STScI | SPACE TELESCOPE SCIENCE INSTITUTE

EXPANDING THE FRONTIERS OF SPACE ASTRONOMY

HST Mission Office Report

Tom Brown

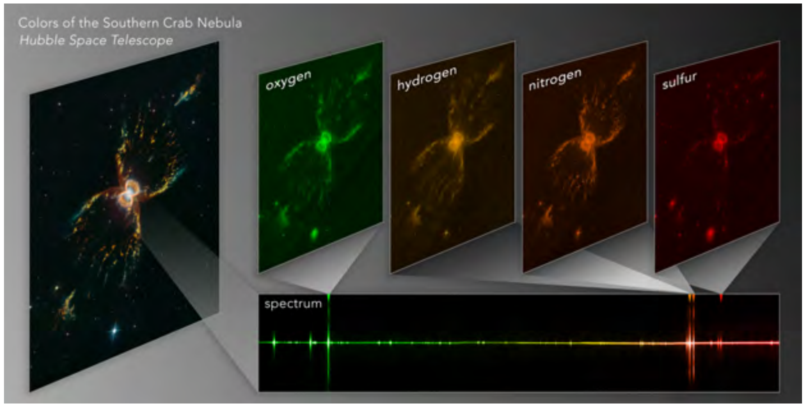
STUC – 13 May 2019

Summary

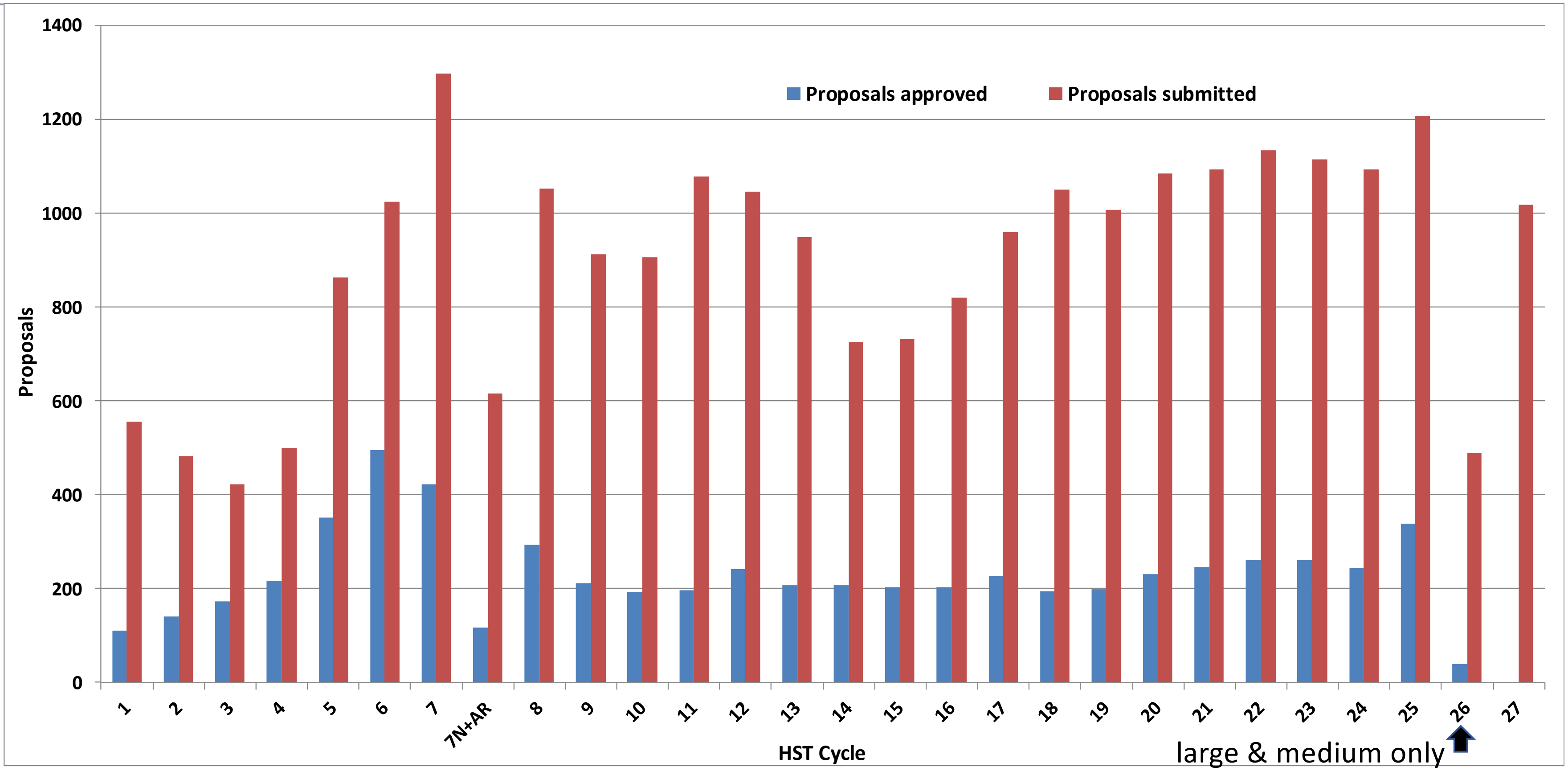
- Hubble demand and productivity remain near all time highs
- HST Senior Review was May 6-8
- Cycle 26 underway, Cycle 27 oversubscription high
- Time-constrained programs continue to be an exciting challenge
- ULLYSES program starting (see Julia Roman-Duval's presentation)
- Instruments performing nominally (see INS presentations)
- Working to mitigate acquisition problems (see Pat Crouse's presentation)
- HST Mission website migration continues (see Carol Christian's presentation)
- We are thinking broadly about the next decade (see John MacKenty's presentation)

Hubble
29th Anniversary Image

Southern Crab Nebula



Science Solicitation and Selection – Oversubscription Remains High



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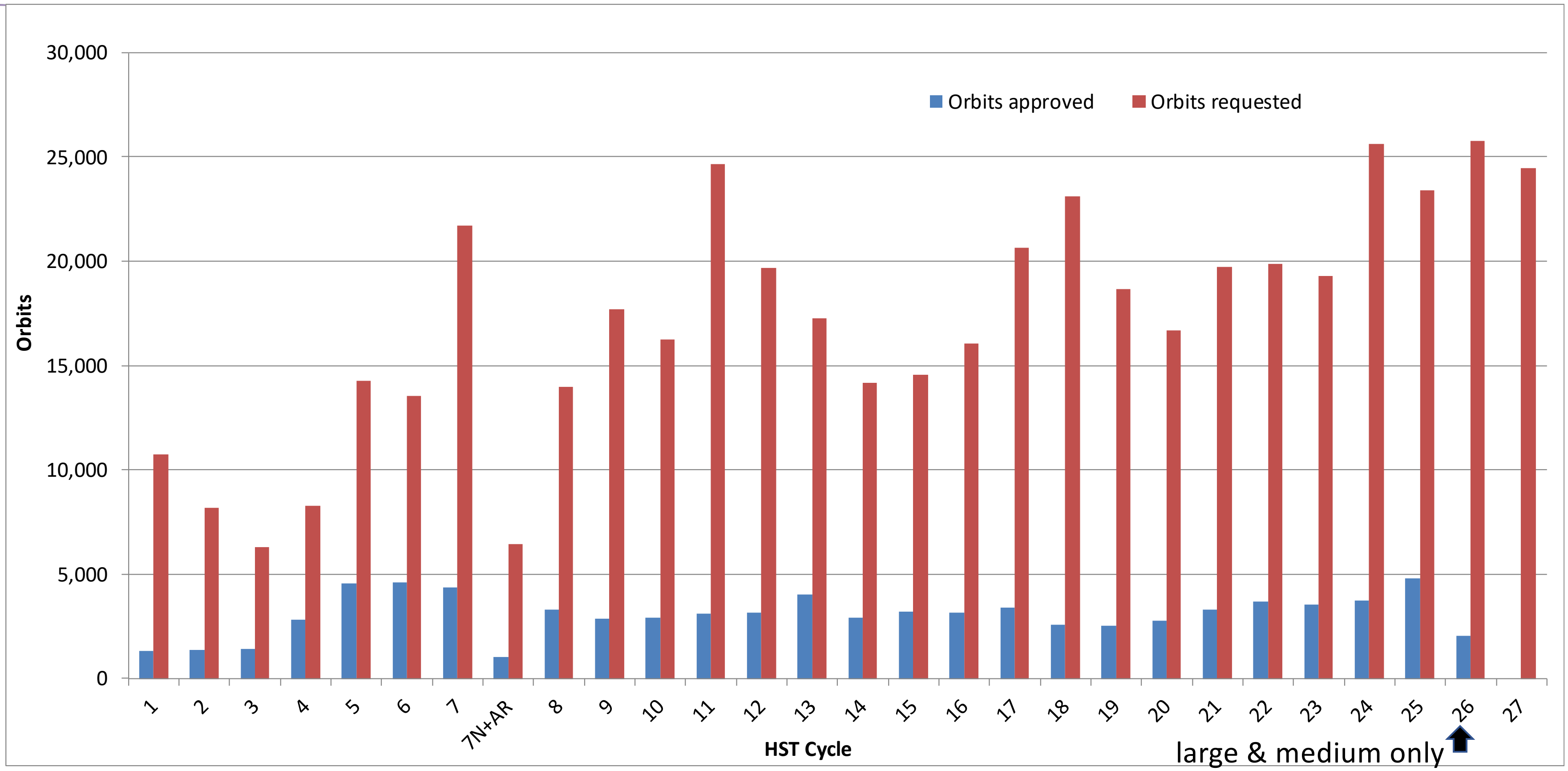
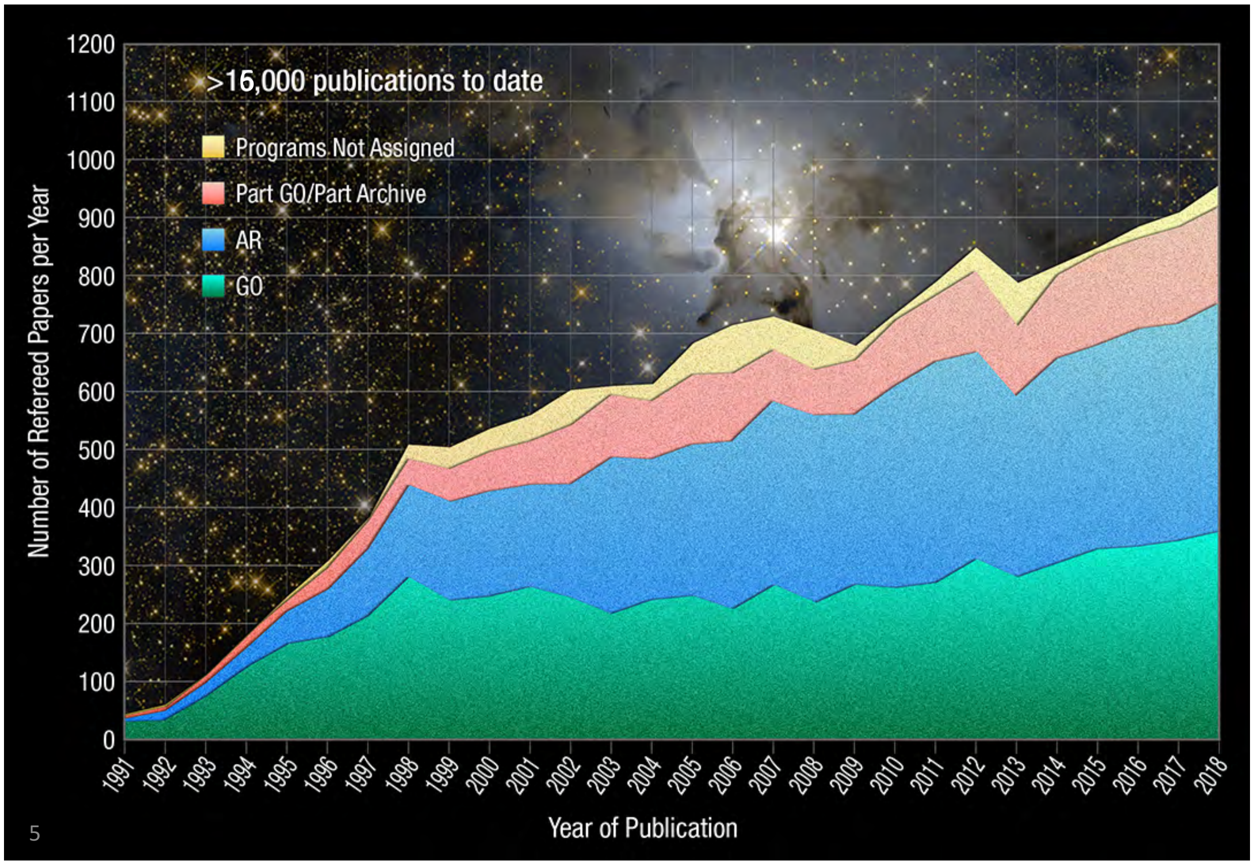


Science Productivity at All Time High



- 950+ refereed science papers a year
- 16,000+ refereed science papers to date
- 800,000+ citations
- 600+ PhD theses
  - currently ~1 per week
- 2+ published papers per day
- 1 in 6 astronomy papers influenced by Hubble
- Hubble h-index continues to climb:

year	2016	2017	2018
h-index	257	274	288

Hubble Senior Review

- HST 2019 Senior Review was a full review
  - 2014 was full review
  - 2016 was delta review
- Process was delayed by government shutdown
  - March 15: Proposal deadline
  - April 22: Panel sent questions to be answered prior to review
  - May 6-8: Site visit by panel
- Site visit
  - Seemed to go well, with lots of pertinent questions.
  - May 6: 2.5 hours presentations + Q&A
    - Nancy Levenson: Welcome and Introductions
    - Jennifer Wiseman: Project Science Perspective
    - Rachel Osten: Science Program, Initiatives, and Outlook
    - Tom Brown: Science Operations
    - Pat Crouse: Flight Operations and Project Management
  - May 7: Committee deliberations + Q&A
  - May 8 Committee deliberations + debrief

EXTENDING SCIENCE

NASA's Space Science Mission Extensions and the Senior Review Process

Committee on NASA Science Mission Extensions

Space Studies Board

Division on Engineering and Physical Sciences

A Report of

The National Academies of
SCIENCES · ENGINEERING · MEDICINE

Recommendation: NASA should conduct full Senior Reviews of science missions in extended operations on a 3-year cadence. This will require a change in authorizing language, and NASA should request such a change from Congress. The Earth Science Division conducts annual technical reviews. The other divisions should assess their current technical evaluation processes, which may already be sufficient, in order to ensure that the divisions are fully aware of the projected health of their spacecraft, while keeping these technical reviews moderate in scope and focused on changes since the preceding review. (Chapter 3)

One Hundred Fifteenth Congress
of the
United States of America

AT THE FIRST SESSION

Begun and held at the City of Washington on Tuesday, the third day of January, two thousand and seventeen

An Act

To authorize the programs of the National Aeronautics and Space Administration, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SEC. 513. ASSESSMENT OF SCIENCE MISSION EXTENSIONS.

Section 30504 of title 51, United States Code, is amended to read as follows:

"§ 30504. Assessment of science mission extensions

"(a) ASSESSMENTS.—

"(1) IN GENERAL.—The Administrator shall carry out triennial reviews within each of the Science divisions to assess the cost and benefits of extending the date of the termination of data collection for those missions that exceed their planned missions' lifetime.

Long Range Plan: Current Status

Cycle 26 averaging 75.4 orbits/week over first 33 weeks

- Without 3-week downtime in fall 2018, 83.0 orbits/week
- Cycle 17-23: 84 orbits/week
- Cycle 24: 82 orbits/week
- Cycle 25: 85 orbits/week

Previous Cycle Completeness

- Cycle 24: 22 orbits left in plan through fall 2019
  - 20 orbits of Sing 14767 exoplanet HOPRs
  - 2 orbits Wong 14661 Juno perijove
- Cycle 25: ~630 orbits remain (due to 1200+ more orbits accepted in Cycle 25)

Nominal Cycle 26 boundary Oct 1, 2018; delta-TAC led to actual start in January 2019

- ~2200 orbits of Cycle 26 material remain

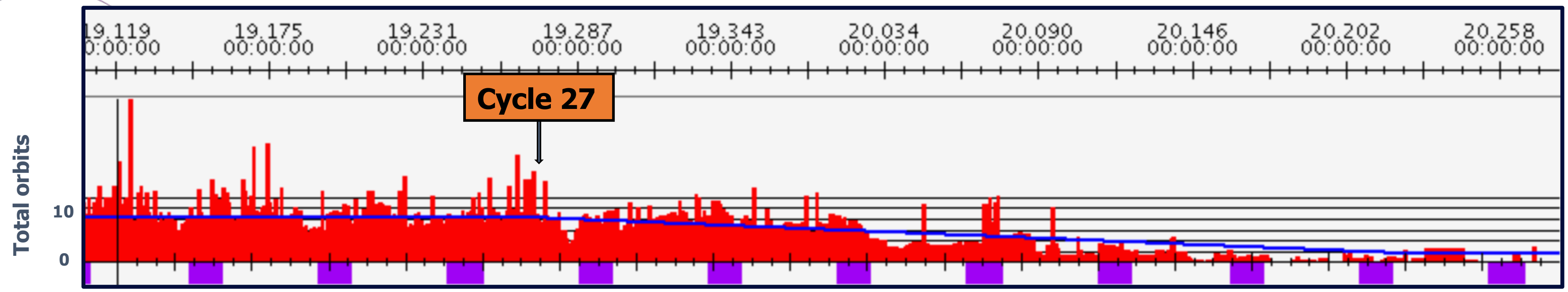
Cycle	Orbits
24	22
25	632
26	2193
Total	2847

C25 snaps	1367
C26 snaps	0
Total snaps	1367

Instrument	Orbits
WFC3	1379
COS	615
ACS	409
STIS	446
FGS	0
Total	2849(1)

(1) Some programs have more than one prime SI.

Long Range Plan: Current Status

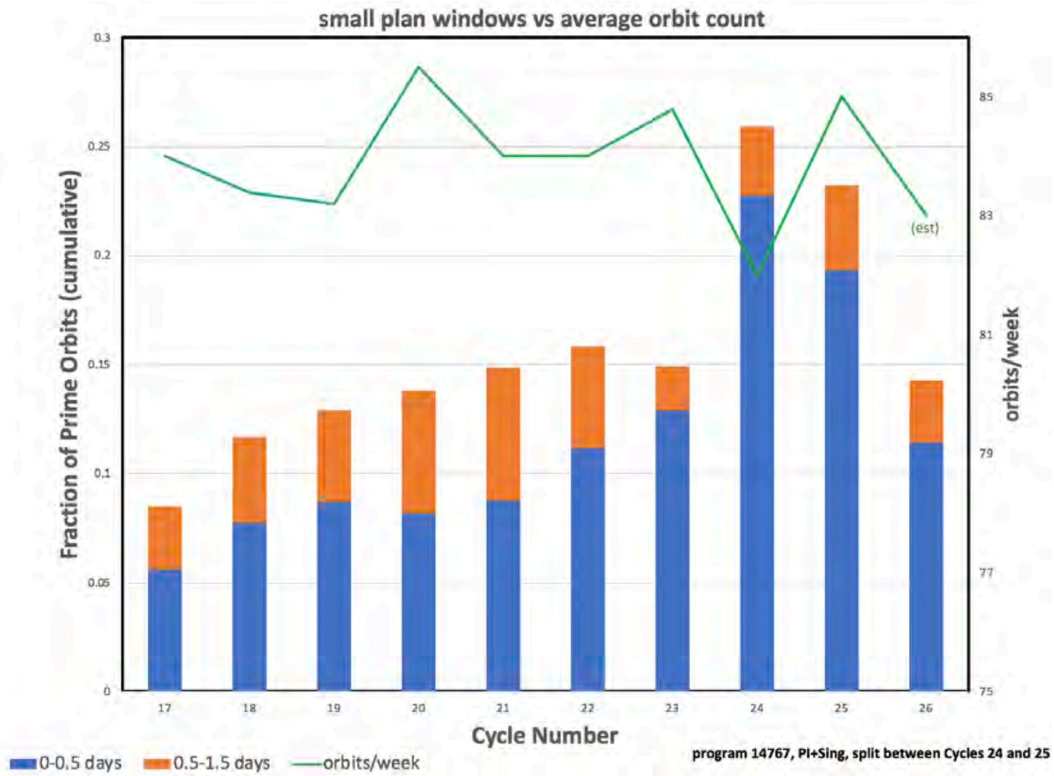


- **While Cycle 26 nominal start was October 2018**
  - Cycle 25 still dominates the current plan
  - Currently, the Cycle 26 tail (Oct 2019 and later) contains ~1500 orbits (2x typical size)
- **Upcoming Cycle 27 milestones**
  - TAC meets June 10-14
    - Awarding 2700 orbits given backlog, acquisition success rate, & ULLYSES
  - Phase II deadline July 26
  - Proposal preparations and LRP build in August
  - Plan windows released in late August

Long Range Plan: Current Status

High percentage of time-constrained science continues to limit LRP flexibility

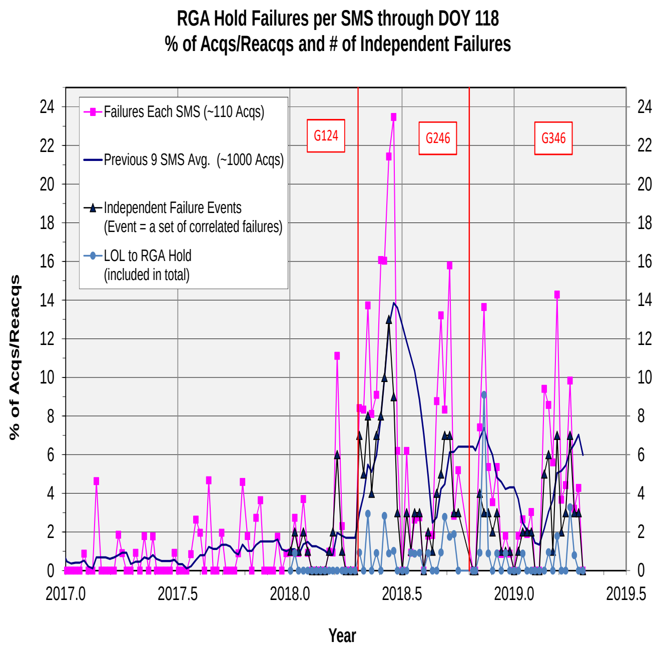
- Fewer cycle 26 programs were highly constrained, but still dealing with Cycle 24/25 visits
- ~15% of current plan has plan windows of 1.5 days or less.
- High number of constraints create conflicts between science programs
  - Calendar pre-builds required to identify conflicts early in the process
- High number of programs requiring small blocks of SAA-free time, so programs requiring large blocks of SAA-free time (4-5 orbits) delayed
- Fewer flexible visits later in plan that can be moved forward to fill schedule gaps

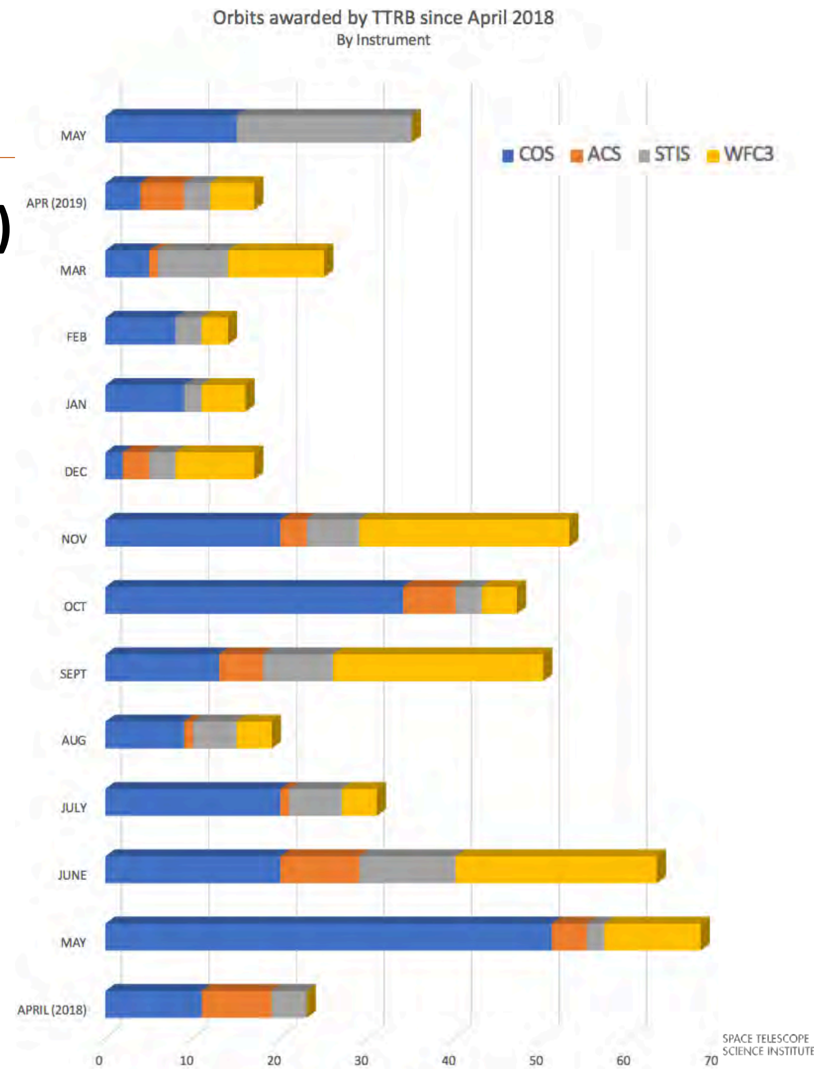


Long Range Plan: Recent activity

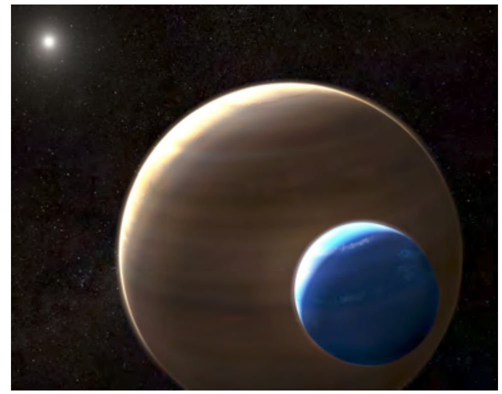
Higher rate of acquisition failures (gyro issues)

- **Higher HOPR rate impacts LRP stability**
  - Some failures are assumed when LRP is built, but higher rate will be assumed for C27





Long Range Plan: Statistics



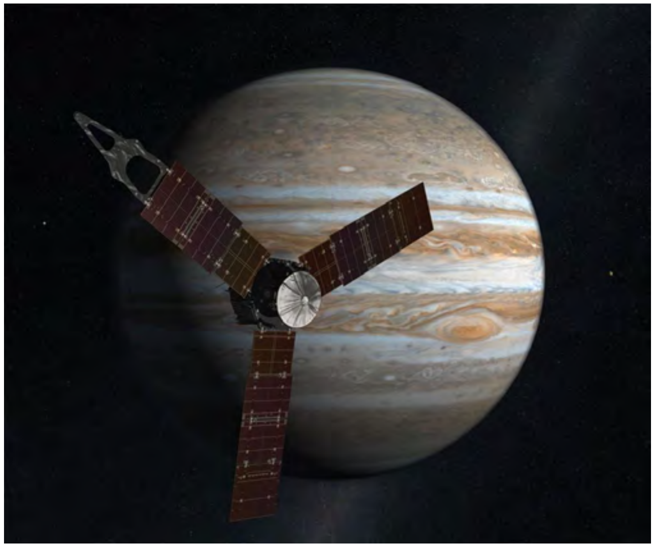
Exoplanet Programs: Highlights

- Sing (Cycles 24/25 Large): 478 of 498 orbits complete
- deWit (Cycle 25 Large): 73 of 114 complete
- Crossfield (Cycle 25 Large): 58 of 127 complete
- VandenBerg - HST observed possible candidate of an Earth analogue from the Kepler Mission
  - 21-orbit visit executed on May 3

- **217 orbits of C24/25 exoplanets with period/phase constraints remain in the plan.**
  - Due to ephemeris limits, only windows less than 70 days from current time are considered reliable
  - Many currently have no windows
  - Two Cycle 26 exoplanet programs were accepted; neither has period/phase requirements
  - Cycle 27 exoplanets will compete with these for time

LRP: Statistics

Planetary Programs: Highlights



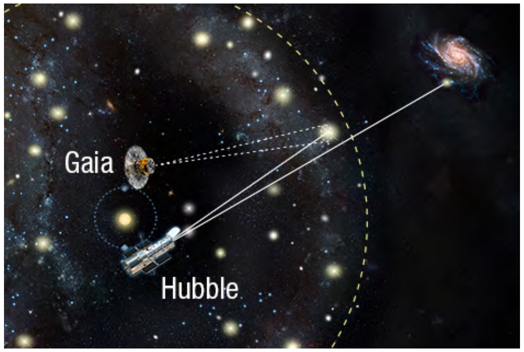
- **Medium/Large Jupiter/Juno programs**
  - Grodent (Cycle 24 Large): 151 orbits, complete
  - Wong (Cycle 24 Medium): 43 of 45 orbits done
  - Grodent (Cycle 26 Medium): 25 of 54 orbits done
- **Europa Cycle 25 mid-cycle campaign**
  - Roth: 46 of 55 orbits done
  - Sparks: 26 of 30 orbits done
  - deKleer: 10 orbits, complete
- **OPAL: Outer Planet Atmospheres Legacy**
  - Cycles 22-24: 29 total orbits per cycle on Jupiter, Saturn, Uranus, Neptune
  - Cycle 25: 41 total orbits
  - Cycle 26: 41 orbits planned
  - Cycle 27: assume 41 orbits for the four planets

Other Large/Medium highly constrained programs: Highlights

- **Homayouni – UV Echoes of Quasar Accretion Disks**
  - 1-orbit visit every other day for 80 days
  - Three quasars targeted in a single orbit
  - As of May 6, 30 of 40 visits have executed or are on a current flight schedule

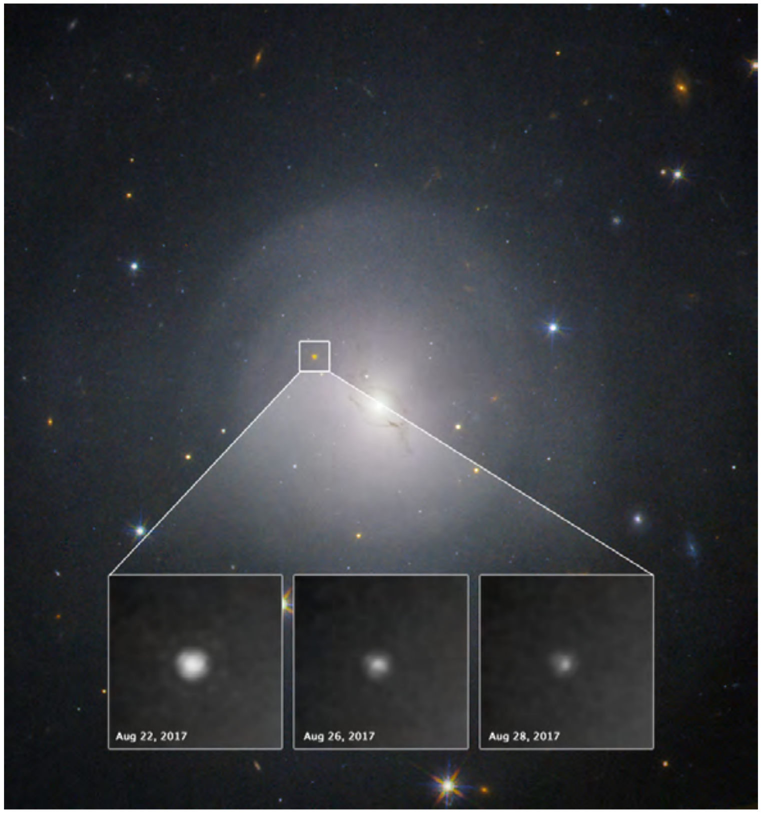
- **MacGregor - Origin and Impact of Flares in the Closest Planetary System – Proxima Centauri**
  - 11 4-orbit STIS-MAMA visits within an 18-day window
  - Coordinated with ALMA
  - All have either executed or are on a current flight schedule
  - Three failures so far, will try again in mid-June

- **Riess – Search for New Physics Amid the Hubble Constant Tension**
  - Time-series observations of extragalactic Cepheids
  - Six galaxy hosts. 11 visits per set, separated by ~14 days
  - One galaxy: 10 of 11 visits observed; another galaxy starts in early May



LIGO follow-up

- Cycle 26 has an ultra-rapid follow-up program for LIGO (PI: Levan, GO-15664)
- An internal WG, in tandem with some members of the transient community, has been looking to optimize the follow-up Hubble observations
- Developing an example program for the community
- Will likely involve pre-defined template and decision tree
- No health & safety concerns – will use WFC3 imaging and grism spectroscopy for UV light curve



Large/Treasury programs

C24/25 Program	alloc	Exec/sched by 5/19/18	Planned before 10/1/19	Planned after 10/1/19	comment
Sing * (C24)	498	478	20	0	HOPRs
Bedin	40	35	5	0	HOPRs
Bowen	91	91	0	0	
Chen	169	148	3	0	18 not in plan
Crossfield - *	127	58	23	46*	
Froning	157	99	55	0	3 not in plan
Jansen	36	36	0	0	completed
Krauss	132	103	26	2	1 not in plan
Riess	168	167	0	0	completed
Shapley	87	87	0	0	completed
Steinhardt	101	48	20	12	BUFFALO. 21 need windows
Suzuki (ToO)	70	22	0	0	2^{nd} cycle SUSHI; completed
deWit - *	114	73	12	20*	9 not in plan

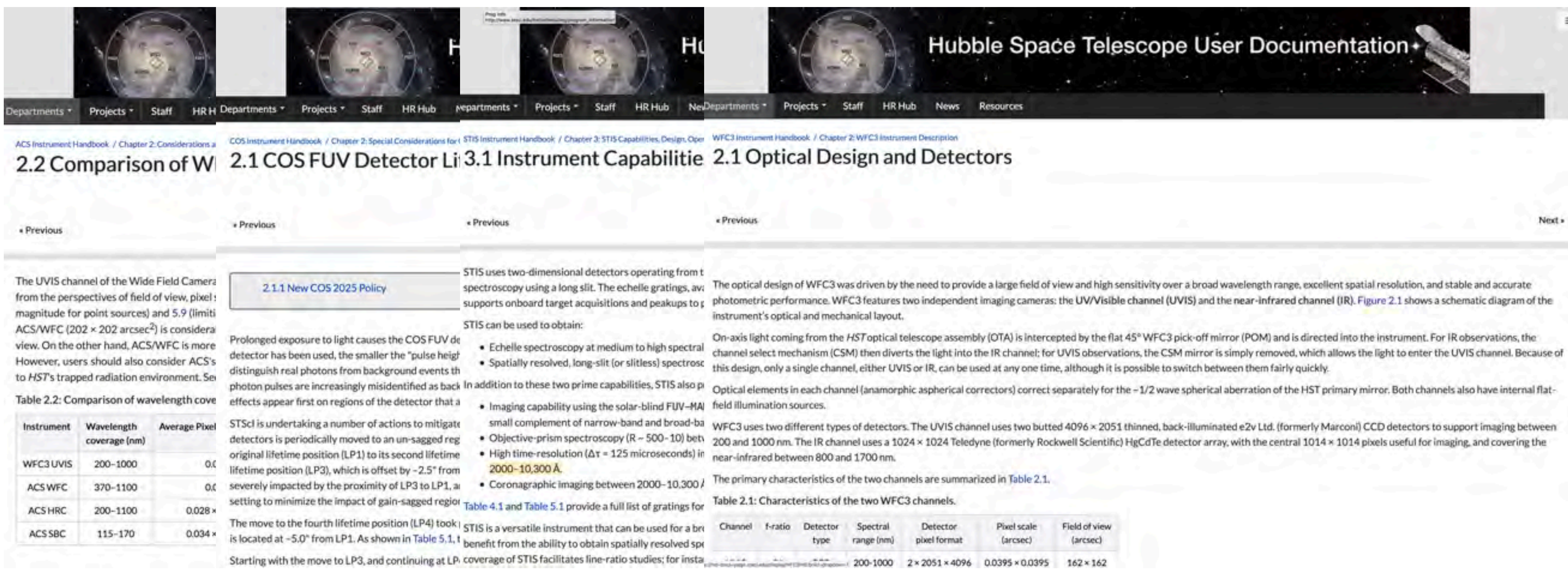
* - exoplanet visits not planned, "in the bullpen" until the LRP group can pull them forward.

Large/Treasury programs

C26 Program	alloc	Exec/sched by 5/19/19	Planned before 10/1/19	Planned after 10/1/19	comment
Freedman	54	0	42	12	
Jaskot	134	0	18	116	
Lee	122	5	23	94	
Levan (ToO)	45	0	0	0	
Parker	206	5	83	118	
Peek	73	3	33	37	
Rafelski	90	0	90	0	
Riess	110	14	35	54	7 not in plan
Teplitz	164	16	16	132	

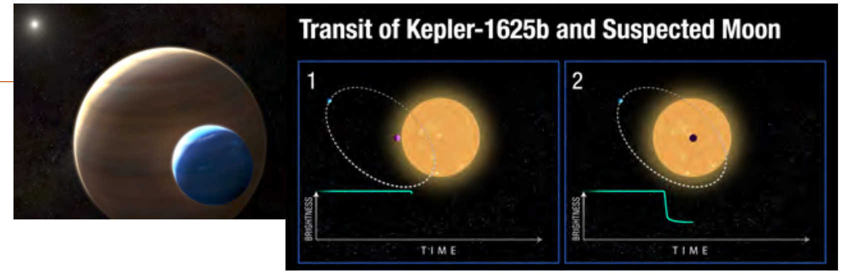
Migration of Website & User Documentation

- Plan to release new Hubble science site and Wiki documentation in mid-June
- Carol Christian will discuss website
- Wiki versions of handbooks nearly complete, following CfP, P2PI, Primer

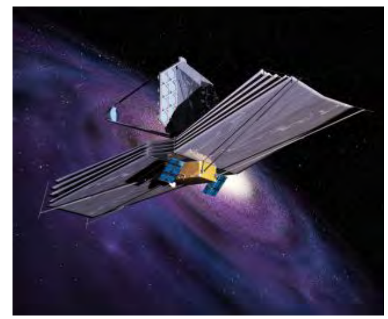


Thinking ahead

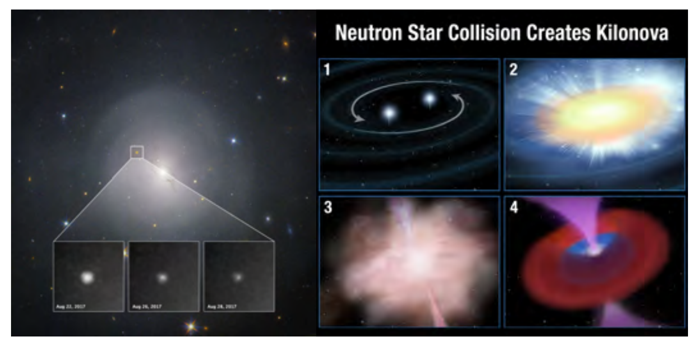
How should Hubble best be used in the next decade?



JWST will be up and running. We need to determine how to solicit and allocate time for science that could be done on either observatory.



All-sky, transient, and multi-messenger astronomy will be coming to the fore.



See John MacKenty presentation and subsequent discussion

Rachel Osten submitting proposal for a Special Session at the Hawaii AAS meeting to explore synergy between HST & JWST

Summary

- Hubble is performing at peak productivity
- Challenges continue from time-constrained programs, but we are working to enable these exciting science explorations
- We're thinking broadly about the landscape in the next decade and Hubble's role in it

Hubble
29th Anniversary Image

Southern Crab Nebula