

A BANNER YEAR FOR SOLAR BALLOON TECHNOLOGY

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

Major Advancements

Solar-powered stratospheric balloons achieved major advancements in test flights, developmental milestones and operational achievements in 2024. Sandia National Laboratories uses tethered and free-floating balloons to loft instrumentation through multiple atmospheric layers to observe and better understand Earth systems.

System Design

The stratospheric balloon system is called a “heliotrope” by Sandia engineers. Its solar-powered envelope, fashioned from lightweight plastic sheeting, is made buoyant by heat from the sun’s rays striking its darkly colored surface. The lift is powerful enough to carry several pounds of scientific gear to heights ranging from 50,000 to 75,000 feet and then maintain a stable altitude for several hours. The craft can stay aloft as long as the sun remains unobscured.

Capabilities

The ability to maintain altitude for long stretches is crucial for many atmospheric sensing operations, and the system has already distinguished itself as an innovative atmospheric research platform. The heliotrope has aided groundbreaking discoveries in areas like infrasound and atmospheric composition.

In 2024, engineers learned even more about the system’s operational capabilities. On April 8, a team sent four heliotropes aloft just prior to the Great American Eclipse to gauge the system’s ability to stay aloft during sustained interruptions in sunlight. 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.



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.



Flight Outcomes

One of the four balloons 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 eclipse flight also marked the first use of the “grand slam” heliotrope configuration. This arrangement uses a helium-filled latex weather balloon to tow the heliotrope to the stratosphere. The weather balloon ascends and eventually bursts well above the clouds, allowing the solar balloon to achieve full power. Thus, this combination enables the launch of heliotropes during cloudy weather.

The heliotrope also set new milestones in test flights. In June 2024, a team from Sandia, in collaboration with Oklahoma State University, launched 11 heliotropes from Belen Regional Airport in mid-New Mexico, breaking the team’s record for the number 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 Sandia’s heliotrope program.

Community Outreach

Additionally, Sandia staff have volunteered through community outreach programs to bring heliotrope flights to the classroom in Albuquerque and Navajo Nation schools. This outreach involves working with STEM programs to engage students in payload and heliotrope construction. Students then get to watch and track 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 the record-setting flights, developmental milestones and operational achievements described here, the heliotrope has solidified its position as a leading platform for stratospheric research.



This heliotrope built by Cleveland Middle School students contained a seed-exposure experiment, flew for 13 hours, and landed 127 miles from its launch site.

For more information

Contact Andy Glen, aglen@sandia.gov

Contributors:

Erika Roesler, Sarah Albert, Ben Bishop, Daniel Bowman, Mathew DeKoning, Micheal Fleigle, Andy Glen, Jessica Lien, Justin LaPierre, Daniel Small, Lauren Wheeler, Gabrielle Whitson, Emalee Hough, Kate Spillman



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