National Aeronautics and Space Administration

Sounding Rockets

Sounding rockets carry experiments to altitudes between 50 and 1,500 km and fly nearly parabolic trajectories. Science missions, such as studies of the Earth's near space environment, solar physics, planetary investigations and astrophysics are flown using sounding rockets. To enable scientists to study geographically unique phenomena, such as the Aurora Borealis or southern sky astrophysics, launch sites around the globe are used. Sounding rockets also enable quick turn around development and testing of new science instruments and technologies for future space missions. A recovery system, such as a parachute for land impact, combined with a bouyant section for water impact, can be added to facilitate recovery and re-use of the payload.

Payload Systems (Sample telescope payload)

Payload support systems include recovery systems, telemetry, boost guidance systems, Attitude Control Systems, deployment mechanisms, and a shutter door among others. Mission requirements determine which support systems are used.

Recovery System
Recovery System houses the parachute and deployment mechanism.

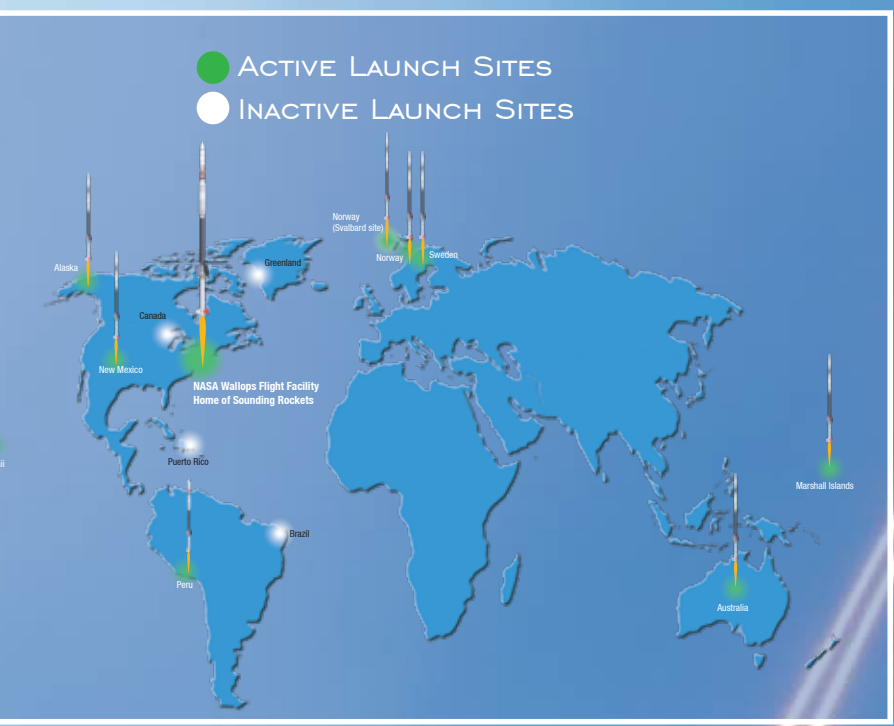
ACS
Attitude Control Systems (ACS) are used to align the payload in space.

Boost Guidance
The S19 is a boost guidance system that keeps the vehicle on a pre–programmed track for the early portion of the flight.

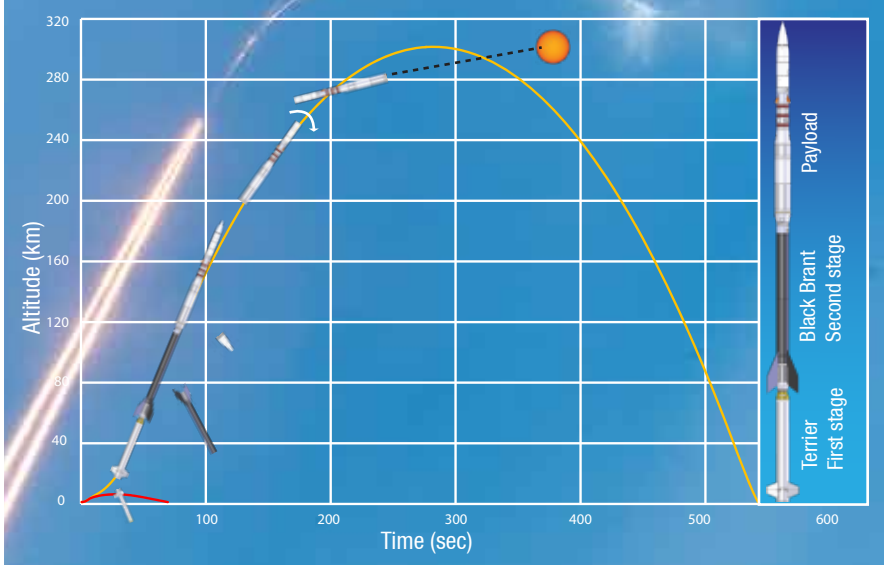
Telemetry
The Telemetry system enables experiment data to be transmitted to a ground station.

Experiment
This section houses the scientific instruments.

Shutter Door
Used mainly for telescope payloads, the shutter door is opened in space allowing the telescope to see the target of investigation.

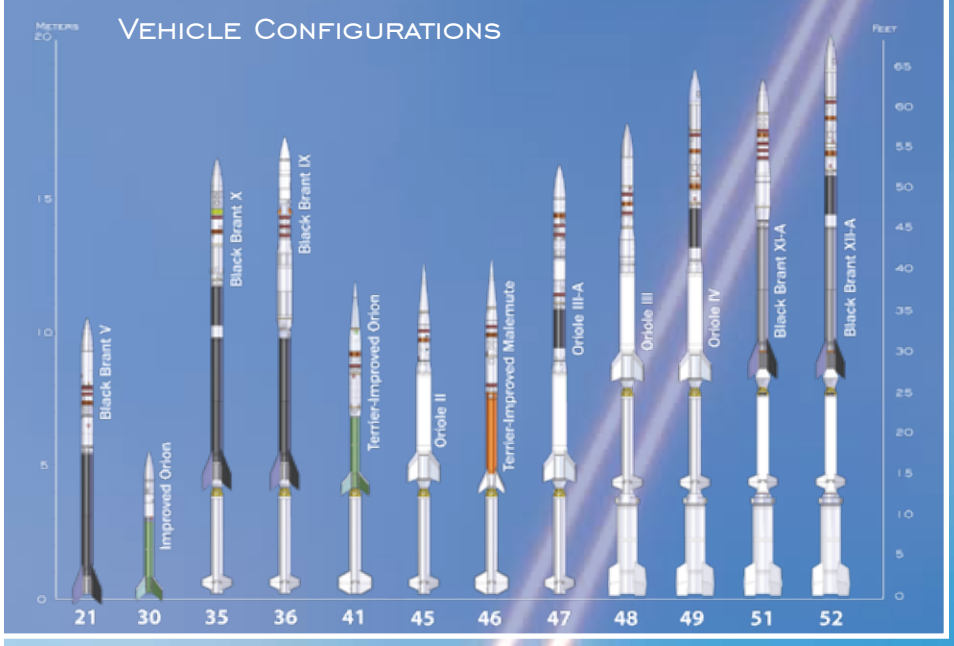


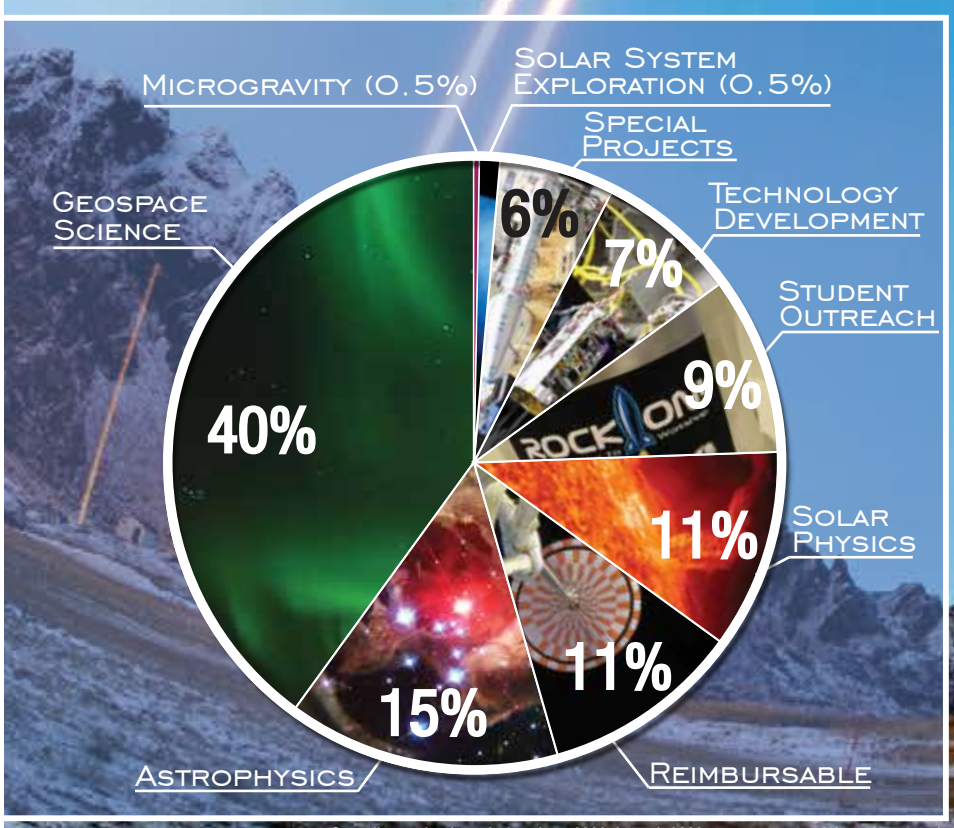
Sample Trajectory



This trajectory profile, for a two stage Black Brant IX sounding rocket carrying a solar telescope payload, shows altitude in kilometers vs. time in seconds. When the fuel in each stage of the vehicle is expended the empty casing is dropped from the stack and the next stage is ignited. As the payload reaches the desired altitude, the ASC aligns the instrument with the science target, in this example the Sun, and data collection starts. The data is transmitted to a ground station and recorded for later analysis by the researchers. All parts re-enter the atmosphere and land downrange from the launch site. Some payloads are equipped with parachutes and are recovered and reused.

Vehicle Configurations

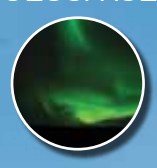




Sounding rocket launch data from 2000 through 2023 as percentage of the science and technology disciplines. A total of 420 launches were conducted during this time period.

HIGHLIGHTS

Geospace Science



Support of the International Geophysical Year (IGY) 1957 included 210 sounding rocket launches • Multiple-payloads reveal temporal-spatial scales within Aurora, Alfvén Waves, Electrostatic Structures • Direct measurements in the Earth's cusp region from Svalbard • NASA's first "tailored" trajectory reveals vertical, horizontal winds over Auroral arc • Direct penetration of lightning electric fields in the Ionosphere - high telemetry rates reveal new Wave Physics

Solar Physics

Highest resolution EUV images reveal how braided magnetic fields heat solar corona • Highest resolution observations of the Sun in the 52-63 nm range • Underflight calibration of solar observing satellites • Studies of the Sun's effects on planetary atmospheres and the heliosphere • Investigation of the cause of solar flares • Imagery of nanoflares on the Sun and their impact on coronal heating

Astrophysics

Search for signatures of first light in the Extragalactic Background • Study diffuse X-rays of the Local Galaxy • Spectral studies of the Interstellar Medium (ISM) to assess the availability of star and planet forming raw materials • Soft X-ray spectroscopy of Supernovae

Technology Development/Special Projects

Highest Mach number inlfatable test conducted with Inflatable Re-entry Vehicle (IRVE) • Aerodynamic Buffet Flight Test (ABFT) • Small deployable sub-payloads • High speed telemetry development

Solar System Exploration

Strongest ever carbon monoxide production discovered in coma of Comet Hale-Bopp • Study the history of water on Venus and its escape from the planet's atmosphere • Composition of Comet ISON measured • Launches to research Comet Shoemaker-Levy impact on planet Jupiter

Reimbursable Missions

Studies of ionospheric conditions and the impact on radio and satellite communications • Specialty vehicle development for Department of Defense • Mars lander parachute concept testing

Student Outreach

Students participate in sounding rocket missions through science missions as undergraduate and graduate students • Dedicated missions for experiments provided by University students and faculty are flown on Terrier-Orion and Terrier-Improved Malemute vehicles

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