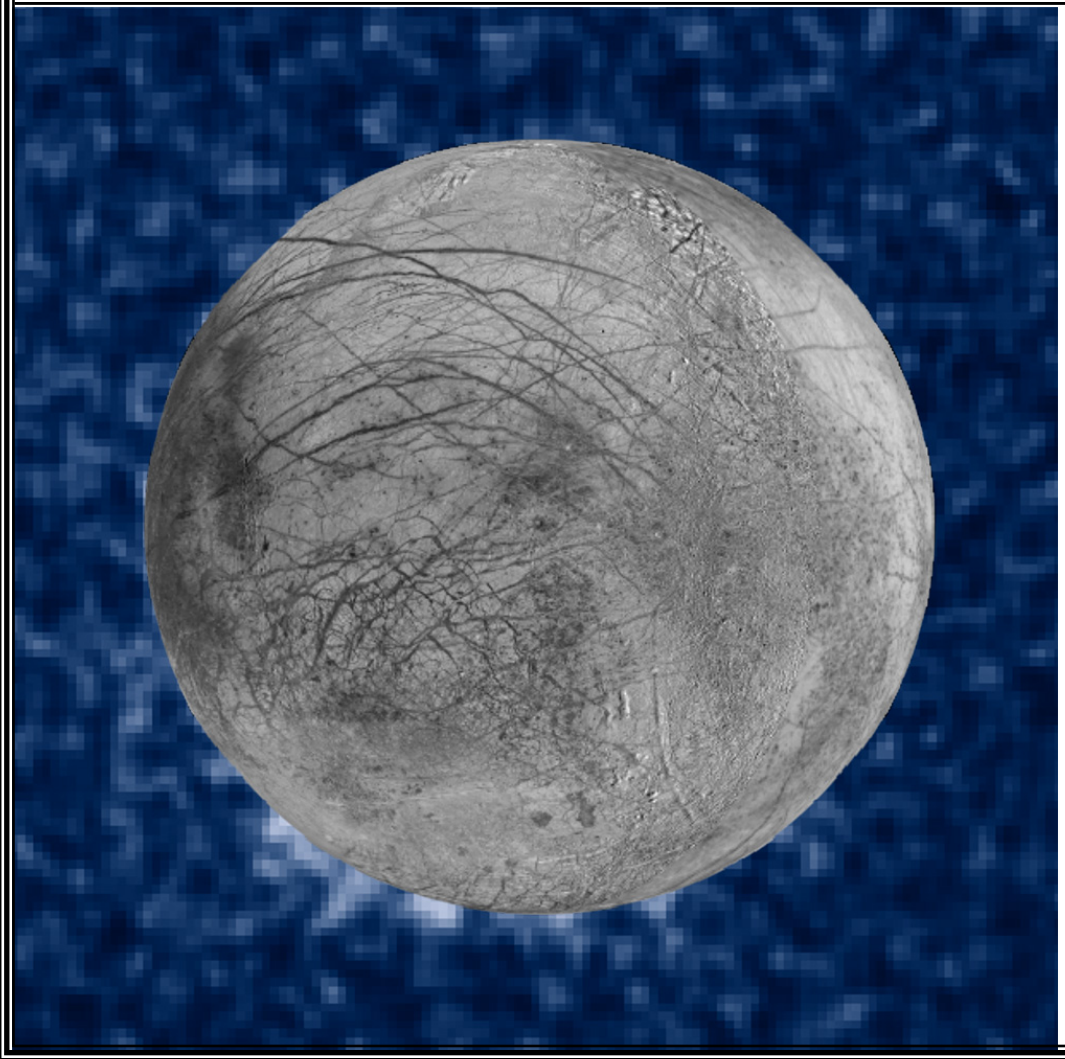
Goddard Space Flight Center

HST/GSFC Project Report



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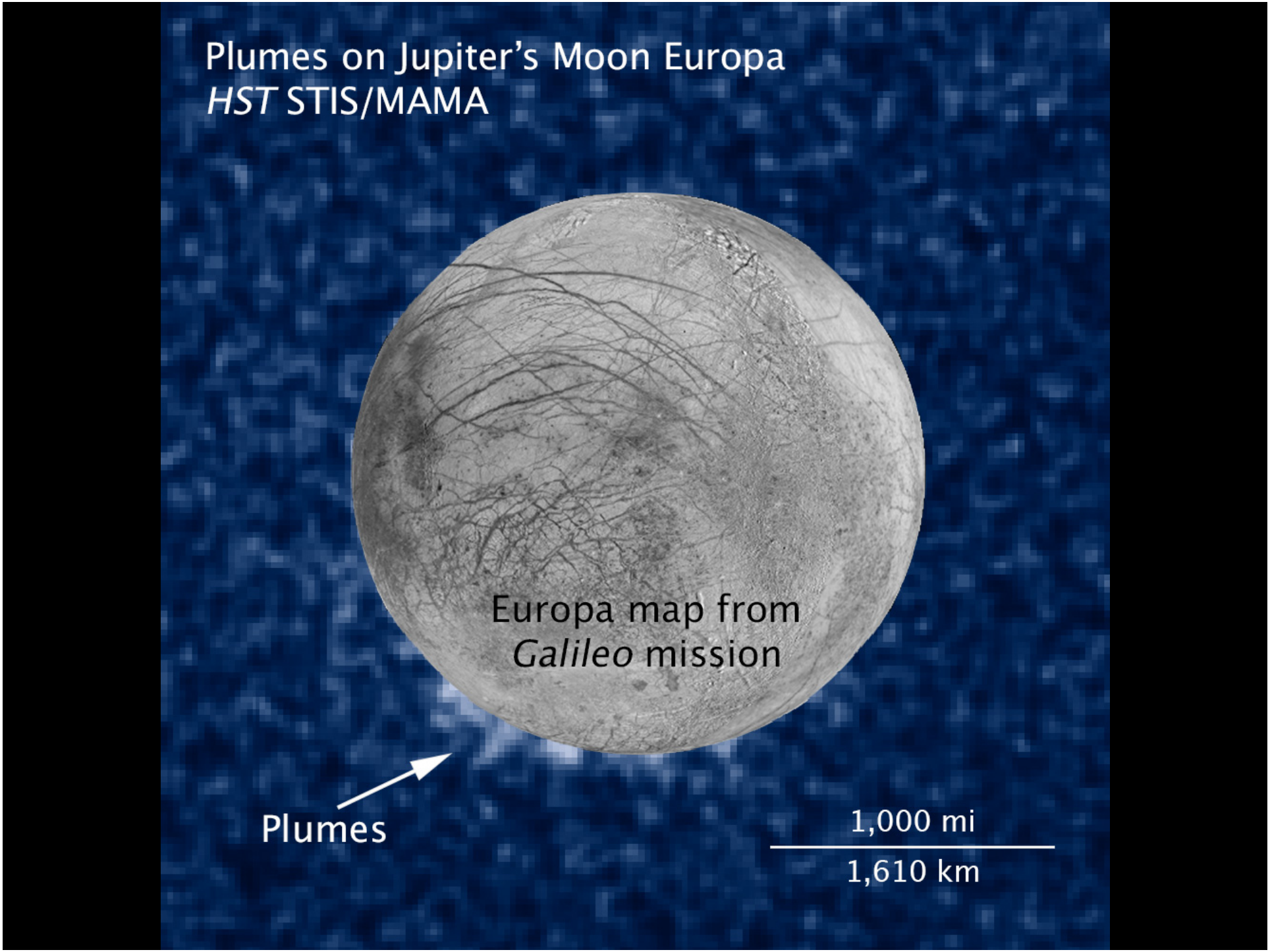
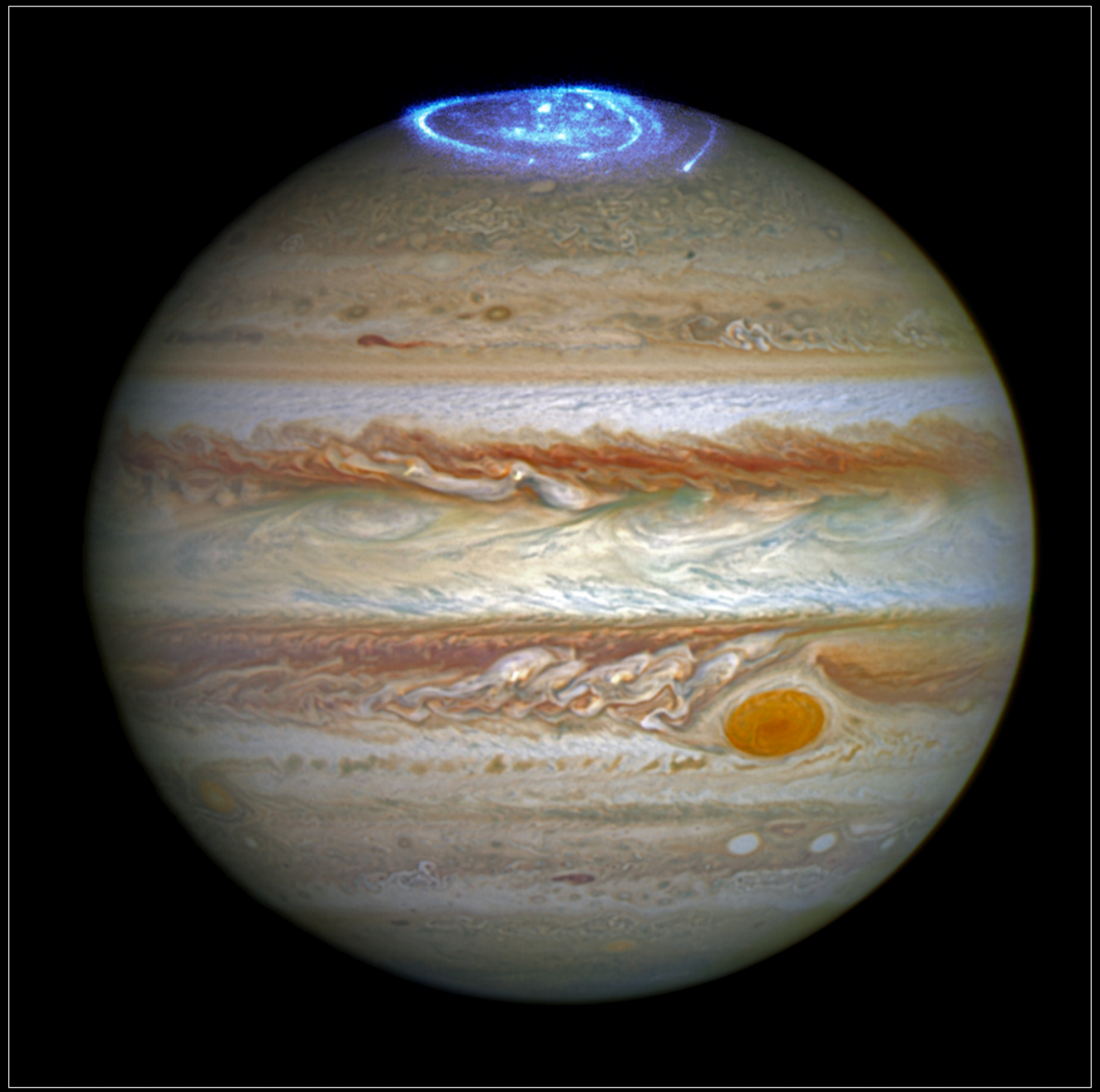
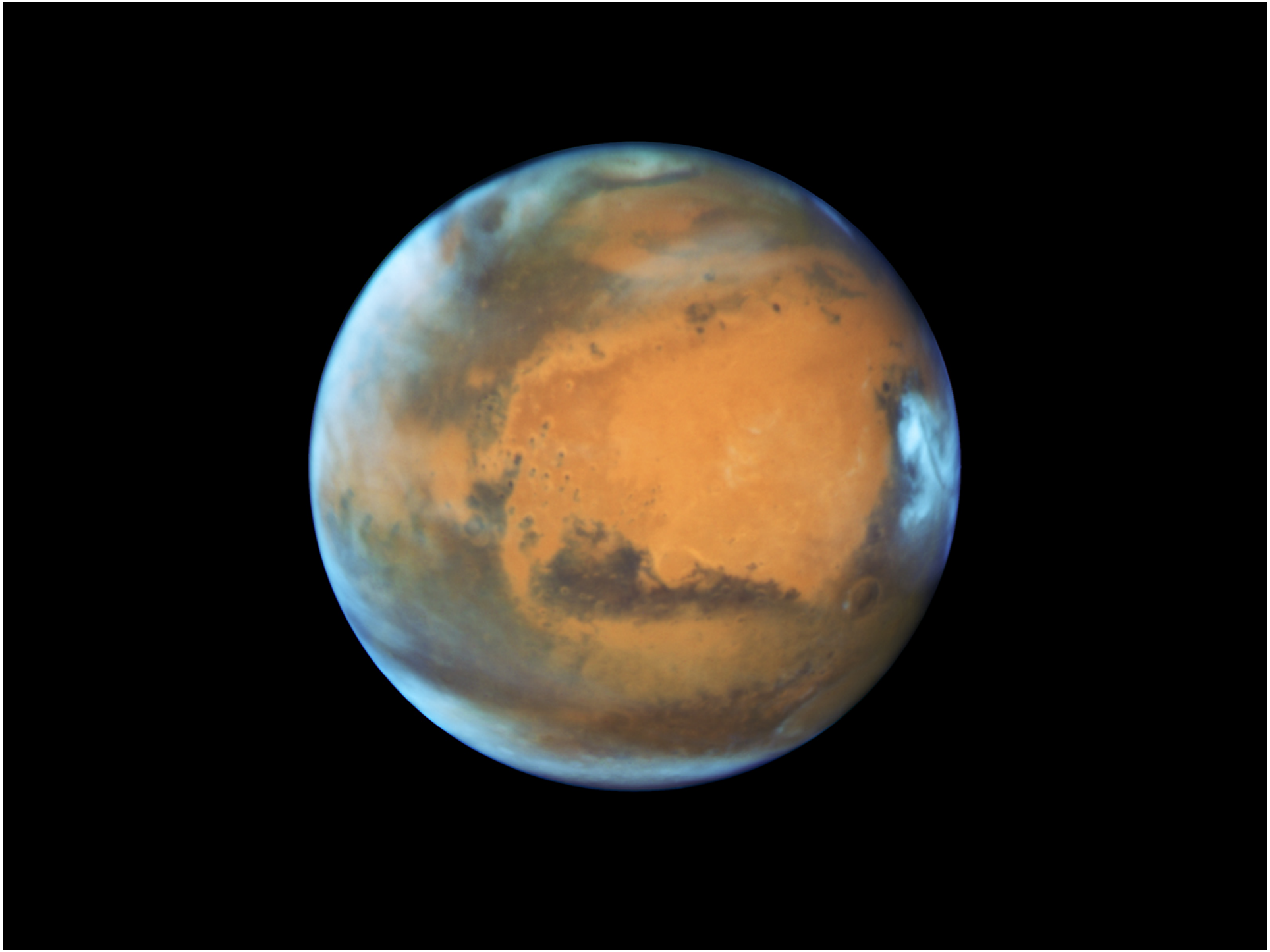
Space Telescope Users Committee Meeting
October 20, 2016


Plumes on Jupiter's Moon Europa
HST STIS/MAMA
Europa map from
Galileo mission
Plumes
1,000 mi
1,610 km

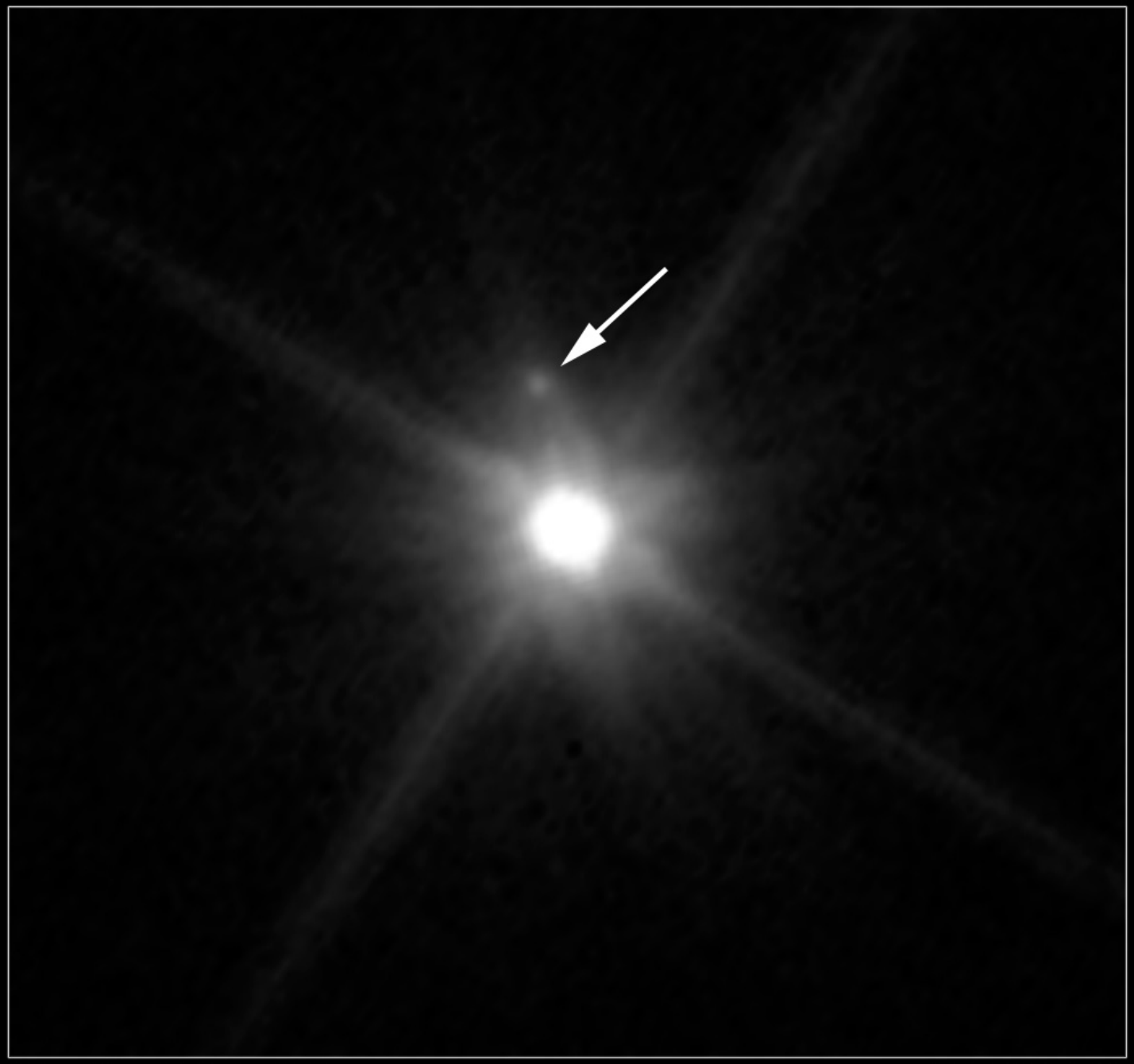
Jupiter and Aurora *HST* ▪ WFC3/UVIS ▪ STIS



NASA, ESA, and J. Nichols (University of Leicester) **STScI-PRC16-24a**

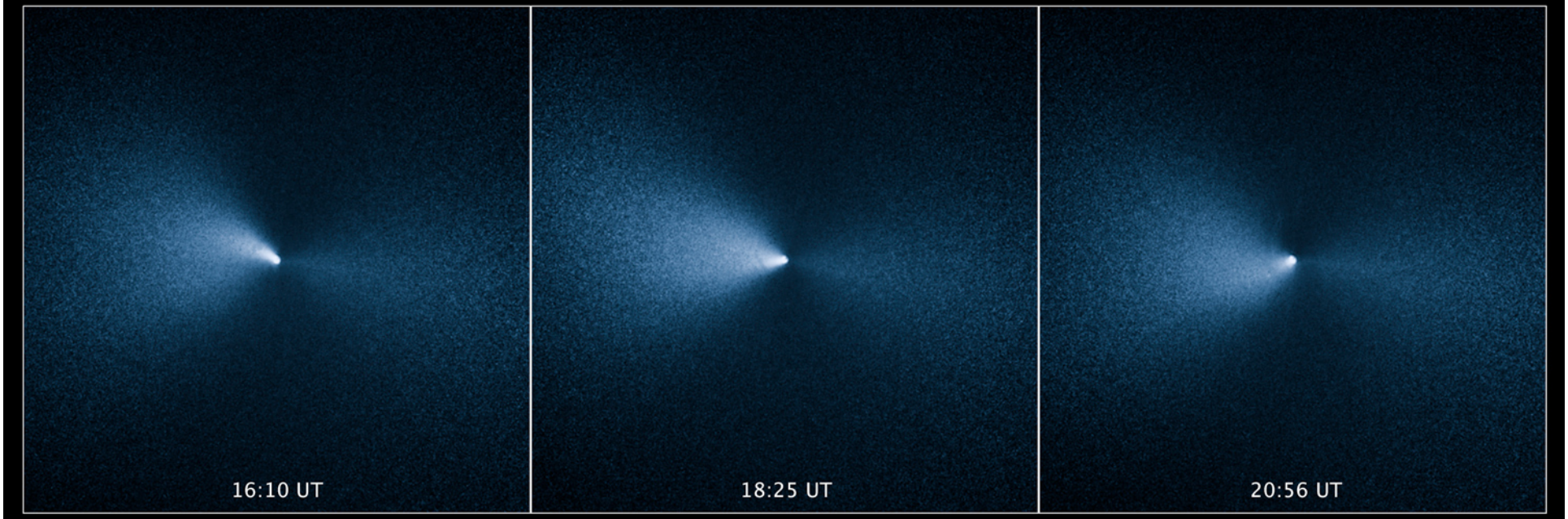


Dwarf Planet Makemake and Moon *HST* WFC3/UVIS



NASA, ESA, and A. Parker (SwRI) **STScI-PRC16-18a**

Comet 252P/LINEAR April 4, 2016 ▪ *Hubble Space Telescope* WFC3/UVIS



NASA, ESA, and J.-Y. Li (PSI) ▪ **STScI-PRC16-14a**

Project Perspective

- **Scientific productivity and operational efficiency outstanding**
- **Frontier Fields observations completed successfully**
- **Innovative Science Initiatives continue:**
  - **UV initiative, Mid-Cycle proposals, Outer Planet Atmospheres Legacy (OPAL) program**
  - **Very Large proposal category included in Cycle 24**
    - The Panchromatic Comparative Exoplanetary Treasury Program awarded 498 orbits
- **Planning for HST/JWST era**
- **2016 Senior Review results and Project response**
- **Observatory Status**
- **Mission Operations**
- **Budget/Contract Status**

Planning for the HST/JWST Era

- **JWST Preparatory Science**
  - Cycle 24 Initiative: "JWST Preparatory Science" encouraged
  - TAC Awarded 13 of 60 proposals
  - Could continue in Cycle 25…
- **Cycle 25/26 vs. JWST Cycle 1 TAC**
  - Initial 2018 schedule - JWST Cycle 1 in May and HST Cycle 26 in June
  - Current plan
    - JWST Cycle 1 unchanged (May 2018)
    - HST Cycles 25 and 26 combined in June 2017
      - Cycle 25 selected as well as 50% of Cycle 26 programs
      - Remainder of Cycle 26 small programs filled via 2-3 Mid-Cycle calls
      - One Cycle 26 delta-TAC for medium & large proposals
      - Cycle 27 returns to nominal June 2019 schedule
- **Synergies after Launch**
  - Continued good health expected for HST, examining how to maximize total science during potentially years of overlapping HST/JWST ops
  - After JWST Cycle 1, Joint proposal opportunities, likely more significant than current Chandra/Spitzer/NOAO opportunities

2016 Senior Review

- **Results**
  - **Directed to plan to $97.3M in FY 17, $98.3M FY 18-20**
  - **Invited to the 2018 Senior Review (a delta review expected)**
  - **Directed to provide a plan to address panel comments**

- **Project Response**
  - **Will explicitly vet high-level strategic scientific initiatives and the selection of Prioritized Mission Objectives communicated in the next Senior Review Proposal (will work with HQ to clarify meaning of PMOs for a mission like HST)**
  - **Will illustrate the use of key metrics in strategic planning and decision making processes to maximize scientific productivity**
  - **Will form a team to study the purchasing power of grantees**

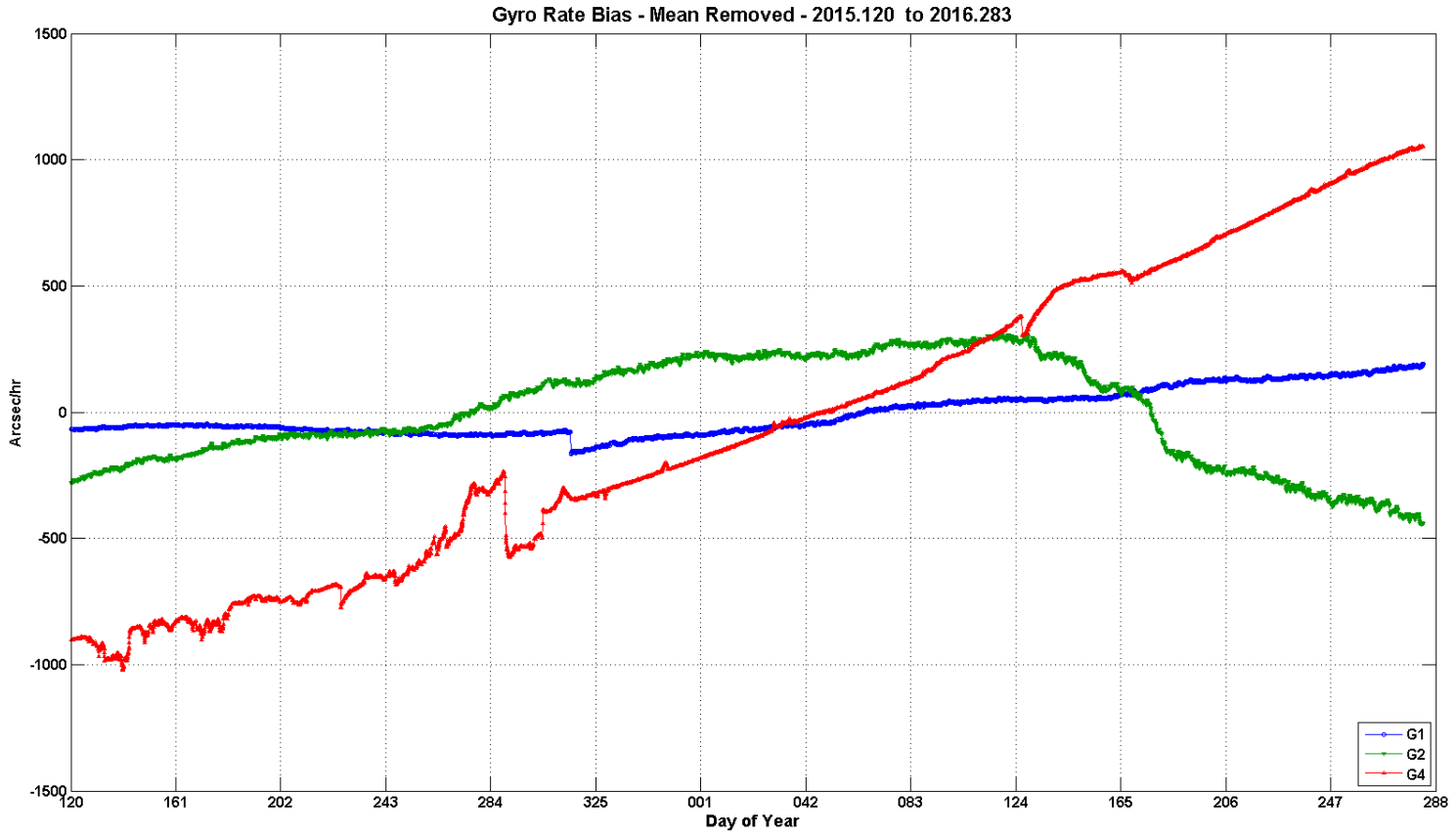
HST Observatory Status

9/30/16

Subsystem		Summary
Science Instruments (SI)	G	• WFC3 performance excellent; Channel Select Mechanism (CSM) movement and dust particles monitored – CSM movements have been significantly reduced – New particle observed 10/2016; last in 12/2015; 8/2013 prior to that • COS – Moved to 3rd position 2/2015; flight software enabling 4th position to be activated 11/7/2016 – Move to 4th position expected in mid-2017 – 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	• 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	• 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	• SI Control and Data Handling (C&DH) has had 8 lockup recoveries since 6/15/09; most recent was 7/2016 • 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	• 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	• Condition of Multilayer Insulation (MLI) observed during SM4 was as expected • 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
  - Elevated Motor Current Tiger Team recommended flight software installed June 2016
  - Monitoring Gyro-2 performance – modest scale factor drift being observed



Mission Operations – Gyro Run Time Performance

9/30/16

Current Gyro Runtimes

Post SM4 RGA	Status	Flex Lead	Total Hours 2016/274
G1	On	Standard	29740
G2	On	Standard	29912
G3	Off – AOA 2011	Enhanced	22353
G4	On – Max Hrs	Enhanced	75209
G5	Failed 2014	Standard	51497
G6	Off	Enhanced	35945

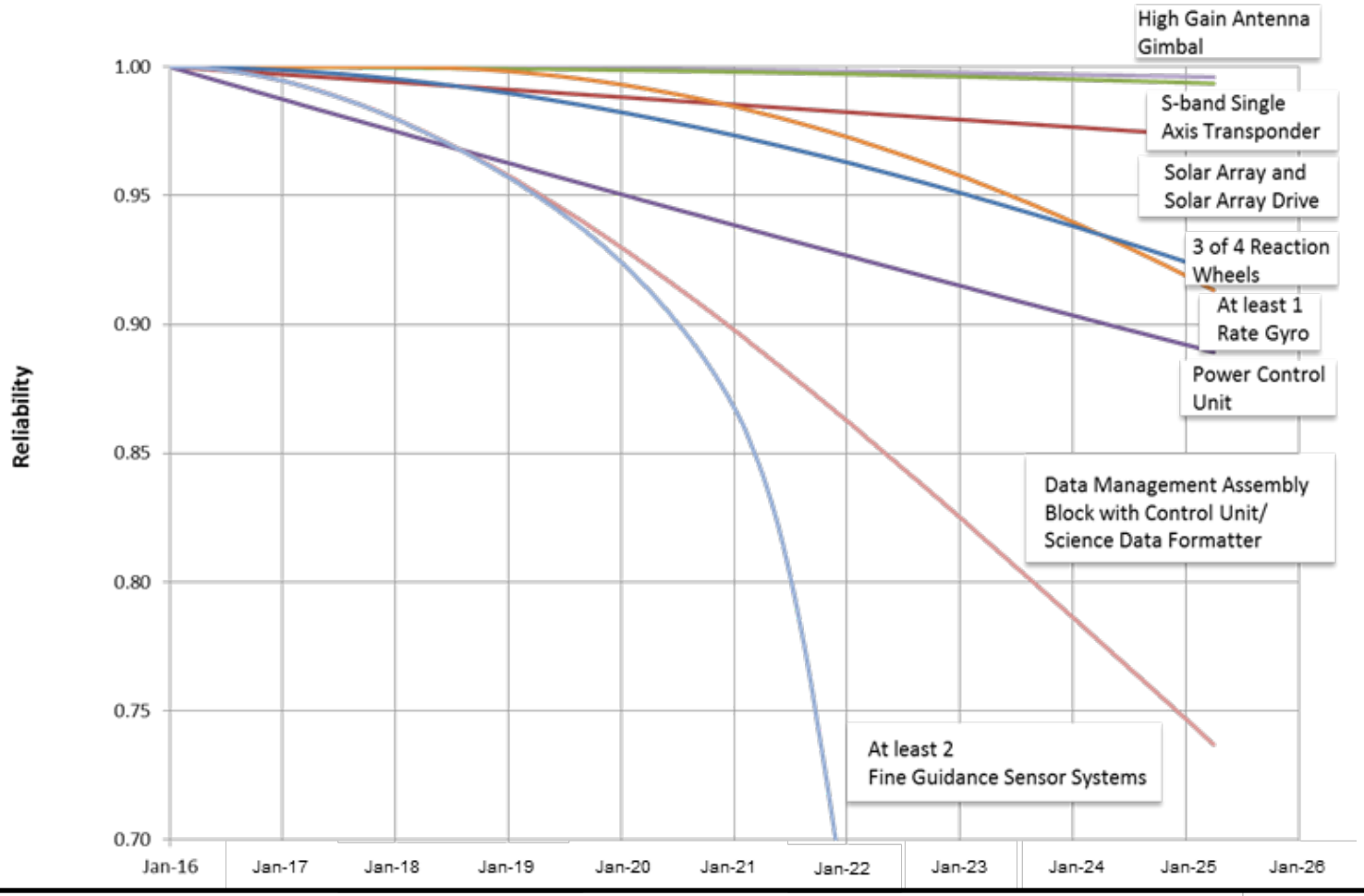
Previous Flex Lead Failure Runtimes

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)	75,209
Minimum runtime hours (SM3A G5, rotor restriction)	13,857
Mean runtime hours for 6 current onboard gyros	40,776
Mean runtime hours for all 22 HST operational gyros	41,208
Mean runtime hours for the 7 HST flex lead failure gyros	44,555

Critical System Reliability

Observatory Systems



Mission Operations

- **Life Extension Initiatives**
  - Anticipate multiple years of overlap with JWST
  - Cosmic Origins Spectrograph flight software will be updated early November
    - Enables 4th and 5th life time positions, and extended operations
    - Anticipate need to switch to 4th position in mid-2017
    - Looking at strategies to extend availability without compromising current science objectives (COS 2025)
  - Fine Guidance Sensors (FGS)
    - May be the life limiting subsystem for the observatory
    - FGS 3 duty cycle maintained at ~10% level
    - FGS 2R2 successfully executing in Clear Filter mode since January 2015 which enables guide stars down to 14.5 magnitude (from 14)
    - FGS 1R on-orbit evaluation underway to verify use of magnitude down to at least 14.25 magnitudes (from 14) in 2/3 Pupil mode

Budget/Contract Status

- **Budget Outlook**
  - FY16 appropriated budget was $98.3M
  - FY17 - the President's Budget is $97.3M
  - FY18 through FY22 budget horizon - guide line is $98.3M annually

- **Science Operations Contract Status**
  - All acquisition steps completed, began execution on July 1
  - Contract period of performance is July 1, 2016 – June 30, 2021

- **General Observer / Archival Research**
  - Cycle 22 and 23 awarded value was $28.9M
    - Cycle 23 included ~200 orbits for Mid-Cycle programs; only 78 awarded
    - Resulting Cycle 23 value stands at ~$27.5M
  - Cycle 24 – tentatively $31.6M (includes ~200 orbits for Mid-Cycle programs)
  - Will seek to minimize negative impact of inflation on future Cycle values

Discussion

- **Questions?**