Purpose of Experiment

Introduction

Astro Digital ("Astro Digital") has designed a non-geostationary orbit ("NGSO") microsatellite (the "Protostar" spacecraft) on behalf of Star Catcher Industries, Inc. ("Star Catcher") to operate in Low-Earth-Orbit (LEO). The Protostar mission is to demonstrate on-orbit optical power beaming by acquiring, tracking, and transmitting laser radiation to a deployable CubeSat. Using an onboard acquisition, tracking, and transmission system, Protostar will conduct both beacon-guided and beaconless tracking experiments to deliver and measure optical power to the CubeSat's solar arrays and measure the resulting power transfer performance.

Star Catcher seeks authority to operate Protostar beginning no earlier than October 1, 2026, with a launch vehicle integration date no later than July 1, 2026. The nominal mission length is three years, with a spacecraft lifetime capability of up to five years. Protostar is a microsatellite based on the Astro Digital Corvus-Micro platform, and will be deployed by SpaceX's Transporter-18 launch vehicle at an altitude of approximately 510 +/- 15 km.

Protostar will deploy a CubeSat referred to as "Protocatcher" as part of this experiment. The Protocatcher CubeSat will be the subject of a separate filing by its manufacturer NearSpace Launch, Inc. on behalf of Star Catcher.

Upon completion of its missions, Protostar will passively de-orbit into the Earth's atmosphere in a manner consistent with the Commission's rules.

Mission Description

During this mission, Star Catcher will demonstrate the optical power transmission capabilities of the Protostar spacecraft and collect performance data to inform future system development. Below is a detailed description of the Protostar mission. Astro Digital will perform satellite operations on behalf of Star Catcher.

Once deployed, Protostar will establish contact with its ground station network for telemetry, tracking, and command ("TT&C") communications.

Protostar will be launched no earlier than October 2026 on the Transporter-18 rideshare mission. The spacecraft will be injected into an orbit of approximately 510 km in a Sun-Synchronous Orbit ("SSO"). At the injection orbit, Astro Digital and Star Catcher will conduct a thorough and extensive evaluation and systems check of the spacecraft bus, communications subsystems, propulsion system, and optical acquisition and tracking payload to confirm nominal performance.

Once Astro Digital confirms that Protostar is operating nominally, it will deploy the Protocatcher CubeSat and begin its mission of conducting optical acquisition, tracking, and power beaming experiments. These experiments will demonstrate the feasibility of space-based optical power transfer and enable evaluation of acquisition accuracy, tracking stability, and power delivery efficiency under operational conditions.

Upon completion of the demonstration phase, Protostar will conclude mission operations and be passivated consistent with orbital debris mitigation requirements.

Satellite Description

Protostar Microsatellite

The Protostar spacecraft is a microsatellite manufactured by Astro Digital for Star Catcher with a mass of 70 kg. Protostar will receive signals from the ground in the 2025-2110 MHz range ("S-band") and transmit in the 400.15-401 MHz band ("UHF") and the 8025-8400 MHz band ("X-band").

Protostar includes a ThrustMe NPT electric propulsion system that enables orbit maintenance, relative positioning for optical experiments, and maneuvering capability if required.

Protostar is equipped with two UHF whip antennas, two S-band patch antennas, and an X-band transmit antenna. These antennas support TT&C and payload communications throughout the mission.

Technical Description

Earth Station Network

Protostar will also communicate with authorized earth station networks for TT&C and data communications. Below is an overview of the third-party ground network that will support the Protostar Mission.

Type	Earth Station Location/Operator	Coordinates	Provider
S-band (Uplink), UHF (Downlink)	Tromso, Norway	69.663, 18.94	KSAT
S-band (Uplink), UHF (Downlink)	Deadhorse, Alaska	70.201, -148.46	RBC
UHF (Downlink)	Fairbanks, Alaska	64.908, -147.705	RBC
S-band (Uplink), UHF (Downlink)	Pretoria, South Africa	-25.861, 28.453	RBC
S-band (Uplink), UHF (Downlink)	Santa Maria, Azores, Portugal	36.998, -25.137	Leaf

S-band (Uplink), X-band (Downlink)	Blönduós, Iceland	65.648, -20.238	Leaf
S-band (Uplink), X-band (Downlink)	Awarua, New Zealand	-46.528, 168.379	Leaf
S-band (Uplink), X-band (Downlink)	Punta Arenas, Chile	-53.041, -70.847	Leaf

Spectrum Use

Below is an overview of the planned frequency use for the Protostar microsatellite. The overview identifies the planned nature of the frequency use as well as other relevant technical considerations.

Coordination with Federal Systems

Star Catcher recognizes that all of the bands in which it seeks to operate in will require coordination with U.S. Federal agencies. Star Catcher has commenced this coordination prior to filing this application and understands that it must finalize the coordination agreements before receiving a Commission authorization.

Star Catcher anticipates being able to successfully coordinate its proposed frequency use. The characteristics and timetable of Star Catcher's proposed use of spectrum are limited and consistent with other commercial missions that have been able to complete coordination with Federal agencies.

Band-by-Band Analysis

UHF Downlink (400.15-401 MHz)

Protostar will transmit signals in the 400.15-401 MHz band for TT&C. Star Catcher is currently coordinating operations around a center frequency of 400.5 MHz.

Star Catcher recognizes that its use of this band will be permitted only on a non-interference basis. Star Catcher will also coordinate its use of this band with the necessary federal agencies.

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
UHF1	60	400.5	Linear

S-Band Uplink (2025-2110 MHz)

Protostar will receive command signals in the 2025-2110 MHz band. Star Catcher understands that all operations in this band will be on a non-interference basis. Star Catcher will coordinate its planned use of the band with U.S. Federal agencies to ensure that it does not cause harmful interference. The short-term duration of the mission, along with the limited duty cycle, and the use of software defined radios should facilitate coordination in an available band segment.

Star Catcher will seek to operate two center frequencies in S-band, one for TT&C and another for data uplink. These channels will be technically identical. The following table identifies the potential center frequency in S-band for the Protostar microsatellite. Star Catcher is currently coordinating operations around center frequencies of 2055 MHz (SB1) and 2047.5 MHz (SB2).

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
SB1	300	2055	RHCP
SB2	5000	2047.5	RHCP

X-Band Downlink (8025-8400 MHz)

Protostar will transmit payload and experiment data in the 8025-8400 MHz band. Star Catcher is currently coordinating operations around a center frequency of 8300.0 MHz.

Star Catcher will seek to operate channels around its center frequency in X-band downlink, for data downlink. These channels will be technically identical. The following table identifies the center frequency in X-band downlink for Protostar, which Star Catcher is coordinating with Federal Government spectrum users.

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
XB1	50000	8300.0	RHCP

Antenna Beam Projections

Predicted antenna gain contours for each transmit and receive beam are provided in a separate technical exhibit submitted with this application (see *Antenna Beam Projection Report*, attached).

The attached report includes graphical depictions of antenna beam coverage over the Earth's surface, as well as the associated gain contour data and parameters for each beam and service support point (SSP).

The contours reflect the operational characteristics of the Protostar system, including antenna design and orbital altitude.

Interference Showings

8025-8400 MHz

The Commission's rules do not specify a PFD limit for the 8025-8400 MHz band. However, rule No. 21.16 of the International Telecommunication Union (ITU) Radio Regulations does. Star Catcher has calculated the maximum PFD levels for transmissions from Protostar in accordance with these ITU PFD limits.

NOAA Authorization

Star Catcher will submit a NOAA application for its Protostar microsatellite. Star Catcher will provide the Commission with confirmation once a NOAA license has been granted, or, alternatively, if it is determined that a NOAA license is not required for the Protostar mission. NearSpace Launch is expected to receive confirmation from NOAA that a remote sensing license is not required for its proposed Protocatcher Cubesat operations on behalf of Star Catcher. Star Catcher will provide that confirmation as an attachment to its application.

Orbital Debris Mitigation

Star Catcher has designed the Protostar microsatellite to comply with the Commission's orbital debris regulations and affirms that all operations will comply with 47 C.F.R. 5.64 of the Commission's Rules. Below, Star Catcher provides an overview of how Protostar will meet the Commission's orbital debris rules, including the provision of an Orbital Debris Assessment Report that demonstrates that Star Catcher's satellite will not exceed any of the limits set forth by the Commission rules.

Star Catcher will register Protostar with the Joint Space Defense Squadron.

Orbital Debris Assessment Report

Star Catcher has provided an Orbital Debris Assessment Report (ODAR) with this application and has also included debris mitigation strategies related to debris release, small debris, accidental explosions, collision risks with large objects, trackability, planned proximity operations and its post-mission disposal plans.