



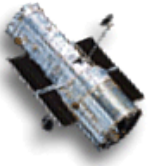
# **HST 2020 Vision**

**STUC Meeting – October 2014**

**K. Sembach, N. Reid**



# Hubble 2020 Vision



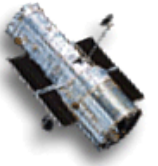
Operate Hubble out to 2020 or beyond so that there is at least one year of overlapping science observations with the James Webb Space Telescope, performed in a manner that maximizes the science return of both observatories by taking full advantage of Hubble's unique capabilities and the astronomical community's scientific curiosity.

2014 Senior Review: *The large oversubscription in scientific demand for observing time on Hubble indicates that there remains far more important and exciting science to be done than the observatory can accommodate. If appropriately funded, the Hubble observatory will in all likelihood continue at its present level of achievement and productivity for years to come.*

2014 Senior Review: *The collective brainpower of the worldwide scientific community that openly competes to utilize Hubble is responsible for extraordinary scientific gains that would not have been envisioned even a decade ago. We find no evidence that this trend of frontier-bending scientific achievement is likely to falter anytime soon.*



# Hubble has a finite lifetime



## Operations through FY21 (Cycle 28)

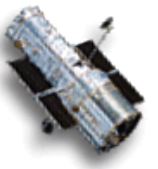
7 cycles (including Cycle 22) x ~4000 science orbits per cycle

=> 28,000 orbits remaining

**What should we do with those precious orbits?**



# Shaping the 2020 Vision



- A person who has not made his great contribution to science before the age of 30 will never do so. - A. Einstein*

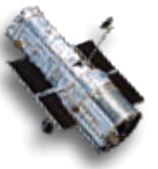
PhD Production		
Year	Astro PhDs*	HST PhDs
2012-13	155	40
2011-12	152	50
2010-11	160	37
2009-10	156	42
2008-09	141	36
2007-08	161	40
2006-07	125	30
2005-06	119	24

Average = 25%

\* Source: <http://www.aip.org/sites/default/files/statistics/rosters/astrost13.pdf>



# Monitoring the outer planets



- Solar System Advisory panel raised the issue of long-term monitoring of atmospheric activity in the outer planets
  - Absent *in situ* planetary probes (e.g., Cassini), HST is crucial in providing high-resolution observations of atmospheric features
    - Probe atmospheric circulation and weather systems; seasonal changes; energy balance – particularly in Uranus & Neptune
    - Serve as local templates for exoplanet properties
  - Year-by-year proposals tend to be regarded as incremental by the TAC
    - Significant gaps in coverage over Hubble's lifetime
    - These impact our understanding of long-term seasonal variations

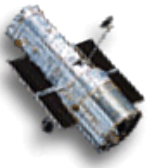
Table 1: Years w/ Planet Coverage by Hubble UV/Visible camera

Planet	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14
Jupiter	Red	Red	Red	Green	Green	Green	Blue	White	White	White	White	Blue	Green	Red	Red	Green	Blue	White	Red	White	Green
Saturn	Blue	Red	Blue	Blue	Blue	Blue	Blue	Green	Blue	Green	Blue	White	White	White	Blue	White	White	White	White	White	White
Uranus	Green	Green	White	Green	White	White	Green	Red	Red	Green	Green	Green	Green	Red	Red	Blue	Green	Blue	White	White	White
Neptune	Red	Red	Red	Red	Red	White	Green	Green	Red	White	Green	Green	Green	Green	Red	Blue	Blue	Red	White	White	White

Color code: white = no data, blue = imaging only, green = wind pairs, red=high res. global maps



# Monitoring strategies



- White paper submitted by Amy Simon-Miller, Glenn Orton, & Michael Wong on behalf of the outer planet community
- Summarizes the science goals of atmospheric studies
- Outlines several scenarios for routine monitoring of atmospheric features on Jupiter, Uranus, Neptune & Saturn (post-Cassini)
  - Paired snapshots / Global maps / Paired global maps
- Global maps of the outer planets provide full longitudinal coverage and determine the spatial variation of distinct cloud features
- Pairs of global maps provide global measurements of the wind field

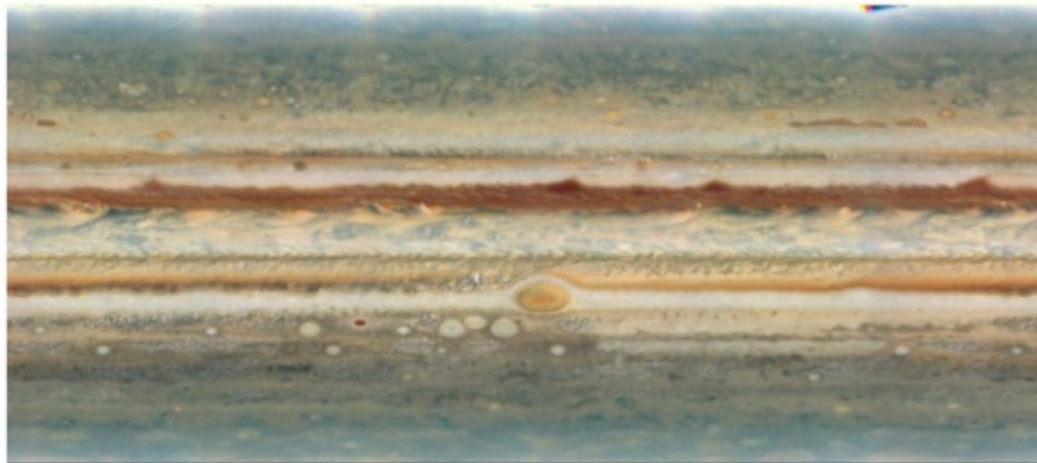
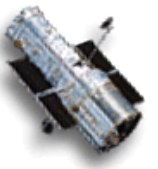


Figure 4. Seven contiguous orbits allow for full longitude coverage on Jupiter.



# HST Vision Programs



- Long-term monitoring programs – Outer Planet Atmosphere Legacy (OPAL) program
  - 29 DD orbits/year (41 with Saturn, post-Cassini)
  - Approved by Director through the end of HST's lifetime
  - Perhaps this concept should be applied more broadly to other astrophysical objects/phenomena (e.g., SN1987A?)
- Institute-led initiatives
  - Frontier Fields – conclude in Cycle 23
- Community-led initiatives
  - Another Multi-Cycle Treasury Call?
- Joint JWST / HST programs?