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SEAQUE: Live quantum space technology demonstration from the International Space Station

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To establish a future quantum network, the effective transport of quantum information presents a significant challenge. Satellite nodes offer a promising solution, as they can achieve lower loss compared to fiber networks and can enable connections over large distances. The Space Entanglement and Annealing QUantum Experiment (SEAQUE) is the first American-led quantum space payload, launch to the International Space Station (ISS) in November 2024. SEAQUE features an innovative waveguide-based polarization-entanglement source, housed within a 6U payload (20 cm x 30 cm x 10 cm). Entanglement verification will be conducted through methods such as a novel state tomography requiring only a single liquid crystal for each qubit, and violations of the Clauser-Horn-Shimony-Holt inequality. To address the challenges of space-based radiation damage on the detectors, the payload will include a high-power laser that provides approximately 1W of optical power to the system's avalanche photodiodes. We also plan to host an engaging public demonstration, where participants can make basis choices for the CHSH inequality, allowing the public to experience first-hand interacting and contributing to the development of quantum space technology. This project is a collaboration involving the University of Illinois Urbana-Champaign (UIUC), University of Waterloo, Jet Propulsion Laboratory (JPL), Boeing, AdvR Inc., and the National University of Singapore (NUS).

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