

FLIGHT PLAN NOTES
(CONSTRAINTS AND GUIDELINES)

A. FLIGHT DESCRIPTION

Orbiter: Atlantis (OV-104)
 Launch Window: 1 hour 6 min minutes May 12, 2009
 Inclination: 28.45°
 Insertion Attitude: 297 nautical miles
 Rendezvous Altitude: 304 nautical miles
 Duration: 11+0+2 Days

B. SHUTTLE AND STATION CREW

Shuttle Crew:

CDR/R2 - Scott Altman
 PLT/IV - Gregory Johnson
 MS1/ EV4 - Michael Good
 MS2/R1 - Megan McArthur
 MS3/EV1 - John Grunsfeld
 MS4/EV3 - Michael Massimino
 MS5/EV2 - Andrew Feustel

C. MAJOR EVENTS

<u>EVENT</u>	<u>FD</u>	<u>MET</u>	<u>DATE</u>	<u>CDT</u>	<u>GMT</u>
Launch	01	00/00:00	5/12/2009	12:31	132/17:31
OMS-2	01	00/00:43	5/12/2009	13:14	132/18:14
OBSS Survey	02	00/19:00	5/12/2009	07:31	133/12:31
HST Grapple	03	01/21:46	5/13/2009	10:17	134/15:17
EVA 1	04	02/17:15	5/14/2009	05:46	135/10:46
EVA 2	05	03/17:15	5/15/2009	05:46	136/10:46
EVA 3	06	04/17:15	5/16/2009	05:46	137/10:46
EVA 4	07	05/17:15	5/17/2009	05:46	138/10:46
EVA 5	08	06/17:15	5/18/2009	05:46	139/10:46
HST Release	09	07/17:45	5/19/2009	05:46	140/10:46
Late Inspection	09	07/21:25	5/19/2009	10:11	140/15:11
Deorbit	12	10/19:18	5/22/2009	07:49	143/12:49

D. LANDING OPPORTUNITIES

		<u>Orbit No.</u>	<u>Site</u>	<u>Local Time</u>	<u>MET</u>
Nominal	Primary	166	KSC	May 23/09:59	10/20:27
	1 Rev Late	167	KSC	May 23/11:36	10/22:05
	Weather	167	EDW	May 23/08:29	10/21:58
EOM + 1	Primary	182	KSC	May 24/10:52	11/21:21
	1 Rev Late	183	KSC	May 24/12:30	11/22:59
	Weather	183	EDW	May 24/09:22	11/22:51
EOM + 2	Primary	197	KSC	May 25/10:08	12/20:37
	1 Rev Late	198	KSC	May 25/11:45	12/22:14
	Weather	198	EDW	May 25/08:37	12/22:06

Landing Sites:

1. Nominal End-of-Mission (EOM):
 - Primary - KSC
 - First Alternate - Edwards Air Force Base (EAFB)
 - Second Alternate (Backup weather alternate) - White Sands Space Harbor (WSSH)
2. Aborts:
 - (a) Return to Launch Site (RTLS): KSC
 - (b) Transoceanic Abort Landing (TAL): Primary - Moron (Single TAL site available)
 - (c) Abort-Once-Around (AOA): Primary - EAFB, Alternates - KSC, WSSH
 - (d) Emergency: The Emergency Landing Sites (ELS) available for this flight are listed in the
Level A Groundrules and Constraints.

E. COMMUNICATIONS

The Summary Timeline contains several databands for ground sites and TDRS events. The TDRS band reflects the three TDRS satellites that will be used for Orbiter coverage (East, West, and Z) and their longitudinal position. The data shown contain satellite line-of-sight (I-bars), Ku-band coverage (unshaded bars), and TDRS SHO schedule (solid bars). The SHO schedule depicts early, normal, and midpass handovers and closed or extended Z satellite coverage.

The GND band contains the AOS/LOS of the US ground sites used for the L-1 Comm Checks and for Deorbit and landing comm. MLA and DFA are for Kennedy Space Center and Edwards Air Force Base respectively, and WSS is for White Sands Space Harbor (which is needed on wave-off opportunities only).

Shuttle

TDRS Support: East (-46°), West (-167.5°), and Z (-275°)
Ground Sites: MLA, WLP, WSS, and DFR
Contingency RTS: DGS, GTS, HTS, OTS, CTS, VTS, and NHS

F. PAYLOADS

The primary objective of this flight is to perform the operations necessary to fulfill the on-orbit servicing of the Hubble Space Telescope Servicing Mission 4 (HST SM4). The main servicing tasks for this mission include the following Extravehicular Vehicle Activity (EVA) items: replacement of three Rate Sensor Units (RSUs); replace two battery modules (includes 6 batteries); change the Corrective Optics Space Telescope Axial Replacement (COSTAR) with the Cosmic Origins Spectrograph (COS); replace the Wide Field Planetary Camera 2 (WFPC2) with Wide Field Camera 3 (WFC3); replace the Fine Guidance Sensor 2 (FGS2); install New Outer Blanket Layers (NOBLs); repair and upgrade the Space Telescope Imaging Spectrograph (STIS); repair the Advanced Camera for Survey (ACS), and install a Soft Capture Mechanism (SCM). Four Payload Bay Carriers are used to secure the servicing items for transport to orbit and return replaced hardware to earth. These are the Super Lightweight Interchangeable Carrier (SLIC), Orbital Replacement Unit Carrier (ORUC), Multi-use Logistic Equipment Carrier (MULE) and the Flight Support System (FSS) to berth the HST for the servicing operations and re-deploy after servicing.

The Orbiter will carry additional equipment to orbit to support a Launch-On-Need (LON) rescue of the HST SM4 crew to support a stay time on orbit of up to 25 days.

G. SECONDARY PAYLOADS

1. IMAX Cargo Bay Camera 3D (ICBC 3D) will be flown in the payload bay mounted to the ORUC.
2. NLP-Vaccine-1C is a commercial payload in support of the National Lab Pathfinder initiative. It is a follow-on to the STS-123, STS-124, STS-126, and STS-119 NLP-Vaccine-1A/B payload and contains pathogenetic organisms, which are being examined to develop potential vaccines for the prevention of infections on Earth.

H. PAYLOADS OF OPPORTUNITY

1. Maui Analysis of Upper atmospheric Injections (MAUI)

The objective of the MAUI payload is to obtain optical signatures of spacecraft plumes using the optical telescope sensors and all-sky images at the Air Force Maui Optical and Supercomputing Site (AMOS). The MAUI payload will require state vector information and may request OMS, Primary Reaction control System (PRCS) and Vernier Reaction Control System (VRCS) burns, if propellant and crew time are available. The MAUI payload may collect data during any encounter opportunity when the Orbiter support activities can be planned to meet the criteria defined.

2. Shuttle Exhaust Ion Turbulence Experiments (SEITE)

Shuttle Exhaust Ion Turbulence Experiments (SEITE) will use space based sensors to detect the ionospheric turbulence inferred from the radar observations from a previous Space Shuttle Orbital Maneuvering System (OMS) burn experiment using ground-based radar. The SEITE payload will require a 10 second dual OMS burn within 300 km range of diagnostic satellites, if propellant and crew time are available. The SEITE payload may collect data during any encounter opportunity when the Orbiter support activities can be planned to meet the criteria defined.

I. ON ORBIT DETAILED TEST OBJECTIVES (DTOs)

1. DTO 805 Crosswind Landing Performance (DTO of Opportunity)

The purpose of this DTO is to demonstrate the capability to perform a manually controlled landing in the presence of a crosswind.

J. SHORT DURATION BIOASTRONAUTICS INVESTIGATIONS (SDBIs)

1. SDBI 1634 - Sleep-Wake Actigraphy and Light Exposure During Spaceflight

This SDBI will use state-of-the-art ambulatory technology to monitor sleep-wake activity and light exposure patterns obtained in-flight. These data should help to better understand the effects of space flight on sleep as well as aid in the development of effective countermeasures for both short and long-duration spaceflight.