

**Acronym:** MAUI

**Title:** Maui Analysis of Upper Atmospheric Injections

**Principal Investigator(s):**

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**Developer(s):**

Air Force Research Laboratory  
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**Sponsoring Agency:** National Aeronautics and Space Administration (NASA)

**Increment(s) Assigned:** 13, 14, 15, 16, 17, 18, 19, 20

**Mission(s):** STS-121/ULF1.1; STS-115/12A; STS-118/13A.1; STS-120/10A; STS-124/1J; STS-126/ULF2; STS-119/15A; STS-127/2J/A, STS-125/HST; STS-128/17A

**Brief Research Summary (PAO):** Maui Analysis of Upper Atmospheric Injections (MAUI) will observe the Space Shuttle engine exhaust plumes from the Maui Space Surveillance Site in Hawaii. The observations will occur when the Space Shuttle fires its engines at night or twilight. A telescope and all-sky imagers will take images and data while the Space Shuttle flies over the Maui site. The images will be analyzed to better understand the interaction between the spacecraft plume and the upper atmosphere of Earth.

**Research Summary:**

- Twelve specified Space Shuttle engine firings will be conducted by the crew during nighttime over flights of Hawaii during several Space Shuttle missions.
- The Maui Space Surveillance Site (MSSS) telescope system will track and observe the engine firings.
- The plume imagery will serve to validate models of the properties of Space Shuttle engine exhaust plumes.

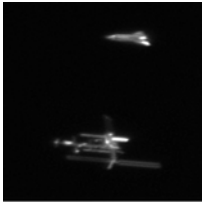
**Detailed Research Description:** MAUI will observe the Space Shuttle exhaust plumes from the Maui Space Surveillance Site (MSSS). The observations will occur when the Shuttle fires its engines at night or twilight over MSSS. Spectrally filtered images and spectra of the radiation resulting from exhaust-atmosphere interactions will be taken by the optical telescope and all-sky imagers. This will reveal the chemical and physical mechanisms associated with the interaction between the chemical species in engine exhaust and the space environment. The improved models of this interaction will result in enhanced space event characterization as well as the determination of sensor requirements for effective plume and contamination analysis of other spacecraft.

**Project Type:** Payload

### Images and Captions:



View of Orbital Maneuvering System (OMS) engine burn to boost the orbit of the Space Shuttle for rendezvous with the *Mir* Space Station. Image courtesy of NASA, Johnson Space Center.



On September 17, 2006, the telescopes at the [Clay Center Observatory](#) in Brookline, Massachusetts captured this image of the Space Shuttle Atlantis just after undocking from the International Space Station during the STS-115 mission. Image courtesy of Clay Center Observatory.

**Operations Location:** Sortie

### Brief Research Operations:

- MAUI will use the optical telescopes located at the Maui Space Surveillance Site (MSSS).
- The telescope will collect images of the Space Shuttle as it fires its engines while in orbit.

**Operational Requirements:** Space Shuttle will have to be in the field of view while over the Maui Space Surveillance Site (MSSS), Hawaii, during night or twilight conditions. This experiment requires the Space Shuttle to complete three types of engine burns or maneuvers: a vernier reaction control system (VRCS) maneuver, primary reaction control system (PRCS) burns at various angles of attack, and retrograde orbital maneuvering system (OMS) burns. In order to achieve the minimum number of 12 burns it will take multiple Shuttle missions to complete this experiment. It is planned for the following Space Shuttle flights to ISS 12A (STS-115), 12A.1 (STS-116), 13A (STS-117), 13A.1 (STS-118), 15A (STS-119), 10A (STS-120), ULF1.1 (STS-121), 1E (STS-122), 1J/A (STS-123), 1J (STS-124).

**Operational Protocols:** The Space Shuttle will fire its engines while orbiting over the Maui Space Surveillance Site (MSSS), Hawaii. The telescope and all-sky imagers will take images and data while the Shuttle flies over the site. The images will be analyzed to better understand the interaction between the spacecraft plume and the upper atmosphere.

**Review Cycle Status:** **PI Reviewed**

**Category:** Technology Development

**Sub-Category:** Spacecraft Systems

**Space Applications:** Results can be used to develop a spacecraft interactions computer model for plume contamination assessment and to better understand the interaction between the spacecraft plume and the upper atmosphere.

**Earth Applications:** Results will help in the interpretation of spacecraft plumes when they are observed from Earth.

**Manifest Status:** Continuing

**Supporting Organization:** Department of Defense (DoD)

**Previous Missions:** MAUI was previously performed during ISS Expedition 13 on STS-121.

**Related Publications:**

[Bernstein LS, Chiu Y, Gardner JA, Broadfoot AL, Lester MI. Molecular Beams in Space: Sources of OH \(A-X\) emission in the Space Shuttle environment. The Journal of Physical Chemistry. 2003 ;107\(49\):10695-10705.](#)

**Web Sites:**

[AMOS](#)

[Maui Space Surveillance Site](#)

**Related Payload(s):** RAMBO, SEITE, SIMPLEX

**Last Update:** 10/03/2008