HASP Student Payload Application for 2027

Payload Title: The RetaGamma Project	
Institution: Retamar School	
Payload Class (Enter SMALL, or LARGE): **SMALL**	Submit Date: 11/8/2026

Project Abstract:

Erich Regener and Georg Pfotzer's experiment has become one of the biggest breakthroughs in the field of astrophysics. It allowed us to discover the Pfotzer-Regener maximum, leading to the birth of particle physics. Therefore, 90 years later, we aim to replicate and expand their observations employing modern equipment.

The proposed payload is designed to measure not only the quantity and intensity but, unlike omnidirectional projects, the direction of incidence. Understanding the spatial distribution of gamma radiation gives key insight into the violence of galactic and extragalactic rays, and potency of air showers.

The system operates within HASP's strict mass, power, and thermal constraints: ensuring safety and reliability come first. The combined measurement hardware weighs well below the given threshold, and the power provided by the gondola should be more than sufficient. Furthermore, to mitigate the considerable temperature range the payload will experience, temperature control mechanisms will be incorporated. The onboard microcontroller will process every log, sending telemetry via the HASP interface. To avoid any single points of failure (SPOF), a microSD card will be mounted as well.

Ultimately, the collected data will validate atmospheric radiation models and provide an accurate dimensional map of Pfotzer's maximum.

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Flight Hazard Certification Checklist

NASA has identified several classes of material as hazardous to personnel and/or flight systems. This checklist identifies these documented risks. Applying flight groups are required to acknowledge if the payload will include any of the hazards included on the list below. Simply place an (x) in the appropriate field for each hazard classification. **Note:** Certain classifications are explicitly banned from HASP (grey filled items on table below) and the remaining hazards will require additional paperwork and certifications. If you intend to include one of the hazards, you must include detailed documentation in section 3.8 of the application as required by the HASP Call for Payloads.

This certification must be signed by both the team faculty advisor and the student team lead and included in your application immediately following the cover sheet form.

Hazardous Materials List		
Classification	**Included on Payload**	**Not Included on Payload**
RF transmitters		**X**
High Voltage		**X**
Lasers (Class 1, 2, and 3R only) Fully Enclosed		**X**
Pressure Vessels		**X**
Non-Rechargeable Batteries	**X**	
Magnets less than 1 Gauss		**X**
Intentionally Dropped Components		**X**
Liquid Chemicals		**X**
Cryogenic Materials		**X**
Radioactive Material		**X**
Pyrotechnics		**X**
UV Light		**X**
Biological Samples		**X**
Rechargeable Batteries		**X**
High intensity light source		**X**

Student Team Leader Signature: _____

Faculty Advisor Signature: _____

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1. Payload Description

The payload consists of two Gamma radiation detection systems, isolated from one another to determine the direction of the radiation, as well as the pertinent data communication and processing systems, which are further described in sections 1.2 and 1.3.

1.1 Payload Scientific / Technical Background

Gamma radiation at balloon altitudes is mostly the footprint of cosmic-ray air showers. Primary cosmic rays, mainly protons, strike nuclei in the upper atmosphere and set off a cascade of secondary particles. Neutral pions in that cascade decay into gamma rays, which in turn produce electron–positron pairs and more photons through pair production and bremsstrahlung. The number of particles grows with depth until the energy per particle falls below the critical energy of air. Ionization losses and absorption then dominate and the intensity drops. The altitude where the shower peaks is called the Pfotzer–Regener maximum. In 1935 Erich Regener and Georg Pfotzer flew Geiger–Müller counters in threefold coincidence on stratospheric balloons and measured this maximum for the first time. It lies at roughly 15–20 km altitude, with the exact value depending on latitude and solar activity. The result helped establish cosmic-ray and particle physics. Ninety years later, our payload repeats the measurement with modern scintillator and silicon photomultiplier (SiPM) technology.

1.1.1 Mission Statement

Our mission is to fly a compact gamma-radiation detector on HASP that records the vertical profile of gamma-ray intensity from the ground to float altitude (about 36 km) and, unlike omnidirectional instruments, also the direction from which the radiation arrives. The data will reproduce and extend the Regener–Pfotzer observations and give an accurate dimensional map of the Pfotzer maximum.

1.1.2 Mission Background and Justification

Most balloon and ground measurements of atmospheric radiation are omnidirectional: they count particles or photons from every direction at once. That gives the intensity at each altitude but hides how the shower is distributed in space. Knowing the spatial distribution of gamma radiation tells us more about the violence of the galactic and extragalactic rays that start the showers, and about how powerful the resulting air showers are.

Three reasons justify the flight:

- **Scientific continuity.** The Pfotzer–Regener maximum is one of the founding observations of particle physics, and a modern, directional repeat adds information the 1935 setup could not provide.
- **Model validation.** The measured profile will be compared with atmospheric radiation models, which are tuned mostly on omnidirectional data.

- **Low-cost, open hardware.** The detector is based on the Open Gamma Project, an open-source SiPM scintillator design. This keeps the payload within the HASP mass, power and thermal limits while using a documented, reproducible instrument.

The team belongs to the Retamar physics group, which has taken part in high-altitude balloon work through its collaboration with the University of North Florida (solar eclipse investigation, NEBP) and in several physics and research competitions (see Section 2).

1.1.3 Mission Objectives

1. **The vertical profile.** Record gamma-ray count rate and dose rate (µSv/h) against altitude during ascent and float, and locate the Pfotzer–Regener maximum.
2. **Measure the direction of incidence.** Resolve the arrival direction of the radiation and build a dimensional map of the maximum.
3. **Validate models.** Compare the results with atmospheric radiation models and with the 1935 observations.
4. **Operate safely within HASP limits.** Stay inside the mass, power and thermal constraints of the platform and avoid any hazard category prohibited by NASA (see the Flight Hazard Certification Checklist).
5. **Avoid single points of failure.** Send telemetry through the HASP serial interface and log every record on an onboard microSD card.
6. **Deliver the HASP products.** Fabricate and test the payload, take part in integration and launch, and submit the data analysis and final science report.

1.2 Payload Systems and Principle of Operation

The payload has two independent sensors based on the Open Gamma Detector. Power is first stepped down to 5V for the microcontrollers and then converted as required for bias voltage.

1.3 Major System Components

The following is a thorough overview on the main systems of the payload, including voltage supply, core processing and particle isolation. It is done so that each system can be targeted on its own and so we ensure nothing goes off.

<u>Gamma radiation detection system:</u>

For this payload we will adapt an existing project – Open Gamma Detector, which consists of a SiMP scintillator. A scintillator like such works like this:

- Radiation, when impacting in the glass of the scintillator, excites atoms and causes them to lose energy in the form of photons. To ensure that part happens correctly, the best option is to use a NaI(Tl) crystal. (Sola Gil, 2019)

- To get the photons differentiated by the photomultiplier, it's crucial for the scintillator to be in complete darkness.
- In order to block irrelevant radiation, it's recommended to keep the container in aluminum foil to block beta and alpha particles.

Signal processing system:

A circuit to amplify and smooth the signals is needed. The photons emitted by the crystal have to be processed and turned into electrical currents to be measured and stored. That is when the photomultiplier comes in. A photomultiplier is a sensor that uses a photosensible surface (known as photocatode). This surface releases electrons when light impacts it. After a process of amplification of current, electrons are a current big enough to be measured.

After it, the current goes through a TIA (transimpedance amplifier), that converts the given current in a proportional voltage. After it, it goes through a voltage comparator that filters out the noise and sums the electrical pulses, giving the number of particles per minute.

Meanwhile, an analog-to-digital converter, joined to a specially designed microcontroller, measures the exact height of each pulse, and the microcontroller calculates a weighted average and returns the value in µSv/h.A specialized microcontroller must be used to order the ADC to read the pulses in the fraction of second they come, because normal microcontrollers are way too slow.

To achieve that, considering any manufactured component is prohibitively expensive, we'll design and create a PCB to join the separate parts.

Data communication system:

The obtained data will be sent over the HASP interface by RS232 to the HASP system. An onboard microSD card storage system will be used as backup in case the serial connection fails in any way.

Electrical power system:

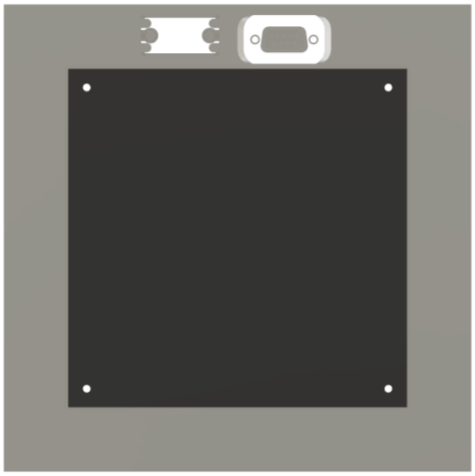
The electrical power subsystem relies entirely on the voltage supply provided by the High Altitude Student Platform (HASP) interface. Our onboard payload architecture has been thoroughly designed, integrated, and verified to ensure full compatibility with this external power source. Furthermore, all components and circuitry have been engineered to strictly adhere to the operational constraints, specifically incorporating a safety margin and robust design practices to guarantee that the maximum voltage limit of approximately 30VDC is never exceeded during operations.

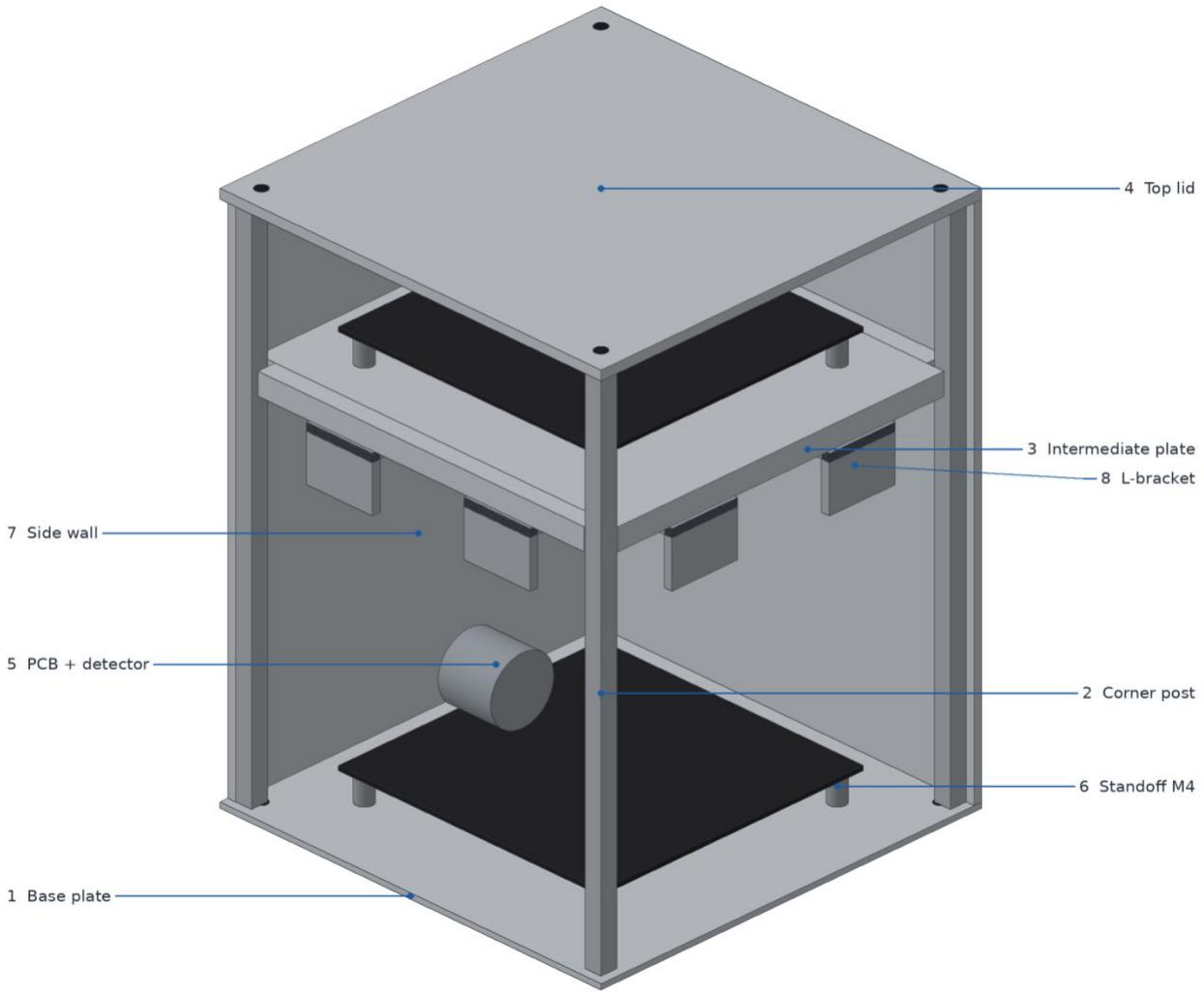
1.4 Mechanical and Structural Design

The payload is a box-shaped aluminium enclosure with an overall envelope of 145 × 145 × 198 mm. Its frame consists of four 6 × 6 mm aluminium corner profiles joined to a base plate and a top lid. Four 3 mm aluminium walls close the sides flush with the envelope and are screwed from the outside with countersunk M4 screws. The capsule will be mounted on the HASP baseplate using stainless steel bolts and Nyloc nuts, which prevent loosening caused by vibration.

The payload is organised in two floors, each carrying one OpenGammaDetector board, 140 mm apart. The lower board is mounted on the base plate and the upper board on an intermediate plate. In both cases the boards sit 10 mm above their supporting plate on M4 standoffs. The 137 × 137 mm intermediate plate is notched at the corners to clear the profiles and rests on eight 20 × 20 × 3 mm aluminium L-brackets, two per wall, mounted underneath it. Each bracket is fixed to the wall and to the plate with M4 stainless steel screws and self-locking nuts, so no thread is cut into the aluminium, which makes the joints more reliable under vibration. The plate therefore acts as a stiffening bulkhead that holds both floors in place and resists horizontal loads.

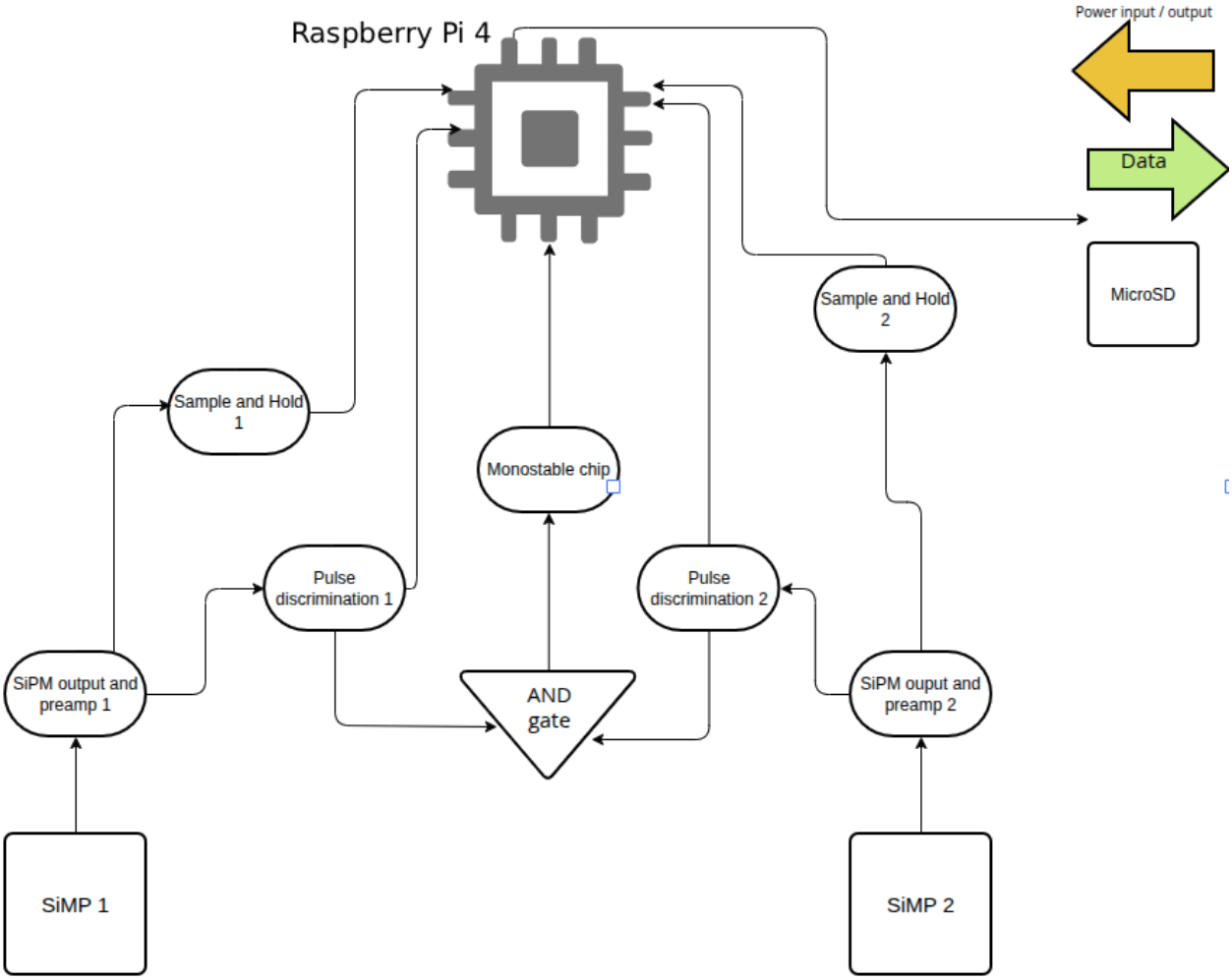
Heavy components are placed on the base plate to keep the centre of mass low and reduce the momentum transferred on landing. The microcontroller and the other electronic boards are bolted using standoffs. The SiPM sensors are very sensitive to vibration and shocks, so employing materials such as Sorbothane or foam around them will be key. Because the payload will fly to the stratosphere, vent holes will prevent trapped air from creating a pressure difference. All dimensions are preliminary and will be confirmed in the final drawings, together with the total mass check against the HAPS limits.



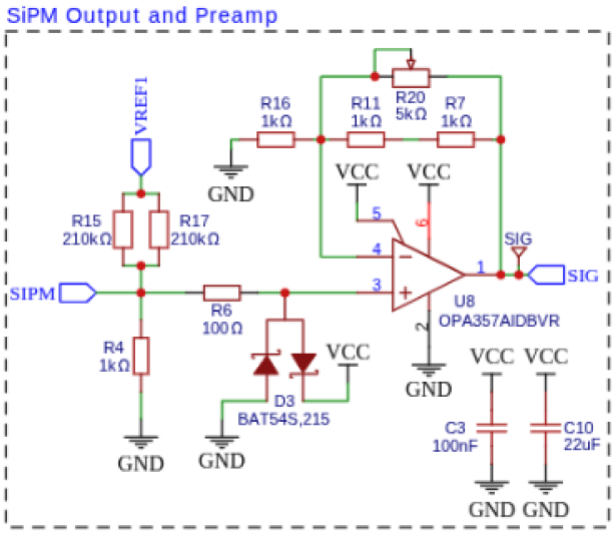

4 Top lid
3 Intermediate plate
8 L-bracket
7 Side wall
5 PCB + detector
2 Corner post
6 Standoff M4
1 Base plate

1.5 Electrical Design

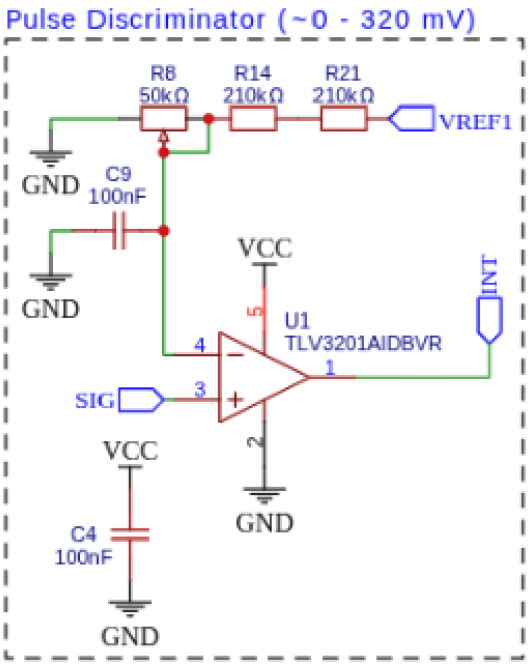
Both sensors are connected in such a way that they can be used simultaneously for individual-detection purposes (such as spectrometry) as well as pair-detection ones (such as direction). To achieve this, we can observe a rough explanation in the following flowchart:



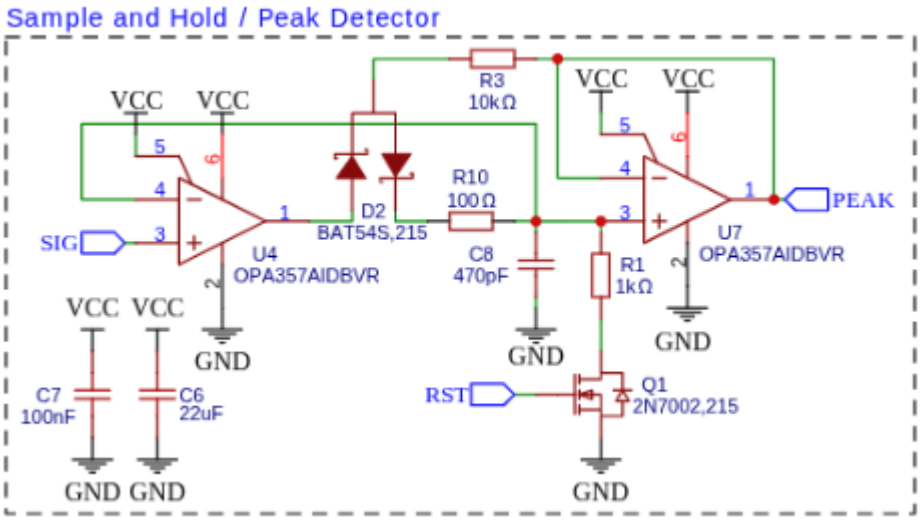
SiPM output and preamp: This system allows the quick and small pulse emitted by the SiPM to be read. Extremely high pulses are redirected to GND and with the OPA357 the pulse is amplified. The result is the SIG pulse.



Pulse discriminator: As the pulse from the SiPM cannot be read by the processor (it is barely microseconds), the TLV320 acts as an on/off switch: leaving background noise out and detecting the real impacts, although the spectrometry is lost, which is why the next module is included.



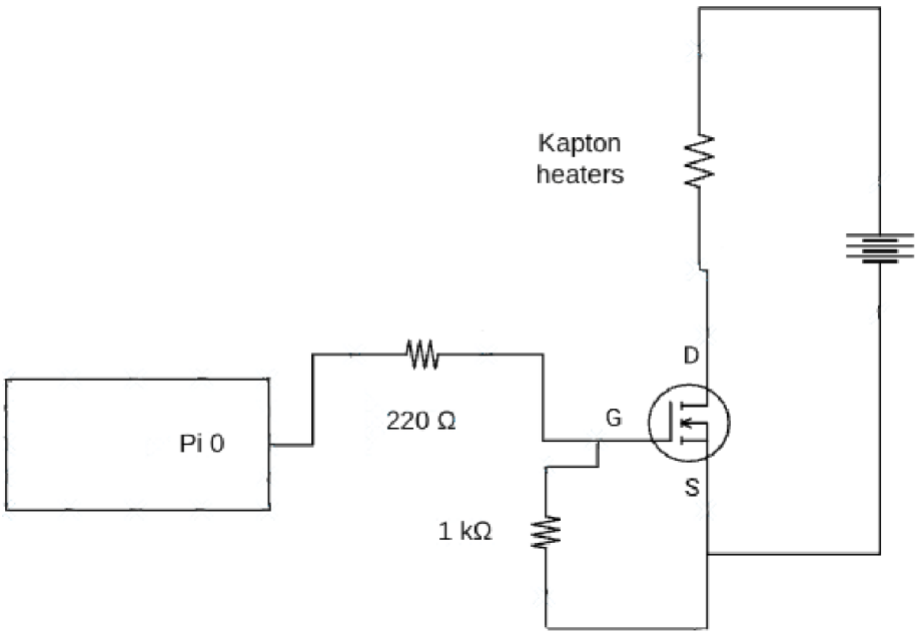
Sample and hold: Here, a capacitor holds the peak voltage, to be read by the processor using an ADC. Next, the capacitor is discharged.



So, now the processor has the intensity and time of every impact of both sensors. What is left is direction, which is solved employing the remaining pieces. The AND gate makes us know whether the ray was vertical or not, helping us know the amount of primary and secondary rays.

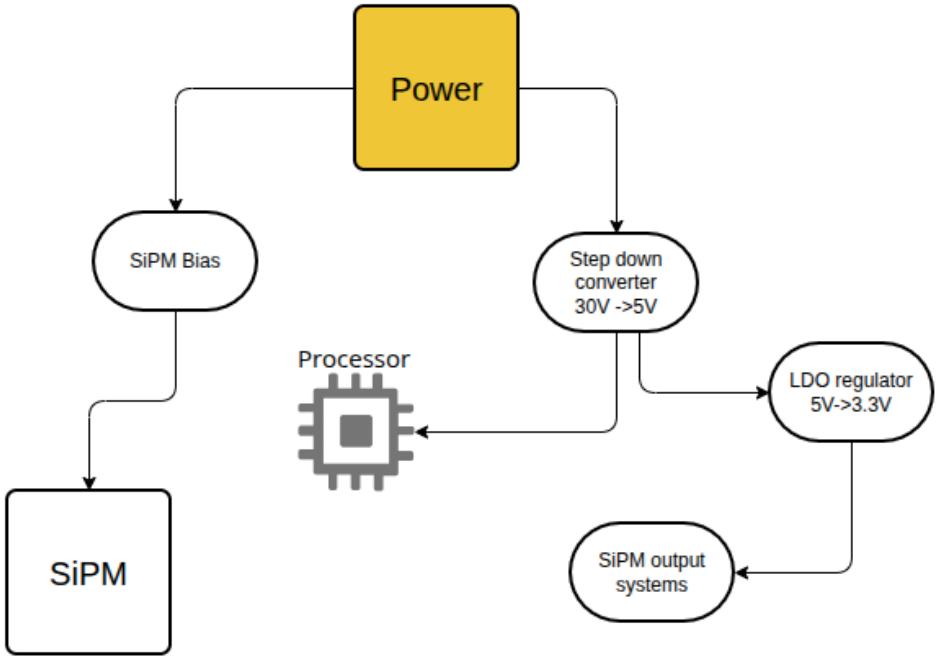
At last, the monostable chip makes the flash become a stable pulse the Raspberry Pi is capable of reading.

In addition to this, the project's thermal plan can be represented as such:

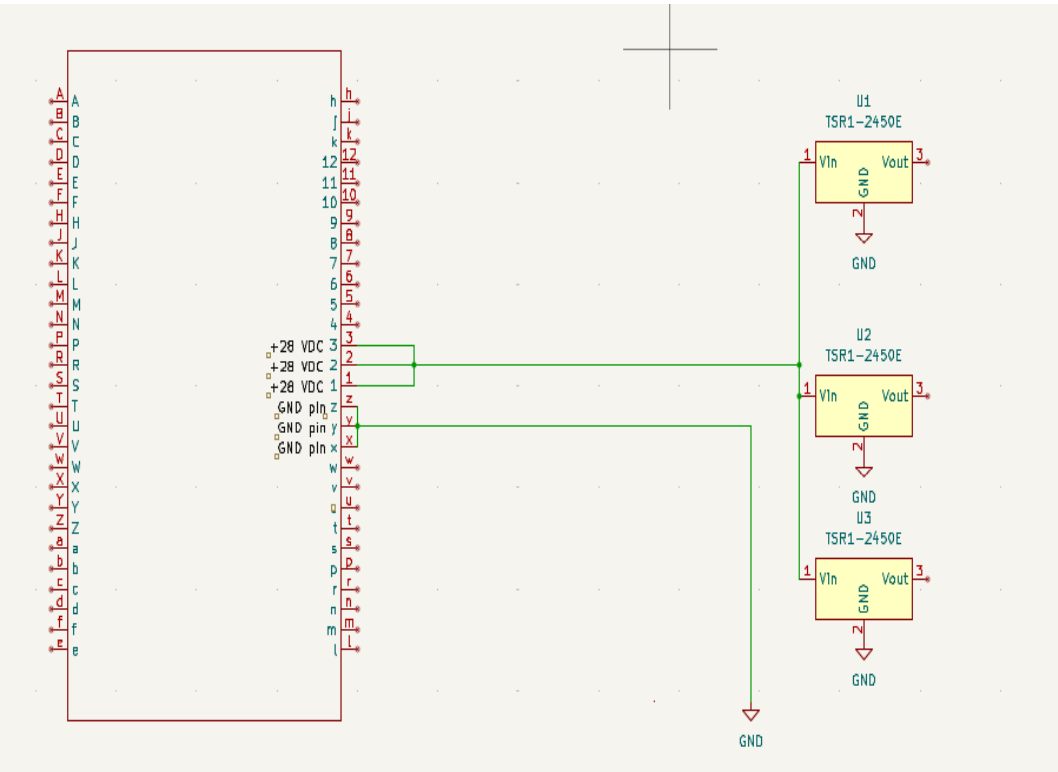


Where kapton heaters are directly connected to the power supply and a MOSFET acts as an on/off switch. A BME280 provides the temperature information required to know whether the kaptons should be on or off.

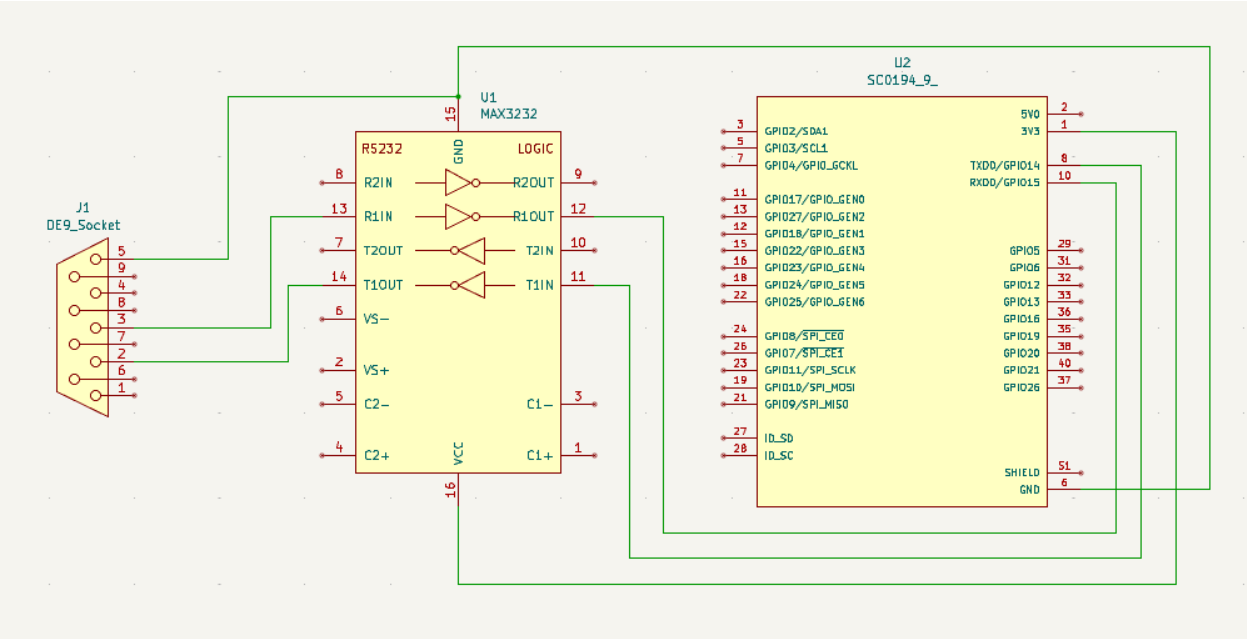
Power is distributed along the payload as follows:



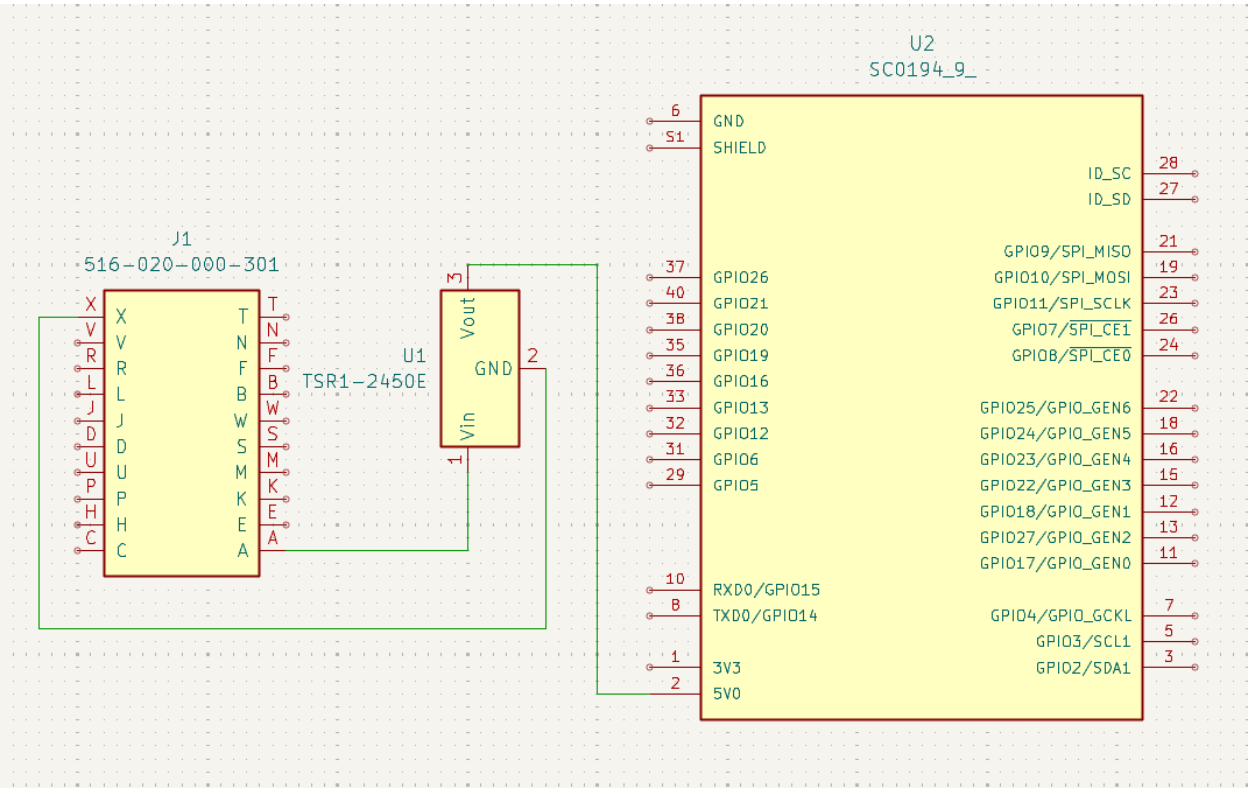
The following schematic shows how the power will be stepped down from the ~28V supplied by the HASP system to the 5V required by the rest of the electronics.



The following schematic shows the distribution of the onboard RS232 Serial Connection:

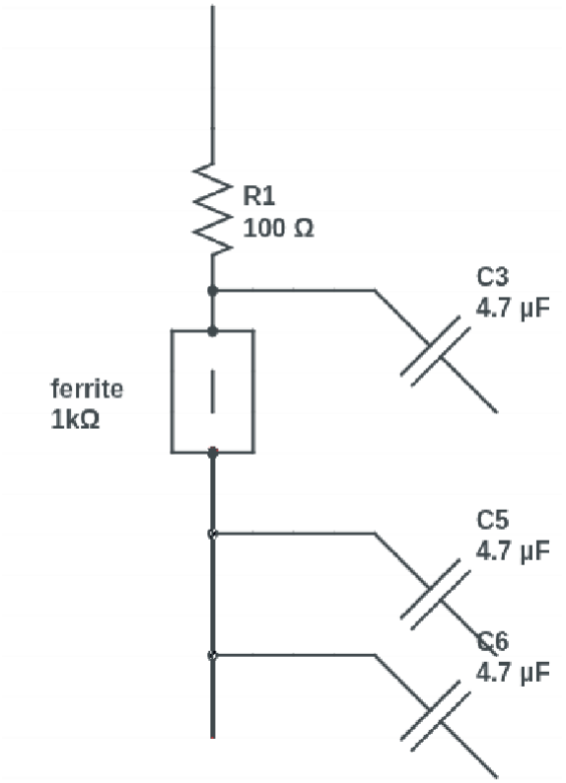


The following schematic shows the distribution of the onboard EDAC connection:



The only out of ordinary components are the LDO regulator and the SiPM Bias. The first allows a steady pulse to be made, which is essential for the output systems explained above, as well as lowering voltage to 3.3V.

The second can be described with this schematic view:



Its sole purpose is, similar to the LDO regulator, to ensure the current that is fed to both SiPMs is steady. Note that capacitors 3, 5 and 6 are connected to GND.

To finish, a microSD card and a RTC clock are also mounted to avoid SPOFs (single point of failures).

1.6 Thermal Control Plan

Due to the diverse range of temperatures that will be reached throughout the flight, it is of the utmost importance to maintain a stable operational temperature inside the payload to ensure the correct operational status of the sensors and other electric components.

The rough average optimal operational temperature was calculated to be approximately 20 ºC (rough estimate) Further precision will be achieved throughout a number of tests done on all major components.

Throughout the flight, the payload may encounter three types of situations. Each situation has its own way to be approached, but the payload must be able to adapt to any of the three situations.

The three situations the payload may encounter are:

- Daytime: the situation that is provided throughout the majority of the flight.
  The payload will be exposed to the Sun´s and Earth´s thermal radiation in some parts of its body reaching up to +60 ºC, while other parts will be cast in shadow, reaching temperatures of -40 ºC.

- Night time: Although not as present in the duration of the flight, it has to be taken into account. In this situation the Sun won't apply radiation directly to the body of the payload. In consequence, the payload will endure temperatures well below -40 ºC.

- Launch / Landing: The time period in which the balloon is still inside the Earth´s rich atmosphere will have a temperature range of [15 ºC , 25 ºC]. This won't impact as much on the operation of the payload.

The outside of the payload will be covered in a reflective and non-absorbent material (e.g. FEP, Mylar) in such a way that thermal radiation won't enter the body of the payload Electric resistance heaters, such as kapton heaters, will be used with a microcontroller and temperature sensors to regulate the temperature of the inside of the payload to achieve the optimal operational temperature.

2. Team Structure and Management

2.1 Team Organization and Roles

Team Members

Full Name	Area of responsibility	E-mail address	Academic year
Dr. José Francisco Romero García	Faculty advisor	pepepaco.romero@retamar.es	-
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Jaime Vara Caruncho (Deputy Leader)	Software and communications	jaime.vara@haspretamar.es	College Freshman (Alumni; Class of 2026)
Alberto Aparicio Ester	Organization	alberto.aparicio@haspretamar.es	H.S. Junior (Class of 2028)
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Mariano Borrero Pitaruqe	Systems and components	mariano.borrero@haspretamar.es	H.S. Sophomore (Class of 2029)
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Jaime Mingote Lladó	Hazards	jaime.mingote@haspretamar.es	College Freshman (Alumni; Class of 2026)

Preliminary Organizational Chart



2.2 Timeline and Milestones

The preliminary work breakdown schedule delineates the essential components of the HASP project, encompassing the Proposal, Integration Plan, Integration Certification Operation Plan, and Science Report. The following table illustrates the proposed work-plan trajectory, outlining the timeline and key milestones.

2027	
January	Conceptual design, and research and review HASP projects to understand issues.
February	Preliminary review for sensors, electric design, software,payload, integration of payload with HASP and data analysis.
March	Final Design Review for sensors, electronic circuits, software, payload, integration of payload with HASP and data analysis.
April	Designing the electrical system and programming the software.
May	Testing electric board calibrate sensors.
June	Fabrication of sensor box and payload body. Reviewing HASP flights, data,and any issues.
July	Integration of sensor and electrical design and software and final testing in vacuum and temperature change.
August	
September	Pre-flight testing of payload, launching of payload from CSBF, Fort Sumner,NM and downloading data files, and data analysis work.
October	Payload recovery, search for issues, review data.
November	Final data analysis and write a science report.
December	Publish science report.

2.3 Anticipated Participation in Integration and Launch operations

We plan to send around four students along with the faculty advisor Dr. José Francisco Romero García to Palestine, TX. For the launch operation we plan on sending 2-3 students along with the faculty advisor Dr. José Francisco Romero García. In both cases the students present will have the most intricate knowledge of all systems and operations, having been briefed before they depart and will be in constant communication with the rest of the team in Madrid, Spain.

3. Payload Interface Specifications

3.1 Weight Budget

This section provides the estimated weight budgets of several parts of the payload. The payload has been divided into four different systems, according to their functions: Gamma Radiation System, Communication System, Data Storage System and Thermal Control System. All masses are given in grams. This is a rough estimate based mostly on datasheets and technical specifications, and could vary slightly when implemented.

Gamma Radiation Detection System		
Item	Mass	Uncertainty
Open Gamma Detector Plate	35	1.5
Silicon multiplier-MICROFC-60035-SMT-TR	0.5	0.1
NaI(Tl) scintillator crystal	75	5.0
Aluminum foil	0.5	0.1
TOTAL (g)	111	8.5

Communication system		
Item	Mass	Uncertainty
Microcontroller (Raspberry Pi Zero)	9	0.5
2-Channel Isolated RS232 Expansion Hat	40	1.0
TOTAL (g)	49	1.1

Data Storage System		
Item	Mass	Uncertainty
Micro SD card	0.4	0.1
RTC-Real Time Clock	5	0.5
Coin Cell Battery CR2032	3	0.1
TOTAL (g)	8.4	0.9

Thermal Control System		
Item	Mass	Uncertainty
Temperature sensor (Exact model TBD)	4	0.5
Kapton Heater (TBD)	20	3.0
TOTAL (g)	24	3.0

Having calculated the mass of each of the systems, and adding the mass of the support structures calculated by the CAD system used to design it: This measure is purely theoretical and so does not have an associated uncertainty.

Total Mass of the System	Mass	Uncertainty
Two Gamma Radiation Detection System	222	17
Communication system	49	1.1
Data Storage System	8.4	0.9
Thermal Control System	24	3.0
Support structures (model)	1540	-
TOTAL MASS (g)	1843.4	13.9

According to these preliminary estimations, the total mass of the payload falls well below the 3 kg limit for small payloads.

3.2 Power Budget

The payload will be powered entirely through the 28V DC rails on the HASP-supplied EDAC connection (which could realistically vary between 26 and 30 V). As a small payload, the current draw is limited to 0.5A)

A DC-to-DC converter will reduce the input voltage to 5V DC, for all our electronics. The SiPM bias circuits have their own regulation as necessary. The Kapton heaters are switched by MOSFETs as required to regulate temperature (Voltage conversion may also be necessary).

The following budget is a rough estimate of how much power each component could utilize. Testing is necessary to ensure the payload remains under the 0.5A limit at all times.

Item	Voltage	Current	Power	Comments
OpenGammaDetector 1	5V	0.25A	1.25W	Estimated from detector electronics
OpenGammaDetector 2	5V	0.25A	1.25W	
Raspberry Pi Zero	5V	0.25A	1.25W	Obtained by testing
Serial HAT (RPi)	5V	0.10A	0.50W	Obtained from Datasheet
RTC (RPi)	5V	0.10A	0.50W	Estimate
Kapton heaters	28V	0.11A	3.00W	Estimate
DC-DC losses	N/A	N/A	1.41W	Assuming 85% efficiency
TOTAL			9.16W	

Under these assumptions, with all electronics operating and heaters switched on, the estimated steady-state power consumed is approximately 9.41W, corresponding to approximately 0.34 A at 28 V, which is below the HASP limit of 0.5A while allowing for slightly higher consumption during heater startup or detector activity.

3.3 Downlink Serial Data

Serial data downlink transmitted from the payload will include some general housekeeping as well as the measurements from both Gamma Radiation detectors.

Housekeeping data includes RTC Timestamp (7 bytes), record counter (4 bytes) and a rudimentary checksum (4 bytes) and microcontroller temperature (2 bytes), for a total of 17 bytes of housekeeping data.

Science data consists of the Energy spectra from both detectors, represented as histograms with 256 energy channels, each containing a 32-bit count value, which comes to 1024 bytes for each of the detectors, for a total of 2048 bytes of science data.

The total size of each data package comes to 2065 bytes. (All byte calculations are estimates to be confirmed, so this figure is approximate.)

The downlink rate will be one of these data packages every 60 seconds. While the 4800 baud serial connection should be able to accommodate this comfortably, the rate could be lowered to 120 seconds or even 600 seconds.

3.4 Uplink Serial Commanding

Uplink commands that have been identified so far include:

- Turning payload power on and off
- Turning each sensor's individual power supply on and off
- Turning the temperature regulating system on or off manually (overriding the automatic operation)

The full command set will be finalized during later stages of development.

3.5 Analog Downlink

We do not intend to use the HASP analog downlinking capabilities.

3.6 Discrete Commanding

We do not intend to use the extra discrete commanding capabilities provided by HASP.

3.7 Payload Location and Orientation Request

Given that all of the positions for small payloads are equally distributed, we do not have a preference for the location of our payload.

3.8 Special Requests

The non-rechargeable battery mentioned in the hazardous items checklist refers to the onboard CR2032 battery present on the RTC module used for timestamping. No other non-rechargeable battery will be used.

4. Preliminary Drawings and Diagrams

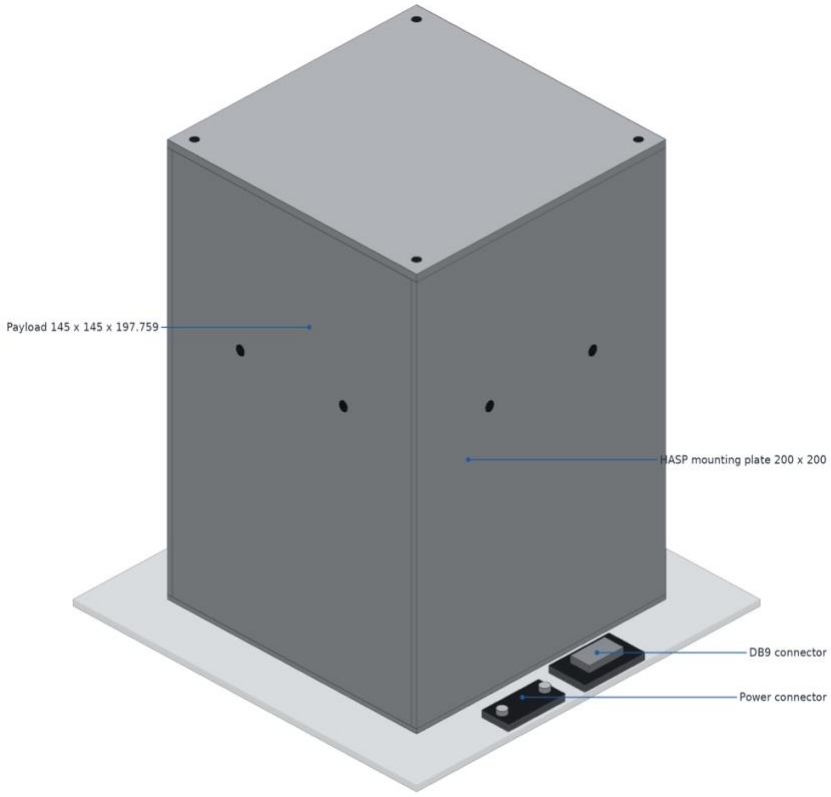
4.1 Overall Payload Design

General payload configuration: two-floor enclosure with one OpenGammaDetector per floor, 140 mm apart, separated by an intermediate plate.

Preliminary structural design: four aluminium corner profiles, base plate, top lid, four 3 mm side walls, and a 137 × 137 mm intermediate plate supported by eight aluminium L-brackets (bolted joints with self-locking nuts) acting as a stiffening bulkhead.

Overall dimensions and geometry: 145 × 145 × 198 mm. Total mass: ~1.8kg

General 3D view of the payload:

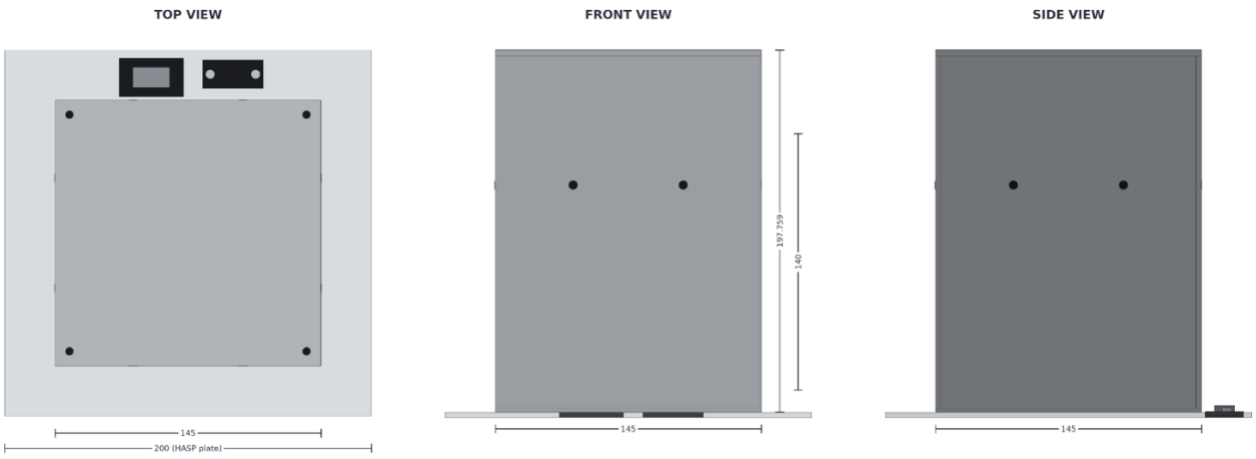


4.2 Mechanical Drawings

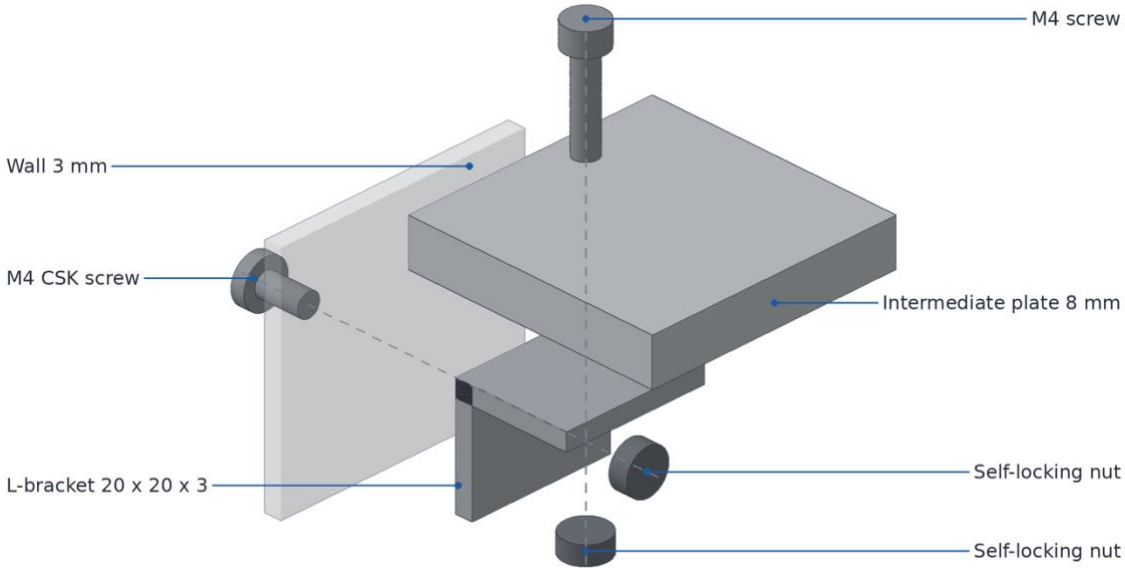
Top view, Front view & Side view.

Dimensioned drawings in millimeters: envelope 145 mm, height 198 mm, floor spacing 140 mm, hole spacing 129.225 mm, PCB side 99.90 mm, profile section 6 mm, plus a detail of the intermediate plate joint.

Preliminary structural materials: aluminium alloy (e.g. EN AW-6082-T6) for profiles, plates, walls and brackets; stainless steel fasteners.



Top, Front and Side Views.



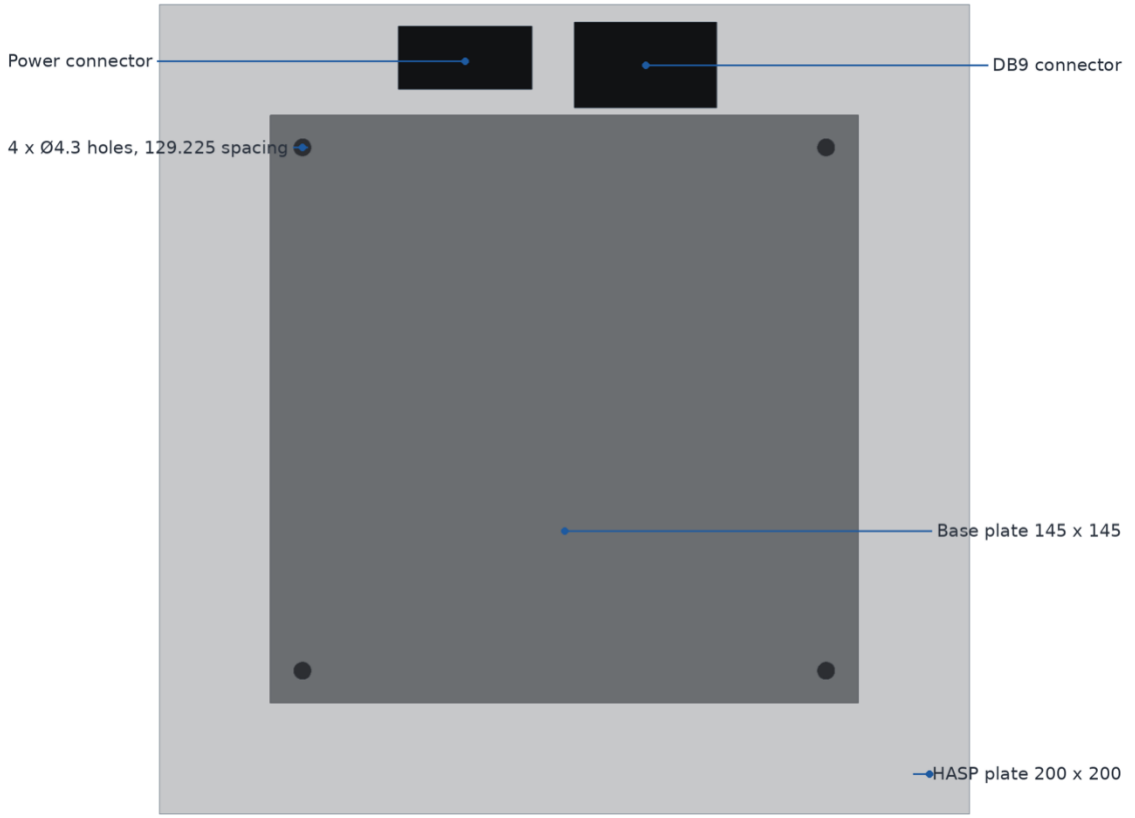
Intermediate floor connection

4.3 HASP Mounting System

HASP mounting plate interface: stainless steel bolts with Nyloc nuts through the base plate, according to HASP specifications.

Fasteners and support structures: M4 countersunk screws for the walls, M4 standoffs for the boards, L-brackets with screws and self-locking nuts for the intermediate plate.

Mechanical stability and load considerations: low centre of mass, rigid walled box, bulkhead plate, damping around the SiPM.



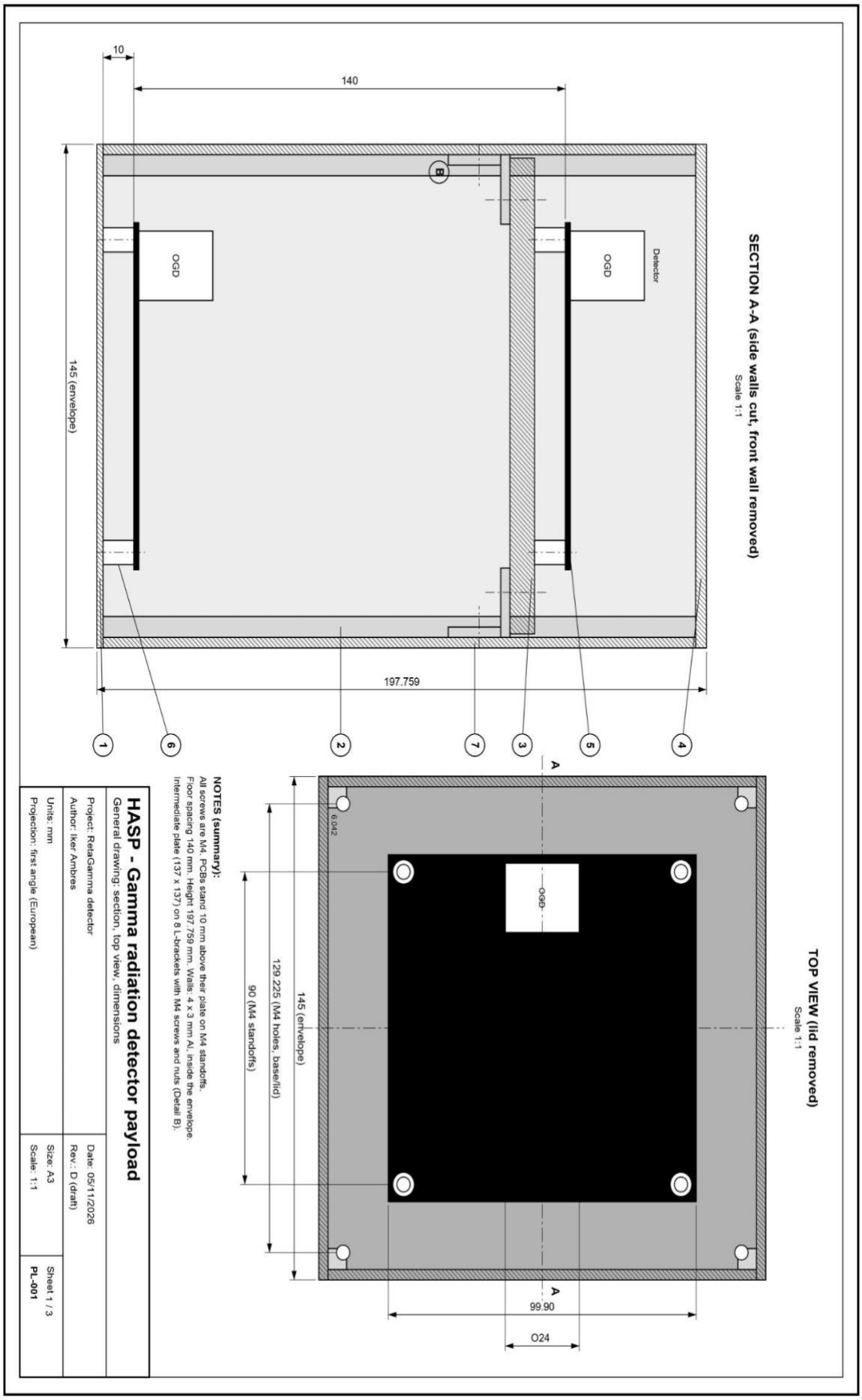
Mounting interface to the HASP plate.

5. References

- OpenGammaProject. (n.d.). *Open Gamma Detector* [Computer hardware and software project]. GitHub. https://github.com/OpenGammaProject/Open-Gamma-Detector
- Gil, P. S. (2019). *Aplicación de SIPMs en detectores de centelleo de NaI (Tl); retos y oportunidades.* Universidad de Zaragoza. https://zaguan.unizar.es/record/87492/files/TAZ-TFG-2019-2294.pdf

Appendix A

General Drawing PL-0



BILL OF MATERIALS

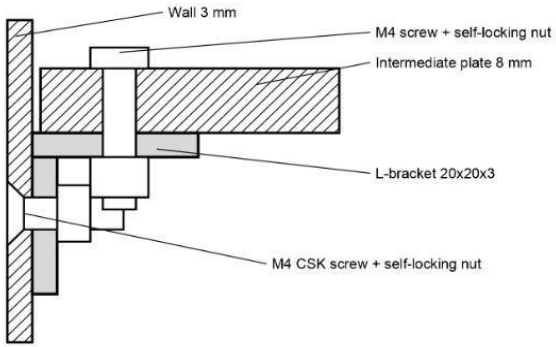
No.	DESCRIPTION	QTY	MATERIAL / DIMENSIONS (mm)	NOTES
1	Base plate	1	Al 145 x 145 x 2*	4x O4.3 holes, 129.225 spacing
2	Aluminium profile (corner post)	4	Al 6.042 x 6.042 ; L approx. 192*	Inside the walls, between base and lid
3	Intermediate plate	1	Al 137 x 137 x 8*	Corner notches for posts; 1 mm clearance to walls
4	Top lid	1	Al 145 x 145 x 3.5*	4x O4.3 holes, 129.225 spacing
5	OpenGammaDetector PCB	2	99.90 x 99.90 x 1.6*	Detector O24 x 20* (axis X)
6	Standoff M4, L = 10	8	-	4 per floor, PCB 10 mm above plate
7	Side wall	4	Al 3 mm sheet, approx. 192* high	N/S 145 wide, E/W 139 wide; flush with envelope
8	L-bracket	8*	Al 20 x 20 x 3, L = 25*	2 per wall, under the intermediate plate
9	M4 CSK screw + self-locking nut (wall to bracket)	8*	Stainless steel	Countersunk head, flush with outer wall face
10	M4 screw + self-locking nut (bracket to plate)	8*	Stainless steel	Through plate and bracket leg (Detail B)
11	M4 CSK screws (walls to posts, others)	-	Stainless steel	Wall-to-post: approx. 3 per interface*

GENERAL NOTES

1. Dimensions in mm. General tolerances per ISO 2768-m.
2. All fasteners are M4 (clearance holes O4.3).
3. Each OpenGammaDetector PCB sits 10 mm above the plate that carries it, on 4 M4 standoffs (bottom: base plate; top: intermediate plate).
4. Two detectors, one per floor, 140 mm apart (measured between the same faces of both PCBs). Total height 197.759 mm.
5. Four 3 mm aluminium walls close the sides flush with the 145 x 145 mm envelope, screwed from the outside with countersunk M4 screws. The corner profiles sit just inside the walls.
6. The 137 x 137 mm intermediate plate (corner notches to clear the profiles) rests on eight 20 x 20 x 3 mm aluminium L-brackets, two per wall, under the plate. Each bracket is fixed to the wall and to the plate with M4 screws and self-locking nuts (Detail B). No thread is cut in aluminium. The plate acts as a stiffening bulkhead.
7. Overall envelope: 145 x 145 x 197.759 mm. Check against the HASP small-payload envelope and mass limit of the current call.
8. Open point: the base/lid holes (centres 7.89 mm from the edge) fall inside the 6.042 profile (3.0 to 9.04 mm) but off-centre; check thread edge distance.

DETAIL B - Intermediate plate joint (section)

Scale 1.6:1



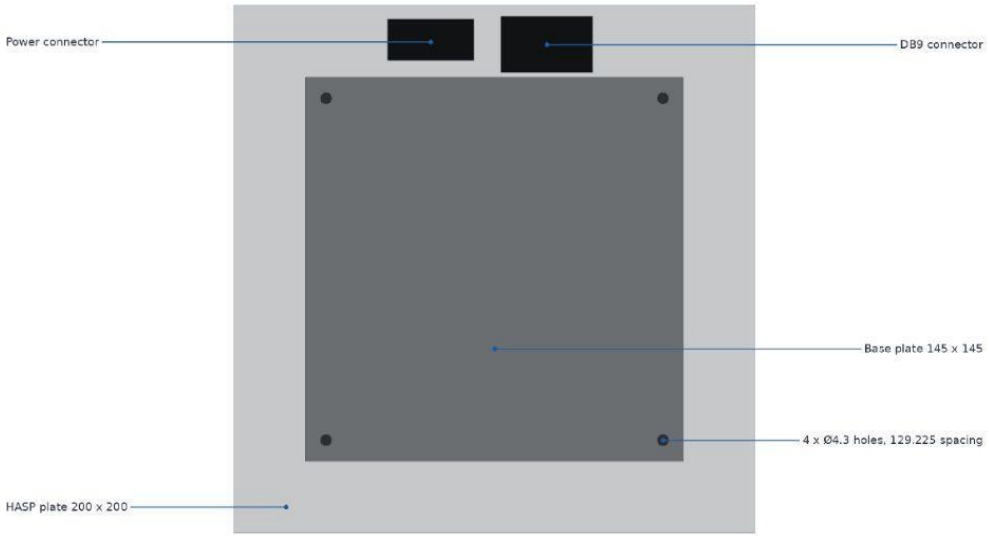
HASP - Gamma radiation detector payload

Bill of materials and general notes

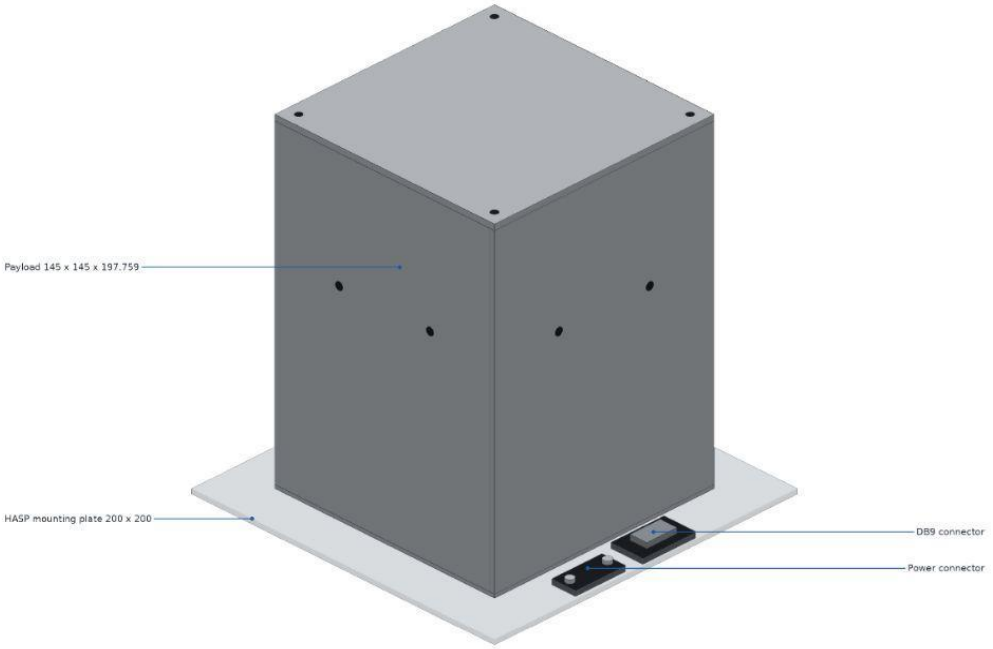
Project: RetaGamma detector Author: Iker Ambres	Date: 05/11/2026 Rev.: D (draft)	
Units: mm Projection: first angle (European)	Size: A3 Scale: -	Sheet 2 / 3 **PL-001**

HASP MOUNTING INTERFACE - Base plate on HASP plate

Bottom view (HASP plate translucent) and isometric view. Scale: not to scale



BOTTOM VIEW



ISOMETRIC VIEW

NOTES

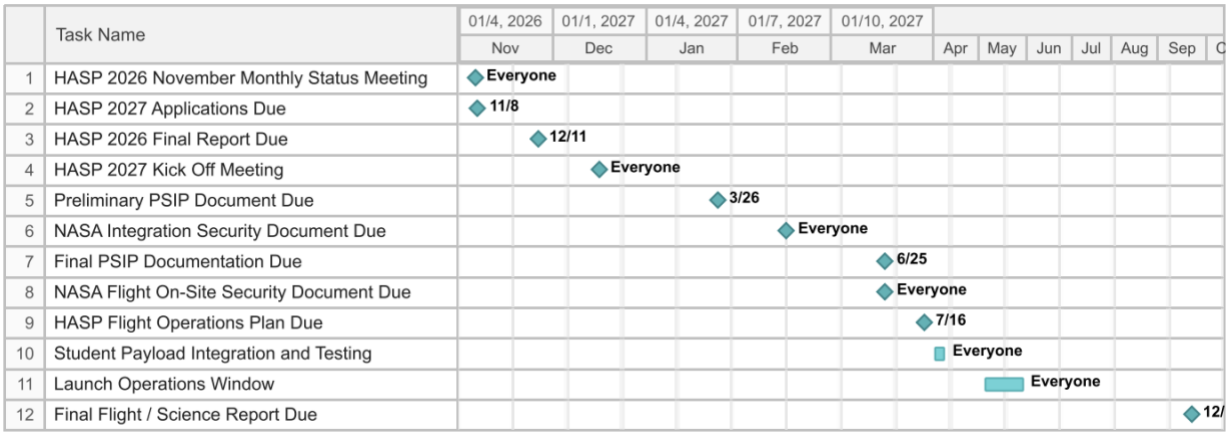
1. HASP plate shown as 200 x 200 mm (*), payload base plate 145 x 145 x 2 mm centred on it. Both estimated from CAD screenshots - verify.
2. Base plate and lid: 4 x O4.3 clearance holes, 129.225 mm spacing (centres 7.89 mm from the edge).
3. Connectors (DB9 and power) are on the HASP plate side, outside the payload footprint (*). Position and size approximate.
4. [TBD] Bolt pattern and attachment points to the HASP plate per the HASP interface manual of the current call.
5. Fasteners: stainless steel M4 bolts with self-locking nuts. Check minimum flight temperature if nylon-insert nuts are used.

(*) Dimension estimated - verify.

HASP - Gamma radiation detector payload

HASP mounting interface
Project: RetaGamma detector
Author: Iker Ambres
Date: 06/11/2026 Rev.: D (draft)
Units: mm Projection: first angle (European)
Size: A3 Scale: -

Project schedule



Key project deliverables:

The following is a list of the key deliverables associated with the proposal. Refer to the project schedule and timeline for delivery dates.

- Complete payload
- Monthly progress reports
- Monthly videoconferences
- Flight Operations Plan
- Final Science Report

Appendix B: NASA Hazard Tables

Appendix B.1 Radio Frequency Transmitter Hazard Documentation

This section is not applicable, as we do not intend to use any RF transmitters.

Appendix B.2 High Voltage Hazard Documentation

This section is not applicable, as we do not intend to use any high voltage circuits.

Appendix B.3 Laser Hazard Documentation

This section is not applicable, as we do not intend to use any lasers.

Appendix B.4 Battery Hazard Documentation

HASP 2024 Battery Hazard Documentation	
Battery Manufacturer	Duracell
Battery Type	CR2032
Chemical Makeup	Lithium / Manganese Dioxide (Li/MnO_2)
Battery modifications	No
UL Certification for Li-Ion	N/A
SDS from manufacturer	https://cdn.prod.website-files.com/6835fa821f0f20d8b0b5850b/697c6f7b631b0a19ef934c93_2026%20Duracell%20Li%20Coin%20AIS_English.pdf Also available on the Internet Archive's Wayback Machine: https://web.archive.org/web/20261108211025/https://cdn.prod.website-files.com/6835fa821f0f20d8b0b5850b/697c6f7b631b0a19ef934c93_2026%20Duracell%20Li%20Coin%20AIS_English.pdf
Product information sheet from the manufacturer	https://www.mouser.com/datasheet/2/490/Duracell_7_4_2023_CR2032L2r_CSFF_R2_A-3225059.pdf Also available on the Internet Archive's Wayback Machine: https://web.archive.org/web/20261108210700/https://www.mouser.com/datasheet/2/490/Duracell_7_4_2023_CR2032L2r_CSFF_R2_A-3225059.pdf

Appendix B.5 Pressurized System Hazard Documentation

This section is not applicable, as we do not intend to use any pressurized systems.