AAPT and NASA Heliophysics Education Consortium

Proposed budget for AAPT work:

**Annual Amounts:**
$20,000 for Physics Teaching Resource Agent (PTRA) time to provide feedback on the NASA materials and to convert them into a form suitable for PTRA workshops (e.g. use a 5E model, link to Next Generation Science Standards, etc.) ($5,000 each for four PTRAs to do the work).

$5,000 stipend for Professor Ramon Lopez, a NASA-supported space scientist at the Department of Physics, University of Texas at Arlington, to act as research content expert and advisor to the PTRAs.

$20,000 to support teacher attendance at PTRA workshops at which the NASA materials are used. (about $500 per teacher x 40 teachers).

**Total**: $45,000 per year. **Five year total**: $225,000.

| Item | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Total |
|---|---|---|---|---|---|---|
| Stipends to Physics Teaching Resource Agents (high school physics teachers) for workshop materials development. 4 each year @$5,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 100,000 |
| Consultant Fee Dr. Lopez, heliophysics expert to work with PTRAs | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | 25,000 |
| Travel for 40 teachers per year to attend heliophysics workshops, $500/teacher | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 100,000 |
| Totals | 45,000 | 45,000 | 45,000 | 45,000 | 45,000 | 225,000 |

**EXECUTIVE SUMMARY**

This is a proposal for a **Heliophysics Education Consortium (HEC)**, which will capitalize on NASA's rich history of sharing its amazing research and technology through

compelling and innovative education projects. The program proposed here continues the Science Mission Directorate's position at the forefront of NASA's educational endeavors by linking the exciting science and missions directly to students and the general public. We have learned from the strengths and weaknesses of previous programs and have a clear plan forward, but the plan is readily adaptable to the inevitable changes that will come.

**We bring an exciting menu of products, programs, and tools to heliophysics education.** These include big events (Sun-Earth Days and International Observe the Moon Night), data-intensive tools (Space Weather Action Center, Helioviewer), informal programs (Solarium), citizen science (Aurorasaurus, Radio JOVE), out-of-school time (After School Astronomy Clubs, Family Science Night), and cross-cutting infrastructure (Space Math, STEM Innovation Lab, Oculus Rift Virtual Reality, and 3D printing). All of this is made accessible, searchable, and easily usable through our heliophysics education portal, HelioSPOTLIGHT.

**Our core team is unequaled in heliophysics education.** The award-winning Goddard Heliophysics Science Division education team has already been highly successful at creating programs that cross disciplines and missions such as Sun-Earth Days and the Space Weather Action Center, and the many years working together have molded an excellent, cohesive team. It is composed of active scientists, educators, and technologists, all of whom have a deep passion for education and public engagement and many years of experience.

**Goddard is the right place for coordination of the Heliophysics education program.** It is the premiere heliophysics research center in the world and has connections to nearly all of the heliophysics missions. It also has excellent research programs in Astrophysics, Earth Science, and Planetary Science, making it an ideal place for projects and products that span the entire Science Mission Directorate.

**We have set up an extensive and highly qualified set of partnerships.** The HEC provides collaborative partnerships both within SMD and with external organizations including technology firms (Google), professional societies (e.g, International Society for Technology in Education and American Association of Physics Teachers), community groups (e.g., Astronomical League and AARP), universities (e.g., University of North Texas), school systems (through National Science Teachers Association and NASA Office of Education), informal education venues (e.g, Museum of Science Fiction and Houston Museum Natural Science), other NASA directorates and government agencies (through NASA Earth to Sky). For a full list of partners, see Section xxx.

The HEC is focused to address the four NASA science goals:

**(1)** We will enable and advance STEM education through formal education in K-12 and college by combining the best pedagogy with NASA unique content and subject matter experts. Our higher education partners DC and Montana Space Grant, University of Alaska Fairbanks, University of North Texas, and Harvard Smithsonian Astrophysical Observatory serve as both dissemination nodes and testing laboratories for new undergraduate curriculum modules. These plans are also supported by leaders in science education research: the National Science Teachers Association, International Society for Technology in Education (ISTE), and the University of North Texas.

**(2)** We aim to improve U.S. scientific literacy through a variety of informal education tools, including Aurorasaurus, Radio Jove, Earth to Sky training modules, space weather kiosks and video walls. This will be supported by our informal education partners: NASA Museum Alliance, Earth to Sky, Maryland Science Center, Museum of Science Fiction, and the Goddard Visitor Center, which have regional/national reach and experience to integrate and disseminate such programs to diverse audiences across the nation.

**(3)** We will leverage our efforts through preeminent partnerships that are selected for their ability to drive high-risk technology solutions, and to quickly research, develop, and disseminate cutting edge products and programs.

**(4)** We will advance national education goals. The first three goals are already naturally addressed in the first three NASA Science Goals. We address the final national goal to Better Serve Groups Historically Underrepresented in STEM fields through our partnership with the National Society of Hispanic Physicists (NHSP) and the Indigenous Education Institute (IEI).

We will develop and implement researched based professional development models that embrace audience diversity and conduct internal evaluation and longitudinal studies into educational technology and pedagogical methods. Dissemination of research-based best practices through professional associations such as NSTA and ISTE, AAPT with webinars, seminars, conferences and distributed curricular units; NASA education avenues and events; and university-based programs such as in-service teachers returning for masters degrees or STEM Educator Certification, and pre-service teacher education. The results will be presented at national science, technology, and education conferences and made available through our national network partners and enabling IT applications.

To reach life long learners we propose to take advantage of proven techniques using video and podcasts. We will be creating a series of dynamic minute-long educational videos in the style of the YouTube channels MinutePhysics or Numberfile that have been shown to find captive audiences. We also plan a podcast that interweaves the history of studying our sun with the building of Solar Probe Plus – the first spacecraft built to go right into the sun's atmosphere. Our Lifelong Learning partners AARP, National Public Radio – "Science Friday," and the Astronomical League work together to bring such content to millions across the country.

The Heliophysics Education Consortium is designed to be an incubator for new approaches and ideas, leveraging our partners' capabilities and quickly and continually communicating successful approaches throughout the consortium. It is flexible in design, optimized to both enhance and extend existing education programs and to invite new players into the consortium to take full advantage of our significant shared resources, science and technology acumen, and partnerships.

A theme running through our entire proposal is a heavy focus on the use of current technology and research-based educational technology applications. Internationally recognized technology partners such as Google provide a real time window into quickly evolving technology applications such as Virtual Reality, robotics, remote viewing, data analytics, cloud computing, and web services. Our proposed team, lead by heliophysicist Alex Young, supported by Project Manager Lou Mayo, and Chief Scientist, Eric Christian, have, collectively over 100 years' experience with NASA missions and mission science. We leverage this experience to

reach out to missions, sub orbital balloon and rocket experiments, and research programs to identify the science objectives, discoveries, and education capabilities of each utilizing our networks of NASA missions and mission scientists, professional societies such as AGU, and our university and college networks and will integrate their exciting stories of discovery into an integrated, national impact, science theme driven program. We will contact, invite, and communicate with mission personnel to facilitate their participation in all of our coordination and integration activities, bringing them into a broad and growing heliophysics education community. By doing this, we will greatly enhance capabilities and impact for these groups by integrating their stories into a large compendium of existing, evolving, and now integrated national impact education program and best practices. The HEC will:

• Take full advantage of our existing relationships with NASA missions and education partners to maintain and build our community of stakeholders through regular monthly communications/ meetings, annual face to face meetings, event driven (e.g., mission and celestial events) communications, HelioSPOTLIGHT website, annual "Big Events," social media, and the establishment and work with a community Board of Advisors.

• Provide active and continual infusion of new ideas, approaches, technologies, and products through our Education Technology Incubator and Educational Research Incubator programs.

• Research current products and programs to ensure mission discoveries are well represented and communicated.

• Conduct evaluations and assessment surveys to ensure mission discoveries are well represented and communicated.

• Provide access to national resources and dissemination infrastructures so that all missions can have greater impact and contact with our target audiences.

• Mentor mission personnel who might feel isolated from the overall heliophysics effort and connect them to the larger heliophysics education community.

• Conduct joint strategic planning at annual meetings to establish common goals for future joint programs with other partners within heliophysics.

• Develop goals and priorities from the heliophysics community decadal survey and fold them into current and planned educational programs such as Sun-Earth Days.

• Provide professional development opportunities in urban, rural and virtual environments

• Develop outcome-based metrics for professional development models, as well as follow the progress of end users for 3-5 years to fully determine the success of program(s).

The Heliophysics Education Consortium will enable NASA's Science Mission Directorate to tell an integrated, coherent, and science driven story through the eyes of NASA to the hearts and minds of our nation.