

REU Research Log

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Week 1:

My primary focus this week has been on how the arty board will be mounted into its own enclosure. As of now the plan is to mount each piece of the payload into its own enclosure with connectors (likely high speed coax cables) on the outside of the enclosure. This way when we receive the board from USCS we can simply connect our board to theirs without hardwiring it in. This allows for greater modularity of the payload and will help should there be any issues with a single item. This week I also assisted in cleaning out the lab so we can begin work in it.

I have been doing research on FAA regulations to make sure that we do not violate them. The relevant regulations are as follows:

- (i) Carries a payload package that weighs more than four pounds and has a weight/size ratio of more than three ounces per square inch on any surface of the package, determined by dividing the total weight in ounces of the payload package by the area in square inches of its smallest surface;
- (ii) Carries a payload package that weighs more than six pounds;
- (iii) Carries a payload, of two or more packages, that weighs more than 12 pounds; or
- (iv) Uses a rope or other device for suspension of the payload that requires an impact force of more than 50 pounds to separate the suspended payload from the balloon.

The first regulation, (i), shouldn't be an issue since some simple calculations show that as long as no side of the payload is smaller than 32in^2 then we will not exceed this regulation. (ii) is more pressing however and we should keep the payload beneath 6lb otherwise we will have to split the payload into two sections which poses many more engineering challenges.

Moving forward I need to ensure that the ARTY board will not overheat during use. From the other team members, I need a test to be run under realistic operating conditions to see just how much power the board consumes. Then, using a laser IR meter I can take the temperature of the board. After knowing the operating temperature, I can design a system to properly heat sink the board.

Week 2:

Not much to do this week on the mechanical side of the LAFTR project. I have been practicing with SolidWorks by drawing up a gondola balloon for another one of Dr. Sample's proposals. I can use Solidworks to help with the design for LAFTR as well, so knowing how to use the program is very helpful.

Week 3:

This week I have looked at mounting the ARTY board in its enclosure. The mounting feet that I ordered seem to work well and the enclosure is also a good fit. Although, the current enclosure is rather heavy. I have been thinking of using a plastic enclosure to save on weight. I could make a custom one and have it 3d printed, although a plastic enclosure is not as good at blocking out noise from the other electrical components. At any rate, I cannot progress too far with building the enclosures/structures since we are still unsure about the size and mass of our components.

I have also been working with the electrical engineering student on getting the power supply together. There are still more questions about whether or not we will use a SIPM or the classic PMT, but for now we are assuming a PMT. We will continue to work towards getting the power supply together, hopefully running the boards and PMT off one lithium ion battery.

Moving forward we need to communicate more with UCSC and maybe hold a virtual meeting with them. This would help tremendously in making sure we work in the same direction that they are.

Week 4:

Finished mechanical concept review for the payload. The main design point for the concept review is noise control. Design wise this means putting all electronic components in separate enclosures so that they do not interfere with each other. I drew up a sketch of one conceivable layout for the payload.

We also got a lab scale this week which allowed me to do some preliminary weight estimations shown here:

Components by Weight

System	Component	Mass (g)	Weight (lb)
Arty			
	Board	81.1	
	Enclosure	335.2	
	SD P-mod	10	
	Arduino	28	
	GPS P-mod x2	18	
PMT			
	Tube	99.5	

	Magnetic shield	102	
	High voltage supply	31	
	D-socket	~30g	
ADELE			
	Board	~100 g	
	Enclosure	~350 g	
Power Supply			
	Battery	~500 g	
	Enclosure	~350 g	
Plastic Case		~300 g	
Foam Box		~300 g	
Total		2634.8	

Allowed 2721 grams

These weights are far from finalized, but give good insight into what we are looking at weight wise. As you can see with this layout we are at 2634 grams which is roughly ~100 grams below our desired 2721 grams (6 lb). This estimation does not include wiring which will have to be shielded for noise protection. That being said, I am overestimating some weights (mainly the aluminum enclosures) and I think we our goal of 2721 grams (6 lb) is achievable.

Moving forward with the mechanical design means that we will need to get the power supply figured out. Details such as battery size and weight are deciding factors for the design. I will continue to work with John Gannon on running power tests and figuring out what sort of battery we need.

Week 7:

This week I have made progress in collecting the hardware necessary to mount the boards. My first approach at mounting the boards involved screwing them down onto a piece of plexiglass then velcroing that plexiglass onto the aluminum enclosure. This method is good for a few reasons: It is easy to remove the boards from the enclosure, there is nothing protruding on the outside of the enclosure, and it seems to be sturdy enough for flight. The downside is that this method takes up an extra quarter inch of space, and that the plexiglass is heavy (weighs 30 grams alone). Weight is going to be a large concern for our project so I don't think that this

mounting technique is the best one. I have also picked up an aluminum pipe which will be used to shield the PMT. I wrapped the PMT in some packing material and slid it into the pipe. This is a simple and lightweight method to protect the PMT during flight. I am looking at getting a magnetic shield for the PMT as well. Me and Gannon have built a voltage divider circuit that can be used to power the PMT as well. We also tested our high voltage power supplies and they work well. We believe that we are ready to power up the PMT and run some tests with that, but we still want to check with Dr. Sample to make sure we are doing things correctly.

In the future I plan to run noise tests on the components, specifically the PMT. For this I will need a lightning generator or something of the sort to simulate flight conditions. Also, I need to design a new way to hold all the enclosures together. A large aluminum shell is too heavy for our purposes, so there needs to be a lighter way to keep things together.