Panel: Impacts of the Budget on Astro2020 Priorities

Perspectives from the co-Chair of the 2025 NASA Senior Review to the NASE Committee on Astronomy and Astrophysics

Megan Donahue, Michigan State University, 6-October-2025

2025 Senior Review Task

Dec 2024 - March 2025

NASA Science Mission Directorate commissions a high level expert review (“Senior Review”) of the portfolio of operating missions for astrophysics every 3 years in accordance with Section 304(a) of the NASA Authorization Act of 2005 and the NASA Transition Act of 2017.

Eight missions in this portfolio as of 2025: Chandra, Fermi, Hubble, Imaging X-ray Polarimeter, NuStar, Swift, TESS and XMM-Newton

Charge: Evaluate mission proposals for extended operations for the capabilities of the missions to continue to execute transformational science, the mission responsiveness to previous reviews and strategic guidance (e.g. Decadal Surveys), mission health, and cost effectiveness.

Reports on individual missions went to NASA.
Overall report went to NASA April 2025; NASA response June 2025; SR2025 report published summer 2025.

OVERVIEW OF SR 2025 PORTFOLIO

- Chandra: high-definition, high sensitivity X-ray E>1.5 keV
- Tess: bright targets for JWST spectroscopy and ground based followup, huge FOV
- XMM: where the baryons are; high sensitivity low-energy X-ray imaging spectroscopy; enhanced rapid and extended-coverage response to TDAMMS
- IXPE: first ever look at polarized X-rays: structure of AGN accretion disks and jets, has only just begun to exploit its capabilities
- HST: unparalleled, exquisite views of the UV, visible, and near-IR sky
- SWIFT: extremely rapid simultaneous X-ray, UV, and gamma ray response to new cosmic news
- FERMI: our gamma ray eyes on the sky, monitoring every part of the sky every 3 hours; first EM signature of a GW
- NuSTAR: high energy X-ray and gamma ray imaging spectroscopy especially crucial extension for XRISM, XMM, Chandra spectroscopy : spinning black holes

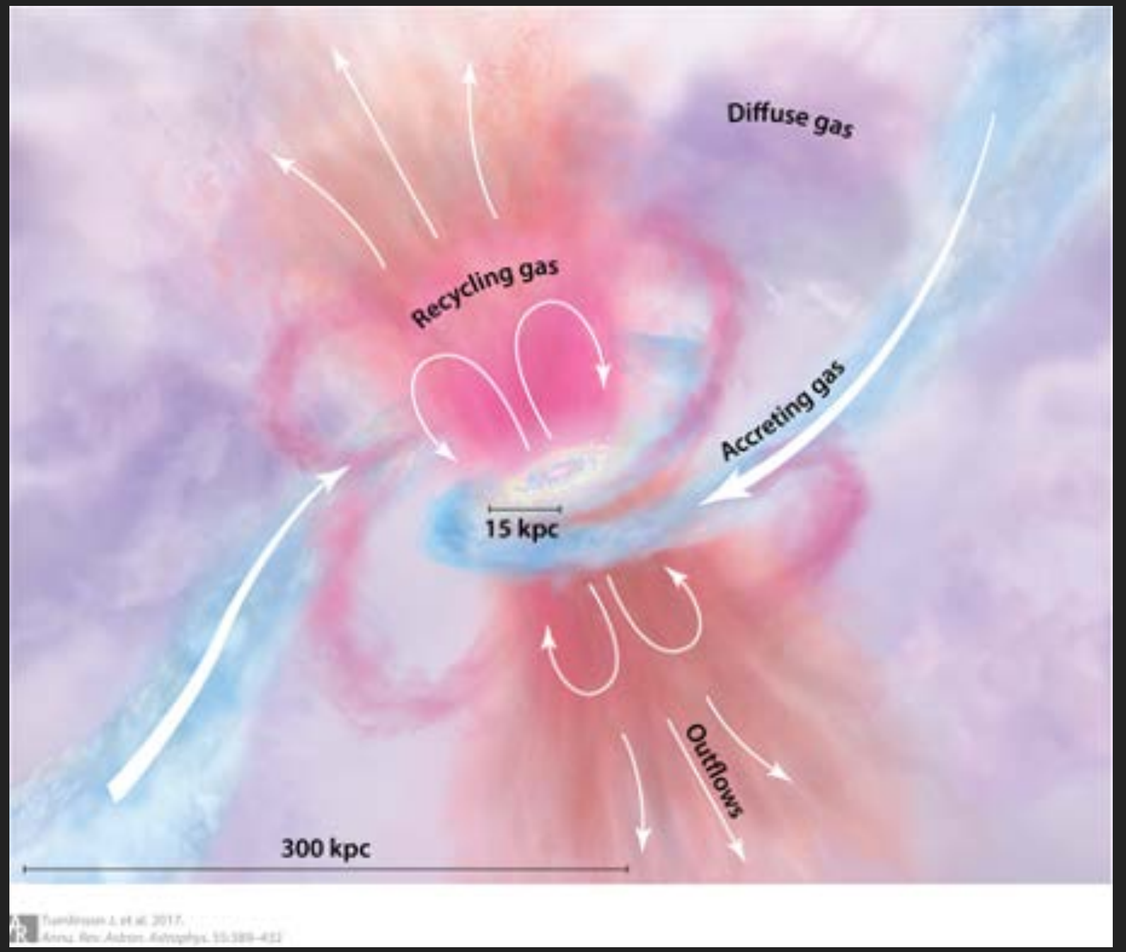
TOTAL Approximate cost per year: ~ $200M ($0.2B)
Less than 1% of the NASA budget. About a nickel a month per US taxpayer

NASA SMD MAJOR QUESTION HERE

ASTRO 2020 DECADAL GOAL HERE

GALAXY EVOLUTION AND FORMATION

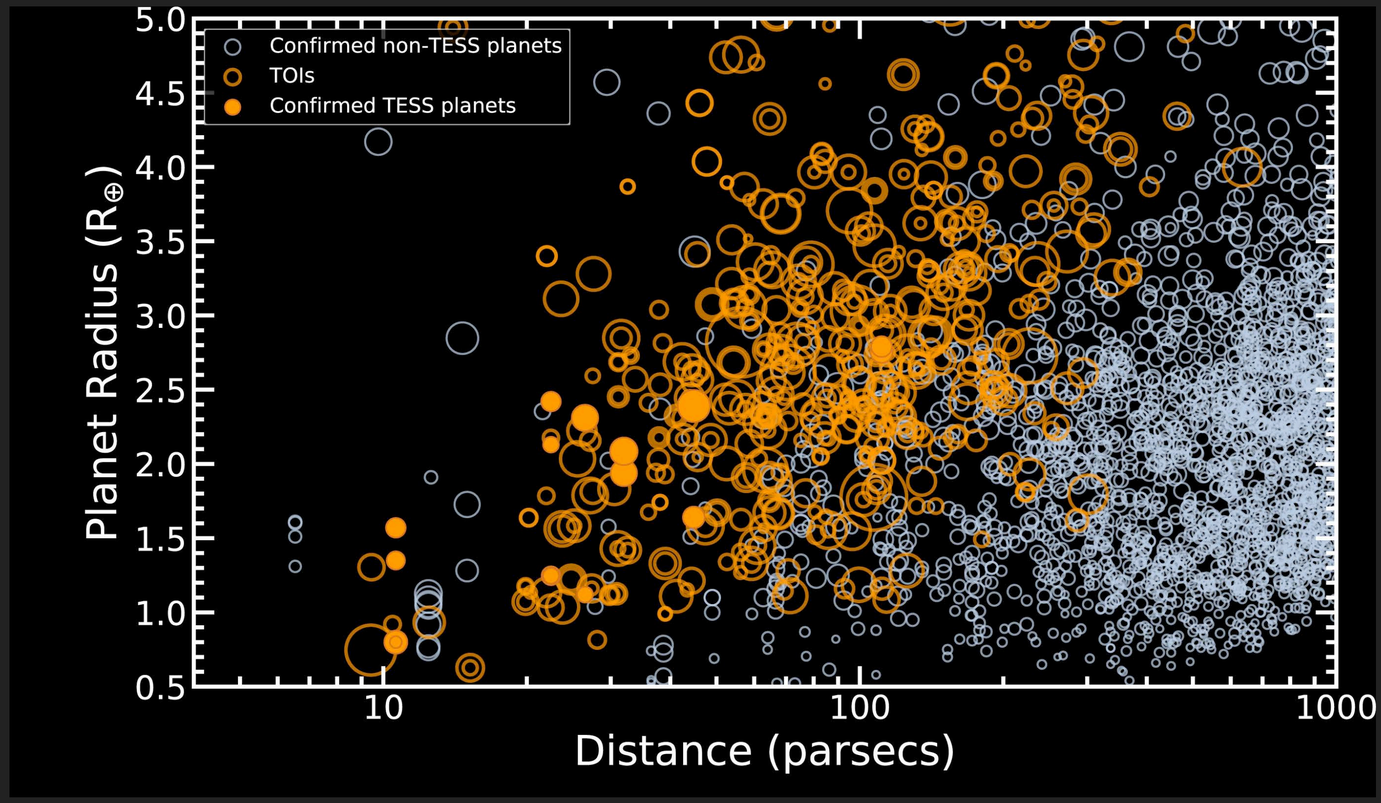
- Formation and evolution of galaxies: the cycle of baryons and star formation (JWST, HST)
- Structure and dynamics of galaxies and their environments: circumgalactic medium and large scale structure (XMM, JWST, HST, XRISM)
- Chemical evolution of gas and galaxies (JWST, HST, XMM, ALMA, XRISM) Imaging spectroscopy: different gas phases cold through hot
- Co-evolution of supermassive black holes and their galaxy hosts (JWST, HST, Chandra)



Tumlinson, Peeples, Werk 2017

HABITABLE PLANETS

- Find (and re-find) exoplanets (TESS)
- Characterize exoplanets (JWST, TESS + ground-based monitoring)
- Characterize broadband exoplanet radiation environment (JWST, HST, XMM, Chandra)



Natalia Guerrero/ Astrophysical Journal Supplements 2020: Sky & Telescope 8 Jan 2020

The mutual success of K2/Kepler, TESS and JWST is undeniable.

BLACK HOLES AND NEUTRON STARS

- Neutron star mergers, gravitational waves, kilonovas (LIGO, FERMI, Swift, XMM, Chandra, TESS)
- Feeding the beast: accretion, jet launching, physics of black hole accretion disks (IXPE, NuSTAR, XMM, Swift, Chandra)
- AGN bolometry: AGN kinetic energy output (Chandra, VLA, SKA)
- Resolving supernova physics, shocks and remnants (Chandra, HST)
- Extreme Particle Physics, MultiMessenger Astrophysics (FERMI, NuSTAR, IXPE, Swift, IceCube, Pierre Auger Observatory)

Multiwavelength image: HST, Spitzer, Chandra, VLA

NASA, CXC, SAO, Astrophotography by Rolf Olsen, NASA-JPL, Caltech, NRAO, AUI, NSF, UOH, M. J. Hardcastle

2025 Senior Review Task Summary

Dec 2024 - March 2025

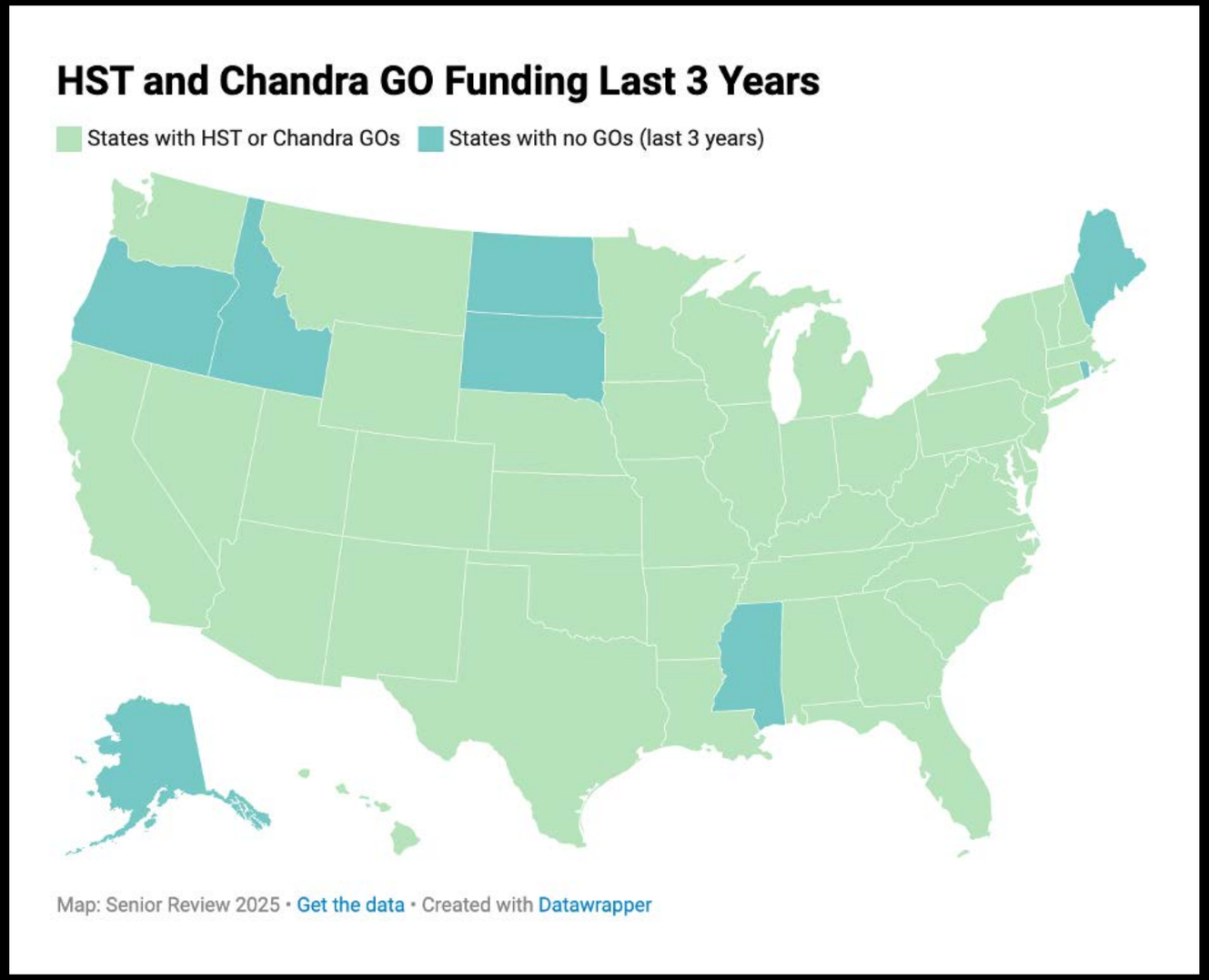
SR2025 found that the full fleet continues to be “capable of producing important, impactful science in a cost-effective manner and will do so if allowed to continue operations”. Furthermore “many of the most insightful science results arise from combining the observations from more than one mission in NASA’s fleet leveraging complementary capabilities.”

The portfolio’s value is “far more than the sum of its parts.”

Consequences of Severe Cuts to Operating NASA Fleet

- Severe reduction in science capabilities and productivity across the board: success across the fleet (including missions in primary phase) is intertwined.
- Severe permanent losses in human capacity, current and future. Reductions or loss of GO/GI funding: impact graduate students, postdocs, dissemination, human capacity and ultimately science productivity
- Increase risks for total or partial mission loss through failure to recover or adapt to changes in orbit
- Decreased community science production as centers reduce or cease support of data analysis and interpretation.
- Cessation of operations — permanent cuts and losses, some opportunities may never recovered; reduces overall mission value to cost ratio to save incremental costs

Where does GO funding go?



Pretty much everywhere

(See light green for states with successful
HST and Chandra PIs in the 2022-2024 cycles)