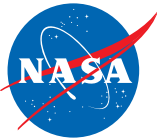


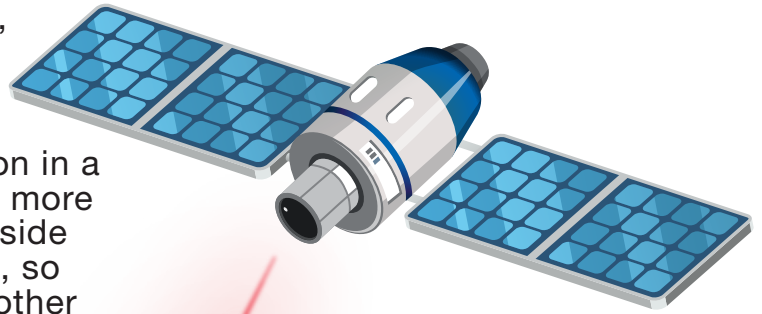
Talking with Light



As NASA explores the Moon, Mars, and beyond, missions need better ways to talk to Earth.

Laser communications is one of these ways!

Lasers, a type of light, can send more information in a single “link” at one time. This allows us to make more discoveries about space. Lasers will work alongside radio waves, which NASA has used for decades, so spacecraft can send messages, or talk to each other in space.



Part of a Bigger Rainbow

Both radio waves and laser light are forms of energy called electromagnetic radiation. They just have different ‘colors,’ or wavelengths, at different points on the electromagnetic spectrum. Spacecraft convert the radiation into specific patterns to send science data back to Earth.

Side Conversations

Each communications telescope on a NASA spacecraft can send and receive information at the same time. It is difficult for a person to talk and listen at the same time, but our satellites can!

Pinpointing a Target

Laser systems use narrower beams than radio waves. This means the telescope must point very precisely to reach its target. Like an athlete throwing a ball to a teammate, the satellite must plan ahead and send its signal at the right moment to reach its ground station.

Pew Pew Pew

NASA ensures that lasers can do no harm to humans or machines! They use the same kind of systems that are used for high-speed internet on Earth, known as fiber optics.

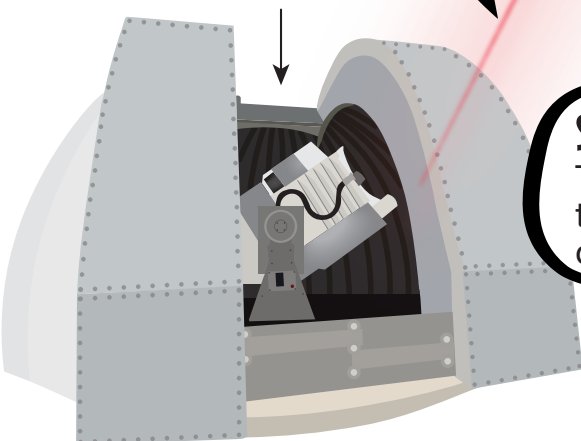
Unseen Energy

Although we have drawn the laser beam in pink here, the lasers used for laser communications are actually invisible to humans!

Staying Dry

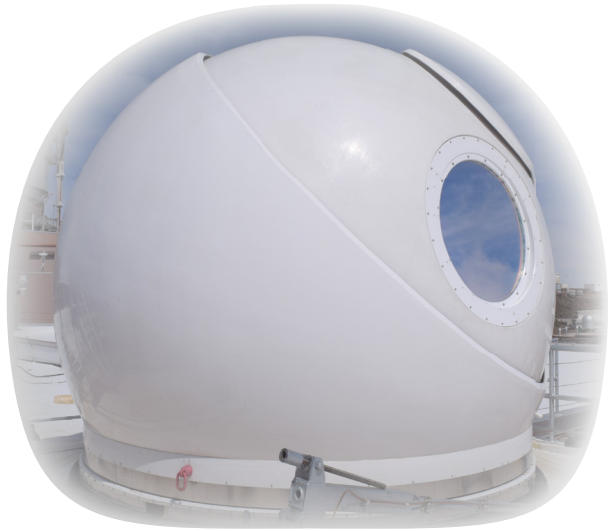
This shell closes when the ground station telescope is not being used. This protects it from dust and weather.

Laser Ground Station





The electromagnetic spectrum is waves of energy that can take many forms including visible light, radio, infrared, ultraviolet and more.



Through the Atmosphere

At a basic level, laser communications satellites need two things to communicate down to Earth: a ground station within view and a clear atmosphere.

NASA builds laser ground stations in places like California, Hawaii, and New Mexico because of their clearer skies. Clouds and air can interfere with laser signals.



Getting Around

Some missions can't see their own ground station from space and have to use relay satellites. LCRD is a laser relay that will connect a laser system on the International Space Station, ILLUMA-T, with Earth. Relays allow NASA to work around obstacles like planets, moons, and more!



In 2021, NASA launched the Laser Communications Relay Demonstration (LCRD).

Future Laser Missions

NASA's Space Communications and Navigation (SCaN) program office is infusing laser communications into multiple missions:

- CubeSat payload near Earth
 - *TeraByte InfraRed Delivery (TBIRD)*
- System on the International Space Station
 - *Integrated LCRD Low Earth Orbit User Modem and Amplifier Terminal (ILLUMA-T)*
- Terminal on the crewed Artemis II Moon mission
 - *Orion Artemis II Optical Communications System (O2O)*

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