

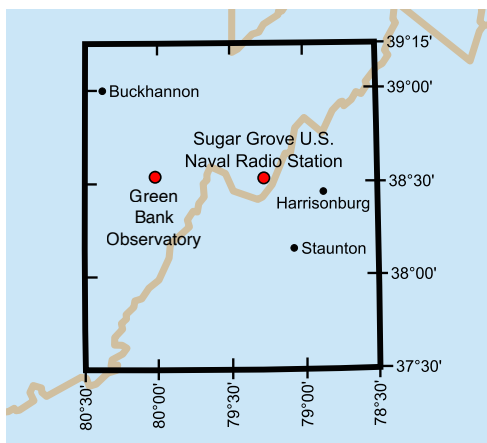
THREATS TO DARK & QUIET SKIES BY **RADIO FREQUENCY INTERFERENCE**

Support efforts to increase regulatory protection of radio astronomy sites.

Satellites should be required to avoid directly illuminating radio telescopes and radio quiet zones.

WHAT IS RADIO FREQUENCY INTERFERENCE?

Radio Frequency Interference (RFI) is defined by radio astronomers as any radio signal not of cosmic origin that disturbs sensitive radio astronomy instrumentation and/or observations. This interference can be generated by artificial sources such as communication signals or radio noise produced by electronic circuits and are typically much stronger than natural signals from astronomical sources. Radio transmissions are often much stronger than celestial sources, and they can have a range of effects on radio astronomy from data loss to hardware damage.



A map showing the extent of the United States National Radio Quiet Zone. Credit: Joel Bradshaw.



Radio telescopes and giant dish antennas in the Karl G. Jansky Very Large Array Radio Astronomy Observatory, New Mexico. Credit: Adobe Stock.

IMPACT OF SATELLITE CONSTELLATIONS (SATCONs)

SATCONs are groups of satellites working together to provide communications services such as broadband internet. They typically transmit in multiple frequency bands across the radio spectrum. SATCONs can be troublesome to radio telescopes since they transmit signals considerably stronger than most astronomical signals. These effects are compounded by the aggregate effects of many satellites flying at once. As many as half a million satellites have been proposed for launch by 2030.

SPECTRUM MANAGEMENT AND FREQUENCY ALLOCATIONS

The radio spectrum is heavily regulated to enable many uses while limiting interference. In the US, the Federal Communication Commission regulates the radio spectrum. The radio spectrum is divided into frequency bands assigned to particular uses with a series of associated rules. Most spectrum bands are shared among several active services, but some bands are shared only among passive services. An important current use is by Earth-observing satellites that provide important environmental data.

MITIGATION TECHNIQUES

To mitigate the impacts of RFI on ground-based astronomy, astronomers employ various measures.

For the most part, astronomers can track the location of satellite signals. Although astronomers know the frequencies and locations of most transmitters, which can help them to devise strategies to mitigate harmful interference, this is not a panacea. Radio astronomers must work together with satellite operators to mitigate impacts on radio telescopes.

RADIO QUIET ZONES

Geographic isolation is the most effective means of reducing RFI from terrestrial radio communications. Radio Quiet Zones (RQZs) are remote areas where use of radio spectrum is legally restricted to benefit radio astronomy. More than a dozen RQZs have been created worldwide. Unfortunately, RQZs are not yet recognized internationally, so protection from satellite and airplane signals is not guaranteed.

PUBLIC AWARENESS AND INDUSTRY COLLABORATION

Raising public awareness about the impact of RFI on radio astronomy is essential, as is collaborating with telecommunications companies, satellite operators, and regulatory bodies to mitigate impacts on observatories. Encouraging responsible use of wireless technologies and promoting cooperation in minimizing RFI sources can contribute to effective long-term mitigation.