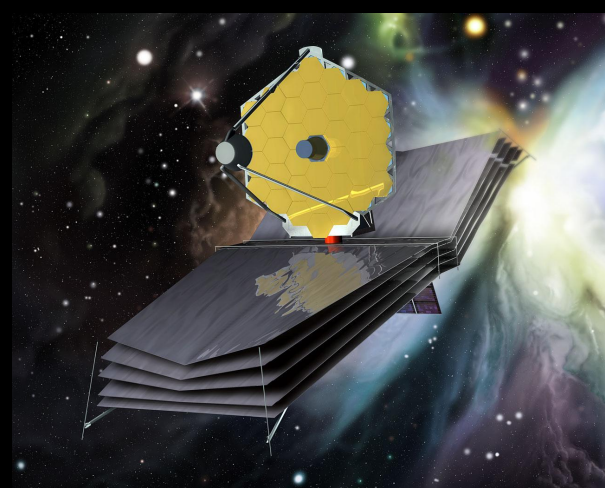
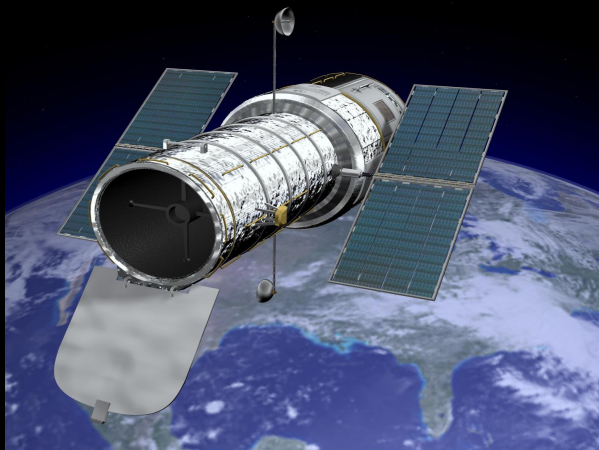


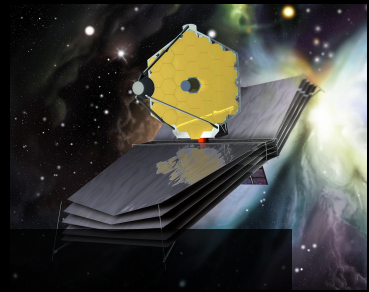
# Long-term Variability Monitoring Strategies for HST and JWST

Progress Report to STUC/JSTUC  
December 1, 2023



*Seeking community input on  
key science areas that exploit  
long time-baseline  
observations.*

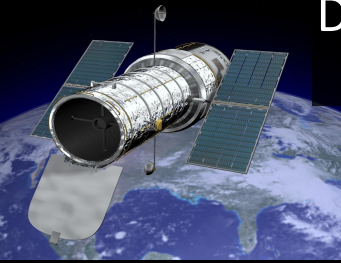
# Long-Term Variability Monitoring Strategies for HST and JWST



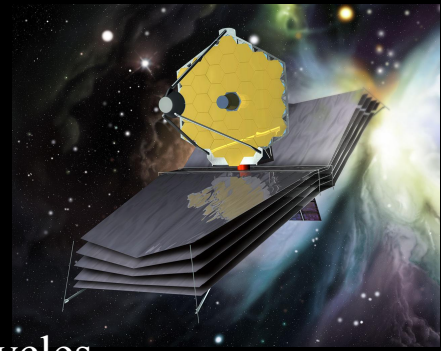
## Working Group membership

Co-chairs: Dana Casetti (Southern Connecticut University)  
and Saurabh Jha (Rutgers University)

Members: Gary Bernstein (U. Penn.), Matt Hayes (Stockholm),  
Lidia Oskinova (Potsdam), Andrew Pace (Carnegie Mellon),  
Robert Quimby (San Diego State), Megan Reiter (Rice),  
Armin Rest (STScI), Adam Riess (JHU/STScI), David Sand (Arizona),  
Dan Weisz (Berkeley)

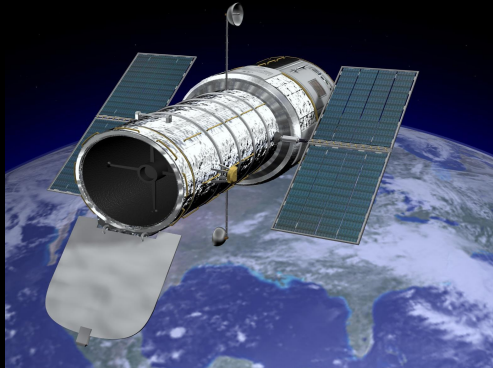


# Long-Term Variability Monitoring Strategies for HST and JWST



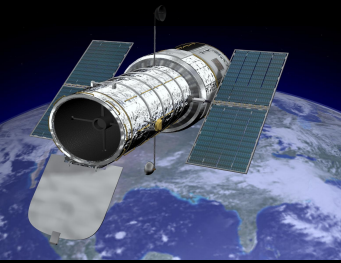
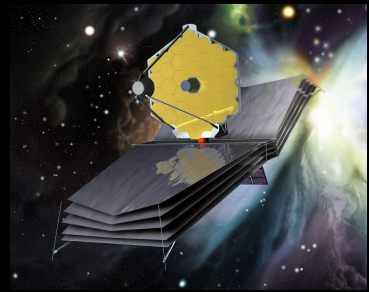
“Variability” includes photometry, spectroscopy, or astrometric motion;  
“Long-Term” refers to observations incompatible with standard proposal cycles

Charter: collect community input, identify key science themes, and make recommendations for HST/JWST LTVM programs and a JWST DDT program for high-redshift transients



# Timeline

- June 15, 2023: call for community input released
- August 17, 2023: virtual town hall
- September 8, 2023: due date for community input via survey form or short contributions
- Fall 2023: working group will make interim recommendations to STScI Director, STUC, and JSTUC (aim to have this by end of December)
- January 2024: working group will present final report (more likely ~February)
- Working group is *advisory* to STScI Director who will make final decisions on implementation, etc.





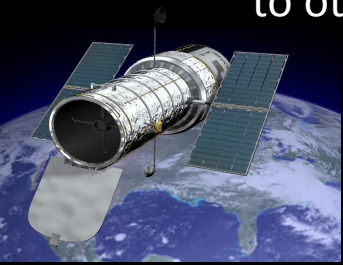
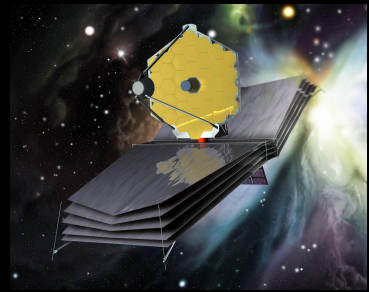
## Long-term Monitoring Strategies Working Group

adapted from JSTUC meeting  
slide  
September 18, 2023

- WG established a regular series of video-cons
- Input solicited via two formats
  - Anonymous on-line survey
  - 1-2 page short contributions submitted by email (not held anonymous)
  - Community invited to attend a virtual town hall August 17
    - ~100 attendees
    - Proceedings were recorded and are available on the charter page
- Submission deadline for survey/short contributions was September 8<sup>th</sup>
  - 91 survey responses, 38 short contributions
  - Materials have been delivered to the WG members
  - ~~In person meeting will be scheduled~~ approx. weekly virtual meetings

# Strong community interest in this science

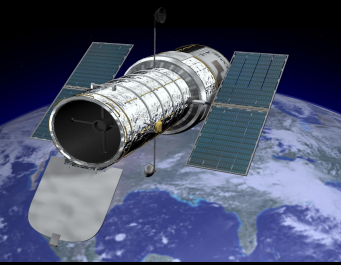
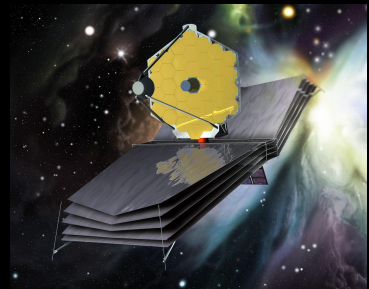
- Wide range of science topics submitted by the community
  - Variable stars (42), Transients (41), Nearby galaxies (28), AGN (27), Solar System (20), Proper Motions (19), Software (12), Exoplanets/BD (5)
- *There is strong community interest in this science. Our primary recommendation will be that long-term science should be enabled and prioritized for HST and JWST.*
- The current proposal process does not adequately enable this science for observations that need longer than a 3 cycle time baseline
  - double (or multiple) jeopardy having to get proposals approved by different panels
  - science return of “first epoch” observations is limited compared to other proposals promising immediate results





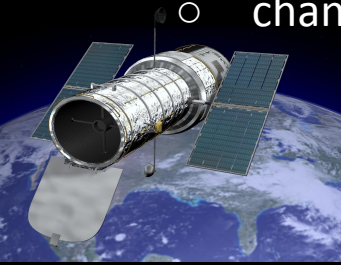
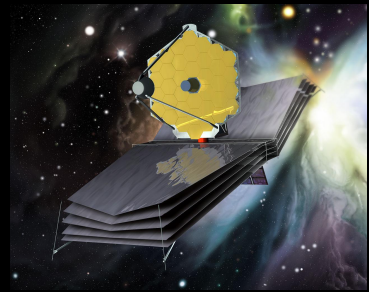
# Enabling long-term science

- we identified three main kinds of long term program needs
  - programs requiring two widely-separated epochs
    - e.g., 10 to 40 year baseline for proper motions
  - programs requiring regular monitoring over a long time baseline
    - e.g., one orbit per year for 10 years
  - community process for establishing high priority fields for first-epoch JWST observations
    - these could have a legacy even beyond JWST lifetime, e.g. for future observatories



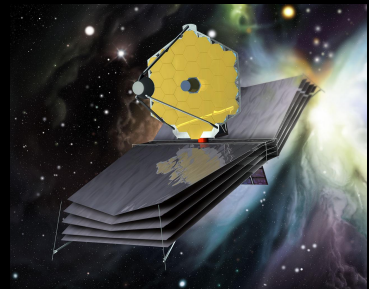
# Enabling long-term science

- considering recommendations for policies to support this science, e.g.,
  - establishing a panel specifically for long-term proposals
  - instructions to panels for reviewing long-term proposals
  - APT checkbox + more info in Special Requirements of proposal
  - pre-allocation of orbits for a long-term pool
  - mechanism to monitor progress for LTVM programs
- other issues to consider
  - coordination of LTVM programs with other facilities
  - accounting of future time/orbits
  - proprietary period of LTVM programs
  - funding allocation for LTVM programs
  - following-up discoveries from long-term monitoring programs
  - changing proposers or multiple teams for LTVM programs





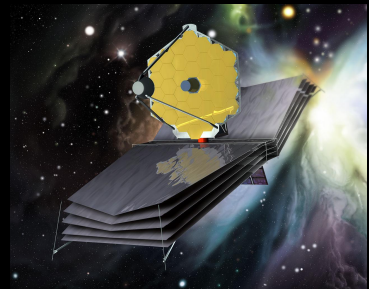
# JWST DDT program for high-redshift transients



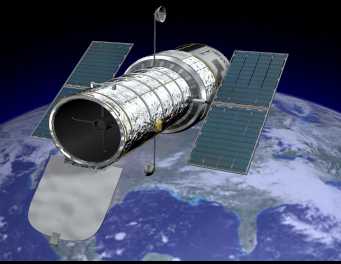
- A key mission success science goal for JWST is to observe the first generation of stars and galaxies: discovering a Pop III supernova would achieve this and is something only JWST can do
  - but there are major uncertainties in the properties and rates of Pop III SN
- Aim to design a program that is capable of detecting Pop III SN if they are common enough, that also should detect many kinds of high-redshift ( $z > 2$ ) transients
  - Hubble diagram with tens of SN Ia from  $z > 2$  out to  $z \sim 5$  (+ further if they exist)
  - have a goal of finding some very high redshift transients
    - $z > 6$  CCSN (rates track changes in IMF; spectra can track changing metallicity)
    - variable AGN at  $z > 8$  to determine SMBH seeding mechanism
    - rarer transients: SLSN out to  $z \sim 10$ ; TDE at  $z > 5$



# JWST DDT program for high-redshift transients

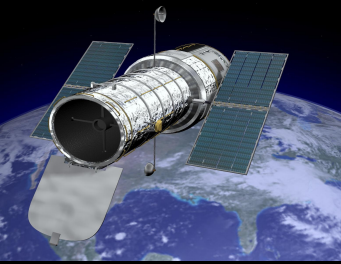


- Considering three kinds of fields:
  - ecliptic poles (enables regular monitoring, e.g. 3-month cadence for  $z \sim 2$  transients, with yearly coadds probing highest redshifts)
  - well-observed extragalactic deep fields (e.g., COSMOS-Web)
  - lensing cluster fields
- Depth, area, filters, and parallel imaging all under consideration
- We anticipate reserving time for *follow-up* (e.g., transient spectroscopy) in the program, as well as enabling follow-on GO proposals to build on this initial investment.
- The survey should also provide a wealth of ancillary science, ranging from solar system objects to high-redshift static sky deep fields



# Executive summary

- There is strong community interest in Long Term science, across a wide range of science themes. Current framework is inadequate for LT science.
- Our primary recommendation will be that long-term science should be enabled and prioritized for HST and JWST.
- We are developing recommendations for policies and processes to bolster LTVM science and for a JWST DDT survey for high-redshift transients.
- We plan to make interim recommendations before the end of 2023 and produce a final report incorporating feedback from STScI and the wider community in early 2024.



**We welcome feedback from the STUC, JSTUC, STScI, and the community as we develop these recommendations!**

