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POC REPORT NEW ZEALAND

5th UNISEC-Global Meeting
Rome, 2017

Jim Hefkey
The University of Auckland

New Zealand Tertiary Institutes

8 Universities

16 Polytechnics





CANSAT NZ



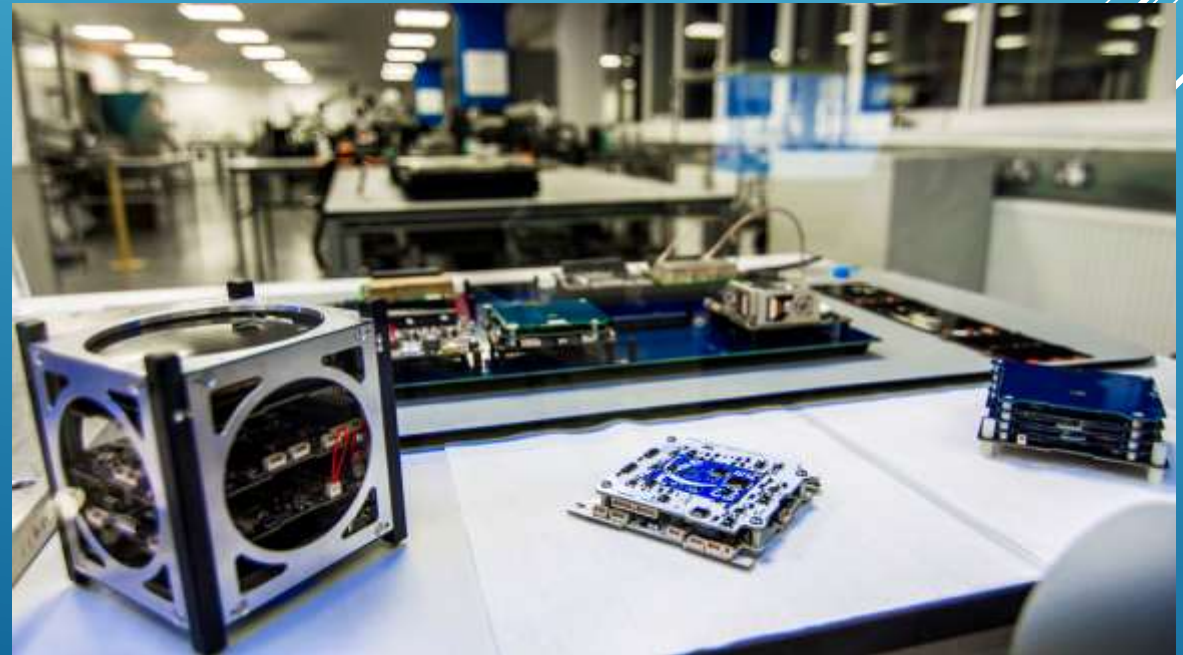
Slow Beginnings



ROCKET LAB

- ▶ **STUDENT-LED CROSS FACULTY PROGRAM**
- ▶ **DEFINE A PROBLEM OR A NEED TO BENEFIT SOCIETY**
- ▶ **FORM THEIR OWN MULTI-DICIPLINARY TEAM**
- ▶ **DEVELOP A SOLUTION TO THAT PROBLEM UTILISING A CUBESAT**
- ▶ **SUBMIT A FORMAL PROPOSAL WHICH INCLUDES A BUSINESS PLAN**
- ▶ **SUBMIT A POSTER AND VIDEO**

AUCKLAND PROGRAM FOR SPACE SYSTEMS



- ▶ **A PROGRAM FOR UNDERGRADUATES**
- ▶ **LEARNING TO WORK ON COMPLEX PROBLEMS WITH PEOPLE THAT DO NOT THINK THE SAME WAY**
- ▶ **OPEN TO STUDENTS FROM ALL FACULTIES**

**AUCKLAND PROGRAM
FOR SPACE SYSTEMS**

A decorative graphic consisting of several parallel white lines of varying lengths, slanted diagonally from the bottom right towards the top right, set against the blue background.

MAKE BIGGER,
HIGHER, SMARTER
YOUR PROFESSION

3.403

3.401





Student teams bid to launch space project

by [Andrew Ashton](#)

Rocket Lab's Mahia launch site inspires students in Auckland to aim sky high.

THE existence of Rocket Lab's new launch site at Mahia is inspiring university students in Auckland to aim sky high – even though the first rocket launch is some months away.

About two dozen teams from the University of Auckland are now competing to design a satellite that would be delivered into orbit from the Rocket Lab launch pad at Onenui Station.

University Faculty of Engineering professional teaching fellow Jim Hefkey said multi-disciplinary student teams from across different university faculties were involved in the competition to design and build their own CubeSat-sized satellite.

"It is critical that the approach we take within the university reflects the real world, where space missions might include everything from astrophysics to archaeology. Complex future problem-solving in all fields, not just space, will require inter-disciplinary teamwork.



COUNTING DOWN: Rocket Lab's launch platform at the Mahia launch site, being manoeuvred into place last week. Picture supplied.



ACTUALLY, IT IS ROCKET SCIENCE

Space is the new frontier at the University of Auckland with the launch of a space systems project where students will design and build a satellite that will be sent into orbit.

The Auckland Program for Space Systems takes an innovative approach that will see multi-disciplinary student teams from across different Faculties working together.

"This project is about creating a culture of cross-faculty team-work that will see students from Arts for example working with students from Science or Engineering," says Faculty of Engineering professional teaching fellow Jim Hefkey.

"It is critical that the approach we take within the University reflects the real world where space missions might include everything from astrophysics to

archaeology. Complex future problem-solving in all fields, not just space, will require inter-disciplinary teamwork."

Almost two dozen student teams have entered the space CHALLENGE competition to design and build their own CubeSat-sized satellite. Students have volunteered for the project which is over and above their courses of study.

"We've had a very enthusiastic response which is great because as space technologies are developing rapidly and decreasing significantly in cost, New Zealand will have a space industry and we need the human resources to help it develop," Jim says.

Each student team will come up with an idea for the mission and the functions they want the satellite to perform. The winning team will qualify to build their satellite and prepare it for flight. Entries will be judged by a panel of academics and industry representatives.

Peter Beck, founder of Rocket Lab, has undertaken to help launch the winning satellite on one of his company's Electron rockets. The launch will occur from the private orbital launch site Rocket Lab has nearing completion on the Mahia Peninsula, south of Gisborne.

The Electron vehicle was designed specifically with the small satellite market in mind - the size of satellite technologies has reduced rapidly in recent years and CubeSats have increased in capability and performance.

Once launched, students will be able to operate the mission from a control centre at the University.



SATL LIGHT

A two sided sail to generate power and propulsion

Solar Cell

Two sided solar cell structure provides maximum efficiency in a light to reflectance ratio to generate more power.

Solar Sail

This side absorbs photons to create the photovoltaic effect. In propulsion mode it will be opened.

Success: Provide a larger power allowance. Reduce power demands from propulsion. Increase orbit lifespan. Allow more complex missions with higher energy demands.

SatL Light | AUCKLAND UNIVERSITY OF TECHNOLOGY

WAT-SAT

Water Quality Assessment in Space

Mission Objective: To measure the number of viable cells and determine necessary regular water quality assessment in New Zealand. In doing this we aim to meet the 'code of best practice' monitoring in New Zealand.

How? We aim to address this issue by creating WAT-SAT, a 100 kg CubeSat which will provide an automated monitoring system for water quality. WAT-SAT will feature a comprehensive imaging payload, similar to the CubeSat pictured below.

Why? New Zealand markets itself off its "Clean, Green" image. It is vital to keep our tourism, fish and farming industries thriving. Because of this, figures such as those reported in 2013 stating that 43% of New Zealand's commercial waterways were rated as "good" or "very good" quality really hit home.

What we want to do: We're solving a problem with a 100 kg CubeSat we recently funded the development of water quality assessment. When we launched we have an overall idea of what we can do, although New Zealand has over 100,000 km² of water, we only have 77 water quality assessment sites.

Design concept for APSS: We are to use the WAT-SAT as a part of coverage for the implementation of Targeted Coastal (TC) - 201 which will implement Targeted Operational Imaging. Devices designed to monitor a target range of water quality elements.

WAT-SAT | AUCKLAND UNIVERSITY OF TECHNOLOGY

No Water. No Life. No Blue. No Green.

Half the world will have a fresh water crisis by 2030

2.8 billion lack access to fresh water

Scan for subterranean fresh water from SPACE

- Sylvia Earle

WAT-SAT | AUCKLAND UNIVERSITY OF TECHNOLOGY

SPECTRA

OUR MISSION: Determine which debris is worth salvaging by using reflectance spectroscopy to determine the chemical composition of space debris.

APPROACH: Spectrometer is used to measure wavelengths of electron-magnetically radiation emitted by debris particles. Data collected will be sent back to earth and compared with existing database which allows accurate logging of the properties of a piece of debris.

POINT OF DIFFERENCE: Spectra were to measure other dimensions to use this technology on a much larger scale and open up a new chapter in commercial spaceflight for New Zealand's aerospace industry.

SPECTRA | AUCKLAND UNIVERSITY OF TECHNOLOGY

Feasibility of Total Electron Content as a Precursor to Earthquakes

Mission: Compare collected CubeSat data with NDWIP data to see if there is a correlation between TEC and seismic activity.

Approach: Measure Total Electron Content (TEC) by measuring the phase shift of radio waves. TIC disturbance propagation.

TEC | AUCKLAND UNIVERSITY OF TECHNOLOGY

Electromagnetic Thruster

Mechanism: The thruster uses a magnetic field to accelerate ions, creating a high-speed jet of plasma that propels the spacecraft.

Objective: To develop a compact, efficient thruster for small satellite applications, providing high specific impulse and low mass.

Electromagnetic Thruster | AUCKLAND UNIVERSITY OF TECHNOLOGY

ELECTRO DYNAMIC TETHERS

WHAT WE ARE TO SOLVE: We aim to solve the problem of power generation for small satellites in orbit. Electrodynamic tethers (EDTs) can generate power by interacting with the Earth's magnetic field.

THE CONCEPT: An EDT consists of a long, thin conductor that is deployed from a satellite. As the satellite moves through the Earth's magnetic field, the conductor acts as a generator.

WHAT ARE ED TETHERS? Electrodynamic tethers are long, thin conductors that are deployed from a satellite. They can generate power by interacting with the Earth's magnetic field.

ELECTRO DYNAMIC TETHERS | AUCKLAND UNIVERSITY OF TECHNOLOGY

Helios

Ionospheric electron flux measurement

Mission overview: Solar flares and coronal mass ejections cause electron flux in the upper atmosphere. The Helios will be a 10kg (1U) CubeSat which we aim to detect the effects of such solar weather events by measuring the electron density in the ionosphere, using a Multi-Needle Langmuir Probe (m-NLP) instrument developed by the University of Otago.

Measurement: The m-NLP consists of an electron counter at the center, and four vertical needle probes measure electron current looking to the ionospheric plasma. This is then converted voltage and digitized. The higher the electron density, the higher the electron current measured across the probe.

Application: The current data of particular events will be recorded and then communicated via download. Then, physical and physical parameters are used to determine the electron density from the current data.

Deployment: The four probe booms are stored onto the CubeSat by face-wrap. To deploy booms, a high current is passed through wires, allowing springs at the base of each boom to pull each up into position.

Helios | AUCKLAND UNIVERSITY OF TECHNOLOGY

OzoCube

THE PROBLEM: The ozone layer is being depleted by human-made chemicals, particularly chlorofluorocarbons (CFCs). This depletion leads to increased UV radiation, which can cause skin cancer and other health problems.

THE SOLUTION: OzoCube is a CubeSat mission designed to measure the total ozone column over New Zealand. It uses a Total Ozone Mapping Spectrometer (TOMS) instrument.

MISSION: OzoCube will measure the total ozone column over New Zealand, providing valuable data for environmental monitoring and policy-making.

OzoCube | AUCKLAND UNIVERSITY OF TECHNOLOGY

Microbe Interaction & Biomass Production

Problem: Many technologies have been produced to ensure successful space flights and missions. Our time in space is limited by our ability to feed ourselves, produce fuel and combat pathogenic illnesses.

Solution: Living Cultures, we will perform a biological experiment that measures:

- 3D Organism Growth
- Food Production
- Bio-fuel Production
- Gene Expression Change

Team Space Silk Road

Microbe Interaction & Biomass Production | AUCKLAND UNIVERSITY OF TECHNOLOGY

SPACE JUNKIES

Problem: Space debris is a growing problem. There is a significant amount of space debris in orbit, posing a risk to operational satellites and future space exploration.

Solution: We will create a satellite-based radar system to detect and track space debris. This system will use a radar system to detect and track space debris, providing valuable data for space situational awareness.

Value: To reduce the risk to operational spacecraft in the Earth's orbital environment, allowing for the continued advancement of the Space Age.

SPACE JUNKIES | AUCKLAND UNIVERSITY OF TECHNOLOGY

R.E.L.I.C

Radar, Extrapolated Radar, Information, Cubesat

Radar: The radar is used to detect and track space debris in orbit. It uses a radar system to detect and track space debris, providing valuable data for space situational awareness.

Missile: The missile is used to track and identify space debris. It uses a missile system to track and identify space debris, providing valuable data for space situational awareness.

Lidar: The Lidar system is used to detect and track space debris in orbit. It uses a Lidar system to detect and track space debris, providing valuable data for space situational awareness.

Data Transmission: The data collected by the radar, missile, and Lidar systems is transmitted back to Earth via a radio link. This data is used to track and identify space debris, providing valuable data for space situational awareness.

R.E.L.I.C | AUCKLAND UNIVERSITY OF TECHNOLOGY

AGRISAT

MISSION: The satellite helps the New Zealand agricultural industry combat operators by providing high resolution and high frequency satellite imagery. We aim to provide data which is accessible and user friendly.

Space Junk: Decommissioned man-made objects orbiting in space. 90% of space junk is unable to be tracked from ground based systems. A crewed mission or unmanned lander will be used to track future launches to help and save a small satellite.

Technical Specifications:

- IMU/D Sensor
- Magnetorquer
- Battery
- Solar Panel
- Computer

Value: To reduce the risk to operational spacecraft in the Earth's orbital environment, allowing for the continued advancement of the Space Age.

AGRISAT | AUCKLAND UNIVERSITY OF TECHNOLOGY

DT-SAT

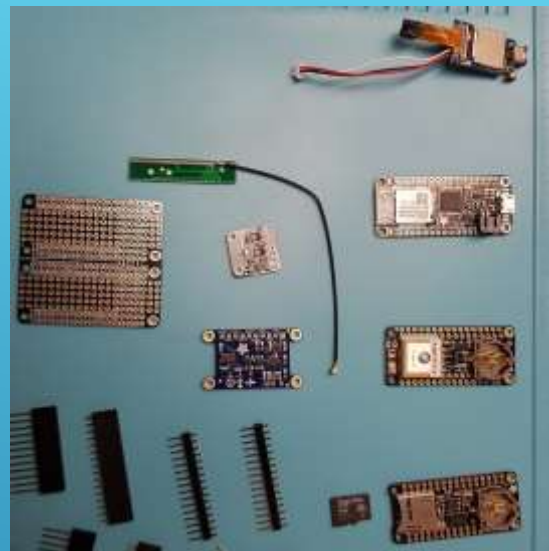
EMBAVOURING TO REDUCE SPACE DEBRIS

Mission Statement: The Debris Tracking CubeSat (DT-SAT) will track, position, velocity and trajectory of orbital space debris. The DT-SAT will scan radar to track the debris before communicating this data to Earth.

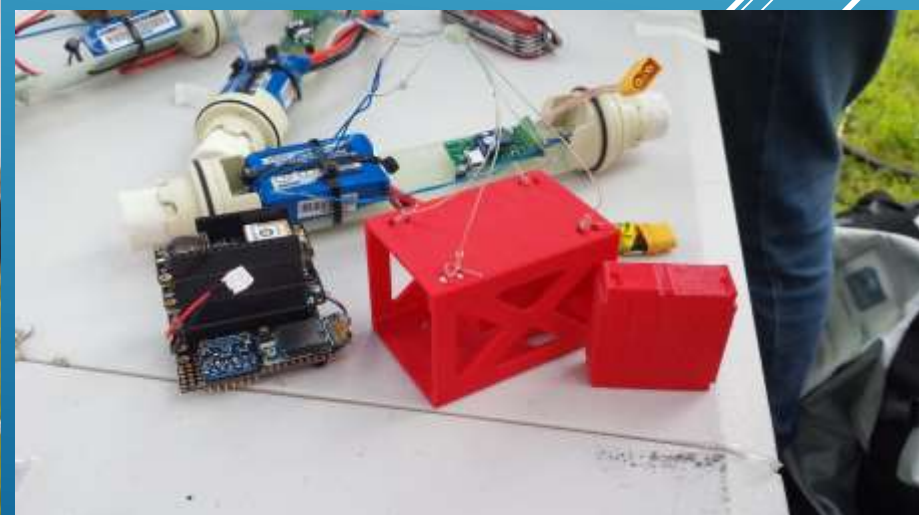
Operation: DT-SAT will collect the data to conduct statistical analysis of the path of space debris, to determine the risk of future collisions.

Value: To reduce the risk to operational spacecraft in the Earth's orbital environment, allowing for the continued advancement of the Space Age.

DT-SAT | AUCKLAND UNIVERSITY OF TECHNOLOGY



P-SAT 2017





UNPACKING 1U
“QUAKESAT”

- ▶ Undergraduate CubeSat funded through UoA Vice Chancellor for 2018 launch
- ▶ P-Sat (Cansat) program funded for 2017
- ▶ Postgraduate Research grant for investigation of Synthetic Aperture Radar

RESEARCH & FUNDING

INVITED SPEAKERS

- ▶ Dr Alice Gorman, Flinders University, Australia
 - ▶ Dr S. Pete Worden, Breakthrough Foundation, USA
 - ▶ Prof. Christine Charles, Australian National University
 - ▶ Robin Sampson, Clyde Space, Scotland

STAFF TALKS

- ▶ Raising The Bar, Auckland City
 - ▶ ASPIRE Conference, UoA
 - ▶ Spring Week on Campus, UoA

PUBLIC TALKS

- ▶ SMALL SAT 2016, USU, Logan, Utah, USA (1 attendee)
 - ▶ CubeSat 2017, Cal Poly, California, USA (3 attendees)
 - ▶ IAC 2017, Adelaide, Australia (2 attendees)
 - ▶ Local meetings, talks and round tables:

NZ Space Agency

UNOOSA

DTA

US Consulate

NZ Agencies

CONFERENCES & MEETINGS

THANK YOU

