Astro2020 Decadal Survey on Astronomy and Astrophysics

Panel on an Enabling Foundation for Research

Nigel Sharp, Program Director
Division of Astronomical Sciences
Directorate for Mathematical and Physical Sciences

Keck Center – 500 Fifth Street, NW – Washington D.C. 20001
2020-02-03

NSF programs that accept and fund theory proposals in A&A

Directorate for Mathematical & Physical Sciences

Division of Astronomical Sciences (AST)

Astronomy & Astrophysics Research Grants (AAG): umbrella program accepts proposals in all areas of A&A. Panels created by topic according to proposal pressure, allowing year-to-year adjustment of balance amongst sub-fields, easy acceptance of new ideas, and flexible response to community priorities.

AST rarely has targeted programs in specific science areas, which are not restricted to theory. One exception was the TCAN program joint with, and continued by, NASA.

Division of Physics (PHY)

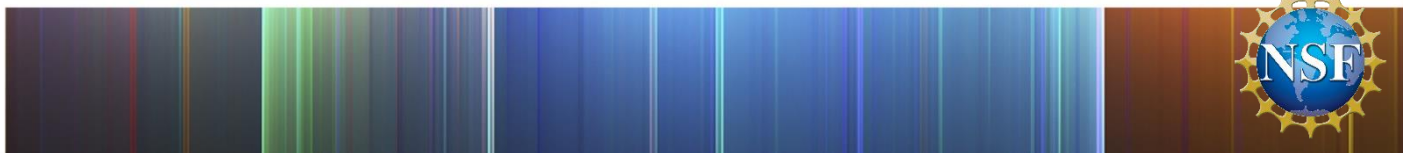
PHY is organized into programs, several of which are relevant, including Particle Astrophysics & Cosmology; EPP Theory; Mathematical Physics; Computational Physics; Plasma Physics; Physics at the Information Frontier; perhaps others. These programs expect proposals targeted at relevant and topical projects.

Directorate for Computer and Information Sciences and Engineering (CISE)

Office of Advanced Cyberinfrastructure (OAC)

OAC runs a number of programs, primarily for needed infrastructure, which regularly change emphasis and even titles and solicitation-specific requirements, but which will support computational and data-enabled theoretical projects.

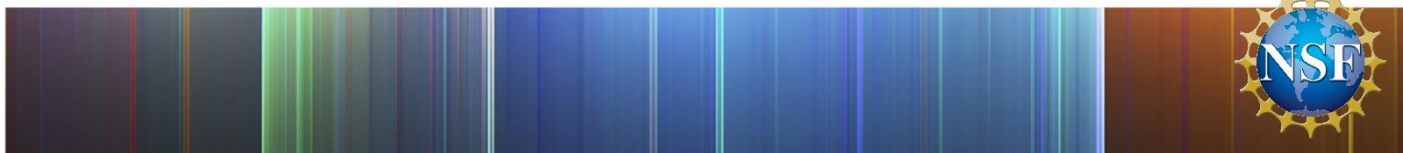
NSF-wide initiatives are usually of limited duration, for a well-defined topic, and not targeted at theory.



Support for Theory in Astronomy & Astrophysics

Difficulties

- Definition of theory? Only analytical work, including calculation? Or numerical calculation, nowadays always computational, and simulation? Compute-intensive data analysis?
  - Many proposed projects are not 100% theory under any definition.
- Which NSF program matches what you want to do?
  - Maybe none, but almost always there's a way. NSF Program Officers are expected to help PIs to submit proposals in the way that best enables us to say yes, which includes choosing the right program. But it may be that you have to recast how you word your project to fit more appropriately to an available program. This may even adjust the emphasis of your project.



Issues suggested for this presentation (1)

- What do you see as the role of theoretical work in your agency's portfolio?
  - It is obviously critical: the legs of science are all important, however defined (observation, theory, experiment, calculation/simulation).
- How has support of theoretical work changed over the past decade?
  - The philosophy remains the same, that the umbrella program distributes proposals by topic, and has a few primarily theory panels but more mixed theory/observation.
  - Funding has fluctuated with NSF's overall budget but has trended upwards, although not as rapidly as the optimism in the 2010 decadal report.
  - Initiatives, the Big Ideas, midscale programs, and other priorities have affected the mix of science topics, but as noted earlier have not been theory-specific. The growth in cross-cutting, multi-disciplinary topics is probably the most relevant trend this decade (HDR, AI, support for computational and data-enabled science, etc.).
  - To first order, funding goes with proposal pressure.

Issues suggested for this presentation (2)

- What do you see as the balance between large computational programs and smaller “pure” theory projects?
  - Balance should be set by the importance of the science goal. Achieving some goals needs a large project: others are more modest. Resource limitations clearly enter into the discussion, but science should be the driver.
- What are the challenges in supporting innovative high-risk theory programs?
  - NSF works by merit review from community members, including you. If you tell us a project is important, we will work hard to support it, but if you don’t assign a high priority to risky work, it won’t be funded. The review process does not have to be conservative: we have found that asking reviewers to identify work that is high-risk but high-return works every time, at least when PIs submit such proposals. Although funding rates remain low, innovative work is awarded at about the same percentage as everything else.

Issues suggested for this presentation (3)

- How do we support a diverse workforce in theoretical astrophysics?
  - Diversity is a major concern across all of NSF.
  - At the review level, we try hard to recruit a diverse set of panelists and reviewers.
  - Instructions to reviewers emphasize unconscious bias and the need to judge on the merits of the written material in front of them. We refer to mitigation studies, online bias testing, and ways to reduce prejudice.
  - There are programs, and adjusted review criteria, for primarily teaching institutions.
  - These do not address the 'leaky pipeline'. We support 'bridge programs' when we can, and when they are proposed. We do our best to fund proposals that include strong efforts for broadening participation. We participate in the REU program, which emphasizes diversity in the undergraduate research experience.
  - Of course, none of these efforts is theory-specific.