



A banner year for solar balloon technology

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Image 1: A solar balloon launch crew prepares an envelope for flight while waiting for the skies to clear.

Solar-powered stratospheric balloons achieved major advancements in test flights, developmental milestones, and operational achievements this year. A solar-powered stratospheric balloon system known as the heliotrope, has emerged as a low-cost platform capable of carrying several pounds of scientific payload to altitudes ranging from 50,000 to 75,000 feet (Bowman et al., 2020; Image 1) for multi-hour level flights. This innovative system has facilitated groundbreaking scientific discoveries in areas such as infrasound and atmospheric composition. Unlike sealed weather balloons that burst, these balloons remain buoyant by retaining hot air within their open envelopes. Because they are solar-powered, they remain aloft as long as the sun remains unobscured.

One notable operational achievement was the use of the 'grand slam' configuration for four flights during the April 8, 2024, Great American Eclipse (Image 2). The 'grand slam' configuration is when the heliotrope is towed to the stratosphere by a helium-filled latex weather balloon. The weather

balloon ascends and eventually bursts well above the clouds, allowing the solar balloon to achieve full power. The scientific payloads included ozonesondes to measure upper atmospheric ozone concentration and optical particle counters to measure aerosols and particulates. GPS units were also onboard to transmit the balloons' locations as solar power decreased during the eclipse. Prior to the eclipse, it was uncertain whether the balloons would remain in flight while in the Moon's shadow. Of the four heliotropes launched, one balloon lost altitude during the eclipse but regained its float altitude when sunlight returned. Measuring this behavior was a significant developmental milestone in understanding solar-powered stratospheric flight systems.

The heliotrope also set new milestones in test flights. In June 2024, a team from Sandia National Laboratories, in collaboration with Oklahoma State University, launched eleven heliotropes from Belen Regional Airport in mid-New Mexico, breaking the team's record of heliotropes launched in a single day. Another milestone was achieved when a 10-meter diameter balloon reached a stable altitude over 65,000 feet, carrying a payload of 5 kilograms—the heaviest payload ever launched and flown by the heliotrope program at SNL.

SNL staff are volunteering hours through community outreach programs to bring heliotrope flights to the classroom in local Albuquerque schools and the Navajo Nation (Image 3). This involves working with STEM programs in New Mexico and the Albuquerque area to engage students in payload and heliotrope construction, followed up with watching and tracking the balloons as they make their way into the upper atmosphere. The past year has been a period of remarkable progress for the heliotrope system. With its record-setting flights, developmental milestones, and operational achievements, the heliotrope has solidified its position as a leading platform for stratospheric research.



Image 2: Four solar-powered heliotropes rigged for a weather-balloon assisted 'grand slam' launched from Texas by Sandia National Laboratories hours before totality of the Great American Eclipse on April 8, 2024.



Image 3: This is a heliotrope built by Cleveland Middle School Students that flew for 13 hours and landed 127 miles from launch, containing a seed exposure experiment.