



Goddard Space Flight Center

HST/GSFC Project Report



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**Space Telescope
Users Committee
Meeting
May 4, 2017**

Project Perspective

- **Science highlights**
- **Scientific productivity and operational efficiency outstanding**
- **Observatory Status**
- **Mission Operations**
- **Budget Status**

Project Perspective

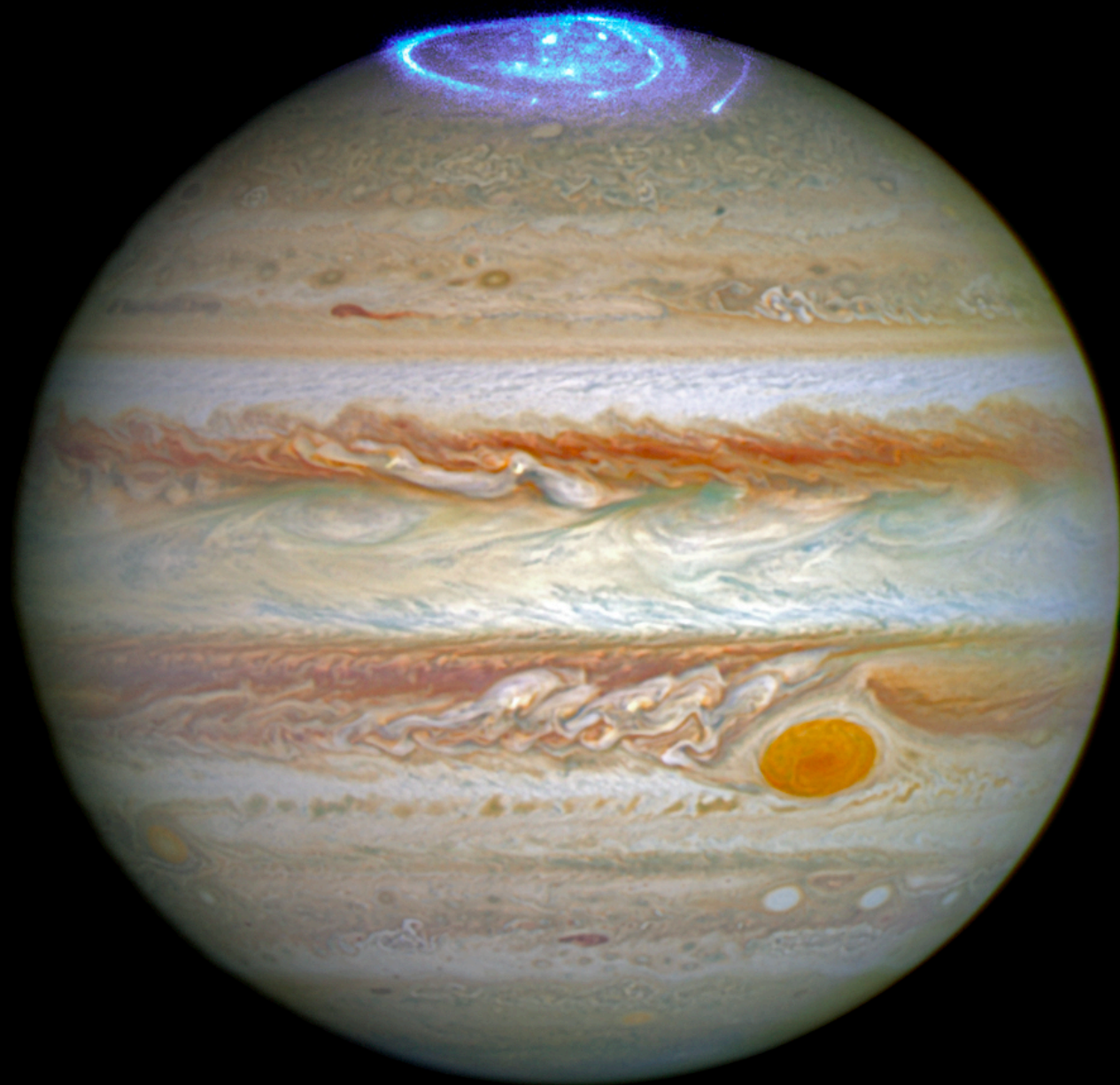
- **Science highlights: STIS 20th Anniversary!**
- **Scientific productivity and operational efficiency outstanding**
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Project Perspective

- **Innovative Science Initiatives continue:**
 - **UV initiative, Mid-Cycle proposals, Outer Planet Atmospheres Legacy (OPAL) program, Very Large Proposals**
 - **JWST Preparatory Science proposal**
 - **Preparing for complementary HST and JWST observations**

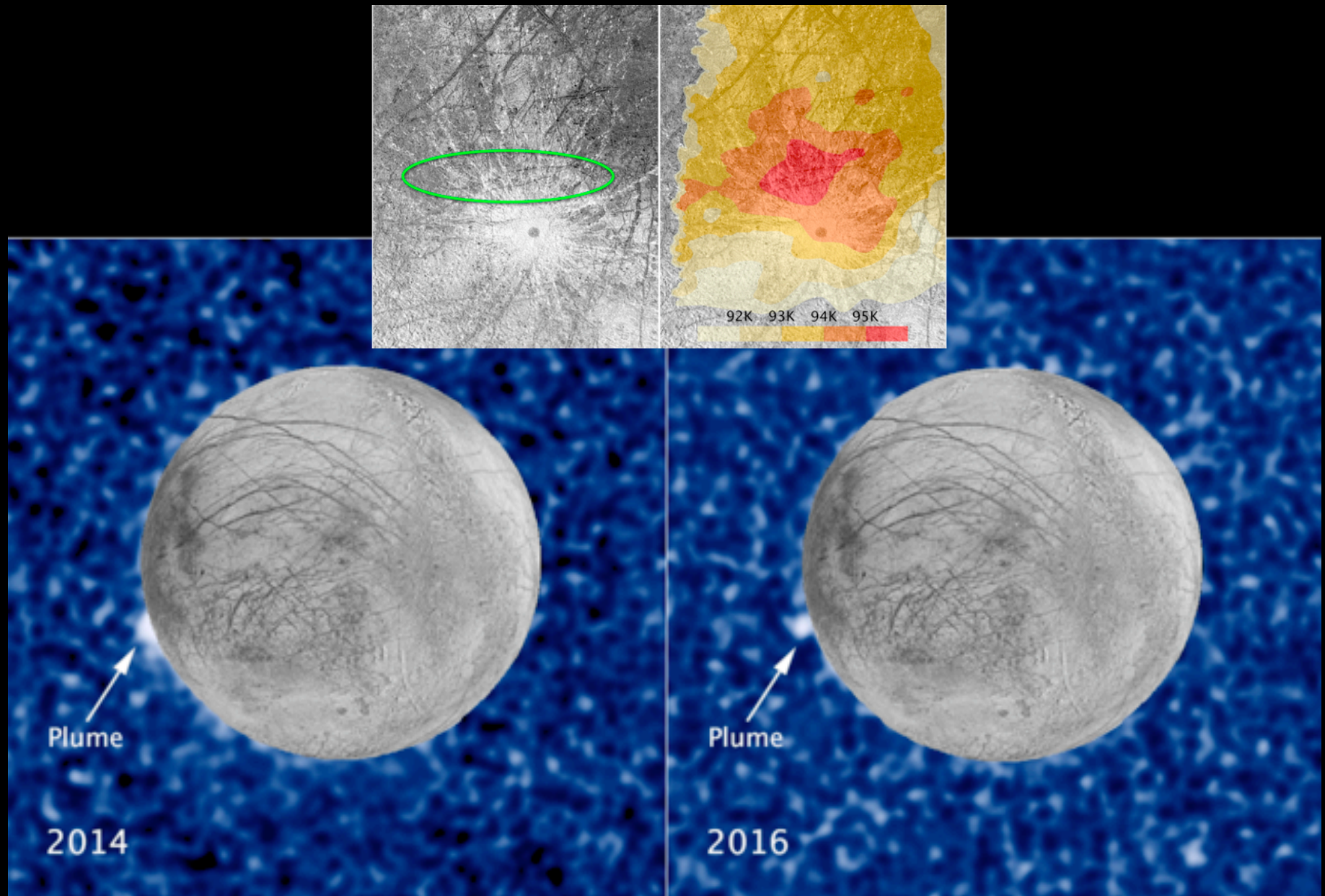


- **20th Anniversary of Space Telescope Imaging Spectrograph (STIS)!**
 - **Innovative and collaborative science with STIS, notably in UV**

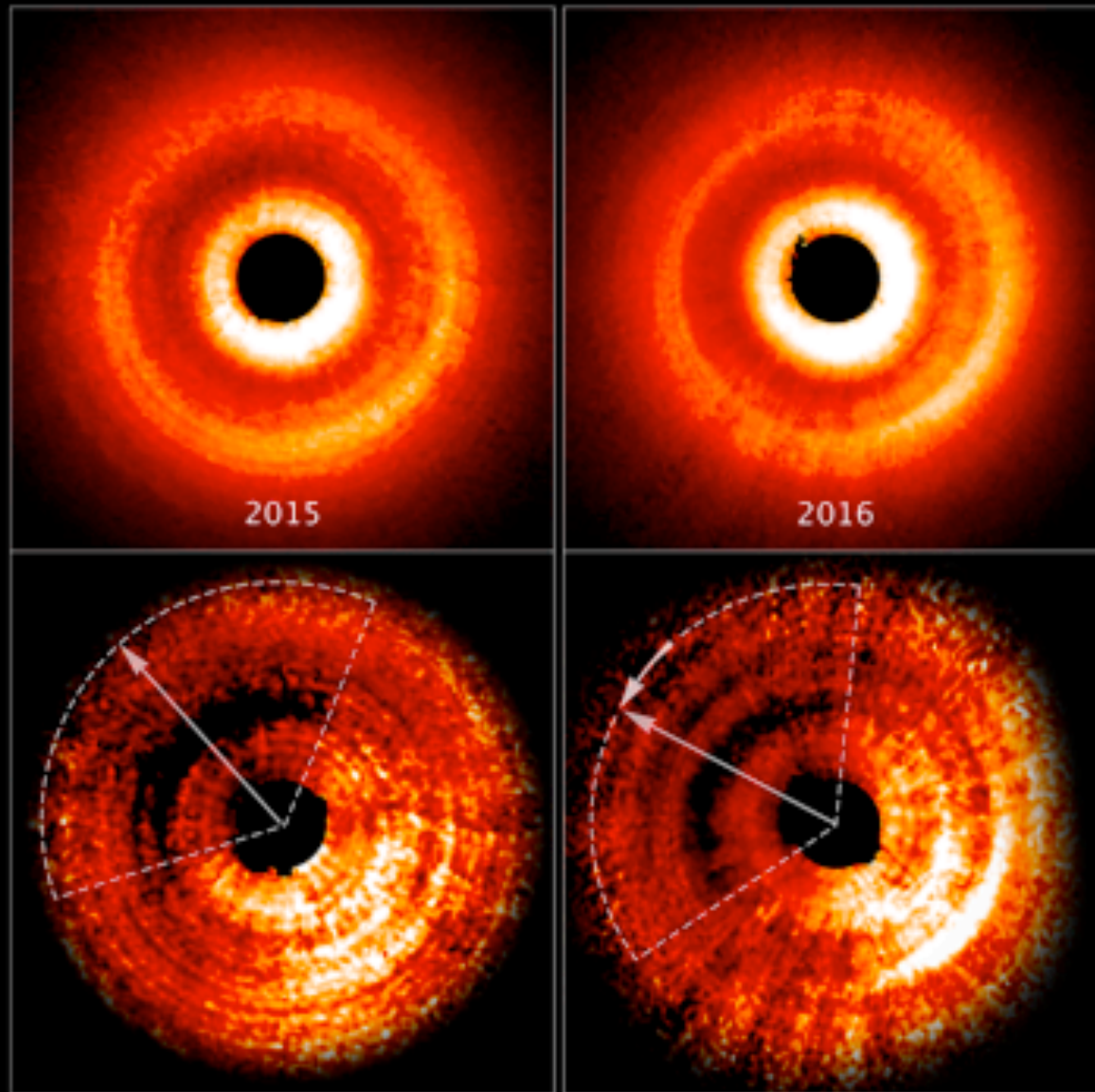


Jupiter with Aurora in UV

Recurring Water Plumes on Europa (Located near Galileo “warm spot”!)



Shadow on TW Hydrae Disk



Exoplanet Spectra: Example spectrum from STIS and Spitzer/IRAC (WASP-39b, Cool Saturn-mass exoplanet)

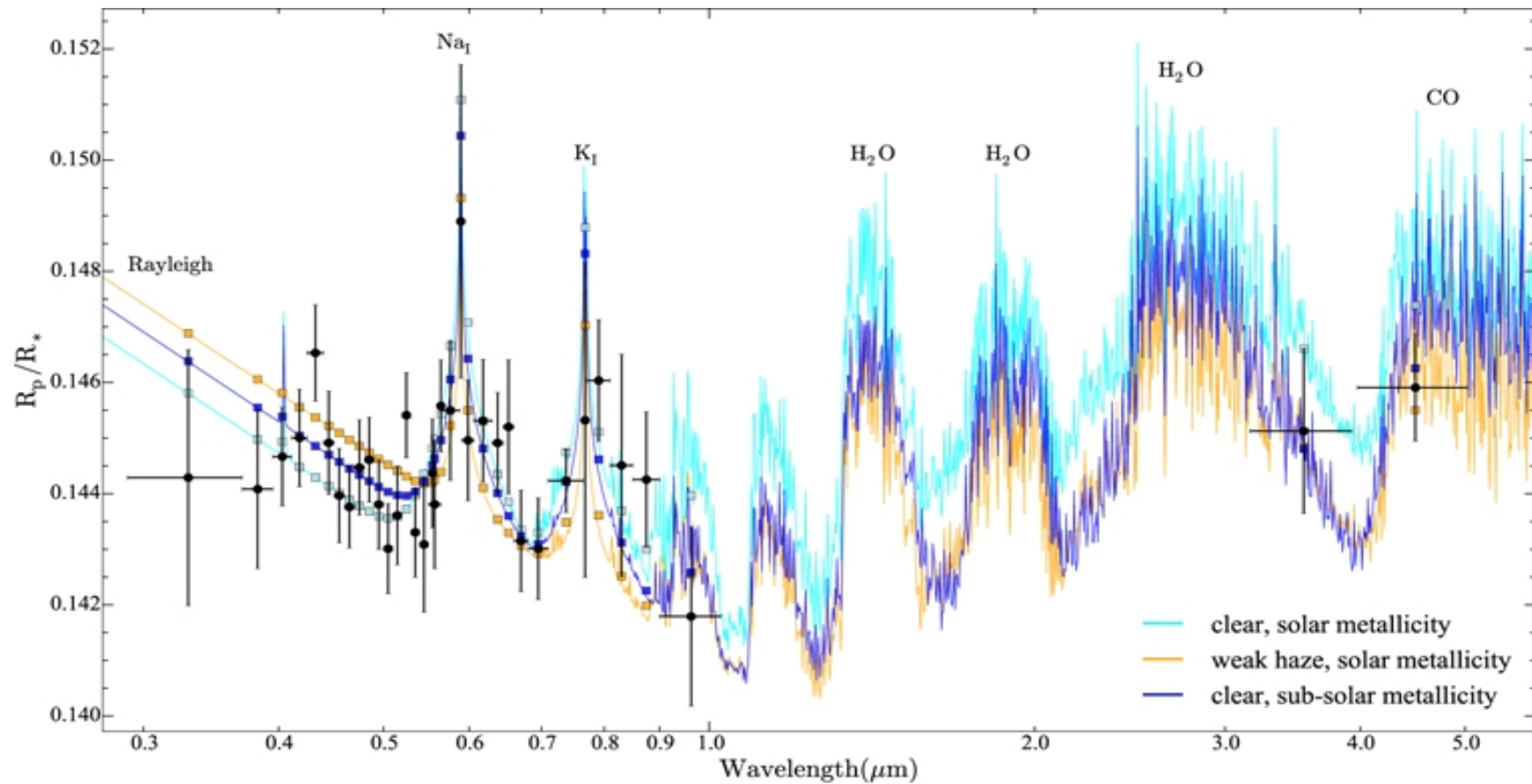
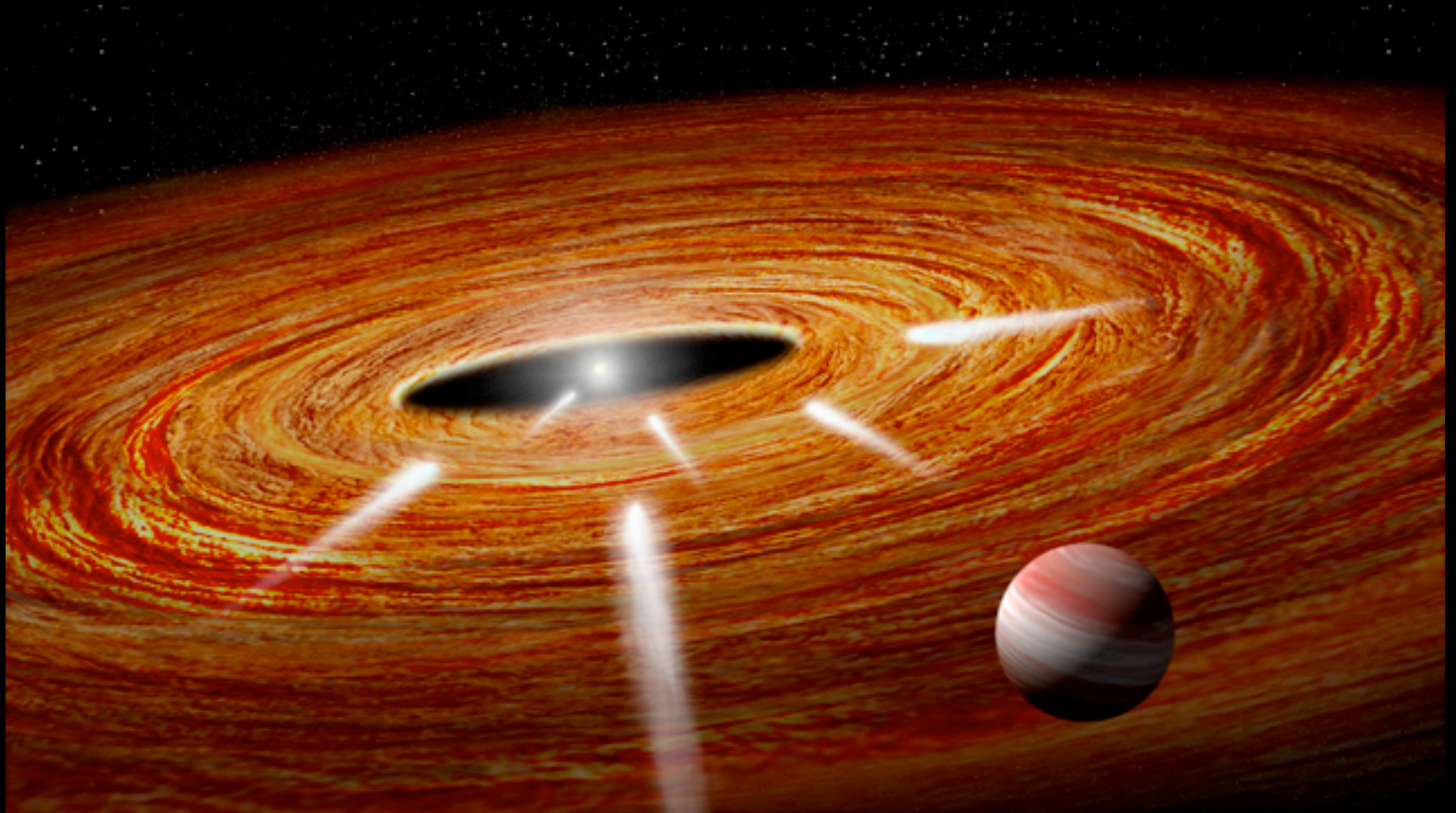


Figure 9 from HST Hot-Jupiter Transmission Spectral Survey: Clear Skies for Cool Saturn WASP-39b
Patrick D. Fischer et al. 2016 ApJ 827 19 doi:10.3847/0004-637X/827/1/19

Exoplanets Plunging Into a Star!



Artist Conception

NASA, ESA, and A. Feild and G. Bacon (STScI)

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HST Observatory Status

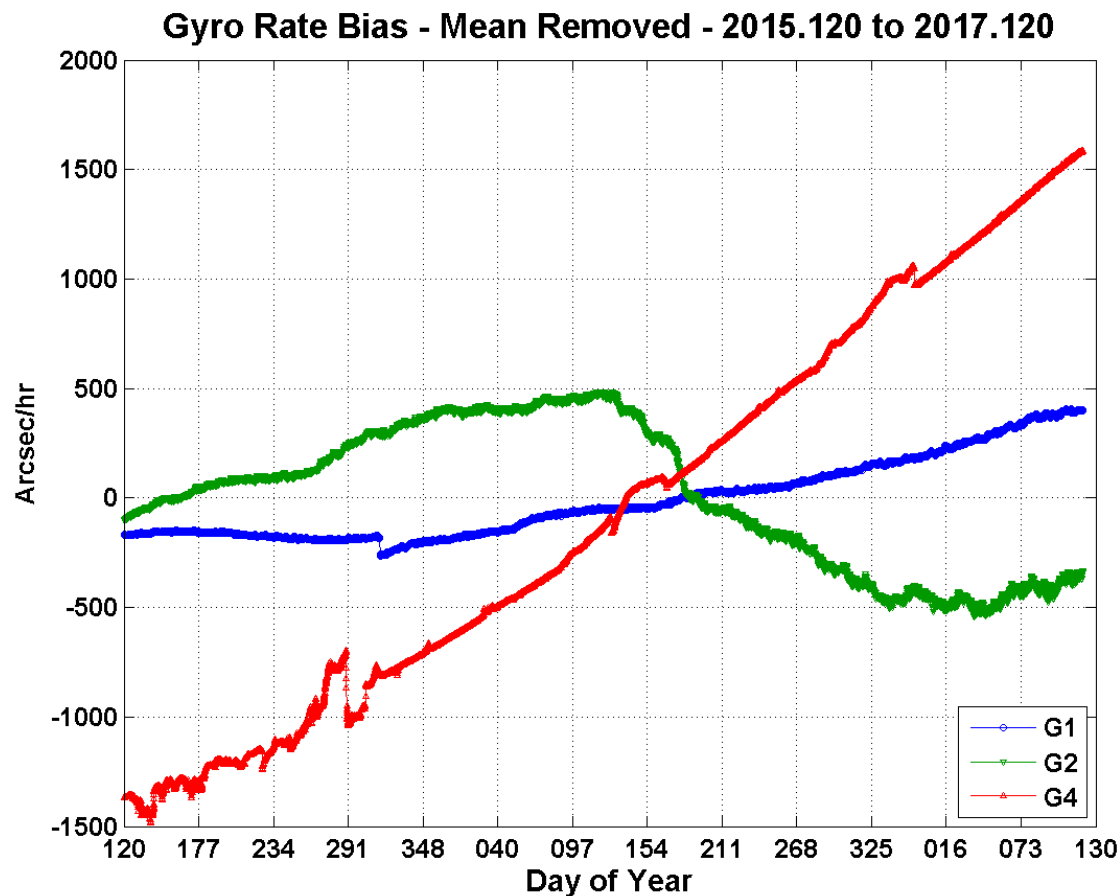
4/30/2017

Subsystem		Summary
Science Instruments (SI)	G	<ul style="list-style-type: none"> WFC3 performance excellent; Channel Select Mechanism (CSM) movement and dust particles monitored <ul style="list-style-type: none"> CSM movements have been significantly reduced without science impact Two particles observed in 10/2016; last two prior were 12/2015 and 8/2013 COS <ul style="list-style-type: none"> Moved to 3rd position 2/2015; installation of 4th position flight software in May Move to 4th position expected in October FUV detector sensitivity monitoring continues following completion of sensitivity ARB closure 4/2011 ACS and STIS repaired instruments (SM4) performing nominally NICMOS in standby following decision to not restart following Cycle 19 proposal evaluations
Electrical Power System	G	<ul style="list-style-type: none"> Performance of batteries is excellent; benchmark set to 510 Amp Hours Solar Array 3 performance remains excellent Solar Array Drive Electronics (SADE) investigation following 2/15/13 SWSP completed; no further actions
Pointing Control System	G	<ul style="list-style-type: none"> Gyro 5 failed on 3/7/14; Gyro 6 powered off 3/13/14; Operating in 1-2-4 configuration; Gyro 3 removed from control loop and powered off in 2011; all gyros configured to operate on secondary heater controller Gyro 4 motor current increased from 120mA to 190mA in 9/2011, has remained stable at ~178 mA Gyros 2 and 1 motor currents increased to 200 mA on 11/8/15 and to 165 mA on 11/11/15, respectively Elevated Motor Current Tiger Team recommended autonomous running restart flight software installed 6/2016 Attitude Observer Anomaly (AOA) (ARB report 10/2011) mitigation completed 11/2012 FGS-3 bearings degraded (~10% duty cycle to preserve life); FGS-2R2 Clear Filter operations began 1/2015
Data Management System	G	<ul style="list-style-type: none"> SI Control and Data Handling (C&DH) has had 10 lockup recoveries since 6/15/09; most recent was 3/16/2017 SI FSW enhanced to protect detectors in event HV left on from SI C&DH lock up event Science Data Formatter (SDF) input cycling modified to reduce thermal load Solid State Recorders (SSRs) 1&3 have each experienced a single lock up while in the South Atlantic Anomaly (SAA); Alert monitors detect condition to minimize data loss
Communications	G	<ul style="list-style-type: none"> Multiple Access Transponder 2 (MAT2) coherent mode failed (12/24/2011); Two-way tracking unavailable Joint Space Operations Center (JSpOC) now the source for the operational ephemeris via Conjunction Avoidance Risk Assessment (CARA) team and the Flight Dynamics Facility
Thermal Protection System	G	<ul style="list-style-type: none"> New Outer Blanket Layers (NOBLs) installed on Bays 5,7, and 8 during SM4 Thermal performance is nominal

Mission Operations – Gyro Performance

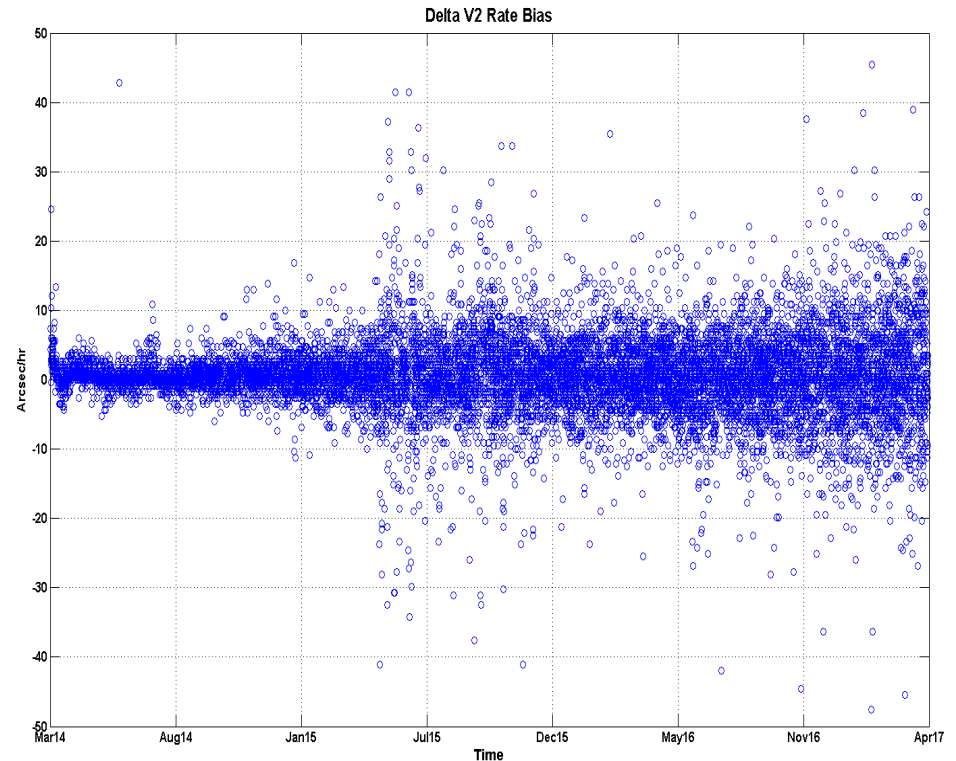
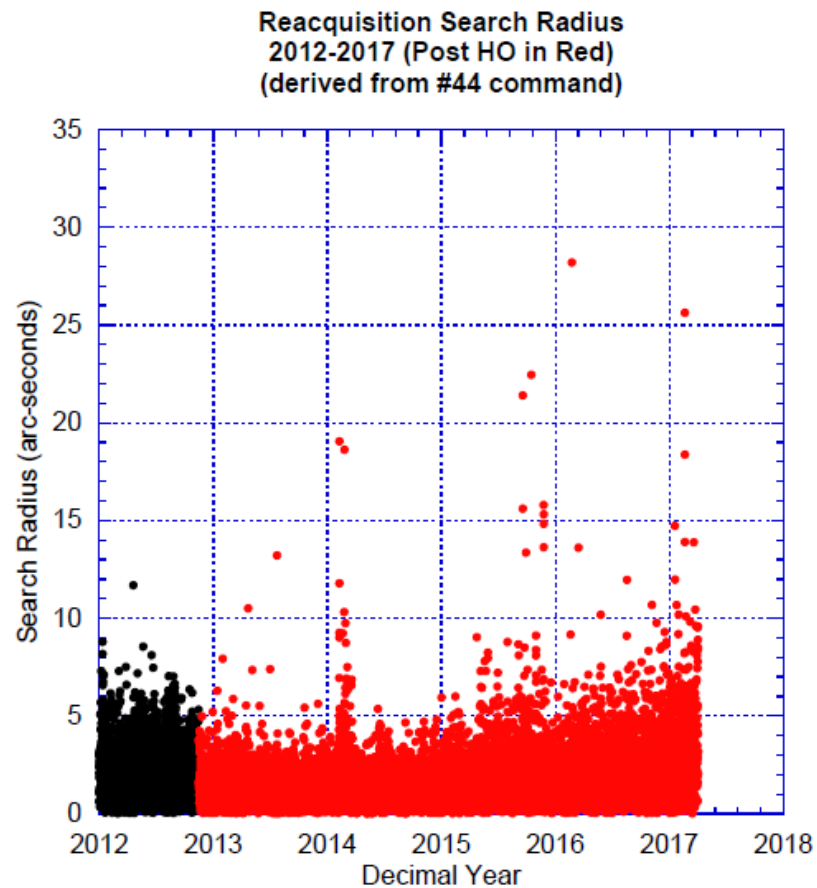
- **Gyro performance update**

- Gyro-4 performance remains stable following “out of family” May-November 2015
- Monitoring Gyro-2 performance, noisier gyro bias and modest scale factor drift



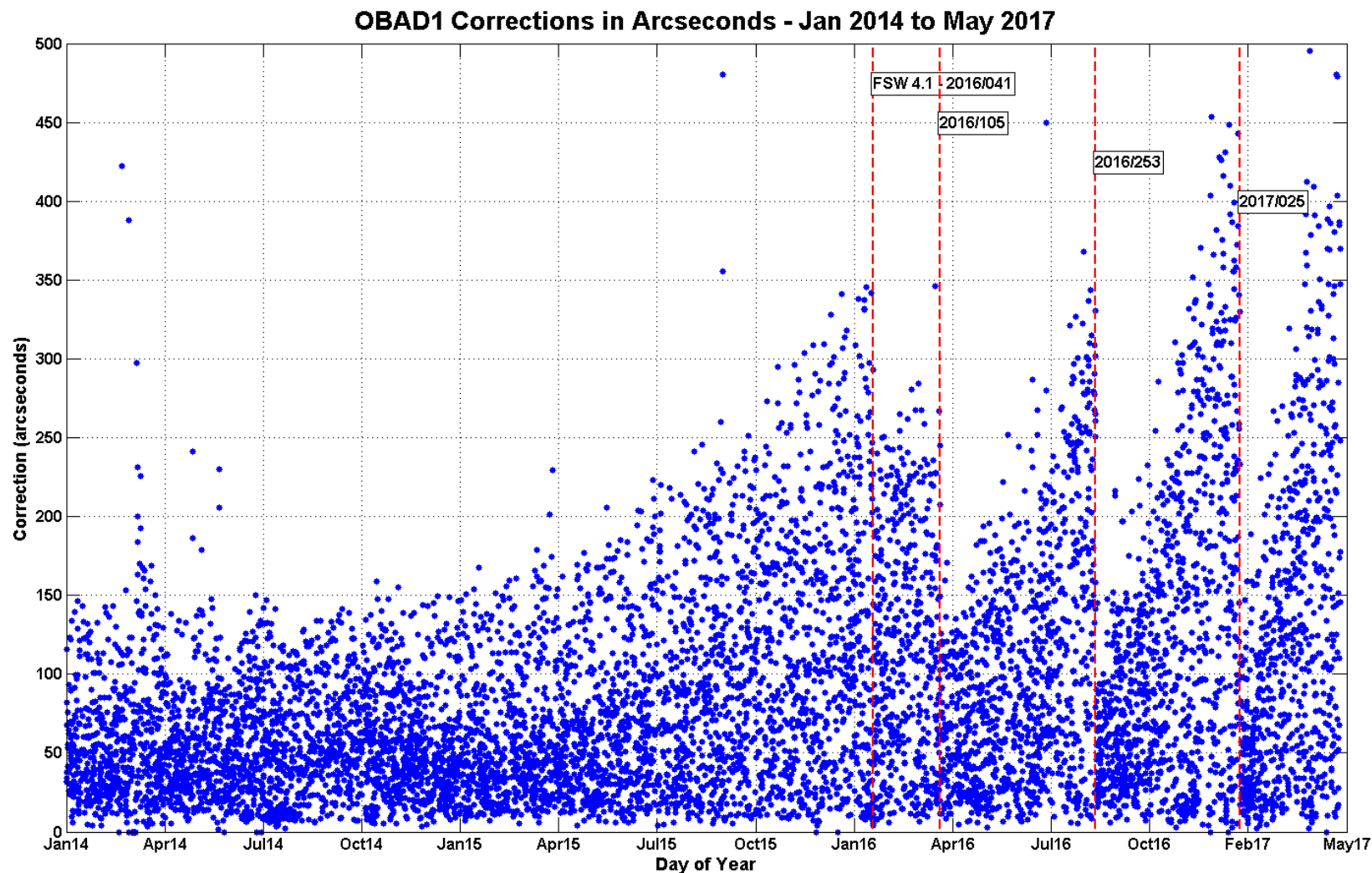
Mission Operations – Gyro Performance

A slow upward trend in the guide star reacquisition search radius is observed and is correlated with an increase scatter in the Gyro-2 bias measurements. Gyro 2 was powered on in March 2014



Mission Operations – Gyro Performance

Onboard Attitude Determination Correction Trend Gyro 2 Scale Factor Drift



Mission Operations – Gyro Run Time Performance

4/30/16

Current Gyro Runtimes

Post SM4 RGA	Status	Flex Lead	Total Hours 2017/120
G1	On	Standard	34828
G2	On	Standard	35000
G3	Off – AOA 2011	Enhanced	22353
G4	On – Max Hrs	Enhanced	80297
G5	Failed 2014	Standard	51497
G6	Off	Enhanced	35945

Previous Flex Lead Failure Runtimes

Date of Failure	Gyro	Flex Lead	Total hours at failure
1992.281	G6	Standard	34825
1997.099	G4	Standard	31525
1998.295	G6	Standard	46276
1999.110	G3	Standard	51252
1999.317	G1	Standard	38470
2007.243	G2	Standard	58039
2014.066	G5	Standard	51497

Maximum runtime hours (current G4) 80,297
 Minimum runtime hours (SM3A G5, rotor restriction) 13,857

Mean runtime hours for 6 current onboard gyros 43,320
 Mean runtime hours for all 22 HST operational gyros 41,901
 Mean runtime hours for the 7 HST flex lead failure gyros 44,555

Mission Operations

- **Life Extension Initiatives – Anticipate multiple years of overlap with Webb**
- **Cosmic Origins Spectrograph flight software update completed**
 - Enables activation of 4th lifetime position
 - Expect move to 4th position by October
- **Spacecraft flight software 4.2 installed April 25 and 26**
 - Updates star catalog and geomagnetic field model
 - Enhances guide star acquisition logic
 - Reorganizes onboard memory in preparation for future updates
- **Future spacecraft flight software enhancements under consideration**
 - Diagnostic Data Recorder
 - Onboard gyro performance parameters determination and update

Budget Status

- **Budget Outlook**

- FY16 appropriated budget was \$98.3M
- FY17 President's Budget was \$97.3M (appears Omnibus provides \$98.3M)
- FY18 through FY23 budget horizon - guide line is \$98.3M annually
- Expect the PPBE-19 budget (President's budget) guidance to become available in late May; short NASA HQ's turn around back to Office of Management and Budget
- Attention is being paid to the level of uncosted project budget – mainly due to rate of obligations to grants outpacing the rate of expenditures being reported – and we are working with STScI to identify approaches to address this concern

- **General Observer / Archival Research**

- Cycle 22 and 23 awarded cycle value was \$28.9M
- Cycle 24 awarded cycle value was \$31.6M
- Anticipate Cycles 25 and 26 values to be on the order of ~\$30M
- May be tasked to revisit Cycle Values in the era of Webb

Discussion

- **Questions?**