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WOLFSAT-1: A 1U CUBESAT TO MONITOR ENZYME ACTIVITY OF IDEONELLA SAKAIENSIS IN THE MICROGRAVITY

Abstract

The Wolfpack CubeSat Development Team (WCDT) proposed the flight of the 1U WolfSat-1 to the Firefly DREAM program in October 2023 and it has since been selected for launch on a Firefly Alpha launch vehicle in 2025. The mission of Firefly Aerospace is to make space attainable for individuals of all ages. As a result, their DREAM 2.0 program was created to provide student teams with launch opportunities as excess payload capacity on their Alpha Launch Vehicle.

The primary mission of the WolfSat-1 is to assess the on-orbit viability of the bacteria Ideonella sakaiensis. A secondary mission seeks to validate the team's novel microfluidic payload and to educate pre-college students through real-world aerospace experiences. This paper will address the sustainability issues that single-use plastics pose and will provide an in-depth discussion about the impacts thatWolfSat-1 will have on future long-term spaceflight missions. The WolfSat-1 will be built upon a 1UFastBus structure developed by Near Space Launch, Inc. (NSL). This FastBus contains an EyeStar-S3Simplex Communications System, live data access via the online NSL Console, five fixed solar arrays, electrical power system with batteries, Flight Processor, Anodized Aluminum Chassis, inhibit switches, and harnessing for external NSL systems.

Researchers have discovered Ideonella sakaiensis is capable of digesting polyethylene terephthalate (PET), which is a common component of single-use plastics. Wolfsat-1 will assess the efficacy of I. sakaiensis' ability to digest PET and similarly related plastics via specific enzyme pathways PETase and MHETase. This experiment will quantify PET consumption via a light-emitting diode and photodetector. Once the experiment begins, the I. sakaiensis will begin digesting the sample as the light-emitting diode is lit against one side of the polymer sample. As I. sakaiensis digests the sample, it will deteriorate, allowing continually larger amounts of photons to be transmitted, increasing the sensor signal to the microcontroller. The mission will be deemed successful if the CubeSat transmits data through the dashboard providing data to compare the ground studies with the microgravity results. If successful, this mission

will impact long term space and earth sustainability, determining whether the metabolic enzyme kinetics of Ideonella sakaiensis align with the results of previous studies on bacteria's behavior in microgravity that suggest up to a 25-30