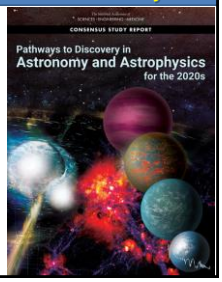
ASTR 4800 - *Space Science: Practice & Policy*

Today: The Astrophysics Astro2020 Decadal Survey

- Next Class: *Solar & Space Physics Decadal Survey.* Guest lecture by Prof. Dan Baker, Director of CU's Laboratory for Atmospheric & Space Physics.
- *Reading:* Summary of report on class website for Oct. 21.
- Interviewee name & bio due to me today by 5 pm today via email.



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2020 Astronomy & Astrophysics Decadal Survey

Presented by: Ella Ho & Bryan Derr

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The Decadal Survey

What is it?

- Produced by National Research Council of the National Academy of Sciences in the United States.
- Recommendations of the research
- How to prioritize scientific funding within astronomy and astrophysics.

Why?

- **Don't leave it to Congress**.
- Let the experts direct the funding and the science goals.

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Statement of Task

Five Main Goals

1. Overview of the current state.
2. Identify challenges and frontiers.
3. Develop a comprehensive research strategy.
4. Recommend decisions for changes.
5. Access the state of the profession.

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Past Decadal Surveys

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Class Exercise

What would you like to see the Astronomy and Astrophysics community focus on in the decade forward?

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The Panels

There are 13 expert panels; 1 profession and societal panel, 6 program panels, and 6 science panels.

Social Panel

- State of the Profession and Societal Impacts

What do you think about the new social panel? Is it necessary?

Program Panels

- Enabling Foundation for Research
- EM Observations from Space 1
- EM Observations from Space 2
- Optical and Infrared Observations from the Ground
- Particle Astrophysics & Gravitation
- Radio, Millimeter, & Submillimeter Observations from the Ground

Science Panels

- Compact Objects & Energetic Phenomena
- Cosmology
- Galaxies
- Exoplanets, Astrobiology, & the Solar System
- Interstellar Medium & Star and Planet Formation
- Stars, the Sun, & Stellar Populations

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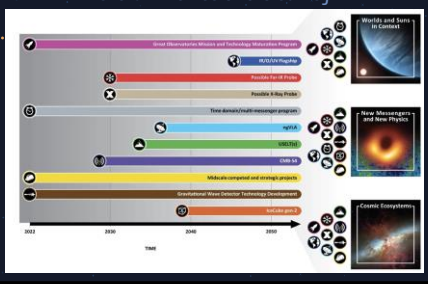
Overall Themes of the Survey



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Worlds and Suns in Context

Earth may be the only planet with life, is it worth the cost to search for biosignatures?

- **Priority Area of Study:** Pathways to Habitable Worlds.
- Step by step program meant to identify and characterize Earth-like extrasolar planets.
- Find possible habitable planets and discover possible signs of life.
- Searching for biosignatures using spectroscopy.

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New Messengers and New Physics

- New gravitational wave tools and temporal monitoring.
- **Priority Science Area:** New Windows on the Dynamic Universe.
- Black Holes, neutron stars, and the explosive events, dark matter, dark energy, and cosmological inflation.
- Understand what happened during the earliest moments in the Universe.

The Nancy Grace Roman Space Telescope

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Cosmic Ecosystems

- **Priority Area of Study:** Unveiling the Drivers of Galaxy Growth
- Gas flow that condenses to form stars and black holes.
- Matter expelled by star systems.
- Multiple types of telescopes.

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The Overall Recommended Program

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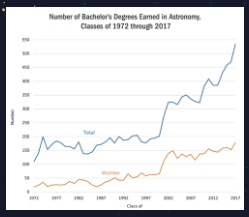
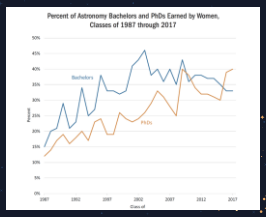
Foundational Activities

- Develop and diversify the scientific workforce.





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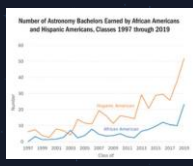
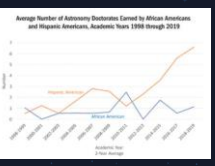
Foundational Activities (cont.)

- Astronomy has one of the worst diversity rates of all science fields.
- Astronomers are 90% white, 8% Asian, 1% black, 1% Latino, and 0% Native American (2007).





Should the diversifying the community be included in scientific recommendations?

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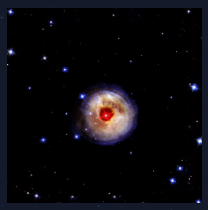
Programs the Sustain and Balance the Science



Time Domain Astrophysics program

- *Highest priority sustaining activity for space.*
- Continue existing programs that are still in development (Roman Space Telescope, JWST, Vera C Rubin Observatory).
- Discontinue the SOFIA (NASA's flying telescope platform) as it is scientifically unproductive and not worth the cost.

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Programs the Sustain and Balance the Science (cont.)

Astrophysics Probe Mission Program

- Create a probe line of missions, cost cap of $1.5 billion per mission and launching ~1 per decade.
- Far IR probe or x-ray probe to compliment ESA's Athena Mission.
- Start by the end of the decade.

The ESA's Athena Telescope

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Programs that Enable Future Visions

Great Observatories Technology Maturation Program

- *Highest priority for Enabling Programs for Space*
- Meant to lower the risk and cost of future space telescope programs.

Should they have recommended a big telescope project like in years past?

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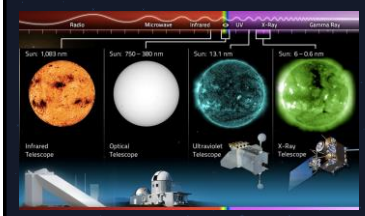
Large Programs that Forge the Frontiers



Future Large Infrared/ Optical/ Ultraviolet Telescope

- Highest priority for Space Frontier Missions.
- Develop a large 6 meter (JWST Sized) telescope capable of detecting biosignatures.
- Estimated $11 Billion US Dollars, most of the funding recommendation.
- Target launch early 2040's.

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Foundations of the Profession Projected Budget

Now that you've seen the costs, do you still think investment is worth it?

Recommendation Topic	Agency	Per Year Budget Increase Relative to FY2019 Agency Budget Allocations (FY2020$)	Cross-Reference in Chapter 3
Faculty diversity, and early-career faculty awards	NSF NASA DOE	(augmentation of) **$2.5M:** $1M NSF; $1M NASA; $0.5M DOE	p. 3-14
Workforce development/diversity, bridge programs and minority serving institutions partnerships	NSF NASA	(augmentation of) **$4.5M:** $1.5M NSF; $3M NASA	p. 3-22
Undergraduate and graduate "traineeship" funding	NSF NASA DOE	(augmentation of) **$3M:** $1M NSF; $1M NASA; $1M DOE	p. 3-23
Independent postdoc fellowships	NSF NASA	(augmentation of) **$1M:** $0.5M NSF; $0.5M NASA	p. 3-23
Treat discrimination and harassment as professional misconduct	NSF NASA DOE	N/A	p. 3-27
Collecting, evaluating, and reporting demographic data and indicators pertaining to equitable outcomes	NSF NASA	(augmentation of) **$1M** Split NSF/NASA	p. 3-29
Include diversity in evaluation of funding awards	NSF NASA DOE	N/A	p. 3-30
Establish community astronomy model for observatory sites	Community	N/A	p. 3-35
Mitigation of radio-frequency and optical interference from sources including satellite constellations	NSF NASA	TBD after evaluation	pp. 3-38 and 3-40
Climate change mitigation actions	Community	N/A	p. 3-42

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Projected Budget New Medium and Large Initiatives

Recommendation Topic	Programmatic Function	Cost Appraisal (FY2020$)	Cross-Reference Page Number Ch. 7
Great Observatories Mission and Technology Maturation Program for IR/O/UV (first half of decade), far-IR and X-ray (second half of decade) missions	Enabling future frontier projects	$1.2B this decade	7-11
Near-Infrared/Optical/Ultraviolet telescope with high-contrast imaging capability	Frontier project, to begin after maturation program	$11B (estimated)	7-17
Time Domain and Multi-messenger Follow-Up Program	Sustaining scientific balance and scale	TBD ($500-800M this decade est.)	7-19
Astrophysics Probe Mission Program	Sustaining scientific balance and scale	$1.5B cost cap	7-20

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Citations

Drier, C. (Dec 2021). "Your Guide to the 2020 Astrophysics Decadal Survey". *The Planetary Society*. Retrieved from https://www.planetary.org/articles/the-2020-astrophysics-decadal-survey-guide

Porter, A. & Ilves. (March 2019). "Women in Physics and Astronomy, 2019". *American Institute of Physics*. Retrieved from https://www.aip.org/statistics/reports/women-physics-and-astronomy-2019

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