped shells of ultracold atoms, including a variety of shell configurations that are possible with this apparatus. I will also discuss the thermodynamics of ultracold shells and review open questions being explored in the current second science run of CAL aboard ISS.

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Session Classification: Fundamental Physics in Space

Track Classification: Precision Tests: Fundamental physics in Space