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June 3, 2021

FCC Office of Engineering and Technology
445 12th Street SW Washington, DC 20554

SUBJECT: CIRBE cubesat mission (FCC application # 0439-EX-CN-2021)

Please find details on the CIRBE cubesat mission included below.

Date license is required: October 1st, 2021
LV integration date: April 1st, 2022
Launch date: June 1st, 2022
Date for initiation of on-orbit operations: June 1st, 2022
Expected mission duration: 12 months base

Principle Investigator for the mission.

Point of Contact Name: Dr. Xinlin Li
Organization Name: University of Colorado
Address: 1234 Innovation Dr., Boulder, CO
E-Mail: xinlin.li@lasp.Colorado.EDU
Telephone Number: 303-492-3513

Technical point of contact for the mission.

Point of Contact Name: Rick Kohnert
Organization Name: University of Colorado
Address: 1234 Innovation Dr., Boulder, CO
E-Mail: kohnert@colorado.edu
Telephone Number: 303-492-6804

*please also include Dr. Xinlin Li on any relevant communications.

Point of contact who can terminate ALL satellite transmissions if interference is detected.

Point of Contact Name: Scott Palo
Organization Name: University of Colorado
Address: 3775 Discovery Dr., Boulder, CO
E-Mail: palo@colorado.edu
Telephone Number: 303-492-4289

*please also include Dr. Xinlin Li and Rick Kohnert on any relevant communications.

Point of contact who can terminate ALL Boulder CO ground station transmissions if interference is detected.

Point of Contact Name: Rick Kohnert
Organization Name: University of Colorado
Address: 1234 Innovation Dr., Boulder, CO
E-Mail: kohnert@colorado.edu
Telephone Number: 303-492-6804

*please also include Dr. Xinlin Li on any relevant communications.

Point of contact who can terminate ALL Fairbanks AK ground station transmissions if interference is detected.

Point of Contact Name: Rick Kohnert
Organization Name: University of Colorado
Address: 1234 Innovation Dr., Boulder, CO
E-Mail: kohnert@colorado.edu
Telephone Number: 303-492-6804

*please also include Dr. Xinlin Li on any relevant communications.

Point of contact for conjunction alerts.

Point of Contact Name: Rick Kohnert
Organization Name: University of Colorado
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Telephone Number: 303-492-6804

*please also include Dr. Xinlin Li on any relevant communications.

Project Description

The primary objective of Colorado Inner Radiation Belt Experiment (CIRBE) is to understand better the formation and decay of the inner belt electrons (100s of keV to multiple MeV), and to determine the intensity and dynamic variations of these electrons with a state-of-art instrument fitted into a CubeSat in a highly inclined low Earth orbit (LEO). These results will help to better understand the space weather effects of these energetic particles to spacecraft subsystem and the radio propagation environment through the ionosphere. The ionosphere density variation, which affects radio propagation, is closely correlated with the precipitation of the energetic electrons. The CIRBE measurements will be used to gain a better understanding of the space environment.

CIRBE is in some ways similar to our previous very successful Cubesat (CSSWE) but differs in that it will have extreme fine energy resolution (100s of energy channels instead of 6). We propose to advance the existing instrument design by incorporating full pulse height analysis (PHA) and additional anti-coincidence technique, such that it will have the fine energy resolution plus much cleaner measurements, but still fit in a 3U CubeSat. PHA will be performed onboard and only the final results: intensity, energy spectrum, pitch angle distribution (PAD) will be downloaded.

License Details

The CIRBE mission will utilize a SpaceQuest TRXU UHF radio operating a half-duplex uplink and downlink at 437.250MHz. CIRBE will also include a Blue Canyon Technologies SDR-S S-band radio operating at 2402MHz that will be used as a data transmitter nominally operating at 1Mbps. Both frequencies have been coordinated with the IARU (see attached coordination letter).

Additional data required for applications requesting use of federal or shared government frequencies.

Spacecraft: CIRBE

Non-geostationary satellite

Inclination: 97° Apogee: 500 km Perigee: 500 km

SSO LTAN : N/A – Not SSO orbit

Orbital period: 94.6 min

Number of satellites in the system: 1

Number of transmitting satellites: 1

Number of transmitting satellites: 1

Transmitter #1 (UHF)

Center Frequency: 437.250MHz

Bandwidth: 30kHz

3dB beamwidth: 300° (Maximum Antenna Gain: 2dBi)

Polarization: Linear

Maximum transmit power: 2 W

ERP¹: (2.85 dBW) 1.93 mW

Modulation: GFSK

ITU emission designator: 30K0G2DCN

Transmitter #2 (S-band)

Center Frequency: 2402 MHz

Bandwidth: 1MHz

3dB beamwidth: 80°

Maximum Antenna Gain: 6.8dBi

Polarization: RCP

Maximum transmit power: 2W

ERP: 7.65 dBW (5.82 W)

Modulation: OQPSK

ITU emission designator: 1M00G2DCN

¹ ERP = EIRP – 2.15dB

Receiver #1 (UHF)

Center Frequency: 437.250MHz

Bandwidth: 30kHz

3dB beamwidth: 300⁰ (Maximum Antenna Gain: 2dBi)

Polarization: Linear

Receiver Sensitivity: -110dBm

Modulation: GFSK

ITU emission designator: 30K0G2DCN

Ground Station #1:

Boulder, CO 80309

40° 00' 32" N, 105° 14' 52" W

Altitude above MSL [m]: 1588

Antenna height above ground [m] : 3 above roof top.

Elevation: 0-90⁰ (min V00 for UHF and V10 for S-Band) Azimuth: 0-360⁰

Transmitter #1 (UHF)

Center Frequency: 437.250MHz

Bandwidth: 30kHz

3dB beamwidth: 13⁰

Maximum Antenna Gain: 22dBi

Polarization: RCP

Maximum transmit power: 500W

ERP: 44.8 dBW (30.5 kW)

Modulation: GFSK

ITU emission designator: 30K0G2DCN

Receiver #1 (UHF)

Center Frequency: 437.250MHz

Bandwidth: 30kHz

3dB beamwidth: 13⁰

Maximum Antenna Gain: 22dBi

Polarization: Linear

Receiver Sensitivity: -110 dBm

Modulation: GFSK

ITU emission designator: 30K0G2DCN

Receiver #2 (S-band)

Center Frequency: 2402MHz

Bandwidth: 1MHz

3dB beamwidth: 2.1°

Maximum Antenna Gain: 38dBi

Polarization: RCP

Receiver Sensitivity: -110dBm

Modulation: OQPSK

ITU emission designator: 1M00G2DCN

Ground Station #2:

Fairbanks, AK 99709

65° 7' 33"N 147° 29' 27"W

Altitude above MSL [m]: 142

Antenna height above ground [m] : 5.5m

Elevation: 0-90° (min V00) Azimuth: 0-360°

Transmitter #1 (UHF)

Center Frequency: 437.250MHz

Bandwidth: 30kHz

3dB beamwidth: 18°

Maximum Antenna Gain: 19dBi

Polarization: RCP

Maximum transmit power: 500W

ERP: 41.7 dBW (15.1 kW)

Modulation: GFSK

ITU emission designator: 30K0G2DCN

Receiver #1 (UHF)

Center Frequency: 437.250MHz

Bandwidth: 30kHz

3dB beamwidth: 18°

Maximum Antenna Gain: 19dBi

Polarization: Linear

Receiver Sensitivity: -110 dBm

Modulation: GFSK

ITU emission designator: 30K0G2DCN