

RICE® ECLIPSE

Fall 2020 Semester Report



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Fall 2020 President's Letter

Dear Friends of Rice Eclipse,

I hope you had a safe and restful holiday break. My name is Jeffrey Michel, and I am the president of Rice Eclipse for the 2020 - 2021 academic year. Now that the fall semester has finished and we are turning the page to a new year, I wanted to take a moment to update you on the team's accomplishments these past few months.

The Fall 2020 semester was in many ways the most challenging semester ever faced by Rice Eclipse. Along with the rest of the world, we have had to adapt our work and our procedures to keep our members and the Rice community safe from COVID-19. On top of this, our technical goals for the academic year are loftier than ever before. I am proud to say that the team has risen to meet both challenges.



At the beginning of the academic year, Rice Eclipse committed to building our largest, fastest, highest-flying rocket yet. Eclipse's 2021 Spaceport America Cup competition rocket, named Athena, will compete in the 30,000 ft commercial solid motor category of the competition this summer. Through Zoom design sessions and rotating machining shifts to maintain safe distancing, Eclipse's Aerodynamics team completed the design of Athena this fall semester, and made significant progress manufacturing the carbon composite airframe. In addition to COVID-19 safety, the team worked around the added challenges of a 30,000 ft target altitude and supersonic flight, building off the lessons learned from our Noctua III competition rocket and implementing new design solutions such as a carbon composite boat tail and an extended motor bay to achieve the higher altitude. The final Athena design is over 12 ft tall and will reach speeds up to Mach 1.67. It will carry a CubeSat format vibration research payload built in collaboration with Dr. Matthew Brake's lab here at Rice. Manufacturing of Athena will be complete in the first half of the spring semester, with a test flight in March.

This semester, Rice Eclipse also completed the design and began manufacturing of the team's Titan II hybrid rocket engine. Titan II is Eclipse's first student-developed hybrid rocket engine optimized for flight, and it will power the team's Spaceport America Cup competition rocket in 2022. The engine passed its critical design review in November, and the first components for the engine's oxidizer tank were sent out for machining in December. Simultaneously, Eclipse's Propulsion team has been diligently preparing procedures and hazard analyses for Titan II's upcoming test campaign, including hydrostatic tests, cold flow tests, and a short-duration hot fire next semester. The propulsion team also successfully hot-fired our smaller Luna hybrid engine this semester, having successfully resolved the engine's injector anomaly from its spring 2020 hot fire test. Luna continues to provide the propulsion team with valuable fuel grain regression rate data to inform the design of Titan II, and a platform for our members to practice engine test procedures.

Fall 2020 President's Letter

Luna's first test next semester will be controlled by Eclipse's brand new student-designed data acquisition and control system, named ARCA. This fall, our Avionics team finished the last remaining ARCA design work and fully fabricated the controller's main board. ARCA significantly expands the team's sensor data collection and valve control capabilities, allowing us to collect more data from more complex engine systems. The full ARCA box is almost complete, and will be finished within the first few weeks of the spring semester for use on both Luna and Titan II.



Team Picture at Tripoli Houston's November Launch

Last but not least, our high-powered rocketry certification program successfully helped twelve of our members earn their Level 1 certifications with reworked, COVID-safe build and transportation logistics. All of our members earn their certifications through the Tripoli Rocketry Association's Houston chapter, and we appreciate their support. The certificates program lets our new members learn the basics of rocketry, gets their hands on hardware, and helps our existing members expand their rocketry knowledge to prepare them for our competition rocket projects.

I am extremely proud of the team for accomplishing so much this semester while keeping our members safe from the risks of the pandemic. They worked through technical and public health challenges to set us up for an exciting spring semester as our major hardware projects come to fruition. None of our work would be possible without the generous support of our sponsors, who helped us raise over \$20,000 this fall to fund the most ambitious slate of projects in Rice Eclipse's history. Your continuing support is vital to the success of the team, so thank you so much for contributing. And thank you all for your technical and moral support of the team over the years. We are excited to continue our work next semester!

Warm regards,

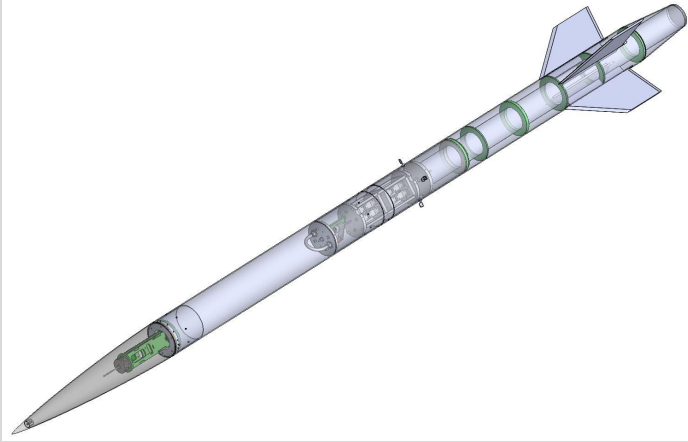
A handwritten signature in black ink, reading "Jeff R. Michel". The signature is written in a cursive style.

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Semester Highlights

Athena Design and Manufacturing

The Aerodynamics team completed the design of Athena, our 2021 Spaceport America Cup rocket, and began fabricating the rocket's carbon composite airframe.



Athena CAD Rendering



Manufacturing Athena's Airframe

Titan II Passes Critical Design Review

The Propulsion team completed a critical design review of our flight-optimized Titan II hybrid rocket engine. Manufacturing of the engine's oxidizer tank began in December.



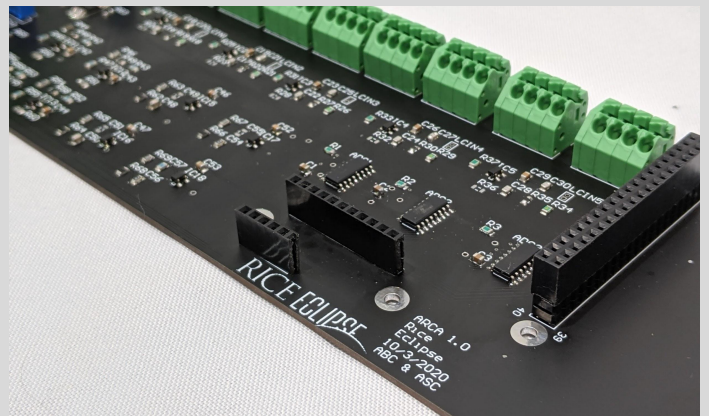
Machining Oxidizer Tank Bulkhead

ARCA Board Fabrication Complete

The Avionics team finished fabricating the main board of ARCA, Eclipse's new data acquisition and control system.



Assembling ARCA



Finished ARCA Board

Semester Highlights

Level 1 Certification Launches

Rice Eclipse members went out for test launches with their own rockets in October and November. With the help of Tripoli Houston, twelve of our new members were awarded their Level 1 high powered rocketry certification. Congratulations!



Fall Certification Launches

Luna Rocket Engine Hot-Fire

The revival of our 50 lb thrust Luna hybrid engine has been highly anticipated since the sudden halt to testing last spring due to an anomaly with an experimental impinging injector. The Propulsion team returned Luna to regular service in October with a successful hot-fire test.



Luna Hot-Fire

Noctua III Flight Test Attempt

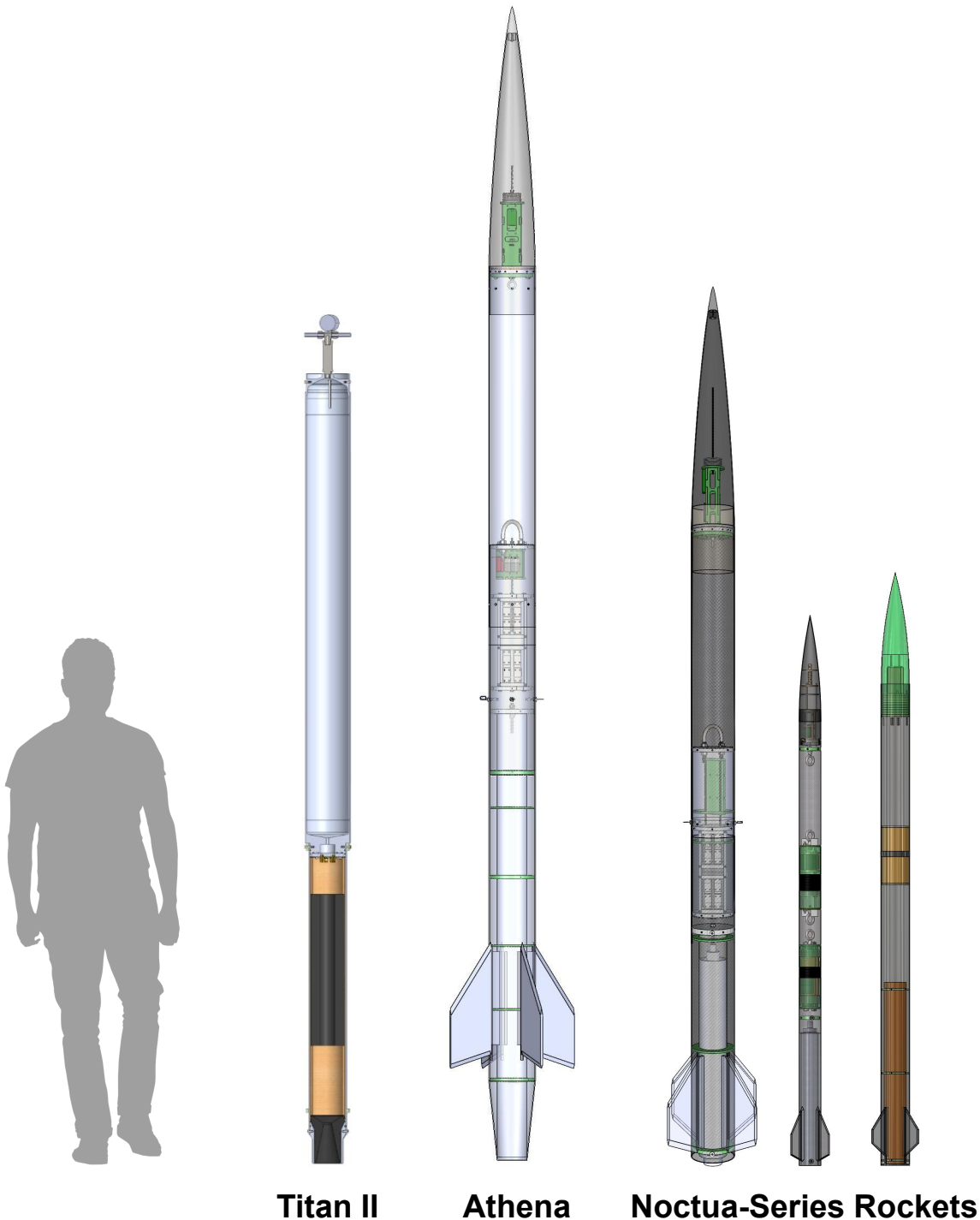
The Aerodynamics team fully integrated our 2020 Spaceport America Cup rocket, Noctua III, for an attempted flight test in November. The test was ultimately scrubbed due to weather, but provided good practice with launch-day procedures. The team will attempt another test this spring.



Noctua III Fully Assembled

Spring 2021 Trajectory

This spring will be an exciting semester for Rice Eclipse. Our Aerodynamics team will finish manufacturing Athena, conduct separation and flight testing, and will compete in the 2021 Spaceport America Cup this June. Our Propulsion team will finish manufacturing Titan II and will complete the engine's first hydrostatic, cold-flow, and hot-fire tests. Last but not least, our flagship Avionics team project ARCA will finish assembly and will debut at the first Luna engine test of the semester. We can't wait to get started!



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