IMPLEMENTING PORTALS OF THE UNIVERSE:

Hubble Space Telescope

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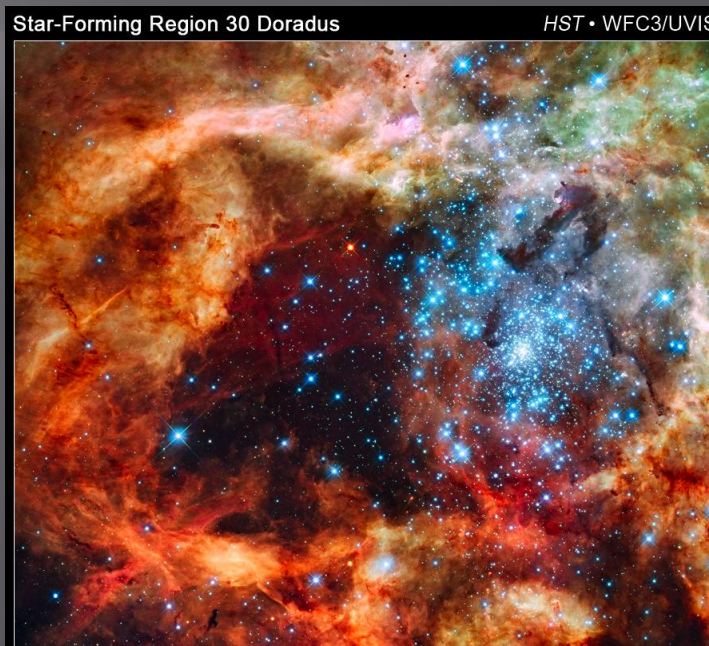


Basic parameters

Mission duration – 22 years and counting
Userbase – 3923 unique authors/co-authors in 2011, > 10,000 registered archive users
Archive data volume – 60 Tbytes
Instruments – Currently 5, 12 over 22 years (ACS, COS, FGS, HSP, GHRS, FOC, FOS, NICMOS, STIS, WFPC1, WFPC2, WFC3)
Wavelength coverage – 0.1- 2.2 microns
Program model – GO, GTO, AR + Theory
Proposals/cycle – > 1000 lately
Users/cycle – 1200 – 1300 per year, 5322 over life of mission
Funding model – GO grants
Default proprietary period – standard:1 year - DD, treasury: 0

RECOMMENDED BEST PRACTICES – HIGHLIGHT # 1

Proposal Process (e.g., Types of Proposals)

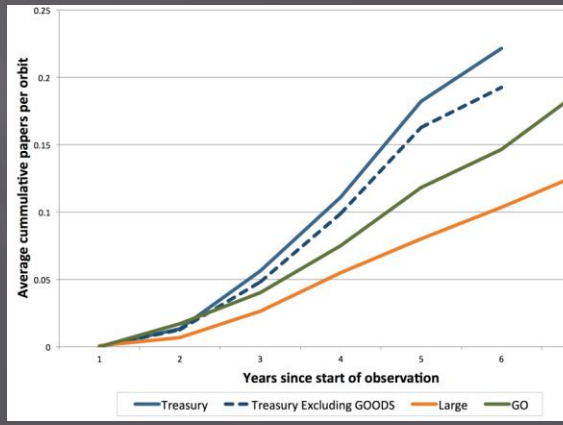
A diverse range of proposal types support a robust science program.

Left to it's own devices, proposal pressure (~10-to-1 oversubscription) leads to a large number of small proposals, making it impossible to do some of the most important science.

We use several techniques to counteract this tendency (e.g., Treasury proposals, TAC subsidies, creative use of DD time) and to maximize science (e.g., shortened proprietary time for Treasury, emphasis on High Level Science Products and legacy value of datasets).

Proposal types include:

- GO
- GTO (Guaranteed Time Observers)
- Large
- Treasury
- Multiple-Cycle Treasury (Cycle 18-20)
- Snapshot
- Parallel
- Target of Opportunity
- Archival (Regular and Legacy)
- Theory
- Director's Discretionary
- Special Calibrations
- Joint proposals (e.g., Spitzer)



Argues for diversity of proposal types, as appropriate for different missions.

RECOMMENDED BEST PRACTICES – HIGHLIGHT # 2

Instrument Calibration and Characterization

Instrument scientists are active research astronomers (self motivated to optimize their own science and hence the communities science at the same time, produce the best possible reference files, develop new modes, …). Scientists are embedded in the instrument teams along with data analysts and programmers.

Information is communicated in a variety of ways: 1) Instrument Handbooks, 2) Data Handbook, 3) team web pages, 4) electronic newsletter, 5) AAS meetings, 6) calibration workshops, …

Examples of contributions, new modes, techniques:

- Diagnostics and correction of spherical aberration (Burrows, Hasan)
- Deconvolution methods (before spherical aberration was fixed – White, Hanisch)
- Hubble Deep Field, Ultra Deep Field (Ferguson, Williams, …)
- NICMOS photometric non-linearity (Riess)
- Drizzle (combination of images), multidrizzle, astro-drizzle (Fruchter, Hooks)
- WFC3 built by "Integrated Team" with strong involvement of STScI staff
- CTE mitigation (pixel-to-pixel reconstruction – Anderson)
- Misc - Spatial scans (Mackenty) , recovering magnitudes for "saturated" stars (Gilliland) , new levels of astrometric accuracy (Anderson)…

Argues for active research staff with commitment to making improvements for the astronomical community.

RECOMMENDED BEST PRACTICES – HIGHLIGHT # 3

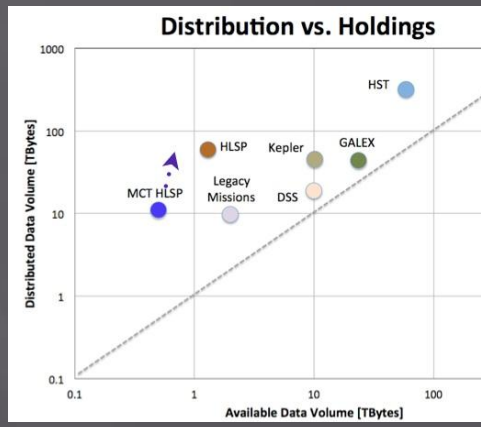
Calibration Pipeline and Archives

The development of the HST calibration pipeline, and a general-use, quick-access archive, changed the paradigm of how astronomers work.

By reducing redundancy, improving uniformity, and using the latest calibration software and reference files, observers can focus on the analysis and interpretation of the data rather than the routine reductions.

Archival progression:

- Basic reductions (flat fields, bias subtraction, …)
- Combining data (drizzle, multi-, astro-drizzle, mosaics, color …)
- Removing artifacts (cosmic rays, ACS bias stripes, CTE trails, …)
- Multi-mission Archive at Space Telescope (Multi-wavelength)
- Easy access, value-added (Hubble Legacy Archive, footprints, …)
- Emphasis on legacy value, High Level Science Products (HLSP)
- VAO compatibility (prepare for several decades, not just next year)



Argues for continual evolution, from simply controlling the bits to value-added products and tools leading to the enhancement of science.

CHALLENGES FOR THE FUTURE

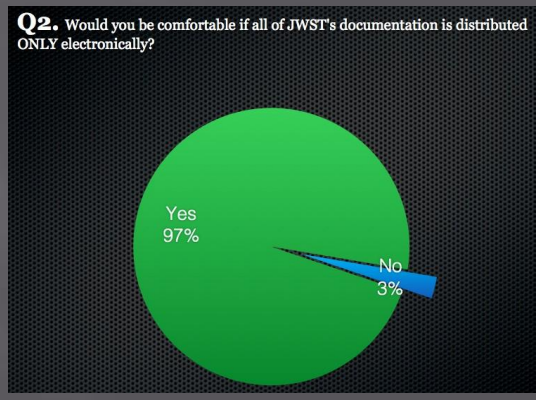
Documentation

When we started, there was no internet. A simple paper document, sent out to users on request, was sufficient.

With the explosion of the information age, we have new challenges (multiple sources of information, need for quick updating of information, compatibility with constantly changing media, predicting the future , …)

Goal might be to make a single change/update and have it propagate to:

- Paper version
- HTML and pdf versions
- Web pages (e.g., instrument teams)
- Wiki
- Help desk reference base (e.g., FAQ)
- Hand-held electronic media (e.g., ipod, i-books, …)



JWST questionnaire at AAS meeting suggests that people may be ready for all electronic?

Argues for keeping pace with how astronomers (and society) get their information, and being cognizant of future trends.

WHAT ARE THE CONSTRAINTS IN CURRENT POLICIES?

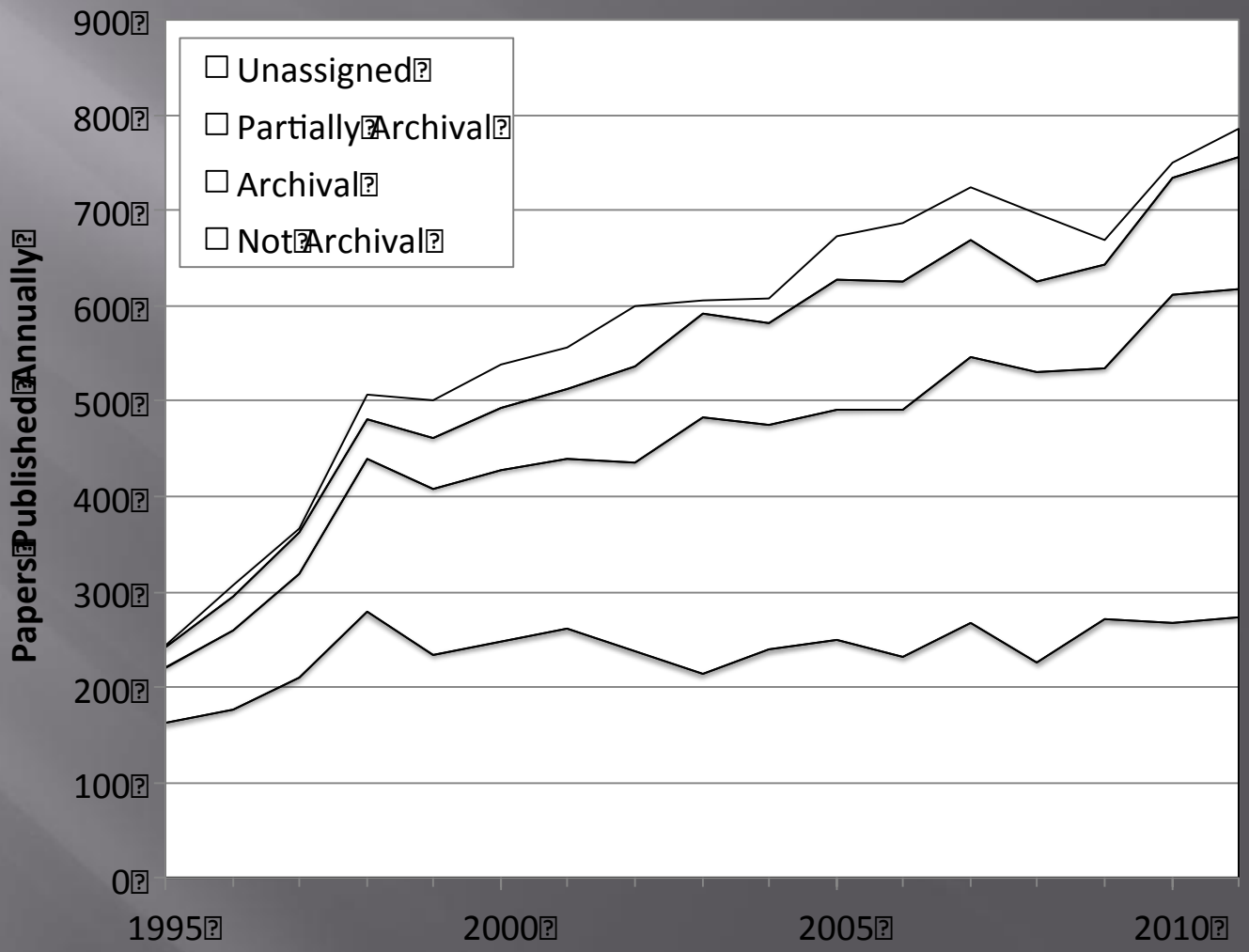
Nothing identified at present.

Suggestions and concerns

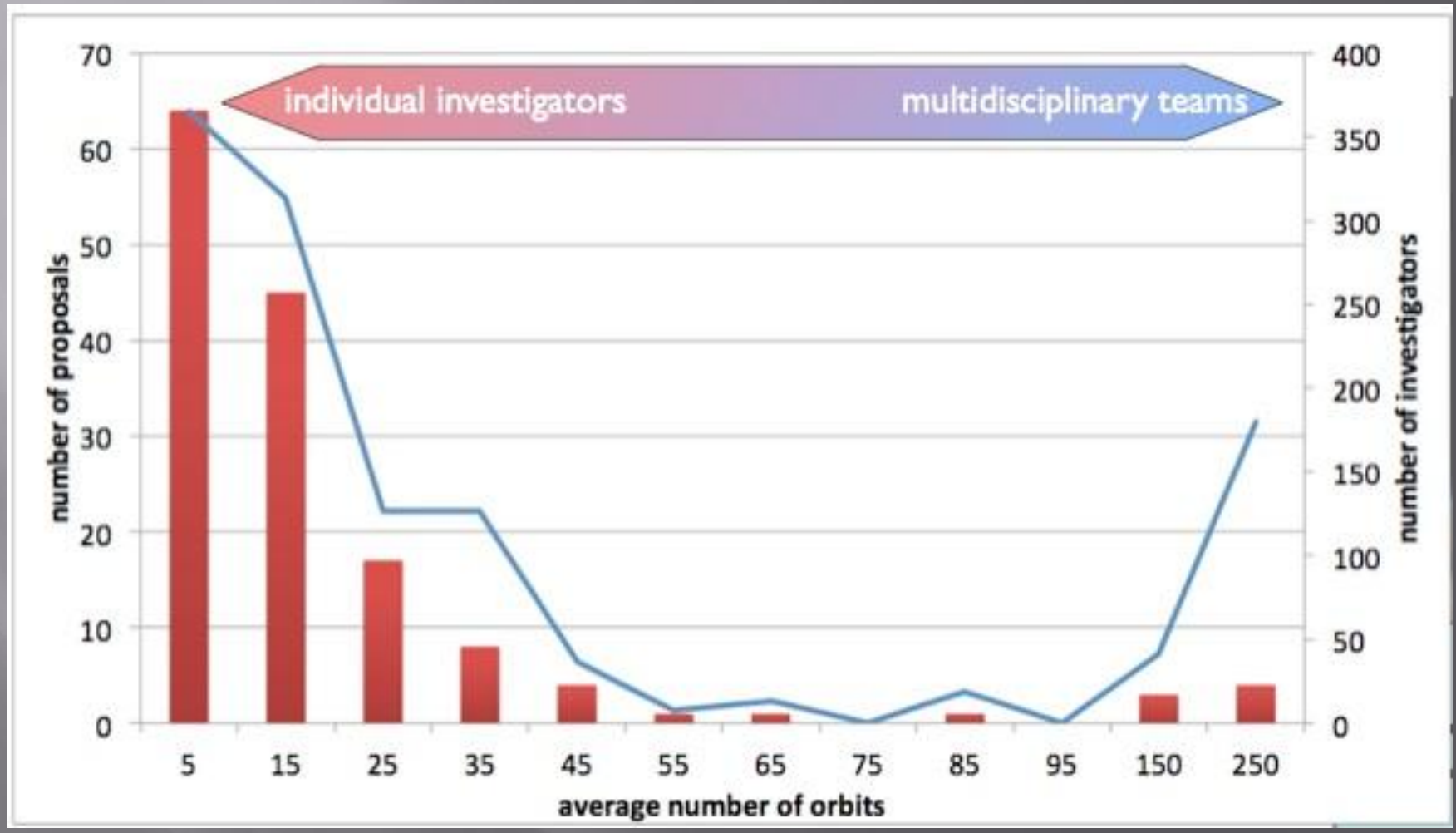
1. Modernize user support using new internet technology.
2. Path forward on science software is unclear (e.g., IRAF support, IFUs for JWST).
3. Value-added archival products and tools should have high priority (e.g., High Level Science Products, Discovery Portal, …).
4. Predicting the future will be important (internet evolution, cloud computing, documentation, …).
5. Hybrid model for grant support being considered for JWST (i.e., a combination of an Financial Review Committee (FRC) and formulaic approach for different types of proposals).
6. More extensive, more direct feedback from users (larger role of Users Committee, town meetings, webinars, more effective surveys, questionnaires at AAS meeting). What works best?
7. Continually reexamining and looking toward the future (e.g., 2nd Decade Committee >> WFC3/IR, Treasury programs, …).

Backup – Importance of Archives

Roughly 2/3 of the papers from Hubble are now coming from archival research.

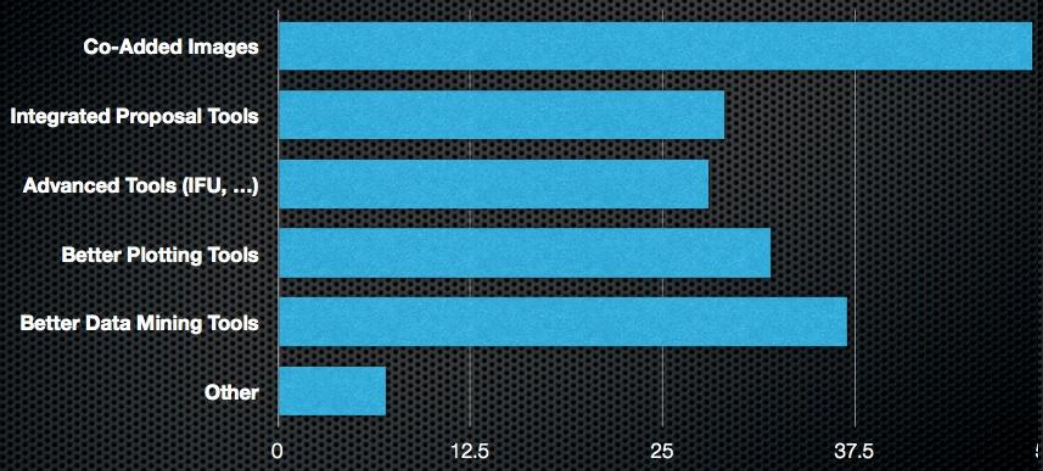


Backup – Proposal size and number of researchers supported.

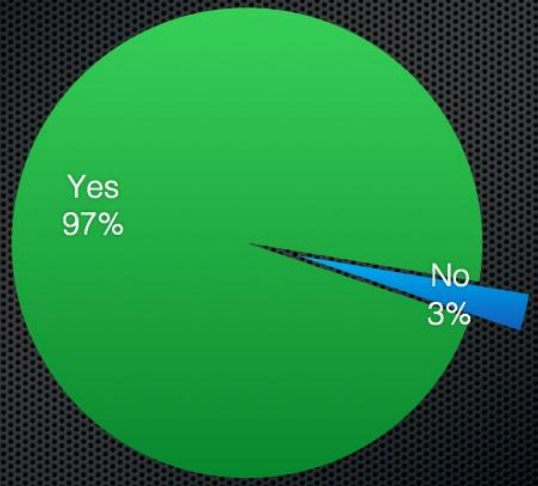


Backup – JWST Questionnaire

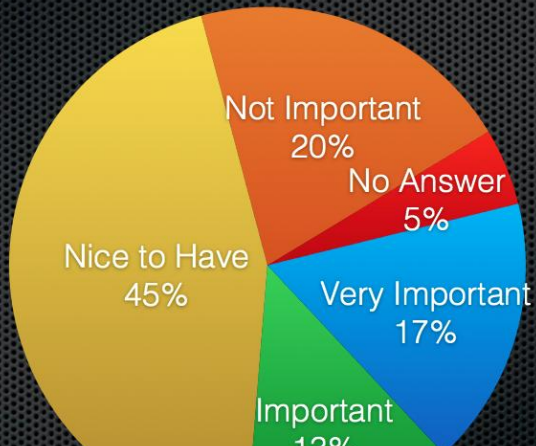
Q1. What kind of data reduction tools would you like to see for JWST that are not available today for Great Observatories such as Hubble, Spitzer, and Chandra?



Q2. Would you be comfortable if all of JWST's documentation is distributed ONLY electronically?



Q3. How important is it for you to be able to access JWST documentation on a mobile device (e.g., iPad, Tablet, iPhone)



Q4. How important is it for JWST's pipeline to release Level 4 data products (e.g., photometry catalogs, star galaxy separation)?