Well formatted header and topic sections

ILLINOIS SPACE SOCIETY

SEDS Spring 2026 GRANT PROPOSAL

Micro-G NExT and Spaceshot Rocketry

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MICRO-G NEXT AND SPACESHOT

Updates on previous funding (if received) are **required**

I. FALL UPDATE

The Spaceshot team experienced a record-breaking and successful semester this past fall after receiving SEDS funding. The primary focus of the term was the successful launch of our onboarding rocket, which is the first flight of the semester designed to give all interested members the hands-on skills in the Spaceshot environment and workflow. This fall saw our highest recruitment in our history, with 101 members participating in launch operations on launch day. The vehicle used for this mission, LUNA (Launch Unit for Novel Architectures), reached an apogee of 13,145 feet, or 4.01 km. This rocket set several records, as it was our first composite onboarding vehicle and our first successful two-stage onboarding rocket. Overall, the LUNA project allowed us to teach a record number of students about multi-stage rockets and composite manufacturing.

This update proves that their previous project provided extensive value to their students

Since the LUNA launch, the team has moved into several ongoing student researched and designed (SRAD) projects. We are currently working on an aluminum fin can project that implements new bonding techniques, in addition to new design work on testing stands. Our Avionics subteam is continuing development on MIDAS. The LUNA flight marked the 8th successful launch of the MIDAS MK2 architecture, which is an entirely student-designed system. We are also iterating on our SRAD recovery system, TBHBR (Tolberone Hard Body Reefing system). This flight was the second successful deployment of the TBHBR system, confirming its reliability for future missions.

Operational safety and community growth are also top priorities for Spaceshot. We are currently working with Aerospace Professor Gonzalez to refine our safety protocols and ensure our documentation meets professional standards to support future launches. Additionally, we are collaborating with other rocketry groups on campus, such as liquid rocketry and electric propulsion to share safety resources and expand interest in engineering and space across the university.

Strong overview of activities since receiving previous funding

Figure 1 (Top Left): Spaceshot's LUNA rocket right off launch; Figure 2 (Top Right): Student adjusting settings with SRAD SAM Turret tracking the rocket using an antenna; Figure 3 (Bottom): Full group photo on launch day.

Well placed and formatted images

II. ABSTRACT

The Illinois Space Society (ISS) is a technical and research-based student rocketry organization at the University of Illinois at Urbana-Champaign. The society is a chapter of the Students for the Exploration and Development of Space (SEDS), a non-profit organization dedicated to promoting space exploration and developing future leaders through engineering projects.

Since the beginning, our mission has been to connect a network of space enthusiasts and industry professionals, serve our community through educational outreach, and provide our members with resources that will assist them in pursuing their dreams in the field of space exploration. We actively foster an inclusive environment by partnering with campus organizations related to minorities in engineering and other diverse student groups across the university to promote representation across all majors and genders.

Detailed introduction and mission statement

Each and every day, ISS members are working on incredible and innovative projects, whether it be launching a high-powered rocket, designing a lunar lander, presenting a paper at an international conference, or inspiring our same passion for space within the next generation of students. We regularly volunteer at local high schools and host students on campus for hands-on learning experiences in engineering across young people from all backgrounds.

This semester, we are interested in securing funding for two technical projects within ISS. The first fundable team is our Micro-G NExT team. This group participates in the NASA Micro-g Neutral Buoyancy Experiment Design Teams (Micro-g NExT) challenge, which tasks students with designing, prototyping, and manufacturing specialized tools for astronauts to use during upcoming Artemis missions to the moon. Each year, the team selects a specific NASA challenge and undergoes a rigorous engineering design process to solve it.

Detailed list of past successes

Since 2014, ISS has represented the University of Illinois in this competition and has been selected as finalists every year. Once a design is selected, the team manufactures a functional prototype to be tested at the Neutral Buoyancy Lab at the Johnson Space Center in Houston, Texas. The team's notable achievements include a tool design selected for presentation at the International Astronautical Congress with the Hans Von Muldau Team Award for Best Team Project in 2019, a 2022 prototype that was acquired by NASA for display in a museum, and a 2025 prototype awarded third place for Best Undergraduate Paper at the AIAA Student Regional Conference. Most importantly, this month, the team was successfully selected to move on in the competition as a finalist in the NASA competition.

Explanation of value to organization

The Micro-G team provides members with hands-on experience in the full systems development and engineering lifecycle including technical writing, research, and fabrication through 3D printing and professional machining. This process includes brainstorming and research, extensive modeling and assembly in CAD software, and a formal proposal presentation to NASA officials. The ISS Micro-G NExT team functions without permanent sub teams, creating an interdisciplinary experience for members. ATHENA leadership is composed of 5 members, including an overall Project Lead, a Technical and Manufacturing Lead, a Research and Testing Lead, a Communications and Outreach Lead, and an Undergraduate Technical advisor. Working alongside undergraduate leadership is a faculty advisor who serves as a subject matter expert and reviewer. The Micro-G faculty advisor for the 2025-2026 school year is Professor Lee Clemon.

The second fundable project is Spaceshot. Spaceshot's mission has been to develop a rocket to reach the Kármán Line, the official boundary of space. The goal has been constantly worked towards through competitions. In recent years, we've competed in the Spaceport America Cup, formerly known as the IREC, securing rankings of 6th in 2019, 4th in 2021, and 2nd in 2023 (out of 158 teams). In 2024, the team traveled to the Mojave Desert to participate in the unlimited altitude division of the Friends of Amateur Rocketry (FAR) competition. Their two-stage rocket Kairos II reached 44,165 feet or approximately 8.3 miles–breaking the previous Illinois record set in 2016. The team took second place in the FAR competition, only 8 points away from first. This past summer, the team returned to FAR to launch a new vehicle *Aether II*, and broke the University altitude once again to 75,124 feet. Spaceshot is divided into 3 main teams - Structures, Avionics, and Recovery. Within these three teams, there are 6 total

Concise overview of funding requests

Clear leadership structure

subteams - Structural Design & Analysis (STR), Fabrication (STR), Electronic Hardware (AV), Guidance Navigation & Control (AV), and Avionics Structures (AV). All the subteams are led by a subteam lead who reports to the hierarchy above them in Spaceshot's leadership. The FAR Rocketry Team faculty advisors are Aerospace Professor Gonzalez and John Williams.

III. MICRO-G NEXT PROJECT MOTIVATION

Proof of significance and impact of project

The main objective of the Micro-G NExT team is to design specialized mission hardware for NASA as part of the Artemis lunar missions. At the beginning of the year, NASA identifies 2 key technological shortfalls for the nationwide Micro-G NExT competition, and teams first select which problem they will address.

Next, the team undergoes a rigorous ideation process, working together to make sure their tool minimizes hazards for crew members/users and complies with strict Neutral Buoyancy Laboratory policies. One example of a hazard teams must account for is pinch points. Since astronaut safety hinges on space suits providing protection from the harsh environment of outer space, it is imperative that suits are not damaged when using tools. A suit could potentially get caught in a pinch point and tear, which would most likely be fatal in the vacuum of space. As part of Micro-G, teams learn the importance of identifying hazards and choosing mitigation methods. For this hazard in particular, teams must either develop mechanisms without pinch points, make sure pinch points are located far away from the actuation mechanism, or create a housing for pinch points that ensure astronauts will not come into contact with them. Each of these choices can be evaluated based on how it affects other requirements, with typical concerns including increased mass, increased complexity, and increased cost of manufacturing. Every choice that members make must be intentional, as the team must document and defend their reasoning in major deliverables such as the proposal, PDR, and final presentation at NASA. This aspect of Micro-G prepares members to balance complex stakeholder requirements with key design drivers and back up engineering decisions with defensible research and testing.

The next major aspect of Micro-G is the proposal. Strength and completeness of the proposal significantly determine whether or not the team will be selected as competition finalists, so there is a notable emphasis placed on crafting a professional grade proposal. At the beginning of this stage, ISS Micro-G team members receive training in technical writing from Micro-G leads. They are then able to build upon this skill by applying it directly to the real-world project. This year's proposal was comprehensive and totaled 52 pages, and past years have been of similar lengths.

Another skill that is integral at the proposal stage is CAD design. The team must submit proof of concept for their tool in the proposal, which allows members to learn about 3D modeling as an efficient way to communicate designs. This also serves as a basis for FEA and hand calculations of stress and strain, answering key proposal questions about the tool. Our team utilizes CAD software, specifically Siemens NX, to model and assemble a full picture of the design. NX is used because it is a widely used industry tool, and gives members a realistic experience of professional CAD work while building a legitimate skill that is recognized by industry professionals. Another important skill that members build is communication. The ideation process involves discussions and 2D sketches of the design, but CAD is the first time when members are able to view the project with a 3D representation. Members must communicate effectively as a team in order to ensure that there is a consistent understanding of the design. Another important application of communication skills within Micro-G is part interfaces. Since parts must fit together during manufacturing and testing stages, members learn and apply the skill of tolerancing to make sure that assembly will go smoothly. In creating CAD models of original parts and mechanisms, members practice spatial visualization skills and learn how to determine optimal dimensions for parts.

After the proposal is submitted the team transitions to manufacturing. The UIUC ISS Micro-G team prides itself on consistently prioritizing in-house manufacturing methods to build its tools, which is done mainly to give members hands-on experience with hardware and manual prototyping methods. Members are given the opportunity to learn the skills of 3D printing, waterjet, drill press, and more. The ISS Micro-G NExT team utilizes on campus resources to complete manufacturing (such as the Siebel Center for Design), which offers students training and certification in tools that could be used for personal projects that further their careers. The team also is responsible for choosing materials for their parts (optimizing for cost, strength, and durability), which provides an important exercise in the business side of engineering. Through this, members are better equipped to understand and solve problems on interdisciplinary teams in industry projects.

Before the team is able to bring the design to Houston, testing is carried out to make sure the tool works as intended. Teams are given requirements that tools must meet as conditions of the challenge, but are not explicitly given instructions on how tools must meet those requirements. In order to test their unique solution, the team comes up with testing protocols featuring testing matrices and structured data collection plans. These testing protocols will later be handed off to Neutral Buoyancy Laboratory divers and are responsible for keeping divers safe while using the tool. These protocols must be carefully worded in such a way that people outside of the project will be able to understand the meaning immediately, once again emphasizing the importance of good technical communication. The experience of generating testing protocols gives members valuable insights into the fields of testing and safety engineering.

Through the Micro-G competition, we provide members with an opportunity to design meaningful tools for future missions and cultivate a number of skills including but not limited to technical writing, human centered design, research, design iteration, professional presentation, and teamwork. All of these prepare members for success in the industry.

Shows strong opportunity for student engagement and value

IV. MICRO-G NEXT PROJECT DESCRIPTION

This semester, the Micro-G team is manufacturing ATHENA, the Adjustable Tool-cart Handle for Efficient Navigation (Figure 4), a project recently selected by NASA as one of only six finalists for the Adjustable Tool Cart Handle Challenge. For this challenge, teams are tasked with building a height-adjustable system designed to accommodate the 1st and 99th percentile astronauts to comfortably traverse the lunar surface during Artemis missions. To meet these goals, ATHENA features two sets of handles and 2 adjustable mechanisms to mitigate potential fatigue sustained from pushing a cart from one handle position. The team is structured with a member first approach, meaning that members of the team have ownership over individual parts/mechanisms and have been able to follow them and be directly involved with that specific part from ideation to manufacturing. This allows newer and non-lead members to gain hands-on experience from the beginning of the project, and enriches their career readiness in specific and identifiable ways.

Detailed and relevant imagery

[Insert Image of ATHENA CAD Model]

Figure 4: Comprehensive CAD model of ATHENA

The design process for ATHENA has thus far included the development of custom ergonomic grip interfaces, precision manufacturing of structural components using waterjet technology, and iterative testing of prototypes to ensure reliability. Currently, the team is moving from a half-scale, 3D printed model to a full-scale assembly while preparing for a Preliminary Design Review with NASA engineers. Multiple tests are planned to verify and validate the design before travel to Houston, including a gym/weight test for handle ergonomics, a pool test to simulate Neutral Buoyancy Laboratory conditions, and movement tests where ATHENA will push/pull a weighted cart on various inclines and terrain. The team is also actively committed to community initiatives, such as hosting rover coding challenges for preschool and elementary school students at the local library, volunteering at university space-specific outreach events such as Illinois Space Day, and developing interactive aerospace exhibits for the UIUC Engineering Open House to demonstrate their design and engage with the community.

V. MICRO-G NEXT TIMELINE

Well formatted and detailed timeline

[Insert image of team timeline (GANTT chart)]

Figure 5: Micro-G NExT Team Timeline

VI. MICRO-G NEXT BENEFITS AND IMPACT

Section devoted to explanation of short-term and recurring impact

The primary benefit of the Micro-G team is the opportunity for students to engage with the full development cycle of a mission design project, more specifically a NASA engineering project. This process allows our members to apply critical thinking and research skills to a specific, real-world problem in the Artemis missions. By working through the format of real NASA, members become comfortable with using the language of the space industry and gain an in-depth understanding of the roles of industry engineers. These experiences prepare our members to enter the design aspect of the engineering workforce at a highly skilled level.

Our history of success demonstrates the long-term impact of this project on our organization. Since 2014, the Illinois Space Society has been selected as a finalist in the Micro-G NExT competition every single year. This consistent record has led to several significant accomplishments, including our 2025 design being awarded 3rd Place for Best Undergraduate Paper at the AIAA Student Regional Conference.

While we have been successful in reaching the finalist stage again this year, the transition from a design proposal to a physical prototype requires significant financial resources. Grant funding from SEDS would be instrumental in helping us move forward into the official manufacturing process. Securing these funds would allow us to obtain optimal materials for our prototype that will be directly featured in our final presentation at the Johnson Space Center. With this grant, we believe that we can establish the foundation to maintain our excellence in the Micro-G NExT challenge.

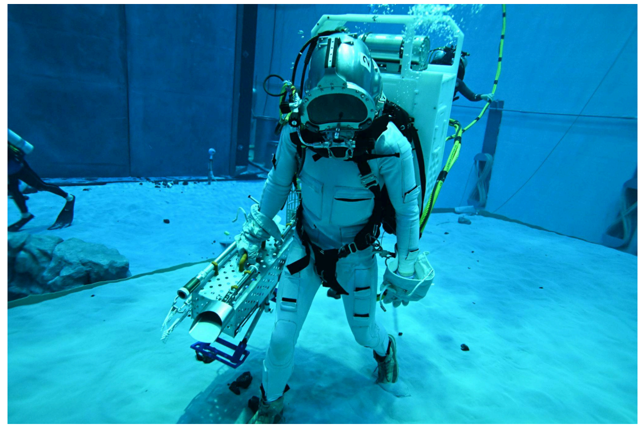

Figure 6 (Left): Micro-G team presenting at Johnson Space Center in 2024; Figure 7 (Right): Simulation of tool in Neutral Buoyancy Laboratory in 2024.

VII. SPACESHOT PROJECT MOTIVATION

Same attention to detail, formatting, and strong evidence continues for second funding request item

The main objective of our rocketry team is to reach the internationally recognized boundary of space and Earth at 330,000 feet, the Kármán Line. As a result, we've expanded beyond Commercial-Off-The-Shelf products and started to develop our in-house components, including fin cans, nose cones, altimeters, tracking systems, ejection systems, and more.

Our structures team builds student-researched and designed (SRAD) fin cans using composites like fiberglass and carbon fiber. Fin geometry is traded in-house by our design team, and manufacturing is completed by our fabrication team. Fabrication does both wet and prepreg layups over carbon fiber plates in order to build a vehicle capable of withstanding high mach flights and bringing us closer to space.

Our recovery team designs and builds our in-house reefing system, which allows our parachute to change in area depending on the flight regime. Our Tolberone Hard Body Reefing system (TBHBR) was engineered entirely by our team and has had great success in our flights, allowing us to continue shrinking our vehicle size while still recovering it reliably.

Our avionics team builds our world-class avionics bays with our in-house altimeter, MIDAS. MIDAS is designed and programmed in-house and has been successful in firing recovery and staging events for our vehicles. MIDAS is also an extremely accurate tracker during recovery efforts, leading us to many rockets, often over 20 miles away. We also develop a live video system in-house, allowing us to view our vehicle's status from the ground while it flies.

With student research and development on many of our rocket's components, we empower our students to extend their technical and hands-on knowledge beyond the classroom environment. Our vision is to educate our members so that they can apply real-world techniques to challenges associated with high-altitude environments.

VIII. SPACESHOT PROJECT DESCRIPTION

This semester, Spaceshot plans to design and build *Aether III*, a continuation of the *Aether* class vehicle flown at FAR last year and the current altitude record holder. With a current predicted max altitude of 120,000 feet, the team plans to continue pushing for higher altitudes and developing the systems necessary for future space attempts. This includes increased loading and aerodynamic capabilities of our fins, attention to the structural integrity of our nose cone under aerothermal loading, development of compact and durable recovery systems, and continued development of altimeters and advanced tracking systems, like our SRAD altimeter MIDAS and Extended Kalman Filter, to confirm altitude readings when the atmosphere is thin.

[Insert CAD image of rocket]

Figure 8 (Top): Visual representation of *Aether II* rocket in OpenRocket software; Figure 9 (Left): Spaceshot's *Kairos* rocket right after launch; Figure 10 (Right).

IX. SPACESHOT TIMELINE

[Insert image of team timeline (GANTT chart)]

Figure 13: Spaceshot Team Timeline

X. SPACESHOT BENEFITS AND IMPACT

The primary benefit of Spaceshot is its ability to provide hands-on technical work and real-world experience designing and building high performance rockets. Members can decide what aspect of the rocket they want to contribute to, ranging from E-Hardware in Avionics all the way to Structural Design & Analysis in Structures. The variety of projects that Spaceshot offers helps them gain invaluable exposure where they apply theories learned in the classroom, and even learn concepts not covered in their academic journey. Learning skills like ANSYS finite element analysis, RasAero, schematic design, C++, composite manufacturing, computer-aided design, and more within ISS prepares its members to enter the workforce as highly skilled and adaptable professionals, ready to leave an impact in the broader field of space exploration.

Grant money is not a one-time investment either; rather, it forms the foundation upon which a series of invaluable experiences are built. During the 2021 to 2022 season, we faced a challenge when a commercial motor malfunctioned, resulting in the destruction of the airframe. While disappointing for the team, these failed flights provided an excellent opportunity to learn recovery reefing, strong fin-can manufacturing, carbon fiber fabrication, failure analysis, etc. In 2023-2024, the team learned from our past experiences and conducted extensive structural testing to ensure that the components could withstand estimated competition loads. In both October and March, the team successfully test launched Intrepid III, the third iteration of this competition rocket to 15,000 ft. These test launches provided data for recovery and avionics teams to assess subsystem performance, such as the parachute reefing systems and live telemetry feed. At Spaceport America Cup 2023, we placed 2nd in the COTS (Commercial Off The Shelf) 30,000 ft category, after successful flight, recovery, and data acquisition. Many points were also earned through poster conference sessions, a technical report detailing design and development of Intrepid III, and presenting subsystems to ESRA judges. Following Spaceport America, the team pivoted to launching at the Friends of Amateur Rocketry launch site, where the team placed 2nd in the FAR-UNL competition in 2024 and broke the university altitude record twice, first in 2024 and again in 2025. The team is hoping to continue pushing higher and closer to the Kármán Line with more flights at FAR and Black Rock, Nevada this year. These launches are extremely costly to the team, and none of this would have been possible without the funding and support we have received from SEDS from the previous years.

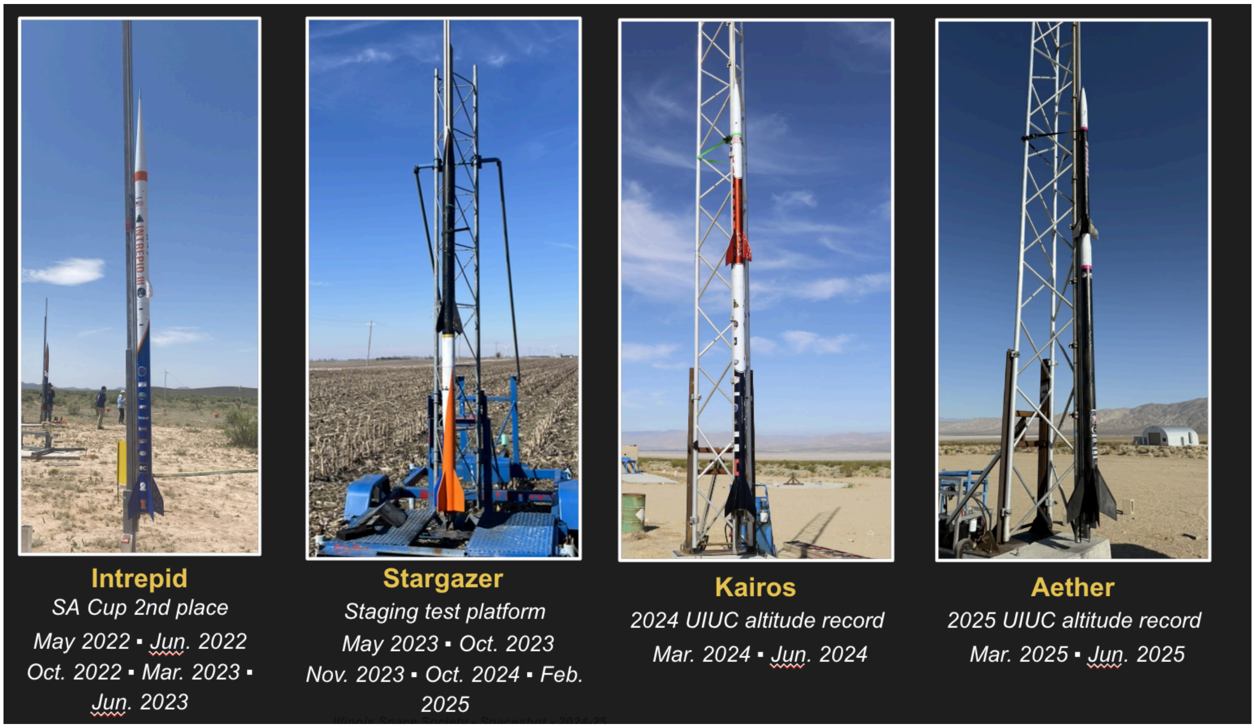

Figure 14: Major Spaceshot summer rocket launch history.

XI. BUDGET AND FUNDING

Because our tool is student-researched and designed, the majority of our budget is dedicated to buying off-the-shelf components and supporting fabrication processes. By providing the resources to fully manufacture this project without financial concerns, we enable our members to gain experience in the physical assembly. The budget list (Table 1) below provides a detailed breakdown of the cost for each item.

Product descriptions, links, quantities, and total cost provided

Table 1: Budget list for Micro-G prototype manufacturing

Component	Quantity	Cost (USD)
Example Product w Link	2	$0.00

Micro-G NExT Total Cost:	-	$0.00

The AeroTech N2700 is a motor required for Spaceshot's spring subscale launch. This motor will allow Spaceshot to test components on a smaller scale in order to validate them for higher Mach and altitude flights, like our summer launch. This motor will be flown with student-researched and designed fin cans, altimeters, tracking systems, and recovery systems. The cost of this motor is expensive for the team to completely cover and being provided the funds to acquire these motors allows our team to continue progressing and growing our members' rocketry knowledge and skills. The budget list (Table 2) for the Spaceshot is shown below.

Justification of budget items

Table 2: Budget list for Spaceshot motor

Component	Quantity	Cost (USD)
Example Product w Link	1	$0.00
Spaceshot Total Cost:	-	$0.00

Table 3: Budget list for Micro-G and Spaceshot total

Component	Quantity	Cost (USD)
Total Cost:	-	$0.00

We understand that the total cost of both projects reaches over the chapter limit (Table 3); however, we would like to request the full [PUT TOTAL REQUEST AMOUNT] to cover a majority of the expenses.

<u>Total Funding Request of Spaceshot and Micro-G NExT: $[TOTAL REQUEST]</u>