

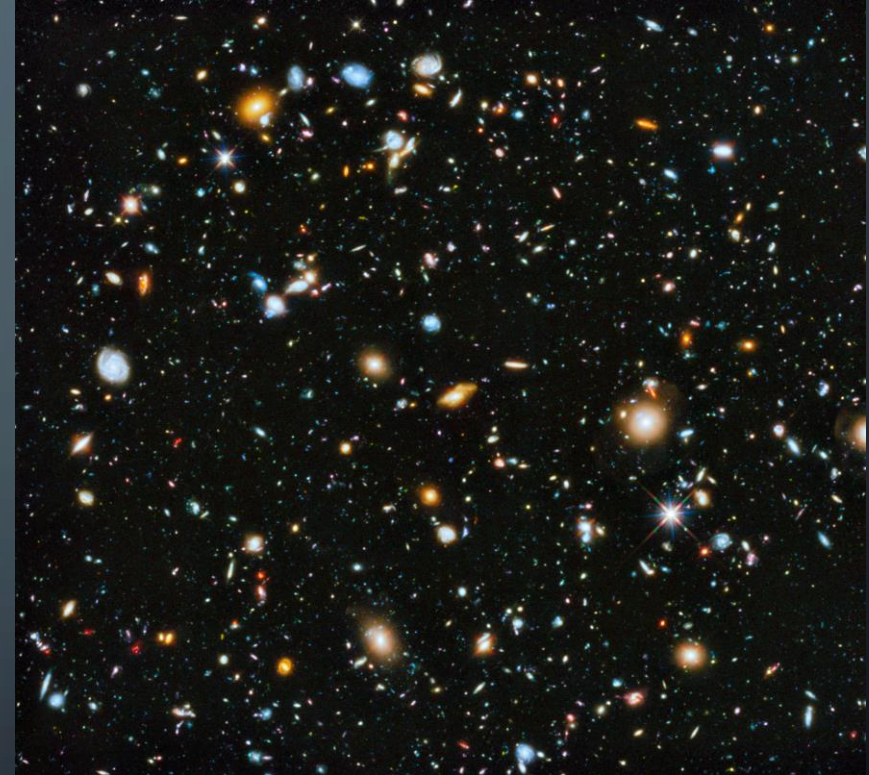
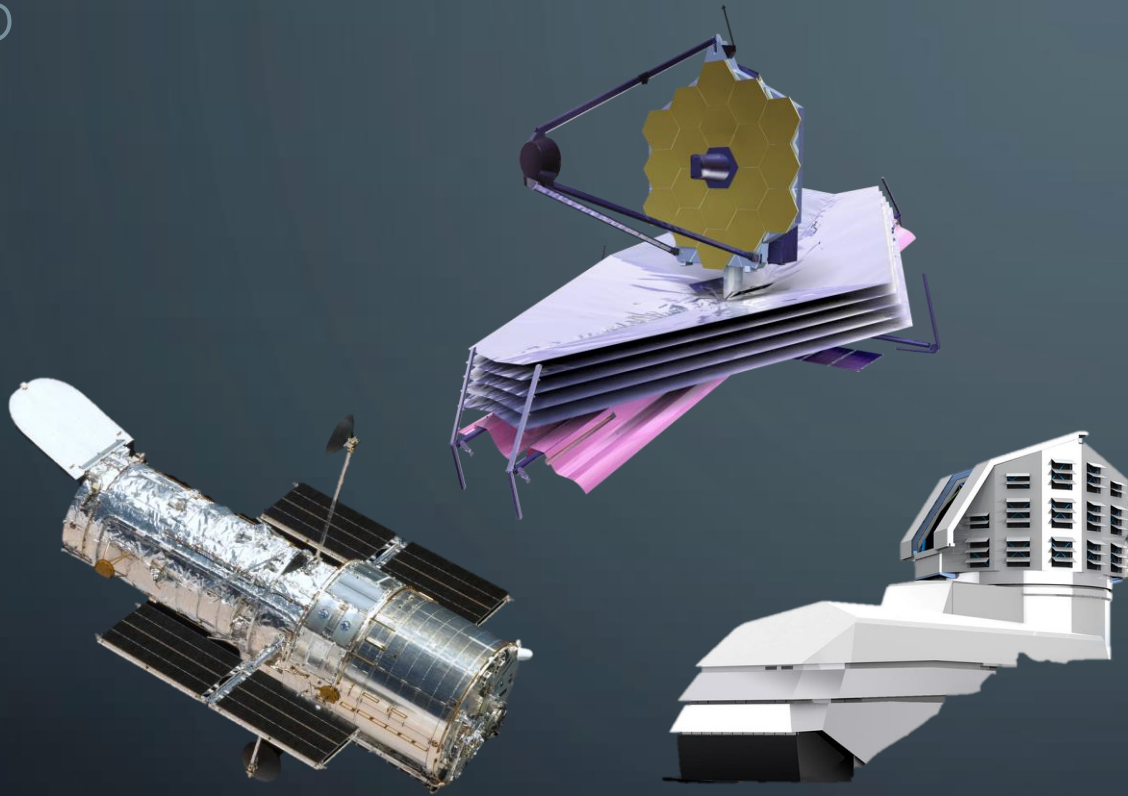
The background is a deep blue gradient with a starry texture. On the left side, there are several faint, white, semi-transparent circular and arc-like patterns. Some of these patterns include tick marks and numbers, resembling a celestial map or a clock face. The numbers visible include 140, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250, and 260. There are also curved arrows indicating a path or direction.

DECADAL SURVEY ON ASTRONOMY AND ASTROPHYSICS 2020

Foundations: Grants and Theory

Ryan Hazlett

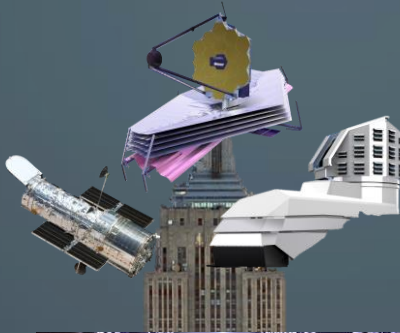
FLAGSHIP OBSERVATORIES



A FOUNDATION SUPPORTING SCIENCE

Processing/Archiving
Data

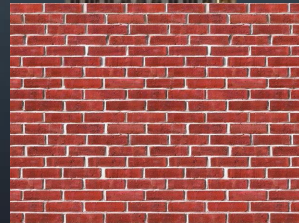
Analysis/Interpretation
of Data



Great
Observatories



Data (Lots of it)

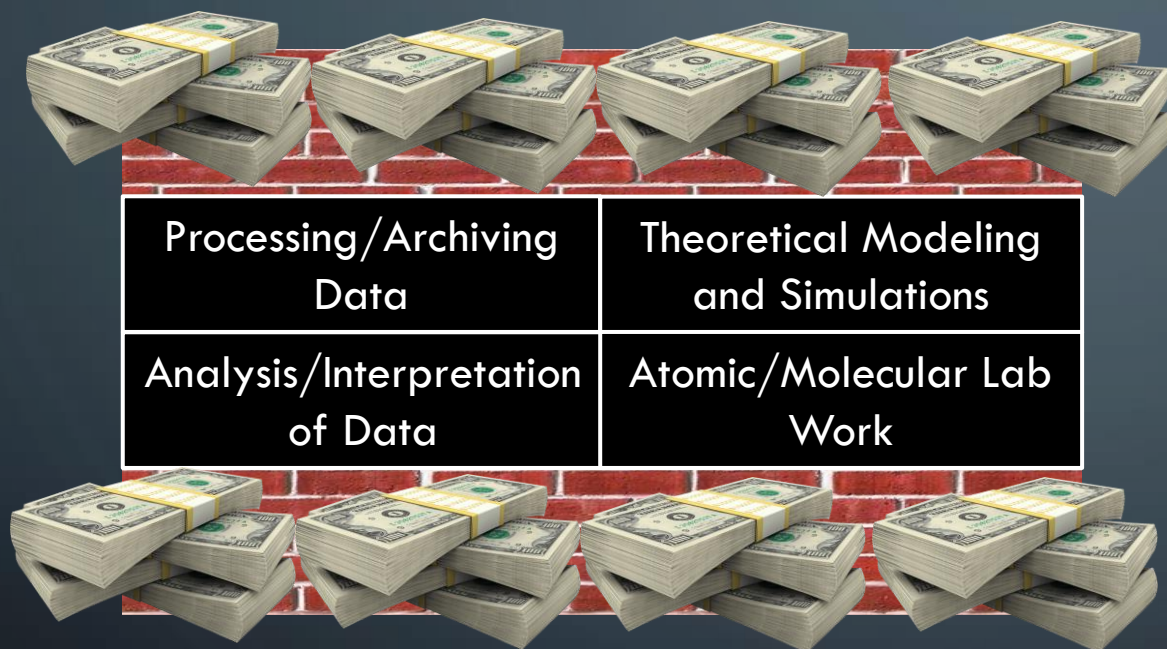


Foundation

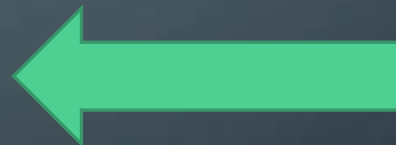
Theoretical Modeling
and Simulations

Atomic/Molecular Lab
Work

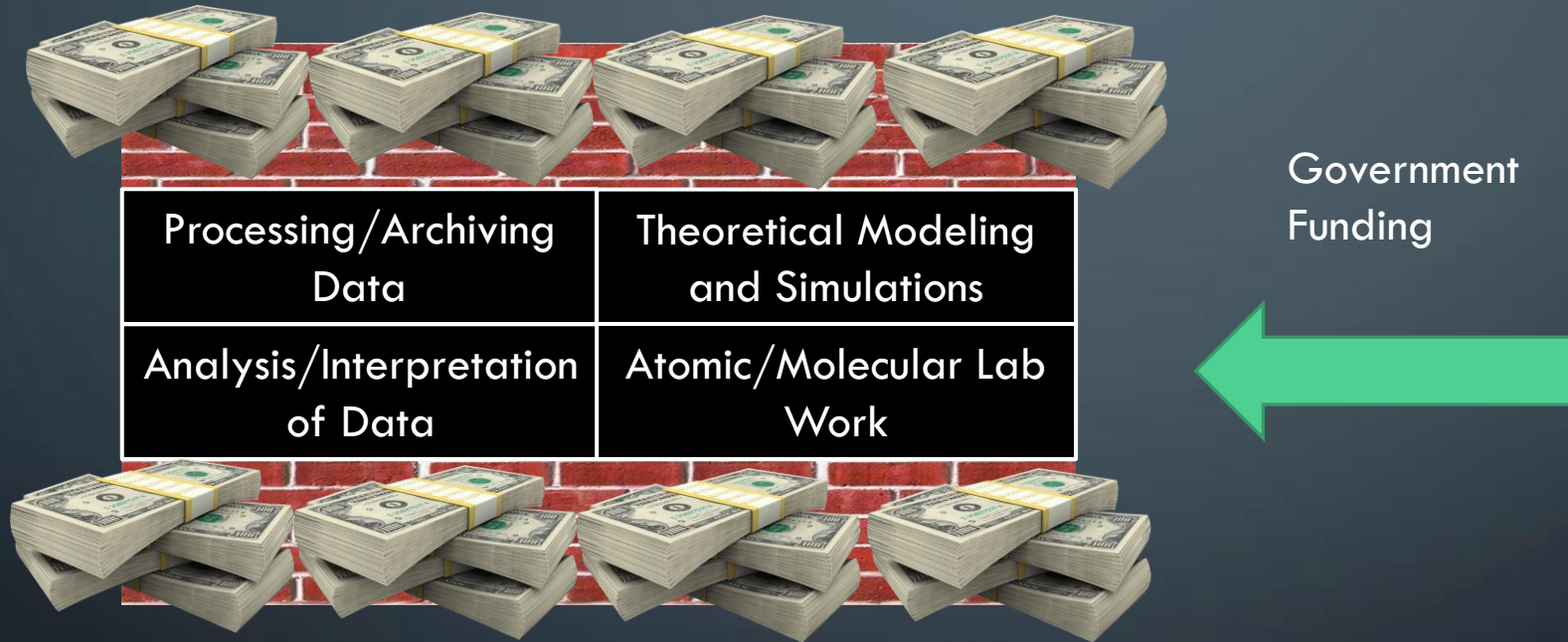
HOW DO WE CREATE THIS FOUNDATION?



Private
Philanthropy



FOCUS ON GOVERNMENT FUNDING

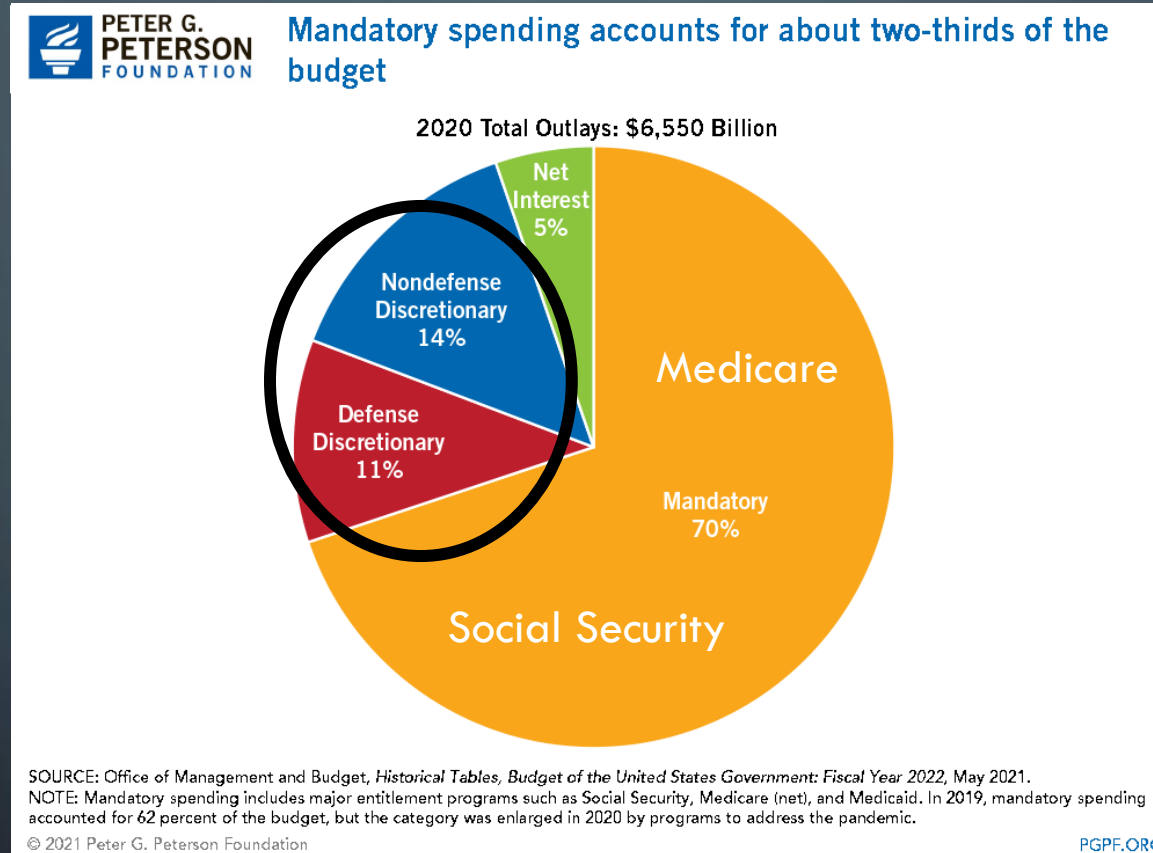


The slide features a dark blue background with white, stylized circuit board traces in the corners. These traces consist of straight lines and small circles, resembling electronic components or data paths. The traces are located in the top-left, top-right, bottom-left, and bottom-right corners, framing the central text area.

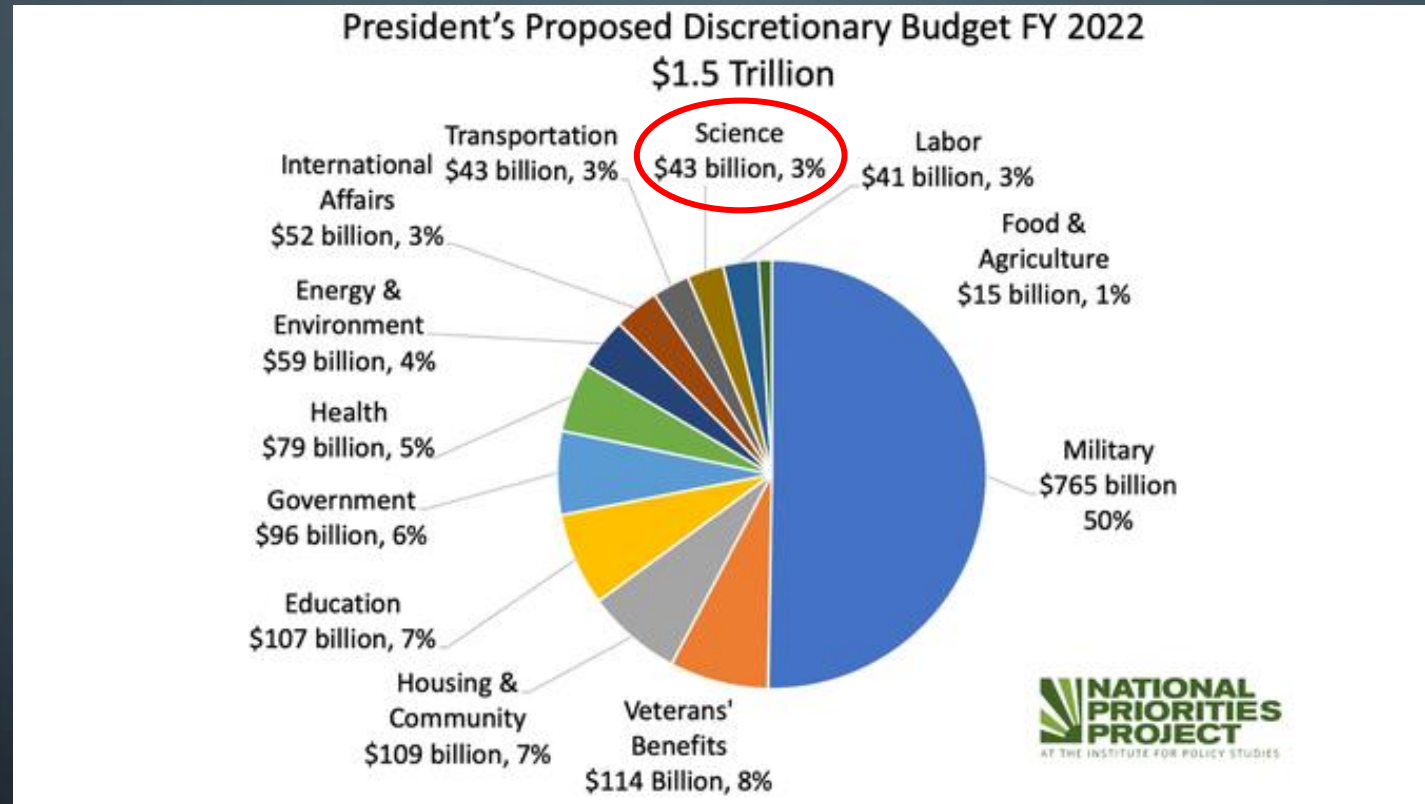
HOW MUCH RESEARCH FUNDING DOES THE NATIONAL SCIENCE FOUNDATION RECEIVE?

RYAN HAZLETT - BAG LUNCH SPRING 2022

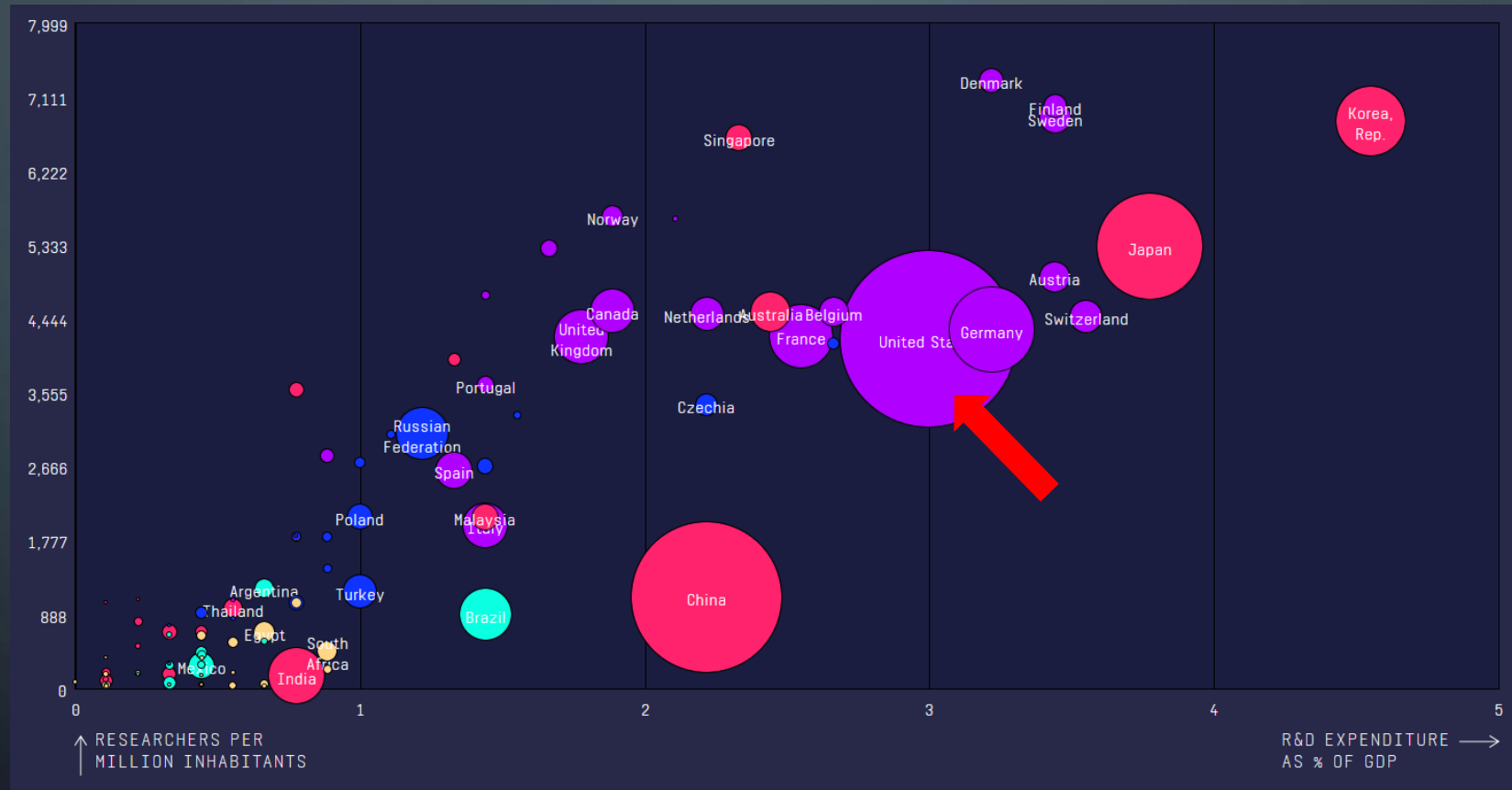
PERSPECTIVE: US SCIENCE BUDGET



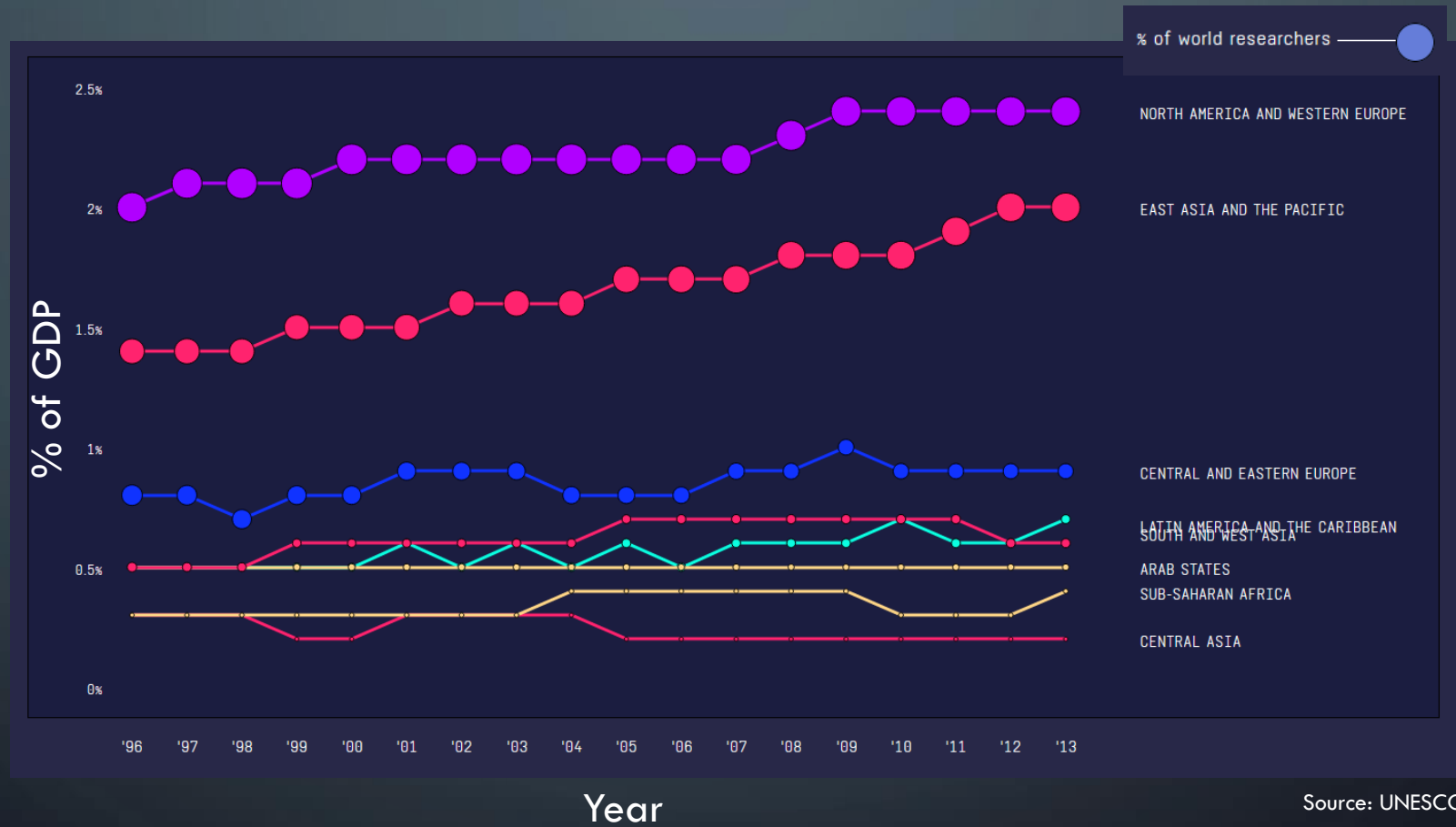
SCIENCE IS 3% OF DISCRETIONARY BUDGET



HOW DOES 43 BILLION DOLLARS COMPARE WITH OTHER COUNTRIES?



HOW IS RESEARCH FUNDING CHANGING AROUND THE WORLD?

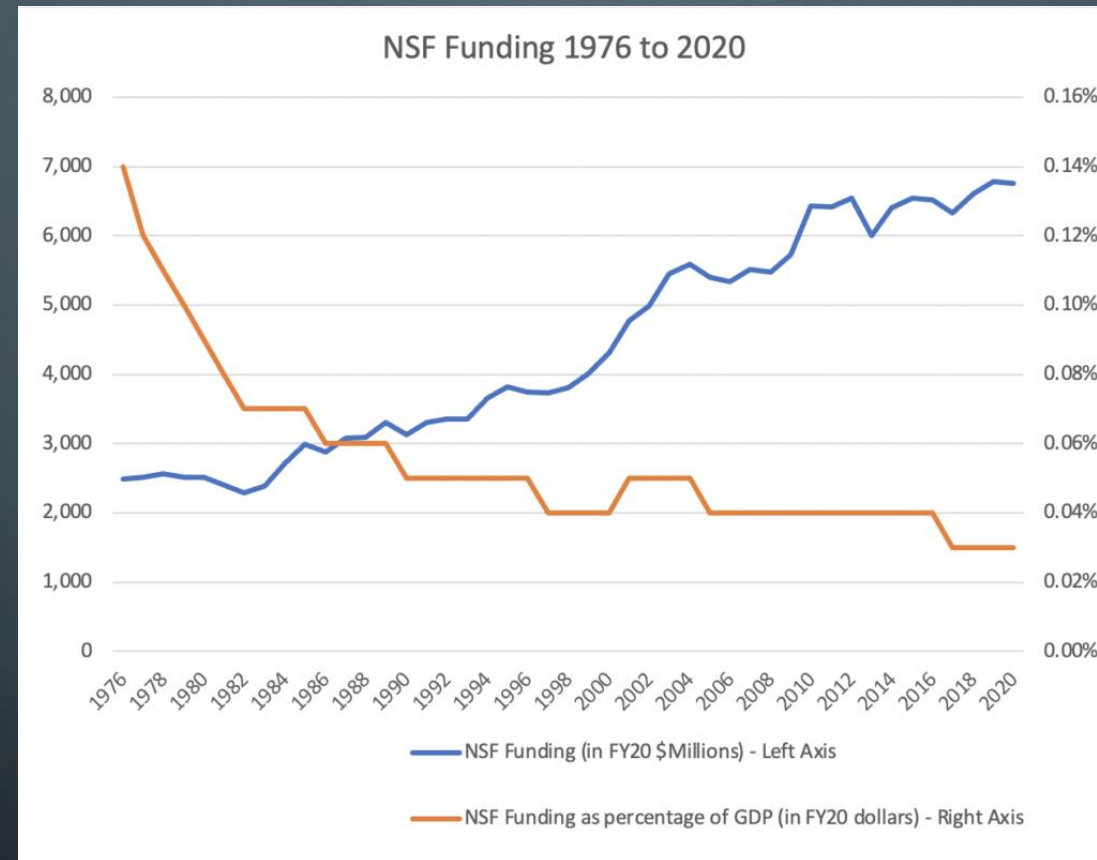




WE JUST COVERED OVERALL RESEARCH FUNDING

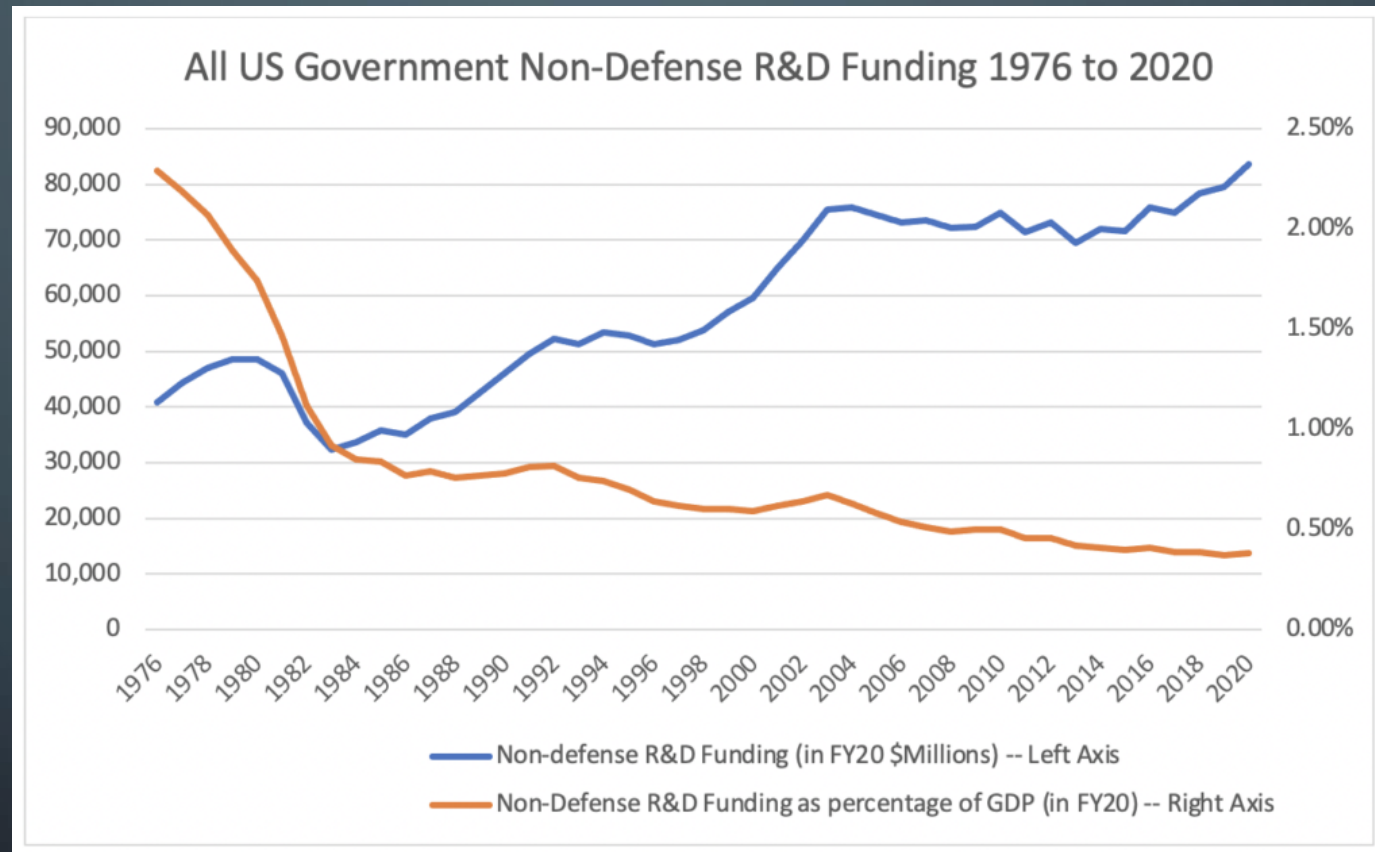
HOW MUCH FUNDING DOES NSF ASTRONOMICAL SCIENCES HAVE TO WORK WITH?

NSF SHARE OF US RESEARCH FUNDING DECLINING



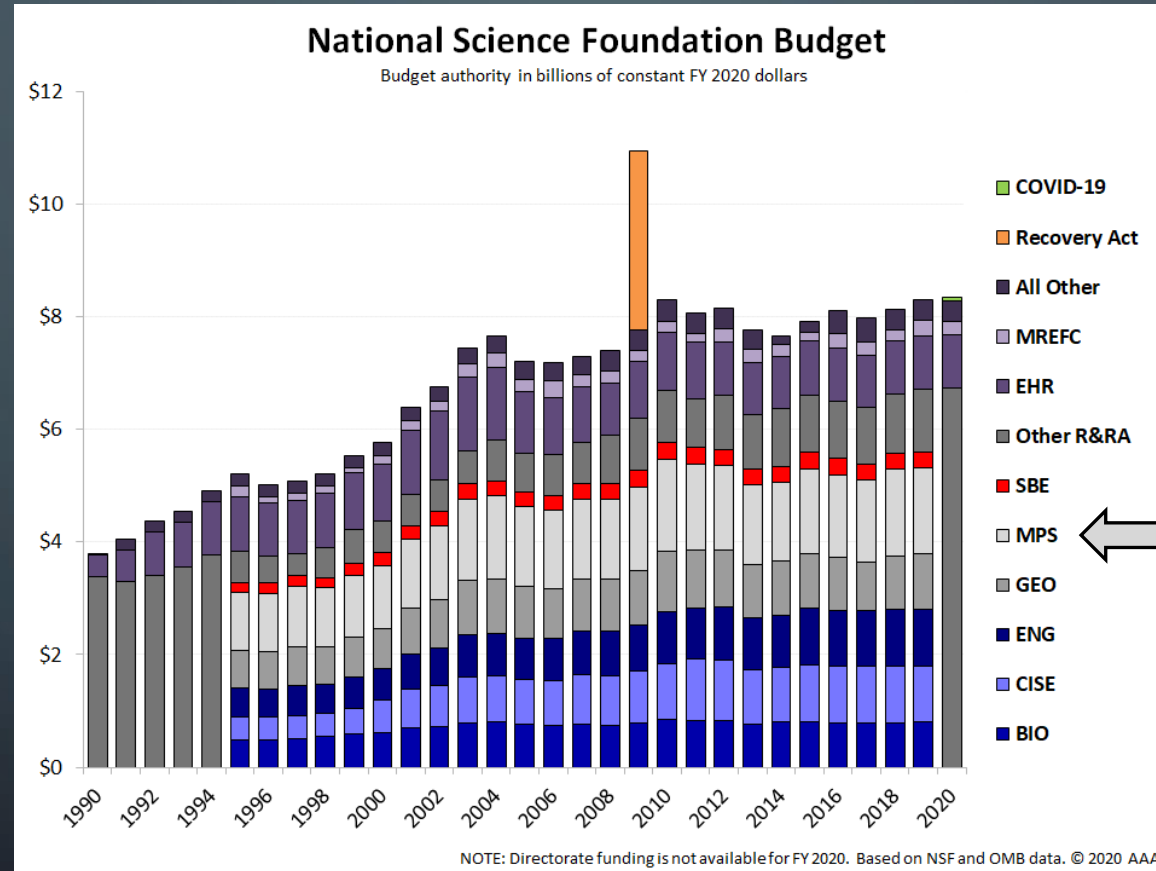
Source: AAAS

NON-DEFENSE RESEARCH FUNDING DECLINING



Source: AAAS

MATH & PHYSICAL SCIENCE (MPS) FUNDING REMAINS RELATIVELY UNCHANGED



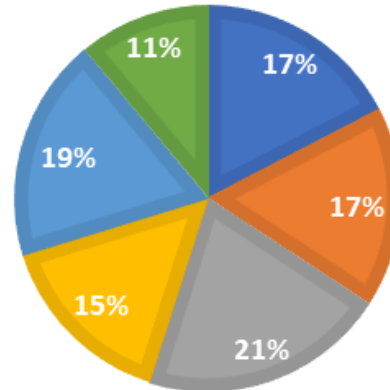
About 7% of
NSF Budget

HOW MUCH FUNDING IS LEFT FOR ASTRONOMY?



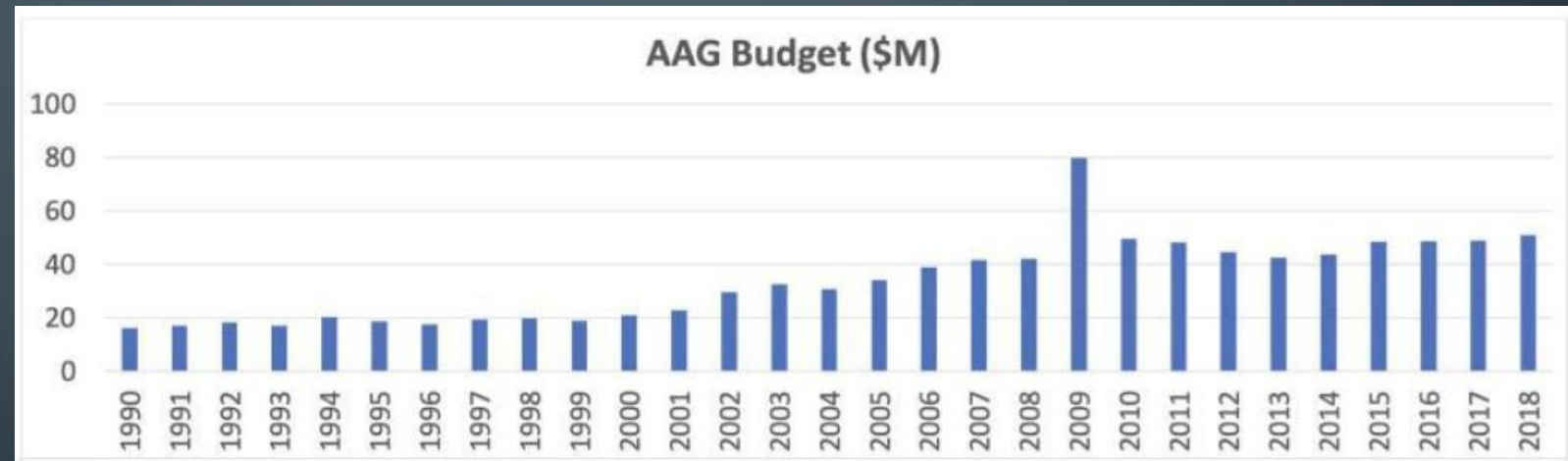
NSF MPS 2022 REQUESTED FUNDING

- Astronomy
- Chemistry
- Materials Research
- Mathematics
- Physics
- Office of Multidisciplinary Activities



\$294 Million dollars
for astronomy

ASTRONOMY FUNDING HAS INCREASED



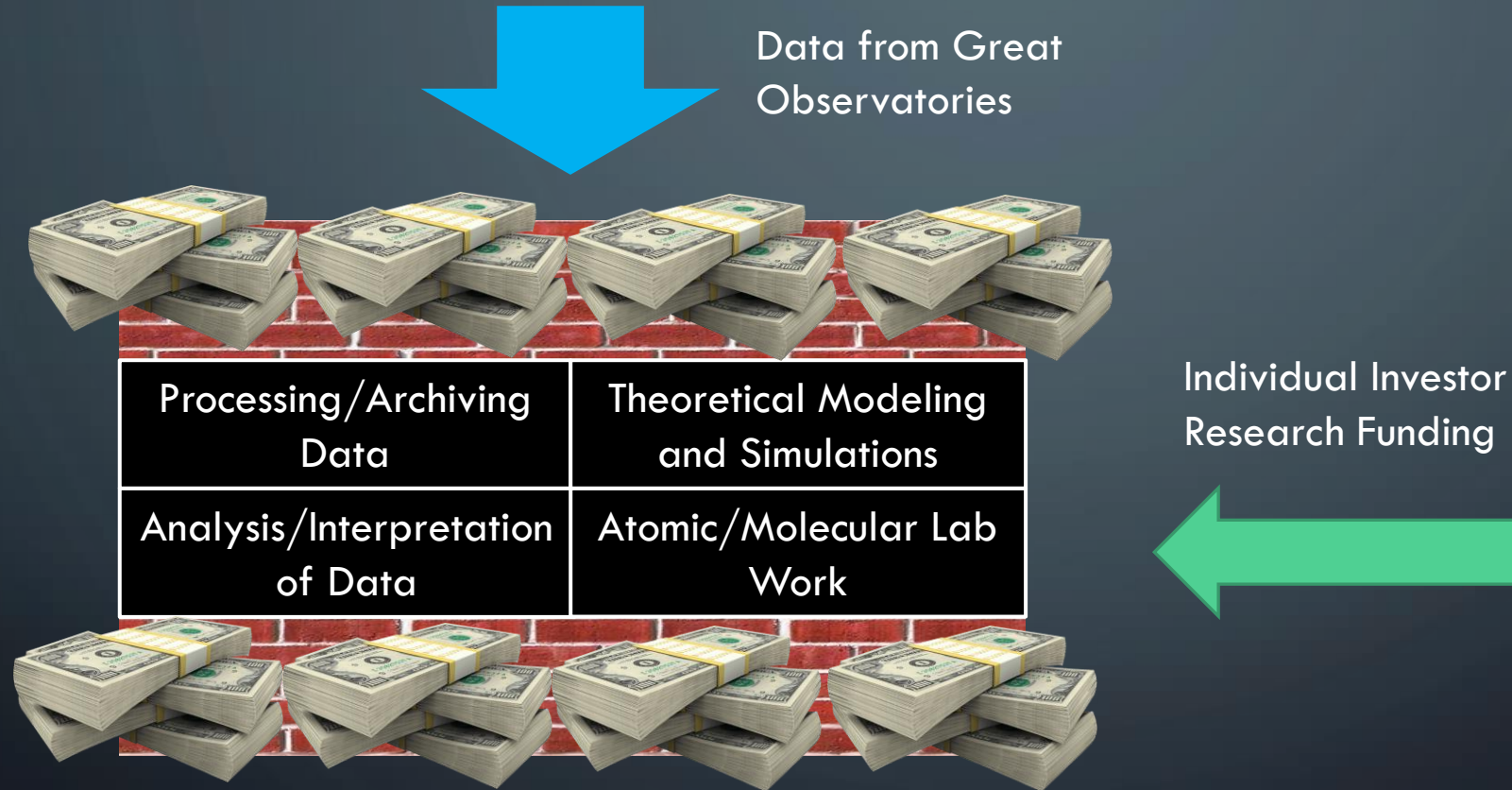
Source: Figure 4.2

BREAKDOWN

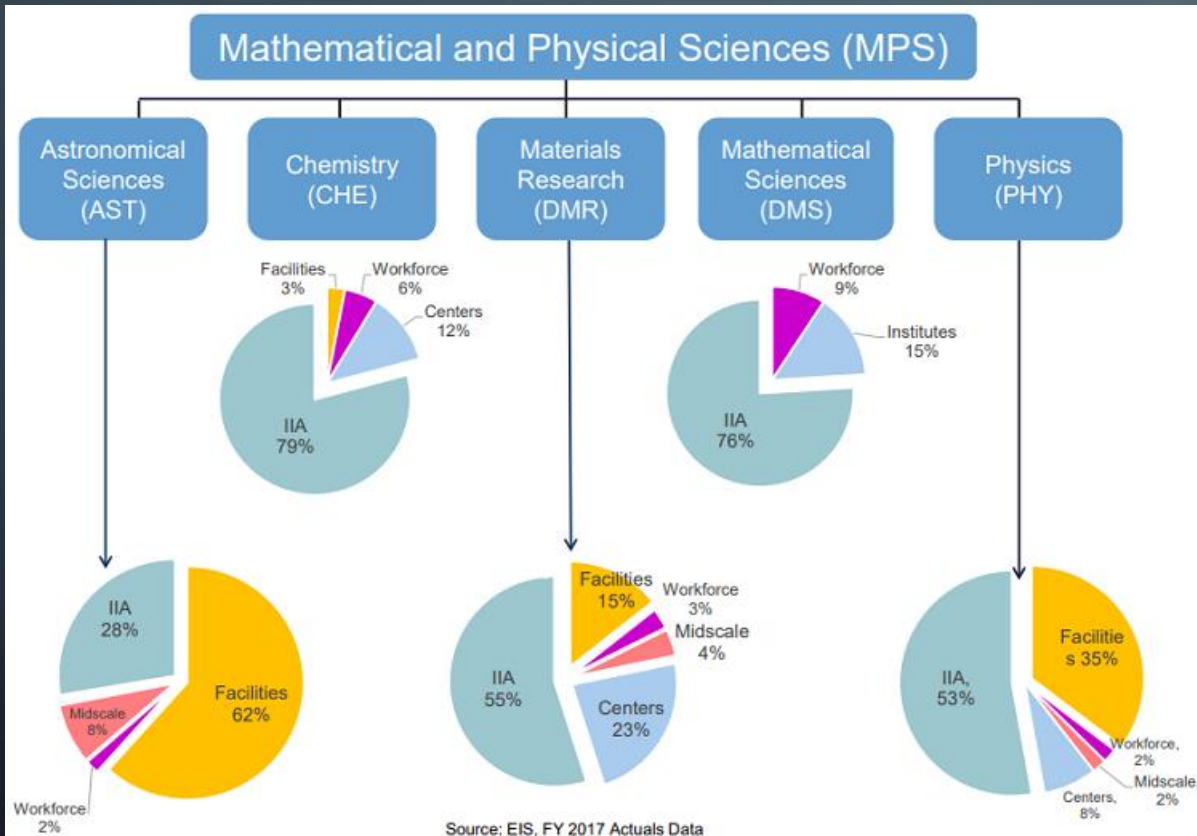


- Astronomy funding has increased over past few decades
- Government funding (as % of GDP) to NSF has declined
- US scientific competitiveness diminishing?

RESEARCH GRANTS AND A STRONG FOUNDATION

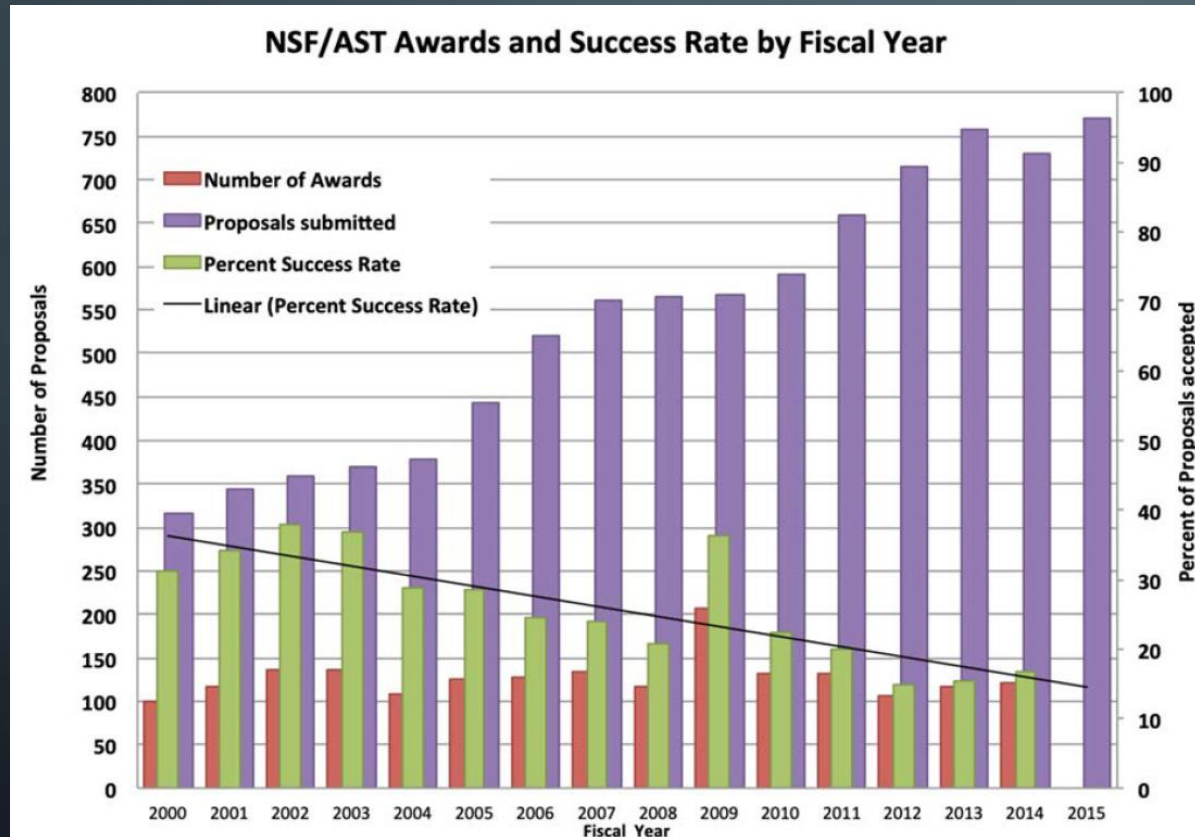


UNBALANCED ASTRONOMY FUNDING?



- **Facilities support** is far higher for astronomy.
- Great Observatories cost a great amount of money.
- Individual Investigator Awards much lower.

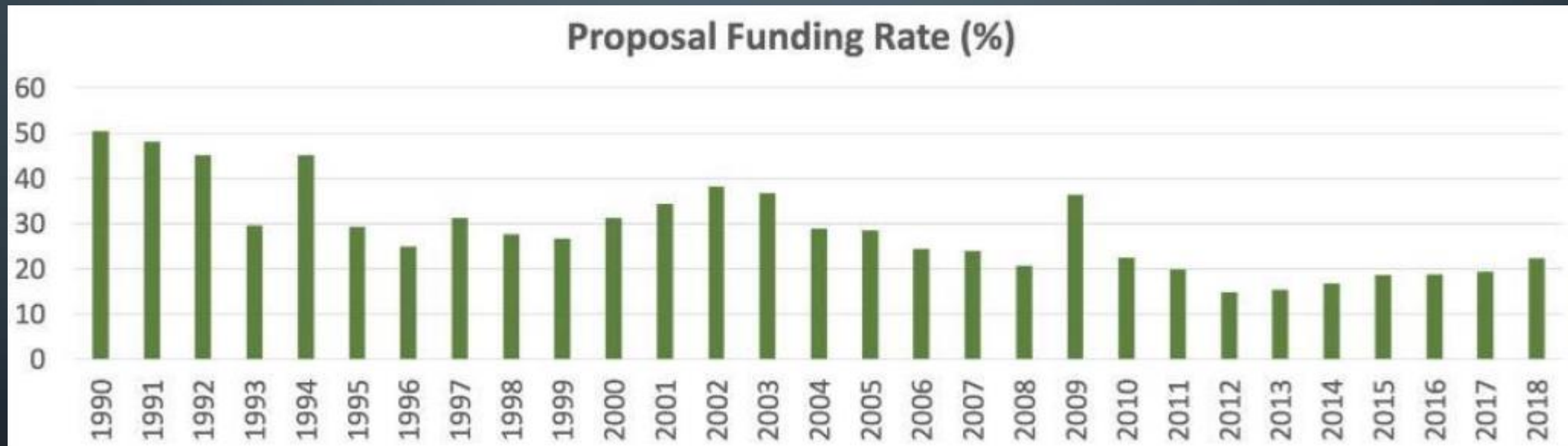
HAVE ASTRONOMY GRANT AWARDS BEEN AFFECTED?



Source: Cushman et al. (2015)

- Number of proposals has drastically increased.
- Number of Awards remains stagnant.
- Success Rate for Awards has fallen from 30% to about 17%

MORE RECENT DATA SHOWS LITTLE IMPROVEMENT



Source: Figure 4.2

ARE ASTRONOMY PROPOSALS TERRIBLE NOW?

- 2015 study investigated if there was a decline in proposal quality.
- Reviewers grade with scale from E (excellent) to P (poor).
- Fraction of proposals judged to be highly deserving has been stable.

RYAN HAZLETT - BAG LUNCH SPRING 2022

Just one proposal per year, please, NSF tells astronomers

As success rates drop, agency seeks to limit applications

By Jeffrey Mervis

Gary Ferland, a theoretical astrophysicist at the University of Kentucky in Lexington, is old enough to remember when he and his colleagues had a 50-50 chance of winning a research grant from the astronomy division of the National Science Foundation (NSF). Now, success rates are at 15% (see graph), creating a situation he compares to playing the lottery.

"If you're trying to support your family on lottery winnings," says the 63-year-old Ferland, "you need to buy a lot of tickets." For many astronomers, that means submitting multiple proposals to NSF every year. The strategy has paid off for Ferland: In 2011, he submitted three proposals and snared two awards; this year, he won another grant by

know have little chance of getting funded.

"It's a first step," says James Ulvestad, director of NSF's astronomy division. If it doesn't achieve the desired effect, he adds, "we may have to make it mandatory in 2016 for the sake of reviewers' sanity."

Biomedical researchers and the National Institutes of Health have long wrestled with similar problems. But a plummeting success rate is a relatively new phenomenon for U.S. astronomers, a much smaller group. "For the astronomy community to be at 15% or below is just now becoming a big deal," notes Joel Parriott, director of public policy at the American Astronomical Society in Washington, D.C.

The numbers behind the crisis are stark. Applications for NSF's bread-and-butter grants to investigators and small teams have doubled in the past decade, to more than

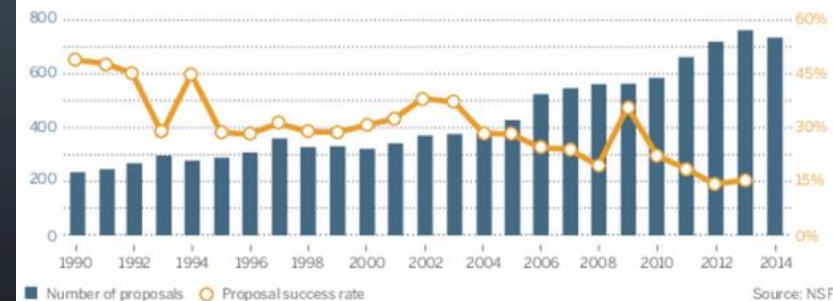
mittee (AAO) main fundement of Engineering cycle, he list themselves gator (PI) on just a sir

A strict lries Jason V astronomy State Univers stars and ex year as a PI reluctant to a ton of co makes an ap submitted t was "stunne a ceiling wo grant writin put in more more money

AAAC m need better lem before steps. To th carry out a current gra

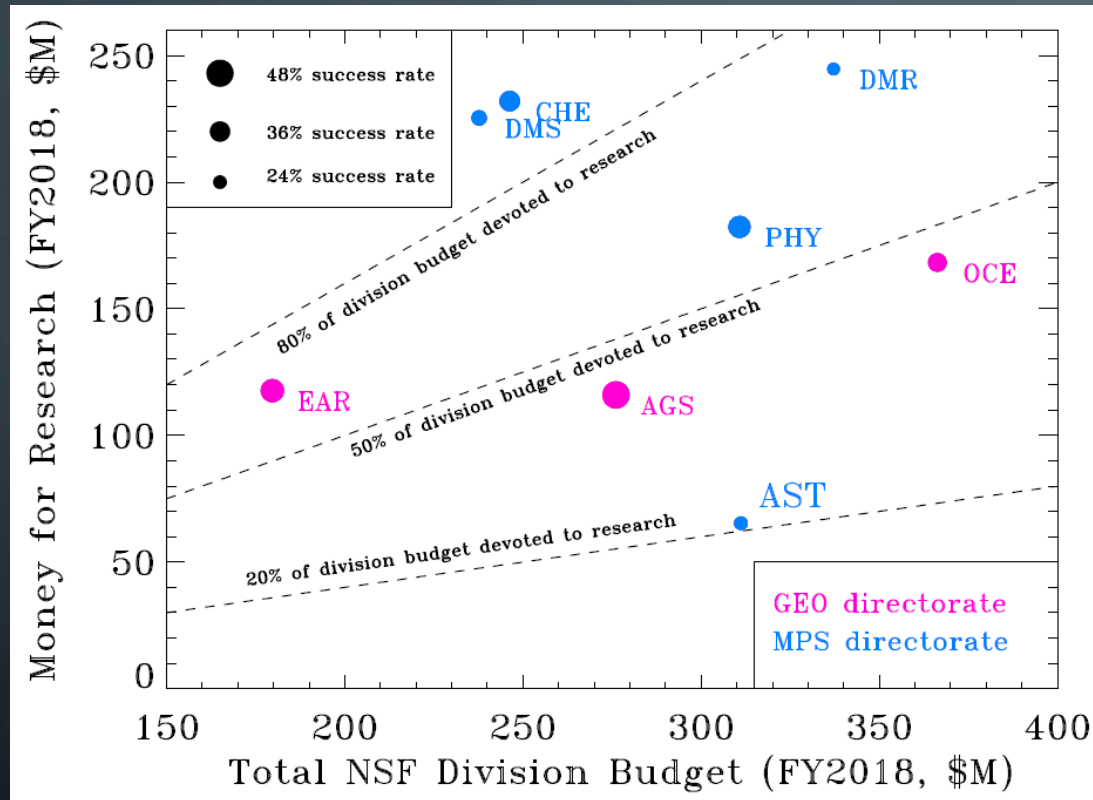
The no's have it

More astronomy proposals contribute to plunging success rates at NSF



Source: *Science* • 20 Jun 2014 • Vol 344, Issue 6190 • p. 1328

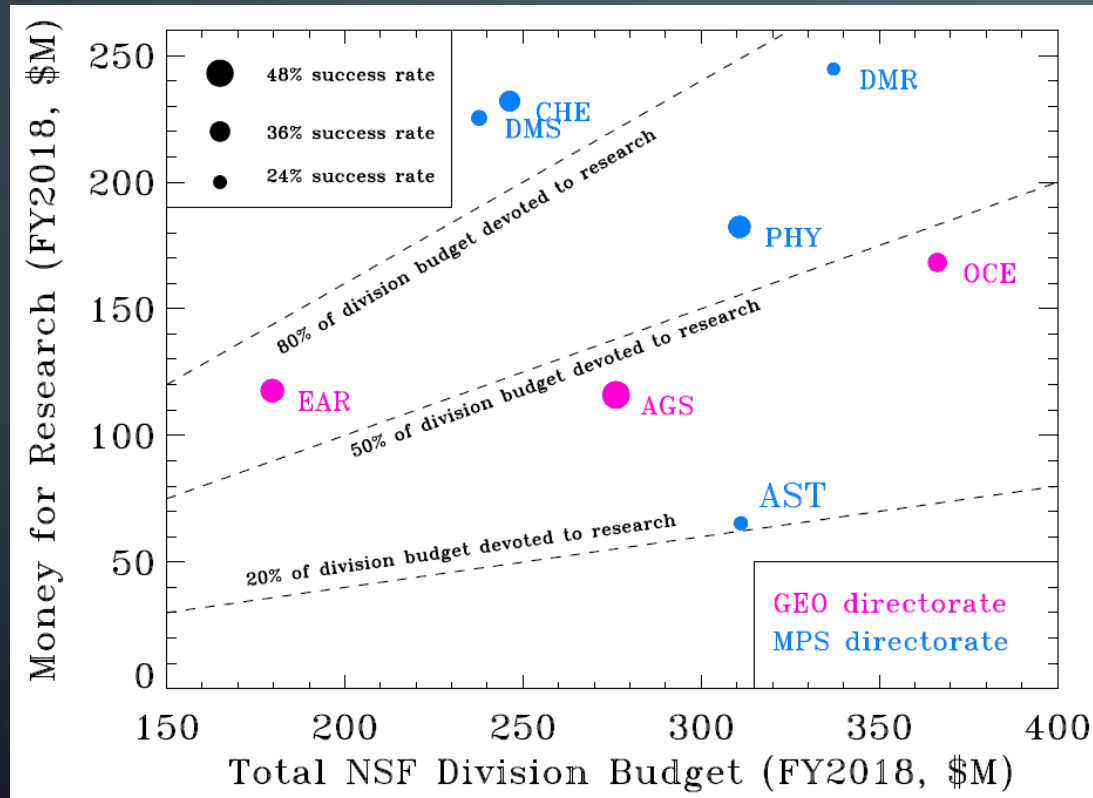
LOW AWARD RATE UNIQUE TO ASTRONOMY?



Source: Figure 4.4

- Astronomy has a large NSF division budget.
- Smallest allocation to research.
- Lowest proposal success rate in division.
- High quality science is not happening!

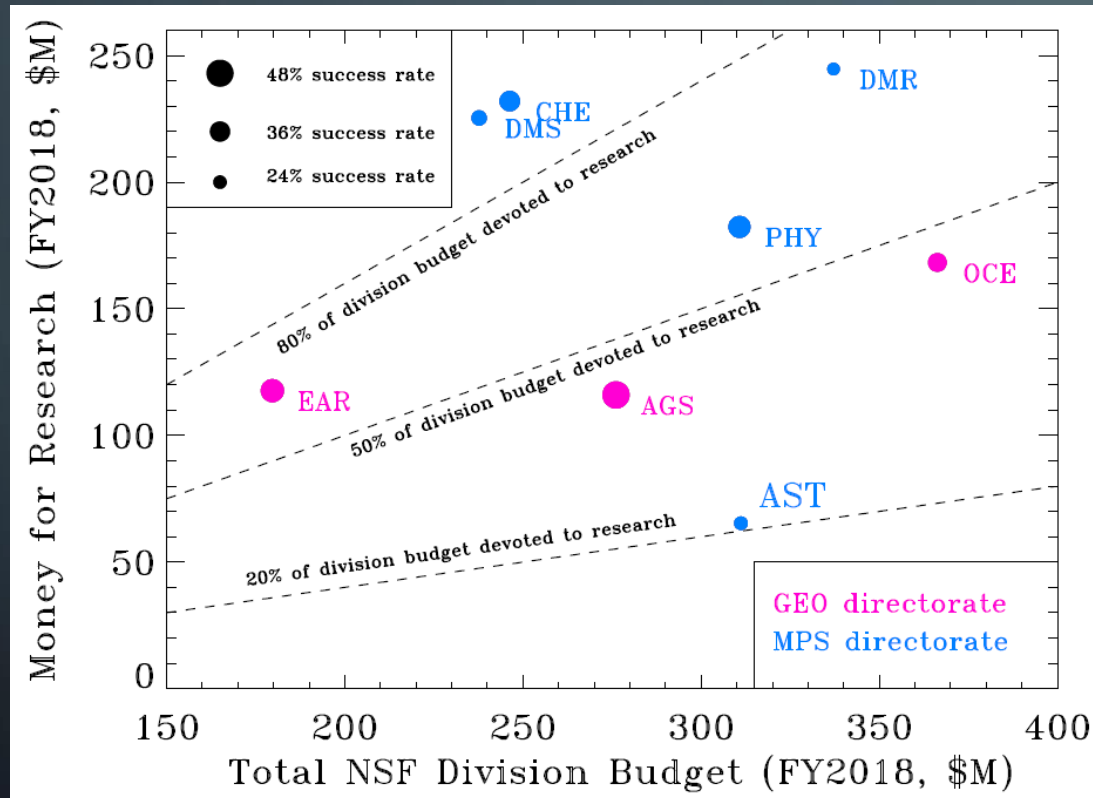
WHAT NEEDS TO CHANGE



Source: Figure 4.4

- Lower acceptance rates disadvantage younger researchers.
- Balance a healthy competitive environment with acceptable risk.
- Aim for early 2000s acceptance rate of ~30%
- 30% chance of no funding after three attempts on average.

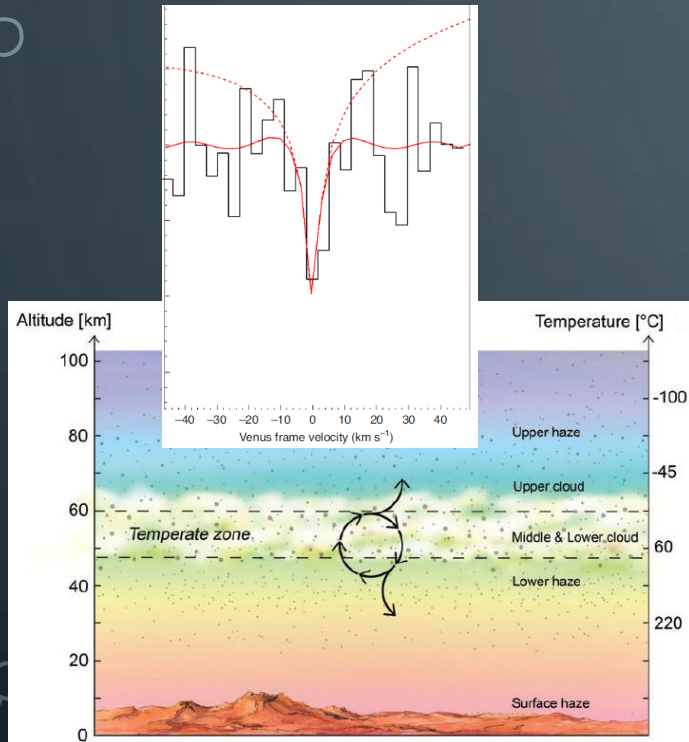
WHAT NEEDS TO CHANGE



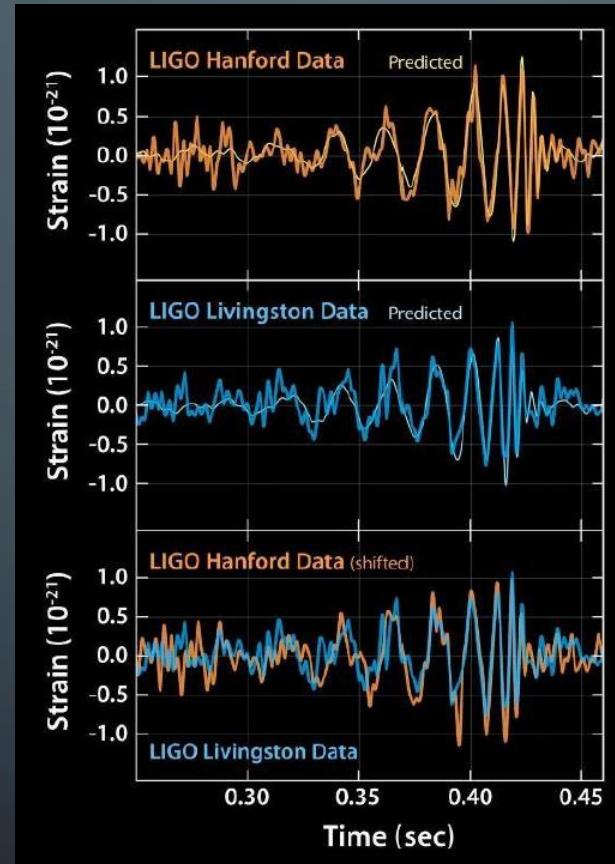
Source: Figure 4.4

“The low success rate for proposals has resulted in members of the community operating under extreme stress”

SITUATION WORSENS WITH THEORY PROPOSALS



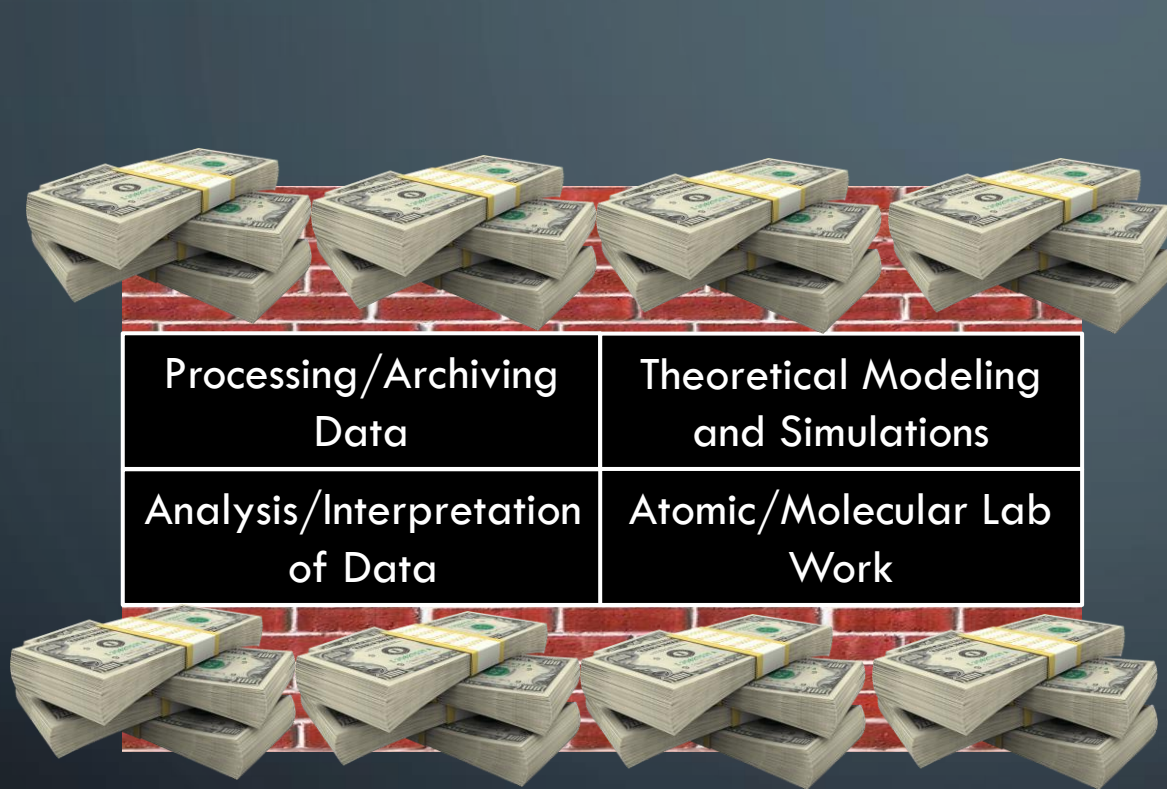
Source: Seager et al. (2020) & Greaves et al. (2020)



Source: Caltech/MIT/LIGO

- Funding rates dropped from 17% in 2010 to 14% by 2013.
- “Little realistic expectation that research will be funded while it is most relevant”
- Theoretical predictions of gravitational wave signal used by LIGO.
- Identifying biosignatures in planetary atmospheres.

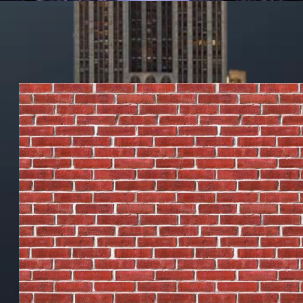
HOW CAN WE BUILD A STABLE FOUNDATION?



Great
Observatories



Data (Lots of it)



Foundation

CONCLUSIONS

- Major observatories will begin producing exabytes of data that needs to be analyzed.
- Tension between funding facilities' operations/maintenance and supporting research utilizing new data through grants.
- Astronomy research grants severely underfunded compared to other fields.
- Will impact the ability to adequately support new facilities and new science in the future.

MOVING FORWARD

- Drastically increase funding for astronomy research grants to ensure high quality proposals aren't passed over.
- Collect better data about proposal success rates.
- Any investments into new facilities should include funding for a data pipeline, analysis, and theoretical work.
- Need to convince congress that great observatories will greatly benefit the American people, ensure continued funding.

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Greaves, Jane S., et al. 2021, *Nature Astronomy*, 5, 655, doi:10.1038/s41550-020-1174-4

Mervis, Jeffery. “Just one proposal per year, please, NSF tells astronomers.” *Science*, vol. 344, no. 6190, 20 June 2014, pp. 1328 doi:10.1126/science.344.6190.1328

Pathways to Discovery in Astronomy and Astrophysics for the 2020s, Consensus Study Report. Washington, DC: The National Academies Press, 2021.

Seager, S., et al. 2020, *Nature Astronomy*, 4, 802, doi:10.1038/s41550-020-1069-4