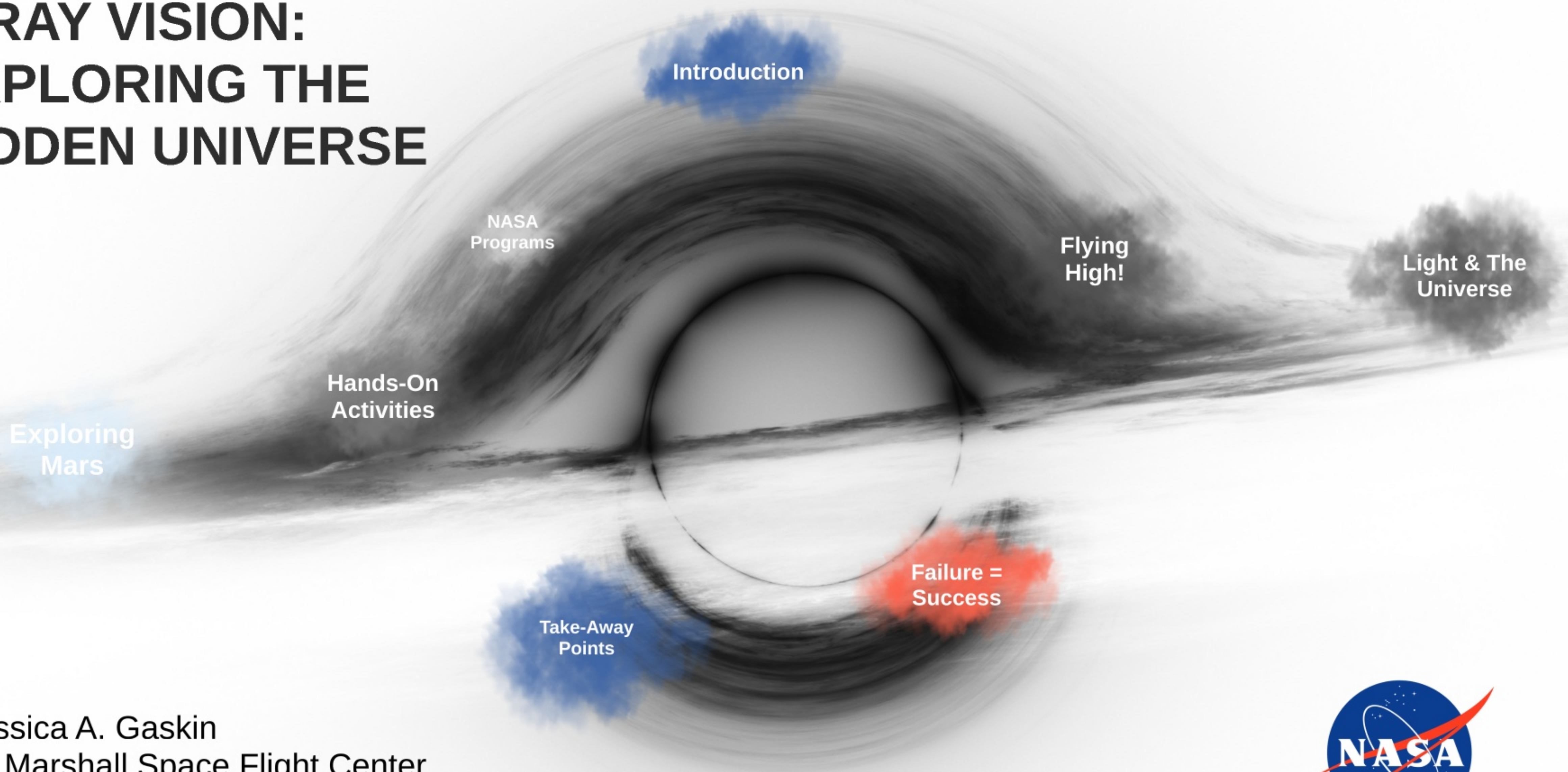
X-RAY VISION: EXPLORING THE HIDDEN UNIVERSE



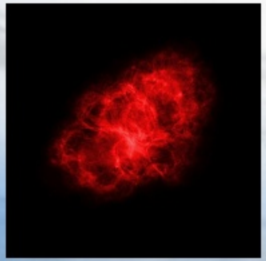
Dr. Jessica A. Gaskin
NASA Marshall Space Flight Center
jessica.gaskin@nasa.gov

MARSHALL SPACE FLIGHT CENTER
NASA
MSFC
Marshall Space Flight Center
B
E
SwRI
University of New Hampshire
ROTATOR
CABLE ASSEMBLY
70°
TDRSS ANTENNA
IRIDIUM ANTENNA
STAR CAMERA, SHUTTER & BAFFLE
WASP OUTER GIMBAL
OPTICS MODULES
WASP INNER GIMBAL
OPTICAL BENCH
DETECTORS
INSTRUMENT PACKAGE
PITCH-YAW ASPECT SYSTEM (PART OF THE SOLAR ASPECT SYSTEM)
Journal of Astronomical Instrumentation
NASA ENGINEERING & SAFETY CENTER
ENGINEERING EXCELLENCE
X
Houston, TX
Socorro, NM
NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY
NMT
1889
Cleveland, OH
CASE WESTERN RESERVE
EST. 1826 UNIVERSITY
Huntsville, AL
UAH
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

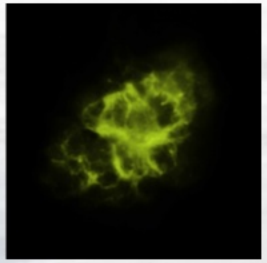
The Complete? Universe

Crab Nebula (Composite Image)

XMM
(UV)

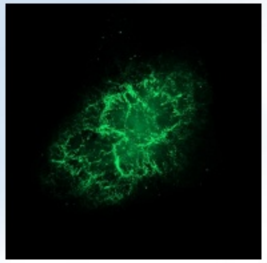


VLA
(Radio)



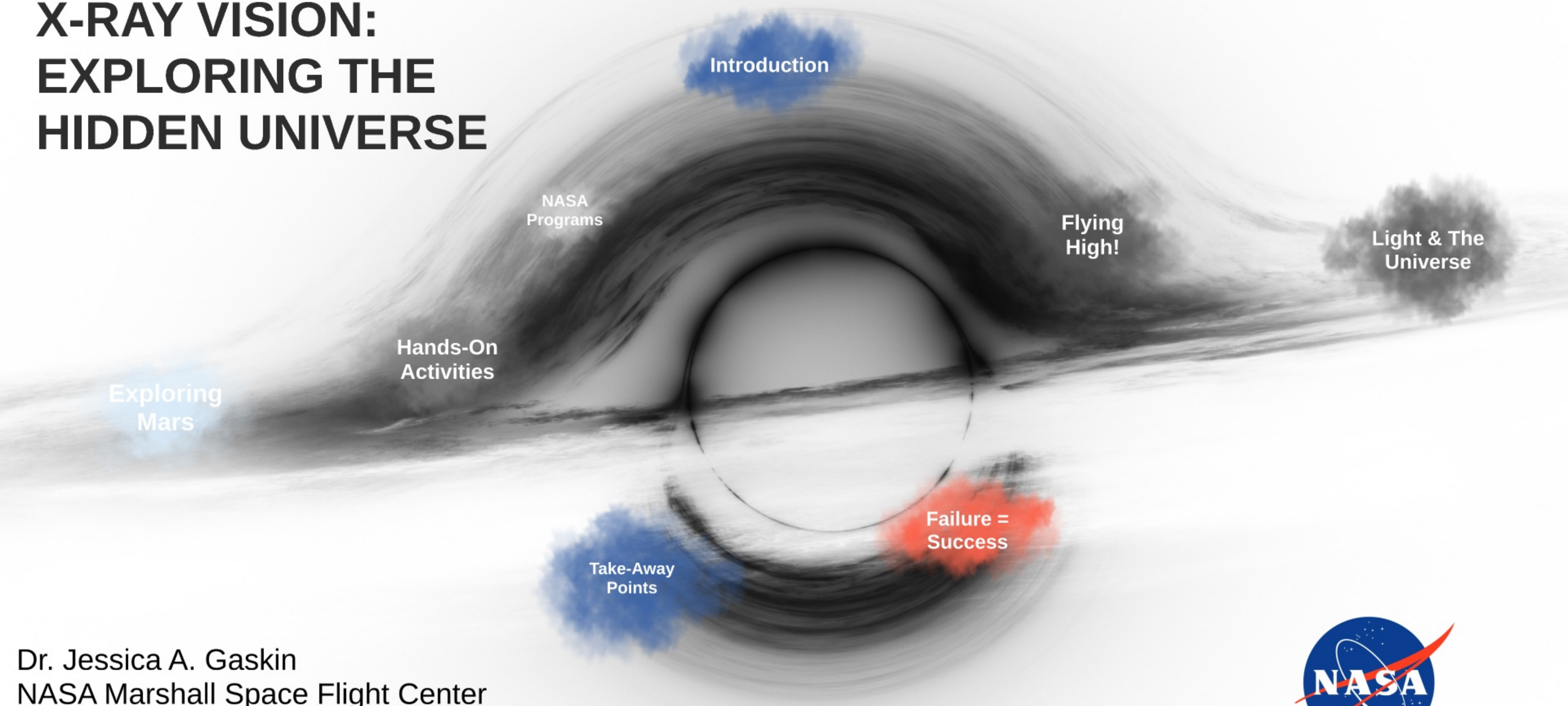
Spitzer
(IR)

Chandra
(X-ray)



Hubble
(Visible)

X-RAY VISION: EXPLORING THE HIDDEN UNIVERSE



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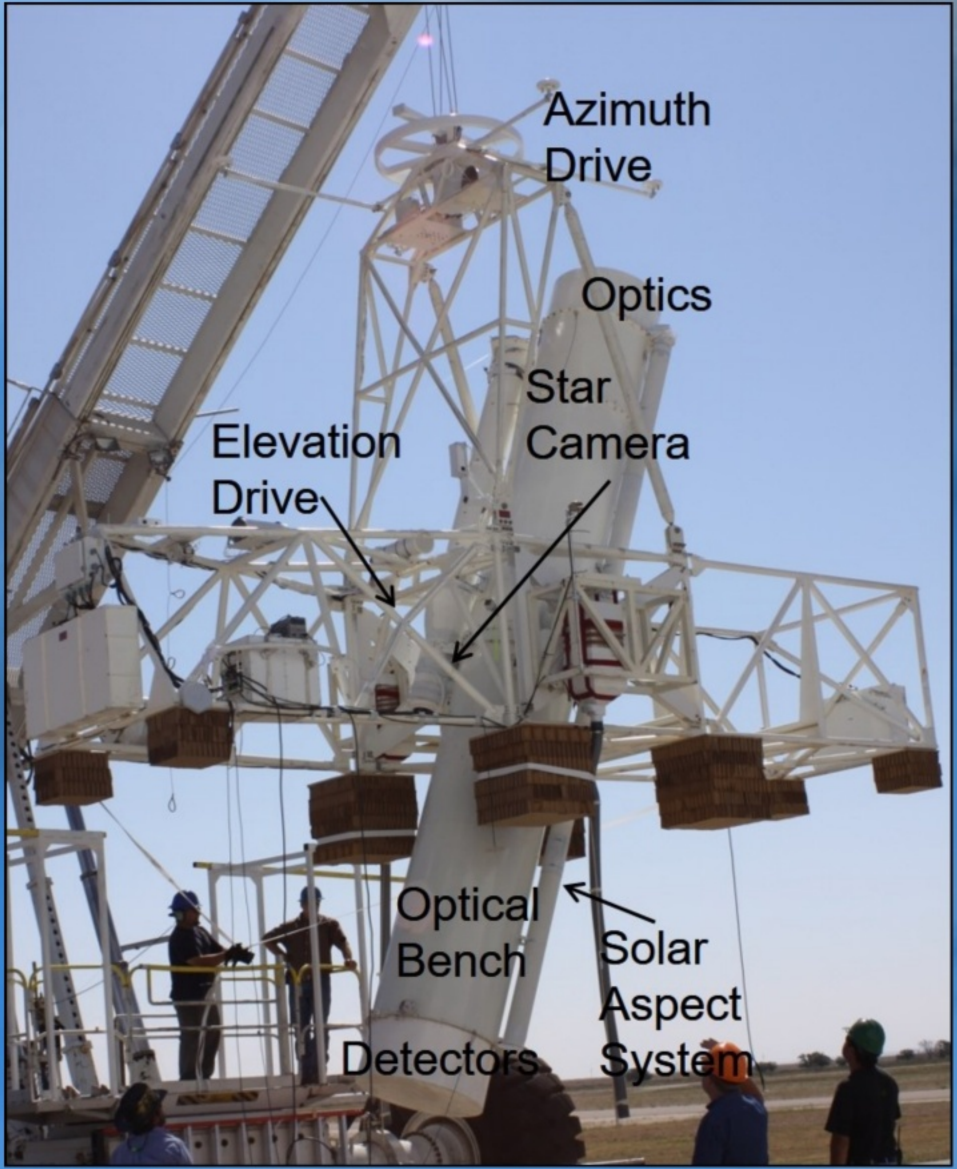
Flying High!

Balloons

Rockets

Spacecraft

Balloon - Borne Payloads



High Energy Replicated Optics to Explore the Sun (HEROES) Mission

History

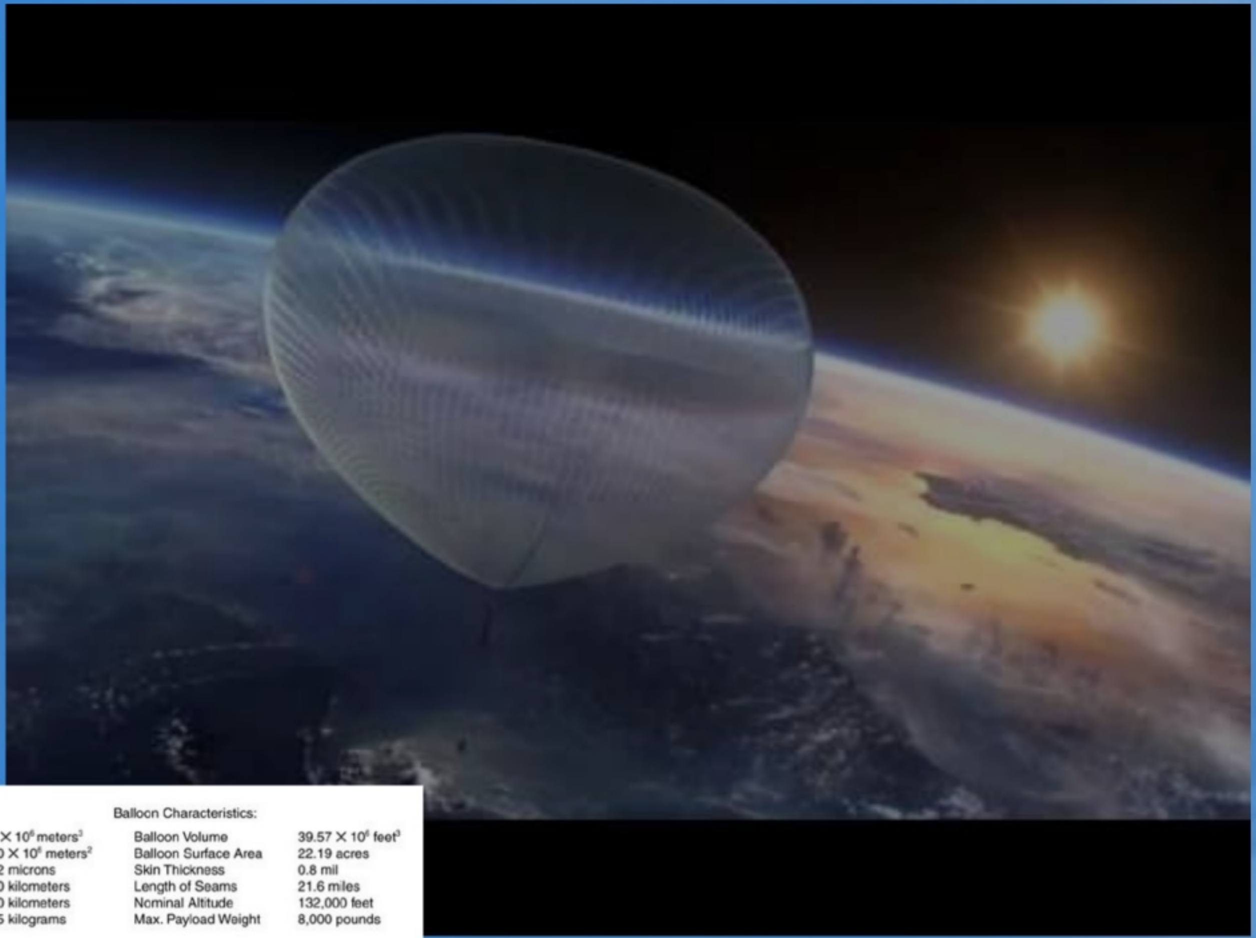
Scientific Balloons

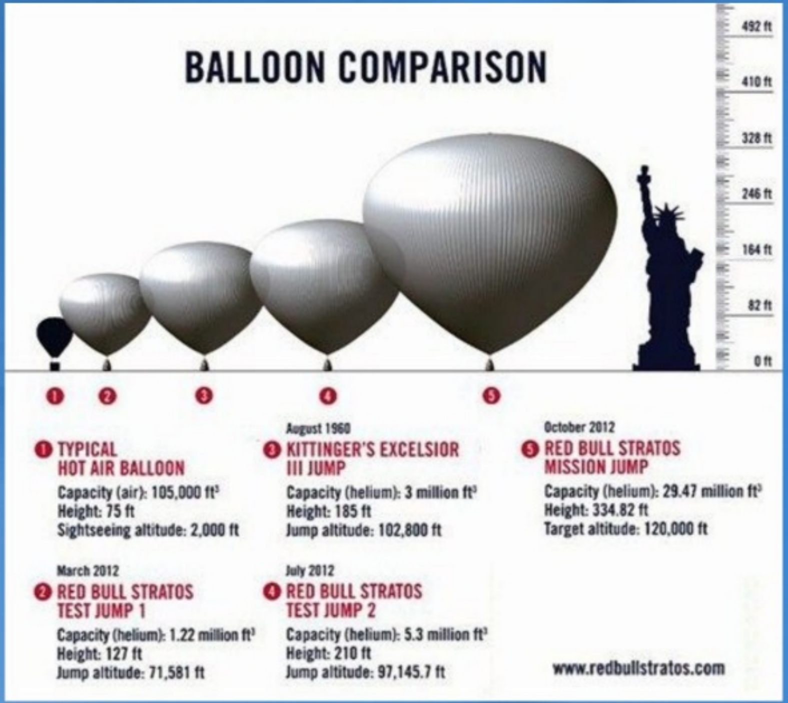
Launch, Flight, Landing

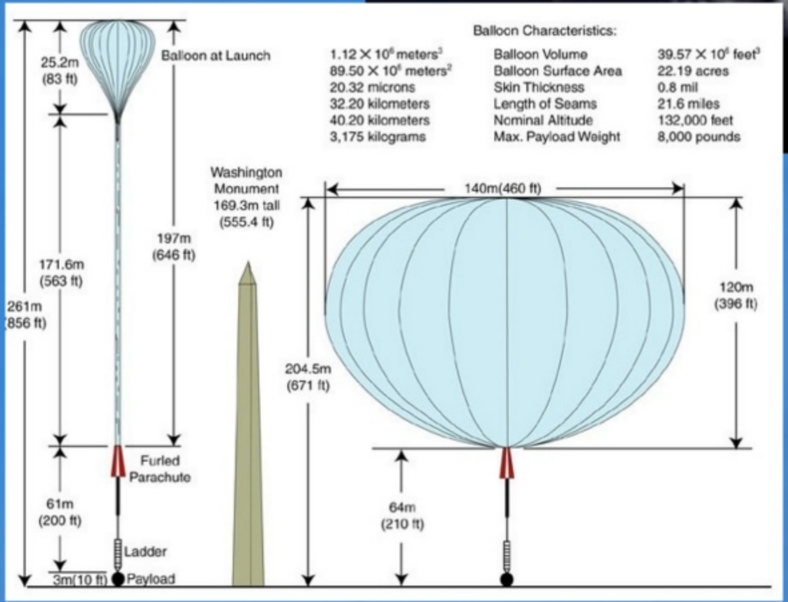
SuperHERO

Conventional and Long Duration Balloon Missions

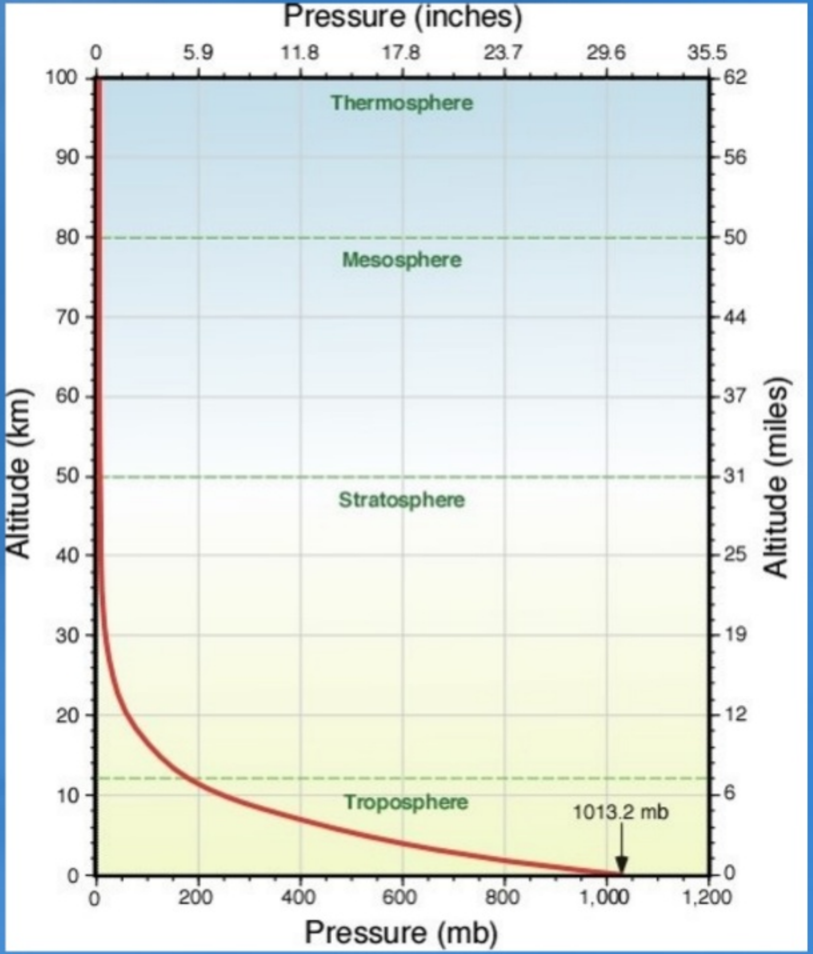
- Vented zero-pressure balloons with ballast.
- Conventional duration balloon missions last ~<48 hours
- Long Duration Flights from Antarctica last up to ~55 days with multiple circumnavigations.
- Ultra-Long Duration Flights can last up to ~100 days.

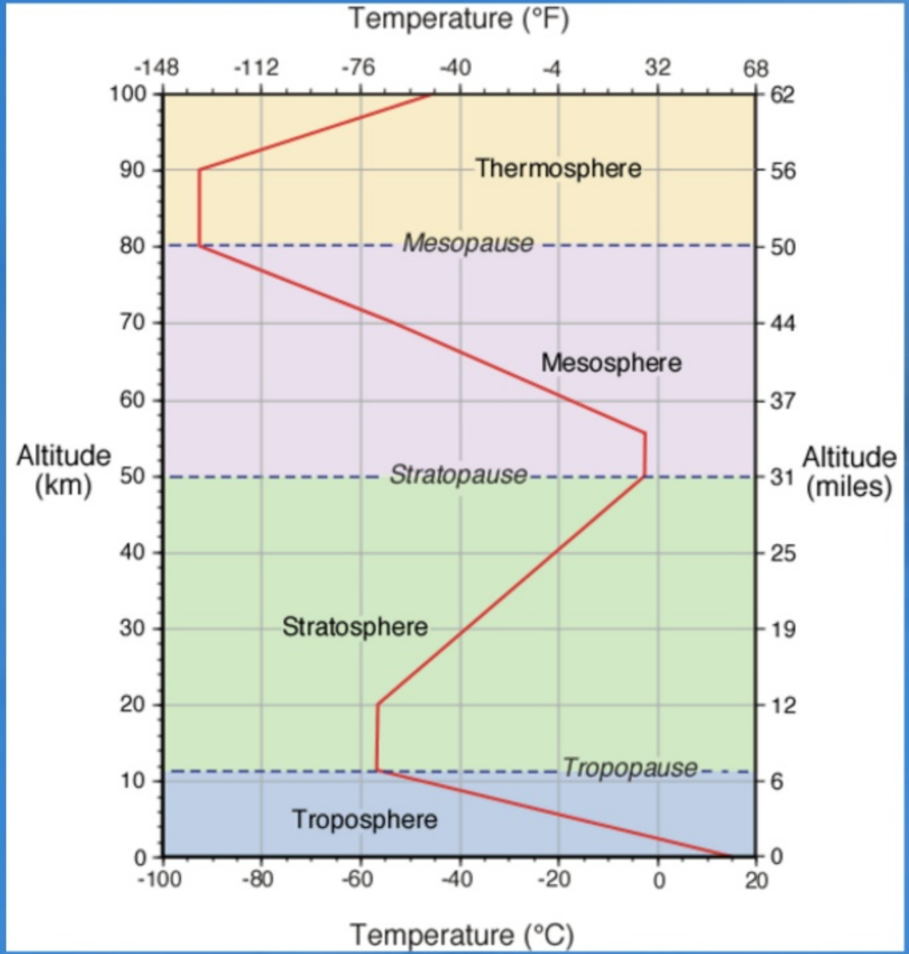






High-Altitude Ballooning Challenges





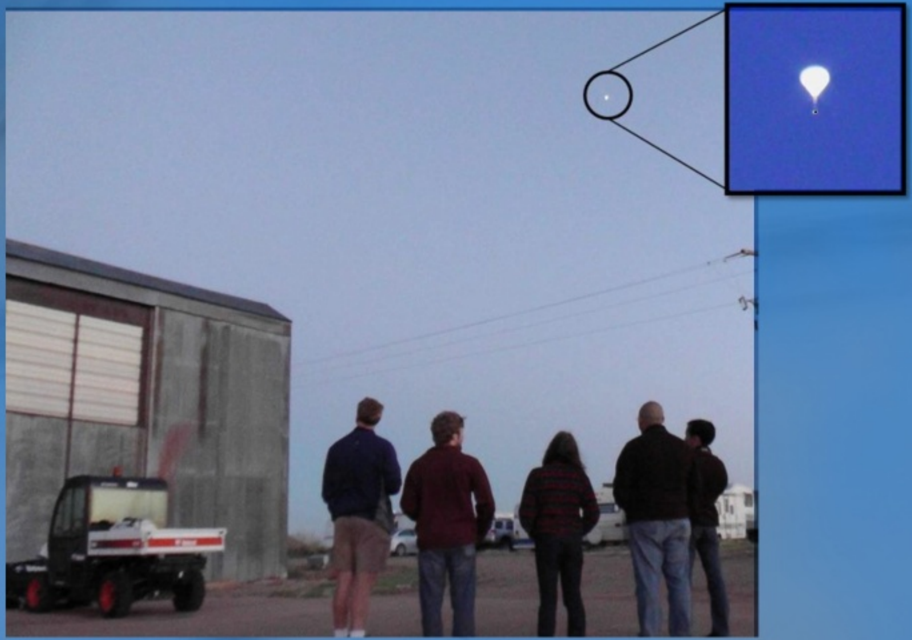
HEROES Mission

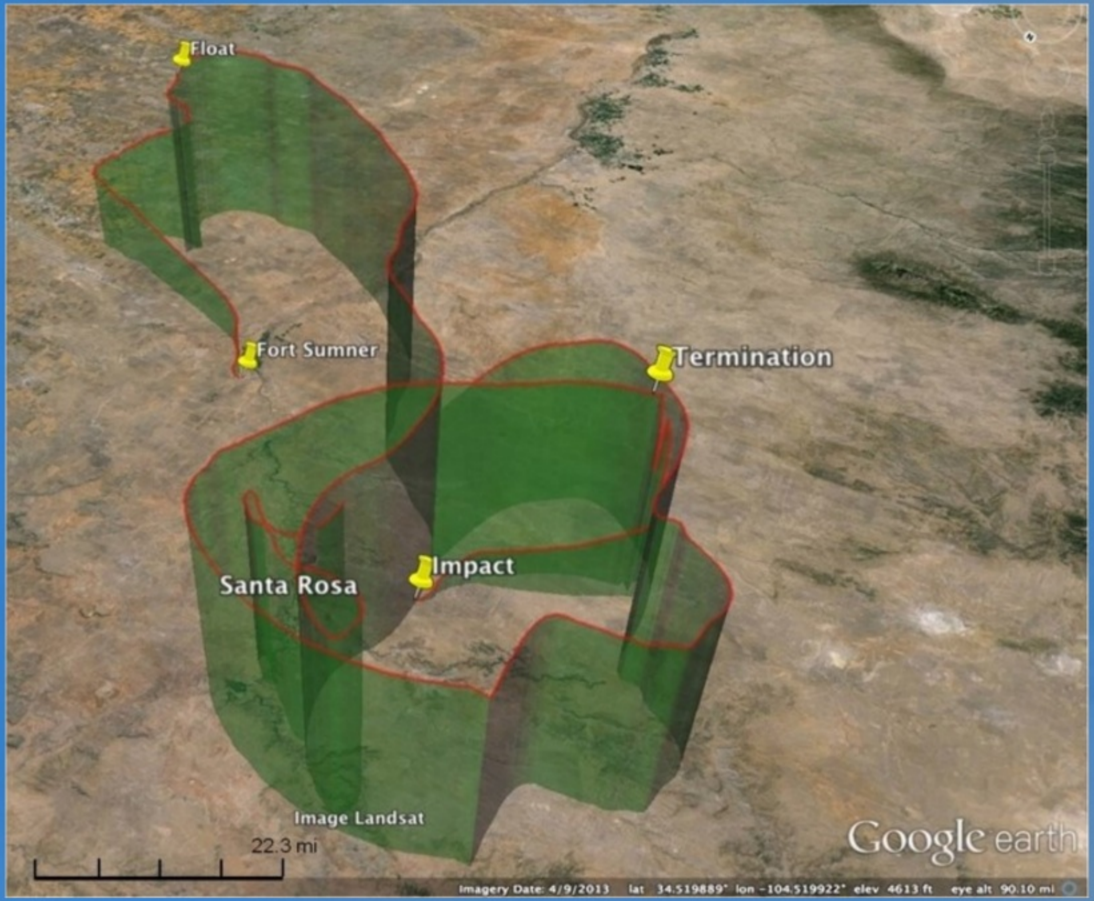
Astrophysics

- Investigate the scale of high energy processes in a pulsar wind nebula.
- Investigate the hard X-ray properties of astrophysical targets such as X-ray binaries and active galactic nuclei.

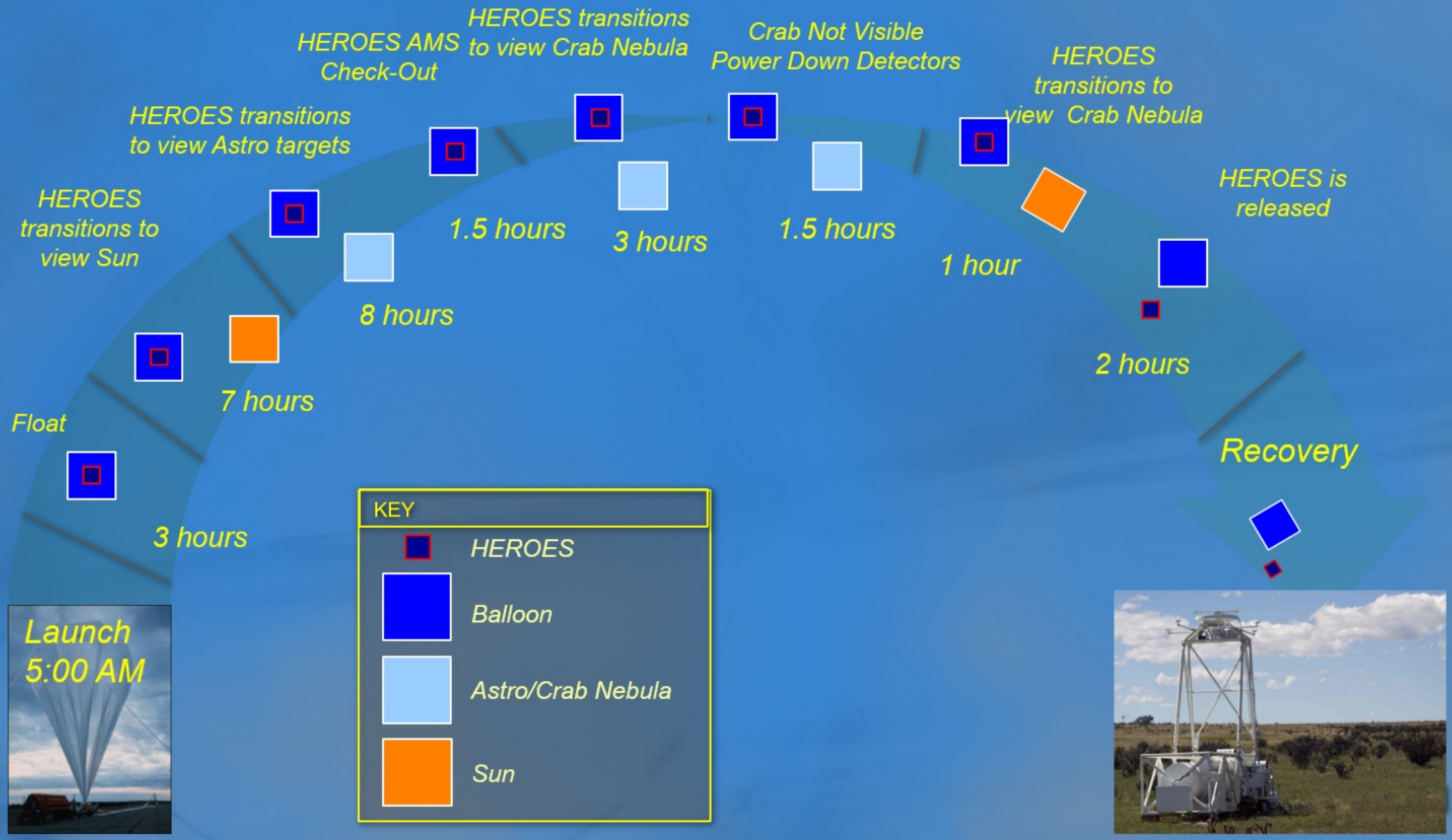
Heliophysics

- Investigate electron acceleration in the non-flaring solar corona by searching for the hard X-ray signature of energetic electrons.
- Investigate the acceleration and transport of energetic electrons in solar flares.



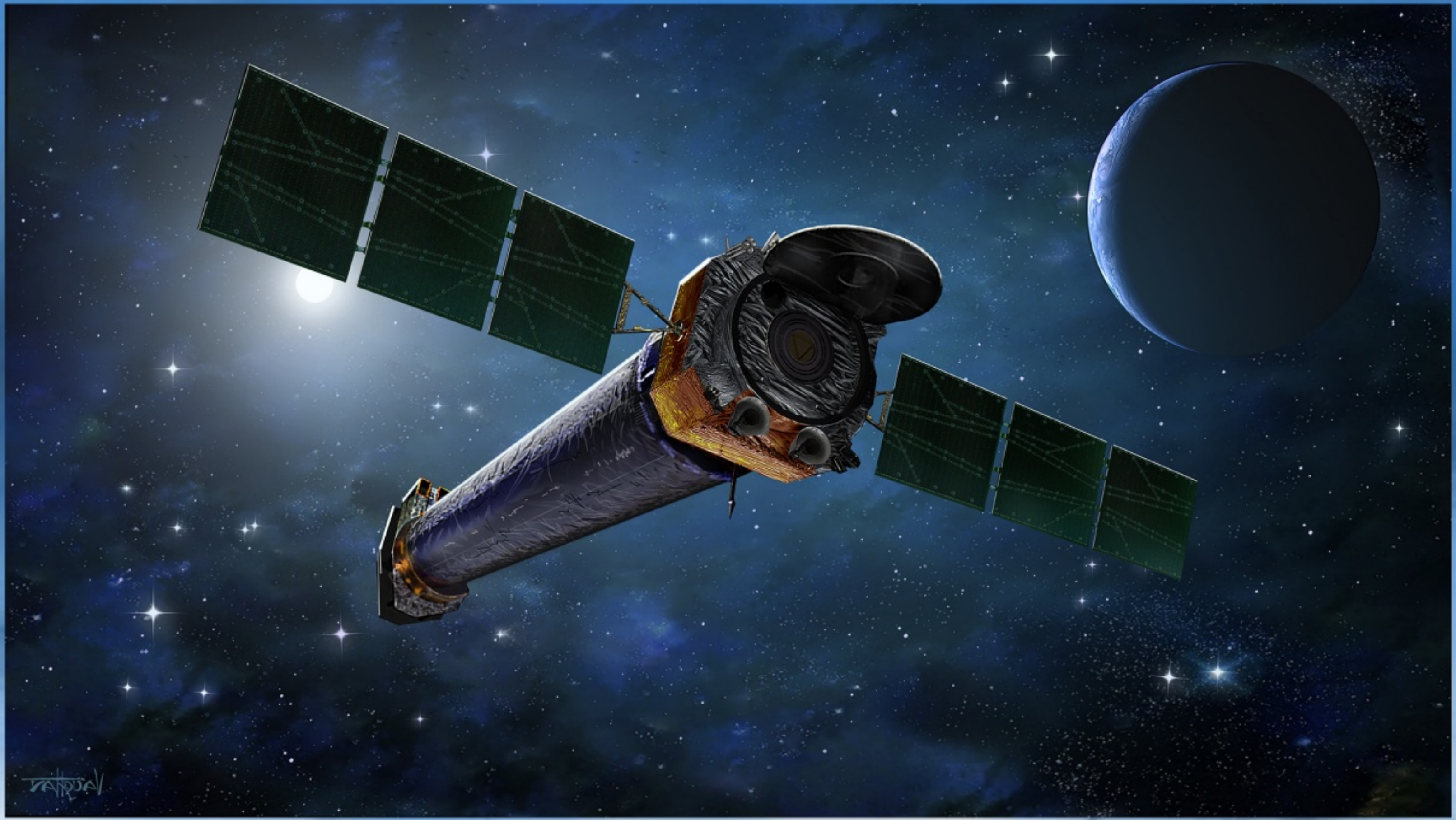


HEROES Observations



Space-Based Missions

X-Ray Optics



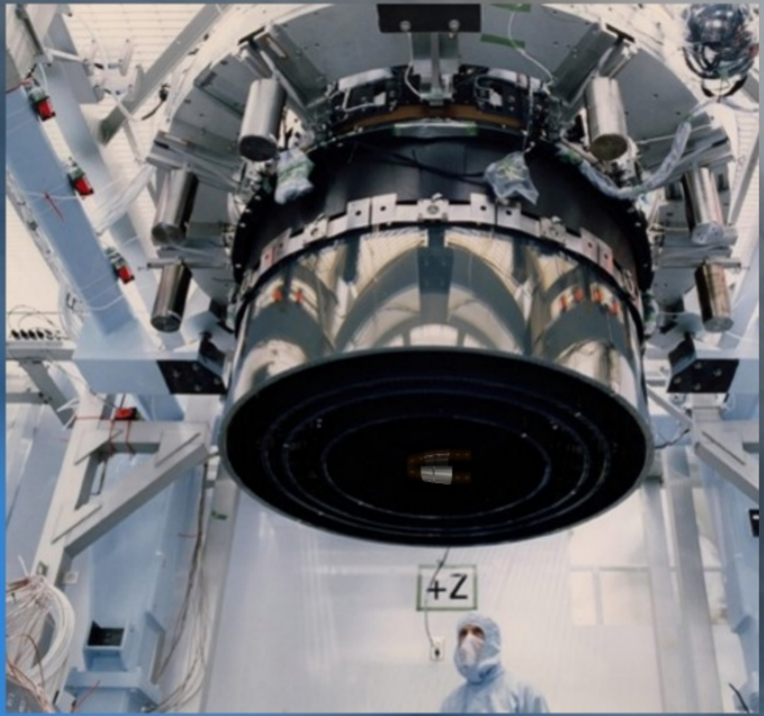
Chandra X-Ray Observatory

Chandra X-Ray Observatory

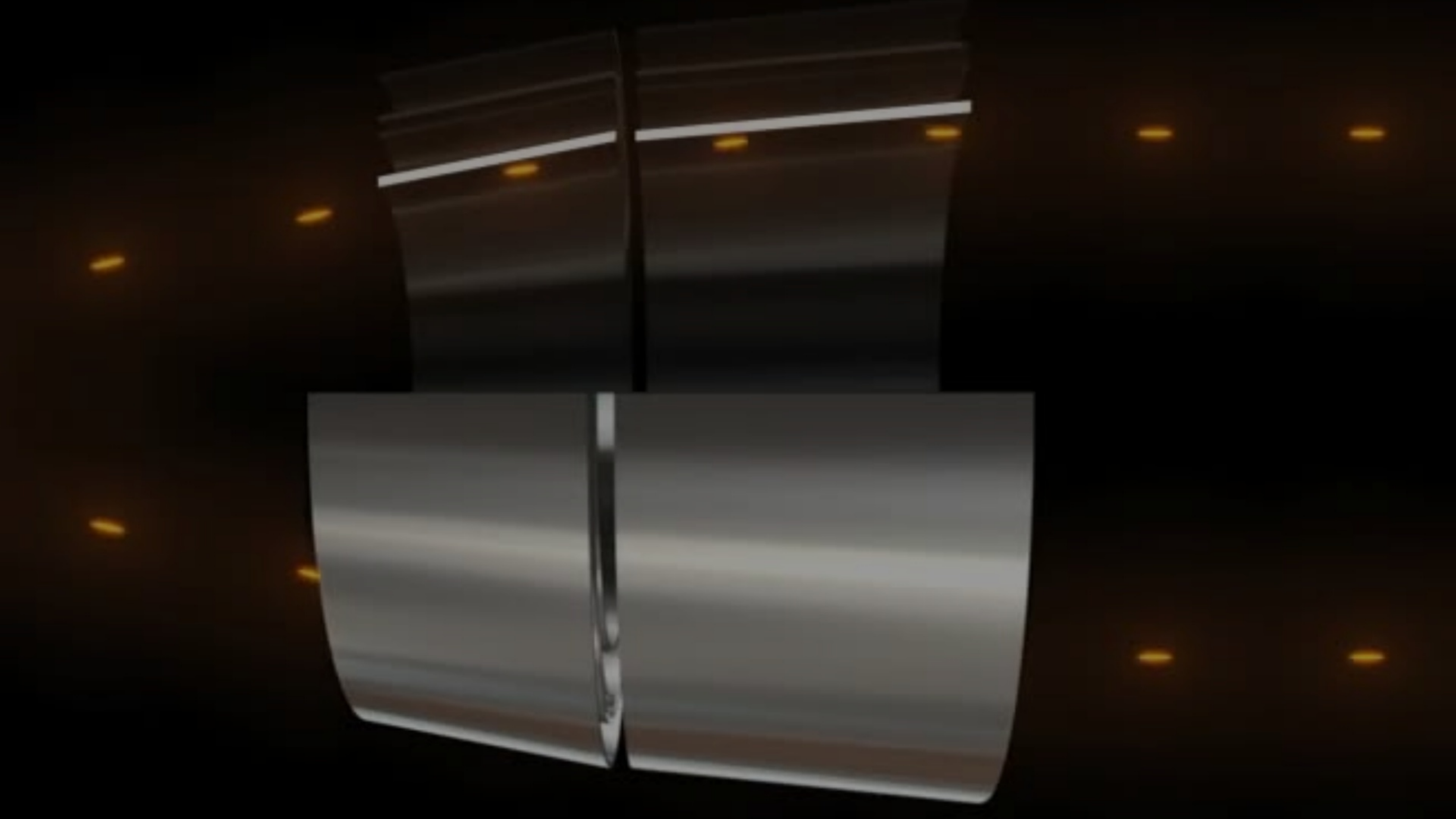
Lynx Observatory

Focusing the Unseen Universe

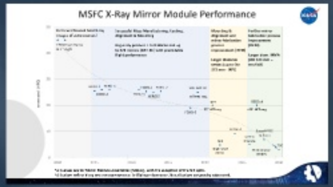
NASA, ESA, NRAO/AUI/NSF and G. Dubner (University of Buenos Aires)



MSFC Advanced Optics: Formulation to Flight



MSFC Advanced Optics: Formulation to Flight



MSFC X-Ray Astrophysics & Optics Team

- Core members of *Chandra*
- Core members of *IXPE*
- X-Ray / Multi-Wavelength Astrophysics
- Mission Development, Leadership, and Support
- Advanced X-ray Optics
- High-Energy Detector Systems
- Large Mission Concepts

ST12

Jessica Gaskin | *Steve Bongiorno* | *Phil Kaaret* | *Doug Swartz (USRA)* | *Peter Maksym* | *Chien-Ting Chen (USRA/EC PhysPAG)*

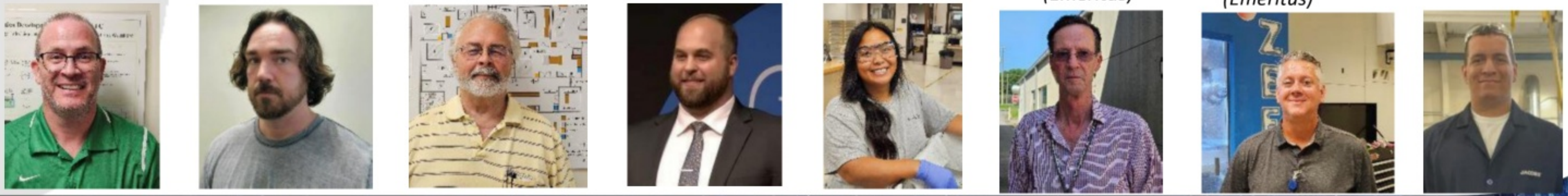
Steven Ehlert | *Oliver Roberts (USRA)* | *Dylan Maurel* | *Lynnie Saade (USRA)* | *Kirtan Dixit (NPP/ORAU)* | *Dave Smith* | *Steve O'Dell*

Allyn Tennant | *Panini Singam (USRA)* | *Danielle Gurgew (USRA)* | *Nick Thomas* | *Jeff Kolodziejczak* | *Brian Ramsey (Emeritus)* | *Martin Weisskopf (Emeritus)*

ST15

Jeff Kegley

ES23



Chet Speegle | *Stephen Cheney* | *Mark Young* | *Patrick Champey* | *Amy Meekham* | *Tom Kester* | *Jason Poole* | *David Banks*

MSFC'S Legacy

MSFC Replicated X-Ray Optics
30 Years of Development, Test, and Flight

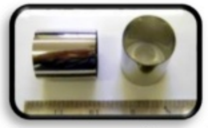
1990 — 1995 — 2000 — 2005 — 2010 — 2015 — 2020 — 2025 +

1993 First MSFC electroformed X-ray optics fabricated in support of AXAF-S

2000 0.5-m diameter replicated shell was produced as proof of concept.

2001 First flight of balloon payload MSFC optics. **<u>Captures the first ever hard X-ray focused images of the sky!</u>**

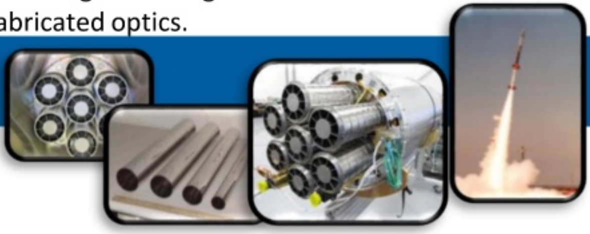
2002 100-µm-thick shell developed for Con-X HXT



2004 Demonstration of the first miniature X-ray optics for small-animal radionuclide imaging.

2007 First demo of X-ray optics for focusing cold neutrons!

2005-2013 Series of HERO/HEROES balloon flights with MSFC optics (~140 mirrors)

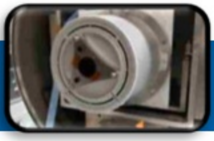


2012-2023 Series of FOXSI sounding rocket flights with MSFC-fabricated optics.

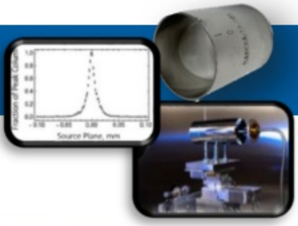
2017 First demo of MSFC-produced optics for the Sandia Z pulsed energy machine.

2019 Launch of Spectrum-Rontgen-Gamma Mission with ART-XC instrument using MSFC-fabricated X-ray mirrors (196 mirrors).

2021 Launch of IXPE with MSFC-fabricated mirrors)



2021 Launch of MaGIXS sounding rocket with MSFC-fabricated mirrors



2022 **<u>High-resolution of 2.3 ± 0.3 (1σ) arcsecs FWHM</u>** measured for MSFC-fabricated optic for the NIF.

2023/2024 FOXSI-4 MSFC-fabricated mirror module with high-angular resolution of ~3.5 arcsecs FWHM (~5-7 arcsec HPD, gravity subtracted).

MSFC's Comprehensive X-ray Optics Development Capability

Our mission:

- **Develop the next generation of *<u>sub-arcsecond full-shell</u>* mirrors and mirror module assemblies**
- Continue supplying lower-cost, moderate-resolution mirrors and assemblies, including wide field-of-view assemblies
- Enhance the performance of X-ray optics with reflective coatings

Comprehensive capability that builds on decades of investment:

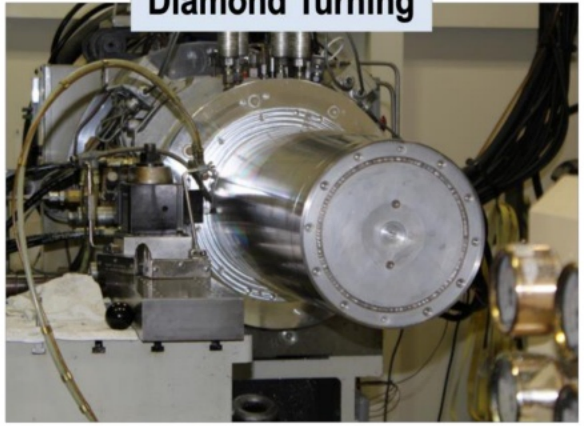
- Optical design and analysis
- Mandrel Fabrication/polishing
- Mirror shell replication
- Mirror direct polishing
- Precision mounting & alignment
- Post figure-correction
- Precision metrology
- Thin-film single and multilayer
- X-ray test & calibration

Full-shell ENR X-ray optic fabrication process

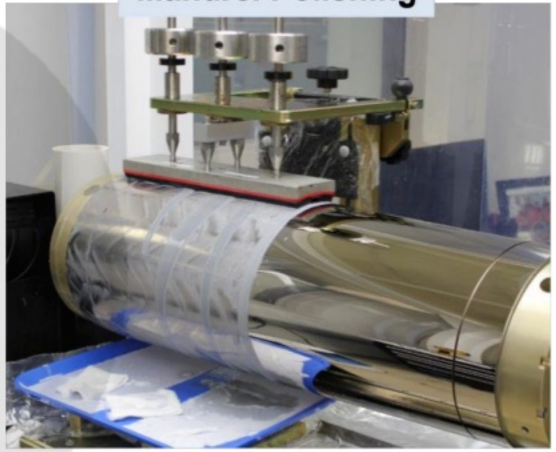
Aluminum Mandrel Blank

EN Plating

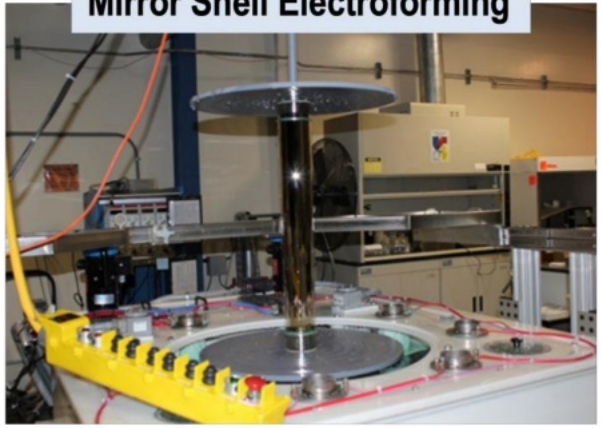
Diamond Turning



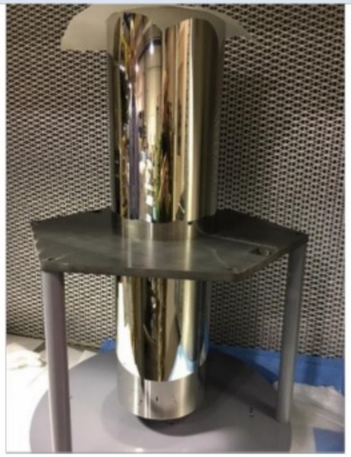
Mandrel Polishing



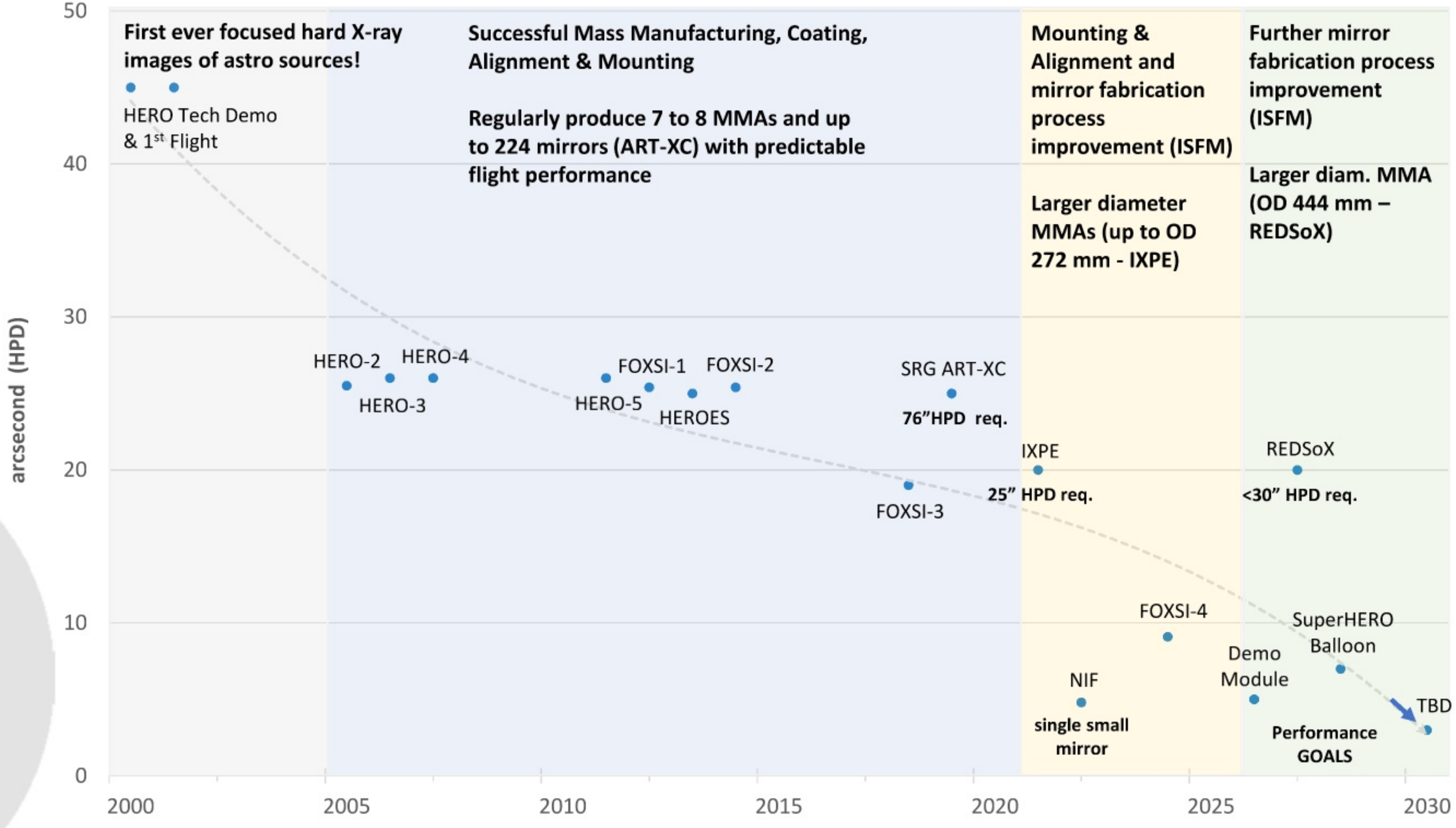
Mirror Shell Electroforming



Mirror Shell After Separation



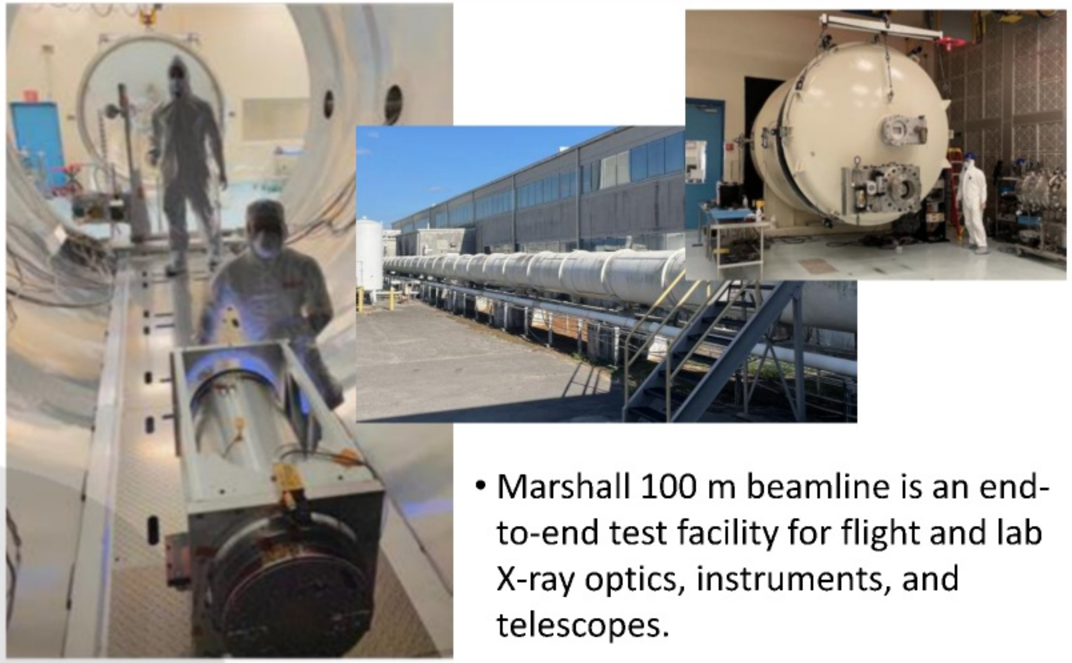
MSFC X-Ray Mirror Module Performance



*All values are for Mirror Module Assemblies (MMAs), with the exception of the NIF optic.
*All values reflect X-ray test measurements or in-flight performance. Not all values are gravity subtracted.

The Marshall 100-Meter X-ray Beamline
Stray Light Test Facility

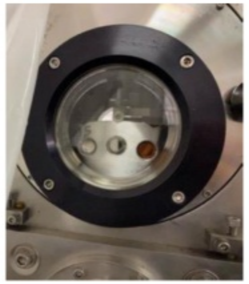
X-Ray and Cryogenic Facility



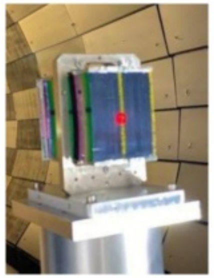
IXPE MMA calibration at Marshall-100m

- Marshall 100 m beamline is an end-to-end test facility for flight and lab X-ray optics, instruments, and telescopes.
- Highly-capable, low-overhead, user-friendly facility.
- X-ray sources from 0.25 to 110 keV.
- Sounding rocket skins can now be mounted directly to the chamber.

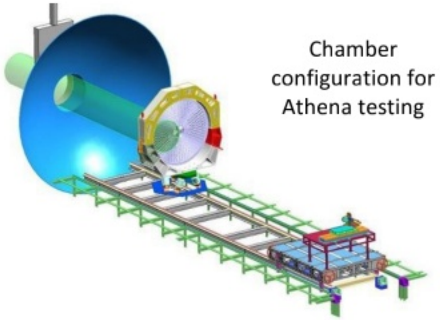
For beamline time contact nicholas.e.thomas@nasa.gov



XRCF Filter Wheel



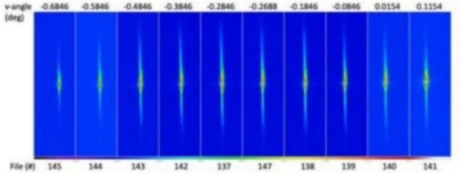
Athena SPO optic test



Chamber configuration for Athena testing

2024 Astro ISFM: Capability Improvements

- X-ray Source and Instrumentation
  - Electron Impact Point Source (EIPS)
  - Filter Wheel Assembly
  - Beam Monitors
  - Focal Plane Instrumentation
- X-ray Data Acquisition and Control System
- Alignment and Metrology Monitoring System
- Focal Plane Instrumentation Positioning System
- Test Article Positioning System
- Upcoming work: Calibration of Schott mirror for HWO & MSFC AMTD mirror.



CCD Alignment X-ray data for SPO test

For beamline time contact jeff.kegley@nasa.gov

Contact Us!

X-ray Astronomy Group Lead

Jessica Gaskin.. jessica.gaskin@nasa.gov

X-ray Mirror Development + Alignment

Stephen Bongiorno .... stephen.d.bongiorno@nasa.gov

Thin Film Coatings

Danielle Gurgew .... danielle.n.gurgew@nasa.gov

X-ray Test Facilities

Nick Thomas (Marshall-100m)... nicholas.e.thomas@nasa.gov

Jeff Kegley (XRCF)...jeff.kegley@nasa.gov

NASA MSFC X-Ray Group Job Pre-Advertisement - 2024
Location: Huntsville, Alabama
Multiple Positions: GS13/14 and GS14/15 Permanent-Hires
Level: Early- and Mid-Career
Sector: Government and National Lab
Work Function/Discipline: Science Research/Physics-Astrophysics
Preferred Education: Doctorate
Citizenship: United States

NASA's George C. Marshall Space Flight Center (MSFC) X-Ray Group in the Astrophysics Branch of the Science and Technology Office plans to hire an early- and mid-career Permanent-Hire research astrophysicist. Successful candidates are expected to conduct an independent program in the research, development, and testing of the next generation of X-ray optics and instrumentation, and to lead/support a thriving high-energy astrophysics research and analysis program that is focused around current and proposed astrophysics missions. The X-ray Group is currently seeking **declarations of interest** via a submitted letter of interest and CV (see below).

Chandra can detect and image X-ray sources that are billions of light years away.

The focusing power is equivalent to the ability to read a newspaper at a distance of half a mile!


Milky Way Central Region

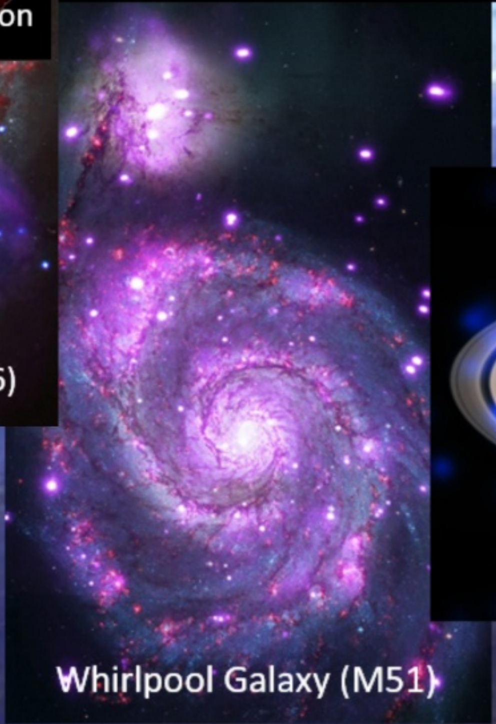
Jupiter

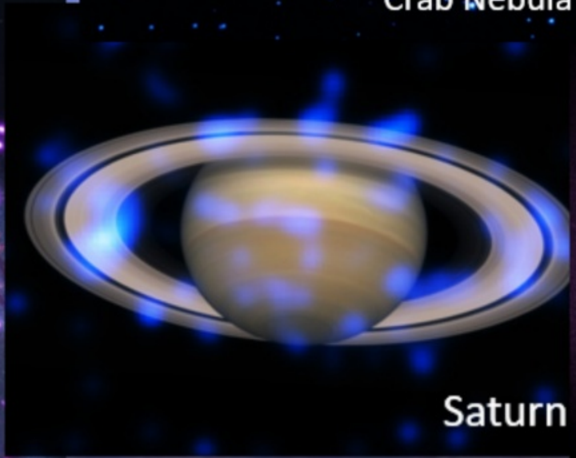

Crab Nebula


Cass A

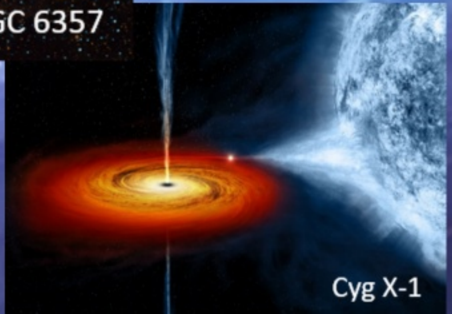

NGC 6357


NGC 4258 (M106)


Whirlpool Galaxy (M51)


Saturn


Perseus Cluster


Cyg X-1


Pathways to Discovery in Astronomy and Astrophysics for the 2020s
LYNX
HabEx
LUVOIR
Origins
X-RAY OBSERVATORY
LYNX

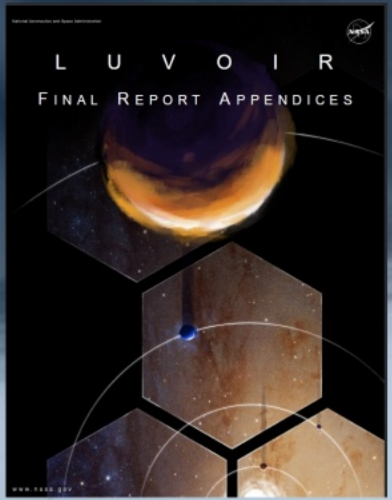
Pathways to Discovery in Astronomy and Astrophysics for the 2020s

X-RAY OBSERVATORY LYNX

HabEx

LUVOIR

Origins



https://www.lynxobservatory.com/

https://www.jpl.nasa.gov/habex/

https://www.luvoirtelescope.org/

https://origins.ipac.caltech.edu/

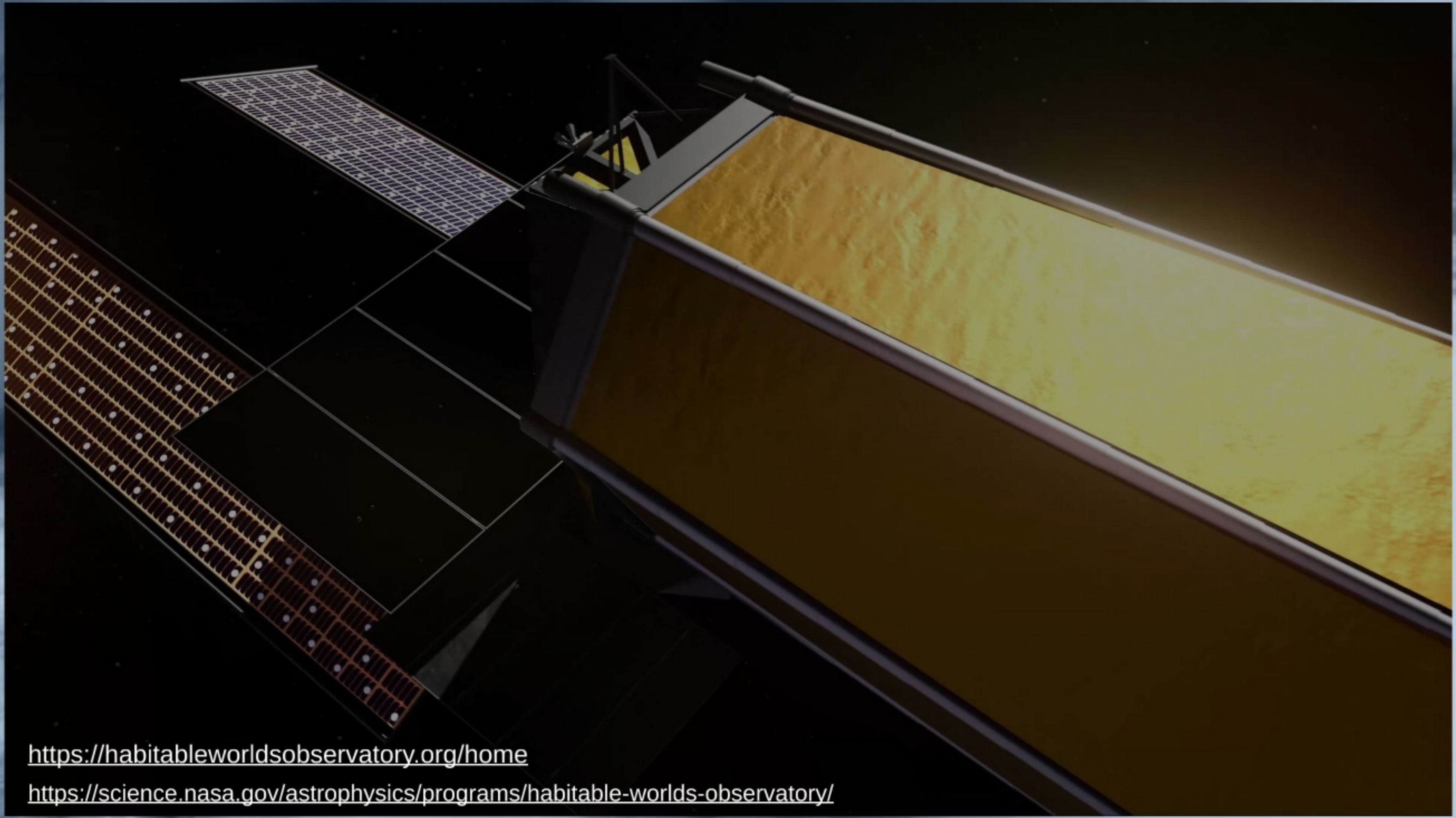
Probe Class Missions: AXIS, CDIM, CETUS, EarthFinder, GEP, PICO, POEMMA, Starshade, STROBE-X, TAP

https://www.nationalacademies.org/

Habitable Worlds Observatory

Creating a 'Super-Hubble'

The Habitable Worlds Observatory will have a large mirror that lets it observe light like NASA's Hubble Space Telescope. It aims to find and study at least 25 Earth-like planets orbiting other stars. This 'super-Hubble' will help us discover how common these planets are. Besides searching for life, it will greatly enhance our understanding of the universe in the coming years, building on the successes of past missions like Hubble, Webb, and Roman.

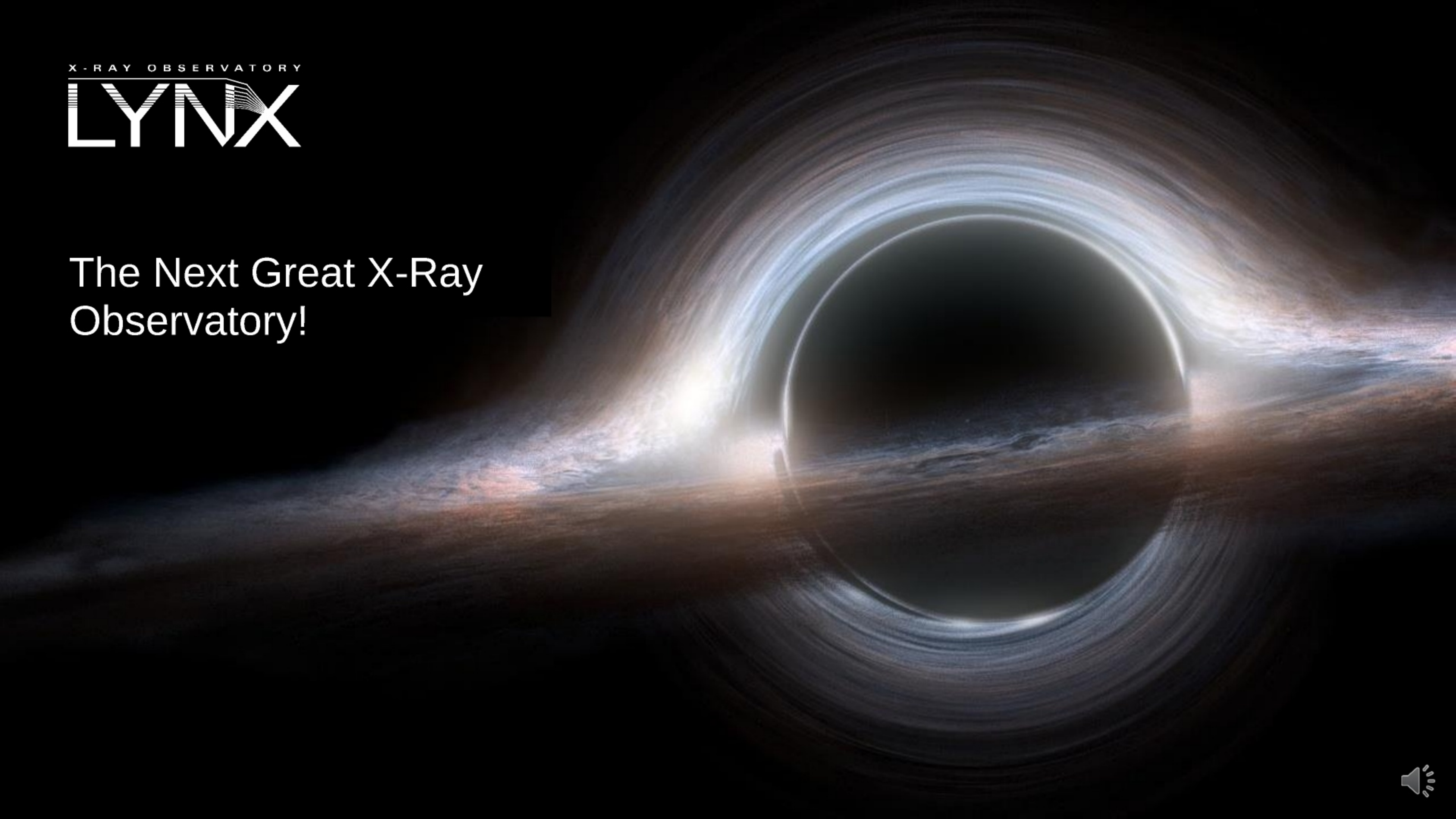


https://habitableworldsobservatory.org/home

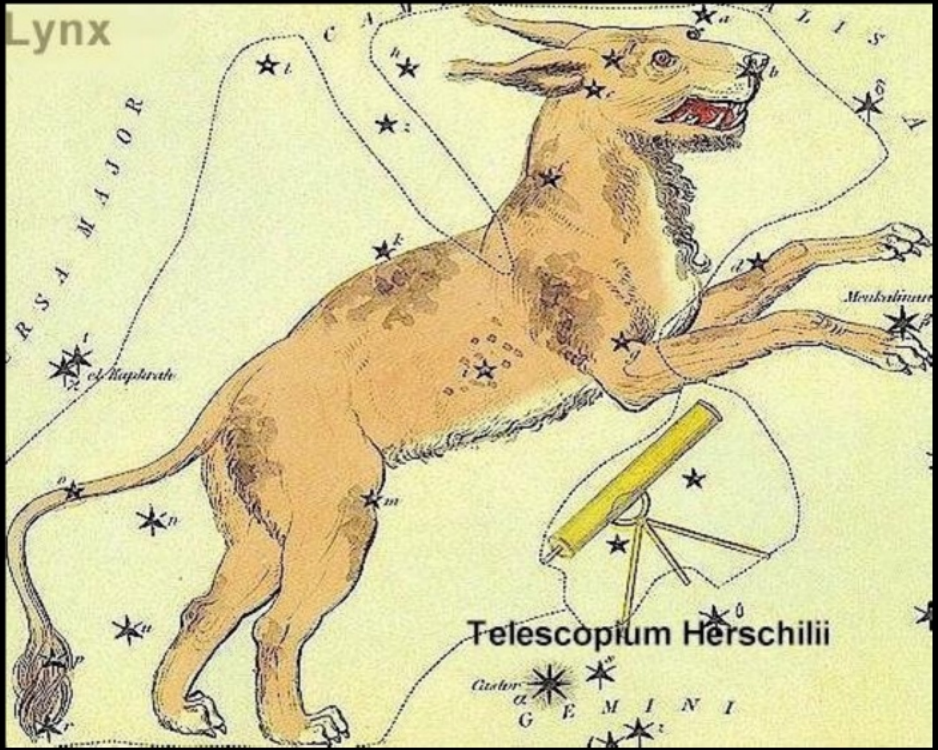
https://science.nasa.gov/astrophysics/programs/habitable-worlds-observatory/

X-RAY OBSERVATORY LYNX

The Next Great X-Ray Observatory!

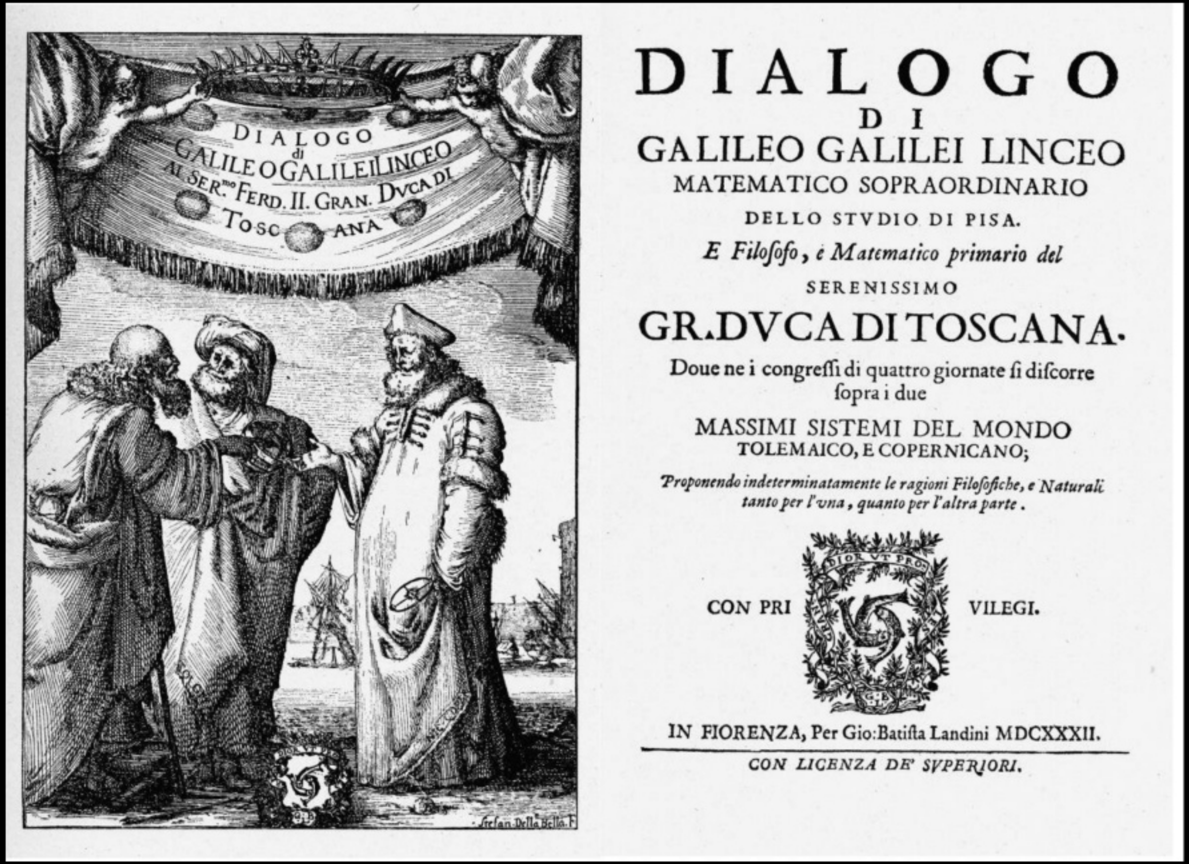


LYNX: THE NEXT GREAT OBSERVATORY



A symbol of great insight in many cultures - with the ability to see through solid objects to reveal the true nature of things.

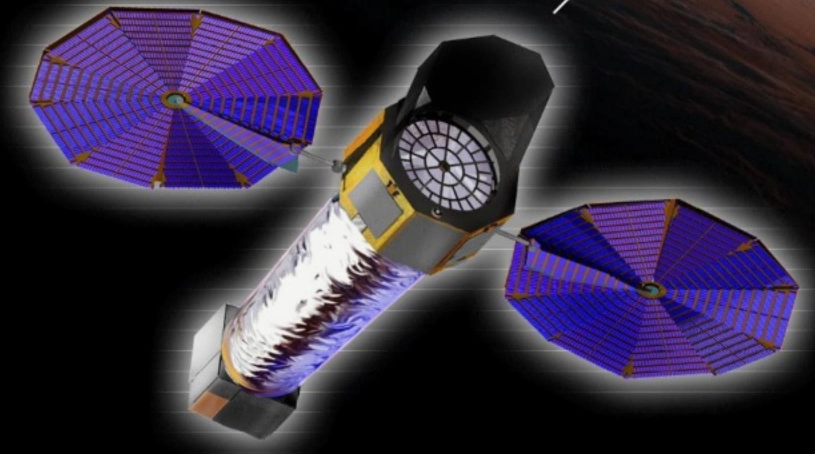
Academy of the 'Lynx-Eyed' was founded in 1603 by Federico Cesi. Perform incisive and penetrating investigations of the natural world.



A NEW GREAT OBSERVATORY

X-RAY MIRROR ASSEMBLY

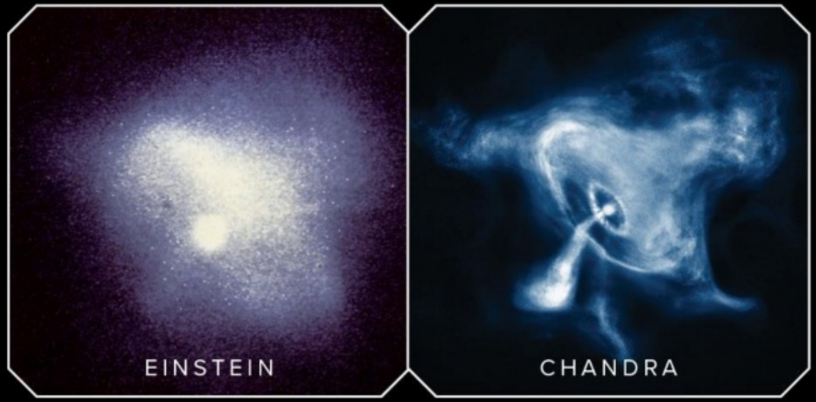
0.5'' Point-Spread Function, stable over a 20 arcminute FoV



HIGH DEFINITION X-RAY IMAGER

LYNX X-RAY MICROCALORIMETER

X-RAY GRATINGS SPECTROMETER



HIGH DEFINITION X-RAY IMAGER

Designed for exquisite imaging and wide surveys, the HDXI is an active pixel array covering a 20′ x 20′ field of view with subarcsecond imaging.

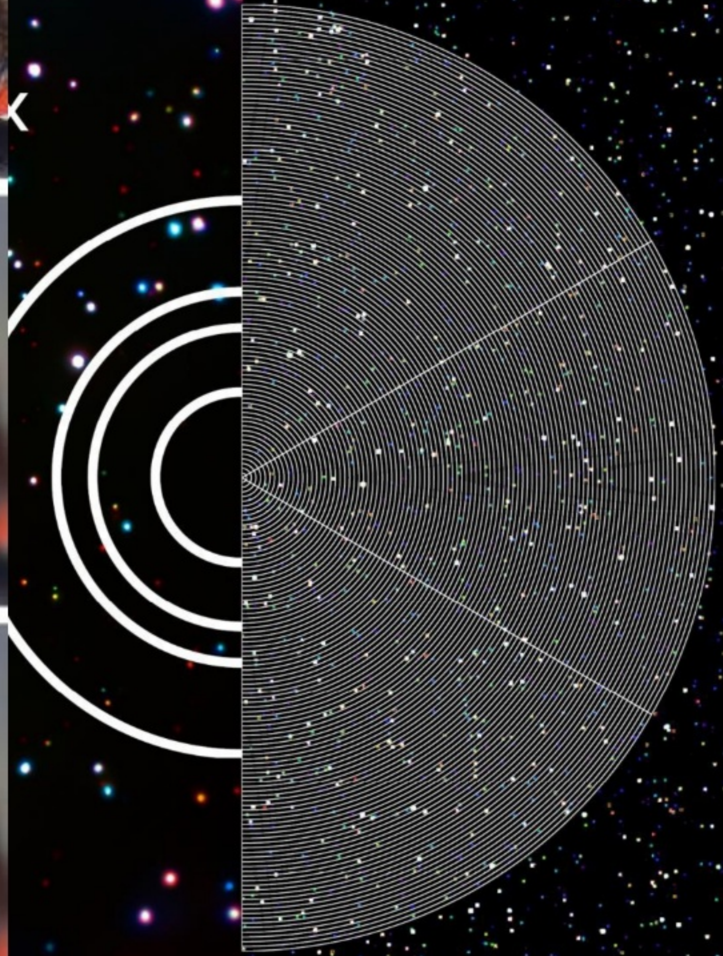
LYNX X-RAY MICROCALORIMETER

Spatially resolved 3 eV spectroscopy across a 5′×5′ field of view, sampled with 1″ pixels. Two subarrays optimized for finer imaging and higher spectral resolution.

X-RAY GRATINGS SPECTROMETER

Spectral resolving power of $R > 5000$ with ~4000 cm^2 of effective area across the critical X-ray emission and absorption lines of C, O, Mg, Ne, and Fe-L.

Created by David J. Marmor, MFA and Michael F. Marmor, MD © 2010 *Archives of Ophthalmology*



50x higher throughput while maintaining *Chandra's* angular resolution.

Like going from your 8” backyard telescope to a 10-m Keck.

What takes Chandra 8 weeks, Lynx can do in ~1 day for deep surveys.

THE SCIENCE

Lynx is designed to pursue three science pillars.

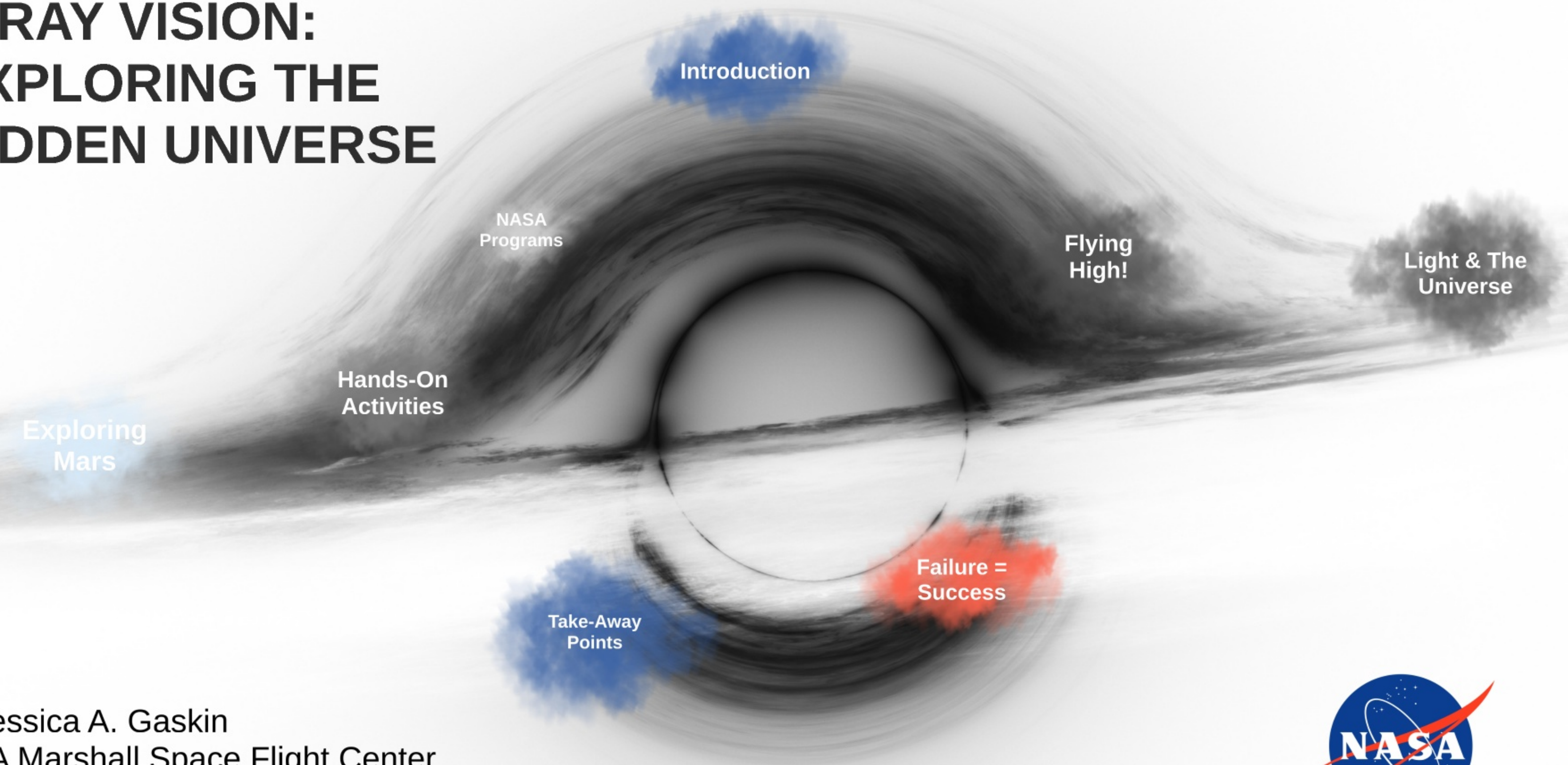
There are ample resources for many other programs, including those unexpected today.

It will be a discovery platform for all.

WWW.HIDDENCOSMOS.ORG


https://www.lynxobservatory.com
https://www.greatobservatories.org/

X-RAY VISION: EXPLORING THE HIDDEN UNIVERSE



Dr. Jessica A. Gaskin
NASA Marshall Space Flight Center
jessica.gaskin@nasa.gov

Failure is an inevitable part of the job

Failure = Success

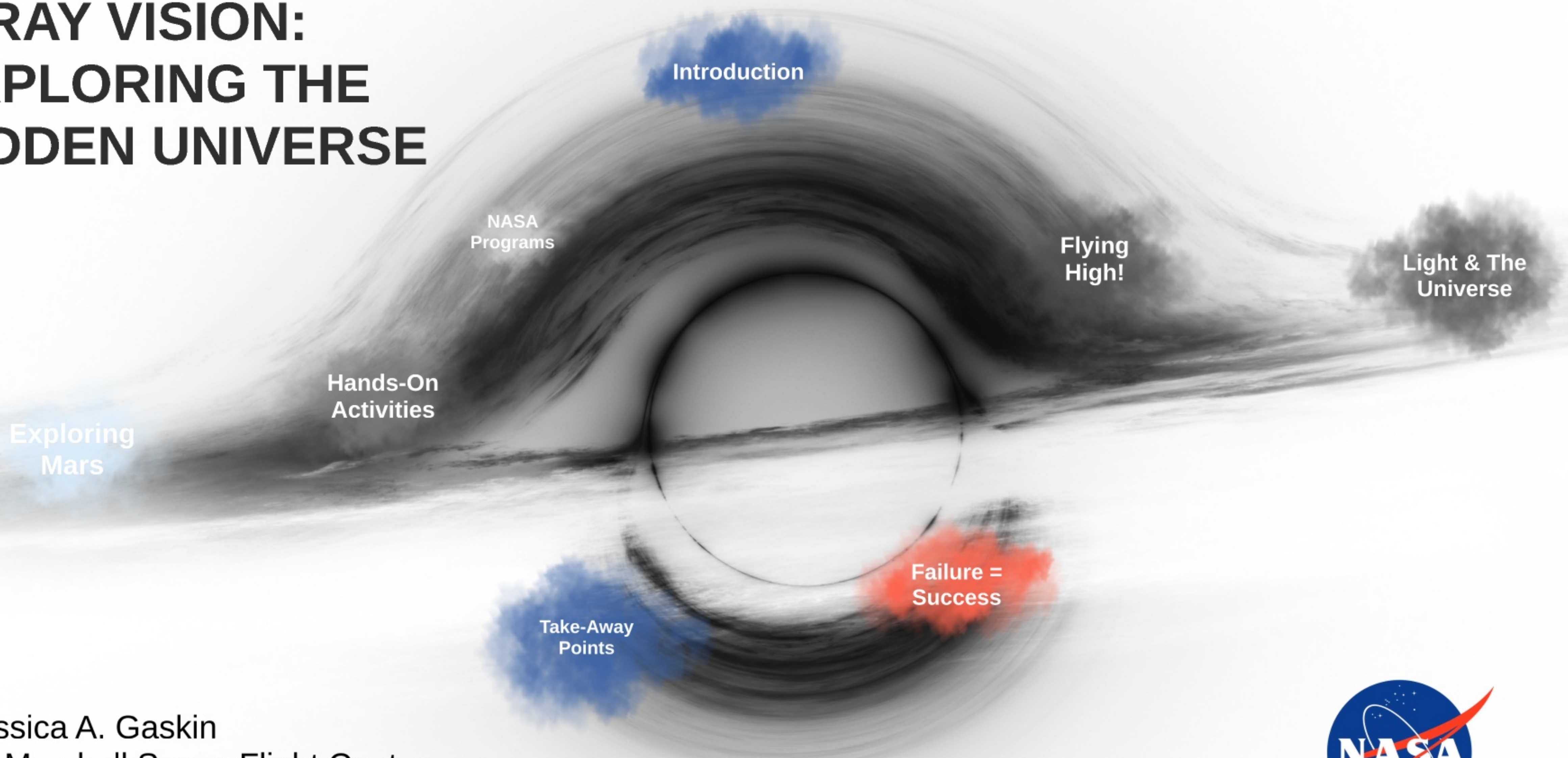
My Failures

Other Failures

Top 3 Failures

1. Melted a priceless detector
2. Imploded a vacuum chamber
3. Crashed a balloon payload

X-RAY VISION: EXPLORING THE HIDDEN UNIVERSE



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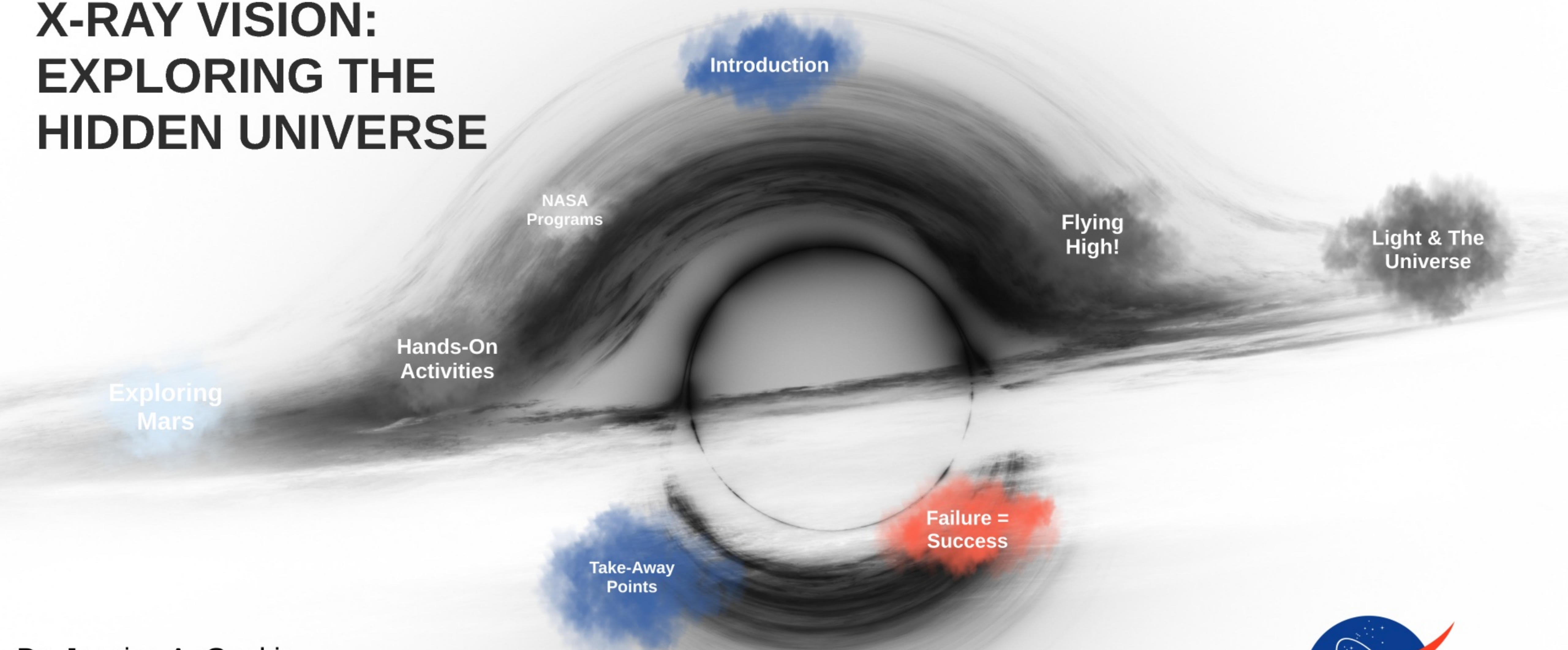
Top 5 Take Away Points

- Developing instrumentation for science requires understanding the physics that drives the science.
- Developing instrumentation requires a fundamental understanding of physics that drives the function of the instrument.
- Instrumentation translates across science disciplines and platforms.
- Innovation is not just developing something new, but using an existing instrument in a diferent way.
- Failure is part of the development / learning process and should be embraced. Don't be afraid to take risks!

X-RAY VISION: EXPLORING THE HIDDEN UNIVERSE



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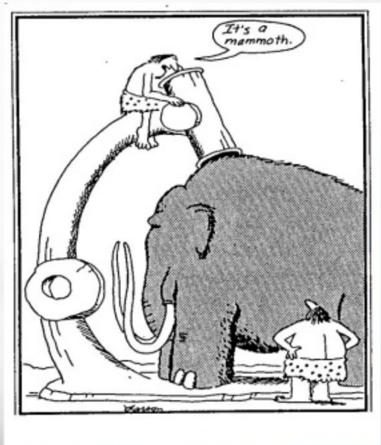
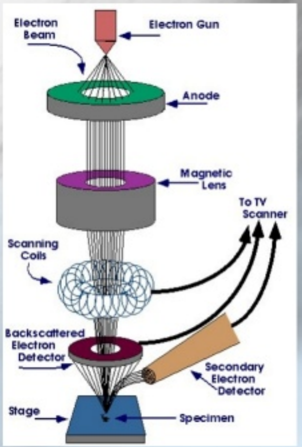
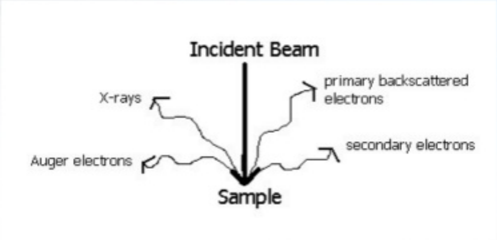




Environmental Scanning Electron Microscope for Mars

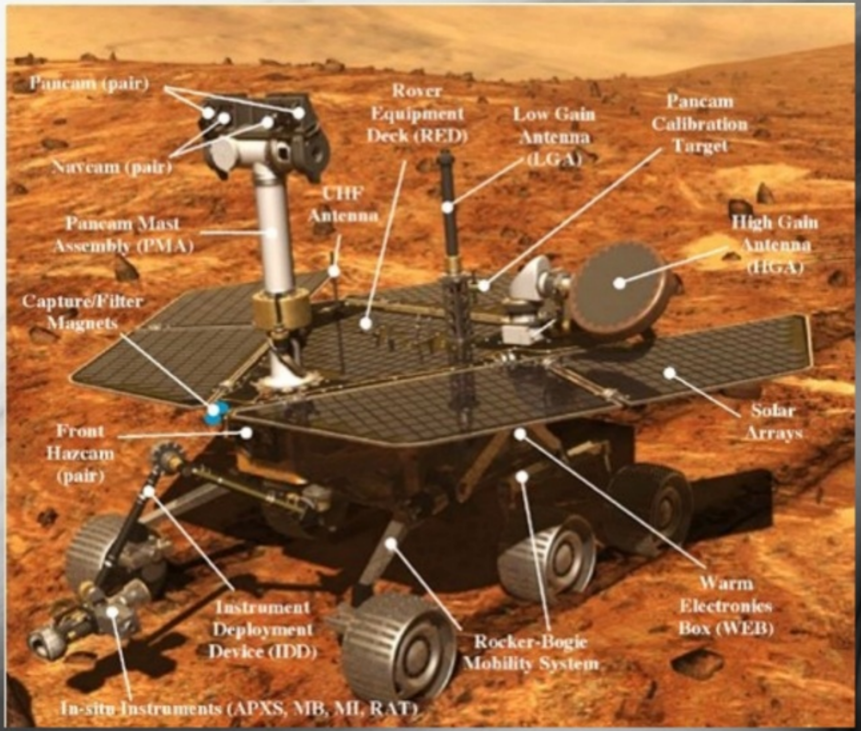


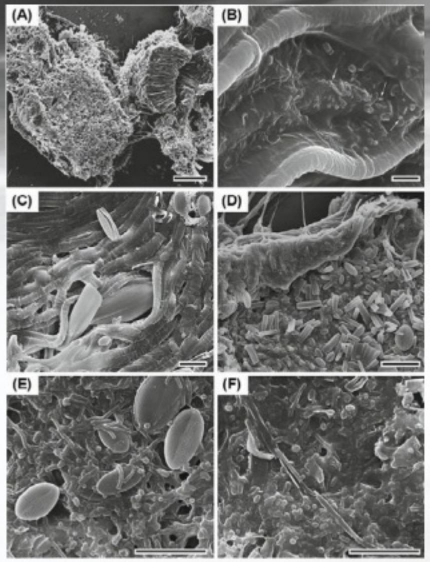
VP-SEM on Mars

MVP-SEM

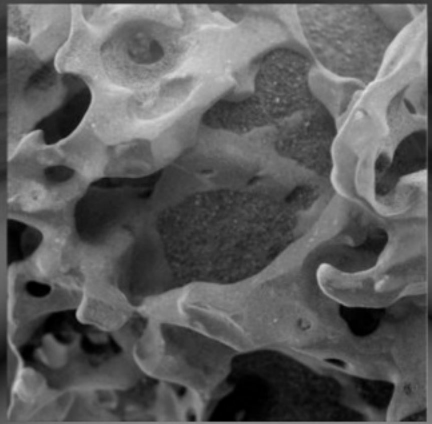
For Fun

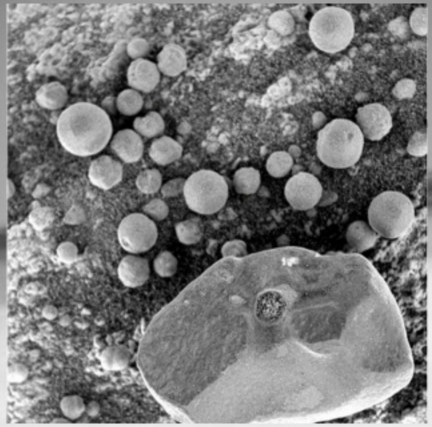
VP-SEM on Mars

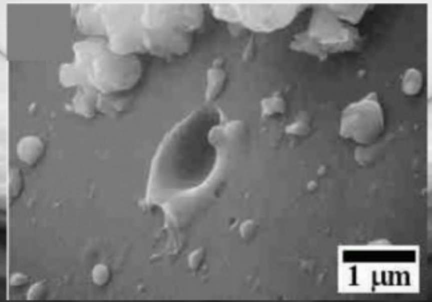




Sorokovikova et al., Journal of Microbiology 51(6):757-65, 2013 "Diversity of cyanobacterial species and phylotypes in biofilms from the littoral zone of Lake Baikal"

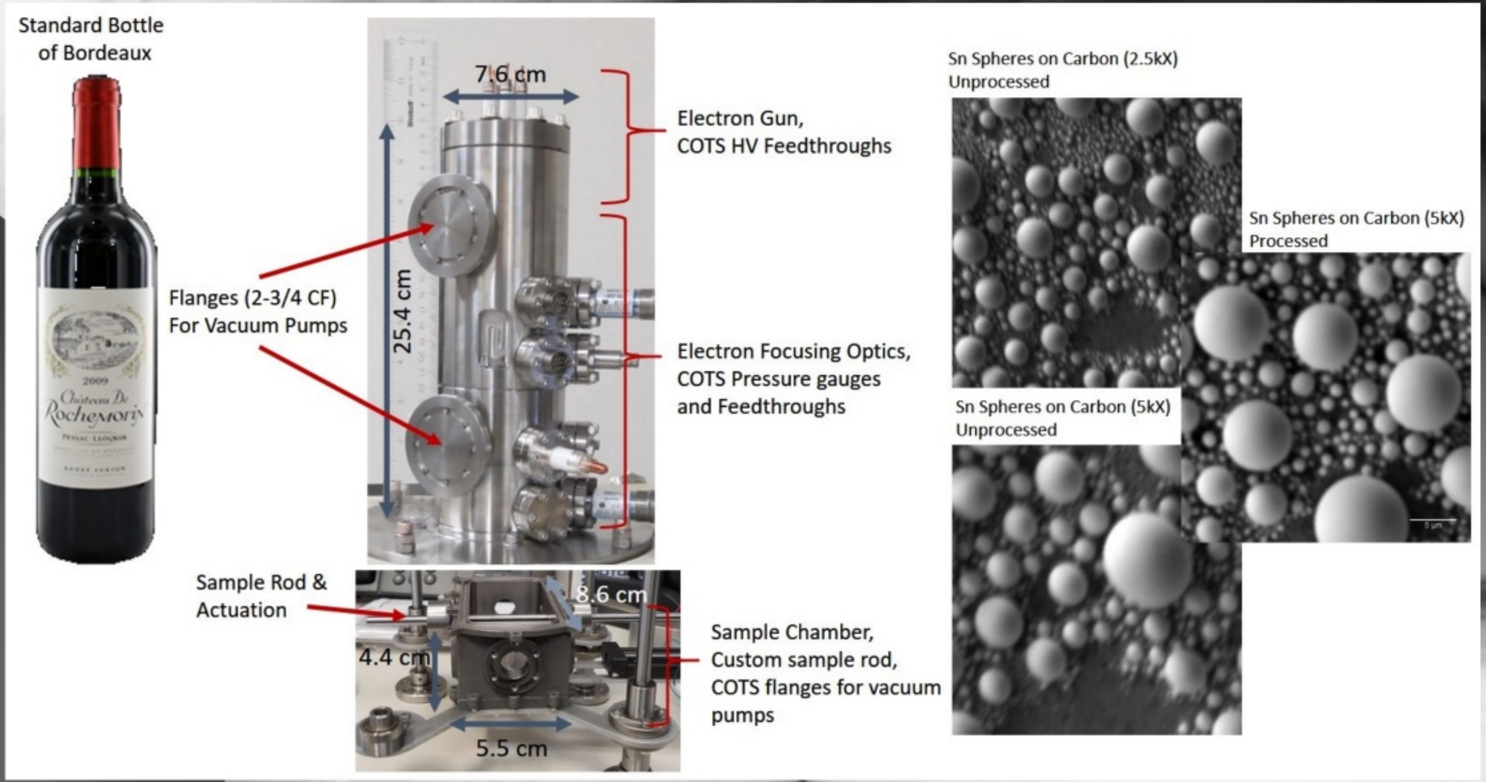


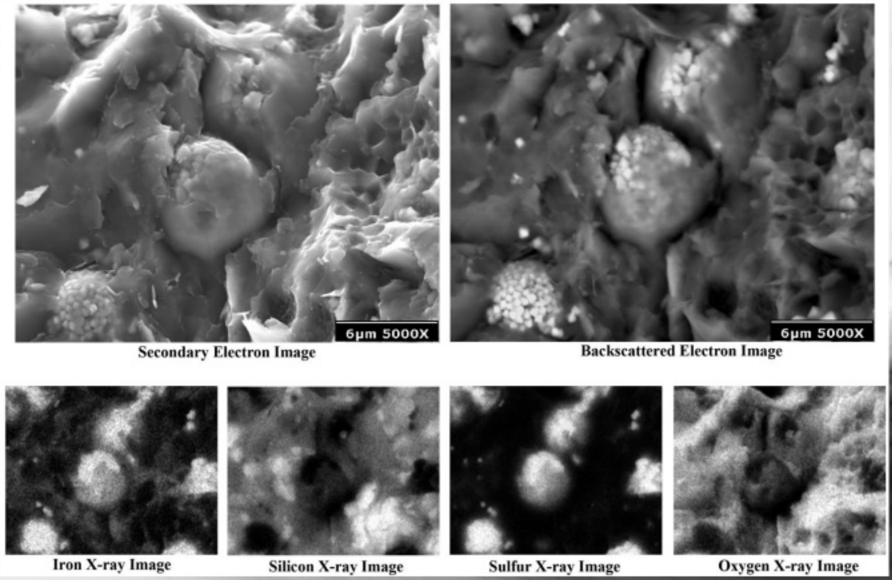




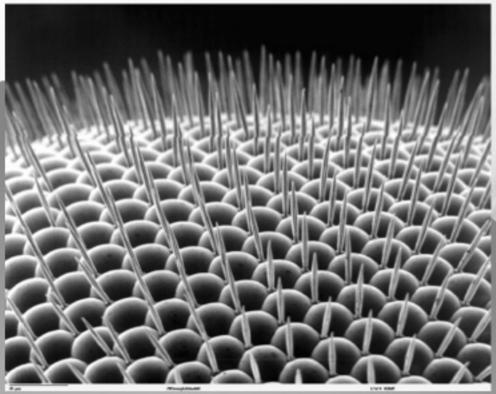
MVP-SEM Development

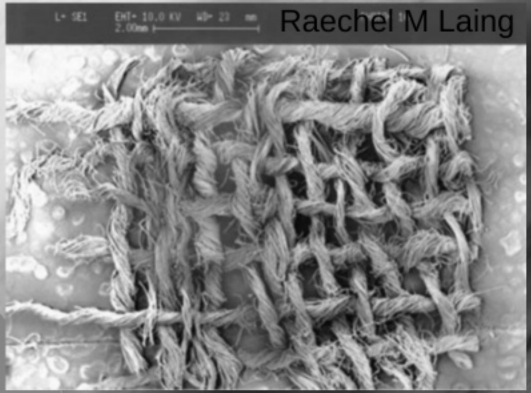
MSFC
Creare
JPL
APTech
Jacobs



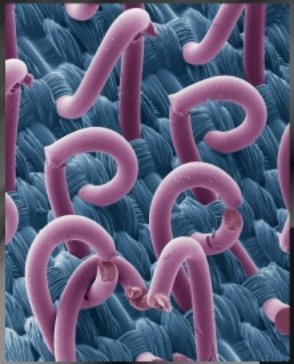


For Fun

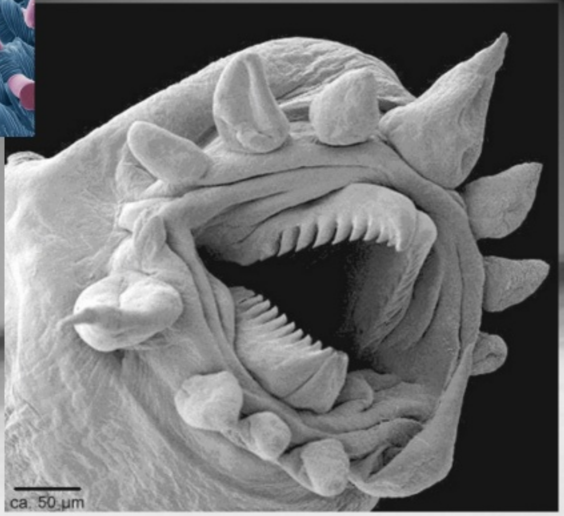


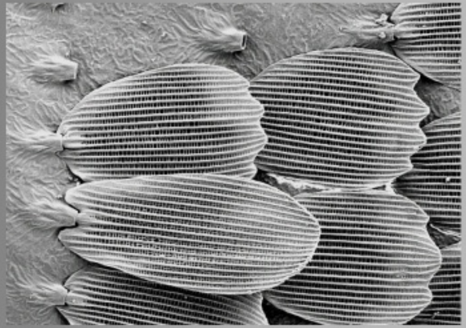


Steve Gschmeissner / Science Source

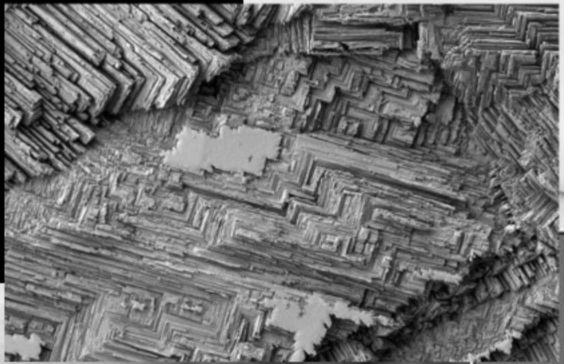


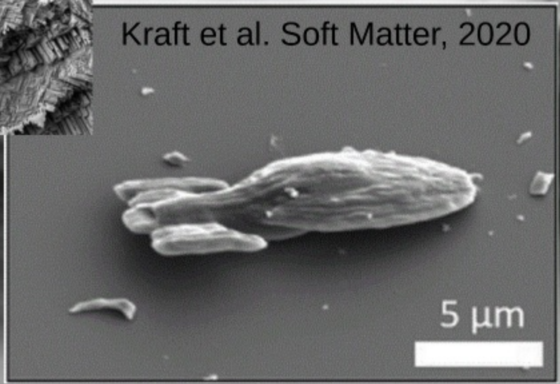
Philippe Crassous / FEI Company (www.fei.com)

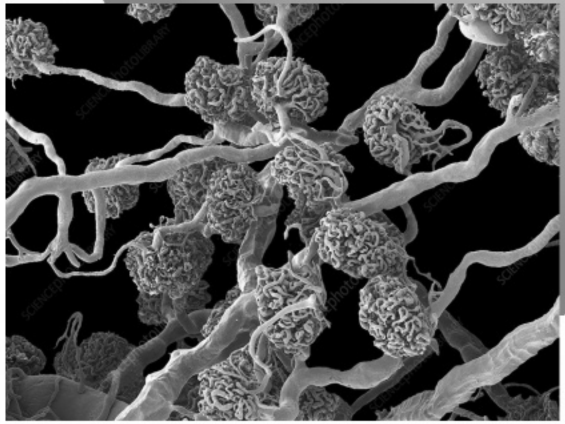




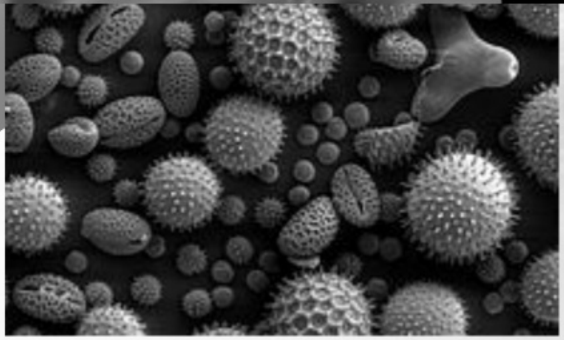
Š Rob Lineton





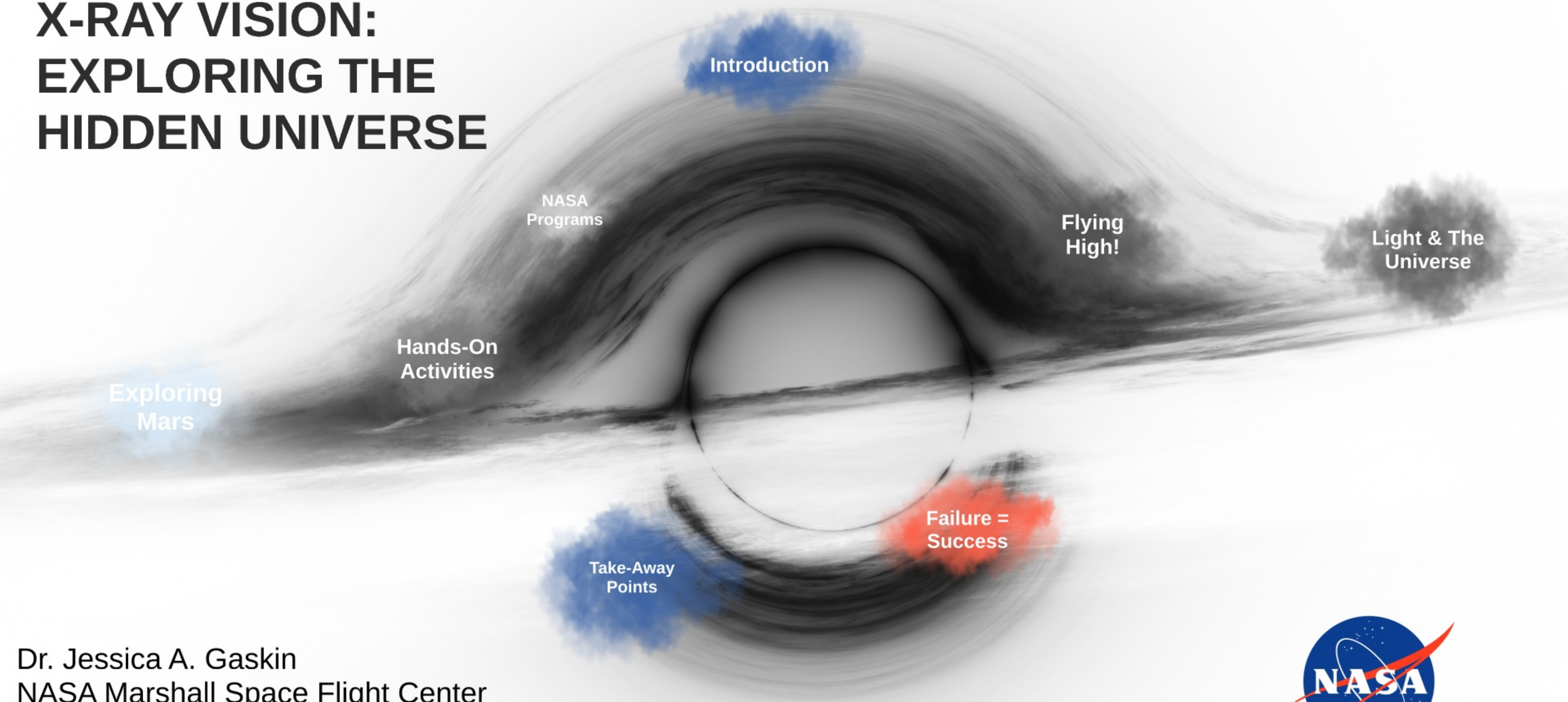


STEVE GSCHMEISSNER / SCIENCE PHOTO LIBRARY



NASA GSFC

X-RAY VISION: EXPLORING THE HIDDEN UNIVERSE



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Opportunities

Habitable Worlds Observatory

NASA Internships & Fellowships

PI Launchpad Workshop

Space Grants

NASA L'Space Program

NASA: https://www.nasa.gov/learning-resources/

Space Technology Research Grants:

- NASA Space Technology Graduate Research Opportunities (NSTGRO) - 3-4 yrs, M.S./Ph.D.
- Early Career Faculty (ECF) - 3yrs, $600k
- Early Stage Innovations (ESI) - 3yrs, $750k
- Lunar Surface Technology Research (LuSTR) - 2yrs, $2M

NASA Pathways (Feb 2025):

Pathways Internship Program prepares you for a career at NASA and offers a direct pipeline to full-time employment at NASA upon graduation.

NASA Internships:

NASA's Office of STEM Engagement (OSTEM) paid internships allow high school and college-level students to contribute to the agency's mission to advance science, technology, aeronautics, and space exploration.

2025 Internship Application Deadlines:
Summer 2025: Feb. 28, 2025
Fall 2025: May 16, 2025

Established Program to Stimulate Competitive Research

EPSCoR establishes partnerships with government, higher education and industry that are designed to effect lasting improvements in a state or region's research infrastructure, research and development capacity, and its national research and development competitiveness.

MUREP

The Minority University Research and Education Project (MUREP) engages underrepresented populations through a wide variety of initiatives. Multiyear grants are awarded to assist Minority Institution faculty and students in research of pertinent missions.

Space Grant Consortium

https://www.nasa.gov/learning-resources/national-space-grant-college-and-fellowship-project/consortium-directors/

The Space Grant national network includes over 850 affiliates from universities, colleges, industry, museums, science centers, and state and local agencies. These affiliates belong to one of 52 consortia in all 50 states, the District of Columbia and the Commonwealth of Puerto Rico.

The 52 consortia fund fellowships and scholarships for students pursuing careers in science, mathematics, engineering and technology, or STEM, as well as curriculum enhancement and faculty development. Member colleges and universities also administer pre-college and public service education projects in their states.

Directors and Websites

AL | AK | AR | AZ | CA | CO | CT | DC | DE | FL | GA | HI | IA | ID | IL | IN | KS | KY | LA | MA | MD | ME | MI | MN | MO | MS | MT | NC | ND | NE | NH | NJ | NM | NV | NY | OH | OK | OR | PA | RI | SC | SD | TN | TX | UT | VA | VT | WA | WI | WV | WY | Puerto Rico

APPLICATIONS TO THE SPRING 2025 PROGRAMS ARE OPEN NOW!

Requirements for participation: Students must be enrolled in a US college or University as an undergrad (graduate students may apply to NPWEE); have access to a computer with internet, webcam, and headset capabilities; and have time to devote an additional 6-10 hours per week, beyond the online session requirements, towards team projects.

The NASA L'SPACE Program is a free, online, interactive experience open to undergraduate and graduate STEM students interested in pursuing a career with NASA or other space organizations. Since it's conception in 2018, 10,000+ participants from over 950 US colleges and universities have gone through the program.

L'SPACE consists of two Academies - the Mission Concept Academy, and the NASA Proposal Writing and Evaluation Experience Academy.

https://www.lspace.asu.edu/

PI Launchpad Workshop

2023 PI Launchpad Workshop

The PI Launchpad 2023 was held in July at the University of Michigan, Ann Arbor. Recordings and documents can be found at the links below. Future Launchpad workshops will be held, please check back for updates.

Previous PI Launchpad Content

Two PI Launchpad workshops have been held, in 2019 and in 2021. As a public service, we have posted all of the content developed for the PI Launchpad here, in the links below. In addition to the workbook used by participants throughout the workshop, we have posted videos and PDFs for all panels and presentations.

Any information contained in this or any linked pages is meant for general use and not for profit. If you use any slides or content from the linked videos and PDFs, you must provide credit to the original author/presenter. If you are unsure of whom to credit, please contact Erika Hamden.

Organizers

The PI Launchpad was organized through the work of:

- Prof. Erika Hamden (University of Arizona)
- Dr. Nicole Cabrera Salazar (Movement Consulting)
- Ellen Gertsen (NASA SMD)
- Dr. Michael New (NASA SMD)
- Julie Breed (GSFC)
- Paula Evans (NASA SMD)
- Michael Liehmon (University of Michigan)
- Kirsten Petree (NASA SMD)
- Paul Propster (JPL)
- Betsy Pugel (GSFC)

2023 Launchpad Workshop

- Workshop Overview & NSPIRES Information
- Pre-application Information Session
- FAQs
- Accessibility Statement

2021 Virtual Launchpad Workshop

- Watch the Presentations and Panels
- PI Launchpad Workshop Content
- 2021 Virtual Launchpad Information
- FAQs
- Accessibility Statement

2019 PI Launchpad Workshop

Science Traceability

James R. Weiss, William D. Smythe and Wenwen Lu
California Institute of Technology's Jet Propulsion Laboratory
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Pasadena, Ca 91109-8099
James.R.Weiss@jpl.nasa.gov, M/S 183-335, 818-354-5420; William.D.Smythe@jpl.nasa.gov, M/S 183-601, 818-354-3612,
Wenwen.Lu@jpl.nasa.gov, M/S 238-600, 818-354-0004

Abstract—Any comprehensive science mission[1,2] proposal must be able to simply explain why it is important to accomplish the goals of the mission and how it will be implemented. This can be accomplished through use of a Science traceability matrix, a construct that is becoming a required component of all NASA science mission proposals. The Science Traceability Matrix (STM) provides the overview of what a Mission will accomplish relative to high-level objectives suggested through Academy of science surveys, NASA Roadmaps, or Program Objectives. It provides a logical flow from these high level objectives through mission objectives, science objectives, measurement objectives, measurement requirements, instrument requirements and spacecraft and system requirements to data products and eventual publications. It is the one document that shows the relationship between all these key elements and the one document that provides the breadth needed to perform and document high level trades effecting science outcome and overall design.

The increasing detail in the requirements flow down represent results of considering underlying key parameters Some of the key parameters considered during requirements definition include: observation importance, ability to make a given measurement, constraints on all systems, number of measurements needed to complete an observation objective, complexity of required measurements, probability for success, measurement fidelity, data quality, community involvement, publishable findings, questions addressed. Parameters underlying instrument definition include: data requirements, pointing constraints, stability requirements, mounting constraints, thermal constraints, power constraints, mass, and volume.

The STM can be used as a gauge to determine the completeness of the definition of a proposed mission If the matrix flows effortlessly from high level objective to publishable science result then it has been carefully laid out. If the logic that ties one aspect to another is not clear then there is more work to be done prior to any proposal preparation.

The science matrix provides a basis for negotiating lower level requirements (typically tracked with tools such as Telelogic's DOORS® requirements tracking tool) and evaluating affects of the results of those negotiations on the ability to achieve objectives originating at higher levels. It also provides a succinct snapshot of those high level objectives – particularly important for high-level goals since there is often no objective algorithm to quantify the relative merits of the conflicting high-level goals. For this case, the matrix provides a convenient notation for assessing and arbitrating the impact on equal-valued objects caused by changes in available mission resources.

TABLE OF CONTENTS

1. INTRODUCTION

A science mission proposal must be able to simply, and quickly explain the importance of mission goals and how those goals are implemented. The Science Traceability Matrix (STM) provides such an overview of what a Mission will accomplish and relates it to high-level objectives suggested by program architecture statements such as the Academy of science decadal survey, NASA Roadmaps, or NASA Program Objectives. The STM provides a logical flow from these high level objectives through Mission objectives, measurement objectives, instrument requirements, spacecraft and system requirements to data products and eventual publications. It is the vehicle that summarizes the relationship between all these key elements and the one document that provides the breadth and scope needed to perform high level trades effecting science outcome and overall design.

1 "0-7803-8870-4/05/$20.00©2005 IEEE"
2 IEEEAC paper #2.0402 version 3, Updated December 22, 2004

2019 PI Lau

Cosmic Origins

Searching for answers about our universe and its origins

HWO Home | Events

Habitable Worlds Observatory (HWO)

Events

HWO Seminar Series

Wednesday, 30 October 2024
Habitable World Observatory Seminar
Aki Roberge, NASA/GSFC
Giada Arney, NASA/GSFC

HWO Meetings

Habitable Worlds Observatory (HWO) Technology Roadmap Webinar
Virtual
14 November 2024

HWO AGN Working Group Meeting
Virtual
19 November 2024
»» Presentations on AGN Science Cases with HWO

News

13 November 2024
Habitable Worlds Observatory (HWO) Technology Roadmap Webinar | Thursday, November 14th, 10:00am – 11:30am PT (1:00pm – 2:30pm ET)
» Details

6 November 2024
Galaxies SIG Seminar: Star Formation in the Diffuse Universe | November 6th 11:00a – 12:00p ET
» Details

REMINDER: NASA Astrophysics Advisory Committee (APAC) Meeting: November 7th & 8th, 2024 | 9:00am – 5:00 pm ET
» Details

PhysCOS Early Career Workshop | November 19th – 21st 2024
» Details

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https://cor.gsfc.nasa.gov/studies/habitable-worlds/hwo-events.php

Curator: Pat Tyler
NASA Official: Peter Kurczynski
› Privacy Policy and Important Notices
› Contact NASA

https://cor.gsfc.nasa.gov/resources/Research_Opportunities.php

Home | Community | Science Interest & Analysis Groups | Mission Studies | Resources

Cosmic Origins Related Research Opportunities

How to Use This Table

Astrophysics research usually begins with writing a proposal. A proposal is a document that is submitted in response to a specific solicitation. This table shows the most common solicitations relevant to NASA astrophysics. Solicitations are released to the public on a specific date, called the Release Date, which is usually about the same day each year for a given solicitation. Some solicitations require submitting a Notice of Intent (NOI). This is a short document declaring your intention to submit a proposal at a later date. If one is required by the solicitation, the deadline is shown in column NOI. Proposals must be submitted by the deadline, called the Submission Date, or they will generally not be accepted. Proposal writing takes time (e.g., three months or more for a first-time proposer). Use the submission date to plan in advance. Hyperlinks on the proposal name will take you to the solicitation. Before you begin writing a proposal, read the solicitation to determine whether you are an eligible proposer, whether your science interests broadly align with the goals of the solicitation, and what will be required to write the full proposal. Good luck!

Opportunity Name	Proposal Dates		
	Release	NOI	Submission
ROSES ▸ Description	14 Feb 2025	–	–
NSF Astronomy & Astrophysics Postdoctoral Fellowship (AAPF) ▸ Description	–	–	15 Oct 2024
NSF Graduate Research Fellowship Program (GRFP) ▸ Description	–	–	15 Oct 2024
JWST ▸ Description	14 Feb 2024	–	16 Oct 2024
Hubble Fellowship Program (NHFP) ▸ Description	3 Sep 2024	–	30 Oct 2024
NASA Postdoctoral Program (NPP) ▸ Description	–	–	1 Nov 2024
NSF Astronomy & Astrophysics Grants (AAG) ▸ Description	–	–	15 Nov 2024

News

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» Details

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Conferences, Workshops, and Meetings

December 9–13, 2024

AGU24: American Geophysical Union's Annual Meeting in Washington, D.C. (onsite and online)

Event Highlights: Town Hall: TH35G - Planetary Science Opportunities with Habitable Worlds Observatory on December 11, 6–7 p.m. Eastern

Poster Session: P028 - Planetary Science and Astrobiology with the Habitable Worlds Observatory on December 12, 1:40–5:30 p.m. Eastern

Oral Session: P52A - Planetary Science and Astrobiology with the Habitable Worlds Observatory on December 13, 10:20–11:50 a.m. Eastern

November 14, 2024

Habitable Worlds Observatory (HWO) Technology Roadmap Webinar (online)

October 30, 2024