



# HASP Monthly Status Report

**Report Month:** March 2023  
**Submitted by:** Benjamin Dyer  
**Submit Date:** 03 / 31 / 2023  
**Institution:** McMaster University  
**Payload Number:** 2023-01  
**Payload Name:** Electron Spectrometer Telescope

## I) Activities During Previous Month:

### Mechanical

Components for the Collimator Shutter Module (CSM) were acquired for testing. The two motor options are a stepper motor and a DC motor both of which were tested to get torque-current curves. It was determined that the DC motor will operate within the power limits while the stepper motor is near the power limit, more information is contained in section II. CSM designs have been updated to use an electro-holding magnet to hold the shutter open so the motor will not operate continuously throughout the flight, this reduces the continuous power draw of the CSM to ~2.5W. Notes on the hazard table for the magnet are in section V.

### Electrical

The power distribution module schematics have been completed and passed internal review. Layout of the PCB has begun, and we expect the board to be ready for fabrication mid-April. A secondary board is being designed to drive the CSM. This is a simple PCB (one power converter and some housekeeping sensors) and is expected to be ready for fabrication by the end of April. Firmware for the PDM has progressed faster than expected since much of the code has been recycled from the NEUDOSE mission. If progress continues at it's current pace some members may be shifted to working on payload firmware instead.

### Instrument - Hardware

The Data Acquisition Module (DAM) has been completed and is currently undergoing fabrication. The Front-End Module (FEM) passed its schematic review, and the components were laid out. The FEM is undergoing final checks to ensure it is ready for fabrication (PCB only). The instrument structure has continued to be developed and is almost ready for review. The method of assembly has been determined along with how the instrument will interface with the payload's structure. Still undetermined is the spacing between the detector and supporting electronics which will be informed by cabling requirements (especially the bend radius of the rigid-flex cables from the Si detectors).

### Instrument - Firmware

Hiring new firmware members has taken longer than expected. Two new members were hired near the end of March and are currently undergoing onboarding. Code from the previous mission has been collected and modules that can be used for this HASP mission have been identified.

## II) Issues Encountered:

We are concerned that the Collimator Shutter Module (CSM) will draw more than the 15W allocated to our payload. The motor will operate one time for less than 10 seconds shortly after the payload has

launched and is receiving power. The DC motor should remain below the 15W limit, however this design requires a clutch which has yet to be fabricated and tested to ensure it will work reliably. We are more confident in the design using a stepper motor which does not rely on a clutch to open the shutter since when unpowered the torsion spring forces the stepper motor to rotate. However, the stepper motor requires 20-25W to overcome the torsion spring while opening the shutter. Since the design we are most confident in may draw more than the allocated 15W, we would like to discuss increasing our allocated power to 30W from 15W (1A fuse instead of 0.5A fuse).

Some components for the DAM were not in stock when sent for fabrication. These have since either come back into stock or suitable replacements have been found and will be soldered in house (all DIP surface mount components).

### **III) Milestones Achieved:**

- DAM is currently being manufactured
- FEM passed schematic review and is nearly ready for fabrication
- PDM passed schematic review
- Physical testing of CSM components completed

### **IV) Plans for Coming Month:**

#### Mechanical

The CSM design will be finalized by mid-April to allow time to generate the necessary documentation for the preliminary PSIP. Thermal simulations of the CSM will be completed to ensure the motor and electromagnet will not overheat, since there is not significant thermal mass. If the simulations indicate high temperatures on the CSM, solutions to sink heat into the payload structure will be explored.

#### Electrical

The PDM and CSM control module will be ready for review by mid-April and end of April, respectively. The PDM and CSM modules will be sent out for fabrication around the end of April. We anticipate populating the boards in-house to reduce manufacturing times, allowing the boards to be tested in May. PDM firmware will continue to be developed and if time allows libCSP will be implemented to improve reliability of communication between the PDM and instrument.

#### Instrument – Hardware

The FEM will be finalized and sent out for fabrication in the next couple of weeks. Once the board is fabricated it will be populated in house due to the low component count. Testing of the FEM will be carried out using our test housing and the 3 silicon detectors we plan on flying. If the DAM arrives in April, the boards will be put through the functional acceptance test and will be integrated with the FEM to test the instrument in its flight configuration. If time allows, a small vacuum chamber will be set up to test the instrument at low pressure to ensure no arcing will occur due the high voltages (by our calculations the breakdown distance is 1mm at 370V (our maximum voltage is 300V) which should not cause any problems, but physical testing is preferred).

#### Instrument - Firmware

Firmware development will begin using the DAM Rev C from the NEUDOSE mission since the digital architecture is effectively the same. Progress will likely be slow due to only one DAM Rev C board being available. Once the new DAM boards are delivered (expected mid to late April) we will switch over to using them for firmware development. This should line up with onboarding of new members for instrument firmware and HDL to accelerate progress.

**V) Other Comments or Questions for HASP Management:**

1. I was unable to find the Hazard Table for magnets on HASP. The part number we plan to use is the M52180/12VDC, an electro-holding magnet. The data sheet for the part can be found here <https://media.digikey.com/pdf/Data%20Sheets/Eclipse%20Magnetics%20PDFs/Electro%20Holding%20Magnet.pdf>.

**VI) Team Composition and Organization:**

<b>Name <sup>(i)</sup></b>	<b>Start Date</b>	<b>End Date</b>	<b>Role</b>	<b>Student Status</b>	<b>Race <sup>(ii)</sup></b>	<b>Ethnicity <sup>(iii)</sup></b>	<b>Gender <sup>(i)</sup></b>	<b>Disabled</b>
Benjamin Dyer	01/10/22	Present	Student Leader	Graduate	Asian	Non-Hispanic	Male	No
Andrei Hanu	01/10/22	Present	Faculty Advisor	Faculty	White	Non-Hispanic	Male	No
Graham Power	01/10/22	Present	Firmware Lead	Graduate	White	Non-Hispanic	Male	No
Connor Chandran	01/10/22	Present	Electrical Lead	Undergrad	White	Non-Hispanic	Male	No
Patrick Chin	01/10/22	Present	Mechanical Co-Lead	Graduate	Asian	Non-Hispanic	Male	No
Angela Tolis	01/10/22	Present	Mechanical Co-Lead	Undergrad	White	Non-Hispanic	Female	No
Jonathan Wang	01/10/22	Present	Mechanical	Undergrad	Asian	Non-Hispanic	Male	No
Michael Altali	01/10/22	Present	Mechanical	Graduate	Asian	Non-Hispanic	Male	No
Kosta Gianicos	01/10/22	Present	Electrical	Undergrad	White	Non-Hispanic	Male	No
Elijah Menna	01/10/22	Present	Electrical	Undergrad	White	Non-Hispanic	Male	No
Felix Yuan	01/10/22	Present	Electrical	Undergrad	Asian	Non-Hispanic	Male	No
Austin Liu	01/10/22	Present	Firmware	Undergrad	Asian	Non-Hispanic	Male	No
Connor O'Reilly Juarez	01/10/22	03/23/23	Instrument Mechanical	Undergrad	White	Hispanic	Male	No
Xingzhi Cheng	01/10/22	Present	Instrument	Graduate	Asian	Non-Hispanic	Male	No
Larysa Duda	01/10/22	Present	Instrument	Undergrad	White	Non-Hispanic	Female	No

- i. Current NASA guidance requires information from up to date legal documentation (for instance, Driver's License, Passport)
- ii. Accepted options include African-American/Black, Asian, American Indian/Alaskan Native, Native Hawaiian, Pacific Islander, White
- iii. Accepted options are Hispanic on Non-Hispanic.