# Level 3 Rocket as a Payload Testing Platform

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## Abstract

The Payload and Integration Lab student team located in the College of Aviation, has been working on the design and construction of a Level 3 rocket capable of carrying a payload to a target altitude. The payloads consist of NanoLabs ranging from 1U (10 cm x 10 cm x 10 cm) to 6U. Each 1U NanoLab can be as heavy as 1 kg. The maximum payload weight is 6 kg. The construction of this rocket follows the certification process provided by the National Association of Rocketry (NAR). The Level 3 rocket is a continuation of previous research conducted at the university. This rocket will allow to assess the performance of future suborbital payloads under the effects of large accelerations, decelerations, vibrations, and impact loads during landing. The overall dimension of the rocket is 17 ft. in length, 10.85 inches in diameter, total wet mass of about 38 kg, and maximum altitude of 21,000 ft..

Level 1 Rocket Launch

Level 2 Rocket Launch

Level 3 Rocket Team with ERAU President

## Previous Work

The student team launched Level 1 and Level 2 rockets with a 3D printed capsule that carried the CRExIM payload (ERAU first Suborbital Payload) to an altitude of 3,700 ft. and 7,500 ft. respectively. The Level 1 rocket carried the CRExIM payload on a capsule that was designed, 3D printed, and tested during the launch. A second generation of the capsule has been designed to house these NanoLabs. All the research that has gone into the Level 1 and Level 2 rockets has further helped the team to design, develop, and construct the Level 3 rocket.

## Future Work

. Finalize Construction (School Year 2018—2019)

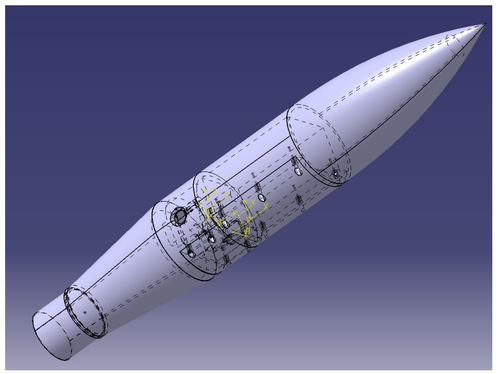
. Launch Test (School Year 2018—2019)

. Launch 1st Payload (School Year 2018—2019)

## Methodology

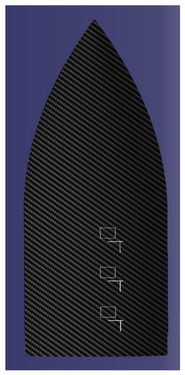
The development of the CAD model of the Level 3 rocket is done using CATIA software. The model is then tessellated to generate an STL file format. This file can then be 3D printed to create a test model. The 3D printers used in the laboratory are MakerBot 2X, Raise3d N2, and Formlabs. The materials used to print the capsule first and second generation is ABS plastic. The third generation will be ABS premium plastic reinforced with carbon fiber fabric.


Level 1 Rocket Capsule



Level 2 Rocket Capsule CAD Design

Level 2 Actual Prototype



Level 3 Rocket Capsule

## Preliminary Results

The results from calculating the apogee altitude for different 1u configuration payloads show that the maximum altitude expected is 21,000 ft. for a 1U payload and 11,000 ft. for a 6U payload. The motor chosen for the launch is the Pro 150 O5800 White Thunder with a total impulse of 30,601 Ns, average thrust of 5,802 N, and burn time of 5.27 seconds. OpenRocket software was used to simulate the flight profile and the loads expected during the launch.


Level 3 Rocket Sections

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