



THE UNIVERSITY OF
SYDNEY

**BREAKTHROUGH
INITIATIVES**



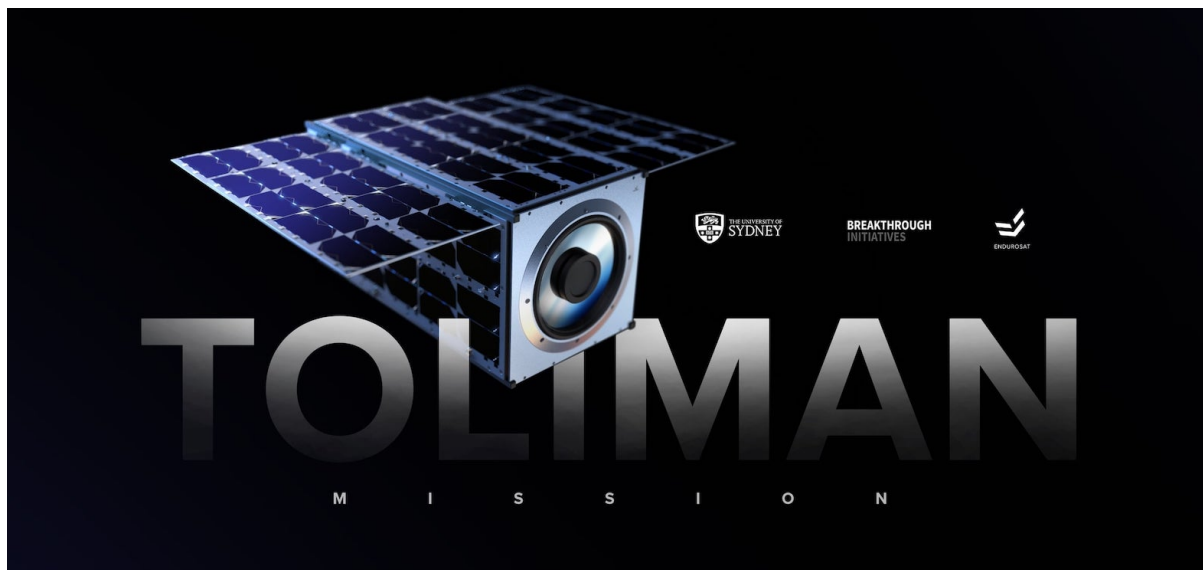
TOLIMAN SPACE TELESCOPE

1. MISSION DESCRIPTION

The University of Sydney's TOLIMAN mission is an exciting science expedition and a step forward in planning for humanity's interstellar journey. It involves using a small space-based telescope to measure changes in the separation of a binary star pair due to the influence of one or more planets orbiting one of them. The telescope will make use of a novel diffractive pupil that acts as a ruler to enable precise astrometry of binary star pairs at the micro-arc-second level. The precise measurements will enable the determination of the orbits of the binary pair and any perturbations, which would be indicative of a planet(s) in the system. This would be a ground-breaking discovery for humankind.

The TOLIMAN mission is primarily funded by the [Breakthrough Initiatives](#), a suite of space science programmes investigating the fundamental questions of life in the Universe: Are we alone? Are there habitable worlds in our galactic neighbourhood? Can we make the great leap to the stars? And can we think and act together – as one world in the cosmos?

Partners on this expedition currently include [EnduroSat AD](#) (Sofia, Bulgaria), designing and manufacturing the 16U CubeSat bus, and [Aperture Optical Sciences](#) (CT, USA), constructing the 12.5cm space-based telescope. The spacecraft development is progressing on schedule and will be assembled, integrated, and tested, ready for launch in Q3 2024. The planned orbit is LEO 550km sun-synchronous, enabling TOLIMAN to perform its observation mission over the course of 3 years, downlinking data back to the University of Sydney.



2. SCIENCE OBJECTIVES

TOLIMAN achieves interferometric monitoring of our astronomical neighbourhood with a ground-breaking small instrument. Using a diffractive pupil optical mask to spread starlight from point sources into overlapping fringes, allows the separation measurement between binary stars to be immune to telescope distortions in space. The diffractive pupil also carries an embedded spectrometer that measures the colour of starlight. The innovative optical and signal encoding architecture is pivotal to the mission performance as the planet's signal is extremely small on the detector: 10^{-6} of the width of one pixel on the sensor.

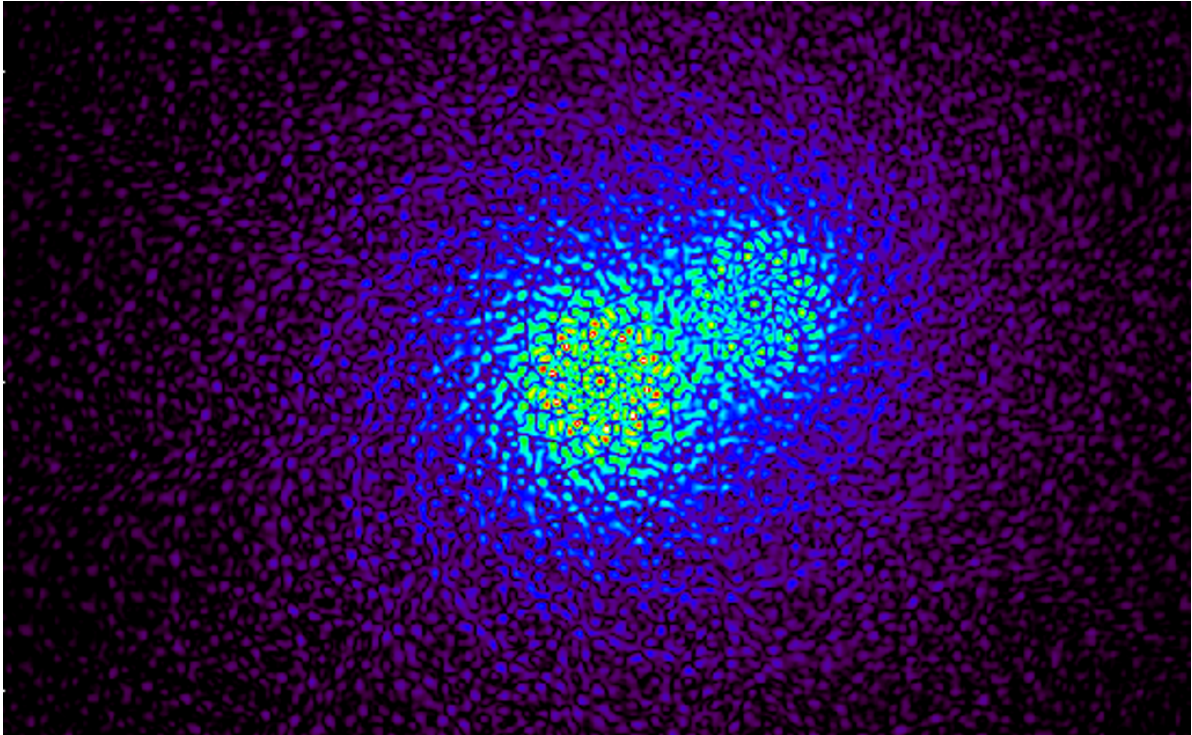


Figure 1: Simulated image of the Alpha Cen star system viewed through TOLIMAN

3. IMPACT FOR AUSTRALIA

This is scientific inquiry at the top rung of every nation's strategic plan, with deep reach into culture. The TOLIMAN mission will be a visible banner for evidence-based reason which serves to attract a new generation into highly skilled career paths in quantitative science and engineering, providing a marquee demonstration of the power of STEM research in making real progress with enigmas that have haunted humanity for millennia.

The impact on science and culture of finding a planet in the Alpha Centauri system is hard to overstate. Alpha Cen hosts two stars so similar to our own sun that any planet discovered there in a temperate orbit would immediately be classified as a "True Earth Analog": the holy grail for the scientific hunt for alien life (astro-biology). As we have only one sure example of a biosphere (the Earth), then finding a planet with similar properties around a star that is a near twin to the sun is as close to the ideal outcome as possible.

In 2024, the TOLIMAN mission has been awarded **The Explorers Club Flag**. The Flag represents an impressive history of courage and accomplishment. The Explorers Club is renowned for various "Famous Firsts" accomplished by its members, including:

- First to the North Pole (1909) – Robert E. Peary & Matthew Henson
- First to the South Pole (1911) – Roald Amundsen
- First to the summit of Mt. Everest (1953) – Sir Edmund Hillary & Tenzing Norgay
- First to the deepest point in the ocean (1960) – Don Walsh & Jacques Piccard
- First to the surface of the Moon (1969) – Neil Armstrong & Buzz Aldrin

It is both an honor and a privilege to receive this special recognition and join this esteemed collection of missions that have significantly contributed to human history.