May 29, 2020

Dear Friends of Rice Eclipse,

I hope you and your loved ones are safe and well amidst the COVID-19 pandemic. My name is Jeffrey Michel, and I am the newly-elected President of the Rice Eclipse Rocket Team for the 2020 - 2021 academic year. Now that the spring semester has come to an end, I wanted to take the opportunity to update you on the team's accomplishments over the past months. It is a pleasure to be able to write this letter to you, though I wish it were under better circumstances.

Rice University transitioned to fully-remote learning and sent almost all students home for the semester starting March 23rd. In spite of this unprecedented mid-semester transition, Eclipse's members achieved significant milestones on our projects both on-campus at the start of the semester and off-campus via remote work from their homes all over the world. While at Rice, our Aerodynamics team completed the first full integration of our 2020 Spaceport America Cup rocket, Noctua III, slated to compete in the 10,000 ft altitude, commercial-off-the-shelf solid motor category of the competition. This integration included the rocket's fully-functional CubeSat-style scientific payload that will perform an in-flight vibration damping experiment in collaboration with Dr. Matthew Brake's laboratory in Rice's Mechanical Engineering Department.

Noctua III is the first step in Eclipse's three-year effort to launch a rocket powered by our flight-optimized hybrid rocket engine Titan II to 30,000 ft altitude in the 2022 Spaceport America Cup. Noctua III will be followed by our 2021 Spaceport America Cup rocket, which will build off lessons learned from Noctua III to fly to 30,000 ft using a commercial solid motor. The lessons learned from the 2021 rocket will in turn be used to construct our 2022 Spaceport America Cup rocket powered by our own hybrid rocket engine. Though our planned test flights of Noctua III this semester and the entire 2020 Spaceport America Cup this summer were cancelled due to the pandemic, designing and constructing Noctua III has been an immensely valuable experience to the team. The rocket incorporates several key technologies needed by the team to launch to 30,000 ft next year. One example of this is the Ejector Connector pyrotechnic parachute release mechanism used by Noctua III. The Ejector Connector successfully completed a set of flight tests at the start of the semester. These successful flight tests were the culmination of two years of work by the team to develop Eclipse's first student-researched and developed single-separation parachute deployment system, a critical technology for rockets flying to 30,000 ft and rockets powered by large hybrid rocket engines. Though it won't take to the desert skies at Spaceport America this summer, Noctua III will fly in a test launch this coming fall to prove out the system and collect valuable in-flight performance data to inform the design of our 2021 Spaceport America Cup rocket.

While on-campus, the Aerodynamics team's certificates program also helped seven Eclipse members earn their high-power rocketry certifications. Five members earned Level 1 certifications and two members earned Level 2 certifications through the Tripoli Rocketry Association's Houston Chapter. As always, we greatly appreciate their support and mentorship for our certificates program, which is the gateway for all our new members to learn the fundamentals of rocketry by building a high-power rocket for themselves.

Not to be outdone, Eclipse's Avionics team finished the hardware design of its new controller for hybrid engine tests and ground operations, named ARCA. ARCA is a completely new engine controller that can support significantly more sensors and actuators than Eclipse's current engine controller. ARCA also fixes several bugs present in Eclipse's old engine controller, and includes several design improvements that make setup much easier during tests. This new hardware will be used alongside the team's new data acquisition and analytics software package called RESFET (Rice Eclipse Software For Engine Testing) on all future hybrid engine tests once the hardware buildup is complete next fall. The Avionics team has also continued ground tests and certificates rocket flight tests of its real-time telemetry and communication system, RTR (Real-Time Rocket). This is the team's first step towards developing a full flight computer for Eclipse's competition rockets.

Last but not least, the Propulsion team completed a critical design review of its Titan II hybrid rocket engine at the start of the semester. This 800 lb thrust engine is the flight-optimized variant of the team's original Titan rocket engine, and it will power Eclipse's 2022 Spaceport America Cup rocket to 30,000 ft. The team used feedback from the design review to complete a second design cycle of the engine. This second design cycle produced key improvements to the engine including an integrated thrust chamber and oxidizer tank bulkhead to save mass, updates to the combustion chamber assembly to ease integration with the airframe, and several design changes to improve machinability of components. The

updated design will be fully documented by the end of June, and Titan II will move into manufacturing next fall, culminating in a cold-flow test of the engine at the end of the fall semester. The Propulsion team's 50 lb thrust Luna hybrid rocket engine also continued testing while the team was still on-campus. The engine was used to test Eclipse's oxidizer pressurization system and a new impinging injector plate design. The Propulsion team also used fuel grain regression rate data collected from Luna tests to develop a regression rate model for Eclipse's hybrid rocket fuel mixture. This model was used to improve the design of Titan II's fuel grain and combustion chamber during Titan II's second design cycle, which is a perfect example of Luna's value as Eclipse's quick-turnaround testbed for hybrid engine technologies. The Propulsion team has continued to design experiments for Luna that will be used to improve Titan II while working from home.

Finally, beyond our technical work, Eclipse also attended the 2020 Owls in Space Symposium. Though many of our usual outreach events were cancelled due to the pandemic, attending the Symposium gave us the chance to engage with the Houston aerospace community and present our work to industry leaders.

I'd like to thank each of you for your continuing support of Eclipse even in the midst of these uncertain times. You are providing Rice University students with an unrivaled aerospace design experience and the opportunity to learn the engineering and leadership skills that will propel their careers beyond Rice. The accomplishments made by all three of Eclipse's teams are only possible with the support of our sponsors. Your continuing support is vital to our success - thank you so much for contributing. We are very excited to continue our work next semester!

Warm regards,

Jeffrey Michel

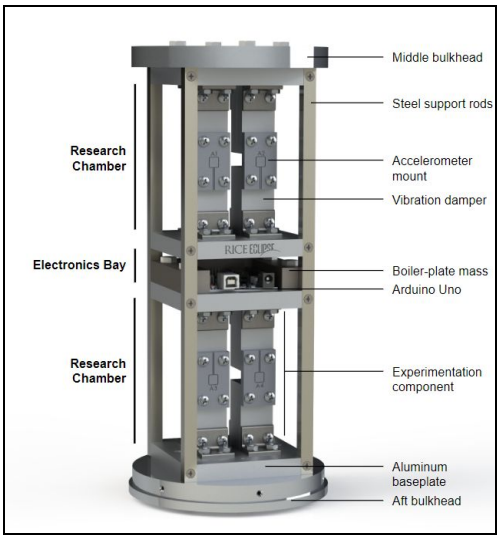
President, Rice Eclipse Rocket Team

jrm20@rice.edu | eclipse.rice.edu

Ejector Connector successful test flight

Composites team post-processing Noctua III airframe

Assembled Noctua III

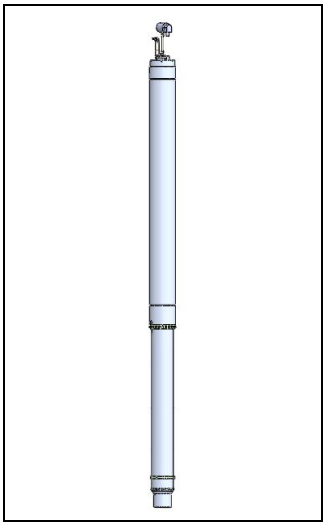


Noctua III research payload assembly

Noctua III full integration

2019 - 2020 team picture

Luna engine assembly



Titan II updated design

Thank you to our sponsors: DaVinci Maker Labs, First Mode, Rice Center for Engineering Leadership, Rice Engineering Alumni, Rice Oshman Engineering Design Kitchen, Rice SA Initiative Fund, Rice Space Institute, SEDS USA, Texas Space Grant Consortium, ExxonMobil, Viasat, and our many individual donors.