

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

**DIVISION ON ENGINEERING AND PHYSICAL SCIENCES
BOARD ON PHYSICS AND ASTRONOMY
SPACE STUDIES BOARD**

The Decadal Survey in Astronomy and Astrophysics 2020
(Astro2020)

Please note: The guiding document for the Decadal Survey is the Statement of Task (found at www.nas.edu/astro2020). The scope, considerations, and approach shown here are additional counseling for the Committee and staff while they carry out their work.

Scope

Reflecting previous astronomy and astrophysics decadal surveys and developments since the last survey, the scope of the study will include the entire breadth of research in the field. In particular, it will include:

- Ground- and space-based observational, theoretical, computational, laboratory astrophysics (as supported by the NASA Astrophysics Division and the NSF), and archival activities and capabilities;
- Solar astronomy, but any prioritization in this area will be limited to ground-based activities. Any findings and recommendations made that relate to ground-based activities (e.g. ground-based solar observatories) will be directed to the NSF and shall include consideration of findings and recommendations in the National Academies report, *Solar and Space Physics: A Science for a Technological Society* (2012).
- Gravitational-wave observations used to inform or as they relate to the full breadth of astronomy and astrophysics. If the committee feels it is appropriate, the report may comment on areas of technology investment in ground-based gravitational-wave observations that would give the best scientific returns. However, activity recommendations shall be limited to those that fall within the areas of implementation by the NSF and by the NASA Astrophysics Division.
- Multi-messenger astronomy and astrophysics investigations that may be conducted using the wide variety of messengers including the full breadth of electromagnetic observations, gravitational-waves, and particles from astronomical sources. Many projects with science topics aligned with the DOE Office of High Energy Physics may also contribute to multi-messenger astrophysics. However, specific multi-messenger activity recommendations shall be limited to those that fall within the areas of implementation by the NSF and by the NASA Astrophysics Division.
- The science of exoplanets, including the search for life in the universe. Any findings and recommendations shall include consideration of the outputs of the National Academies committees that are developing science strategies in exoplanet science (“Exoplanet Science

Strategy”) and astrobiology (“Astrobiology Science Strategy for the Search for Life in the Universe”), the reports of which are expected to be released in 2018, as well as areas of potential collaboration between and within agencies and non-federal entities.

The scope of the study will exclude project or activity recommendations in the following areas:

- Fundamental physics, such as studying the physics of particles and fields, other than through naturally occurring observables.
- Direct detection or accelerator-based dark matter particle searches that are traditionally considered and carried out by the NSF and DOE particle physics communities.
- Microgravity research.
- Construction of projects whose agency-supported implementation is already in progress, specifically JWST, DKIST, LSST, and DESI.

In order to ensure consistency with other advice developed by the National Academies for NASA, the following additional scope guidance is provided:

- The study will assess whether NASA’s plans for WFIRST, Athena, and LISA play an appropriate role in the research strategy for the next decade. The study may include findings and recommendations regarding those plans, as appropriate, including substantive changes in NASA's plans. Recommendations may include, but are not limited to, actions ranging from increased investments (upscopes) to reduced investments (descopes) and termination. It is not necessary to rank WFIRST, Athena, and LISA among other recommended activities for space.

Considerations

The study's prioritization of research activities will be based on the committee's consideration of identified science priorities; independent assessments of cost and cost risk as well as technology readiness and risk; the likely emergence of new technologies; computational infrastructure for modeling, data assimilation, and data management; and opportunities to leverage related activities including consideration of interagency cooperation, federal/non-federal partnerships, and international collaboration.

In developing a comprehensive research strategy, the study will also:

- Consider agency (NASA Astrophysics Division, NSF Division of Astronomical Sciences and other NSF divisions supporting astrophysical research, and DOE Office of High Energy Physics) expectations of future budget allocations in the field, including interface areas, as well as expectations for the completion of projects already under development, and design recommendations based on budget scenarios relative to those expectations; the study may also consider scenarios that account for higher or lower than anticipated allocations.
- Consider activities and investments of all relevant and appropriate sizes, from research programs to development and operation of small, medium, and large facilities and other projects.
- Consider the status and evolution of ongoing programs (“programs of record”) of the agencies, including the balance of activities and investments of all relevant and

appropriate sizes and types, research programs (including individual investigator programs), ongoing support of operational missions and facilities, and the balance that would best address the committee's recommended science priorities and comprehensive strategy.

- Consider and clearly define the study's interpretation of “balance”, using the National Academies report, *The Space Science Decadal Surveys-Lessons Learned and Best Practices (2015)*, as a guide.
- Consider ongoing and planned international and privately-funded activities and capabilities, including possible joint ventures and collaborations between and within domestic and foreign agencies, taking into account the roles and fractions of participants.
- Consider ongoing and planned activities and capabilities in other organizational units of NASA, including (but not limited to) in-space assembly and servicing and existing and planned research platforms in Earth orbit and cis-lunar space.
- Consider any technological innovation or development required to attain the science priorities and enable the activities in the comprehensive strategy.
- Consider the development of cyber-infrastructure as it impacts the scientific capabilities and utilization of facilities, archival research, and theoretical capabilities.
- Consider utilization of and access to existing and proposed facilities for U.S. users.
- Consider the full breadth of astronomy and astrophysics activities by seeking input from non-federal entities such as private philanthropic organizations, international organizations, foreign government agencies, universities, professional societies, privately funded research centers, and other groups that are interested or potentially interested in this area.

Approach

The study will provide recommendations primarily to the NASA Astrophysics Division, the NSF Division of Astronomical Sciences, and the DOE Office of High Energy Physics. Other divisions (e.g., NSF Division of Physics, Office of Polar Programs, or the Directorate for Computer and Information Science and Engineering) may be included as appropriate.

The committee will consist of approximately 18 members and be responsible for the overall organization and execution of the study, as well as the production of a final consensus report that will undergo the usual National Academies review processes. Given the current breadth of astrophysical topics in the multi-messenger era, the composition of the committee and panels must include the appropriate range of scientific and technical expertise. In addition, the composition should take full advantage of the diversity of the astronomy and astrophysics science community in factors such as gender, race, ethnicity, career stage, types and sizes of institutions, geographic distribution, and disability status.

The final report will represent a comprehensive and authoritative analysis of the subject domain and a broad consensus among research community stakeholders. To do so, it is anticipated that the committee will utilize approximately nine specialized panels whose structure will be determined by the committee. The allocation of the domain of study among the panels will be determined by the committee. An important role of the panels will be to evaluate input from the

research community about issues of scientific and programmatic priorities in the field. The work of the study panels will result in separate, independent reports compiled into a second published volume; panel outputs will be guided by the committee and used to prepare a single final report.

In assembling the committee and panels, calls for nominations will be sent to the astronomy/astrophysics community and sponsors. National Academies staff will nominate a candidate for chair after consultation with the National Academies' boards and standing committees that represent the astronomy/astrophysics community, as well as other leaders of the community. The chair will then work with National Academies staff and members of the astronomy/astrophysics community to develop the structure for the study and a slate of nominees for the balance of the committee. Nominees for panel members will be selected in a similar fashion. In assembling the slate of nominees for the committee and panels, National Academies' staff will follow National Academies' procedures for reducing and balancing biases, and for ensuring that the committee and panels have the needed expertise across disciplines and diversity among their members, including gender, underrepresented groups, types and sizes of institutions, and geographic distribution.

It is essential that the study solicit inputs from across the astronomy and astrophysics community broadly construed, by means of town hall meetings, sessions at geographically dispersed professional meetings, solicitation of white papers, and use of electronic communications and networks. It is anticipated that a call for white papers will be issued prior to the commencement of the study itself. The committee may also convene focused workshops on special topics of interest. Other input-gathering methods will be explored and used, such as the pre-study early-career astronomers event.

In designing and budgeting the study, the Academies will include resources for independent, expert analysis on cost-risk and technical risk associated with potential recommended activities as input to the committee's prioritization process.

The committee may consider unrealized activities from previous astronomy and astrophysics decadal surveys that are submitted to the study for consideration in the prioritization process, unless stipulated otherwise in the Scope section of this document.

Prioritized activities will be binned into broad cost categories, and into ground-based and space-based categories, where possible.