HANGAR FLIGHT TESTING OF A SUBSCALE VENUS VARIABLE-ALTITUDE AEROBOT. Jacob Izraelevitz[1], Michael Pauken[1], Siddharth Krishnamoorthy[1], Ashish Goel[1], Carolina Aiazzi[1], Leonard Dorsky[1], Kevin Baines[1], James Cutts[1], Caleb Turner[2], Kevin Carlson[2], Tim Lachenmeier[2], and Jeffery Hall[1].
[1]NASA Jet Propulsion Laboratory, California Institute of Technology (4800 Oak Grove Drive, Pasadena, CA 91109)
[2]Near Space Corporation (5755 Long Prairie Road Tillamook, OR 97141)

Introduction: The clouds of Venus offer a unique environment: ample sunlight, Earth-like temperatures and pressures, and strong zonal winds that can carry an in situ aerial platform around the planet in just a few Earth days. This cloud layer is key to the solar radiative balance of the planet, the transport of materials between the atmosphere and the ground, and the interactions (physical, chemical, and possibly biological) between atmospheric constituents. The two Vega balloon flights in 1985 [1], launched by the Soviet Union, successfully flew in the Venus clouds using superpressure balloons, which have a fixed buoyancy and nominally provide access to only a single altitude.

JPL and Near Space Corporation are taking the next step in planetary balloon exploration capability by developing controllable variable-buoyancy balloons [2,3] that provide access to a large range of altitudes over the course of the flight with accordingly increased science return [4]. The "aerobot", a robotic buoyant vehicle consisting of both a balloon and its payload, is expected to sample aerosols, measure atmospheric conditions & processes, and listen for seismic activity from the surface. This type of variable-altitude aerobot was considered a primary mission asset for the Venus Flagship Mission study [5] for the 2023-2032 Planetary Science Decadal Survey.

Objective: The objective of this presentation is to provide an overview of our 1/3 subscale variable-altitude Venus aerobot prototype, built over the last two years as a collaboration between JPL and Near Space Corporation. The prototype employs pumped-helium buoyancy modulation [2,3] and is made of fully Venus-relevant materials, including a metallized Teflon-Kapton outer balloon and Vectran inner gas reservoir. The full-scale aerobot would target the 52km to 62km altitude band on Venus with a hanging gondola mass of 100kg.

Results: We will present data from our subscale prototype's first set of indoor flight tests in the Tillamook Air Museum hangar in August 2021, and compare its performance to our physics-based simulation models (FLOATS package - FLight Operations and Aerobot Trajectory Simulator) which is used for extending our flight predictions to Venus conditions. We will further place this prototype in a mission context, and describe JPL's technology maturation efforts to bring variable-altitude aerobots to Venus.

Figure 1: Subscale (~5m diameter) variable-altitude Venus aerobot, made of metalized Teflon with an internal buoyancy reservoir, in flight at the 40 meter-tall Tillamook Air Museum hangar.

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References:

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