NASA Astrophysics Update

PCOS Town Hall, American Physical Society Virtual Spring Meeting
April 18, 2020

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Director, Astrophysics Division
Science Mission Directorate

Charts posted at: https://pcos.gsfc.nasa.gov/

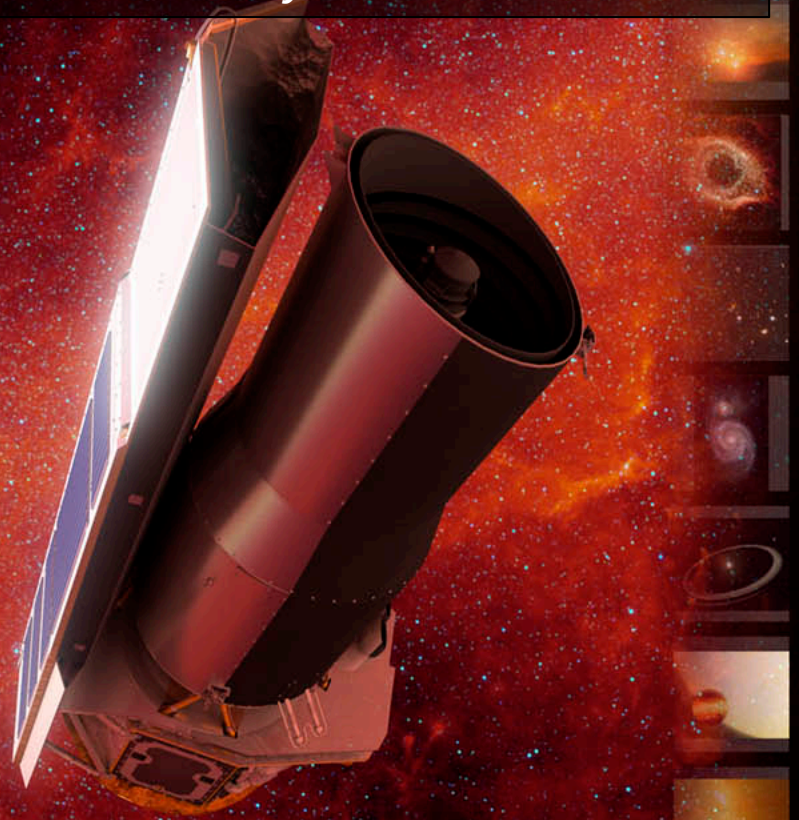
NASA Astrophysics Celebrate Accomplishments

https://www.nasa.gov/content/hubbles-30th-anniversary

What did Hubble see on your birthday?: https://www.nasa.gov/content/goddard/what-did-hubble-see-on-your-birthday

30 years, 30 images countdown: https://www.flickr.com/photos/nasahubble/albums/72157713228021437

After 16.5 yrs of science exploration on the infrared cosmic frontier as one of NASA's Great Observatories, Spitzer ended its mission on 30 January 2020, 2:30 PST.



Engineering feats extended mission life post-cryo in 2009 and overcame challenges due to Spitzer's increasing distance from Earth.

Spitzer Space Telescope

Spitzer enabled discovery near and far, to the edge of the universe, yielding 8,800+ refereed papers.

- First detection of light from an exoplanet
- First detection of molecules in exoplanet atmospheres
- Measurement of star formation history of the Universe to z>2, looking back >10 Gyr
- Measurement of the stellar mass of the Universe to z>8, looking back ~13 Gyr

https://www.spitzer.caltech.edu/final-voyage

TESS

Transiting Exoplanet Survey Satellite

Launched April 24, 2018

Observation Sector 23 (Orbit 54) in progress

45 confirmed planets
1766 planet candidates

239 publications submitted, 181 peer-reviewed (53% exoplanets, 47% astrophysics)

Last update: April **7**, 2020

https://tess.mit.edu/

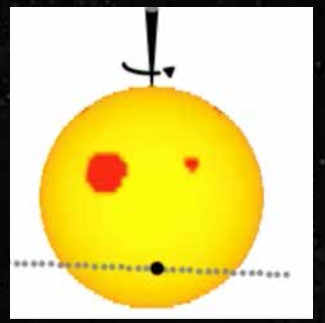
A Young Planet Transiting DS Tuc A

Neptune-sized planet around a G star (DS Tuc A) in the 45Myr in the Tucana-Horologium association

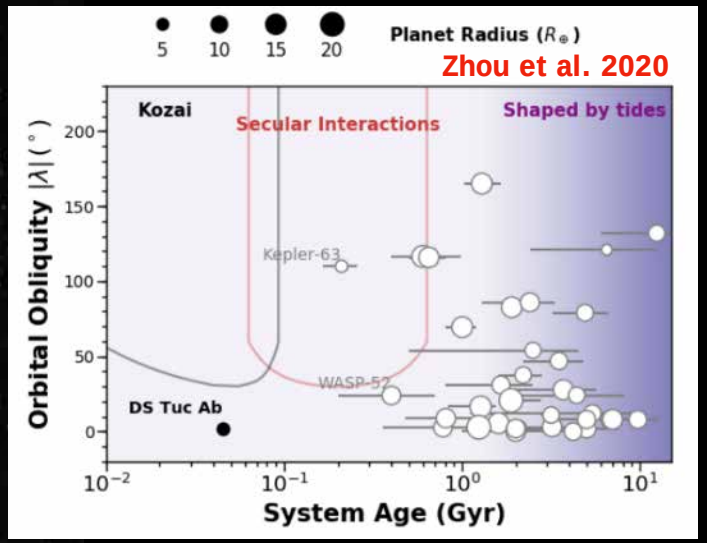
DS Tuc A has a binary companion 175 AU away. Stellar companions can effectively tilt protoplanetary disks.

In this case, a low obliquity is found between the planet's orbit and the host star's equator.

Obliquities shed light on planet formation scenarios. The lower right figure shows all planets with measured obliquities. DS Tuc Ab is the youngest, and more systems like this will help us understand the timescales of giant planet formation in disks.



TESS discoveries by:
Zhou et al. 2020
Montet et al. 2020



WFIRST

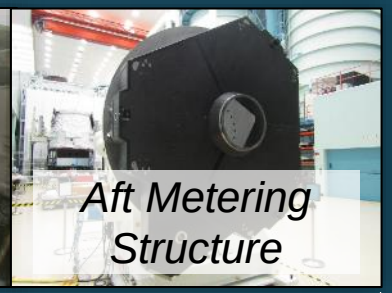
Progress on Hardware

Confirmed and entered Phase C on Feb 28, 2020

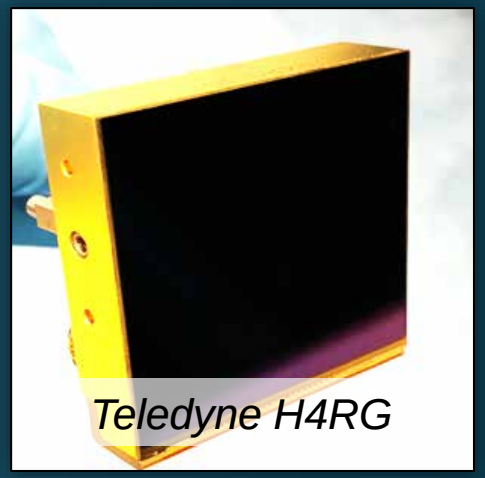
https://www.nasa.gov/feature/nasa-approves-development-of-universe-studying-planet-finding-mission


Primary Mirror - Full Tool Polish (5/19)


Secondary Mirror


Aft Metering Structure

Telescope


Teledyne H4RG


Photon Counting CCD


Detector readout custom ASIC chip


F158 Filter


Prism assembly

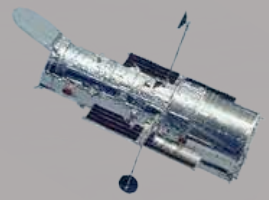

Deformable Mirrors

Instruments

NASA Science
Status under Coronavirus Restrictions

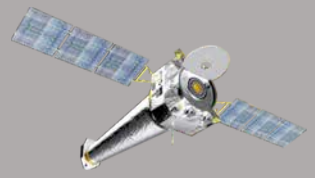
Astrophysics Operating Missions

Hubble 4/90
NASA Strategic Mission



Operations Nominal

Chandra 7/99
NASA Strategic Mission



Operations Nominal

XMM-Newton 12/99
ESA-led Mission

Operations Nominal (ESA)

Spitzer 8/03
NASA Strategic Mission

Mission Complete!

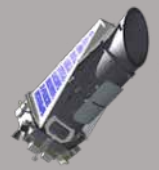
Gehrels Swift 11/04
NASA MIDEX Mission

Operations Nominal

Fermi 6/08
NASA Strategic Mission

Operations Nominal

Kepler 3/09
NASA Discovery Mission



Mission Complete!

NuSTAR 6/12
NASA SMEX Mission

Operations Nominal

SOFIA 5/14
NASA Strategic Mission

Operations Suspended

ISS-NICER 6/17
NASA Explorers Miss. of Oppty

Operations Nominal

TESS 4/18
NASA MIDEX Mission

Operations Nominal

Data Archives
HEASARC, IPAC, MAST, etc.

Operations Nominal

Coronavirus (COVID-19) Response –Missions

- Missions are doing as much as they can virtually right now
  - Suspended most hands-on work within NASA, including suborbital research
- Prioritizing Mars 2020 as it is close to launch
  - James Webb Space Telescope also continues to be a priority
- Continuing operating missions, consistent with conditions at operations centers
  - Working with Space Communications Program and have a plan in place if communications capabilities are affected
- Some exceptions to mandatory telework at Centers that do not substantially add risk to the workforce

NASA Astrophysics R&A Program Update

including known Adjustments due to Coronavirus

Astrophysics ROSES-2020 R&A Elements

Supporting Research and Technology

- Astrophysics Research & Analysis (APRA)
- Strategic Astrophysics Technology (SAT)
- Roman Technology Fellowships (RTF)
- Astrophysics Theory Program (ATP) (biennial, not this year)
- Theoretical and Computational Astrophysics Networks (TCAN) (triennial, this year)
- Exoplanet Research Program (XRP) (cross-div)
- Topical Workshops, Symposia, and Conferences (TWSC)

Data Analysis

- Astrophysics Data Analysis (ADAP)
- GO/GI programs for:
  - Fermi
  - Swift
  - NuSTAR
  - TESS
  - NICER

Mission Science and Instrumentation

- Sounding rocket, balloon, cubesat, and ISS payloads solicited through APRA
- XRISM Guest Scientists (one time)
- Astrophysics Explorers U.S. Participating Investigators (triennial, this year)
- Astrophysics Pioneers

Separately Solicited

- GO/GI/Archive/Theory programs for:
  - Chandra
  - Hubble
  - SOFIA
  - Webb
- NASA Hubble Fellowship Program
- NASA Postdoctoral Program
- FINESST Graduate Student Research Awards

New in ROSES-2020:

- Astrophysics participates in cross-divisional TWSC
- XRISM Guest Scientist
- Astrophysics Explorers U.S. Participation Investigators (APEX USPI)
- Astrophysics Pioneers
- GO & ADAP proposals will be evaluated dual-anonymously
- Data Management Plan will be evaluated as part of the intrinsic merit of proposals
- High Risk / High Impact: special review process will be implemented
- Announcement that ROSES-2021 will enable open software/code/source/models

Astrophysics Pioneers

- The FY21 President's Budget Request contains a new initiative for Astrophysics – A new class of small missions
- Astrophysics Pioneers
  - Fills in the gap between existing ROSES investigations (<$10M for APRA) and existing Explorers MO investigations ($35M for SmallSats)
  - Managed as Research and Analysis projects with enhanced oversight
  - Will be solicited through ROSES; relieves burden of writing full Explorers MO proposal
  - Will include SmallSats, Large CubeSats, CubeSat constellations (all as rideshare/secondary payloads), major balloon missions, and ISS attached payloads
- Community announcement released on Feb 20, 2020
  - Draft Pioneers appendix to ROSES-2020 planned for late spring 2020 and a final version by June 2020. Proposals are anticipated to be due in September 2020 and selections announced in early 2021

Coronavirus (COVID-19) Response – Research

- We know that progress on funded research may slow and in some cases even stop due to necessary telework, lack of access to facilities and labs, and other family obligations
- SMD understands this potential outcome and will work with the research community and its institutions to mitigate any impacts and to make plans, when possible, for a way forward
- OMB has issued guidance; NASA has instituted a number of grant administration flexibilities to ease the burden on grant recipients during the COVID-19 emergency.
  - Allows for paying soft-money researchers as well as graduate students, post-docs, and other lab staff during the COVID-19 epidemic, if the institution's own policies allow for it
  - Allows for institutions to charge restart costs to their grants
  - Provides agencies flexibility with regard to the submission of proposals, including accepting late proposals

SMD COVID Grants FAQ: https://science.nasa.gov/researchers/sara/library-and-useful-links

NASA FAQ on Grants and Research during the COVID-19 Epidemic: https://www.nssc.nasa.gov/grants

OMB guidance in Memo M-20-17: https://www.whitehouse.gov/wp-content/uploads/2020/03/M-20-17.pdf

NRESS Virtual Panel Meetings Support: https://nspires.nasaprs.com/tutorials/infoPage/virtualSupport.html

Watch the NSPIRES email lists for up-to-the-minute changes in due dates or policies

Astrophysics ROSES-2020 R&A Changes

We are working hard and are implementing extra steps to fund NASA awardees as quickly as possible and we continue to make new selections as quickly as possible.

All astrophysics peer reviews through June 2020 will be virtual panels; decisions on future peer review panels will be made on a rolling basis

- Conducted 4 peer reviews virtually, one of them dual-anonymous, and the feedback from reviewers who served is very positive

Virtual panels often take more days to complete, so due dates and peer review dates for XRP, TCAN, ADAP, and Webb Cycle 1 (all peer reviews in July/August) will be assessed to delay some and spread out the work

ADAP will not be offered in 2021 to reduce the work next year as we recover from the impacts of COVID-19: focus efforts without reducing opportunity space

- The selection rate this year will approximately double
- All of the funding planned for selections in both 2020 and 2021 will be committed in 2020 – no reduction in funding to the community
- This reduces the work for both NASA and the community without reducing the opportunity space for community funding
- This allows more awardees to be assured of funding this year
- Note: as planned, ADAP will be dual anonymous this year

NASA Astrophysics Missions Update

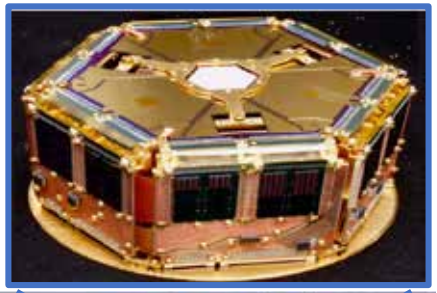
Webb

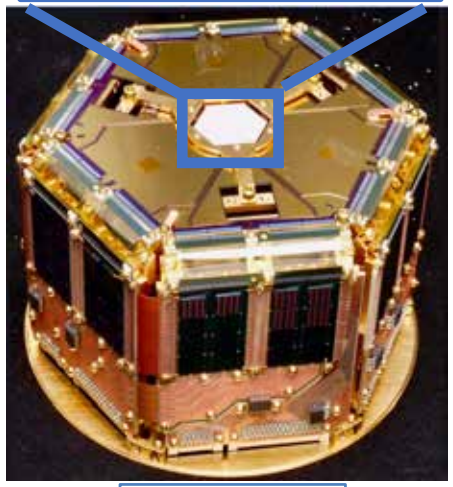
The James Webb Space Telescope

The Webb observatory in the clean room in Redondo Beach, CA in August 2019

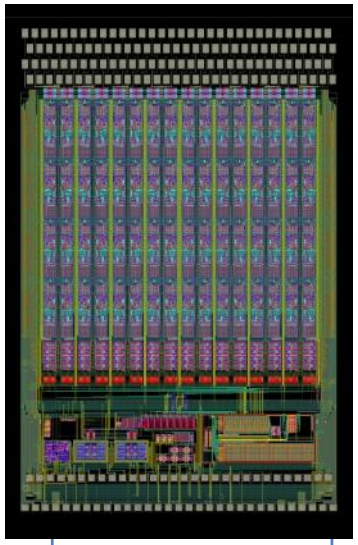
https://www.jwst.nasa.gov/

- Observatory is fully integrated
- Observatory-level environmental testing (vibration and acoustics) this Spring
- Final deployments follow environmental testing through the Summer
- Numerous launch and commissioning exercises through the year at STScI
- Cycle 1 proposals due later this year
- Launch Readiness Date in 2021
- COVID-19 update
    - Integration and testing continues, though at reduced efficiency
    - The observatory remains safe in its cleanroom environment





X-IFU-FPA



VERITAS ASIC Design

XRCF mirror Calibration

ATHENA

ESA's Large X-ray telescope

Currently in Phase B, Adoption 2022, Launch ~2031/2032

X-IFU, X-ray IFU, 3000+ Pixel cryogenic imaging calorimeter

- NASA providing Focal Plane Array (FPA)
- US-developed Time Domain Multiplexing recently agreed to be baseline readout scheme

WFI, Wide Field Imager

- NASA providing design for readout ASIC
- NASA providing analysis to reduce background rate

Mirror Calibration

- Baseline mirror calibration plan to use NASA/MSFC XRCF as calibration facility

US Data Center, GO program planned

Laser Interferometer Space Antenna (LISA)

Mission Status (ESA lead, NASA support)

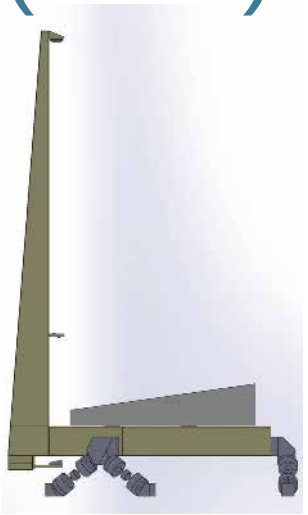
- ESA currently in mid-Phase A, Mission Adoption <2024, Launch ~2034
- Design continues to mature (e.g. downselect of payload configuration)
- Split of hardware responsibilities between ESA, ESA Member States, and NASA beginning to consolidate

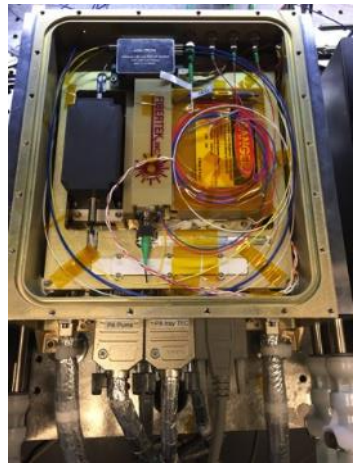
NASA Technology Development Activities

- First version of NASA LISA Technology Development Plan released
- Contract awarded to deliver structural models and engineering development units for LISA Telescope
- LISA Laser and Charge Management System on track to reach TRL-5 in 2020
- US Phasemeter and Microthruster activities maintained for risk reduction

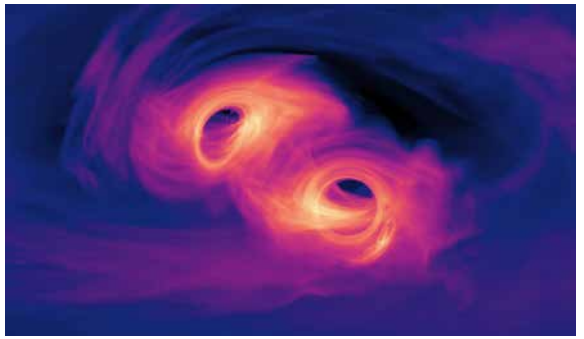
NASA-sponsored Science Activities

- NASA LISA Study Team (NLST) and NASA LISA Study Office (NLSO) provided input to Astro2020
- NLST analyzed potential US science participation in LISA
- NLSO participating in prototyping activities for science ground segment
- NLSO developing scenarios for US contributions to SGS





TOP LEFT: Proof-of-concept design for LISA telescope with bipod mounts (GSFC). TOP RIGHT: prototype amplifier unit for LISA laser (GSFC/FiberTek). BOTTOM LEFT: NASA TRL4 Charge Management Device under test at U. Trento (UF). BOTTOM RIGHT: Simulation of accretion flow around binary black holes (GSFC)

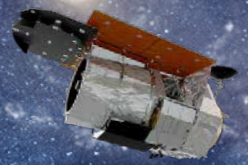


https://lisa.nasa.gov/

+ SMEX/MO (2025), MIDEX/MO (2028), etc.

Formulation
Implementation
Primary Ops
Extended Ops

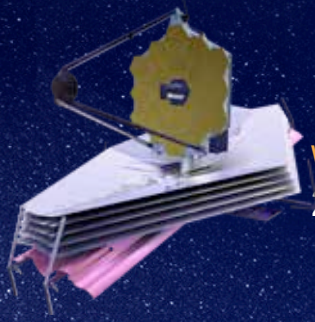
Spitzer
8/25/2003
1/30/2020



WFIRST
2025/2026

Euclid (ESA)
2022

SXG (RSA)
7/13/2019

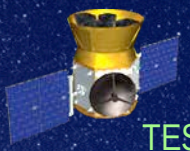


Webb
2021

Ariel (ESA)
2028

Chandra
7/23/1999

XMM-Newton (ESA)
12/10/1999

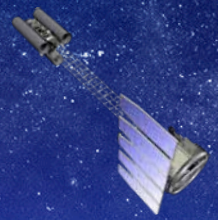


TESS
4/18/2018

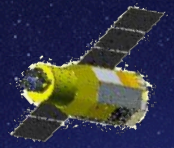
NuSTAR
6/13/2012

Swift
11/20/2004

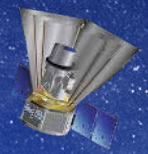
Fermi
6/11/2008



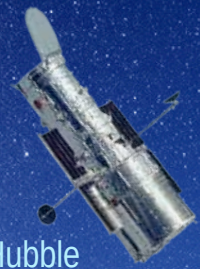
IXPE
2021



XRISM (JAXA)
2022



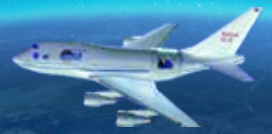
SPHEREx
2023



Hubble
4/24/1990

ISS-NICER
6/3/2017

GUSTO
2021



SOFIA
Full Ops 5/2014

Revised February 28, 2020

+ Athena (early 2030s), LISA (early 2030s)