

# **Science Policy Topics**

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SMO

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# Outline

- Joint Observing Programs
  - Past usage and current status
  - XMM
  - Subaru
- Future Very Large Programs with HST
  - Past programs
  - Future possibilities
- Other topics
  - Rolling programs
  - JWST support
  - Other options?
- Summary

# Joint Observing Programs (1)

- Instituted to avoid double jeopardy in the TAC process
- Chandra
  - HST TAC allocates up to 400 ksec;
  - Chandra TAC allocates up to 100 orbits.

HST Cycle	ksec	Chandra Cycle	Orbits
9	328	3	90
10	345	4	51
11	170	5	43
12	115	6	77
13	85	7	60
14	130	8	25
15	60	9	59
16	89	10	62
17	110	11	99
18	170	12	84
19	0	13	96
20	270	14	66
21	0	15	44

# Joint Observing Programs (2)

- Spitzer
  - Relative allocations have changed from cycle to cycle
  - Cycle 16 included the category of Coordinated HST-Spitzer programs
    - Large programs that were reviewed by a joint HST-Spitzer TAC
  - HST TAC currently allocates up to 60 hours;
  - Spitzer TAC allocates up to 60 orbits.

HST Cycle	Hours	Limits	Spitzer Cycle	Orbits	Limit
14	19.1	225	2 – cryo	18	130
15	31.8	125	3	74	90
16	203.1	125 + Coordinated	4	1	90
18	12	100	7 - warm	24	125
19	28	60	8	14	60
20	0	60	9	56	60
21	26	60	10	10	60

- Spitzer is included in the 2014 Senior Review

# Joint Observing Programs (3)

- XMM-Newton
  - HST TAC can allocate up to 150 ksec;
  - XMM TAC can allocate up to 30 orbits

HST Cycle	ksec	XMM Cycle	Orbits
20	0	11	30
21	172	12	28

- Initial 2-year trial period has been extended
- XMM has requested that, given the oversubscription in Cycle 21, we consider expanding the program to 60 orbits/300 ksec (see later)

# Joint Observing Programs (4)

- NOAO:
  - HST TAC can allocate up to 5% of the time available on selected telescopes;
  - NOAO TAC does not award HST time

HST Cycle	Nights	HST Cycle	Orbits
11	13	17	5
12	17.5	18	6
13	4	19	0
14	2	20	10.1
15	0	21	0
16	0		

- NRAO – starting this cycle
  - HST TAC can award up to 3% of the time on US facilities
  - NRAO TAC can allocate up to 30 orbits

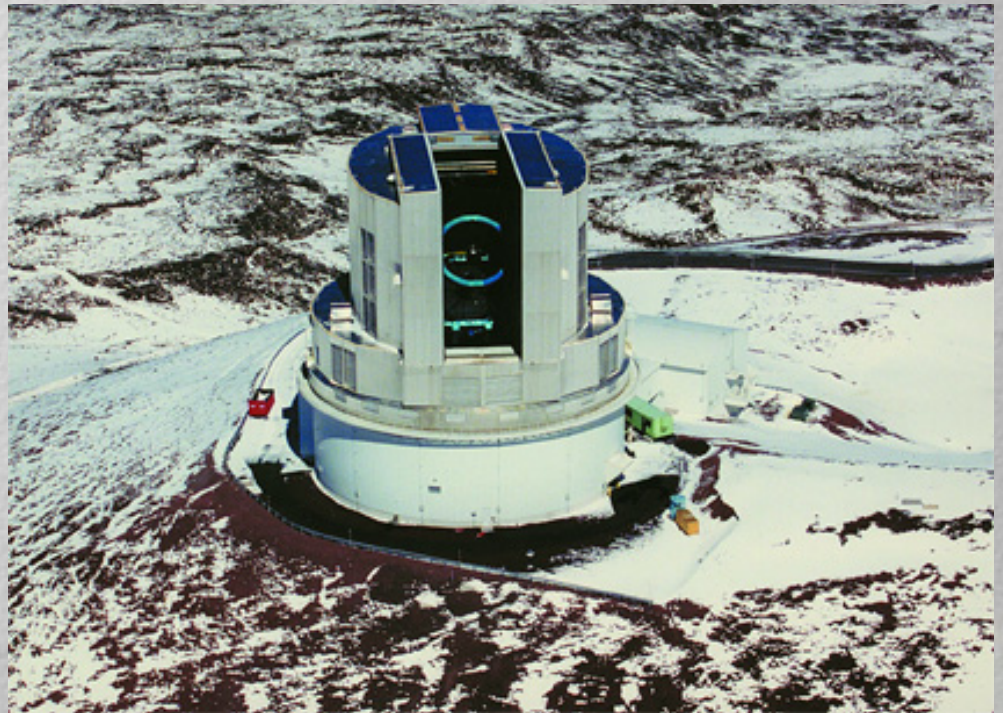
# Joint Observing Programs (5)

- Status for Cycle 22

Program	HST Orbits available	Cycle 22 proposals (submitted)	Total request
Chandra	<100	9	551 ksec
Spitzer	<60	3	36 hours
XMM	<30	9	355 ksec
NOAO	-	14	31.6 nights
NRAO	<30	4	87 hours

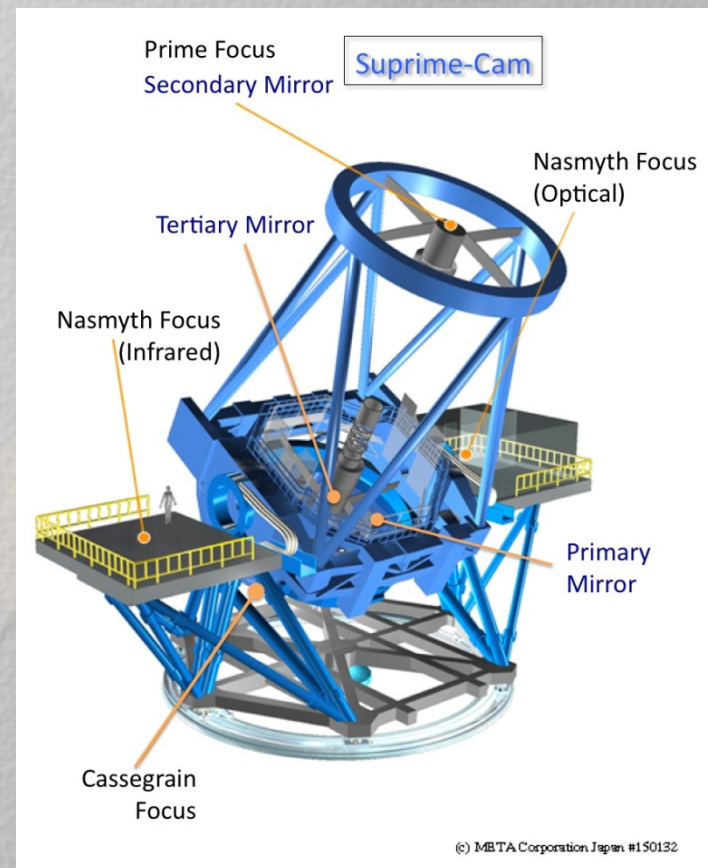
# A New Joint Program

- STScI has been pursuing informal discussions with NAOJ/ Subaru Observatory regarding the potential for establishing a Joint Program.
- Subaru
  - 8-metre telescope on MKO



# A New Joint Program

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- Subaru
  - 8-metre telescope on MKO
  - Extensive complement of OIR instruments

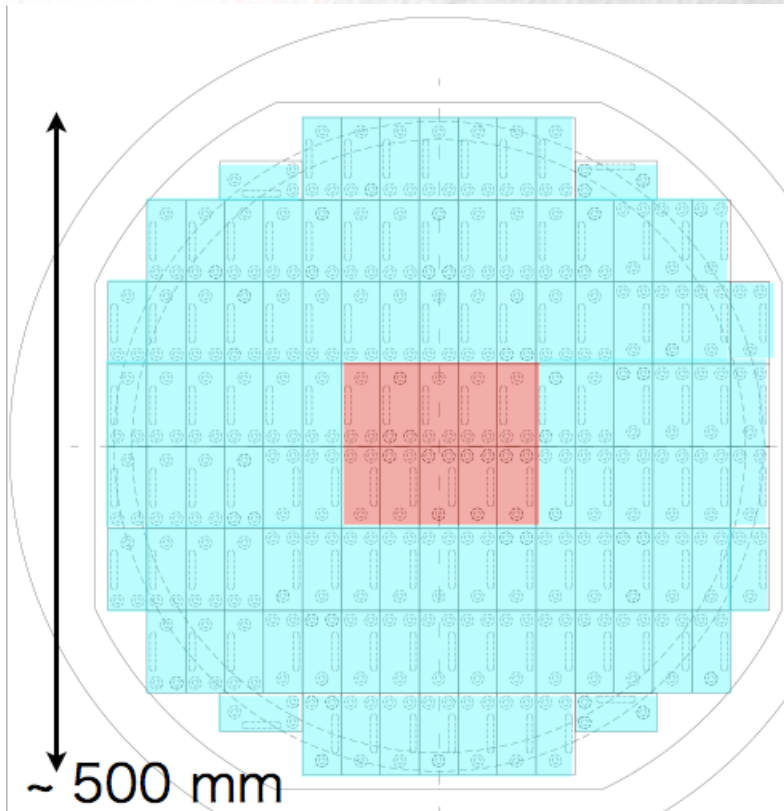


# Subaru facility instrumentation

Subaru Telescope has a suite of eight facility instruments providing imaging and spectroscopic capabilities over the full range of wavelengths from optical to mid-infrared.

- AO188 - Subaru 188-elements Adaptive Optics system - delivers diffraction-limited images in the near-infrared.
- COMICS - Cooled Mid-Infrared Camera and Spectrograph - provides imaging and spectroscopy from 8-25 microns.
- FMOS - Fiber Multi Object Spectrograph - provides fiber-fed multi-object spectroscopy from 0.9-1.8 microns over a 30 arcmin field of view.
- FOCAS - Faint Object Camera And Spectrograph - provides optical imaging and longslit and multi-slit spectroscopy over a 6 arcmin field of view.
- HDS - High Dispersion Spectrograph - provides extremely high-resolution optical spectroscopy.
- IRCS - Infrared Camera and Spectrograph - provides imaging from 0.9-5.5 microns, and low-resolution and echelle spectroscopy over the same range.
- MOIRCS - Multi-Object Infrared Camera and Spectrograph - provides imaging and low-resolution spectroscopy from 0.9-2.5 microns over a 4 arcmin x 7 arcmin field of view.
- Suprime-Cam - Subaru Prime Focus Camera - provides optical imaging over a large field of view with a mosaic of CCDs.
- HSC - Hyper Suprime-Cam - provides optical imaging over a very large field of view (1.5 degree diameter) with a mosaic of CCDs.

# Subaru facility instrumentation

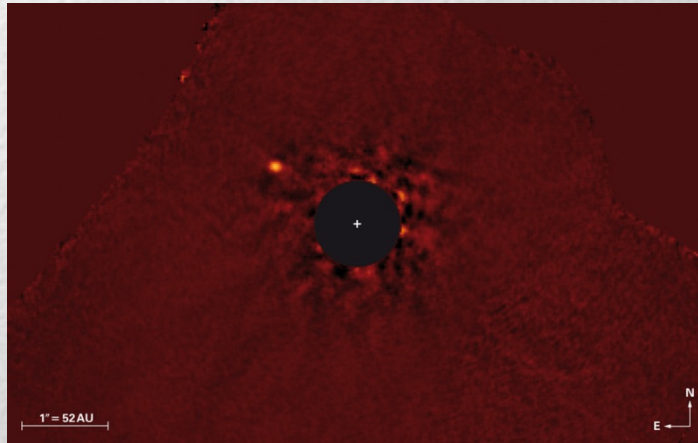


Suprime Cam: Array of 10 CCDs covering  
~34'x27' field of view

HyperSuprime Cam: Array of 116 CCDs  
covering ~1.5 sq. degree field of view

# Subaru visitor instrumentation

- HiCIAO - High Contrast Instrument for the Subaru Next Generation Adaptive Optics - provides a near-infrared imaging capability in the vicinity of bright sources.



$\kappa$  And b with HiCIAO

- Kyoto3DII - Kyoto tridimensional spectrograph II - provides Fabry-Perot / filter imaging and integral field / long-slit spectroscopy in the optical.
- RAVEN - Multi-Object Adaptive Optics(MOAO) demonstrator - delivers diffraction limited images in 2 science channels to IRCS.
- SCExAO - Subaru Coronagraphic Extreme Adaptive Optics - delivers high contrast images of the innermost surrounding of bright sources to HiCIAO.

# Subaru Joint Program

- STScI has been pursuing informal discussions with NAOJ/ Subaru Observatory regarding the potential for establishing a Joint Program.
- Subaru
  - 8-metre telescope on MKO
  - Extensive complement of OIR instruments
  - Subaru is currently classically scheduled, but the intention is to introduce more queue scheduling in the near future
  - Currently discussing the potential for time-sharing at the level of  $\sim 5$ -6 nights on Subaru ( $\sim 50$ -60 hours) against 50-60 orbits on HST, potentially starting in Cycle 23
  - Subaru has had a preliminary discussion with its user committee
    - Favourable response
  - Based on feedback, we will look to develop an implementation plan for presentation at the October STUC meeting



# Joint Programs for Cycle 23

- Chandra
  - Maintain program at current level (100 orbits)
- Spitzer
  - Maintain program, possibly adjusted to match Senior Review
- XMM
  - Maintain the program at the current level, 150 ksec/30 orbits, or
  - Adjust to 200 ksec/40 orbits
- NOAO & NRAO
  - Maintain at current levels (30 orbits for NRAO)
- Subaru
  - Explore options for a joint program at the 50-60 hour/50-60 orbit level



# Very Large Programs on HST

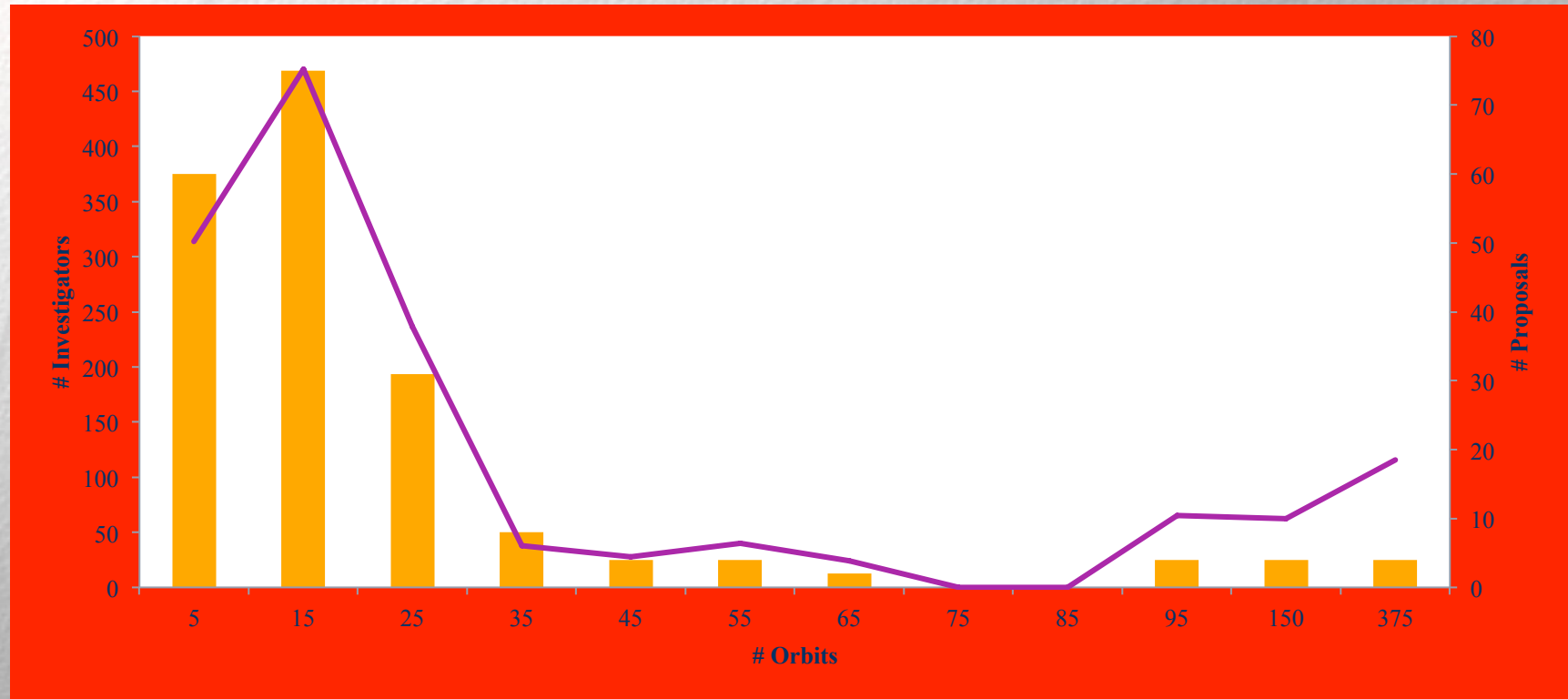
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# Program scale and focus

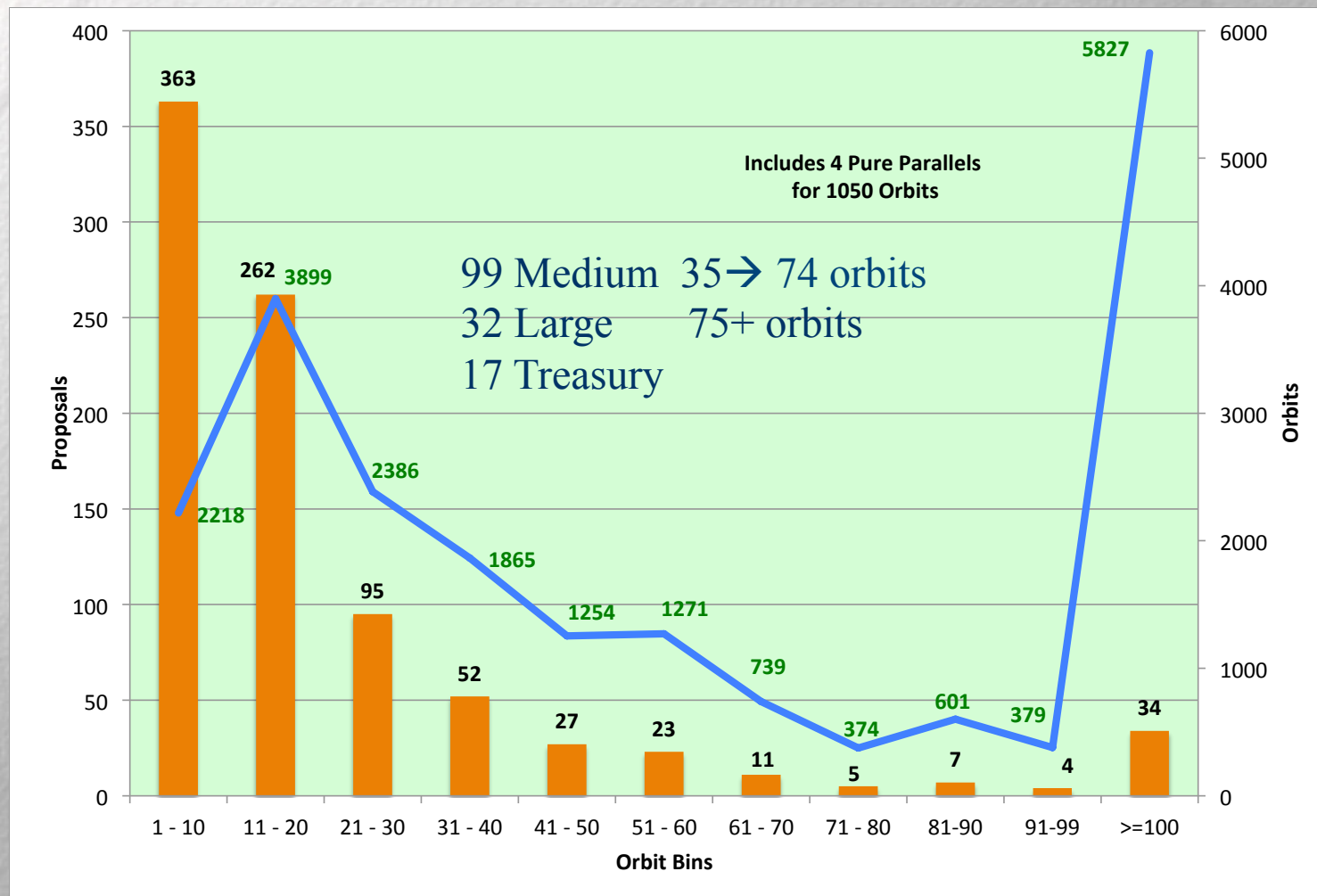
- In recent cycles,
  - ~50% of the orbits are allocated to many small programs (1-20 orbits)
  - ~30% of the orbits are allocated to a few large programs (>75-100 orbits)
  - Small programs (<20 orbits) support ~1100 investigators, with 4-5 members per team
  - Large programs(>75) support ~150-200 investigators, with 20-50 members per team
- Science
  - Different scale programs have different science goals

# Cycle 21 accepted programs



- Majority of programs are relatively small scale
  - ~130 programs < 20 orbits
- Handful of large,

# Cycle 22 submissions



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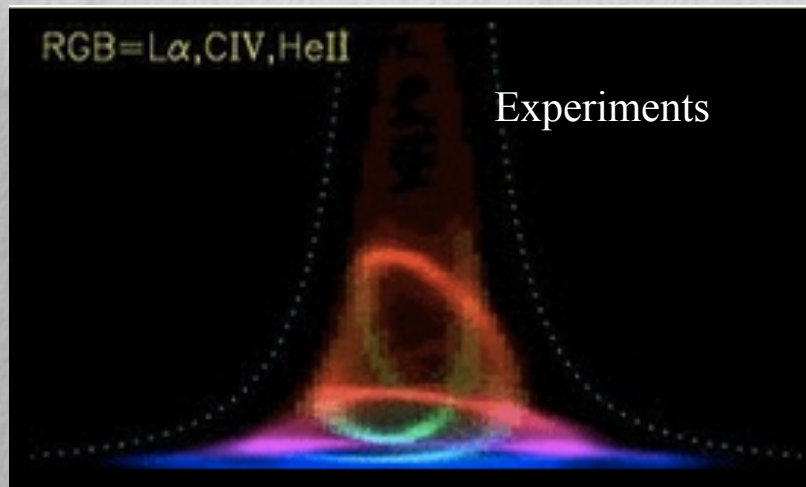
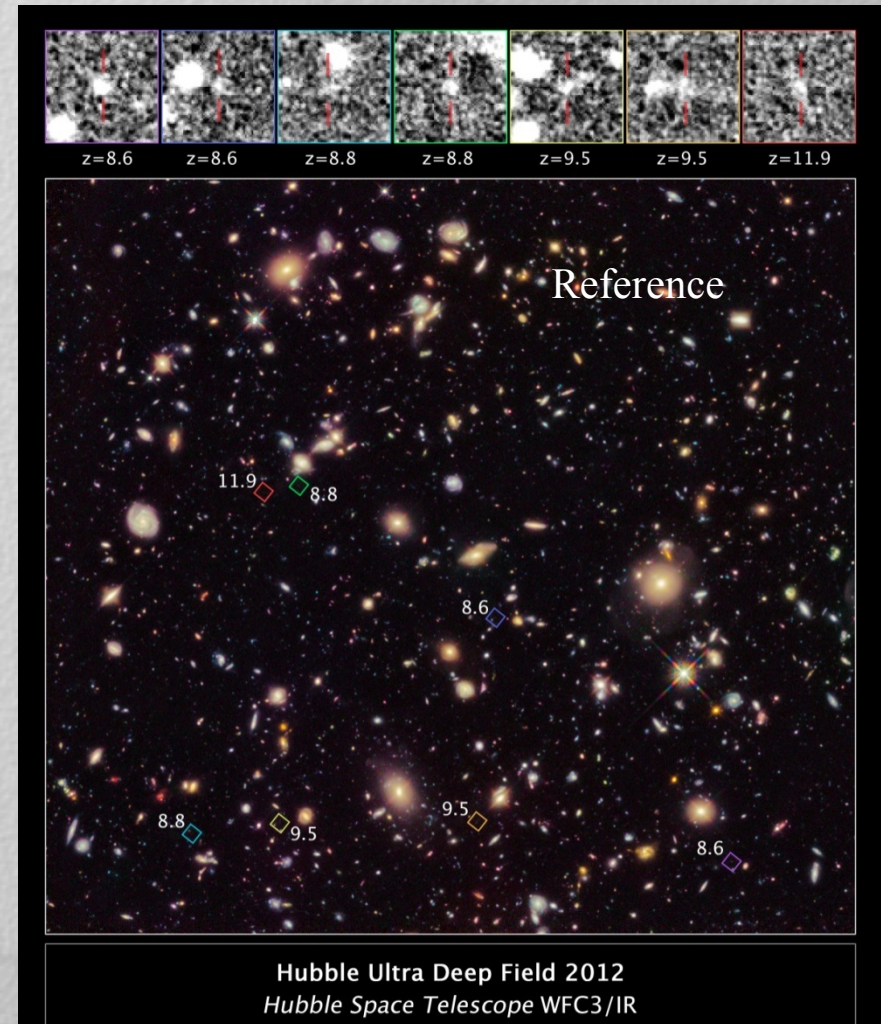
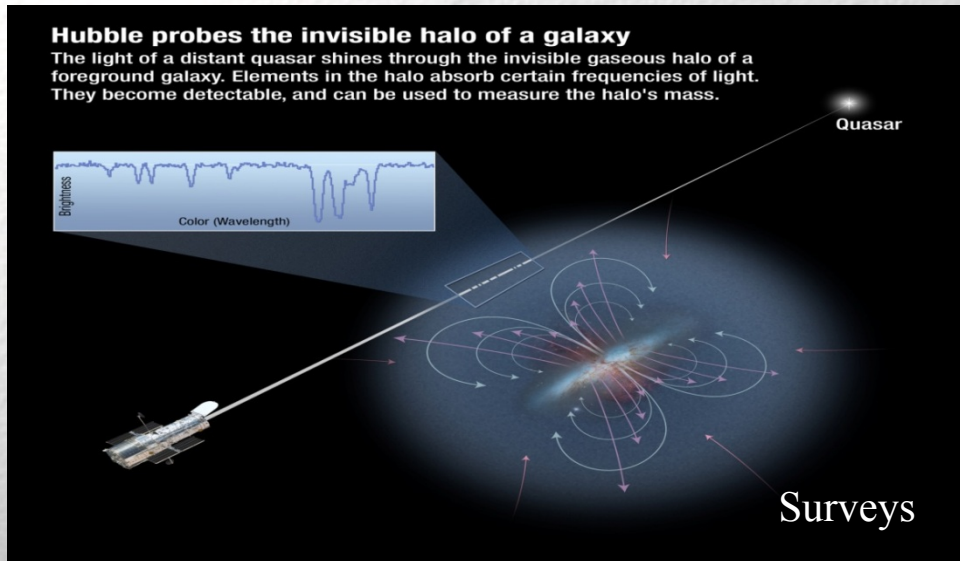
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4/14/14

# Program scale and focus

- In a typical cycle,
  - ~50% of the orbits are allocated to many small programs (1-20 orbits)
  - ~30% of the orbits are allocated to a few large programs (>75-100 orbits)
  - Small programs (<20 orbits) support ~1100 investigators, with 4-5 members per team
  - Large programs(>75) support ~150-200 investigators, with 20-50 members per team
- **Science**
  - Small programs are generally narrowly focused experiments, targeting no more than a handful of objects to address specific questions
  - Large programs are often surveys, covering sufficient individual targets to allow reliable statistical analysis of intrinsic properties
  - Large/Treasury programs can provide reference datasets for multiple scientific investigations, and
  - Large programs can be narrowly focused experiments that focus on large-scale issues that require extensive datasets

# Large programs:



Measuring black hole masses through  
reverberation mapping in AGN

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# Game theory and proposal size

Each panel (including the TAC) has a fixed orbit allocation

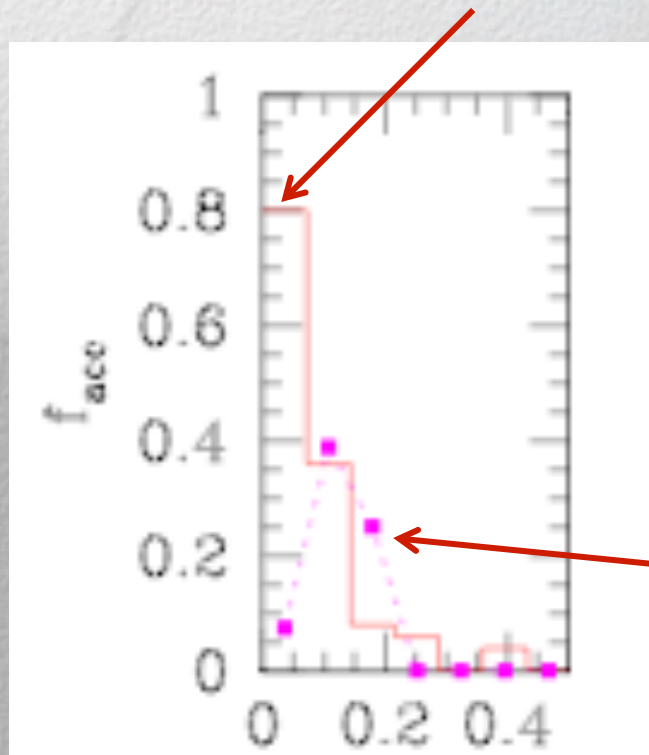
Scale the orbits requested by each proposal against the panel orbit allocation,  $A_O$

Proposal size,  $S_P = N_{\text{orb}} / A_O$

Look at the proposal success rate,

$f_{\text{acc}} = N_{\text{accepted}} / N_{\text{submitted}}$   
as a function of  $S_P$

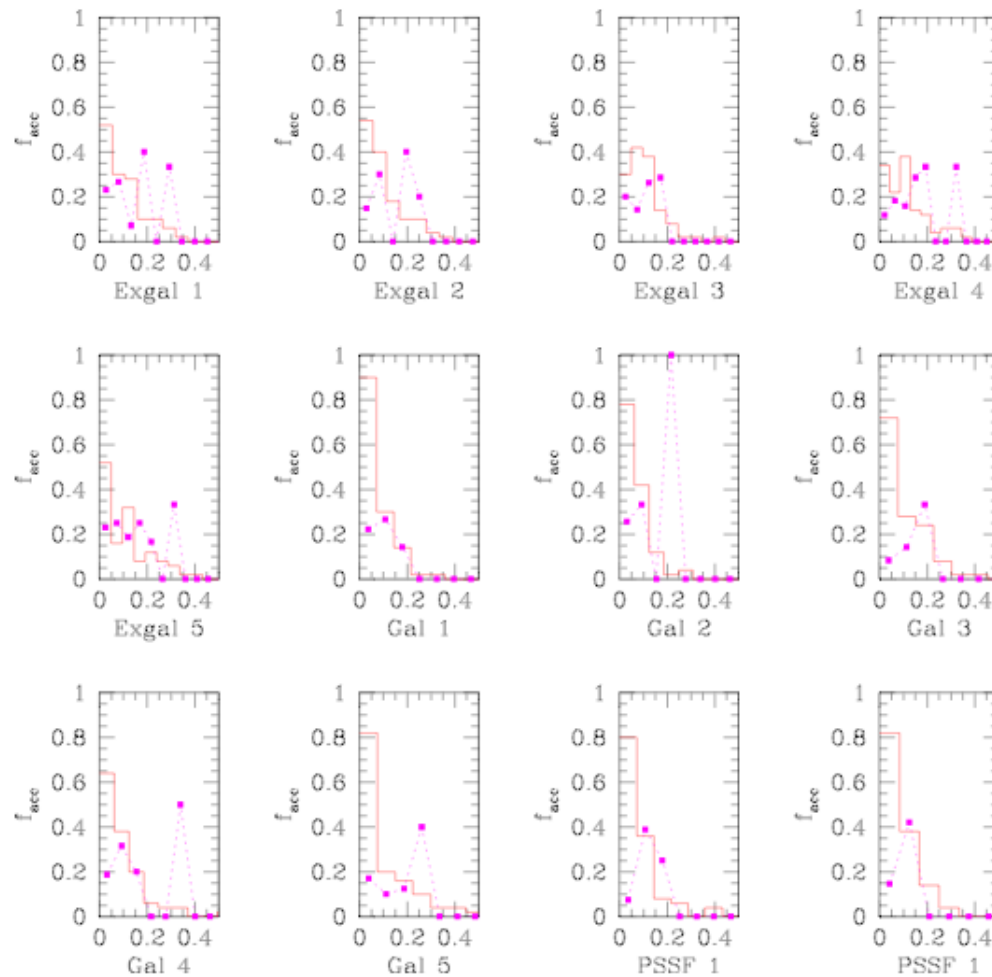
Submitted proposals  
Arbitrary vertical scaling



Success rate

$S_P$

# Constraints: Game theory and proposal size



Cycle 17 data

Analysis of many panels shows consistent statistical behaviour

The success rate of a proposal drops significantly when

$$S_p > \sim 0.25 A_O$$

TAC

$A_O \sim 1000$  orbits

$S_p$  (max)  $\sim 250$  orbits

NB: the community intuitively understand game theory; *PI's tailor their proposals to meet practical limits.*

**MCT programs were introduced as a separate category to avoid this selection bias.**

# Past largest-scale HST Programs

- MCT programs
  - PHAT: Stellar pops, Imaging Andromeda 834 orbits
  - CANDELS: Galaxy evolution & SNe 902 orbits
  - CLASH: Galaxy clusters & SNe 524 orbits
- DD Programs
  - HDF: Galaxy evolution 150 orbits
  - UDF: Galaxy evolution 400 orbits
  - Frontier Fields: Galaxy clusters and Galaxy evolution 560-840 orbits
- TAC programs
  - COSMOS, wide field galaxy evolution 590 orbits
  - PANS, High-z supernovae 420 orbits
  - GOODS, galaxy evolution 398 orbits
  - 3D-HST, galaxy evolution WFC grism 248 orbits
  - Spectral Library: Hot Stars 230 orbits
  - Decelerating & dust free, SNe 219 orbits
  - ANGST, stellar pops in nearby galaxies 218 orbits
  - SHOES, Supernovae 208 orbits
  - UV UDF, galaxy evolution 204 orbits
  - PEARS, galaxy evolution grism spectra 200 orbits
  - UDF09, galaxy evolution 193 orbits
- Strong preference for imaging survey & reference programs, focused primarily on galaxy evolution, high-z supernovae and stellar populations in nearby galaxies

# Community impact

- Analysis of publications from HST programs (Apai et al, 2010, PASP) shows that
  - Small programs produce more papers per orbit, but individual papers have relatively low impact
  - Large programs produce fewer papers/orbit, but more papers per program, and generally have a higher impact (more citations/paper)
  - Programs on different scales tackle different scale science questions
  - Treasury programs have more publications than Large programs
  - MCT programs have the prospect of being more productive than Treasury programs

# Productivity

Program	Type	Cycle	Science focus	Orbits	Publications	Notes
HDF	DD	5	Galaxy evolution	150	201	Imaging
PANS	Large	11	High-z supernovae	420	41	Imaging
GOODS	Treasury	11	Galaxy evolution	398	557	Imaging
UDF	DD	12	Galaxy evolution	400	126	Imaging
COSMOS	Treasury	13	Galaxy evolution	590	209	Imaging
PEARS	Treasury	14	Galaxy evolution	200	37	Grism spectra
UV UDF	Large	14	Galaxy evolution	204	20	Imaging
Dec_dust	Large	14	High-z supernovae	219	31	Imaging
ANGST	Treasury	15	Stellar populations	218	58	Imaging
SHOES	Large	15	High-z supernovae	208	7	Imaging
WFC3 ERS	DD	17	Star formation	214	112	Imaging, grism spectra
UDF09	Treasury	17	Galaxy evolution	193	86	Imaging
3D-HST	Treasury	18	Galaxy evolution	248	14	Grism spectra
PHAT	MCT	18-20	Stellar populations	834	18	Imaging
CANDELS	MCT	18-20	Galaxy evolution, SNe	902	115	Imaging
CLASH	MCT	18-20	Galaxy clusters, SNe	524	37	Imaging
Frontier Fields	DD	20-21 (22?)	Galaxy clusters, galaxy evolution	560-840	1	Imaging
Spectral library	Treasury	21	Hot stars	200	0	Spectra
<Cycle 14>	Large	14	6 programs	<245> (874)	<23> (80)	Imaging
<Cycle 14>	Treasury	14	2 programs	<167> (334)	<83> (165)	Imaging

# Past MCT Programs

Separate call for proposals – specific criteria

- Does the proposal offer the potential of solving a key, high-impact scientific question or questions?
- Can the science goals **only** be achieved as part of a Multi-Cycle Treasury Program, rather than through the standard HST time allocation process?
- Thirty-nine proposals were submitted
  - 4 proposals were accepted in 3 programs
  - Reviewed by MCT TAC – unconflicted senior community members
- A number of science areas were proposed but not selected, including
  - Solar System science
  - Exoplanet science
  - Intergalactic medium investigations
  - Active Galactic Nuclei
- Some topics have been addressed through Large & Treasury programs, but
- Several science areas likely remain viable for large-scale programs

# Another MCT call?

- Original MCT concept was received with some skepticism in the community....
- But as the programs progressed, questions were also raised regarding whether we might consider another call
  - In particular, Cycle 18-20 MCT programs are all imaging programs
- To explore community interest, we issued a call for white papers on potential MCT topics in mid-2012 in conjunction with the call for input for the HDF Initiative
  - White papers on 8 scientific topics were received

# Suggested MCT Topics

- Constraining dark energy through observations of  $\sim 100$  SNe at  $0.6 < z < 0.8$
- Reverberation mapping of multiple AGN
- A Virgo cluster survey
- Large-scale structure at  $z > 2$  through a multi-colour wide-field (1-2 sq. deg.) survey
- Galactic Centre near-IR imaging survey
- Characterising the circum-galactic medium at  $z < 0.4$
- Imaging survey of  $z > 1.5$  galaxy clusters
- Spectroscopic survey of transiting exoplanets

# Looking forward

- MCT programs were implemented in Cycles 18-20
  - ~750 orbits/cycle, 500 from GO & 250 from DD
  - Large program allocation reduced to 500-600 orbits
  - Regular GO allocation was maintained
- Cycles 21 & 22 return to “standard” orbit distributions
  - ~1,000 orbits for Large & Treasury Programs
  - DD time allocated to Frontier Fields program
- DD time may be available in Cycle 23 and/or Cycle 24
  - Pending the Frontier Field decision
- HST is ageing
  - Increasing risk regarding completion of multiple-cycle programs

Any new MCT-scale programs should be completed on a shorter timescale

# Options

- The MCT approach
  - Separate call for very large programs, reviewed by a specialist TAC
  - Emphasises different nature of these programs
  - Requires a high-level TAC with broad expertise
    - Can minimise conflicts, but probably selecting only 1 proposal
  - Allows scope for complementary proposals through standard call
    - Although, unlike the FF programs, none were submitted for MCT programs
    - Sets schedule – call ~October, deadline ~December, TAC ~February
- “Very Large Programs” as a new category within the standard call
  - Allows TAC to rank against standard “large” programs
    - Deliberations will be affected by conflicts – preselect chairs to avoid conflicts?
  - Set aside orbits for this category or leave to the TAC’s discretion?
- Program scale?
  - 400-600 orbits? Limit to one proposal?
  - Supplement with DD time, when available?
  - Distribute allocation over 2 cycles to aid scheduling?
- Other considerations
  - Require that science goals can only be achieved by a program of this scale
  - Should there be specific guidance on types of proposal
    - Spectroscopy? UV-specific? Not galaxy evolution?
- We ask the STUC for feedback and advice on these questions

## Other topics

# A rolling TAC?

- HST has an annual review process for “standard” proposals
- HST users can submit DD proposals during the cycle
  - But those programs are limited to time-critical observations (with a very few exceptions)
  - How can I get quick observations of the coolest brown dwarf, the highest redshift galaxy, etc that’s still going to be there, unchanged, for the next cycle
- Net result is that if you miss the deadline, you may not get any chance to see data for more than a year
- HST is ageing
  - Increasing risk that capabilities won’t be available next cycle
- Can we find a faster way of reacting to new discoveries?
  - Take a page out of Gemini’s book

# Rapid response proposals

- Allow proposers to submit in-cycle GO proposals
  - Proposal accumulate between April & December
    - Proposals after December go to the standard TAC
  - Proposals are distributed for review twice (3 times?) during the cycle
    - (June?), September (or October?) & January
  - Proposals reviewed by a standing committee drawn from the previous TAC
    - Proposals should be written for generalists, not specialists
- Requirements:
  - Either the proposal could not have been submitted at the previous deadline
    - i.e. focused on a new discovery
  - Or the proposal is a pilot program for a larger-scale investigation for a future HST cycle
  - Proposals are limited to no more than 5 orbits
  - All data are non-proprietary
- Success will depend on maintaining a modest intake
  - What's the threshold for an “exciting” discovery?
- We could start testing this approach in Cycle 22

# JWST & HST

- JWST is scheduled for launch in October, 2018
  - STScI has an obligation to maximise its scientific productivity
- JWST instrumentation is focused on observations at near- and mid-infrared wavelengths
  - Potential for limited observations  $6,000 < \lambda < 10,000 \text{ \AA}$
  - No capabilities at shorter wavelengths
- HST is clearly well placed to provide high-resolution supporting optical/UV observations
  - The aim is to maintain HST operations through 2020, but...
  - HST's status 5 years hence is a matter for speculation.
  - HST observations alone may not be scientifically competitive in current cycles.
- How can we provide an opportunity for such observations in advance of JWST's launch?

# Proposal mechanisms

- JWST preparatory programs
  - GO proposals for observing time in support of future JWST programs
  - Science ranked with other GO proposals, but orbits taken from a separate pool ( TBD orbits)
  - Requires a separate proposal for JWST time
- Dedicated JWST support
  - Set aside a significant fraction (50%) of a future HST cycle (eg Cycle 24 2016/17 or Cycle 25 2017/18) for JWST support
  - Carries risk with regard to HST capabilities
- Joint HST-JWST proposals
  - Potential reciprocal arrangement with JWST in future cycles
  - Contingent on HST functionality
  - Analogous to Joint HST-Spitzer/Chandra/XMM proposals; proposal submitted to prime observatory
  - Science ranked with other GO proposals
- STScI welcomes input from the STUC on this issue

# Summary:

We invite comments from the STUC on the following:

- Joint programs
  - Should we maintain XMM as is, or go to 200 ksec/40 orbits?
  - Does the STUC support exploration of a joint HST/Subaru program?
- Very Large Programs
  - We believe there remain science questions that can justify MCT-scale programs
  - Should we consider a new MCT call, or fold in with the standard process?
  - Are there particular constraints or recommendations that should be associated with this type of proposal?
- A rolling TAC
  - Should we explore the potential for in-cycle GO programs?
- JWST
  - How should HST be used to prepare for JWST observing programs?