High Altitude Student Platform

Call for Payloads 2022

Issued October 20, 2021 by

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and

Balloon Program Office
NASA Wallops Flight Facility
Wallops Island, VA

Q&A Teleconference: November 12, 2021
Notice of Intent: November 19, 2021
Application Development Teleconference: December 17, 2021
Application Due: January 07, 2022

I. Introduction

The High Altitude Student Platform (HASP) was originally conceived to provide students with flight opportunities that are intermediate between those available with small latex sounding balloons and Earth orbiting satellites. HASP is a support vehicle developed with flight-proven hardware and software designs that uses an 11 million cubic foot, thin film polyethylene, helium filled balloon to carry multiple student built payloads to altitudes of ~120,000 feet (~36km) for durations up to 20 hours. The HASP platform is currently designed to support eight small payloads of ~3 kg weight and four large payloads of ~20 kg weight (i.e. 12 experiment "seats"). A standard interface is provided for each student payload that includes power, serial telemetry, discrete commands, and analog output. HASP will archive student payload data on-board as well as telemeter the stream to the ground for real-time access. **See the HASP website (https://laspace.lsu.edu/hasp/) for further information.**

Construction of HASP was supported by the Louisiana Board of Regents, the Department of Physics and Astronomy at LSU, and the Louisiana Space Grant Consortium (LaSPACE) program. The NASA Astrophysics Division of the Science Mission Directorate, the NASA Balloon Program Office, Wallops Flight Facility, and the HASP Management team have committed to supporting one HASP flight per year through 2025.

This Call for Payloads (CFP), jointly issued by the HASP Management team and the NASA Balloon Program Office (BPO), solicits student groups to apply for a "seat" on the 2022 HASP flight. To apply, student groups will need to develop a proposal describing their payload, including science justification, principle of operation, team structure and management, as well as full payload specifications of weight, size, power consumption, mechanical interface, data requirements, orientation preference, and initial design drawings. This application is solely for a seat on the HASP platform and not for financial support for student teams. The costs of hardware development and testing, travel to Palestine, TX and/or Fort Sumner, NM for interface verification and flight operations or any other student payload or team expenses are **not** covered by this application (see section XII).

This application must be submitted on or before January 7, 2022. A Notice of Intent form will be due on November 19, 2021 for all groups considering a proposal for HASP 2022. A teleconference to answer general questions about the HASP program and application process will be held November 12, 2021. A second teleconference on December 17, 2021 has been added to assist participants and answer any questions they may have as they are completing their applications. Preference will be given to payloads that are clearly demonstrated to be designed, built, and operated by students. Notification of selection will occur at the end of January 2022. The remainder of this document describes the HASP system, student payload interface, anticipated program schedule, and how to prepare and submit your application.

II. Call for Payloads Summary

Q & A Teleconference:	**November 12, 2021**
Notice of Intent:	**November 29,2021**
Application Development Teleconference:	**December 17, 2021**
Application due date:	**January 7, 2022**
Submit e-mail PDF version of application to:	hasp@lsu.edu
Application contents:	See Section X

III. The HASP Website

The website for the HASP program can be found at https://laspace.lsu.edu/hasp/. This website contains details about the overall program, brief descriptions of payloads that have flown on previous missions, news announcements, a calendar of events, document templates and technical documents. During a flight, the website also provides access to real-time imaging, positional tracking of HASP, housekeeping status information, plus datasets downlinked from the student payloads. It is recommended that you review the information on the HASP website as you develop your flight application.

IV. HASP Description

Figure 1 shows an image of HASP prior to the 2006 launch with student payloads integrated. The four large payload positions are on the top of the central structure while the eight small payloads are mounted on fiberglass outrigger booms. The small payloads may be mounted for nadir pointing. The core structure of the platform is a welded aluminum gondola frame with dimensions of 112 cm long, 91.5 cm wide, 51 cm tall. For flight, HASP is attached to the Columbia Scientific Balloon Facility (CSBF) Frame (see Figure 2) which provides support for the CSBF vehicle control equipment and attach points for suspension cables, crush pads, and the ballast hopper. Suspension cables run from each of the four corners of the CSBF frame to a pin plate that attaches to the flight train. The CSBF control equipment provides control over the balloon systems, as well as HASP uplink and downlink telemetry.

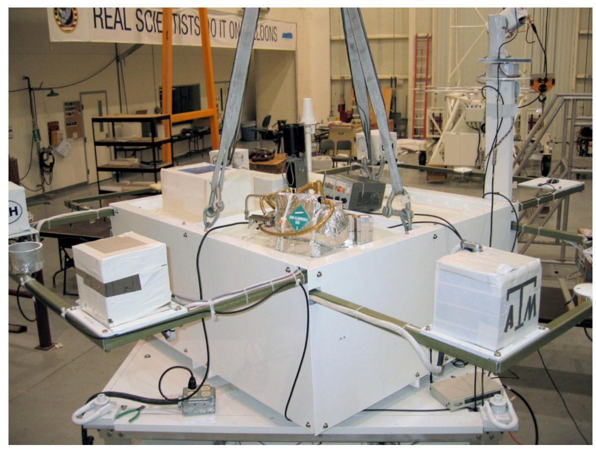

Figure 1: The HASP configuration

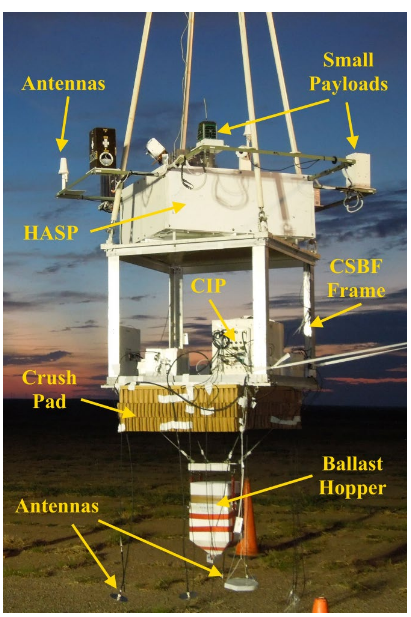

Figure 2: The HASP flight configuration

The CSBF equipment passes uplinked commands to and downlinked telemetry from the HASP control system, which consists of the Flight Control Unit (FCU), the Serial Control Unit (SCU), and the Data Archive Unit (DAU) with associated on-board data storage. The hardware design and controlling software for the FCU, SCU, and DAU were developed under the NASA supported Advanced Thin Ionization Calorimeter (ATIC) long-duration balloon project at Louisiana State University and have been adapted to HASP. Also mounted in the interior of the frame are lithium cells that supply power to the HASP systems, student payloads, and some CSBF electronics. Solar shields are mounted on the core frame to maintain the electronics and battery temperature as well as to thermally isolate the CSBF equipment from the rest of the HASP components.

Attached to the core structural frame are four composite material braces that are used to support eight small student payloads. Each brace extends about 55 cm away from the aluminum frame and supports two small student payload mounting plates. These braces minimize interference between the metal frame and any student payloads that may exercise data transmitters during flight, as well as maximize the unobstructed payload field of view (FOV). Mounting plates for four large student payloads are located on the top of the HASP aluminum frame structure. Specific details about the payload mounting plates and the student payload interface are provided in the next section.

The HASP **command and control subsystem** provides the means for receiving and processing uplinked commands, acquiring and archiving the payload data, downlinking status information, and controlling the student payloads. There are three primary modules in the subsystem: the Flight Control Unit (FCU), the Serial Control Unit (SCU), and the Data Archive Unit (DAU). The FCU "manages" the subsystem; decoding commands received from the CSBF supplied Mini-SIP and distributing them, watching for units that may need to be reset, and collecting status data for downlink. In addition, the FCU also monitors the power system, collects pressure and temperature information for housekeeping records, and sends the student payload serial data to CSBF control for downlink to the ground system. The SCU provides a serial communication link to each of the student payloads, including collecting a telemetry bit stream from each payload and distributing uplinked payload serial commands as appropriate. The DAU controls the on-board recording of all data to a multi gigabyte compact flash drive. The existing design, including the CSBF equipment, supports a ~36 kilobit per second downlink rate, which should be sufficient to telemeter all student payloads and overall HASP status data during the flight. During a flight, the downlinked data is made available through the HASP website. In addition, on-board recording of these same data to the archive compact flash drive is a backup in case the Line-of-Sight (LOS) link is lost for any reason.

The primary **power source** for HASP will be 11 cell lithium battery packs, eight of which will supply ~29 to 32 Volts for ~270 Ahr @ +20° C. The HASP power system closely follows the Advanced Thin Ionization Calorimeter (ATIC) experiment design so subsystem components can be readily reproduced. In this concept, the 30 V bus is run through the gondola and required voltages are converted locally. This approach simplifies the gondola wiring and minimizes power loss. Each supply in the power system includes a relay to control the flow of power via discrete on and off commands, an appropriate DC-DC converter, and voltage/current sensors that are used to monitor the state of the power system. Voltage/current sensors are also placed on the main 30 V bus. Each student payload will have similar on/off control and voltage/current monitoring, but main bus power of 30 V will be supplied, and the student payload will need to do local conversion as required. ***Note that while we refer to this power bus as "30 V," the actual supply from the batteries varies. It is closer to 32 V to 33 V at the beginning of the flight, decreasing to 29 V to 30 V toward the end.***

HASP will be flown, with the support of the Columbia Scientific Balloon Facility (CSBF), from the ConUS launch site in Ft. Sumner, New Mexico once a year in late summer. Launch will be scheduled by the NASA Balloon Program Office at Wallops Flight Facility for early morning (i.e. dawn) when surface winds are calm. The balloon will be inflated such that the ascent rate will be about 1000 feet per minute. Thus, ascent to the float altitude of about 120,000 feet will take

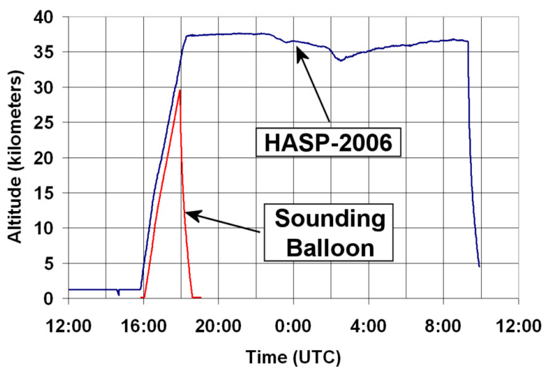

Figure 3:The HASP Flight Profile

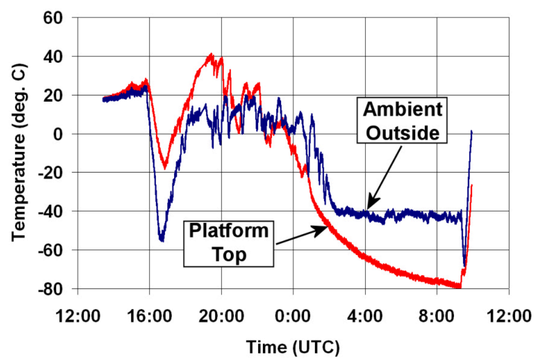

Figure 4: Typical temperatures during flight.

roughly 2 hours. The time at float will then directly depend upon the strength and direction of the high-altitude winds. Typically, the vehicle can stay at altitude for 5 to 15 hours, possibly longer under certain situations, before the flight must be terminated to parachute HASP into a safe landing zone. Recovery of the full vehicle usually takes less than one day. The actual flight profile (altitude vs. time) for the 2006 HASP flight is shown in Figure 3 (blue curve) compared with the profile for a typical short-duration latex, sounding balloon flight. Temperatures encountered during the HASP 2006 flight are shown in Figure 4. The red curve is from a sensor placed in the location of a large payload and the blue curve is the temperature at a small payload. The dip in both curves at about 17:00 is due to passage through the tropopause, but the temperature will warm once float altitude is reached. After sunset, at about 2:00 UTC in the plot, temperatures again dip to very low values. Further, at float altitude the ambient pressure is 5 – 10 millibars. Payloads must be designed to survive and operate under these conditions.

During the flight we intend to maintain LOS (line-of-sight) telemetry. The HASP ground system will receive and display the downlinked housekeeping status information and will archive the student payload serial data into disk files. Files with UTC time stamped GPS position and altitude information will also be generated. Student teams will be able to download these files from the HASP website in order to monitor their payload status in near real-time. In addition, HASP will fly a video camera system that provides real-time views of the student payloads, the balloon and the Earth during launch, flight, and

Figure 5: Live video camera view during the HASP 2019 flight

termination (see Figure 5). If your payload undergoes a visible configuration change (i.e. you have moving parts or external indicator lights), an onboard video camera can be used to monitor these changes throughout the flight. Student payloads will also have limited commanding capability during flight. This will include a limited number of discrete commands plus 2-byte serial commands (defined as desired). Prior to flight, the student team will provide HASP operations with a listing of all commands, which will then be issued upon request by HASP flight support personnel. Following recovery, copies will be made of all the flight datasets and distributed to each group for their science data analysis.

V. Student Payload Interface

Specifications for the mechanical, electrical, and data interfaces between HASP and a student payload are provided in the latest version of the document "HASP – Student Payload Interface Manual" which can be obtained from the Participant Information page (https://laspace.lsu.edu/hasp/Participantinfo.php) or the Technical Documents page (https://laspace.lsu.edu/hasp/Documentation.php) of the HASP website. It is highly recommended that you download and review this document prior to developing your payload application. A brief summary of the payload constraints and interface is provided in Table 1 and below. ***Note that the HASP Interface Manual is updated periodically. In the event of conflicting information between this "Call for Payloads" and the "Interface Manual" the most recent document should be used.***

Mechanical: HASP supports two classes of student payloads. **Small** payloads have a maximum weight of 3 kg and are located on the HASP "outrigger" braces. **Large** payloads can weigh up to 20 kg and are located on the top of the HASP aluminum frame. In your payload application you will need to indicate your payload class as either small or large. **The total weight of all components associated with your payload must not be greater than the class mass limits.** Payload groups requesting the placement of payload components anywhere other than on a designated payload seat are required to submit a special request which can be included as a part of the application and must receive a waiver granting approval from LSU HASP Management, CSBF and BPO. This approval may include additional paperwork including flight safety documentation and analysis. See section VIII for more information regarding special requests. If your application is accepted for flight, your team will be sent the payload mounting plate appropriate for your class. These plates, shown in Figure 6, are constructed from ¼" thick PVC, include wiring for the electrical /

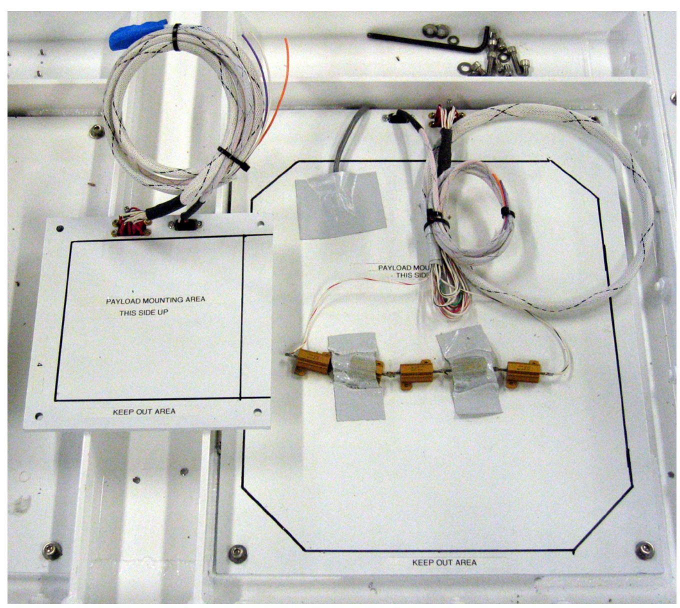

Figure 6: The small (left) and large (right) student payload mounting plates.

data connections, and are marked to indicate the allowable footprint for your payload. Student teams are not allowed to alter anything outside of the payload plate footprint including the EDAC and DB9 connectors. Within the allowed region the plate can be modified for payload support structure and, if needed, downward pointing apertures. [Note that located immediately below each large payload will be the HASP thermal and EM insulation plates, so downward pointing apertures would not be appropriate.] Note that any intrusion of any part of your payload into the "KEEP OUT AREA" might result in your payload being disqualified from flight. All components attached to the mounting plate by the student team (e.g. payload, support structure, bolts, DC converters, antennas, etc.) must be included in the weight budget and total less than the maximum allowed for the payload class. The size of the allowed footprint and payload height is given in Table 1 on the following page.

Note that the payload must be secured so that it remains intact and attached to the mounting plate under a 10 g vertical and 5 g horizontal shock. It is advised that appropriate analyses and/or test data be collected to provide evidence that your payload and mounting will satisfy this requirement.

Electrical: A twenty pin EDAC 516 (manufacture number 516-020-000-301) will be used to interface with HASP system power and analog downlink channels. Power is supplied as +30 VDC with a maximum current draw for small payloads limited to 0.5 amps, and for large payloads to 2.5 amps at all times. **Note: that the power supply to your payload is fused and exceeding the current limit stated above for any length of time could result in a blown fuse. Blowing your HASP power supply fuse at any time may result in your payload being disqualified for flight. Additionally, if a fuse is blown during flight it will be impossible to restore power to that payload.** It will be the responsibility of the payload to convert internally the +30 VDC to whatever voltages are required. In addition, two 0 to 5 VDC analog channels will be accessible through the EDAC 516 connector. These channels are digitized and transmitted by the CSBF telemetry systems every minute to provide real-time monitoring of two key payload parameters independent of HASP system operations. Discrete commands are transmitted to and routed through the ballooncraft via highly reliable systems and are generally used to control critical, basic functions. Every payload will already have one pair of discrete commands assigned to turn on and off the payload power. Some payload seats have access to additional discrete command lines on their EDAC connector available for student payload use. Small payload seats (1, 2, and 5) have access to two (2) additional discrete command lines. Small seat applicants requesting additional discrete lines must indicate this in the application and specify the payload seat they are requesting. All large payload seats have access to up to an additional four (4) discrete lines.

Data: Serial communications use a DB9 connector with pins 2 (receive / transmit), 3 (transmit / receive), and 5 (signal ground) connected. The protocol is RS232 and the port setup is 8 data bits, no parity, 1 stop bit, and no flow control. The serial port is set to 1200 baud for small payloads and 4800 baud for large payloads. *[Note that the term "baud" is used to designate the timing between bits on the serial link and is* ***not*** *necessarily your "bit rate". Your "bit rate" is determined by the amount of data (the number of bits) you are transmitting on the serial line per unit time. In addition, your "bit rate" cannot exceed the "baud" rate. For example, suppose you have a small payload and are sending to HASP a data record of 45 bytes each minute. Your bit rate would be 6 bps (bits per second) and each bit would be sent at a "speed" of 1200 baud.]* HASP will collect data from the student payload as a bit stream: listening for and receiving data

Table 1: Payload Interface Specifications (v2016)

Small Student Payloads:

Total number of positions available:	8
Maximum Total Payload weight (sum of **ALL** payload components):	3 kg (6.6 lbs)
Maximum footprint (must include mounting structure):	15 cm x 15 cm (~6" x 6")
Maximum height (may need to be negotiated with neighbor payloads):	30 cm (~12")
Supplied voltage:	29 - 33 VDC
Available current:	0.5 Amps @ 30 VDC
Maximum serial downlink (bit stream):	<1200 bps
Serial uplink:	2 bytes per command
Serial interface:	1200 baud, RS232 protocol, DB9 connector
Analog downlink:	two channels in range 0 to 5 VDC
Discrete commands:	Power On, Power Off
	(It may be possible to negotiate up to 2 additional commands; i.e. F1 on, F1 off)
Power, Analog, & discrete interface:	EDAC 516-020

Large Student Payloads:

Total number of positions available:	4
Maximum Total Payload weight (sum of **ALL** payload components):	20 kg (44 lbs)
Maximum footprint (must include mounting structure):	38 cm x 30 cm (~15" x 12")
Maximum height (may need to be negotiated with neighbor payloads):	30 cm (~12")
Supplied voltage:	29 - 33 VDC
Available current:	2.5 Amps @ 30 VDC
Maximum serial downlink (bit stream):	<4800 bps
Serial uplink:	2 bytes per command
Serial interface:	4800 baud, RS232 protocol, DB9 connector
Analog downlink:	two channels in range 0 to 5 VDC
Discrete commands:	Power On, Power Off
	(It may be possible to negotiate up to 4 additional commands; i.e. F1 on, F1 off)
Power, Analog, & discrete interface:	EDAC 516-020

until the internal buffers fill, then packaging this buffer as a record for on-board archiving and telemetry to the ground system. On the ground, the HASP records will be unwrapped and written to disk in the order the bits were received from the payload. It is quite feasible that payload records can be split across HASP buffers and that, on occasion, a transmitted packet can be corrupted. Therefore, it is strongly advised that the payload adopt a record structure of its own that includes a unique header identification, record byte count, and checksum. A suggested record format is provided in the "HASP – Student Payload Interface Manual".

It will also be feasible to uplink a two-byte serial command to your payload. Any number of two-byte commands can be defined, but each command will need to be entered into the ground system and uplinked separately by a HASP operator. As the same serial port will be used for both downlink and uplink, the payload will need to periodically check the port to determine if any commands are being uploaded from the HASP SCU. When a 2 byte command is requested by a team, the HASP operator will manually send the requested bytes with no checking on whether or not that is a valid command for that payload. Therefore, it is the responsibility of the payload to determine the validity and contents of the serial command. Uplink commanding can be unreliable, and you should minimize the number of commands you plan to use during flight. Also the command string received by the payload will contain bytes of header and footer information in addition to the 2 command bytes. It will be the responsibility of the payload to properly parse and extract the command bytes out of this string. The format of the command string sent to a student payload as well as suggestions on how to improve commanding reliability is provided in the "HASP – Student Payload Interface Manual".

We note that many student teams have a common problem with interfacing controllers such as the Arduino Mega or Raspberry Pi with the HASP serial interface. Many times, this is because the controller uses TTL levels while the serial interface uses RS232 level. Thus, you will need to "level shift" the signals between the payload controller and HASP (e.g. SparkFun Transceiver Breakout – MAX3232, BOB-11189).

Integration and Flight Commanding: Individual payload commanding during both integration and flight are handled using an interactive Google Sheets document. Each payload is given a unique account that is coded to allow that group to send command requests and other comments to the HASP Management. The HASP management team can then send the commands and update the payload group as to the command status. The entire system is both color-coded and numerically keyed to ensure that all parties are aware of the status of payload commanding.

Thermal: The HASP platform provides **no** thermal control to the student payloads. It is the responsibility of the payload developers to ensure that their experiment will remain within acceptable temperature limits. **Note:** payloads are prone to overheating at float in sunlight and freezing in darkness due to high heat input from direct sunlight and the inefficiency of convection and conduction heat transfer mechanisms in a vacuum environment.

Vacuum: During flight, your payload will need to operate at very low ambient pressures of 5 to 10 mbar. In such a vacuum, convection is not very efficient in transferring heat loads and, without adequate protection, high voltage systems can discharge and arc, which could lead to electronics damage or blowing the fuse on the HASP power supply for the payload. It is the responsibility of the payload developers to ensure that their experiment will operate correctly in a low-pressure environment.

Hazards: The NASA Balloon Program Office (BPO) and the Columbia Scientific Balloon Facility (CSBF) lists particular items that are hazardous to personnel and/or the flight systems. All potential hazards need to be clearly identified in the HASP application and, if the payload is accepted for flight, the student team must provide all documentation, testing, and risk mitigation plans required by the BPO and CSBF prior to integration with HASP. **NOTE: Several hazards are explicitly <u>banned</u> from flight on HASP and will results in application and payload disqualification if used. Table 2 lists all potentially hazardous materials and identifies them as either banned or requiring additional documentation and review prior to approval. The additional documentation details can be found in appendix B.** The list above is not exhaustive. Any hazard not explicitly disallowed, may require extensive documentation provided to NASA safety before that hazard will be allowed to fly. Further, student team leaders and faculty advisors

Table 2: Hazardous Materials List	
RF transmitters	**See Appendix B**
High Voltage	**See Appendix B**
Lasers (Class 1, 2, and 3R only) Fully Enclosed	**See Appendix B**
Intentionally Dropped Components	**BANNED**
Liquid Chemicals	**BANNED**
Cryogenic Materials	**BANNED**
Radioactive Material	**BANNED**
Pressure Vessels	**See Appendix B**
Pyrotechnics	**BANNED**
Magnets	**BANNED for field strengths greater than 1 Gauss**
UV Light	**BANNED**
Biological Samples	**BANNED**
Batteries	**See Appendix B**
High intensity light source	**BANNED**

should be aware that providing the documentation, certification, and plans required by BPO and/or CSBF for assessment of any identified hazards could consume considerable resources. It is, therefore, our advice that student teams should not incorporate any hazard identified in this section even if they are not banned. **Please see Appendix B for more information about Balloon Program Office's documentation that is required for hazards and additional payload information.**

VI. Anticipated Schedule

The anticipated schedule for the upcoming HASP campaign is illustrated in Table 3. The dates in this table are approximate and are subject to change. The payload selection for this flight will be announced at the end of January 2022. Our comments on your application, including requests for further information, will be forwarded to you shortly following the selection announcement. A response to these comments should be submitted by your team within the following two weeks. You will be required to submit a brief status report each month and participate in a monthly teleconference. The status report will be due on the last Friday of each month and the teleconference will be held on the first Friday of each month. Details about the status reports and teleconference participation can be found below under "Deliverables" (Section VII).

Figure 7: Student teams at the HASP 2017 integration and system test.

A *NASA Integration On-site Security Clearance Document* listing all participants going to the CSBF facilities at Palestine, TX for HASP integration must be provided to the HASP management team by April 29, 2022, while an equivalent document for all participants going to the CSBF facilities in Ft. Sumner, NM for the HASP flight will be due by June 24, 2022. A description of the requirements for these lists can be found under “Deliverables” (Section VII) and in the Appendix. **Note: Foreign nationals from Designated Countries will not be allowed on-site at NASA facilities. See Appendix A for the link to the US Department of State’s current list of designated countries.** The template for these lists will be available on the Participant Info section of the HASP website.

A preliminary version of the *Payload Specification and Integration Plan (PSIP)* will be due in April and a description of the document can be found in “Deliverables” (Section VII). We will provide comments on the preliminary PSIP which should then be incorporated into revisions for the final version of the document (due in June).

Figure 8: HASP and student payloads in the CSBF BEMCO chamber in preparation for thermal / vacuum testing.

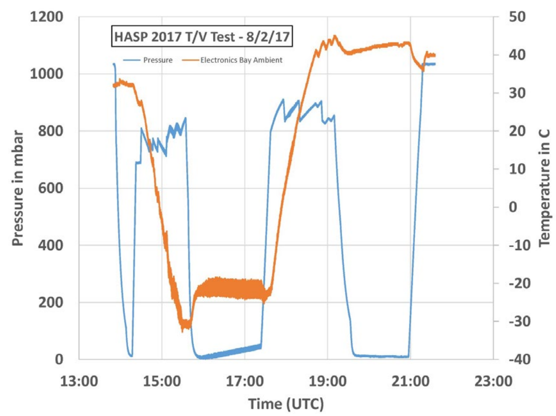

Figure 9: A typical temperature (orange) and pressure (blue) profile for a HASP thermal / vacuum test.

Student payload integration with HASP will take place around the last week of July/first week in August at the CSBF facility in Palestine, TX and will include thermal/vacuum testing to simulate the temperature and pressure extremes that your payload will experience during a HASP flight (see Figures 7, 8, and 9). During the integration process you will need to successfully satisfy the HASP serial communication, power and mechanical interface requirements, plus prove that your payload operates correctly during one of the two thermal/vacuum test opportunities offered. In addition, your final *Flight Operations Plan (FLOP)* will also be due. Upon successful integration, the team will be issued a *Payload Integration Certification (PIC) with flight certification*. The flight certification is useful for justifying flight operation support from your funding agency. If issues are uncovered and not resolved during integration, then you will likely be issued a *PIC without flight certification*. There will be about two to three weeks prior to flight to correct problems. However, on the flight-line there will be no pre-launch testing and little flexibility to resolve any problems. Thus, the decision to participate in the HASP mission without flight certification will need to be considered between your funding agency and your team.

We strongly urge all student teams to perform some level of thermal / vacuum testing of your payload prior to arriving at CSBF for HASP integration. Performing a thermal / vacuum test will enable you to identify potential flight issues with your payload early and still have time to correct these issues prior to HASP integration. Note that student teams that do not have local access to a testing facility may contact HASP Management (hasp@lsu.edu) to determine if testing using the LSU Bemco Balloon Environment chamber would be feasible. Any environmental testing request should be made at least 30 days prior to any anticipated test. Scheduling a test will be considered as time and resources permit.

Table 3: Anticipated HASP 2022 Schedule

November 12, 2021	Q & A Teleconference
November 19, 2021	Notice of Intent Letter Due
December 17, 2021	Application Development Teleconference
January 07, 2022	Application due date
~January 28, 2022	Announce student payload selection
February –November 2022	Monthly status reports and teleconferences
April 29, 2022	Preliminary PSIP document due
April 29, 2022	NASA Integration Security Document due
June 24, 2022	Final PSIP Document due
June 24, 2022	NASA Flight On-Site Security Document Due
July 22, 2022	Final FLOP Document due
July 25 – July 29, 2022	Student payload integration at CSBF *
August 29 – Sept 02, 2022	HASP flight preparation *
September 03, 2022	Target flight ready *
September 05, 2022	Target launch date and flight operations *
September 07 – Sept 11, 2022	Recovery, packing, and return shipping *
September – November 2022	Monthly status reports and teleconferences
December 09, 2022	Final Flight / Science Report due

* These dates are preliminary and subject to change

Flight operations are planned for Ft. Sumner, New Mexico during late August / early September. The HASP vehicle and support crew will be arriving on site in late-August. Any student payloads that have already integrated with HASP (i.e. in early August) can be flown without any further intervention by the student team. Data during the flight will be available for access via the HASP website. **Note: Teams will not be allowed to follow the HASP recovery team.** The payload will be returned to the group following the flight using your supplied container and pre-paid shipping label. **(Note that if a shipping container and pre-paid shipping label is not supplied by the time of HASP recovery, return of your payload may be significantly delayed and you may need to travel to CSBF or LSU to pick up your payload.)** If the full dataset is desired, it will be in zipped format on the HASP website sometime after the flight. If the raw data from HASP's flight disks is desired, you will need to request a copy.

Exact launch dates are impossible to predict and are highly dependent upon the local weather conditions and the number of experimenters waiting for launch. At this time, we are targeting early September, but this could easily be one week earlier or several weeks later.

Note that on-site participation by the student team during Integration and System Testing at CSBF in Palestine, Texas and during Flight operations in Fort Sumner, New Mexico is **not required** provided you have fully and accurately completed the PSIP and FLOP deliverables (see section VII) and supply a flight ready and tested payload. The PSIP and FLOP document all your payload interfaces to HASP, as well as fully describe your data interface, data format, commands and payload test, and verification procedures. With these documents, HASP management should be able to understand how your payload is supposed to operate. Further, your flight data during integration and flight operations is available online for you to verify at your home institution and command requests can be delivered to the remote operation site. However, HASP management will not take responsibility for interpreting documentation, diagnosing issues, or modifying / repairing payload problems. HASP Management will also not take responsibility for any integration, pre-launch or flight operation procedures other than a simple power up and power down. Any payload supplied with incomplete documentation that encounters a problem during integration or pre-launch, or that requires complex preparation, without student team personnel on-site to address issues, will not be flown and will merely be returned to the responsible institution. Plan accordingly!

VII. Deliverables

Even if your payload application is accepted, your seat on the next HASP flight is contingent upon providing status reports, documentation describing the payload, meeting required deadlines, as well as plans for integration and flight operations, plus participation in the monthly teleconferences. In addition, application for a future HASP flight will be contingent on delivery of a *Final Flight/Science Report* for any past flights. These documents are described below, and templates are available on the HASP website. *Note that filling out these documents is not necessary for your application, but it will give you an idea of the kind of information that you might include in your application and what we will require once your payload is developed.*

Monthly Status Reports: A status report from the student team lead will be due on the last Friday of the month from January through November. This is a brief report, no longer than one or two pages, that describes that month's 1) activities of the team members, 2) issues encountered during payload design / development, 3) milestones achieved and 4) current team members, demographics, and leaders. A template that teams must use for these reports is available at https://laspace.lsu.edu/hasp/Documentation.php. The report should be e-mailed to hasp@lsu.edu and can be in either MS Word or PDF format.

Monthly Teleconference Meetings: A teleconference will be held on the first Friday of the month from February through December. At least the Faculty Advisor and Student Team Lead should be present at the teleconference, but we encourage all team members to participate. These teleconferences will be used to 1) announce upcoming events and schedules, 2) provide feedback on the monthly status reports, 3) answer questions on the HASP interface, 4) provide expert advice on payload development, and 5) share experiences among HASP participants. Details about the teleconference call-in line and procedure will be announced at a later date.

Payload Specification & Integration Plan (PSIP): This document provides technical details on the final flight configuration of your payload including measured weight, measured current draw (@30 VDC), downlink data format and rate, uplink commands, analog output usage, discrete command usage, and dimensioned mechanical drawings. In addition, your plans for integration with HASP should be detailed including, at least, all test procedures and test procedure validation results, requested test equipment, schedule, and personnel participating in integration. If the payload includes an item from the Hazardous Materials List, additional safety form may be required in both the preliminary and final PSIP. A template that teams must use for these reports is available at https://laspace.lsu.edu/hasp/Documentation.php. A preliminary version of this document will be due April 29, 2022 and the final version will be due June 24, 2022.

NASA Integration On-site Security Clearance Documentation: This document provides required information to CSBF and Wallops Flight Facility that is necessary for an individual to be allowed onsite at the Columbia Scientific Balloon Facility in Palestine, TX. This information is time sensitive. Foreign nationals born in US State Department designated countries or with citizenship from designated countries will not be granted entry to NASA facilities. Additionally, the HASP team, CSBF, and NASA will not provide letters of visa sponsorship / invitation. We are also not responsible for visa delays inside of embassies, so plan accordingly. This document must be completed by April 29, 2022. Any individual that may travel for this trip needs to be included on this document. **No additions to this list will be accepted after this date.** See Appendix A for more information. The spreadsheet required for this security document is available at https://laspace.lsu.edu/hasp/Documentation.php.

NASA Flight On-site Security Clearance Documentation: This document provides required information to CSBF and Wallops Flight Facility that is necessary for an individual to be allowed onsite at the HASP launch site in Ft. Sumner, NM. This information is time sensitive. Foreign nationals born in US State Department designated countries or with citizenship from designated countries will not be granted entry to NASA facilities. Additionally, the HASP team, CSBF, and NASA will not provide letters of visa sponsorship / invitation. We are also not responsible for visa delays inside of embassies, so plan accordingly. This document must be completed by June 24, 2022. Any individual that may travel for this trip needs to be included on this document. **No additions to this list will be accepted after this date.** See Appendix A for more information. The spreadsheet required for this security document is available at https://laspace.lsu.edu/hasp/Documentation.php.

Flight Ready Payload: The final instrument that satisfies all the interface requirements specified in the *HASP—Student Payload Interface Manual*, is fully described in the PSIP, with flight operations documented in the FLOP, as well as satisfying the science objectives described in the original HASP application and has been tested to prove that all such requirements have been met. The Flight Ready Payload is delivered prior to HASP integration and system testing at CSBF in August and will be returned to the responsible institution following the flight.

Payload Integration Certification (PIC): At integration all interfaces will be documented and validated, correct operation of the payload will be verified, and any issues identified will be detailed. This certification will be handled by HASP management during integration. A sample form, customized for your payload, will be sent to you following receipt of your Payload Specification & Integration Plan. Note that you will not be certified to fly until the PIC is complete.

FLight Operation Plan (FLOP): This document will detail procedures for flight line setup, pre-launch checkout, flight operations, error recovery, pre-terminate procedure, and payload recovery including a timeline showing specific events relative to launch at T=0 and identifying personnel participating in flight operations. Note that any payload operations to be performed other than power-up ~one hour prior to launch (T – 1 hr) and power down prior to terminate must be specified in this document. This document is due on July 22, 2022 before integration begins. A template that teams must use for this document is available at https://laspace.lsu.edu/hasp/Documentation.php.

Final Flight / Science Report: A final report on the results from the flight of your payload is due by December 09, 2022. This report should include an assessment of the payload performance, problems encountered, lessons learned, as well as the science / technical results from the flight, plus demographics of all participants in your project.

Balloon Program Office Documentation: Please see Appendix B for information that the NASA Balloon Program Office will request in order to facilitate NASA WFF Safety and Mission Assurance Division's ability to perform both flight and ground safety assessments for the Fort Sumner Campaign. There are three forms to be completed that will provide the necessary information for each payload.

VIII. Special Requests

We will entertain requests for your payload to exceed one or more of the constraints on weight, dimension, telemetry, and location. All waiver requests **MUST** be fully described including a weight table, power table, dimensioned mechanical drawings, power supply schematic, etc. AND must clearly justify how the waiver will impact your science. Such applications will be accepted **only** if we feel that the request is fully justified and if we feel that we can provide the additional resources. Thus, it is strongly advised that if you decide to make a special request, you should also include a section discussing the implications if your request is not granted. Note that a statement that the modification will enable you to acquire more data is not sufficient to justify exceeding a constraint. You must **prove how a major scientific objective will be lost** if your request is not granted. Note that flight applications without a fully justified waiver request describe a payload and science objectives that are achievable within all HASP constraints. Finally, even if a waiver is granted the student team will need to assume all risk associated with exceeding a HASP constraint including possible rejection of the payload by CSBF following compatibility testing, damage to or loss of the payload, and loss of payload data.

IX. Q&A Teleconference

A special "meet-me" teleconference will be held on **Friday, November 12, 2021 at 10:00 am (central time)** for groups planning to submit a HASP application. During the teleconference, we will present a brief description of the HASP program, what we expect to see in all applications, and will address any questions you may have. Groups who have previously flown on HASP as well as new organizations should plan on attending this Zoom teleconference. A second Application Development teleconference will be held on **Friday, December 17, 2021 at 10:00 am (central time)** to discuss any questions potential applicants may have while creating their proposal. To participate in either or both teleconferences, please register at https://laspace.lsu.edu/hasp2022-qa-registration-form/. Once registered, all the appropriate Zoom information will be emailed to the participants.

X. Application Preparation and Submission

For the 2022 HASP flight, eight small and four large payload seats will be available for student groups. To be considered for the 2022 HASP flight, all teams must submit a complete payload application on, or before, **January 07, 2022.** These applications will be reviewed, and seat awards will be announced at the end of January 2022. The template for the HASP 2022 application can be located on the HASP Participant Information page of the HASP website -- https://laspace.lsu.edu/hasp/Participantinfo.php.

The application package consists of a standard HASP application cover sheet, payload description, team management and structure, payload interface specifications, and preliminary drawings. It can be submitted in either MS Word or PDF, or in hardcopy format.

The **cover sheet** form is a 1-sheet description of the payload. The boxes on the cover sheet should be self-descriptive with the following exception. Identify in “Payload Class:” whether you are applying for a **small** or **large** payload seat. The “Project Abstract” is limited to 200 words and should provide a brief summary of your payload “science” objectives, team structure, and interface requirements. If your team has a name different from the project name, you can enter it in the “Team Name” box, otherwise enter the payload acronym or leave blank. If your team or project has a website, enter the URL in the next box. Finally, we will need full contact information for the faculty advisor and the student who will be the interface between the student team and HASP management. The cover sheet is limited to one page.

The **payload description** provides a one to two-page summary of your scientific objectives, a high-level review of your payload systems plus a statement of the principle of operation of your experiment. This section should provide the reader with a reasonable understanding of the “why, what, and how” of your payload. Be sure to include a thermal control ‘plan’.

The application should also include a description of **how your team is structured and managed**. This could include an organization chart and/or a listing of the team leads. Full contact information (including e-mail address) should be provided for the principle team leads plus faculty advisors. Also include a description of how the team effort is organized and managed as well as a preliminary timeline, with milestones, leading to integration with HASP and flight operations. We will also need to know how many personnel are anticipated to participate in the integration at CSBF and flight operations at Ft. Sumner.

The **payload specifications** section should describe what HASP resources you will use and how your payload will fit within the HASP constraints. This section should include your weight budget with uncertainties, mounting plate footprint, payload height, power budget, downlink serial telemetry rate, uplink serial command rate, anticipated use of analog downlink channels or additional discrete commands, as well as the desired payload location and orientation, and potential hazards. Also include a brief description of your anticipated procedures during integration with HASP and flight operations. You may also request resources that somewhat exceed those specified for your payload class or those that are not mentioned in this document. See Section VIII for what should be included in a waiver request. Payloads that are significantly impacted by the limited resources available are unlikely to be good candidates for a HASP flight.

A collection of **preliminary drawings** illustrating particular aspects of your payload are required in this application. Typical items to include here would be a dimensioned drawing of your payload, power circuit diagram showing wiring to the EDAC connector and all voltage converters, anticipated modifications to the payload mounting plate, sketches of your mounting structure, and illustrations of your preferred payload orientation and location on HASP. Failure to include this required information could potentially result in a rejection of your flight application.

Finally, completed documentation of any hazardous items you are planning to include in your payload, as identified in Table 2 and Appendix B, must be attached to your application. Failure to include this documentation will result in rejection of your application. Further, adding a hazard following acceptance of your application for HASP will result in disqualification of flight status.

An example HASP Student Payload Application is provided on the HASP website along with this CFP and the application cover page in MS Word format. The example application is from a previous student team that provided most of the information we want to see in a HASP application. HOWEVER, note that these applications were submitted several years ago before new documentation requirements concerning hazards and safety were put in place. We strongly advise that ALL members of student teams considering applying for a HASP seat read the current HASP CFP, the application template, the example application, and the HASP Student Payload Interface Manual. All of these documents can be found on the HASP "Participant Information" page https://laspace.lsu.edu/hasp/Participantinfo.php.

Once completed, your application should be submitted electronically as a fully searchable PDF or MS Word or in hardcopy to the address listed in section XI by January 7, 2022. As the applications are reviewed, priority will be given to those payloads that are clearly student designed, built, managed, and operated, but projects with only a partial student component are also welcome to apply. The application will be reviewed for completeness, consistency, scientific or technical justification, and ability to fit within the HASP constraints. Seat awards will be announced at the end of January 2022.

XI. Submission of Application

Your completed application should be **submitted electronically by 11:59 pm of Friday, January 07, 2022 (Central Time) to the HASP Management Team at hasp@lsu.edu .** Electronic applications received after this deadline will be reviewed only after on-time applications and only on a space-available basis. The electronic copy should be formatted as a fully searchable PDF file (preferred) or as a Microsoft Word document. For any other formats, your application will be returned unreviewed. You will receive an acknowledgement that your application was received.

Alternatively, you can submit a hardcopy of your application by the due date / time given above to the following address:

Douglas Granger
326 Nicholson Hall / Tower Drive
Department of Physics & Astronomy
Louisiana State University
Baton Rouge, LA 70803-4001

Note that as long as your electronic copy is submitted on time, there is no need to submit a hardcopy application.

XII. Financial Support

Each applicant for a HASP seat must provide their own financial support for payload development, testing, integration in Palestine, TX, flight operations in New Mexico, and subsequent data analysis. Such financial support, for example, is needed for, but is not limited to, purchase of supplies, sensors, lab equipment, student salaries, test facility fees, faculty advisor support, travel expenses, special services, shipping, structural materials, electronic components and other similar items. It is **highly** recommended that a team seek / develop the needed financial resources at the same time as completing this application.

XIII. Potential Modifications to Protocols and Schedules

We are currently planning for normal operations in 2022. However extended impacts from the COVID-19 pandemic could lead to additional protocols, modifications to existing procedures, and / or restrictions for integration and flight participation, as well as impacts to schedules and even the flight itself. Updated guidelines and information will be provided to participants as quickly as possible, if modifications become necessary.

XIV. Private Company Support for a HASP Student Team

Private companies cannot use HASP, or provide support for a HASP student team, to claim improvement on their product technical readiness level or similar commercial gain. If a private company supports a student team, the team application must make it clear what support is provided by the private company and what effort is planned to be accomplished by the students. A letter of support from the private company specifying the company contributions to the team and committing the company to not claim commercial gain as a result of the HASP flight must be included in the application. Note that a company logo can be affixed to exterior of a student payload in acknowledgement of the company support.

Attachments
Required Proposal Forms

The NOI is required if you intend to submit a proposal to HASP, however submitting an NOI does not mean you are required to submit a proposal. NOI information will be used to communicate with potential applicants should changes to the CFP be required. Only the Lead Institution needs to submit an NOI.

- **NOI (due November 19, 2021)**

HASP Program Notice of Intent (NOI) to Propose

This NOI must be submitted by either the Student Leader or Faculty Advisor to LaSPACE on, or before, Wednesday, November 19, 2021 via email to hasp@lsu.edu. No institutional signature is required for the NOI.

TENTATIVE PAYLOAD TITLE:	
INSTITUTION:	
Type: (UNIVERSITY, MSI, COMMUNITY COLLEGE, HIGH SCHOOL, ETC)	
NAME OF STUDENT LEADER:	STUDENT LEADER E-MAIL:
MAILING ADDRESS:	STUDENT LEADER PHONE NUMBER:
NAME OF FACULTY ADVISOR:	FACULTY ADVISOR E-MAIL:
MAILING ADDRESS	FACULTY ADVISOR PHONE NUMBER
ADDITIONAL INSTITUTIONS IF SUBMITTING A MULTI-INSTITUTION PROPOSAL:	

Appendix A: NASA On-Site Security Clearance Requirements

If the Applicant is a US citizen:

1. If the site visit is less than 29 days,
    a. No background investigation is required
    b. Government issued identification is required to access CSBF sites (PSN, FTS, etc.)

2. If the site visit is greater than 29 days,
    a. Background investigation is required
    b. Required to fill out forms to be assigned a NASA identity

If Applicant is a Foreign National:

1. If applicant has been assigned a US Green Card, see requirements listed above for US Citizens.

2. If applicant does not have a Green Card and is from a Non-designated Country,
    a. Notify CSBF of individual name, email address, affiliated institution
    b. Applicant must create a NASA profile
    c. ESTA, Passport, Visa, I94, etc. potentially required
    d. WFF will perform a background check

Note: Students born in, or with citizenship from, US Designated Countries will not be approved for access to NASA facilities. For more information on US Designated Countries, please go to this site -- https://oiir.hq.nasa.gov/nasaecp/.

Appendix B: Required Hazard Documentation for NASA's Scientific Balloon Program Office

NASA Scientific Balloon Program Office (BPO) primary mission manager point of contact for High Altitude Student Platform's (HASP)'s mission is Amy Canfield and Andy Hynous. In the event that your payload includes a non-banned hazard, NASA BPO will require additional information on this hazard to be included in your PSIP. This additional information is required as hazards could include personnel injury or death, and health issues and is needed in order to facilitate NASA WFF Safety and Mission Assurance Division's ability to perform both flight and ground safety assessments for the Fort Sumner Campaign. The required data below and additional data provided in the PSIP will be included in the Ground and RF flight safety plans generated by NASA WFF Safety and required for HASP flight operations.

I. Radio Frequency Transmitter Requirements for HASP Flights

RF transmitters are listed as a safety hazard by NASA. As such, the use of RF transmitters on HASP must be documented and approved in the Ground and RF flight safety plans. Any team that will use a transmitter must provide the following information in both their application and in the PSIP document supplied later in the flight season. **In addition, the frequency range 425 – 435 MHz is used for critical flight operations and therefore BANNED** for any payload use. This table needs to be completed for each RF transmitting device type that will be flown on HASP.

HASP 2022 RF System Documentation	
Manufacture Model	
Part Number	
Ground or Flight Transmitter	
Type of Emission	
Transmit Frequency (MHz)	
Receive Frequency (MHz)	
Antenna Type	
Gain (dBi)	
Peak Radiated Power (Watts)	
Average Radiated Power (Watts)	

II: High Voltage Hazard Requirements for HASP

High Voltage systems are listed as a safety hazard on NASA payloads. Therefore, the use of High Voltage on HASP must be documented and approved in the Ground and Flight safety plans. A source is considered High Voltage if the output voltage is greater than 50V. Any team that will use a high voltage source must provide the following information in both their application and in the PSIP document supplied later in the flight season for each source type. In addition, a detailed schematic, safety plan and procedure for operation must be included in this application. A final version of these requirements must be included in the PSIP submitted later in the flight cycle.

HASP 2022 High Voltage System Documentation	
Manufacture Model	
Part Number	
Location of Voltage Source	
Fully Enclosed (Yes/No)	
Is High Voltage source Potted?	
Output Voltage	
Power (W)	
Peak Current (A)	
Run Current (A)	

III: Lasers (Class 1, 2, and 3R) Hazard Requirements for HASP

Lasers are listed as a safety hazard on NASA payloads. Therefore, the use of lasers on HASP must be documented and approved in the Ground and Flight safety plans. Only Class 1, 2, and 3R lasers will be considered for flight. All other laser classes are **banned**. Any team that will use an on-board laser must provide the following information in both their application and in the PSIP document supplied later in the flight season for each source type. The laser approval process is a very time-consuming operation and complete data must be submitted with the application to ensure that payload team is notified of approval status early in the HASP timeline. In addition, a detailed schematic, safety plan and procedure for operation must be included in this application.

HASP 2022 Laser System Documentation			
Manufacture Model			
Part Number			
Serial Number			
GDFC ECN Number			
Laser Medium			
Wave Type		*(Continuous Wave, Single Pulsed, Multiple Pulsed)*	
Interlocks		*(None, Fallible, Fail-Safe)*	
Beam Shape		*(Circular, Elliptical, Rectangular)*	
Beam Diameter (mm)		**Beam Divergence (mrad)**	
Diameter at Waist (mm)		**Aperture to Waist Divergence (cm)**	
Major Axis Dimension (mm)		**Major Divergence (mrad)**	
Minor Axis Dimension (mm)		**Minor Divergence (mrad)**	
Pulse Width (sec)		**PRF (Hz)**	
Energy (Joules)		**Average Power (W)**	
Gaussian Coupled (e-1, e-2)		*(e-1, e-2)*	
Single Mode Fiber Diameter			
Multi-Mode Fiber Numerical Aperture (NA)			

IV: Pressure Vessel Hazard Requirements for HASP

Pressure Vessels are listed as a safety hazard on NASA payloads. Therefore, the use of any pressure vessel on HASP must be documented and approved in the Ground and Flight safety plans. **Note: For this hazard class, a pressure vessel is any contained volume not open to ambient pressure, not just vessels at positive (>1 atm) pressure.** Pressure vessels include all Pressurized Ground Support Equipment (PGSE), and all Pressurized Instrument Systems or Payload to be Flown Onboard the Balloon, such as low and high pressure gaseous systems, cryogenic systems, large volume vacuum systems and other pressure systems. Any team that will use a pressure vessel must provide the following information in both their application and in the PSIP document supplied later in the flight season for each source type. In addition, a preliminary detailed schematic, FEA analysis, safety plan and procedure for operation must be included in this application. A final version of these requirements must be included in the PSIP submitted later in the flight cycle.

HASP 2022 Pressure Vessel Documentation	
Description	
Maximum Operating Pressure (PSIG)	
Fluids (GN2, Air, etc)	

V: On-Board Batteries Hazard Requirements for HASP

Batteries are listed as a safety hazard on NASA payloads. Therefore, the use of any batteries on HASP must be documented and approved in the Ground and Flight safety plans. Unmodified general use alkaline and lithium-ion batteries will be approved but must be documented in the form below. Any modifications to pre-packaged batteries are **banned** and will not be allowed on HASP**.** Previous battery types that have been approved on HASP are listed below:

- Any domestic battery manufacturer: Duracell, Energizer, Rayovac, etc
- Voltaic Systems V50
- Ultralife U9VL-J-P
- Tenergy ICR14500

HASP 2022 Battery Hazard Documentation	
Battery Manufacturer	
Battery Type	
Chemical Makeup	
Battery modifications	*(Must be NO)*
UL Certification for Li-Ion	