**IMAP Student Collaboration Document**

**I. BACKGROUND**

The Interstellar Mapping and Acceleration Probe (IMAP) Student Collaboration (SC), as defined below, provides current or aspiring graduate or undergraduate students, including advanced high schoolers opportunities for an authentic experience that increases their interest in scientific and technical careers and enthusiasm for space exploration, while equipping them with engineering and science skills. A strong justification for requiring IMAP Student Collaboration derives from the 2013 NRC Decadal Survey *Solar and Space Physics: A Science for a Technological Society* (2013). It specifically calls out “[v]ibrant university-based solar and space physics education and research programs that extensively involve experimental science and engineering undergraduate and graduate students focused on instrument development and space systems are vital to maintaining the health of the field.” The 2013 NRC Decadal Survey identifies as the highest recommendation for the current decade the DRIVE initiative (Diversify, Realize Integrate, Venture, Educate). Under the headline “Educate” it recognizes that “it is critical to ensure sufficient resources for education and training, and to develop the skills necessary for the next generation of space researchers and for technologically literate workers in many other fields.”

The 2007 National Research Council (NRC) report, *Meeting the Workforce Needs for the National Vision for Space Exploration*, suggests that “training students to build satellites, gain hands-on experience with the unique demands of satellite and spacecraft systems, and acquire early knowledge of systems engineering techniques is an important resource for NASA. NASA needs to play a role in training the potential workforce in the skills that are essential and/or unique to the work the agency conducts.”

An IMAP SC is distinguished from traditional assistantships, scholarships, fellowships or internships based on the level of hands-on experience in the IMAP spaceflight project. An IMAP SC therefore must not be proposed to provide whole year or multi-year tuition and stipends.

**II. IMAP SC POLICY**

1. Principal investigators (PIs) have wide latitude to create a SC opportunity that offer authentic, hands-on experiences within the mission life-cycle.
   1. The IMAP SC emphasizes student participation across the flight or instrument system life cycle (design, build, test, and operations).
   2. The IMAP SC is subject to the same management principles as other flight system elements and subject to the overall exigencies of mission success, including descope.
   3. The IMAP SC does not have to provide individual student participants with an experience in every operational phase of a mission.
   4. The IMAP SC may involve students in multiple phases of the mission spanning scientific formulation; mission planning; systems engineering; design and development of flight hardware; qualification, test and integration; and mission operations and data analysis.
2. The IMAP SCs must be separable from the mission, i.e., the SC is incorporated on a nonimpact basis. If the IMAP SC component is *not* funded or if funded encounters developmental problems, fails in flight, etc., the SC may not impact the conduct of the baseline and threshold investigation or put mission development at risk
3. The IMAP SC must have science or engineering merit that depends upon the proposed IMAP mission implementation. A proposed IMAP SC’s potential to add value to the science or engineering of the mission, however, is optional but encouraged.
4. Mentoring is an essential component of the IMAP SC and a flexible approach is appropriate. Compensation for mentors may also be appropriate. A mentoring plan may include but is not limited to:
5. Project management teams, both in terms of their structure and the reporting paths of scientists and engineers within it, should support mentoring.
6. Other types of mentors can include experienced undergraduates, graduate students, postdocs, experienced technicians, etc.
7. Mentoring need not be exclusively one-on-one, but mentor time should be allocated for sufficient individual attention to ensure success.
8. Risk management strategies for the IMAP SC must recognize and accommodate a spectrum of technical complexity and relationships with the primary mission objectives.
9. The IMAP SC should (1) Ensure human safety; (2) Avoid likelihood of collateral damage to hardware or property; (3) Preserve the learning environment by encouraging innovative approaches; (4) Accept a reasonable risk that technical objectives may not be achieved.
10. The IMAP SC should adapt and apply standard NASA flight program risk mitigation processes such as (1) Adopt and adhere to strict technical requirements; (2) Establish and implement clear requirements for interfaces to spacecraft systems to simplify review; (3) Be separable and not interfere with success of the primary mission
11. The IMAP SC is conducted in accordance with Federal civil rights laws and NASA diversity and inclusion policies and best practices that address underrepresentation in STEM fields. The composition of proposal teams; SMD’s peer review panels (science, engineering, and technology); science definition teams; and mission and instrument teams also must comply with Federal civil rights laws and NASA diversity and inclusion policies.
12. The IMAP program budget is structured to require SC proposals and protect IMAP SC funding once established (see Section III).

**III. IMAP STUDENT COLLABORATION RESOURCES**

The IMAP program budget is structured to require SC proposals andprotect IMAP SC funding once established. SC costs up to the IMAP SC incentive are not counted against the PI-managed mission cost cap. If an IMAP SC is selected, NASA retains the option to fund or not to fund it in full or in part.

The IMAP AO specifies policies regarding the allowable cost of the proposed SC:

1. There is no minimum and no maximum allowable cost for the IMAP SC request; however; the STP program set aside $5M (FY17 dollars) as IMAP SC incentive.
2. When the proposed IMAP SC costs more than the incentive, the additional cost shall be within the PI-managed mission cost.
3. Only minimal SMD funding may be committed to the IMAP SC prior to project confirmation (KDP-C).
4. IMAP SC resources will not be available to solve project cost overrun issues. The IMAP SC does not provide an opportunity for cost-savings for projects.
5. SCs must set aside adequate reserves to respond to unexpected costs
6. Individuals who are funded by SMD to participate in the IMAP SC should be compensated when appropriate.
7. The funding mechanism available for the IMAP SC is a grant/cooperative agreement. Therefore, institutions proposing an IMAP SC cannot charge a fee.

I**V. EVALUATION**

In the Step-1 evaluation, a proposed SC will be evaluated only for its impact on mission feasibility. The merit of the proposed SC will not be evaluated in the Step-1 evaluation; the merit of the proposed SC will be evaluated as part of the evaluation of the Step-2 Concept Study Report, or at the end of Phase A in case NASA chooses a one-step selection.

The evaluation of IMAP SCs will include criteria that first measure intrinsic scientific or technical merit potential followed by actual student development impacts. The focus on graduate students, undergraduate students as well as advanced high schoolers for the IMAP SC is a priority because it is at this broad critical junction that individuals, including from groups traditionally underrepresented or underserved in STEM, make decisions to pursue and persist in degrees that will provide the skills required by the future space science workforce.

IMAP AO managers are responsible for the pre-award IMAP SC evaluation and for monitoring a PI’s post-award evaluation of the IMAP SCs.

Pre-Award

1. A special panel and/or reviewer instructions for the evaluation of IMAP SCs may be necessary to supplement standard AO review practices.
2. IMAP SCs are evaluated by experts who are qualified to address either scientific/technical merit or student development impact or both.
3. Evaluation of the overall value of proposed IMAP SCs should balance scientific/technical merit and risk of technical failure against potential student development impacts.
4. The three *minimum* SC review criteria for student development impact are:

* *Quality, Scope, Realism, and Appropriateness*. Student level and IMAP SC research objectives are both clearly defined. SC mentors and supervisors are identified and have clear lines of responsibilities. The proposal includes a description of what constitutes, to the proposer, a successful SC effort.
* *Diversity.* SC participant recruitment and retention (R&R) practices or proposed inclusion strategies are described, including proposed R&R likely to reach disadvantaged individuals and/or those from groups underrepresented in STEM.
* *Evaluation*. The IMAP SC has a proposed evaluation methodology based on techniques appropriate to the SC activities proposed. The evaluative processes document outputs and intended outcomes and use metrics to demonstrate progress or explain the lack of achievement by the SC component.

1. Post-Award

During the PI’s regular reporting to NASA throughout a project’s lifecycle, IMAP student collaboration is reported with the same rigor as other project activities at key decision points.

The PI is responsible for IMAP SC student development impact evaluation status/metrics. These metrics may include process evaluation and longitudinal (3-5 year or more) tracking of subsequent, employment and/or degrees obtained and student perspectives on the value of the SC experience.

The IMAP standing review board will include SC expertise.

**V. Selected Bibliography Related to Student Collaborations**

Chen, X. (2013). STEM Attrition: College Students’ Paths Into and Out of STEM Fields (NCES 2014-001). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC. Available from: <https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2014001rev>

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NASA Non-discrimination Regulations for Federally Assisted Programs

<https://odeo.hq.nasa.gov/documents/Non-Discrimination_Regulations.pdf>

National Research Council (NRC) Decadal Strategy for Solar and Space Physics (2013), Solar and Space Physics: A Science for a Technological Society. Available in the IMAP Program Library.

National Research Council (NRC) and National Academy of Engineering (NAE), 2012 Community Colleges in the Evolving STEM Education Landscape: Summary of a Summit. Available from: <https://www.nap.edu/catalog/13399/community-colleges-in-the-evolving-stem-education-landscape-summary-of>

National Research Council; Division of Behavioral and Social Sciences and Education; Board on Science Education; Committee on the Status, Contributions, and Future Directions of Discipline-Based Education Research; Susan R. Singer, Natalie R. Nielsen, and Heidi A. Schweingruber, Editors. 2012. Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering. Available from: <https://www.nap.edu/catalog/13362/discipline-based-education-research-understanding-and-improving-learning-in-undergraduate>

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