

Solar Flare and Ionosphere Explorer (SoFIE)

Citizen Science Opportunity for Amateur Radio Operators

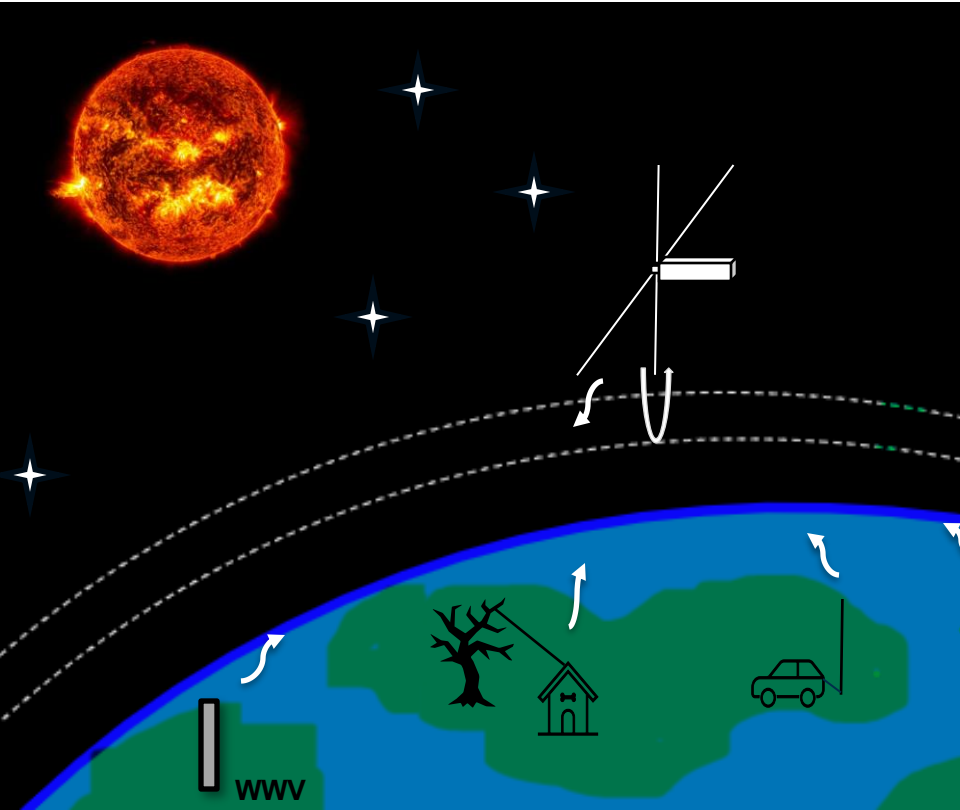
March 15, 2026

Dr. Lanika Ruzhitskaya, Saint Francis University
Dr. Nathaniel Frissell (W2NAF), University of Scranton
Dr. Kornyanat Hozumi, University of Scranton
Dr. Jeffrey Mendenhall, MITLL





Solar Flare and Ionosphere Explorer (SoFIE)



Mission

Undergraduate and High School STEM

Scientific Objective

Study coupling between solar flares and Earth's ionosphere

Approach

3U CubeSat w/ HF instrument (3-30 MHz), 500 km polar orbit
Transionospheric radio propagation experiments w/ amateur radio community

Launch

No earlier than late 2027



Science Objective

- To study the effects of solar flare interaction with the Earth's ionosphere
 - How does the ionosphere respond to solar flares?
 - How does the ionosphere recover from solar flares?
- Solar flares are an intense, sudden bursts of radiation from the surface of the Sun that occur when large amounts of magnetic energy are released near sunspots or active regions
 - EUV and X-ray production increases electron density in the F-Layer and ionizes the D-Layer, respectively
 - Coronal mass ejections (CME) and associated geomagnetic storms can also significantly affect the F-Layer and the polar regions
- SoFIE will measure the impact of solar flares on the ionosphere through transionospheric radio propagation experiments





SoFIE Components

Payload

HF Instrument

Soft X-ray Sensor (Chestnut Ridge High School)

Aurora Camera (Altoona Area High School)

630nm Camera

Spacecraft Bus

Solar panels

Battery

On-board computer

UHF / S-band radios

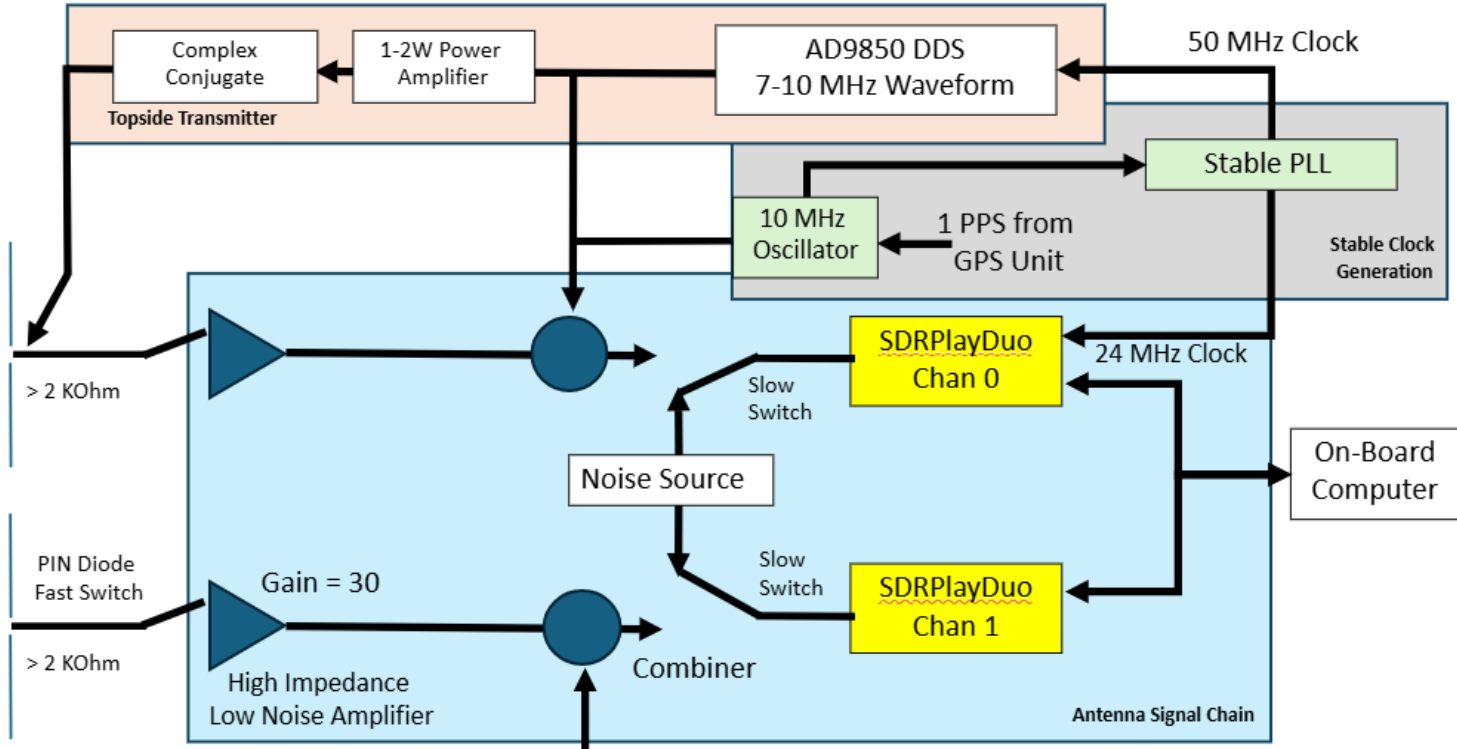
Magnetorquers

Inertial measurement unit



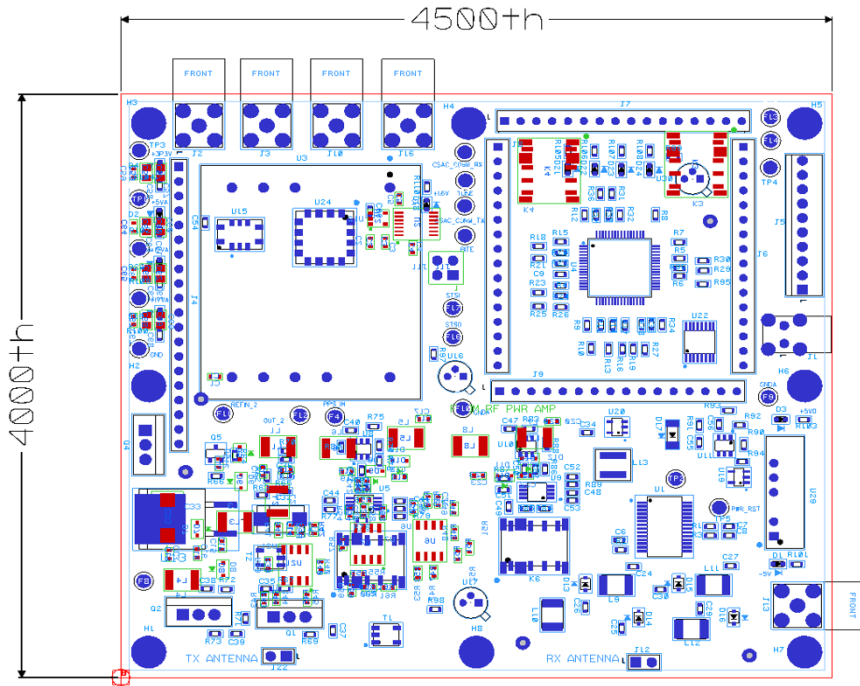


HF Instrument



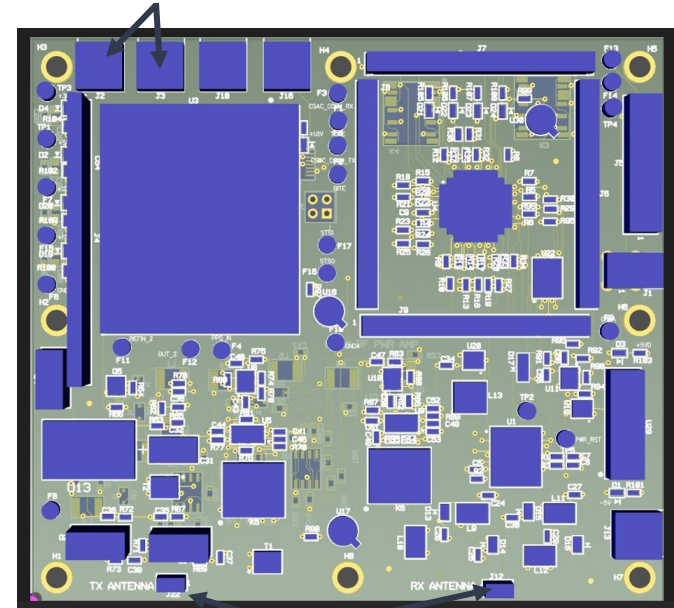


Antenna Interface Board



David Fisci (AB1RX)
Jon Schoenberg (NT1D)

SDR Interfaces

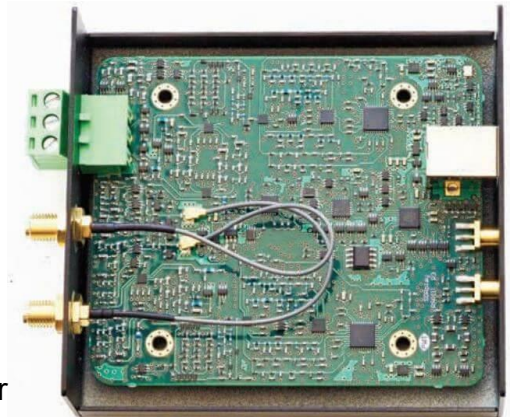
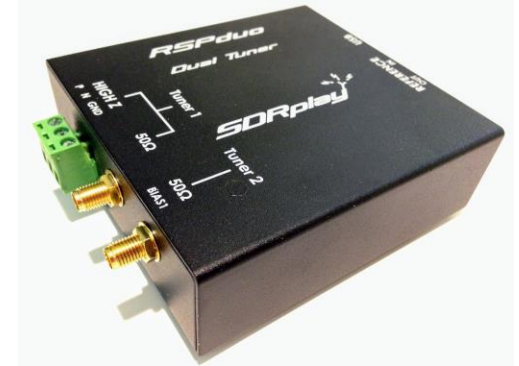


Antenna Interfaces



SDRPlay RSPDuo

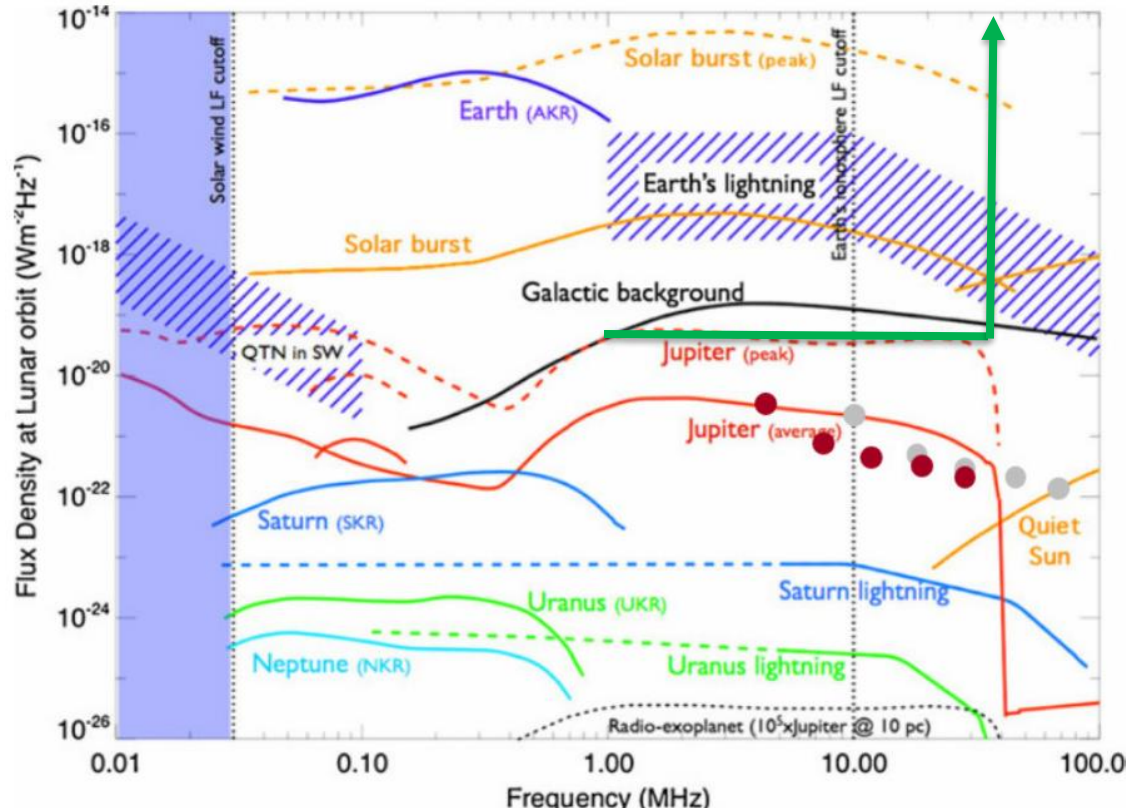
- **Dual independent tuners:** Orthogonal dipole operation
- **Frequency coverage:** 1 kHz – 2 GHz
- **ADC:** 14-bit
- **Instantaneous bandwidth:** up to 10 MHz (2 × 2 MHz in dual mode)
- **Noise figure:** ~15 dB (SDR) and 3dB (LNA)
- **Antenna inputs:** 2 Coaxial
- **Interface:** USB 2.0
- **Size/Weight:** 98 × 94 × 33 mm, 315 g



LNA = Low Noise Amplifier



HF Instrument Performance



Dynamic Range

HF Sensitivity



Flight Spacecraft Bus



GPS Antenna

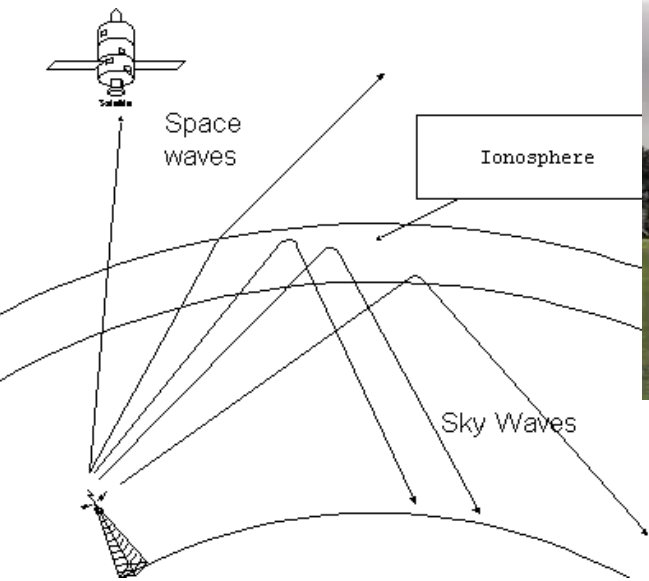
Solar Panels

Structure

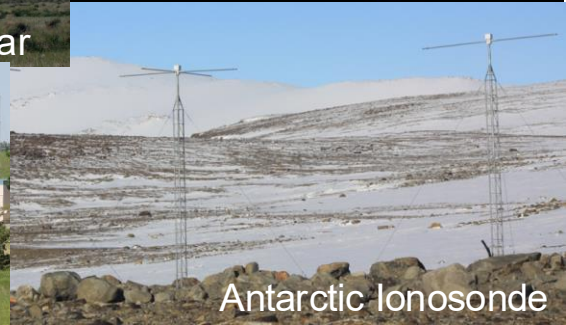
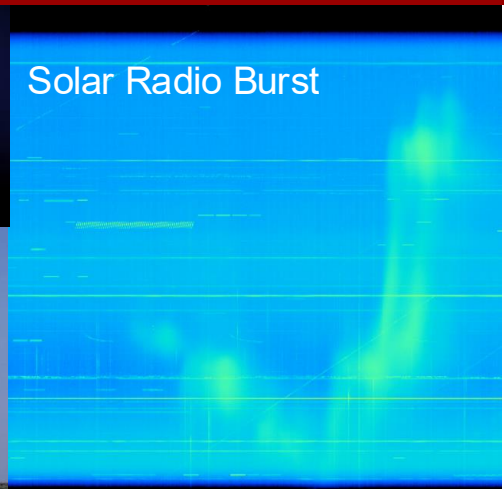




SoFIE Experiments



<https://man.fas.org/dod-101/navy/docs/es310/propagat/Propagat.htm>





Collaboration Opportunity

- We have the opportunity to fly SoFIE over MIT Haystack Observatory and coordinate simultaneous data collections*
 - Topside and bottomside sounding
 - Transionospheric radio propagation
 - Calibrated ground truth



*Dr. Philip Erickson (W1PJE), Director of Haystack

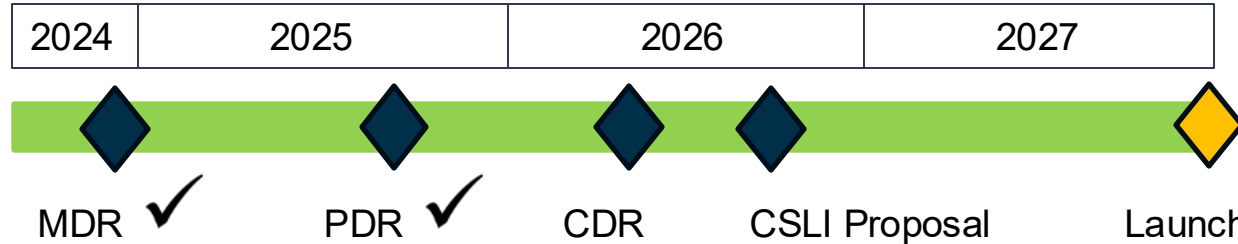
MIT Haystack Observatory
https://archive.ll.mit.edu/publications/Annual_Report_2014.pdf



SoFIE Mission

- Saint Francis University's first CubeSat
- Primary Objective: Undergraduate STEM experience
- Secondary Objective: Science Mission (Solar flare interaction with Earth's ionosphere)

Timeline



MDR: Mission Definition Review
PDR: Preliminary Design Review
CDR: Critical Design Review
CSLI: CubeSat Launch Initiative



Opportunity for Amateur Radio Community

- Transionospheric radio propagation measurements are essential to fulfill the scientific objective of the SoFIE mission
- Roles for Ham operators
 - Design of experiments
 - Individuals or teams
 - Single or multiple frequency
 - Polarization
 - Time of flight
 - Doppler shift
 - Other!
 - Execution of experiments (weekly)
 - Data analysis
- HamSCI will coordinate global HF campaigns through its portal, engaging the worldwide amateur radio community to expand the mission's scientific and public impact





SoFIE Team

- Saint Francis University - Mission Lead
- University of Scranton - HamSCI Lead
- Chestnut Ridge High School - X-ray Sensor
- Altoona Area High School - Aurora Imager
- Ecuadorian Space Agency - Spacecraft Bus
- Amateur Radio Community - Citizen Scientists



To join the SoFIE program,
please contact hamsci@hamsci.org (Gary Mikitin AF8A)