



## Tech Snapshot Space

LA-UR-19-31819

Published: Dec 10, 2019

# EXTREMELY LOW RESOURCE OPTICAL IDENTIFIER (ELROI)

*A License Plate for Satellites*



## SUMMARY

Engineers at Los Alamos National Laboratory have developed a "license plate" for satellites to help solve the growing problem of space traffic management. The Extremely Low-Resource Optical Identifier (ELROI) is a simple, easy-to-fly, solar-powered beacon that can be attached to a satellite for tracking. Each ELROI unit transmits a custom identification number which can be read from the ground using signal-processing techniques also developed at Los Alamos. Development of ELROI leverages the Lab's 50 years designing and building space-based sensors and instruments.



## MARKET

New launch providers and small satellites have lowered the barrier of market (and orbit) entry - and with profound results! Satellite launches have tripled in the past decade, the commercial space sector has grown by 10x, and projections put the small satellite market worth at greater than \$7B, with Compound Annual Growth Rates (CAGRs) of over 20%, by 2022. With the substantial investment in small satellites for communication, observation, and space exploration - a reliable way to track space vehicles is critical.

## BENEFITS

ELROI is an accessible and affordable solution which enables satellite identification anywhere, anytime, without waiting for complicated orbit measurements, and regardless of proximity to other space vehicles.

- Easy to Implement - ELROI enables simple assignment of unique IDs that anyone can read
- Solar Powered - ELROI maintains autonomy even if satellite loses power
- Compact - ELROI is designed to be easy to fly, taking up minimal satellite real estate
- Lightweight - ELROI's lean design is appropriate to fly on large and small vehicles alike
- Enables Identification - ELROI enables proactive identification of on-orbit objects

## CONTACT

Kaelyn Badura  
[kbadura@lanl.gov](mailto:kbadura@lanl.gov)  
505-665-8032



## WHY WE ARE BUILDING EXTREMELY LOW RESOURCE OPTICAL IDENTIFIER (ELROI)

There is no easy way to proactively identify most satellites in real-time. This is concerning as each man-made object in orbit (~20,000 as of 2019) must be tracked to prevent devastating collisions that create more space debris and harm ongoing space operations. Owners and operators also need to know the precise location of their satellites to predict when they will pass overhead. ELROI helps solve these problems by providing a simple "license plate" that can be read from the ground.



## WHAT'S BEHIND OUR TECHNOLOGY

ELROI uses optical communication instead of radio frequency, which leverages the advantages of extremely precise detectors to get the most information from every photon (or particle of light). This means ELROI can transmit an recognizable ID from space with no more power than a laser pointer.



## OUR COMPETITIVE ADVANTAGES

ELROI is inexpensive, small, light-weight, low-power, and does not interfere with other communications. This makes it suitable for almost any satellite, and enables continuous operation even if the satellite loses power or radio communications. As compared to market standard radio-based technology, ELROI uses fewer precious satellite resources (size, weight, and power), does not cause interference, and does not require access to already crowded radio frequency bands.



## OUR TECHNOLOGY STATUS

ELROI has been proven on the ground, and prototypes are being finalized for space. Future plans for ELROI include additional on-orbit testing and observation, creating a miniaturized electronics package for commercial distribution, and a commercial call for licensing and collaboration interest. If you have questions about how to get engaged early, or would like to request notification when the official commercial call has been posted, please contact Kaelyn Badura at [kbadura@lanl.gov](mailto:kbadura@lanl.gov).



## PUBLICATIONS AND IP

### Intellectual Property

ELROI Beacon: U.S. Pat. No. 10,250,336

ELROI Data Transmission: U.S. Pat. Appl. No. 16/539,380

Additional aspects of ELROI are being evaluated for intellectual property protection and may be added to the ELROI portfolio.

### Press

LANL 1663 Publication: [Averting Orbital Apocalypse](#)

SPIE Digital Library: [NMTech CubeSat](#)

Bradbury Science Museum: [What's being done to combat space debris build up?](#)

SpaceNews: [Laser "license plate" could improve identification of cubesats](#)

ABQ Journal: [Clearing Space Clutter](#)

### Technical publications

R.M. Holmes and D.M. Palmer, "Extreme background-rejection techniques for the ELROI optical satellite license plate," *Applied Optics*, vol. 58, 2019, pp. 814-825. <https://doi.org/10.1364/AO.58.000814>

D.M. Palmer and R.M. Holmes, "Extremely Low Resource Optical Identifier: A license plate for your satellite," *Journal of Spacecraft and Rockets*, vol. 55, no. 4, 2018, pp. 1014-1023. <https://doi.org/10.2514/1.A34106>

### Conference proceedings

R.M. Holmes, C.T. Weaver, D.M. Palmer, "The First Orbital Flight of the ELROI Optical Satellite License Plate," *Proceedings of the AIAA/USU Conference on Small Satellites, Advanced Technologies II, SSC19-XII-06* (2019)

R.M. Holmes, C.T. Weaver, and D.M. Palmer, "ELROI satellite license plate demonstration on a CubeSat," *Proc. SPIE 10978, Advanced Photon Counting Techniques XIII*, 1097808 (2019)

R.M. Holmes, C.T. Weaver, D.M. Palmer, "ELROI: A satellite license plate to simplify space object identification," *Proceedings of the Advanced Maui Optical and Space Surveillance (AMOS) Technologies Conference* (2018)

R.M. Holmes, C.T. Weaver, D.M. Palmer, "ELROI: A license plate for satellites that anyone can read," Proceedings of the AIAA/USU Conference on Small Satellites, Assuring the Space Ecosystem I, SSC18-XI-01 (2018)

R.M. Holmes, S. Gill, J.Z. Harris, J.S. Lansford, R. Myers, C.T. Weaver, A.P. Zucherman, A.M. Jorgensen, D.M. Palmer, "Progress on ELROI satellite license plate flight prototypes," Proc. SPIE 10659, Advanced Photon Counting Techniques XII (2018)