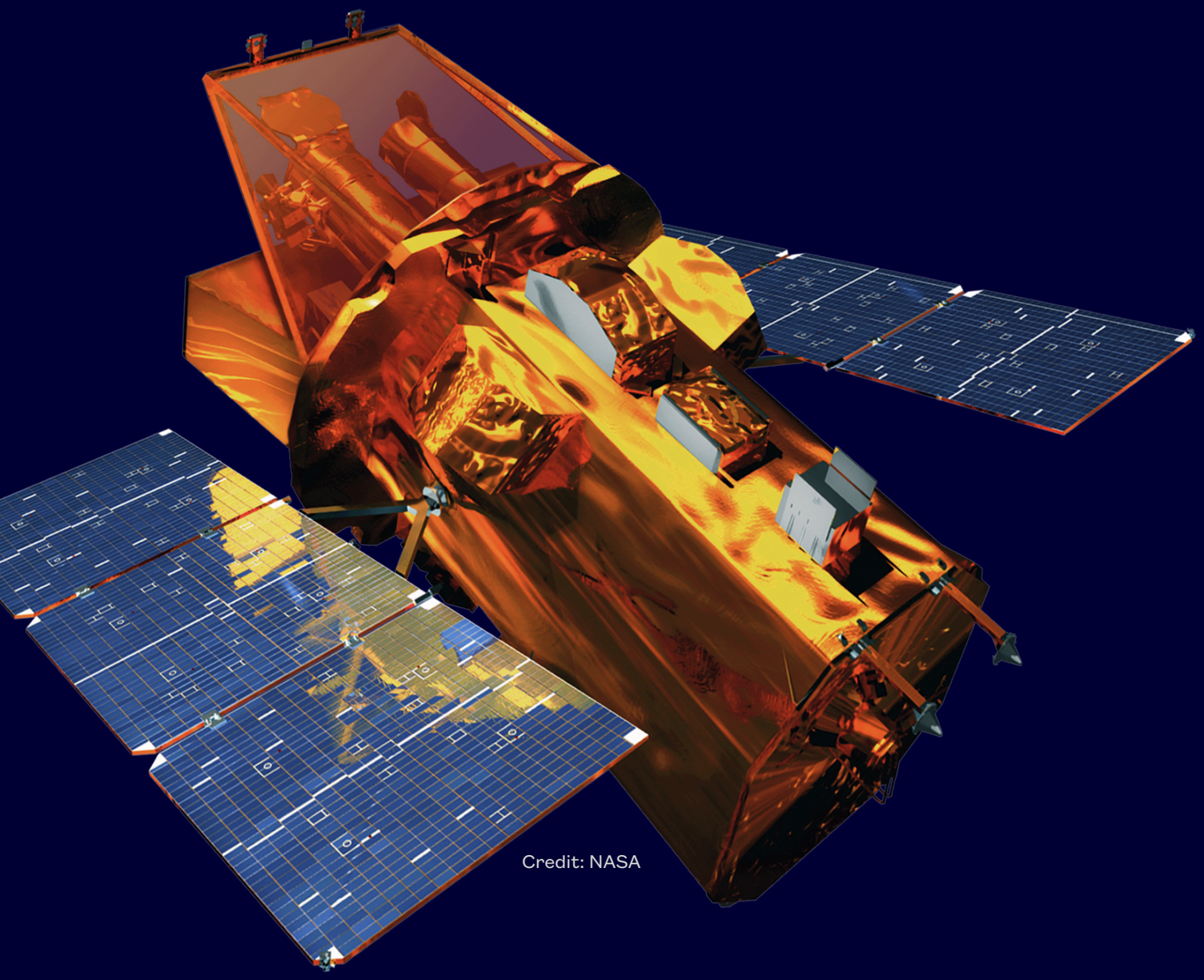
Neil Gehrels Swift Observatory: A Key Player in the Multi-Messenger Era



Credit: NASA

Bindu Rani

Swift GI Lead

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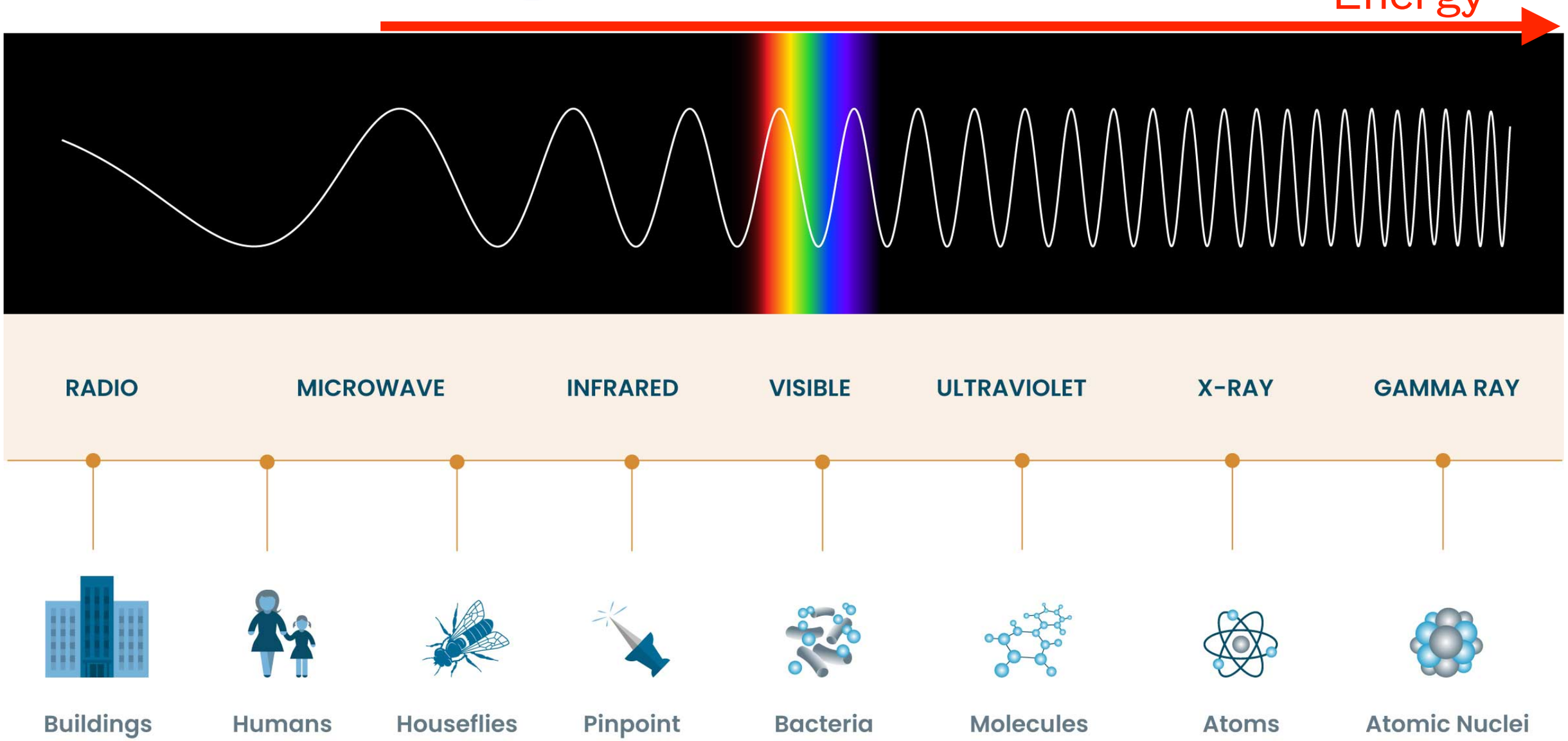
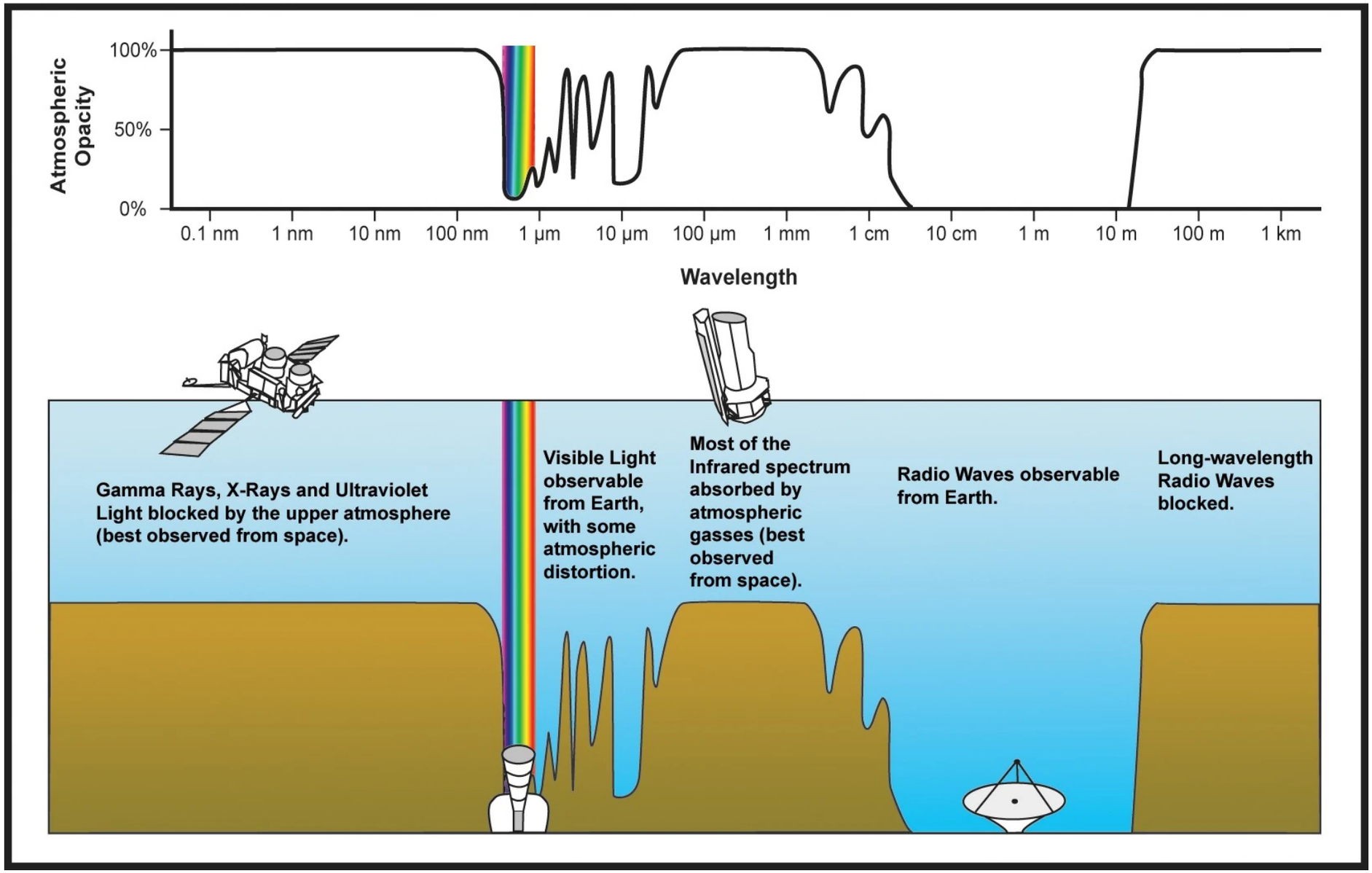
Electromagnetic spectrum



Credit: https://hubblesite.org/contents/articles/the-electromagnetic-spectrum

Telescopes in Space?

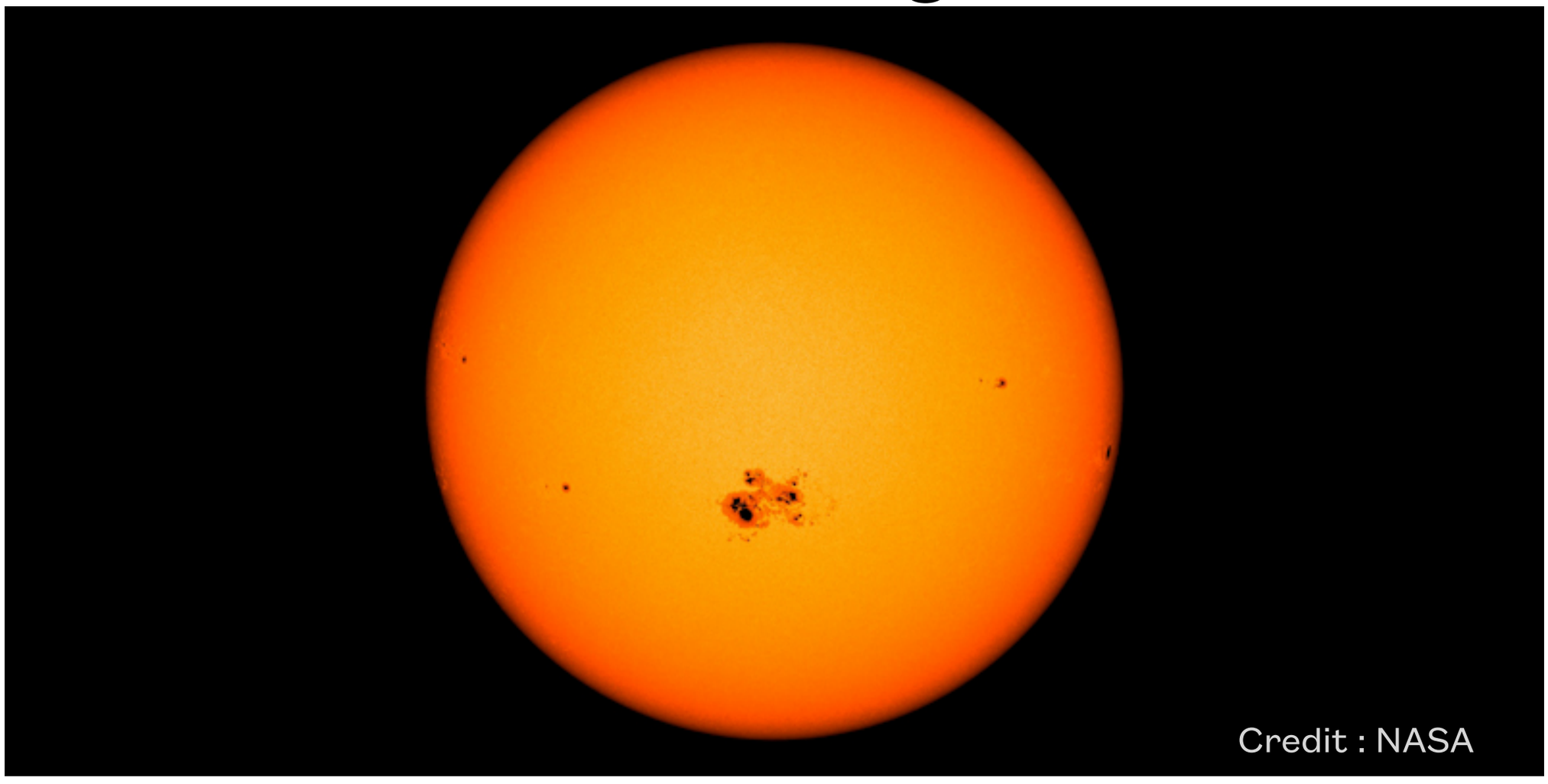


https://physics.stackexchange.com/questions/135260/can-someone-explain-to-me-the-concept-of-atmosphere-opacity

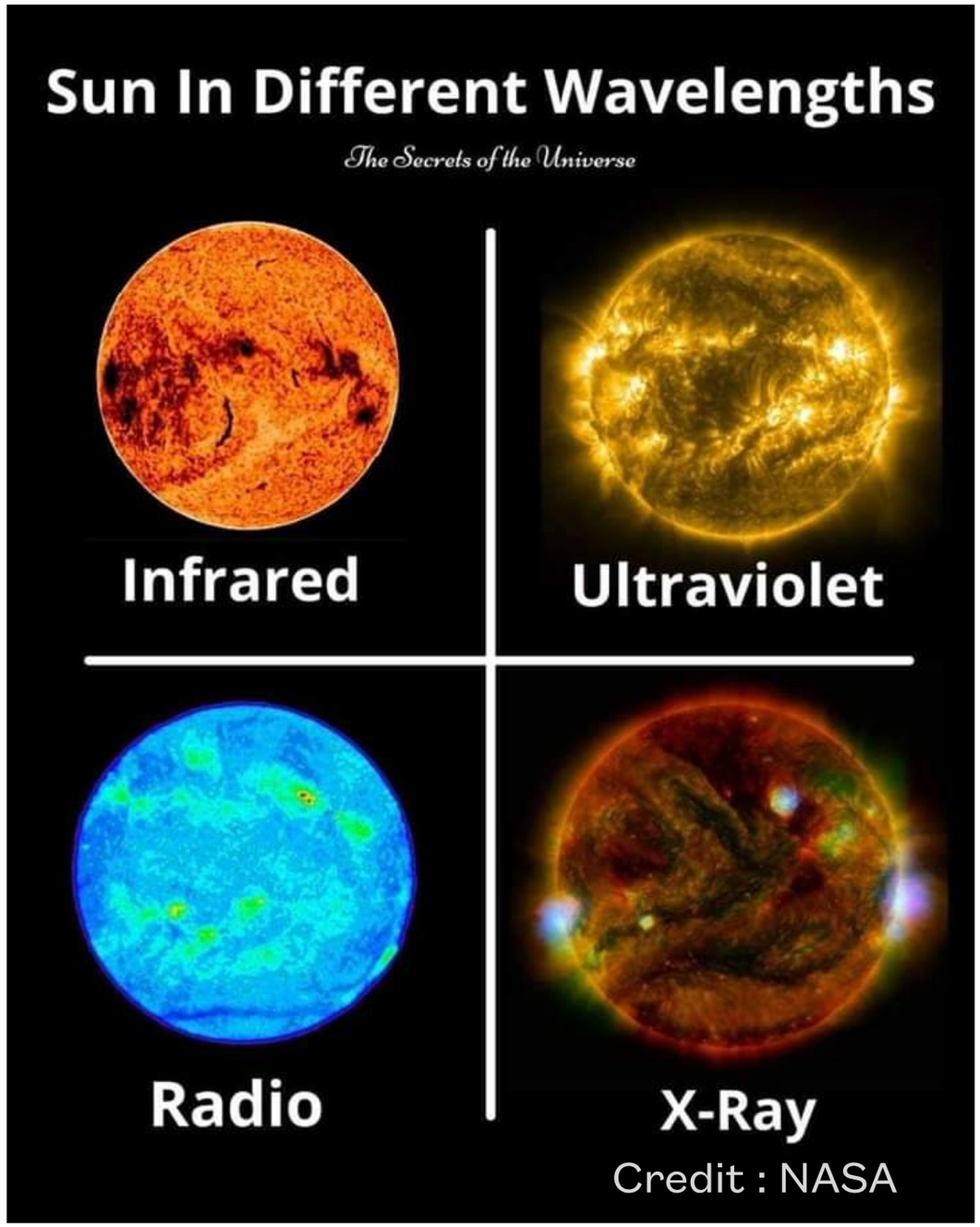
Why Observe in Multiple Wavelengths?

Sun

In visible light



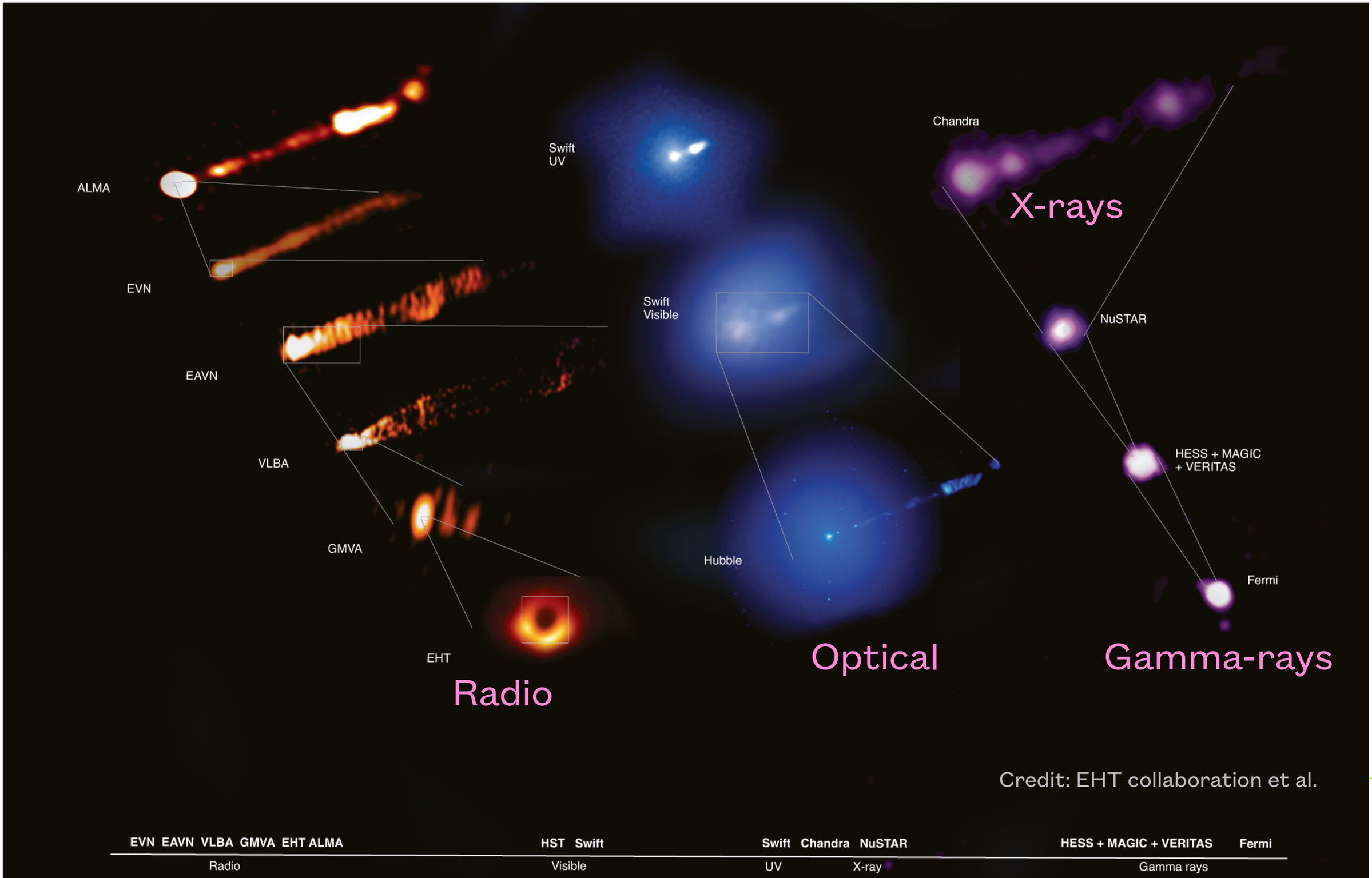
Sun across different wavelengths



The Sun in different wavelengths reveals unique aspects of its structure and activity.

https://science.nasa.gov/heliophysics/

M87 in different wavelengths



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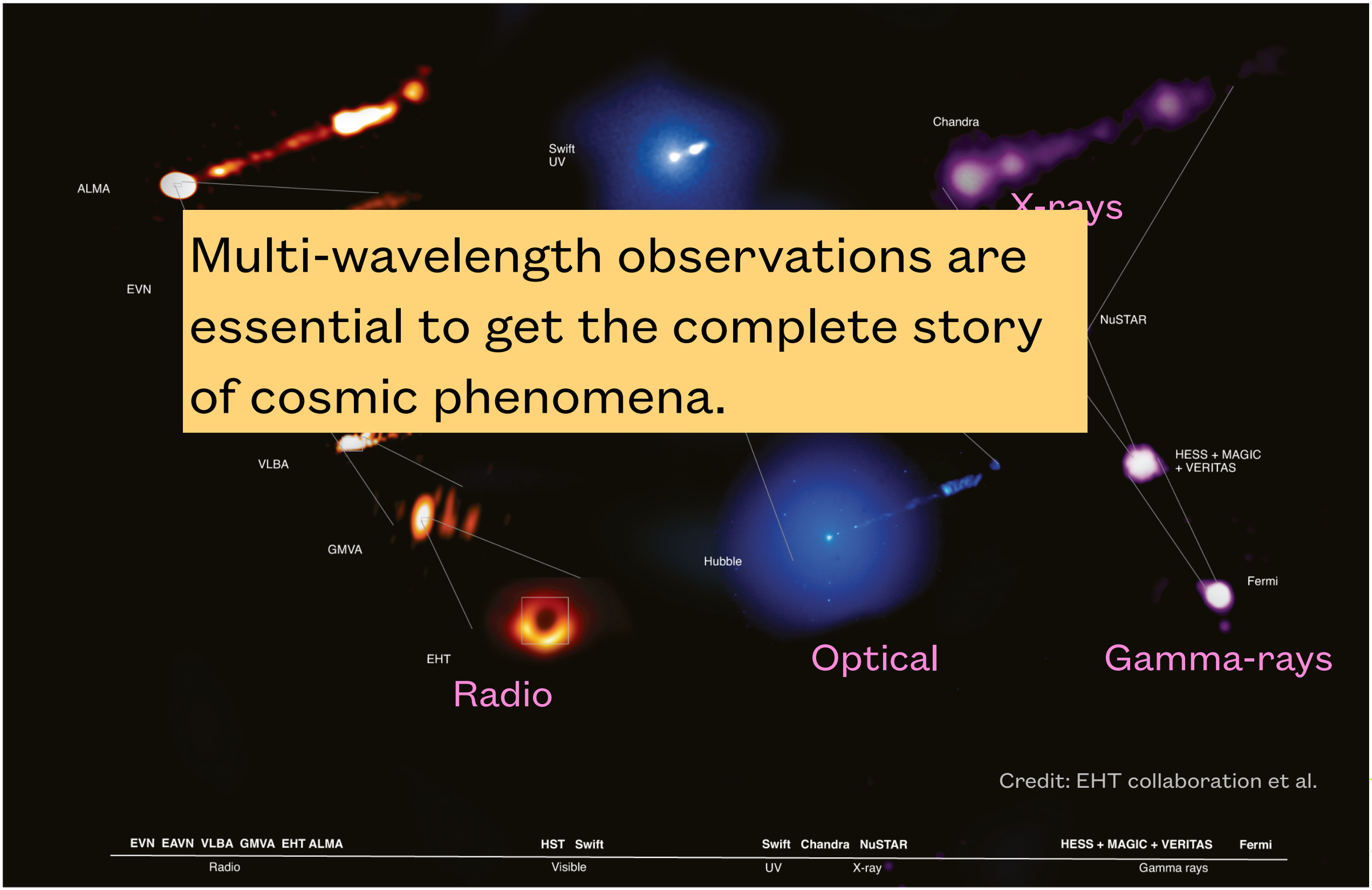
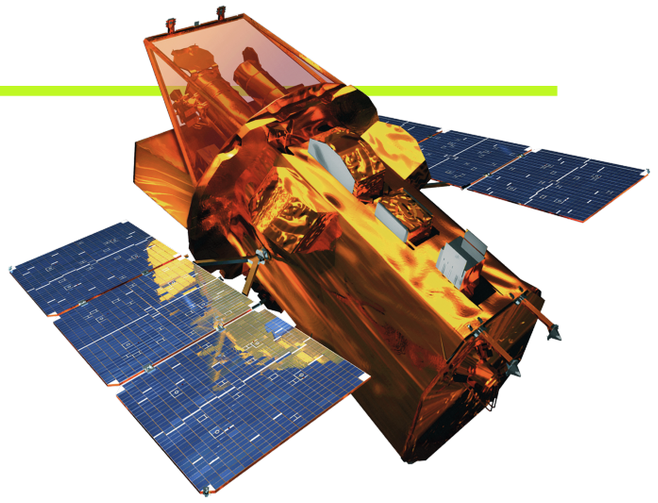


Swift Observatory



Launched on 20 November 2004

Burst Alert Telescope (BAT): 15-350 keV, 1.4 sr field-of-view, ~ 3’ localization

X-Ray Telescope (XRT): 0.2-10.0 keV, 24’ x 24’ field-of-view, 3” localization

UV/Optical Telescopes (UVOT): 170-650 nm, 17’ x 17’ field-of-view, 0.5” localization

https://swift.gsfc.nasa.gov/about_swift/

Swift observes:

1. Exoplanets
2. Brown Dwarfs
3. Stellar Flares
4. Pulsars and Magnetars
5. Novae
6. X-ray Binaries
7. Supernovae
8. Star-forming Regions
9. Gamma-ray Bursts
10. Tidal Disruption Events
11. Active Galactic Nuclei
12. Clusters of Galaxies
13. And more ..

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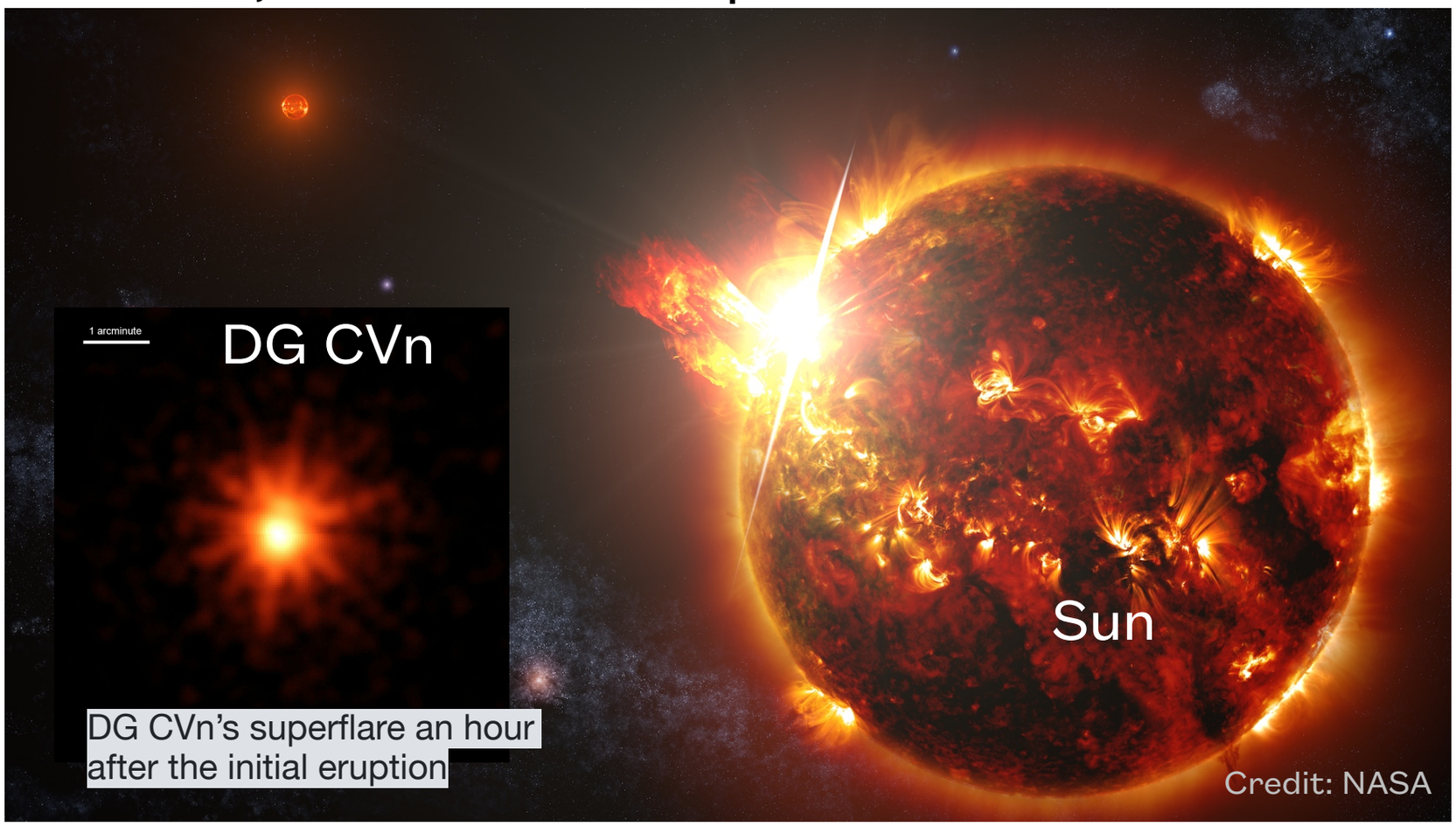
10,000 times more powerful than solar flares



On April 23, 2014, NASA's Swift mission detected a record-setting series of X-ray flares unleashed by DG CVn, a nearby binary consisting of two red dwarf stars (Osten et al. 2016, ApJ, 832).

https://ui.adsabs.harvard.edu/abs/2016ApJ...832..174O/

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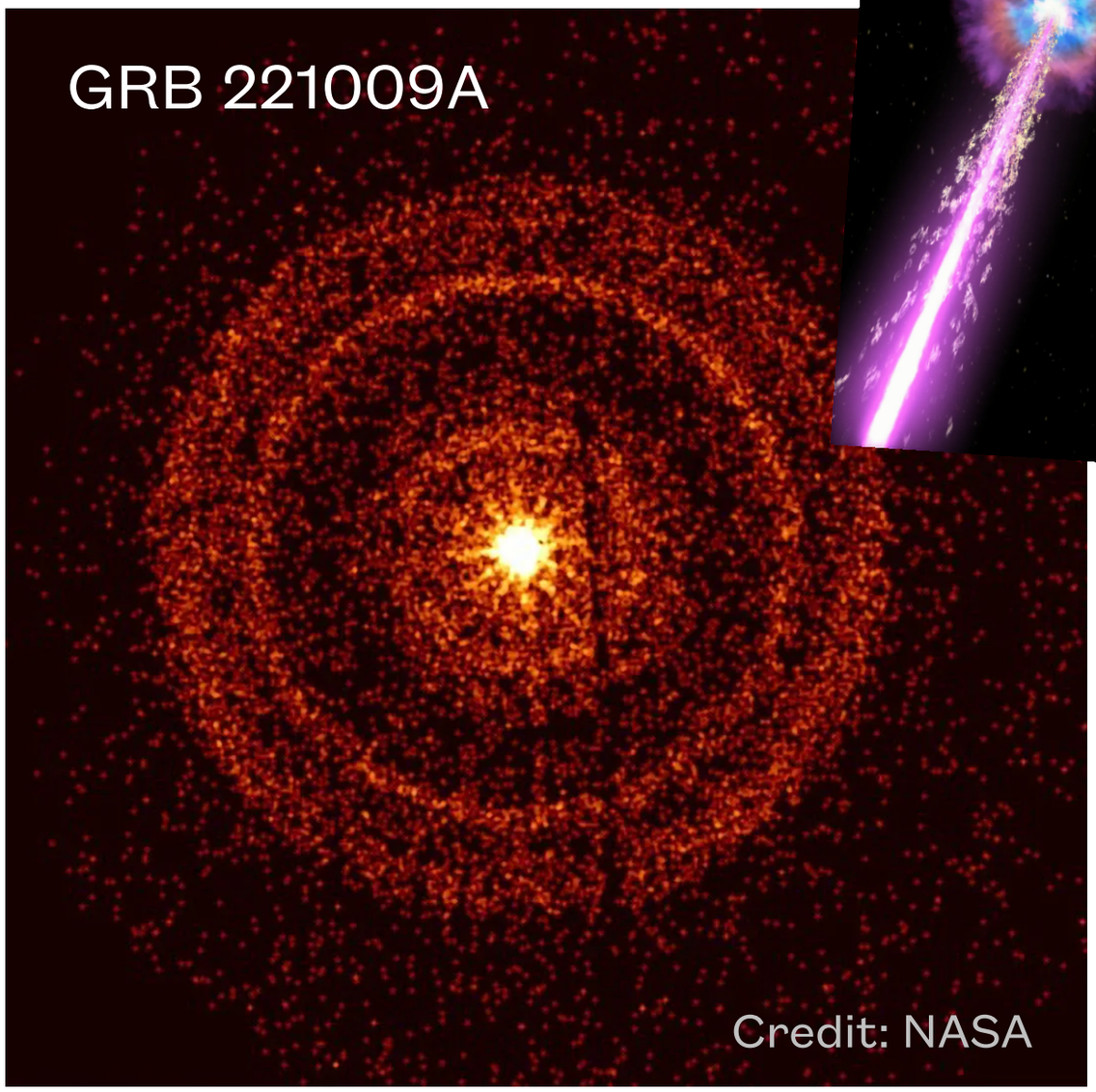

The Brightest of All Time gamma-ray burst (**BOAT GRB**), likely marking the birth of a new black hole, was discovered by Swift and Fermi on Oct. 9, 2022, and observed by about 50 space- and ground-based telescopes.

https://www.science.org/doi/10.1126/sciadv.adi1405

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Swift captures a black hole eating a star

Credit: NASA universe

When a star strays too close to a monster black hole, gravitational forces create intense tides that break the star apart into a stream of gas.

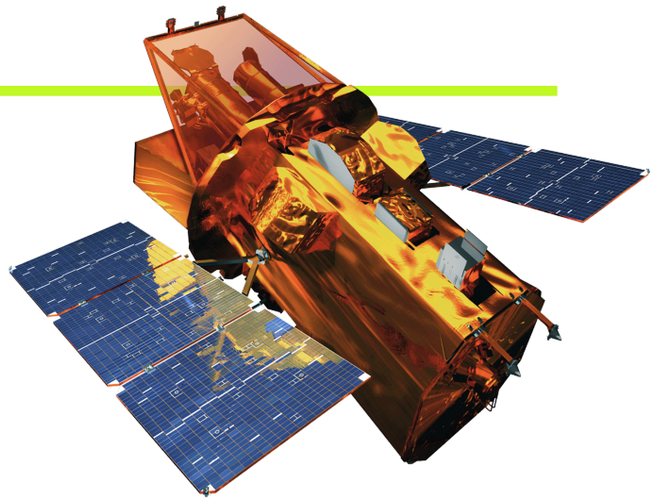
https://www.nature.com/articles/s41550-023-02073-y

Multi-Wavelength

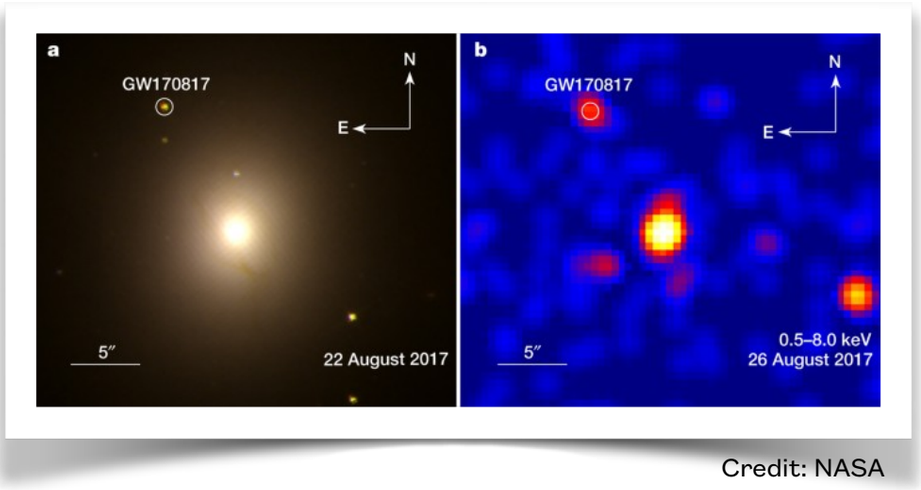
+

Multi-Messenger Astronomy

Multi-messenger era



Gravitational waves

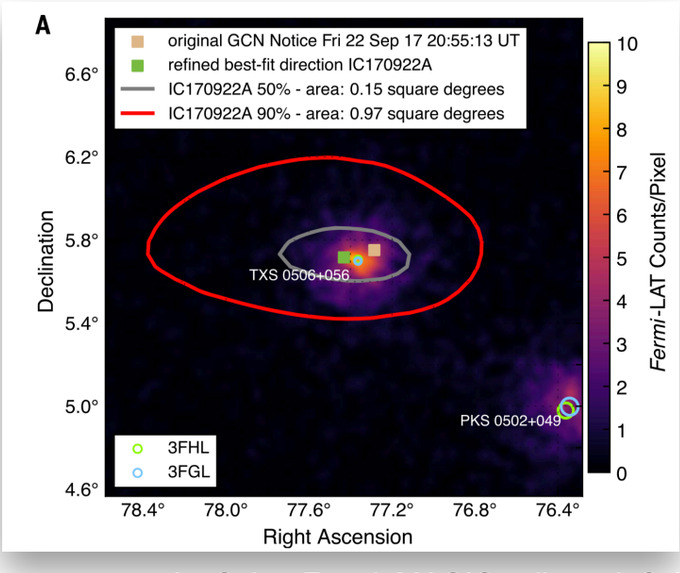


Credit: NASA

Swift's Ultraviolet/Optical Telescope (UVOT) detected **the first observation of UV emission from a kilonova.**

Aug 2017

Neutrinos



IceCube, Fermi, MAGIC coll. et al. Science 2018

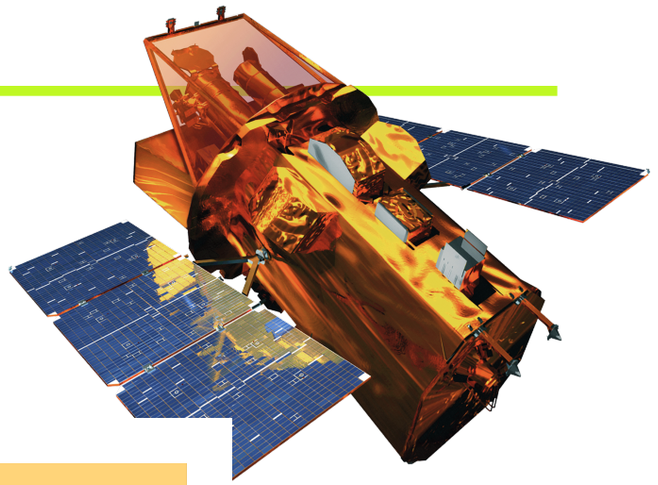
290 TeV neutrino coincides with high-energy flare in TXS 0506+056

Sept 2017

https://www.science.org/doi/10.1126/science.aap9580

https://www.science.org/doi/10.1126/science.aat1378

Swift in Multi-messenger era



Unique Rapid Response Capability

- Swift's fast detection and response time sets it apart from other observatories.

Crucial for Multi-Messenger Observations

- Plays a key role in observing transient events, such as GRBs, TDEs, GW, flaring AGN, and others.

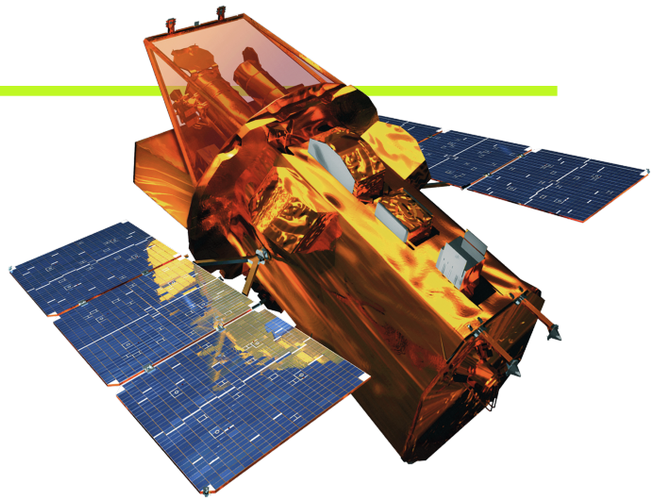
Simultaneous X-ray/UV-optical Observations

- Swift provides nearly simultaneous X-ray and UV/optical observations, offering a comprehensive view of transients.

Collaborations for Deeper Insights

- Works with more than 30 ground- and space-based observatories.

Requesting Swift time



Guest Investigator Program :

https://swift.gsfc.nasa.gov/proposals/swiftgi.html

Annual call (mid/late September)

Awards funding and observing time

Any number of targets

Up to 1 Ms of observing time (per program)

Proposals are due Thursday, September 26, 2024, 4:30 PM EDT.

https://swift.gsfc.nasa.gov/news/2024/aug20_workshop.html

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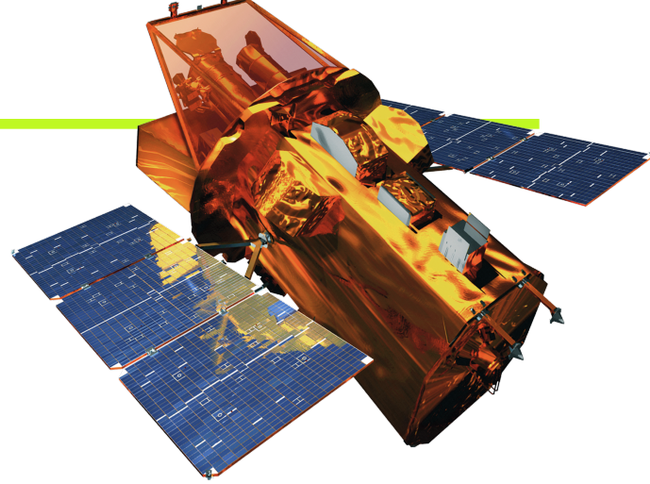

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Target-of-Opportunity Program:

Accepted anytime

Awards only observing time

Single target per request

Typically < 10 ks per request

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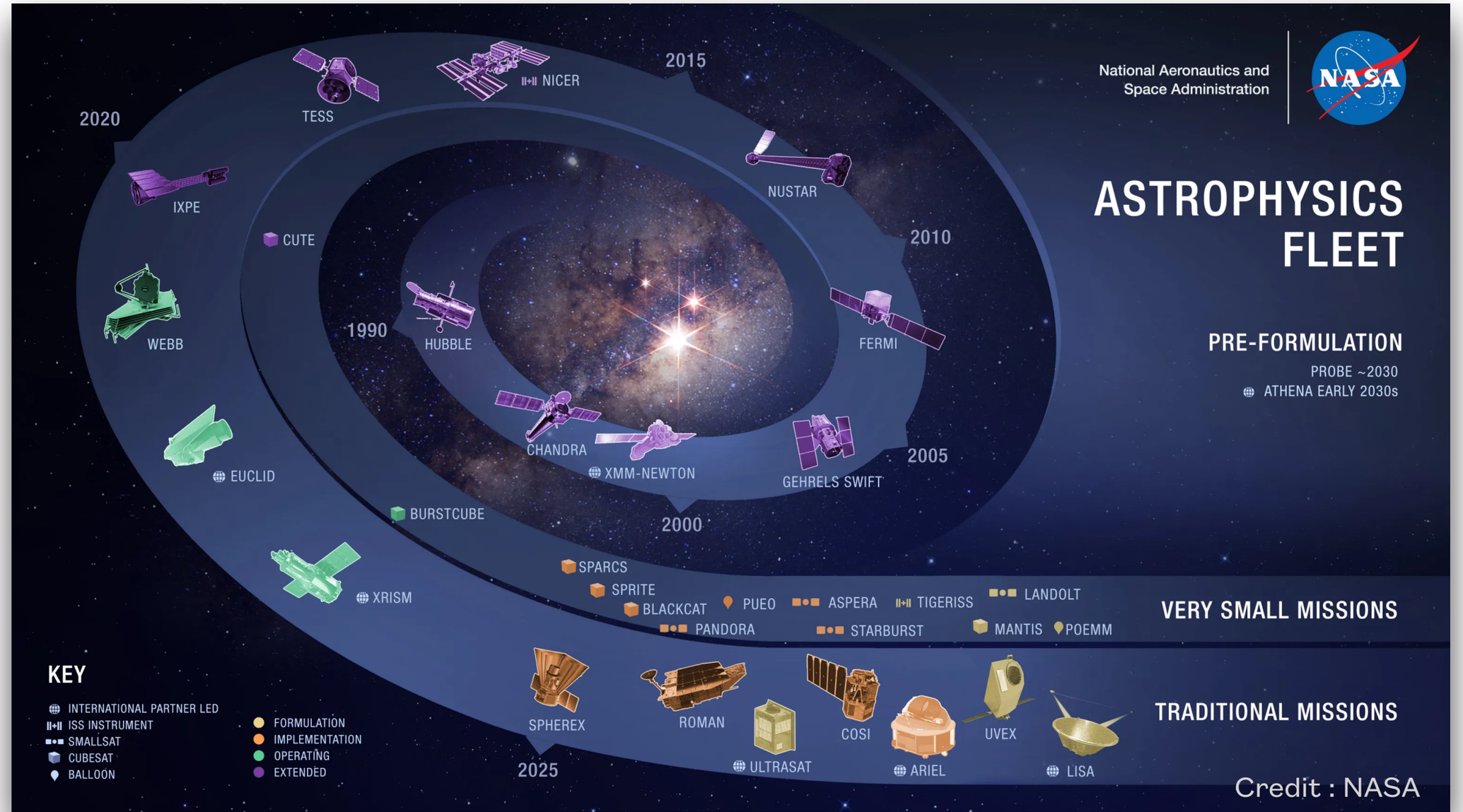
Other missions

Time-domain, Imaging, Spectroscopy, Polarimetry, etc.



Research opportunities

1. NASA Internship Programs:

https://www.nasa.gov/learning-resources/internship-programs/

2. NASA DEVELOP National Program

https://appliedsciences.nasa.gov/what-we-do/capacity-building/develop

3. NASA Space Grant

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

4. NASA GeneLab for Students (GL4U)

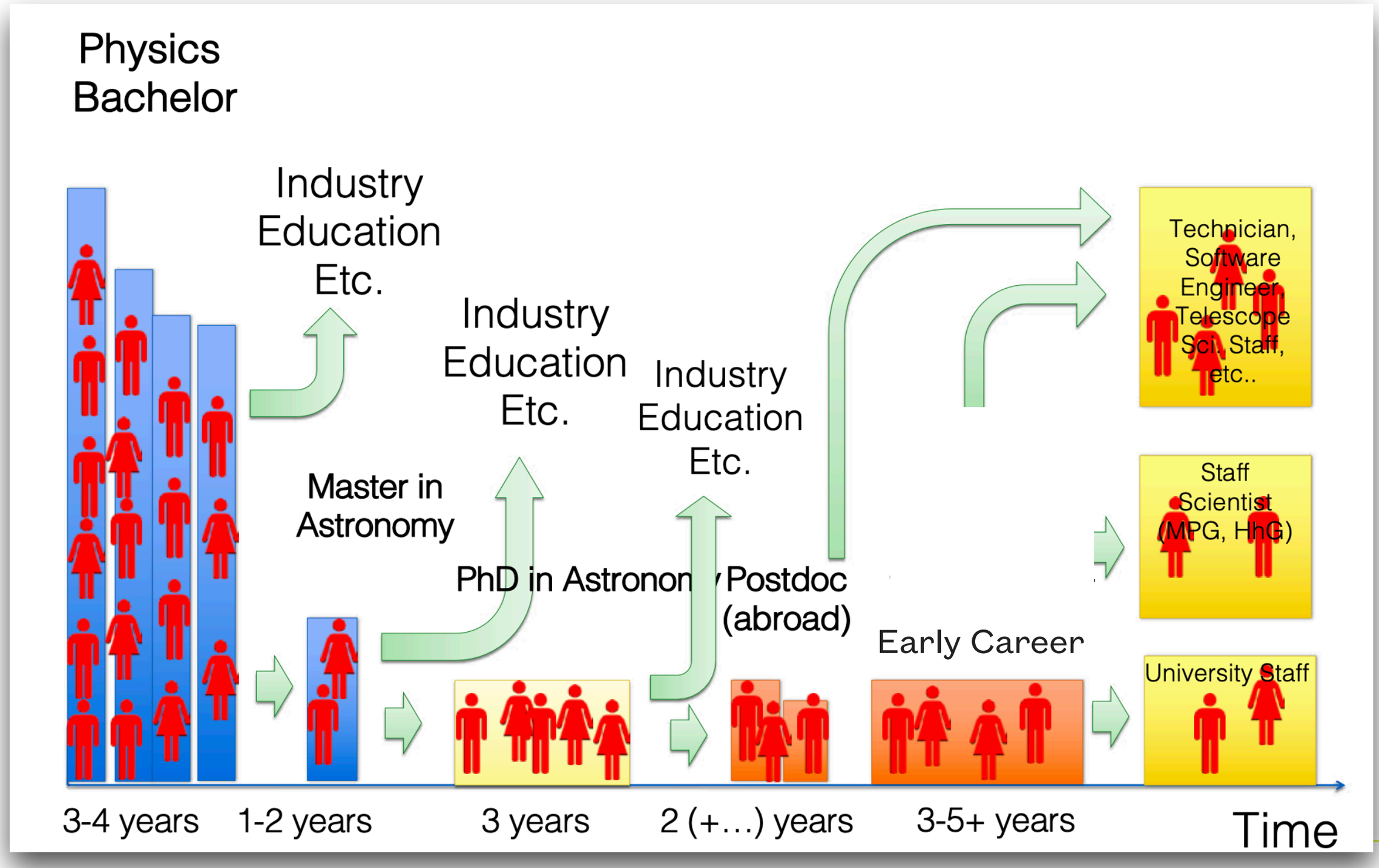
https://genelab.nasa.gov/genelab-universities-gl4u

5. NASA STEM Engagement

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

6. And others …

Astronomer's Life Cycle



Credit: E. Ros (MPIfR, Germany)

Bindu Rani

Swift GI Lead Scientist

bindu.rani@nasa.gov

Thank you for being here today!