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The physics honor society

Sigma Pi Sigma Chapter Project Award Proposal

Project Proposal Title	**Aggie Physics Collaboratory (APC): A Cross-Disciplinary Student Research Incubator at an HBCU**
Name of School	**North Carolina Agricultural and Technical State University**
Sigma Pi Sigma Chapter Number	**4819**
Total Amount Requested	**$2,000.00**

Abstract

The Aggie Physics Collaboratory (APC) is a chapter-wide, student-led research incubator uniting NCAT SPS members across astrophysics, biophysics, materials science, quantum, nuclear, and climate physics. APC provides centralized equipment, research training workshops, and collaborative project space for multiple student teams to investigate real scientific questions. The yearlong program culminates in an SPS-sponsored "Aggie Physics Research Showcase" open to faculty, students, and the local community. APC strengthens SPS's research culture, expands undergraduate research accessibility, and establishes NCAT as a leading HBCU hub for interdisciplinary physics research.

Proposal Statement

Overview of Proposed Project

Brief Description

The Aggie Physics Collaboratory (APC) is a student-run, multi-project undergraduate physics research program organized under a unified Society of Physics Students (SPS) initiative. Rather than centering on a single research topic, APC establishes a shared collaborative infrastructure that supports multiple student research teams working in parallel across diverse physics subfields.

The collaboratory will provide:

- **Shared equipment and supplies**
- **Skill-building workshops (e.g., Python, LaTeX, spectroscopy, data analysis)**
- **Faculty-supported, student-led research teams**
- **Weekly or biweekly cross-team check-ins**
- **Public-facing research presentations**
- **An end-of-year SPS Research Showcase**

Goals of the Project

1. **Increase the number of undergraduates engaged in meaningful physics research.**
2. **Provide shared infrastructure and supplies that support diverse student-led research topics.**
3. **Strengthen SPS identity as a research-centered organization.**
4. **Foster a culture of scientific collaboration across physics subfields.**
5. **Generate research outputs suitable for conferences, SPS Zone Meetings, and potential publications.**

Research Groups Included (Model Structure)

The Aggie Physics Collaboratory will support the following SPS sub-teams:

- **Astrophysics Group – Exoplanet modeling, TESS/Kepler data analysis, photometry**
- **Biophysics Group – Biomechanics experiments, bio-optics, diffusion modeling**
- **Materials Physics Group – Introductory E&M experiments, elasticity, thermal conduction, catalyst studies**
- **Climate Physics Group – Atmospheric modeling, radiative transfer, green infrastructure simulations**
- **Nuclear / Particle Physics Group – Radiation detection, cosmic ray measurements, computational simulations**
- **Quantum & Computational Physics Group – Quantum algorithms, simulations, and materials modeling**

Intended Audience

- **Approximately 25–35 SPS student researchers**
- **Physics majors and minors**
- **First- and second-year students exploring research for the first time**
- **NCAT faculty research mentors**
- **The local community and nearby high schools (via the Research Showcase)**

Background and Motivation

NCAT SPS has a wide range of student research interests but currently lacks a unified framework that enables cross-disciplinary projects to share resources and infrastructure. As a result, students often face barriers in accessing laboratory materials, computational tools, or research support outside of formal faculty-led labs.
The Aggie Physics Collaboratory addresses this gap by creating a centralized, student-driven research ecosystem. APC empowers students to collaboratively explore physics beyond the classroom while strengthening the SPS chapter's core mission: advancing undergraduate leadership, research engagement, and scientific curiosity.

Use of Space and Resources
While APC will not operate from a single dedicated room, the tools and resources supported by this award will be distributed across existing physics laboratories within the department building. This approach allows each research group to work in a lab environment already aligned with its subfield, while still functioning within the unified APC framework.
The award will therefore support shared equipment, materials, and computational resources that are accessible across multiple laboratories rather than centralized in one location.

Faculty Alignment and Spring–Fall Structure
Each APC research group is already aligned with a faculty member actively conducting research in that domain, ensuring appropriate mentorship and academic support for all proposed groups.
During the Spring semester, the primary focus will be on:

- **Onboarding students into research groups**
- **Introducing foundational research skills and laboratory practices**
- **Connecting students with faculty mentors**
- **Building collaborative research culture and baseline competencies**

During the Fall semester, the emphasis will shift toward student-led research projects emerging from this onboarding process. Teams will develop more defined research questions, experiments, simulations, and presentation-ready outcomes.
Specific details regarding each faculty member's active research focus at the start of the semester will be collected during the first week back. However, we can confidently confirm that all proposed APC groups will be appropriately supported.

Interim and Final Reports
Both the interim and final reports will be structured as collaboratory-wide progress overviews and will include:

- **Updates on overall program development**
- **Descriptions of student engagement and experiences within each research group**
- **Status of onboarding, training activities, and project development**
- **Outcomes achieved and challenges encountered**

Each report will conclude with a clear set of next steps, outlining how the Aggie Physics Collaboratory will continue to evolve and how student-led projects will progress.

How Proposed Project Meets the Purpose of the Award

1. **Strengthens the SPS Chapter**

- **APC builds sustained, yearlong collaboration, increasing membership and creating a culture of research excellence.**

2. **Advances Undergraduate Research**
   - **Multiple research groups will produce mid-year and final project results.**
3. **Encourages Creativity & Imagination**
   - **Each group chooses its own question; the award funds the infrastructure, not a single narrow topic.**
4. **Builds Recruitment & Retention**
   - **Underclassmen gain a low-barrier entry to real research.**
5. **Encourages Leadership**
   - **Team leads, project managers, and SPS officers gain professional research leadership experience.**
6. **Produces Shareable Outcomes**
   - **Posters, talks, Python notebooks, and publications can be shared at APS, NCAT Honors Symposium, NSBP, ABRCMS, and SPS meetings.**

Plan for Carrying Out Proposed Project

Personnel

- **Project Director: SPS Vice President**
- **Data/Computing Lead: Oversees workshops and coding support**
- **Lab Manager: Handles equipment access, sign-outs, and safety**
- **Team Leads: One per research subgroup**
- **Faculty Advisors: Physics faculty who provide guidance**

Marketing

- **SPS interest meetings**
- **Flyers in Smith Hall, Marteena, Price, NSB, and Barnes**
- **Instagram + GroupMe announcements**
- **Classroom outreach to intro physics students**

Participation

Expected: 25–35 SPS members across 6 research teams.

Project Timeline

- **January–February**
  - **Kickoff meeting**
  - **Form teams**
  - **Buy equipment and software**
  - **Begin workshops (Python, spectroscopy, etc.)**
- **March–April**
  - **Data collection**
  - **Lab experiments**
  - **Weekly team check-ins**

- **May**
  - **Mid-Year SPS Research Report**
- **August–October**
  - **Continued research**
  - **Interdisciplinary meetings**
  - **Poster drafting**
- **November**
  - **Final SPS Aggie Physics Research Showcase**
  - **Submission to conferences**
- **December**
  - **Final internal report**
  - **Planning for Year 2**

Project Evaluation Plan

Success will be measured through:

Quantitative Metrics

- Number of student researchers
- Number of teams completing projects
- Number of posters, reports, or presentations
- Participation in conferences

Qualitative Metrics

- Surveys evaluating research experience
- Faculty mentor evaluations
- Reflection documents from team leads

Long-Term Metrics

- Increased SPS membership
- Increased retention of physics majors
- Increased participation in faculty research labs

Budget Justification

The $2,000 budget supports shared equipment, essential research materials, computing resources, and final presentation costs.

Shared Research Equipment ($900)

- **Optical breadboard materials**
- **Laser pointers + optics kits**
- **Arduino sensors (pressure, temperature, motion)**
- **Radiation detector (Geiger counter)**
- **Solar irradiance sensor**
- **Small telescopic mount / photometry equipment**

  These resources allow all sub-teams to use common equipment.

Consumables & Materials for Experiments ($450)

- **Sample materials (metals, plastics, catalyst surfaces)**
- **Biophysics gels, diffusion media**
- **Batteries, wiring, breadboards, adhesives**
- **Weather sensors, humidity probes**
- **Cloud chamber materials**

These support hands-on experiments across subfields.

Software, Cloud Storage & Data Tools ($300)

- **Python library add-ons**
- **Cloud storage for modeling results**
- **SciPy/Mathematica student licenses**
- **Data hosting for Showcase website**

Workshops, Printing & Outreach ($200)

- **SPS Research Showcase poster printing**
- **Programs/booklets**
- **Snacks for workshop events**

Contingency ($150)

- **Unexpected equipment replacement**
- **Additional experiment supplies**

Every line item directly strengthens undergraduate research opportunities within SPS.