

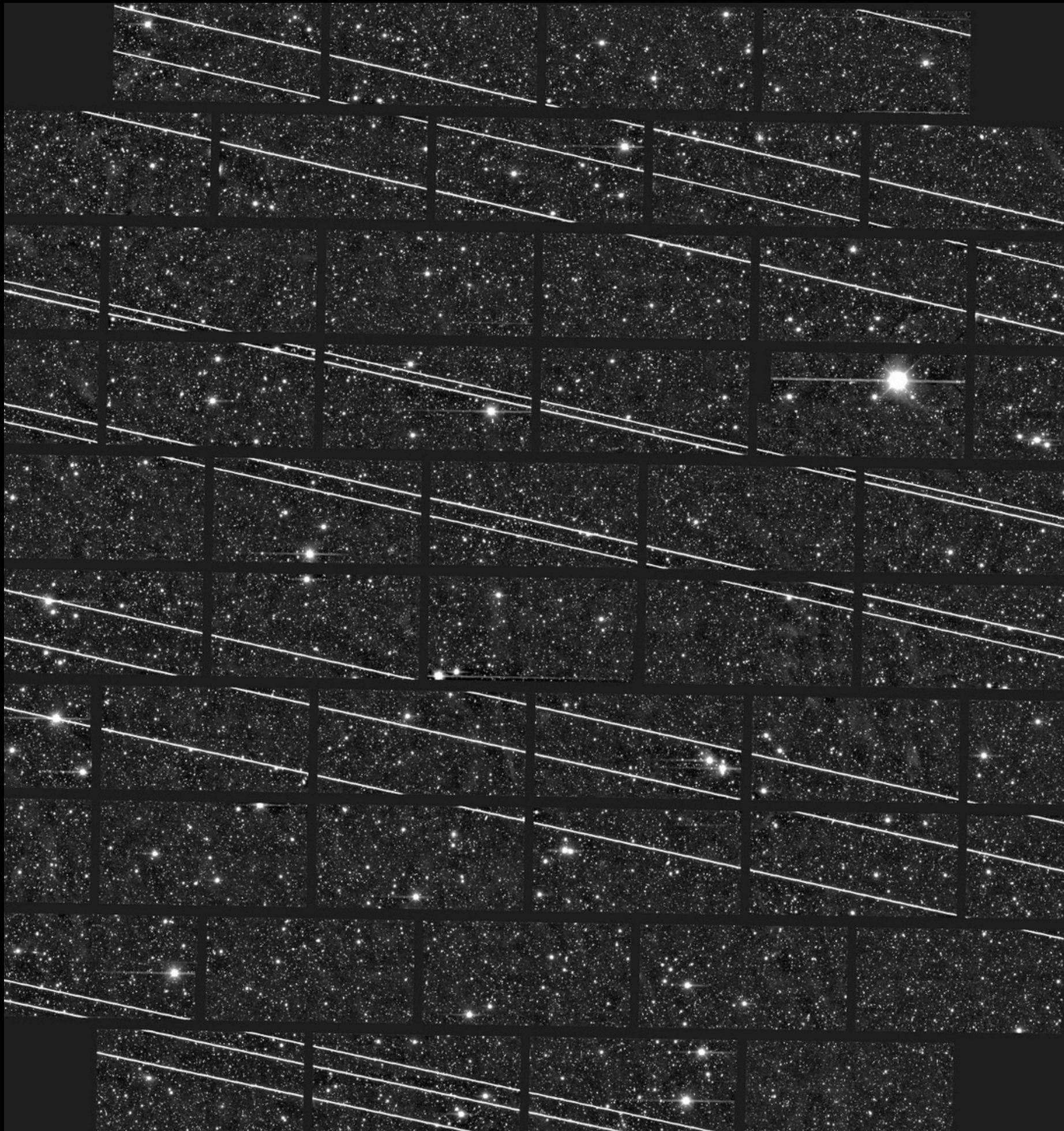


From Stars to *Satellites*

How Embracing the Dark Side will Kickstart Australian Space-Based Astronomy



Dr. Sarah Caddy,
Observational Astronomer,
University of Melbourne Space Lab,



We usually don't want
satellites in our images!

As an Astronomer who went
from **stars** to **satellites** -

A lot of Astro's treat you like
you've converted to the **dark
side of the force**

I'm about to convince you why
observing satellites can be a
good thing!

As an Astronomer, I feel responsibility to help protect the night sky...

But unfortunately we pollute it with debris, in the very same way we do the oceans



Image Credit: Caroline Power

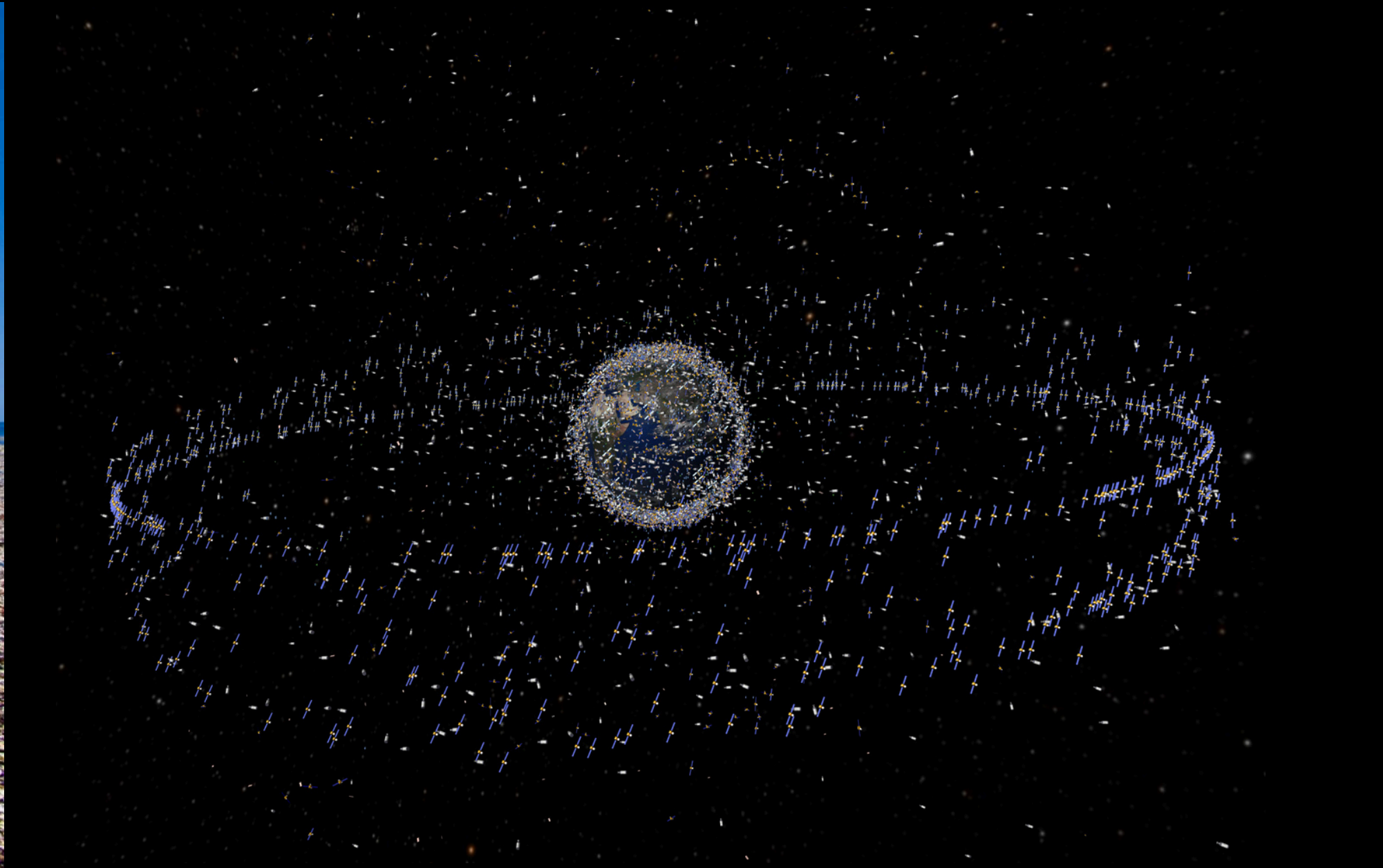


Image Credit: ESA

It's in our interest to protect the skies -
Promoting Dark and Quiet Skies and Sustainable
Astronomy is **one of the 10 core priorities** of the
2025 decadal plan.



Image Credit: Anthony Horton

The first step to achieve this, is **accountability**.

To do this, we need **eyes on the skies**.

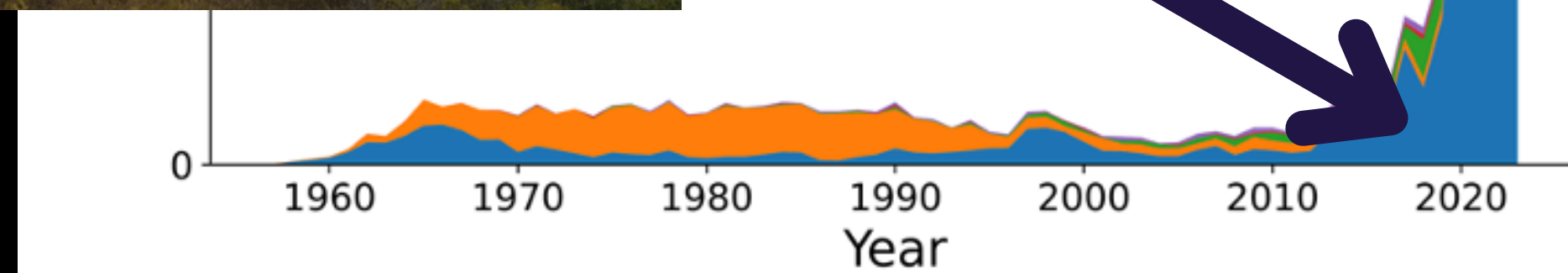
Space can **no longer a place** where **no one is**
watching you.

Time for some scary statistics...

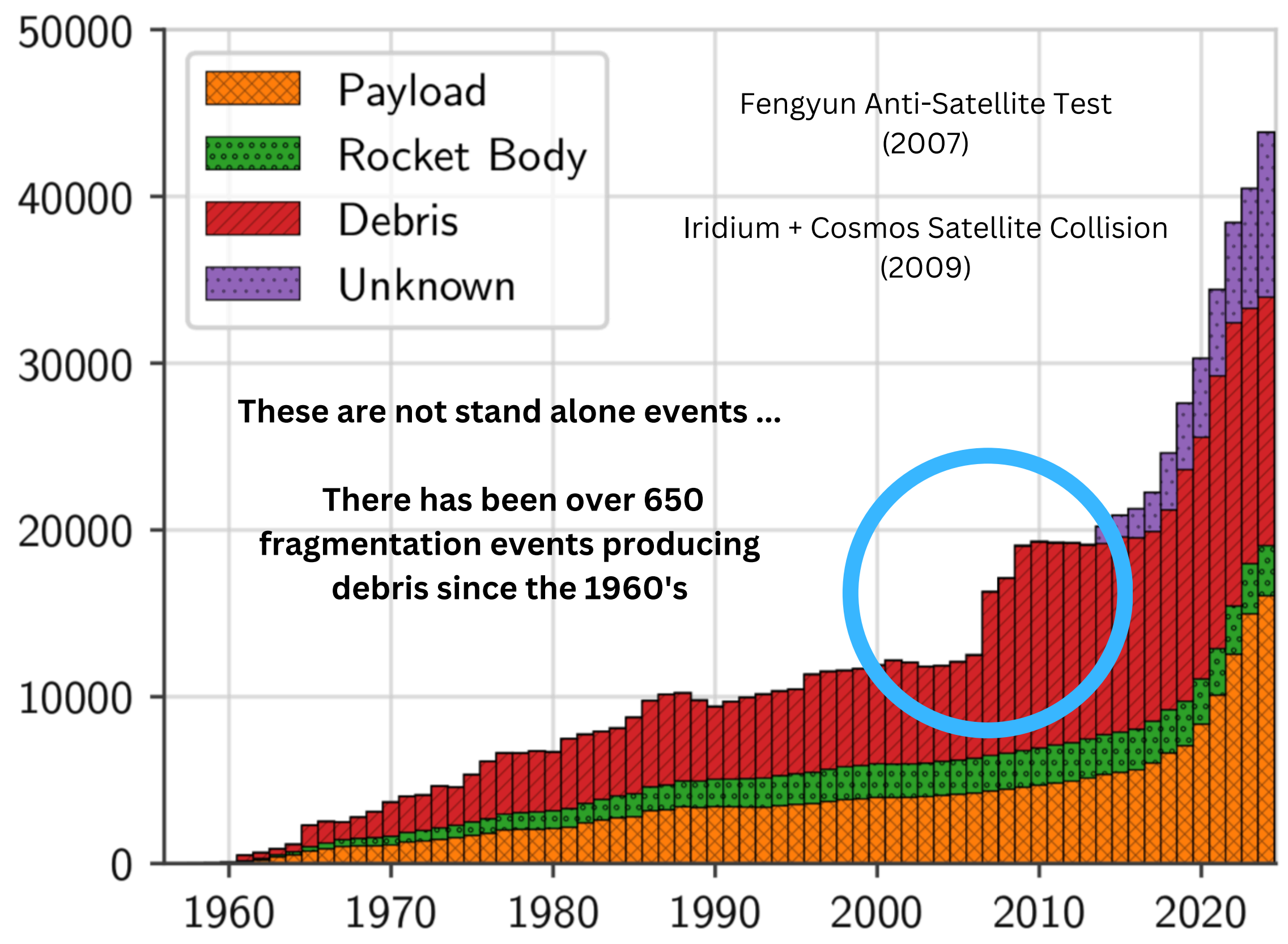


SpaceX first Starlink
Launch in 2019

Since then the number of
objects launched to orbit
has skyrocketed



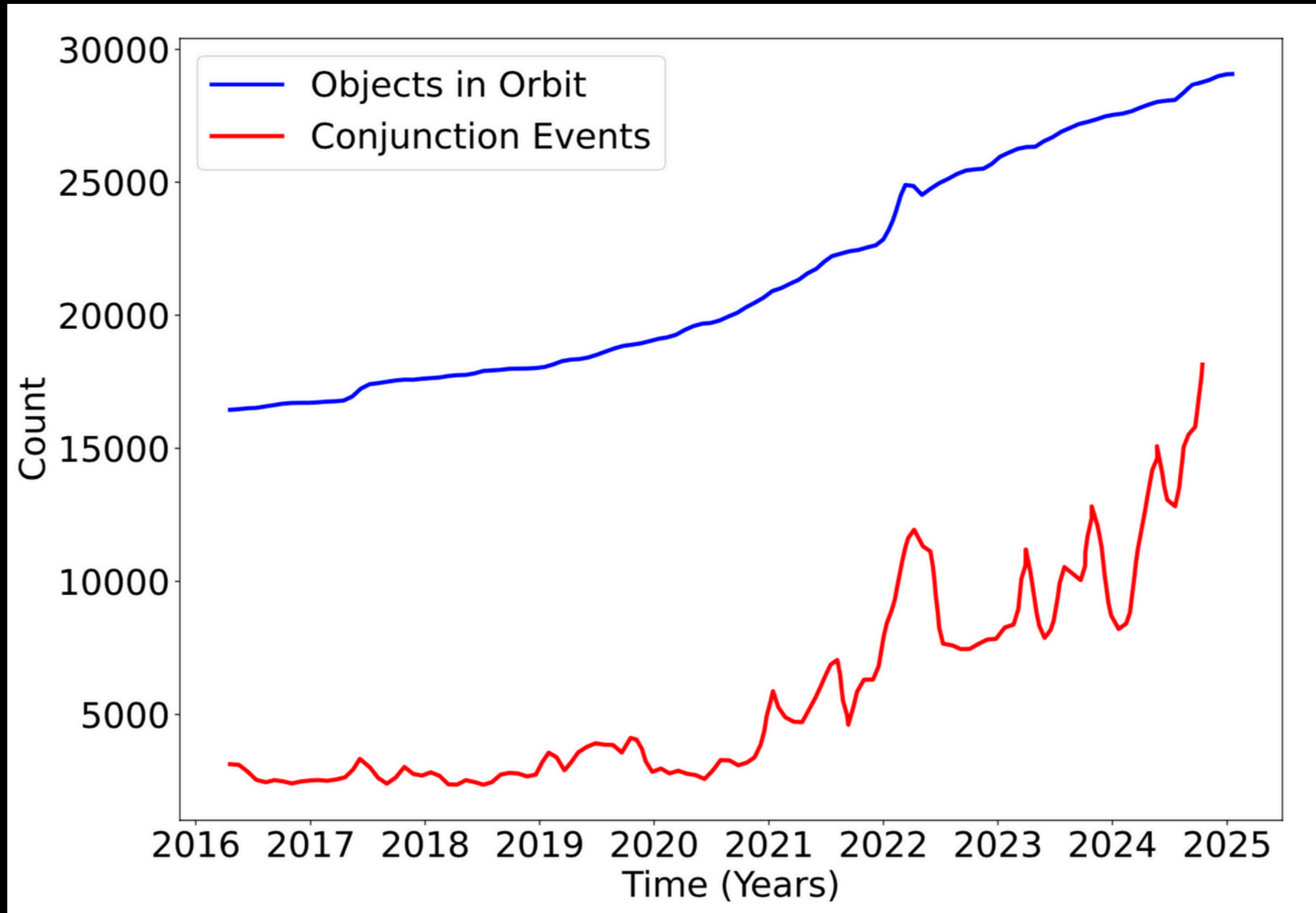
Total Number of
Space Objects



Catsamas et al. 2025 (in press)

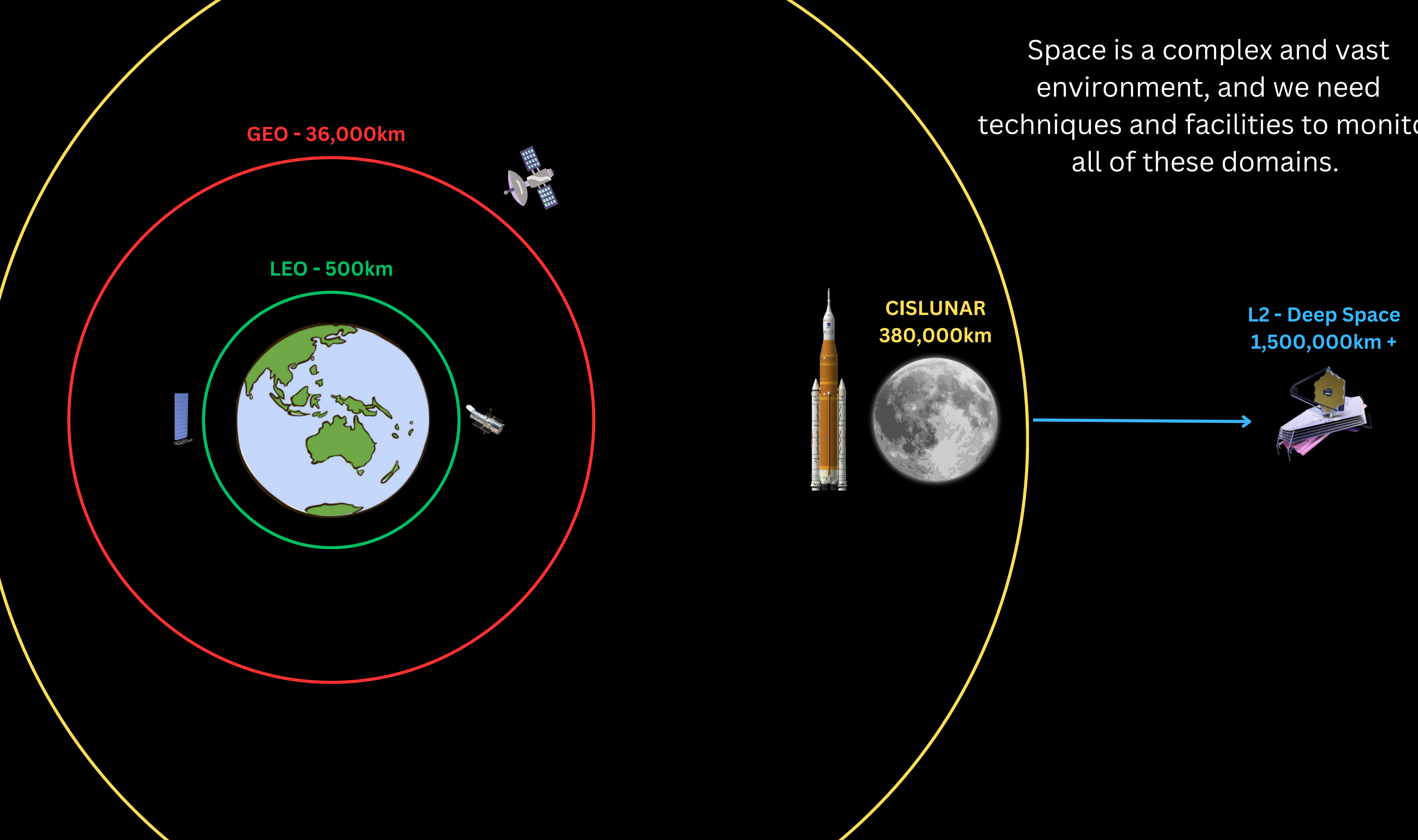
Year

18,000 Conjunction Events PER MONTH ...
i.e. ~600 per day



Data source: NASA (2025)

Space is a complex and vast environment, and we need techniques and facilities to monitor all of these domains.



Space Domain Awareness is the study and monitoring, of human made objects in space...



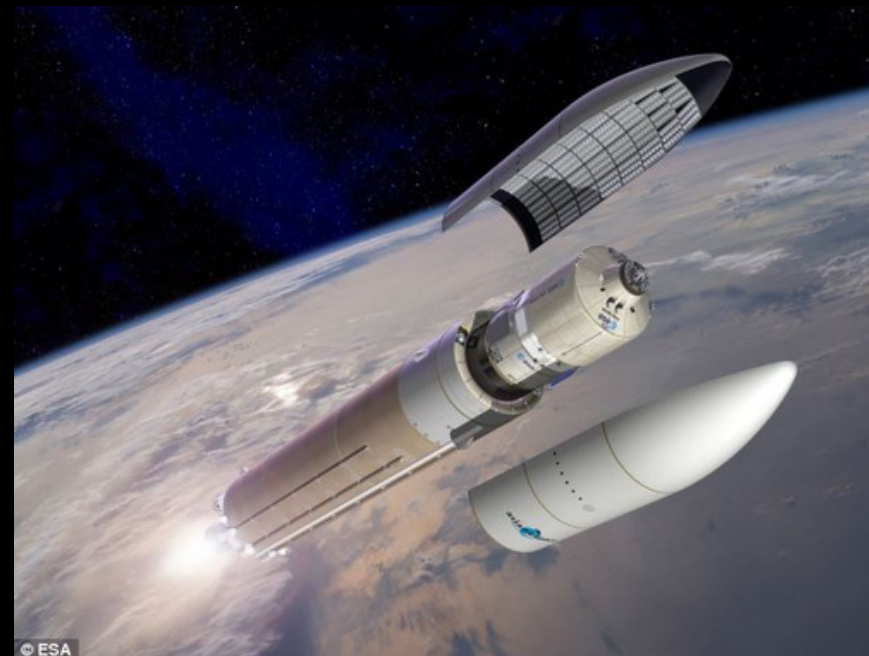
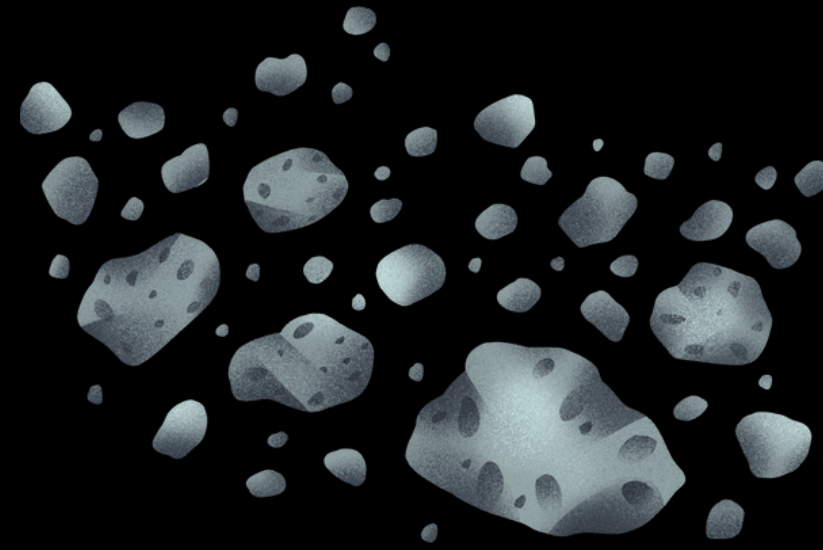
This could include:

Satellites

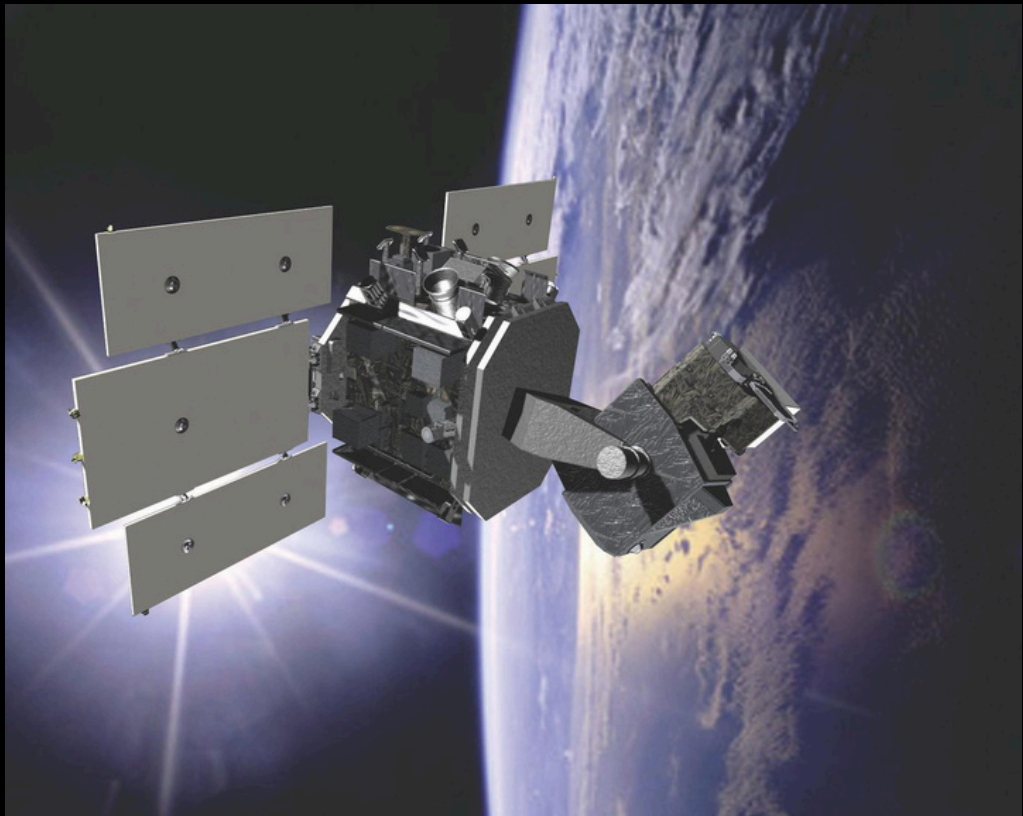
Asteroids

Debris

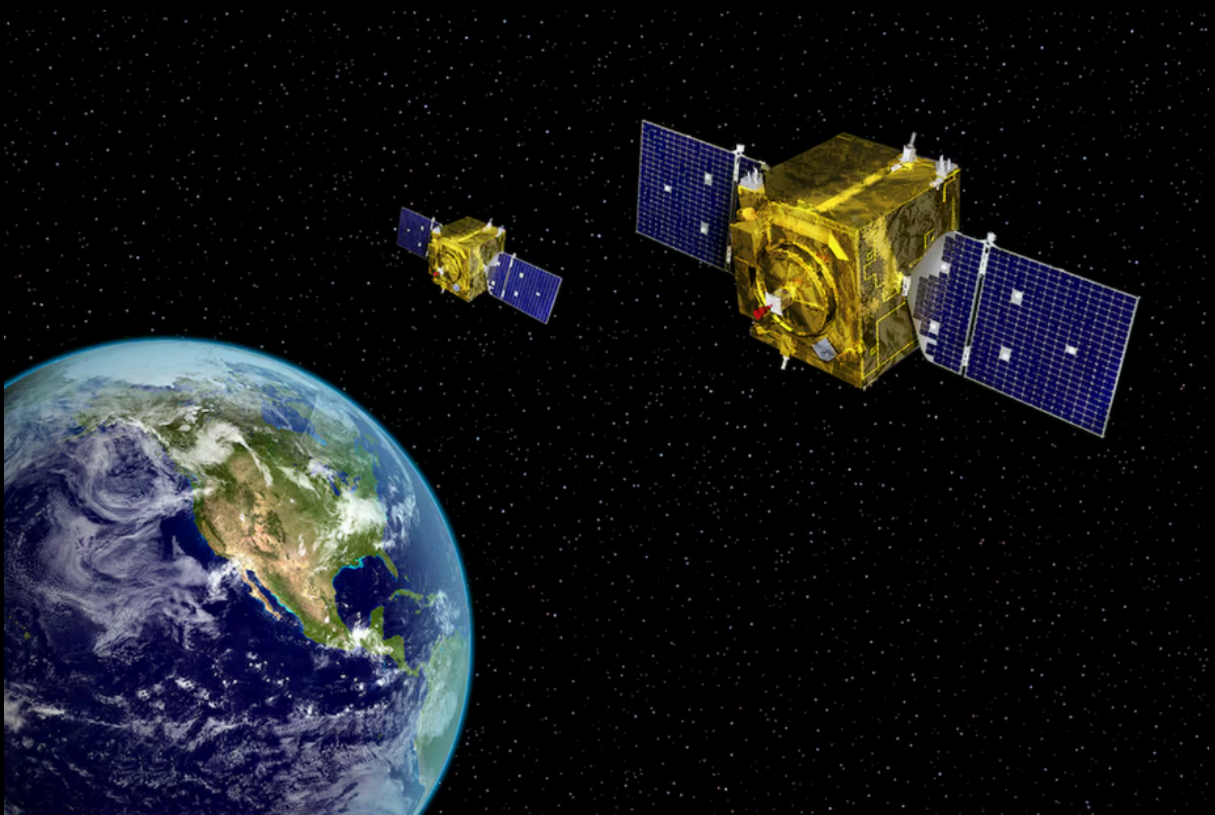
Rocket Bodies



Examples of SDA facilities both
on the ground and in space

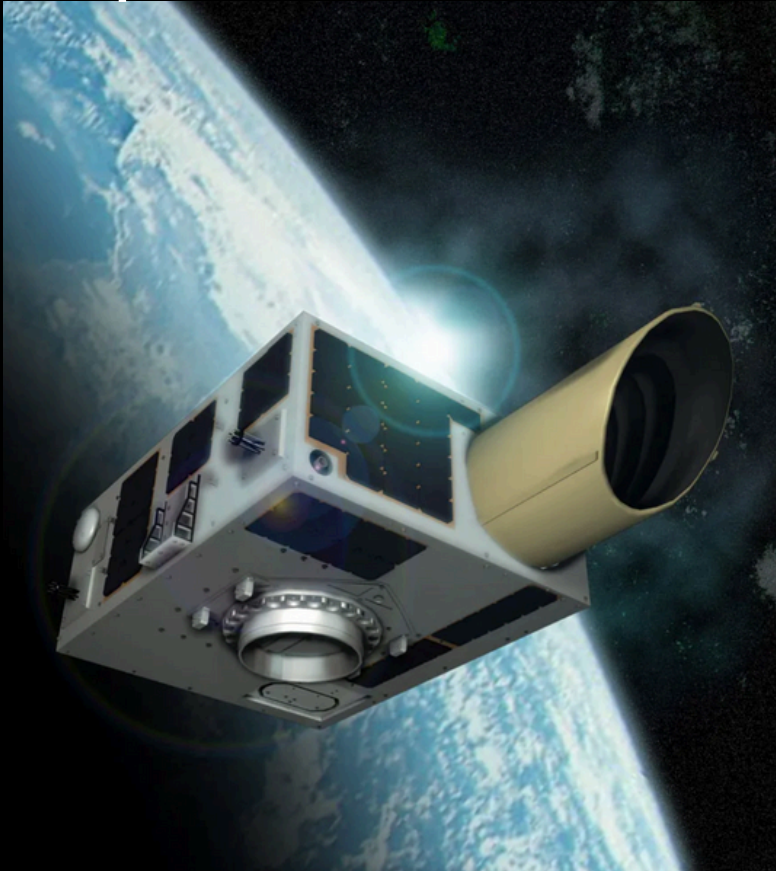


SBSS - US



Geo Sentinals - US

Sapphire - Canada



AEOS - US



AMOS - US



SPACECOM - UK



What's the benefit of Space-Based Space Domain Awareness Systems?

- 1) You can monitor all of Geostationary orbit from a single facility
- 2) You can cover larger swathes of Cislunar space from a single facility
- 3) You don't have to worry about the limitations of observing during the day
- 4) You can access infrared wavelengths!
 - thermal monitoring of operational status
 - satellites can't hide in the Earth's shadow!

There are 3 key questions we want to answer for every target

Where is it? (localisation)

What is it? (characterisation)

Does it have potential to effect the environment around it?
(status and intent)



These apply to astronomical objects as well!

Where is it?

What is it?

Does it have potential to effect the environment around it?





Basic Imaging

Light curve analysis

Polarimetry

Photometry

Spectroscopy

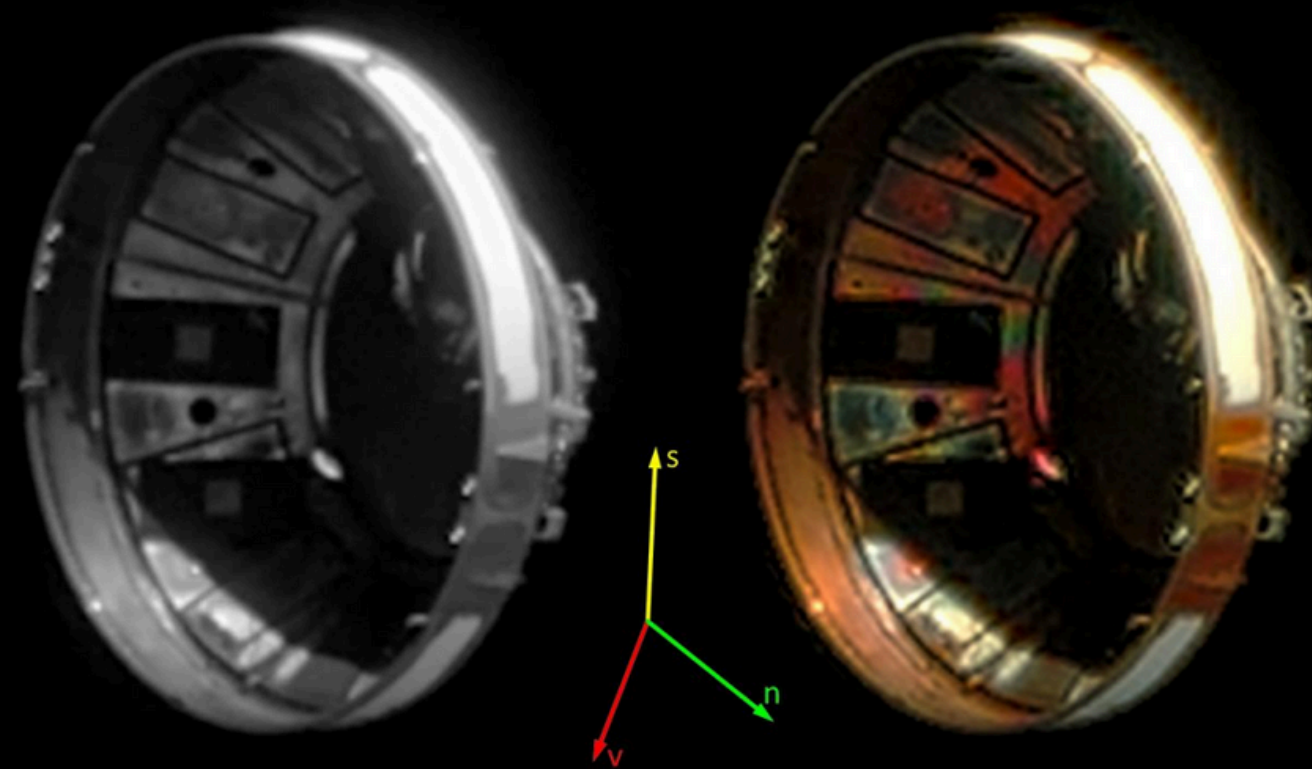
Basic Imaging

Light curve analysis

Polarimetry

Photometry

Spectroscopy



MAXAR Technologies

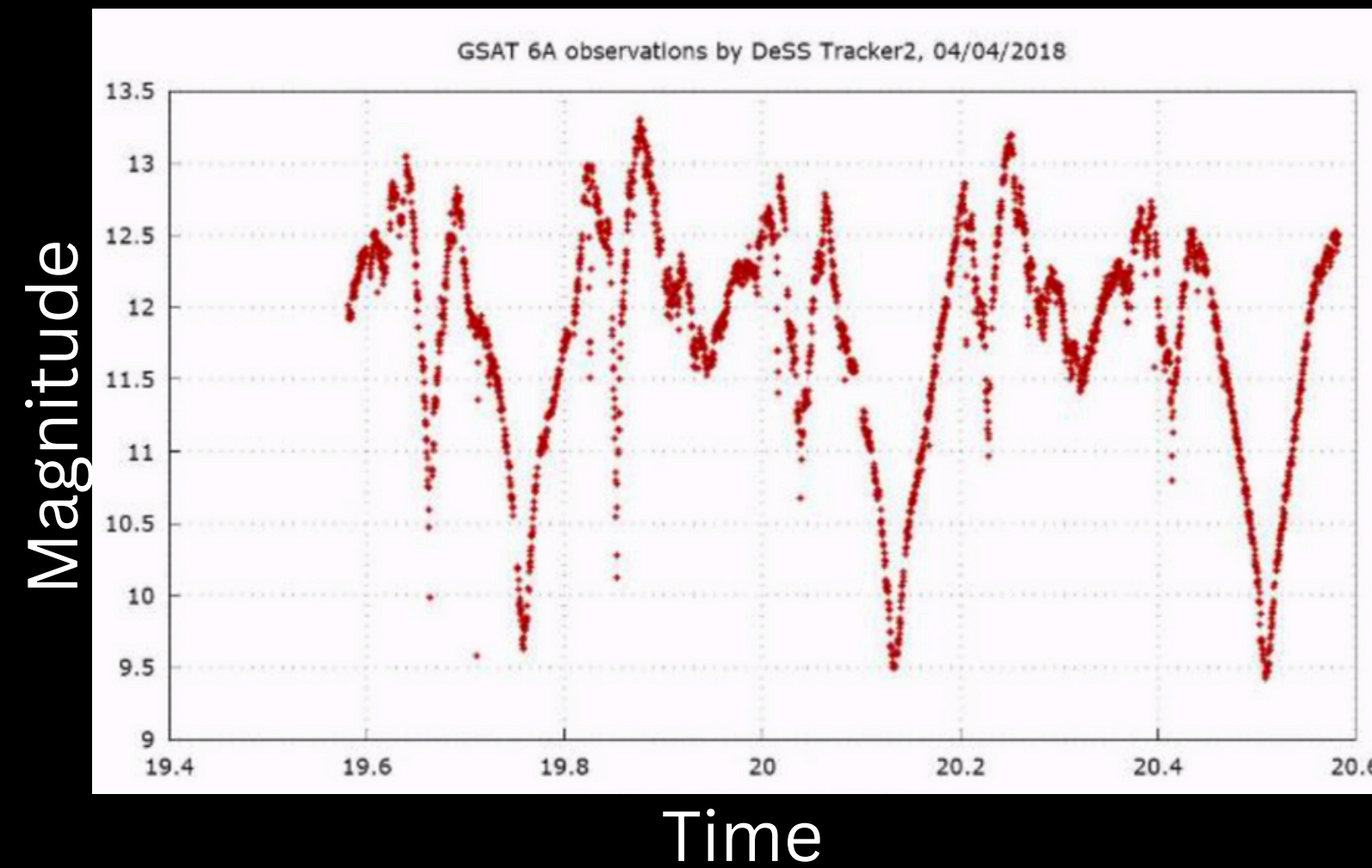
Basic Imaging

Light curve analysis

Polarimetry

Photometry

Spectroscopy



Kerr et al. 2021

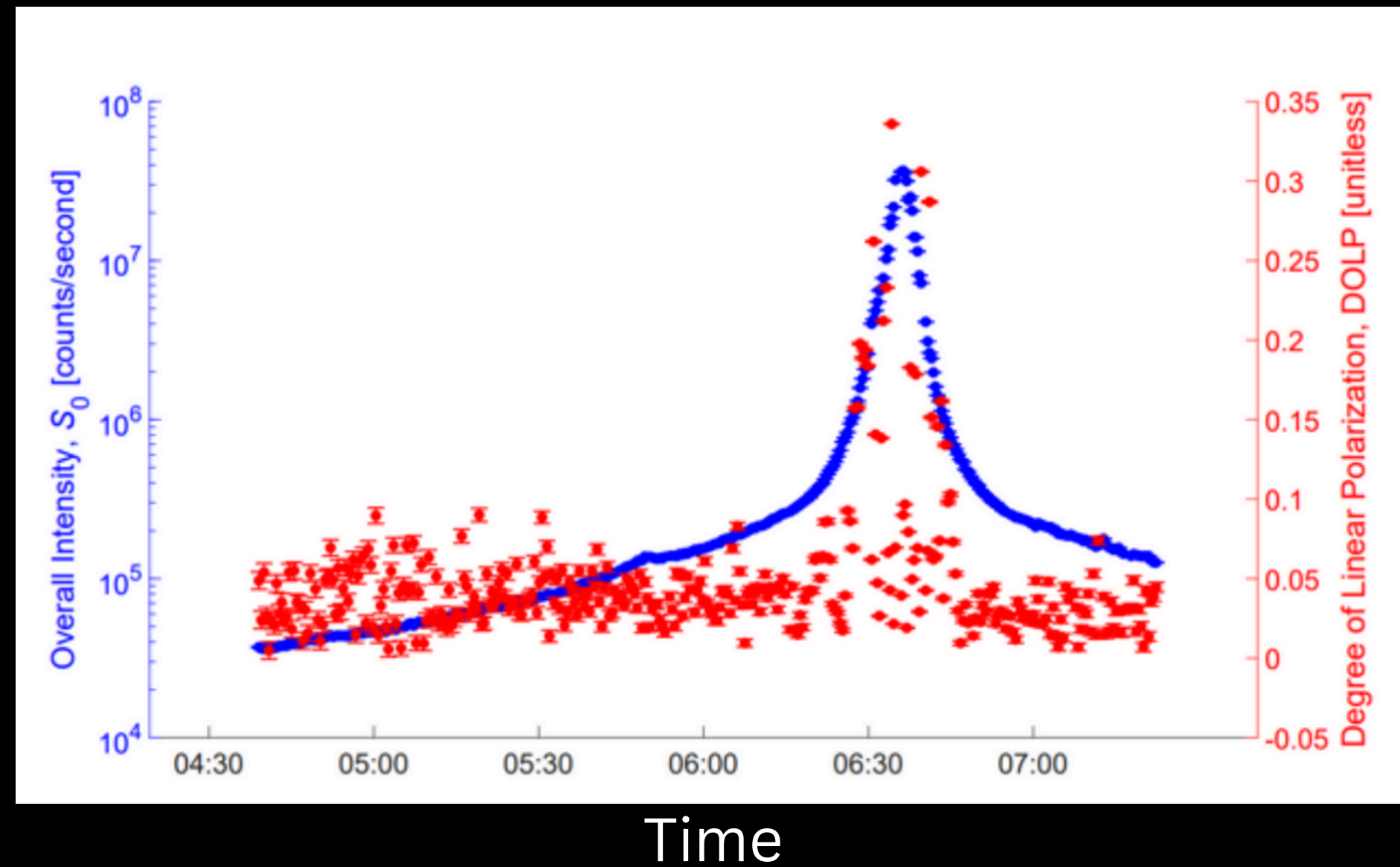
Basic Imaging

Light curve analysis

Polarimetry

Photometry

Spectroscopy



Linear Polarisation

Jensen et al. 2021

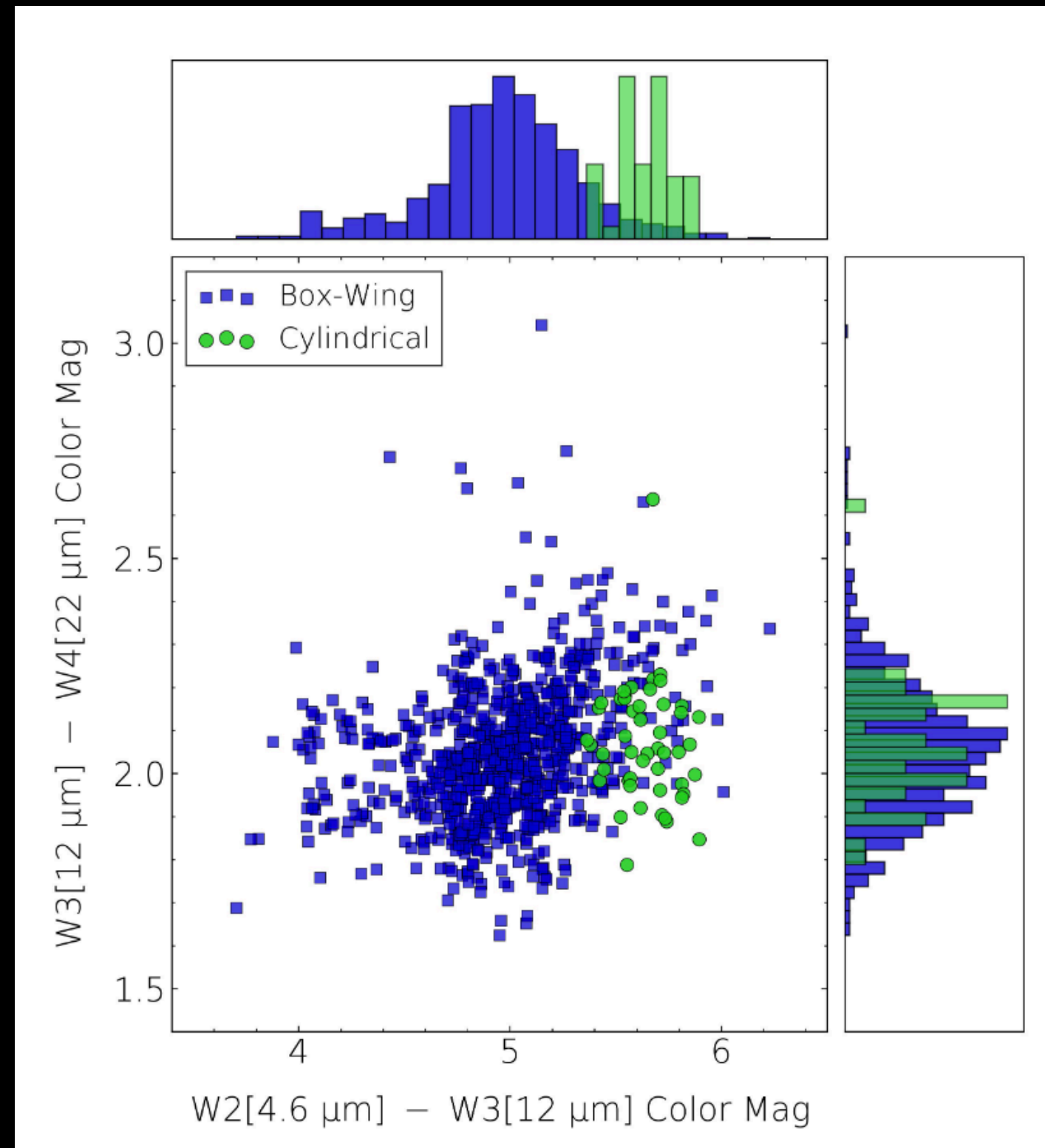
Basic Imaging

Light curve analysis

Polarimetry

Photometry

Spectroscopy



Lee et al. 2017

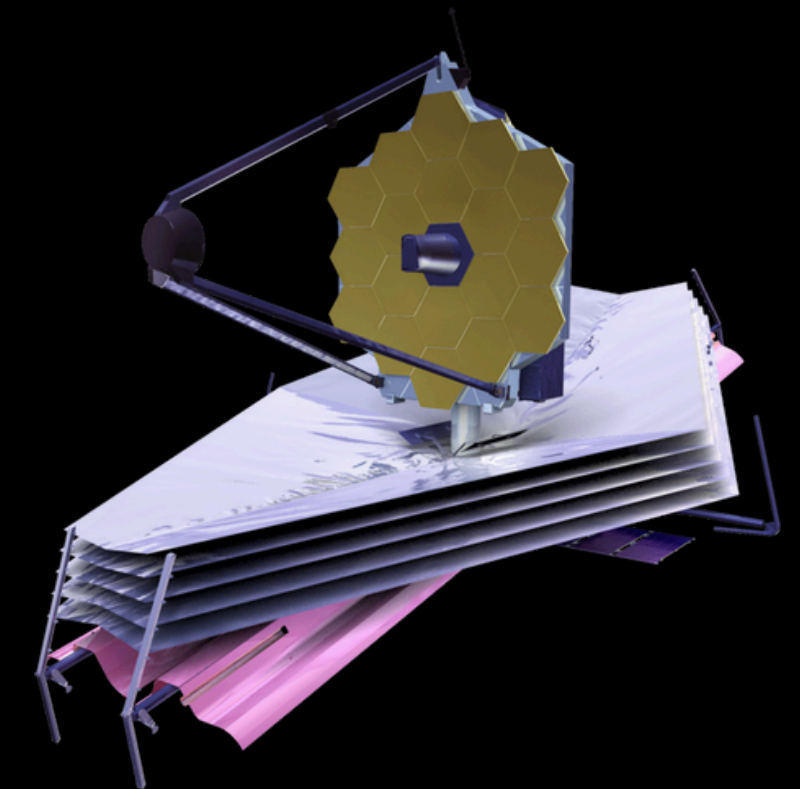
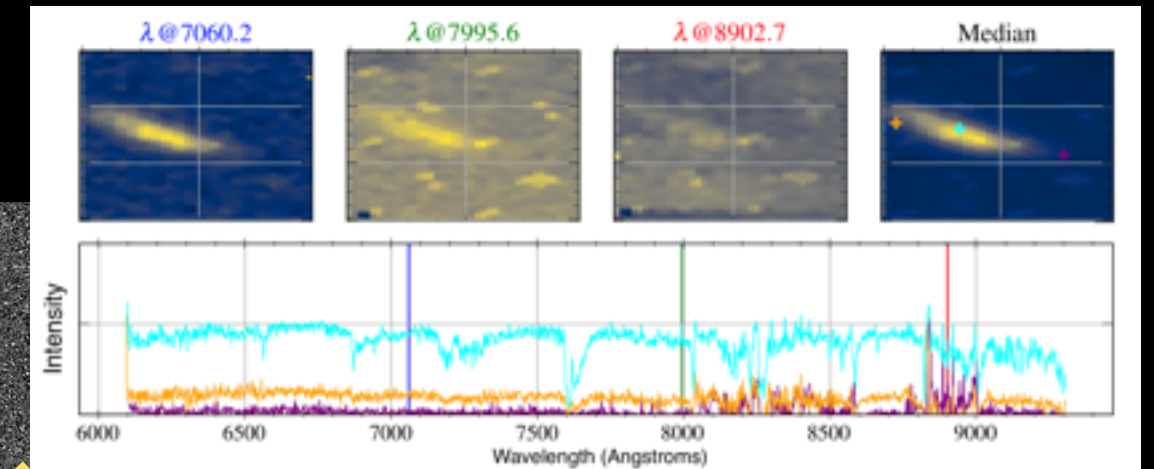
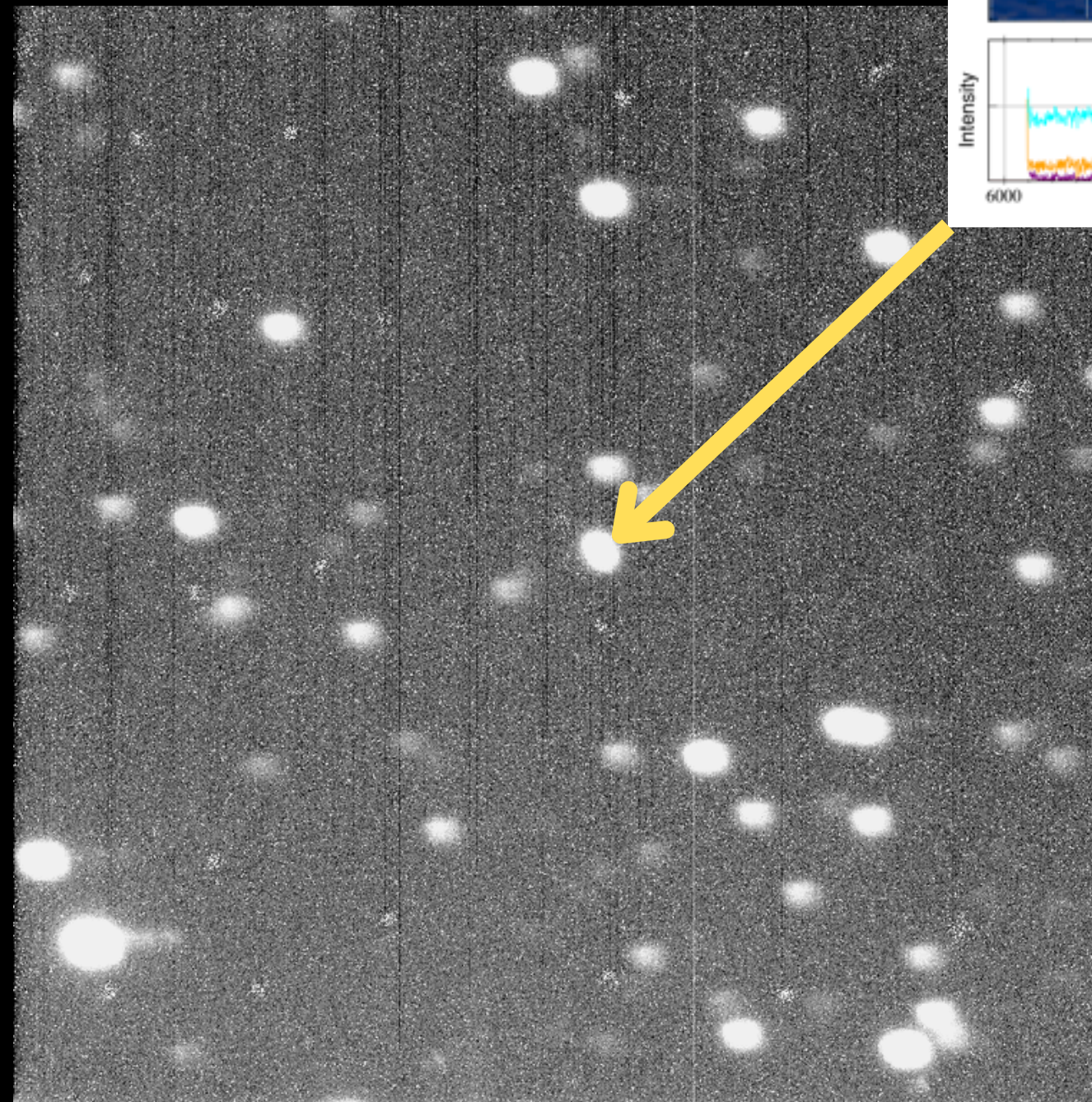
Basic Imaging

Light curve analysis

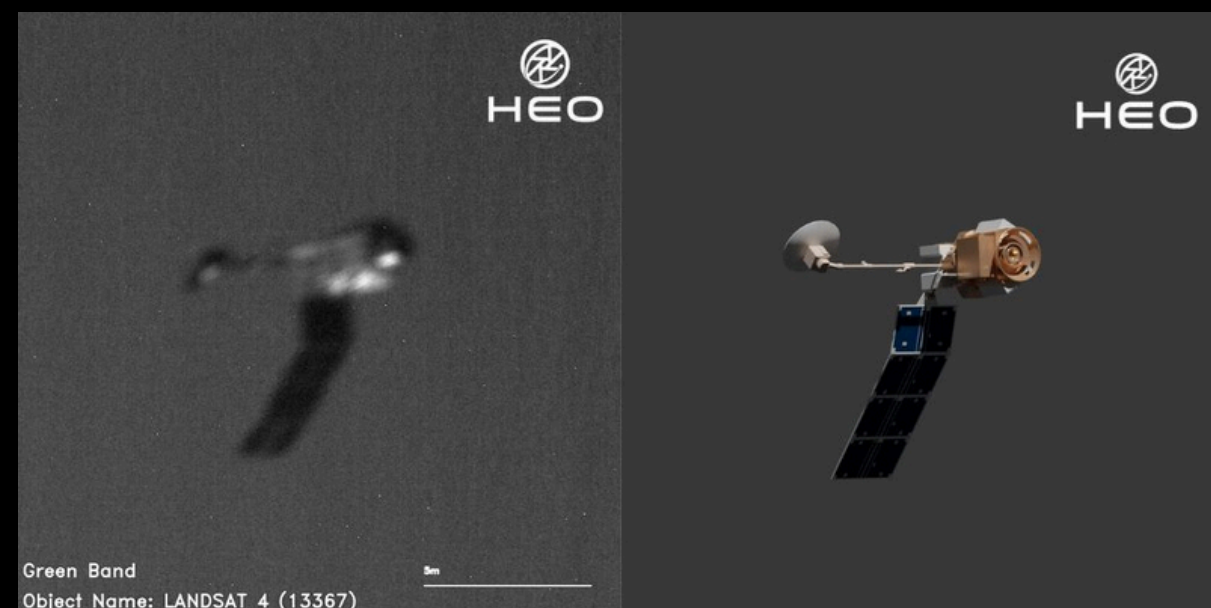
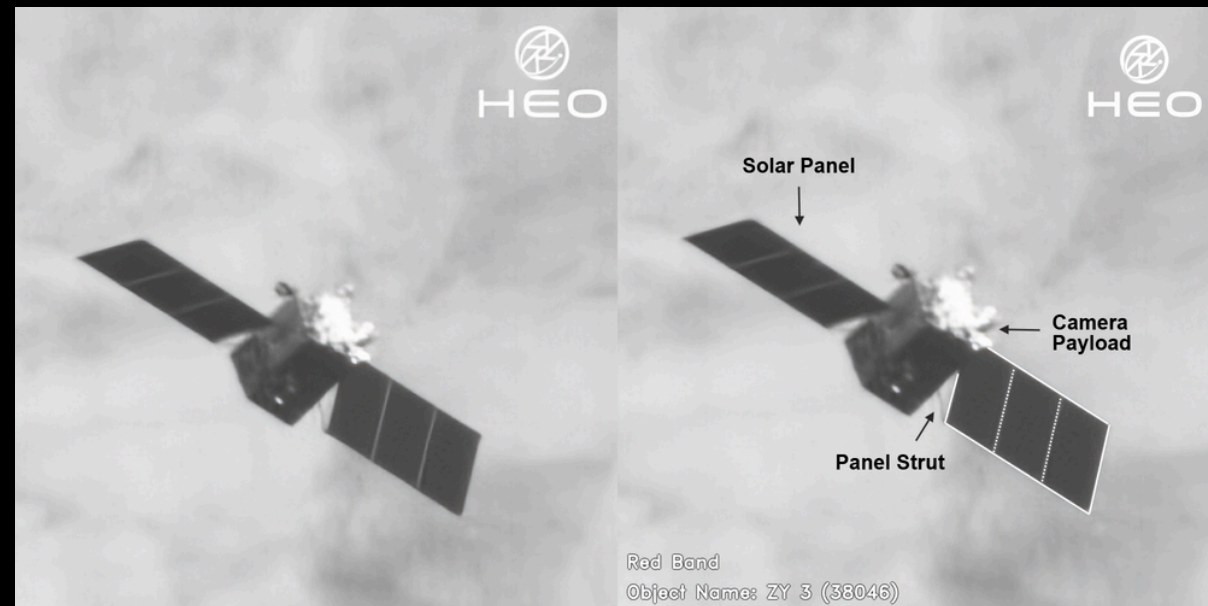
Polarimetry

Photometry

Spectroscopy



Australian Industry is already waking up to this - why aren't we?

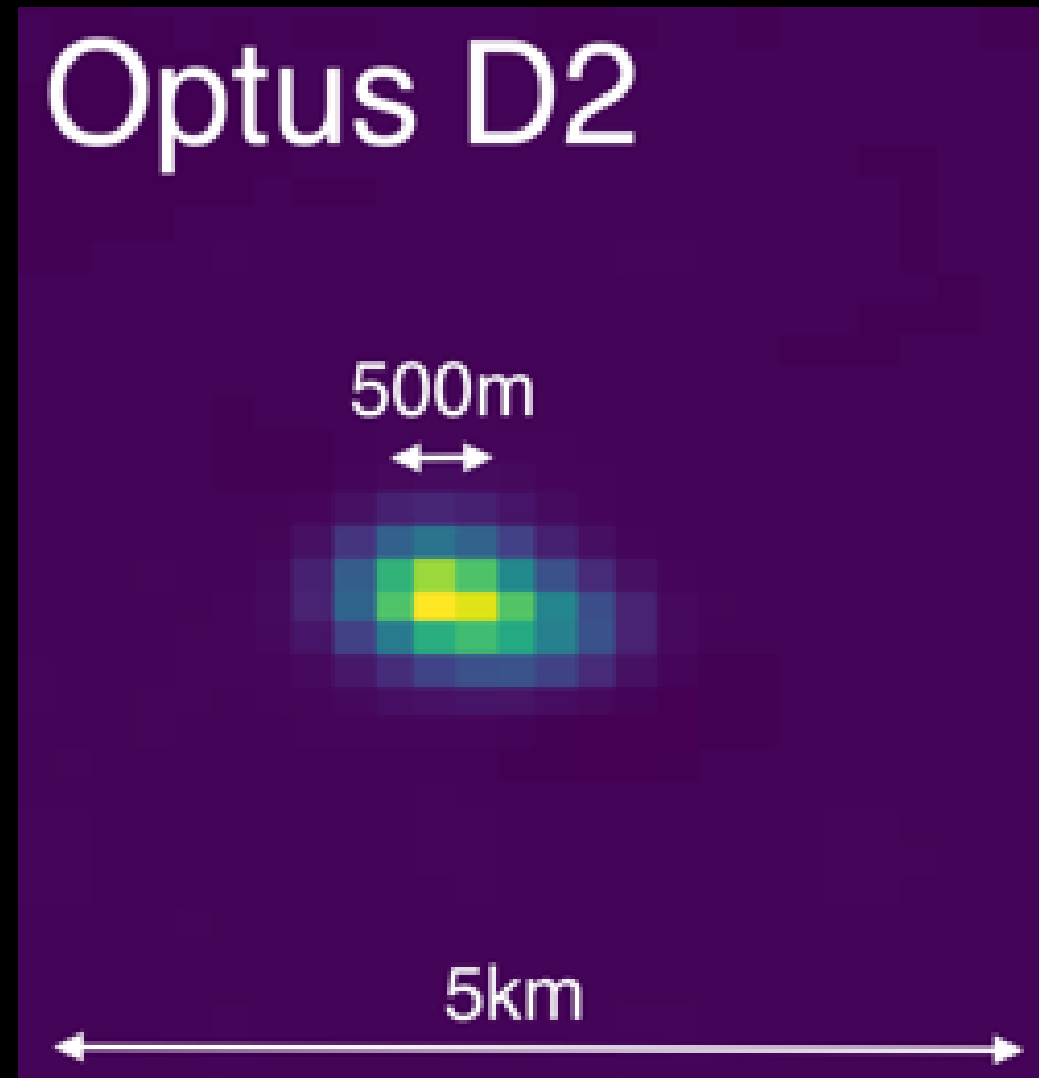




And it's not just Australian industry!



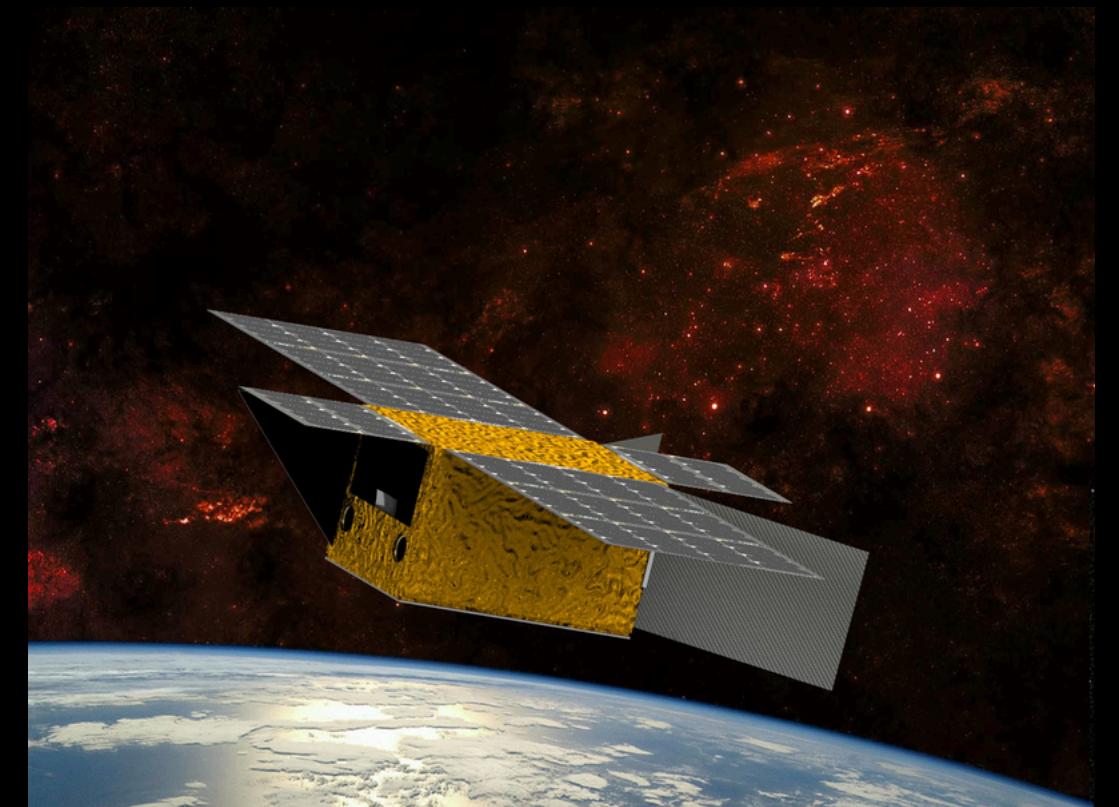
But what if the satellite I'm interested in, looks like this?



Not even HST can resolve objects at GEO, let alone L2...

Thermal infrared observations can help!

Moving from **stars** to **satellites** is ALREADY kickstarting
Australian Space Based Astronomy!



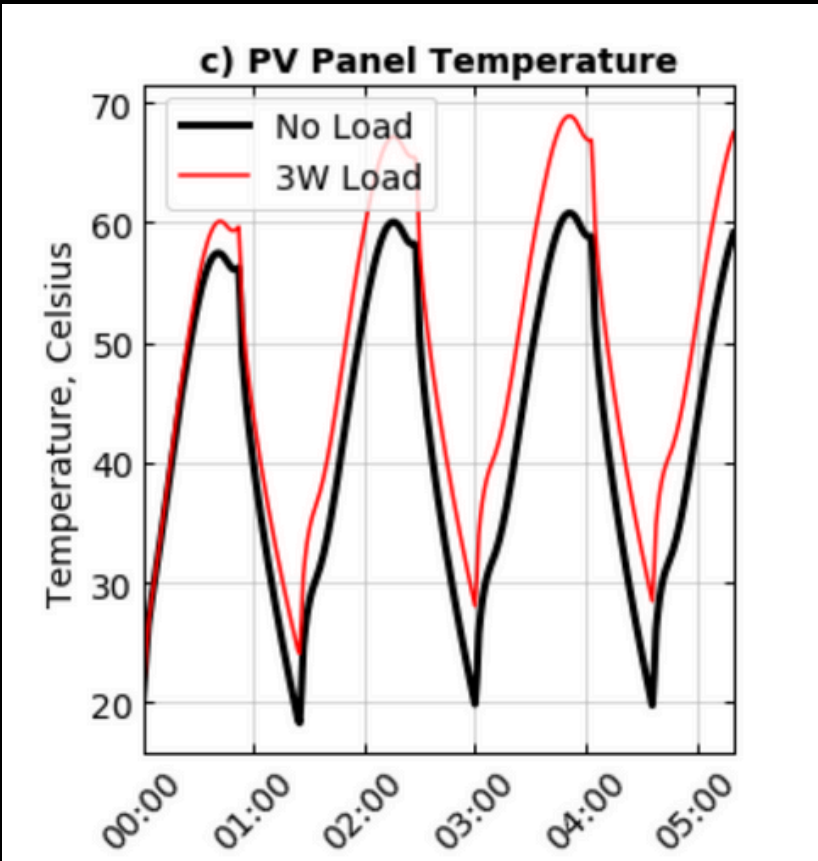
Thermal Infrared Space
Telescope for SDA

How it will collect Infrared Intelligence...

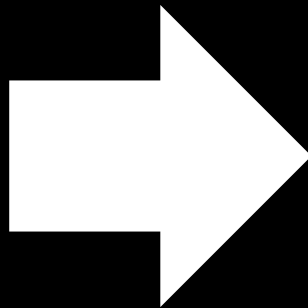
Observable

Solar Panel
Temperature

Temperature



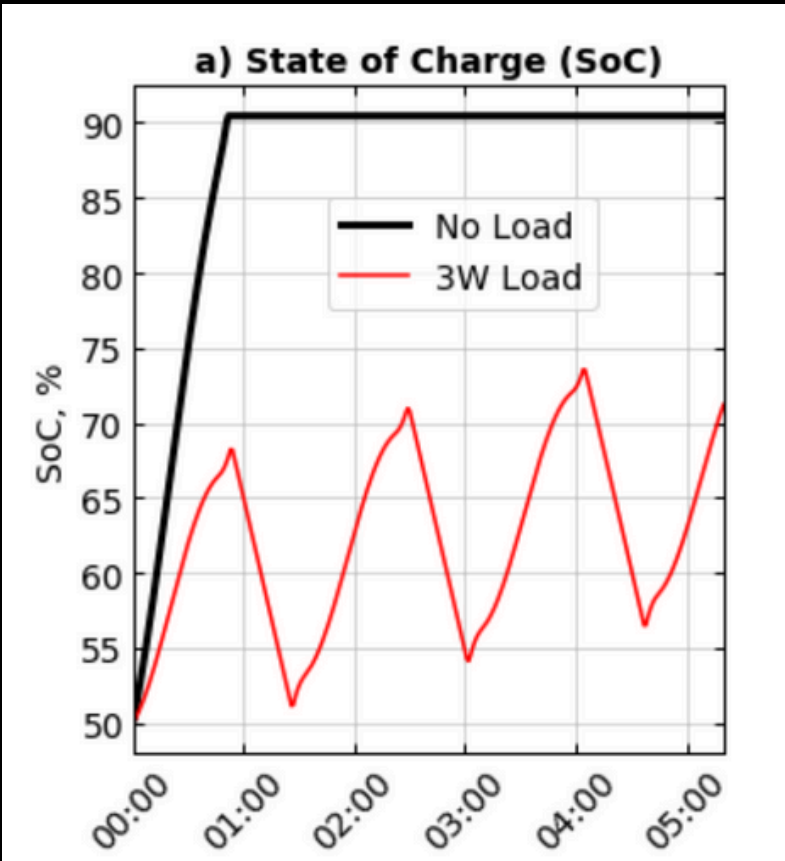
Time



Intelligence

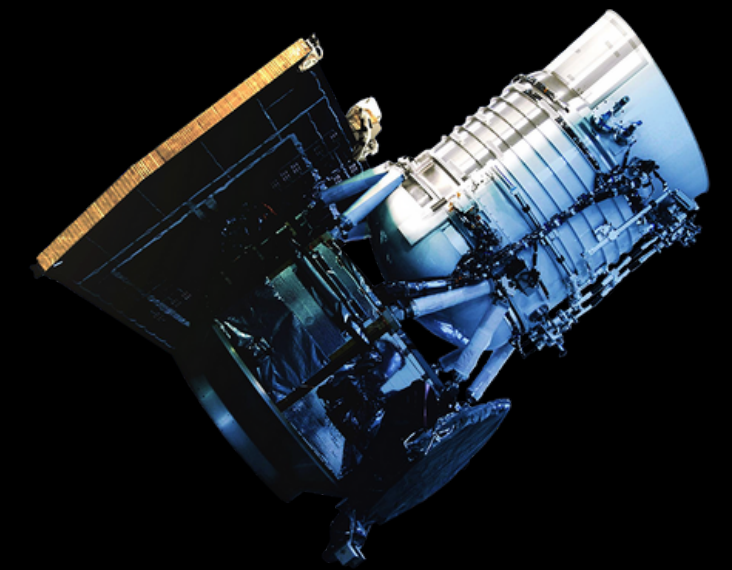
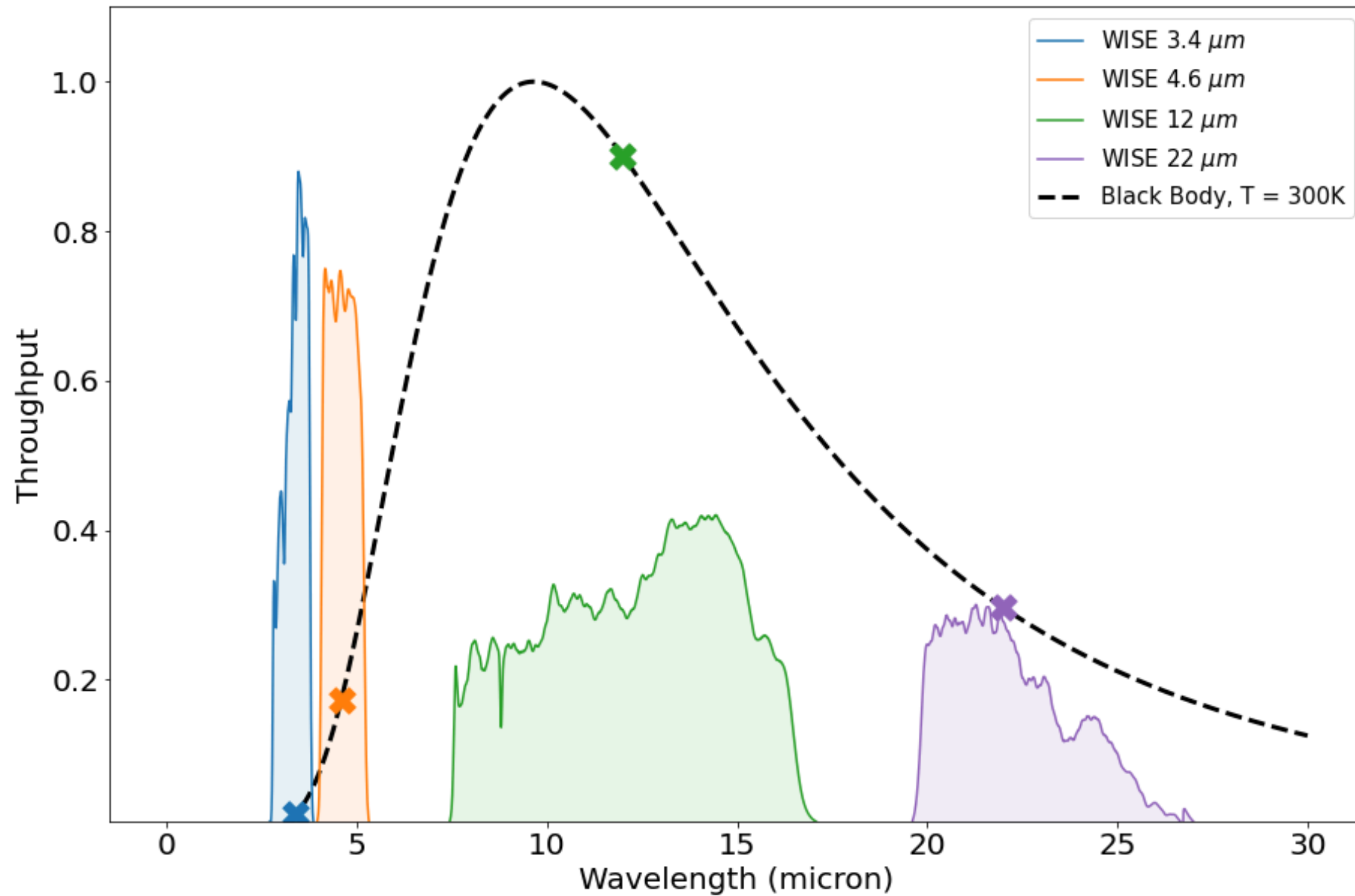
Satellite Operations

Battery Charge



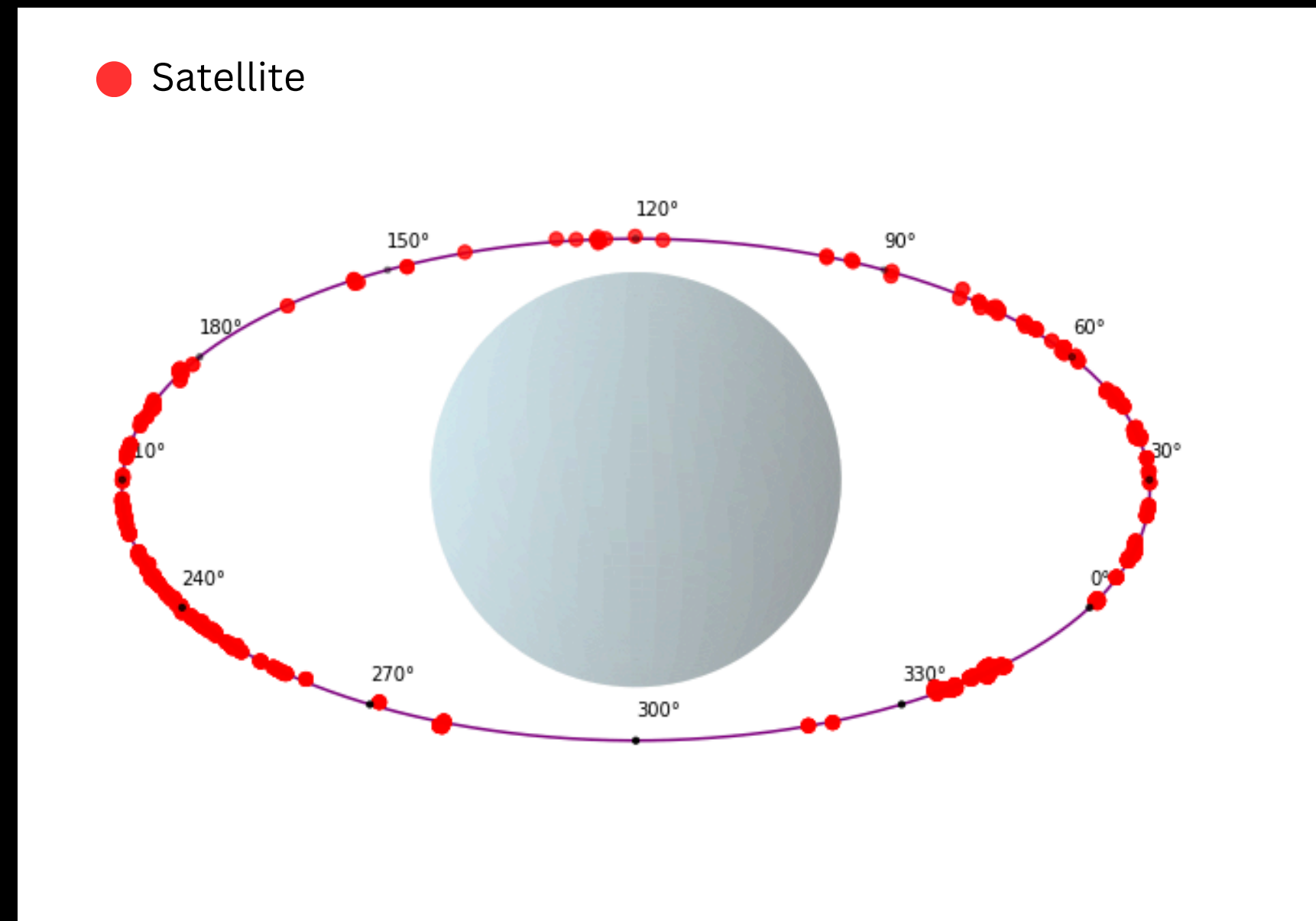
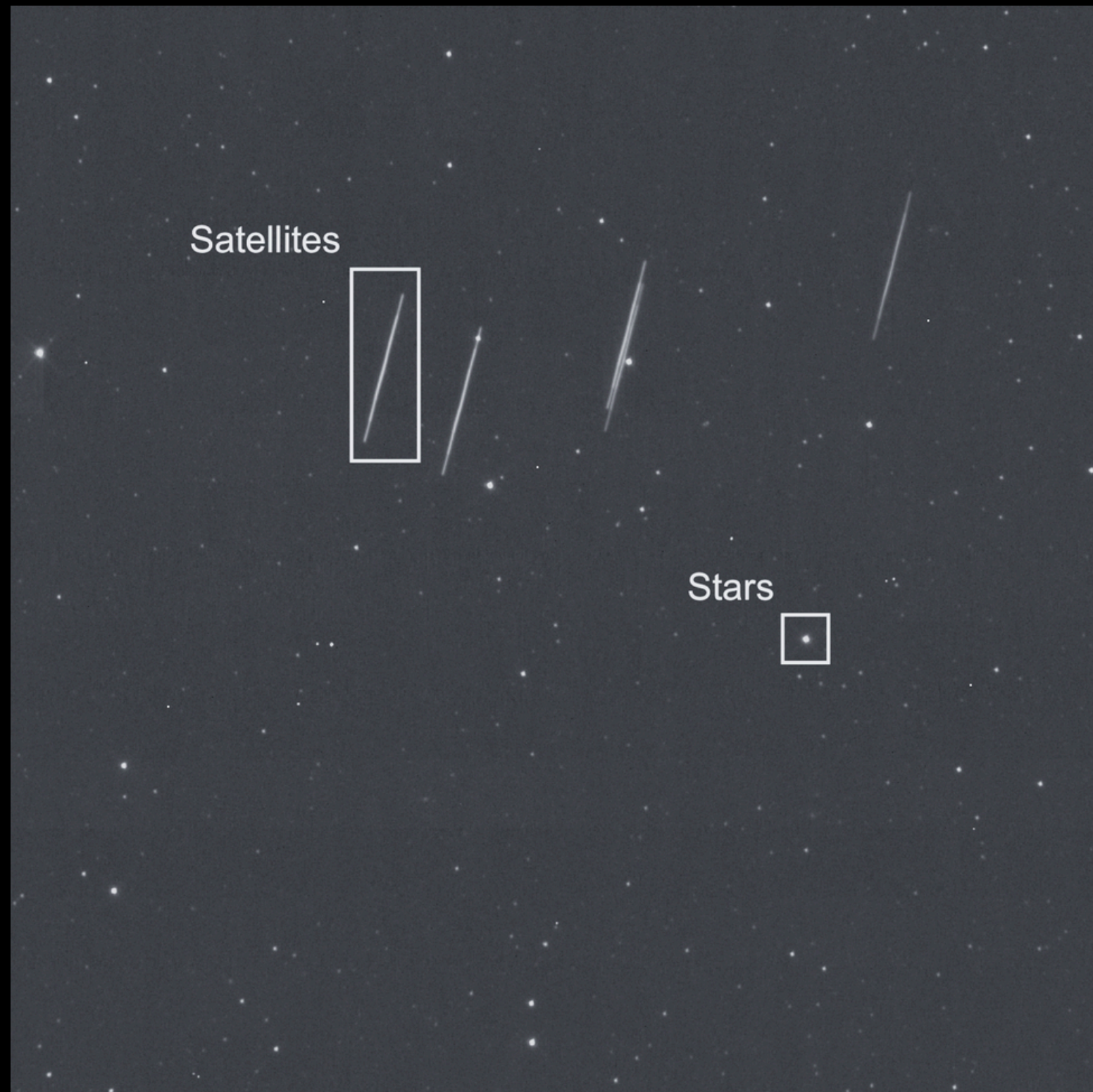
Time

Concept of Operations based on WISE Space Telescope Observations



Wide-Field Infrared
Survey Explorer

Satellite Identification

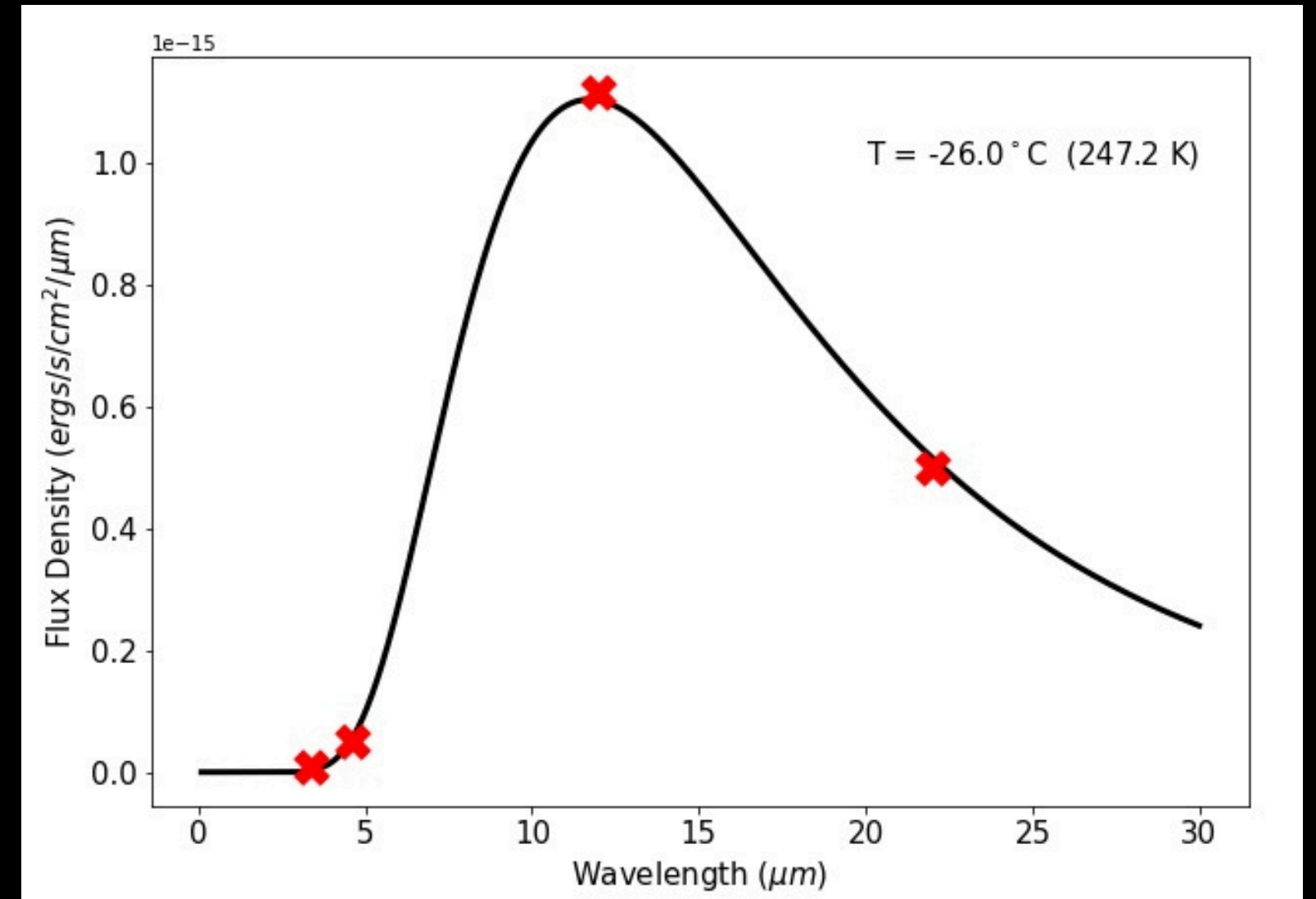
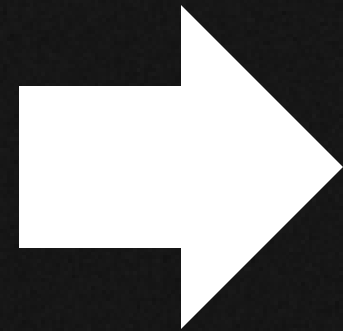


Streak Photometry

Optus C1

Optus D3

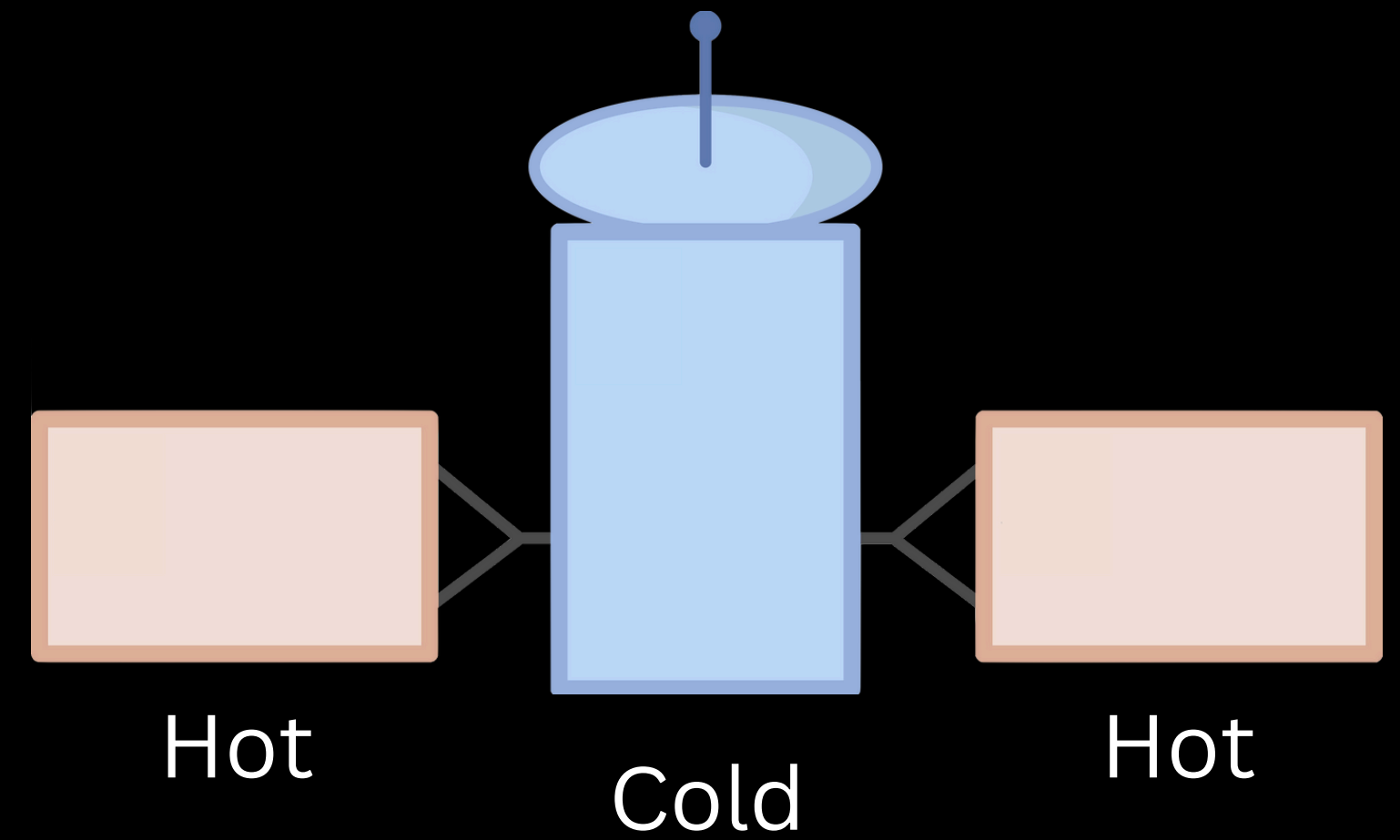
+ Catalog Matching



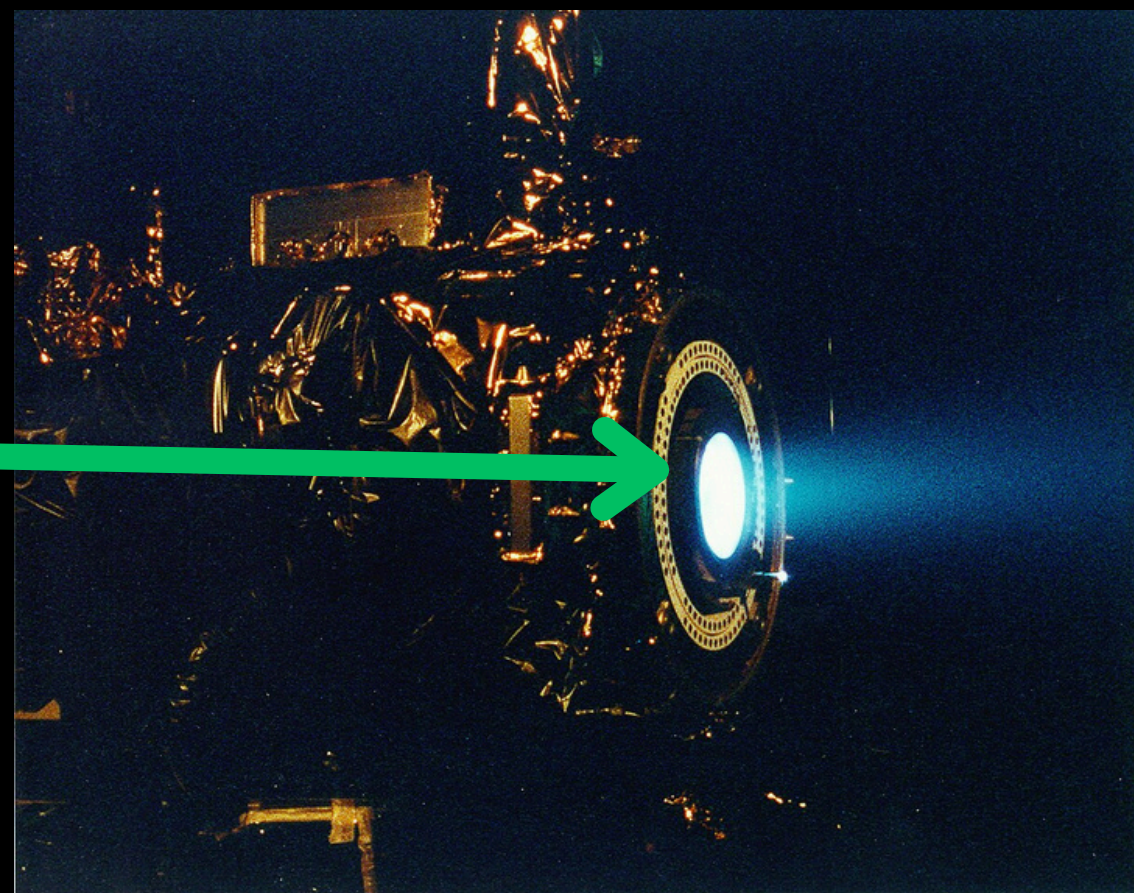
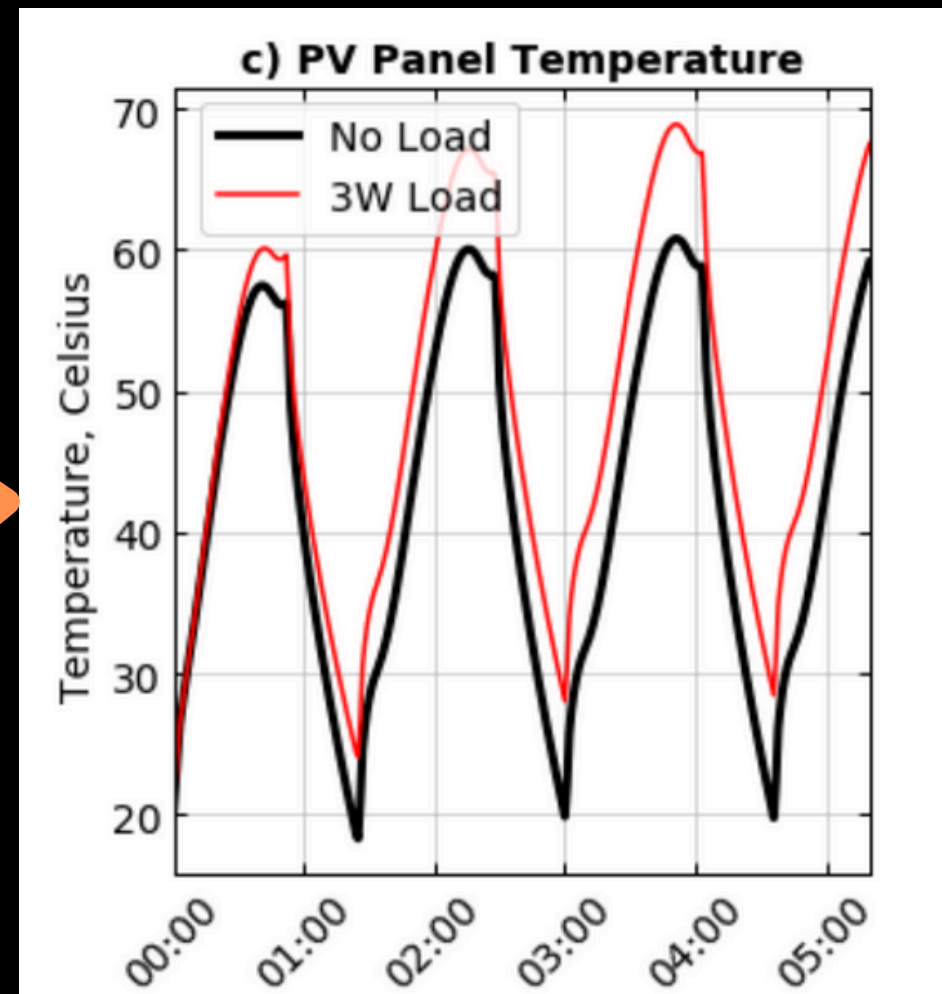
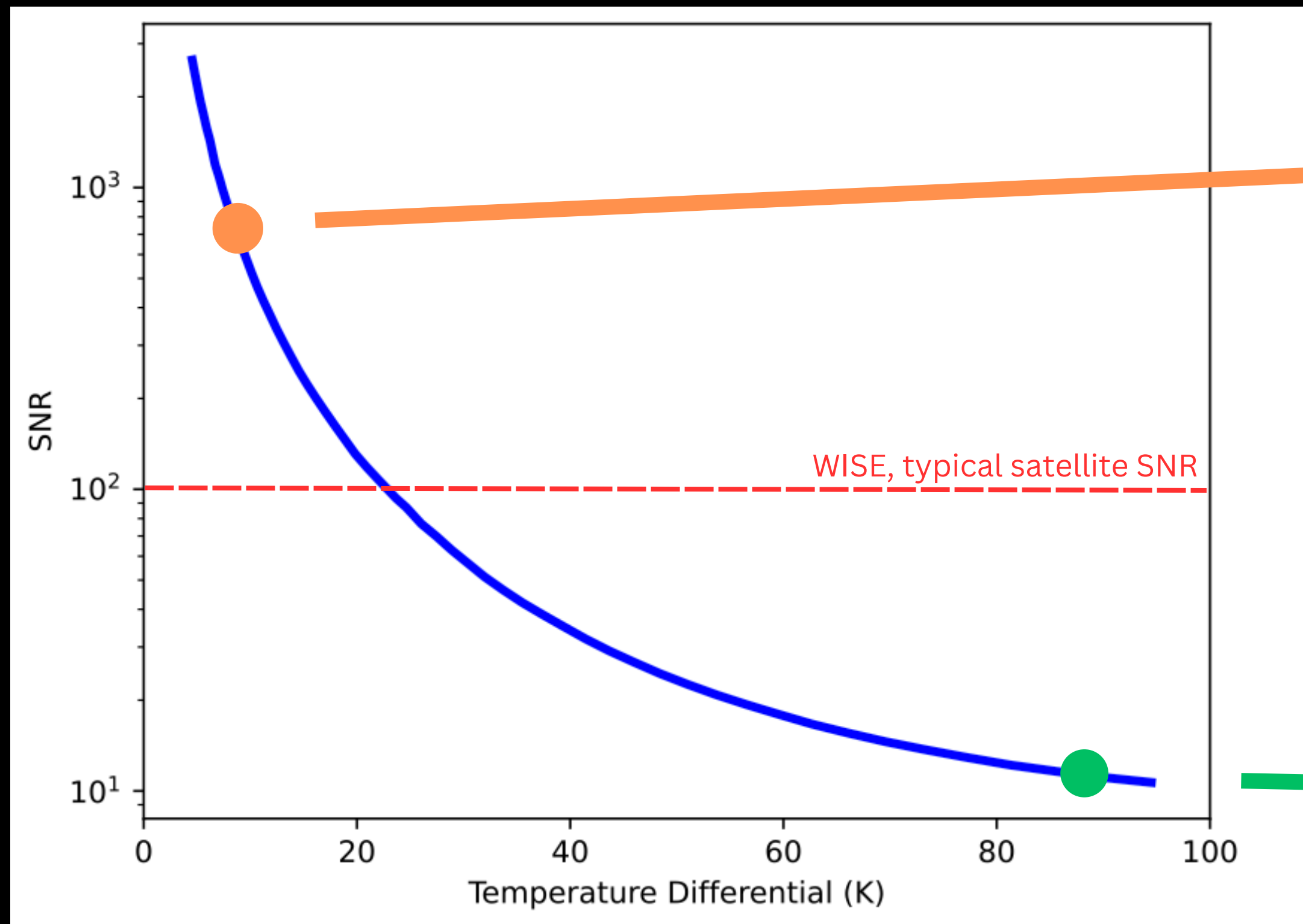
Basic Single Body Thermal Model



2 Body Thermal Model

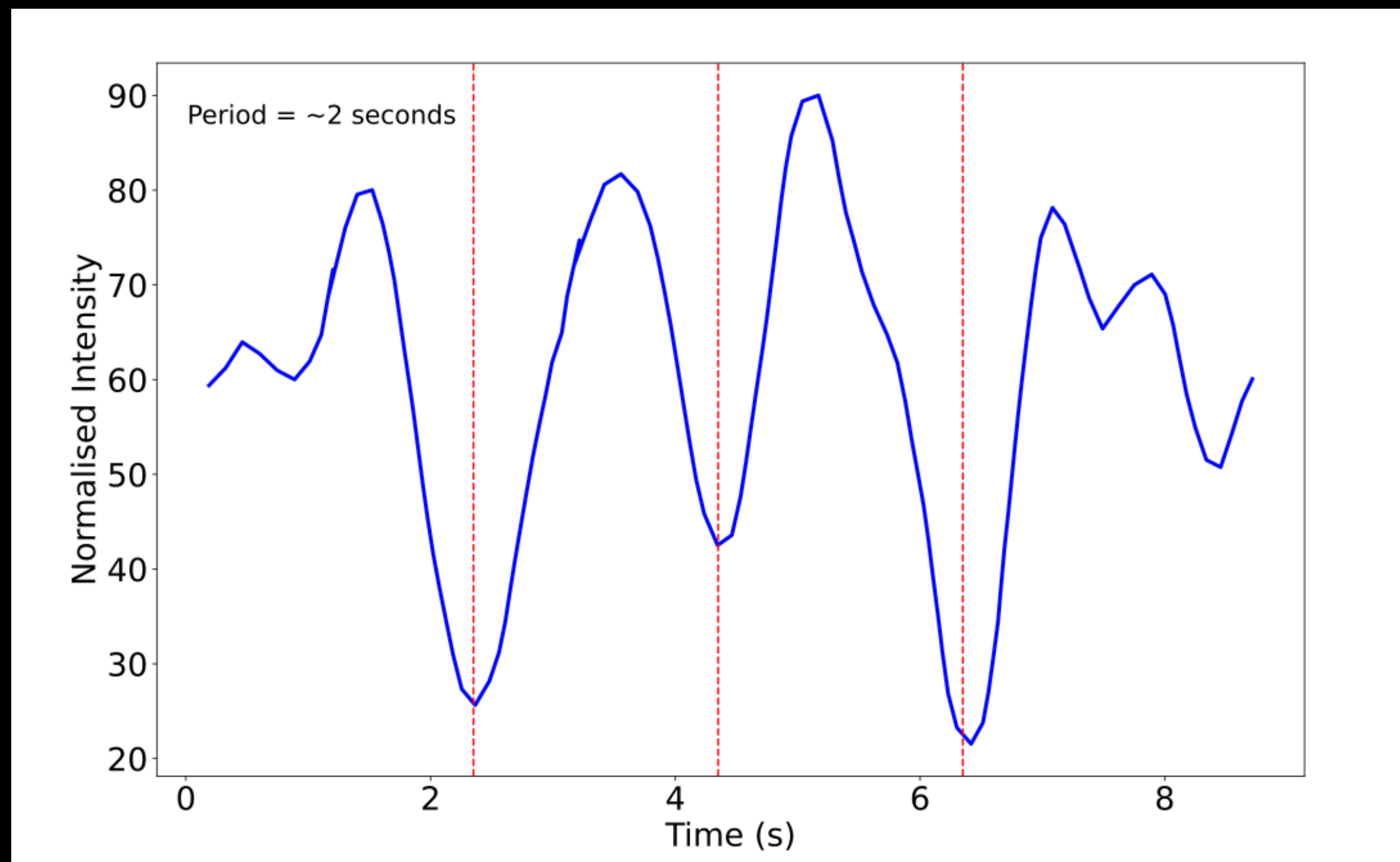


Monitor Power Flows?





WISE W3 Band (12 micron)





For those unconvinced by the noble path,
I'm going to try a slightly more *pragmatic* approach...





3.9m Anglo Australian Telescope

1974 - New South Wales

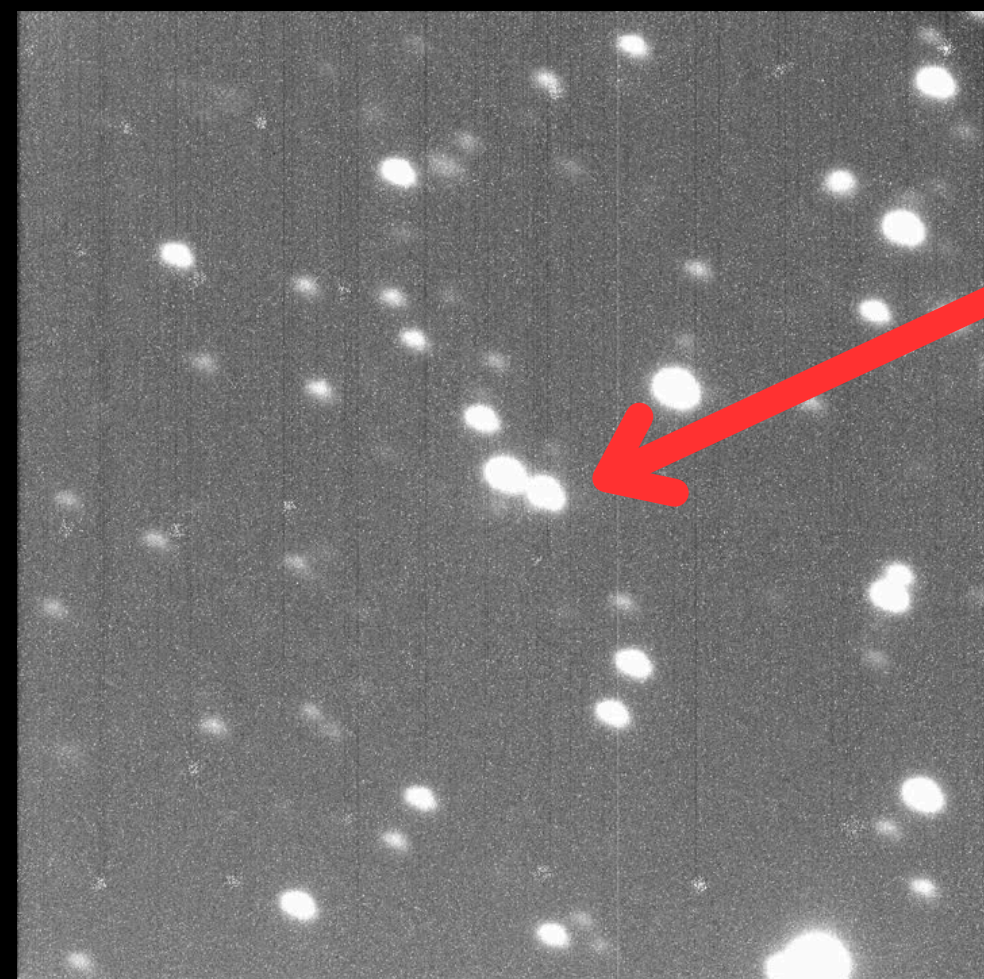


3.6m Space Surveillance Telescope

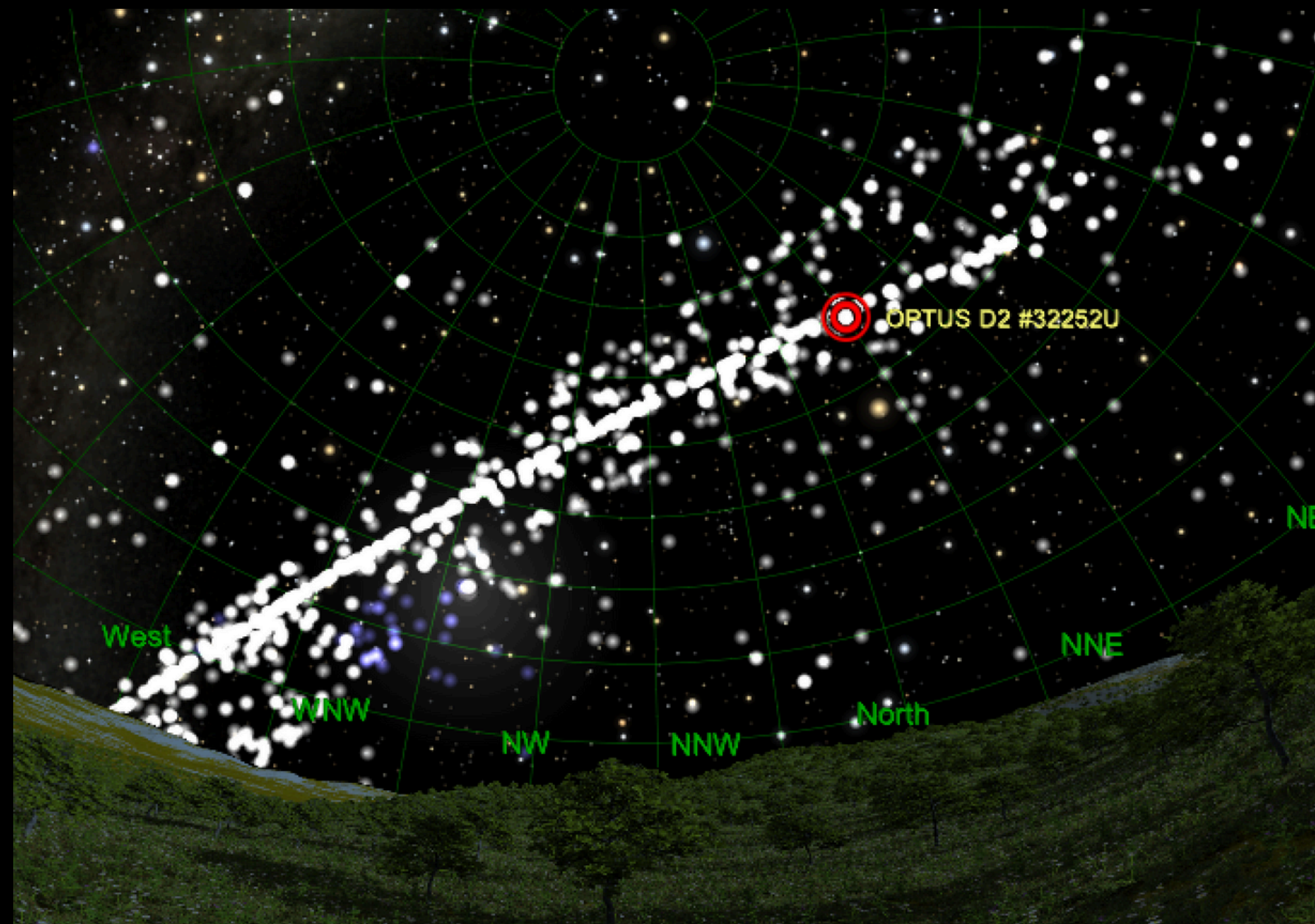
2020 - Western Australia



Euclid



JWST





You know **those annoying streaks** in your images
that you throw away?

Did you know the **government will pay you** for
that data?

Current ATM View - ATM 2024 0838

ASA Space Capabilities and Services Panel

Contact Details

Contact Officer - ASA Space Panel

Email Address: procurementinbox@industry.gov.au

Web Address: <http://www.tenders.gov.au>

ATM ID: ATM 2024 0838

Agency: Department of Industry, Science and Resources

Category: 80161500 - Management support services

Close Date & Time: 28-Feb-2025 3:00 pm (ACT Local Time)
[Show close time for other time zones](#)

Publish Date: 20-Dec-2024

Location: ACT, NSW, VIC, SA, WA, QLD, NT, TAS
Canberra, Sydney, Melbourne, Adelaide, Perth, Brisbane, Darwin, Hobart

ATM Type: Request for Tender

APP Reference: [047 - ASA - 2024/25](#)

Multi Agency Access: Yes

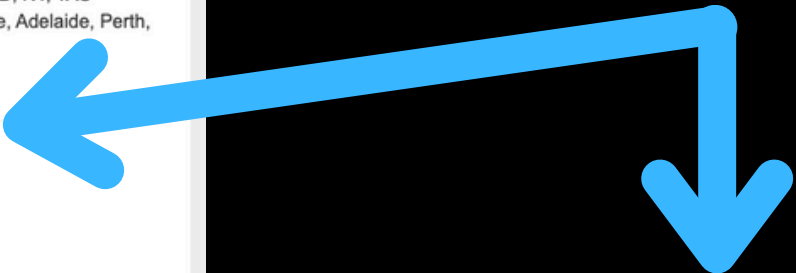
Multi Agency Access Type: All Agencies

Panel Arrangement: Yes

Multi-stage: No

Both of these are still open!

Closes 28th Feb 2025



Current ATM View - ATM_2024_0983

Space Situational Awareness (SSA) Capabilities for Launch and Return Support in Australia

Contact Details

Director Civil Space Monitoring Pathfinder

Email Address: CTOprocurements@space.gov.au

ATM ID: ATM_2024_0983

Agency: Department of Industry, Science and Resources

Category: 25200000 - Aerospace systems and components and equipment

Close Date & Time: 28-Feb-2025 5:00 pm (ACT Local Time)
[Show close time for other time zones](#)

Publish Date: 20-Jan-2025

Location: ACT, NSW, VIC, SA, WA, QLD, NT, TAS
Canberra, Sydney, Melbourne, Adelaide, Perth, Brisbane, Darwin, Hobart

ATM Type: Request for Information

Multi Agency Access: No

Panel Arrangement: No

Multi-stage: No

Description: Through this RFI, the agency is aiming to further understand Space Situational Awareness (SSA) capabilities that can support the safety and success of both launch and return operations within Australian areas of responsibility. With a rapidly growing space industry, Australia is poised to be a desired location for both commercial launches and re-entry services, serving both domestic and international parties.

The Agency is encouraging industry experts to provide their valuable insights on how these services can provide tracking, monitoring and risk management required for safe and sustainable space launches and returns to Australia. By gaining an understanding of the SSA capabilities, the Agency can better understand how a secure foundation of capability and infrastructure would support launch and return activities.

Approach to Market (ATM) – Services



Australian Government

Approach to Market

To establish Contract for Procurement of Commercial Space Situational Awareness (SSA) Data Services

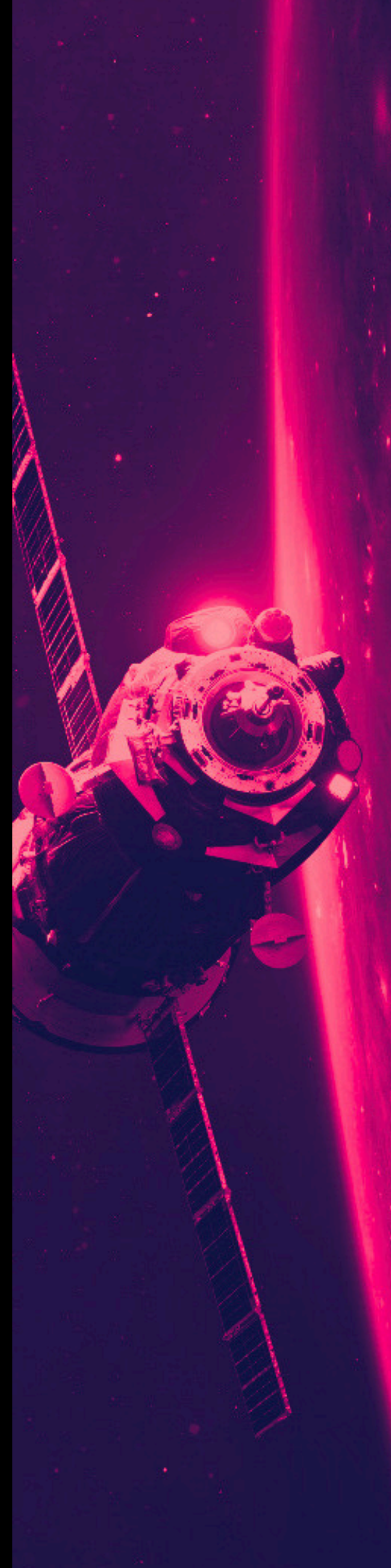
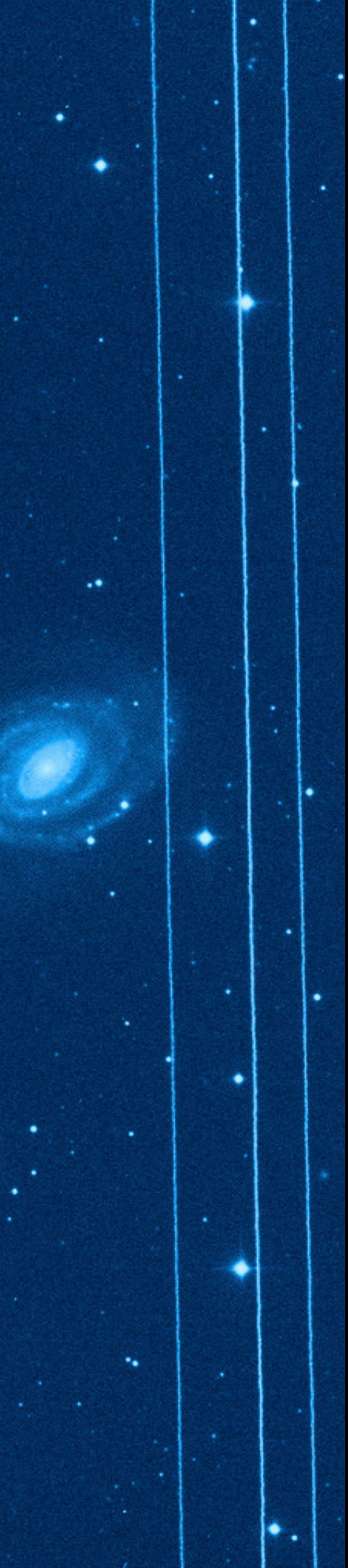
Reference ID: 2022/23 – ASA - 021

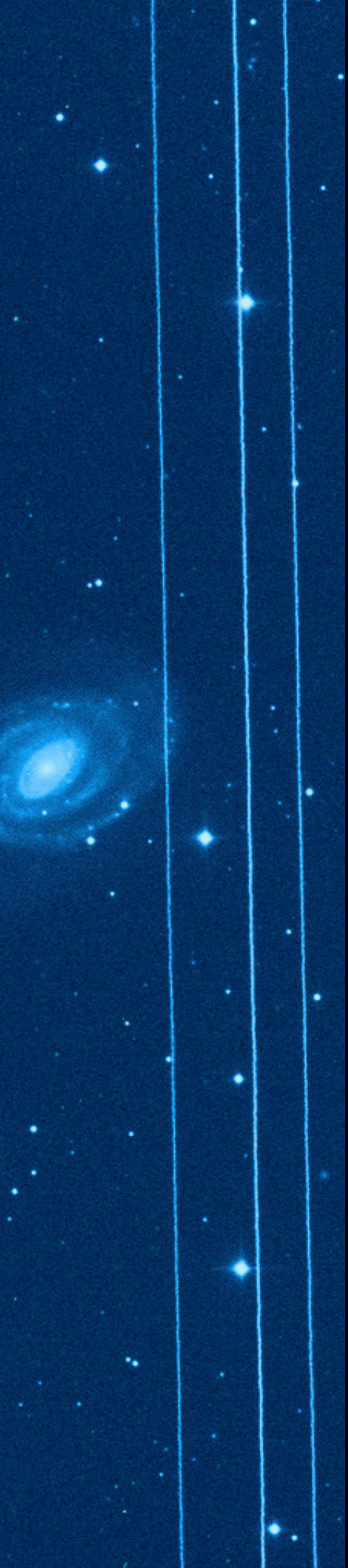
UNSPSC: 81112000 Data services



Ultimately, working together with satellite operators, defence and industry, Space Based Space Domain Awareness presents us with an invaluable opportunity to build the infrastructure, skills and technology required to develop Australian Space Telescopes and kickstart Australian Space Based Astronomy.

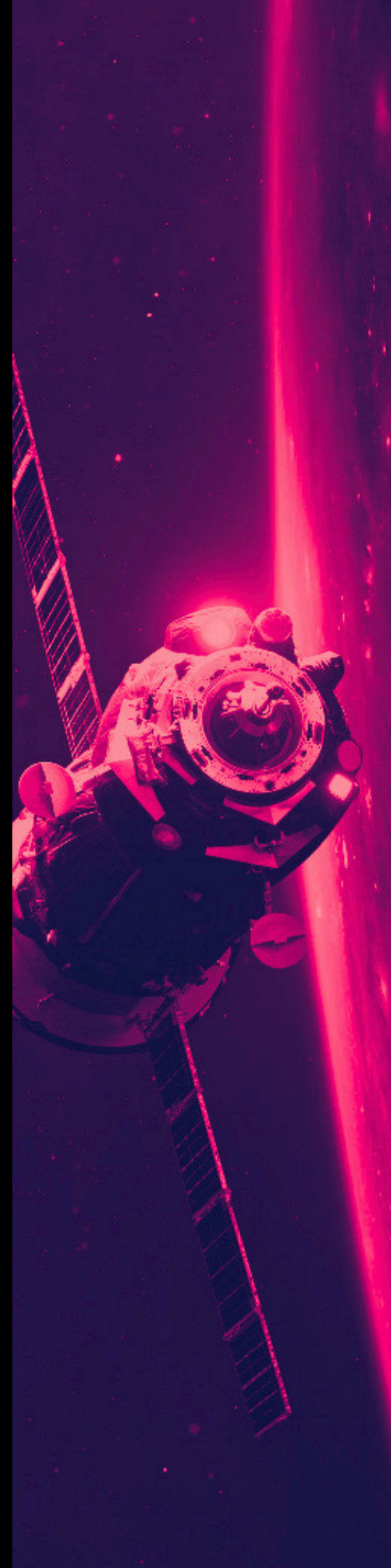
One last message from me...





We can do so much more than we
think we can,

And we can contribute solutions to
problems so far beyond what we
thought we ever could





There is *no such thing* as an
“ex-astronomer”

Only Astronomers who apply their skills to problems
outside the box





Until we all stop thinking in this way,

We will never truly realise the full potential that
Astronomy has to make a positive impact on our world.



Australian Space Based Astronomy is already on the
Horizon

