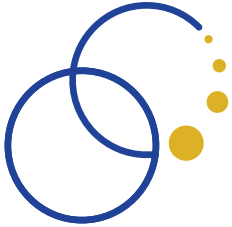


# ANNUAL REPORT

TO MARCH 2023



INTERNATIONAL SPACE CENTRE



RESEARCH  
EDUCATE +  
INSPIRE



THE UNIVERSITY OF  
WESTERN  
AUSTRALIA

PICTURED  
SPACE BOOT CAMP  
SEPTEMBER 2022

BELOW 2022 saw great expansion of media coverage of the International Space Centre and the WA space industry in general.

SUNDAY, JULY 24, 2022

NEWS 29

# It's written in the stars

There's a new space race to the Moon, Mars and beyond. WA is poised to play a key role while helping to unravel the universe's mysteries, writes **John Flint**

**W**hen the first woman steps on the Moon, which NASA hopes will happen in three years, live footage will be beamed around the world courtesy of technology being pioneered in Perth.

And it won't be like the grainy black and white vision of Neil Armstrong's "giant leap for mankind" on July 20, 1969. The first humans to return to the lunar surface in more than 50

years will be shown leaping around and exploring the Moon's South Pole in glorious 4K high-definition.

But more on that later. The Moon and a permanent base provide a stepping stone to Mars and beyond in what is a new and captivating space race.

Indeed, there is so much happening or about to happen in the heavens that stargazers, dreamers, and sci-fi nerds alike are going to be staring into the night sky for longer and with more wonder than ever.

The enormity, beauty and mystery of the universe was thrillingly captured in the first images from the James Webb Space Telescope this month.

Just thinking about what lies ahead and all the possibilities for adventure and discovery in the final frontier is an escape from our earthly problems.

With war, disease and climate emergency undermining humankind's future on this fragile blue planet, do we need to become a multi-planetary species to ensure our survival, as

Elon Musk claims? What if the discoveries, research and technological advances from future space missions provide solutions to problems on Earth?

Vital exploration or expensive folly, space is the future and it's undeniably exciting.

**T**he James Webb Space Telescope, the successor to the famous Hubble Space Telescope, does more than provide a window into the far reaches of the universe. It is

a cosmic time machine that can reveal the birth of the first stars and galaxies, close to the dawn of time.

Located 1.5 million kilometres away, the biggest telescope in space is powerful enough to peer back to 100 million years after the big bang — which happened about 13.8 billion years ago.

It's because of the speed of light.

When we look up at the

Continued P30

## CONTENTS



**04** FOREWORD  
A message from the ISC Director and Chair.

**06** NODE HIGHLIGHTS  
A quick snapshot of our favourite moments this year from the ISC's Nodes.

**09** ENGAGEMENT HIGHLIGHTS  
Activities with industry, government, the public and academia we enjoyed this year.

**16** EDUCATION AT THE ISC  
How our researchers have inspired students to a career in space, and strengthened the education pipeline.

**20** MEDIA  
Our research in the news!

**26** CAPABILITIES  
A Node-by-Node breakdown of the progress we've made over the year.

**47** OUR TEAM  
Node Leaders, the ISC Board and the Executive Committee.



THE UNIVERSITY OF  
**WESTERN  
AUSTRALIA**

# FOREWORD



THIS YEAR, THE INTERNATIONAL SPACE CENTRE (ISC) HAS SOLIDIFIED ITS POSITION AS A VIBRANT AND DIVERSE COMMUNITY OF BRILLIANT INDIVIDUALS UNITED BY THEIR PASSION FOR SPACE. WITH OVER 100 DEDICATED ACADEMIC STAFF MEMBERS AND POST-GRADUATE STUDENTS, ALONG WITH A GROUP OF RECENTLY APPOINTED EXTERNAL ADJUNCTS, OUR TEAM IS CAPABLE TO SHAPE WESTERN AUSTRALIA'S ROLE IN THE SPACE SECTOR.

Over the past year, the ISC has witnessed a remarkable increase in its domestic and national prominence. This is evidenced by the extensive media coverage highlighting groundbreaking space work, our significant growth on social media platforms, and our strong partnerships with local industries and government entities. The ISC brand now belongs to the leading names in Australia's multifaceted space landscape.

Our expanding range of multidisciplinary competencies, spanning sciences, engineering, arts, and law, firmly establishes the ISC as a key player in the Australian space industry. We possess the capability to undertake ambitious projects and push the boundaries of space exploration and research. Over the past 12 months, several of our nodes have achieved notable space research milestones. For example, a new collaboration between our nodes for space medicine and microgravity has led to a breakthrough method in measuring brain fluid pressure in humans. This discovery, published in Nature Microgravity, holds the potential to reduce vision damage experienced by astronauts on long-haul space flights.

The University of Western Australia (UWA) fully endorses the pivotal role of the ISC in advancing the university's strategic priorities within the burgeoning space sector. In 2022, the UWA Executive reaffirmed its unwavering support to facilitate



the ISC's transition from its formative phase into a sustainable centre capable of supporting new research ideas and realising space education needs.

I extend a heartfelt *Thank You* to all ISC members, partners, and friends who have played an integral role in bringing our vision to life: Together, we are creating an exciting culture and driving economic growth through space research and education.

And here's a fascinating tidbit: In the mere 30 minutes it took me to write this editorial, approximately 2 tonnes of cosmic dust have made their way into the Earth's atmosphere.

Fly safe,

Associate Professor Danail Obreschkow  
**Head of the International Space Centre**



AS CHAIR OF THE ISC BOARD AND SPEAKING FOR ALL BOARD MEMBERS, IT'S BEEN EXCITING TO SEE THE GROWTH OF THE ISC UNDER DANAIL'S CAPABLE LEADERSHIP.

What began in early in 2021 as an ambitious plan to join UWA's considerable research capabilities on living and working in space, has now evolved into a vibrant and very visible new institute on the national and international stage. Through national recognition via significant grants and awards, via new publications and enhanced cross-capability collaboration, ISC is set to transition to its Phase 2 program of development in 2023. In this Phase 2 period, the Board is looking forward to supporting the efforts of Danail, the ISC staff and researchers to grow the international visibility and success of ISC as we engage further with the Australian Space Agency and space agencies elsewhere in the world. The Board remains committed to work with the UWA Executive to maintain and strengthen the supported needed for ISC to achieve its significant potential.



Professor Peter Quinn  
**Chair of the Board of the International Space Centre**

**BELOW ASSOCIATE PROFESSOR DANAIL OBRESCHKOW (LEFT IMAGE), AND PROFESSOR PETER QUINN (RIGHT) ACCOMMODATING GUESTS AT THE INAUGURAL ISC TOUR IN FEBRUARY 2022.**



# NODE HIGHLIGHTS



## → PLANTS FOR SPACE CENTRE OF EXCELLENCE

UWA WAS ONE OF FIVE AUSTRALIAN UNIVERSITIES TO RECEIVE A TOTAL \$90 MILLION FUNDING BOOST TO CREATE FOOD AND MEDICINES FOR SPACE EXPLORERS.

The Australian Research Council is providing \$35 million for the new Australian Research Council **Centre of Excellence in Plants for Space**, led by the University of Adelaide, with additional funding and in-kind support from 38 partner organisations bringing the total value to \$90 million.

The UWA node of the program is led by three WA Scientist of the Year Award winners including Professor Harvey Millar, Professor Ryan Lister and Professor Ian Small, all from UWA's School of Molecular Sciences. Professor Lister is also from the Harry Perkins Institute of Medical Research.

UWA receives a portion of more than \$7 million for its part in the project. The Centre of Excellence will

help establish a long-term human presence in space.

"Long-term off-Earth habitation is on the horizon but the success of these missions depends on having medicine and nutritious food without the need for resupply missions from Earth," Professor Lister said.

"We'll develop food plants for long-term space nutrition using duckweeds that are one of the fastest growing plants," said Professor Millar.

Professor Small said the space work had spin-off benefits for agriculture on Earth and would help reduce the sector's carbon footprint.

BELOW PROFESSOR HARVEY MILLAR, DR BHAYGYA DISSANAYAKE AND DR HUI CAO EXAMINE SPECIMENS IN THE PLANTS FOR SPACE NODE.



# NODE HIGHLIGHTS



## → ASTRONOMY FROM SPACE

SPACE ENTHUSIASTS AND ICRAR ASTRONOMERS CELEBRATED THE FIRST IMAGES FROM NASA'S \$14 BILLION JAMES WEBB SPACE TELESCOPE'S HISTORY-MAKING VIEW OF SPACE.



UNIVERSITY OF WESTERN AUSTRALIA'S INT'L SPACE CENTRE  
Perth, Western Australia

ABOVE UWA BROADCAST LIVE ON NASATV DURING THE RELEASE OF THE FIRST LIGHT IMAGES FROM THE JWST.

The ISC was one of only a handful of institutions in the world to get the first working images from the most powerful orbiting telescope. UWA Astronomy Professor Simon Driver said they had no idea what the First Light images would be but they did know the telescope had already observed many of the team's target fields.

"It is fantastic to be part of this and to know UWA students were among the first in the world to work on the telescope's data," Professor Driver said at the time.

The James Webb Space Telescope (JWST) was designed to probe the mysterious structures and origins of the universe and our place in it by detecting infrared and mid-infrared wavelengths.

As part of an 80-person international team, Professor Driver said there had been a 'frenzy of online meetings' to prepare for processing the data from space, as soon as it came down from the telescope. Driver's team had the first 110 hours booked on JWST during the first year of observations – a privilege afforded to few.

"UWA's key focus is to find the very first photons, minted by the very first stars, which have been travelling for over 13 billion years before hitting the telescope's mirror and forming an image for us to study," he said.

"UWA contributed to the background analysis, source detection and the measurement of the extragalactic background light for some of the very first images."

On July 12, NASA crossed live to the International Space Centre during a global press conference.

The International Space Centre was the only NASA-accredited outreach event in Australia, chosen by NASA's Strategic Partnerships Manager (Science Mission Directorate) Anita Dey, and as such was invited to participate in the live cross, pictured above.

The ISC then took a public deep dive into the First Light Images from the telescope on July 14, with experts Professor Simon Driver, and Drs Sabine Bellstedt and Elisabete da Cunha. The event sold out quickly and was covered extensively in the local and national media.

# NODE HIGHLIGHTS



## → SPACE SITUATIONAL AWARENESS

TRACKING AND MONITORING OF SATELLITES AND SPACE JUNK, PREDICTING SPACECRAFT POSITIONS AND IDENTIFYING HAZARDOUS BODIES FOR INTERNATIONAL SPACE AGENCIES IS ALL IN A DAY'S WORK FOR THE SPACE SITUATIONAL AWARENESS NODE AT THE ZADKO OBSERVATORY.

2022 was a massive year for our Space Situational Awareness Node. The team joined the International Asteroid Warning Network (IAWN), and almost immediately played a key role in tracking a near-Earth asteroid travelling between the Earth and the Moon.

The team received an ARC Linkage Grant for research, in partnership with the Polish Space Agency and industry, and upgraded their equipment and infrastructure with the granting of an ARC LEIF, led by Dr Bruce Gendre. A new telescope (C14@ZADKO) was installed in the Zadko Observatory as a dedicated robotic telescope to be used for Near-Earth Object monitoring and SSA Space Defence. During commissioning of this scope, SSA member Arie Verveer collected important data for the International Asteroid Warning Network on a potentially hazardous asteroid passing near Earth.

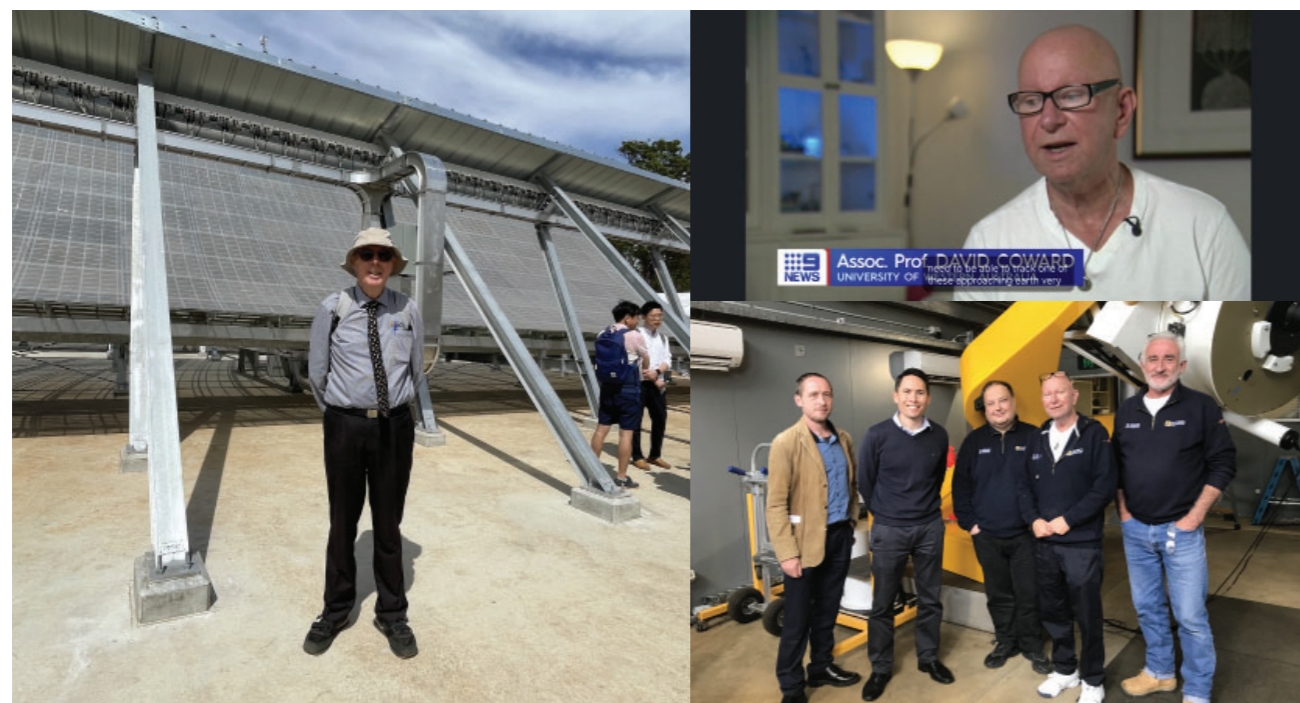
Earlier in the year the SSA team commenced a collaboration with the UNSW and Canberra Deep Space Communication Complex in Planetary Defence.

Dr Bruce Gendre visited France in December 2022 and January 2023 for discussions with CNES, ESA and Arianespace.

The crew led many visits throughout the year. The Department of Jobs, Tourism, Science and Innovation toured the facility to equip them to promote the capabilities within the State.

And to wrap it all up, leader of the SSA Node Associate Professor David Coward was selected as a Finalist in the *Australian Space Awards* for Academic of the Year.

**BELOW, CLOCKWISE FROM LEFT JOHN KENNEWELL** OF THE SSA NODE, AT THE OPENING OF THE WA SPACE RADAR IN COLLIE (JAN 2023), **A/PROF. DAVID COWARD** ON NINE NEWS, DESCRIBING THE NEAR EARTH OBJECT AND **JTSI AND THE SSA TEAM (JTSI PRINCIPAL POLICY OFFICER SIMON AARONS, JTSI SPACE DIRECTOR JAMES YUEN, DR BRUCE GENDRE, A/PROF. DAVID COWARD AND JOHN KENNEWELL)** TOUR THE ZADKO OBSERVATORY.



# ENGAGEMENT HIGHLIGHTS



## → SPACE BOOT CAMP

BUILDING AN EDUCATION PIPELINE TO STEER STUDENTS OF ALL LEVELS INTO SPACE CAREERS IS A GUIDING OBJECTIVE OF THE ISC. WE BEGIN AT THE SECONDARY LEVEL WITH OUR POPULAR SPACE BOOT CAMP.



**ABOVE A PLANTS FOR SPACE WORKSHOP AT SPACE BOOT CAMP SEPTEMBER 2022, WITH PROFESSOR HARVEY MILLAR.**

Each camp is unique and presenters come from both UWA and industry. NASA scientists and founders of industry guide the Years 9 and 10 students through thought experiments and workshops to expose them to the realities and difficulties of working in space. Following the first successful Space Boot Camp in January 2022, the scope of the September camp was increased to accommodate an extra 20 positions.

The latest camp also saw an extra day being added, which included dedicated workshops held in off-site industry locations, with students interacting directly with leaders in current space research and development programs. This time the students toured Fugro SpAARC's new facilities prior to the official state-wide launch. SpAARC manages robotics in harsh-environment remote operations in Australia, around the world and in space. Notably, some students who showed passion and engagement were invited back after Space Boot Camp to be mentored at Fugro SpAARC.

Students in 2022 were also treated to a Mars rover landing workshop at First Mode, who help governments, companies, and individuals identify and replace equipment that generates greenhouse gas emissions in the most extreme environments.

The Fogarty Foundation and the Australian Space Agency both financially sponsored the camp to extend its reach and allow access to geographically and financially disadvantaged students. Twenty scholarship positions each year for the next three years have been added directly due to the Fogarty Foundation's support. We also saw an increase in students who identified as female as compared to the first camp, thanks to intentional marketing in that area (34F 46M).



**STUDENT SURVEY RESPONSE** "After seeing everything at Space Boot Camp I really want to have a career in the space industry!"

# ENGAGEMENT HIGHLIGHTS



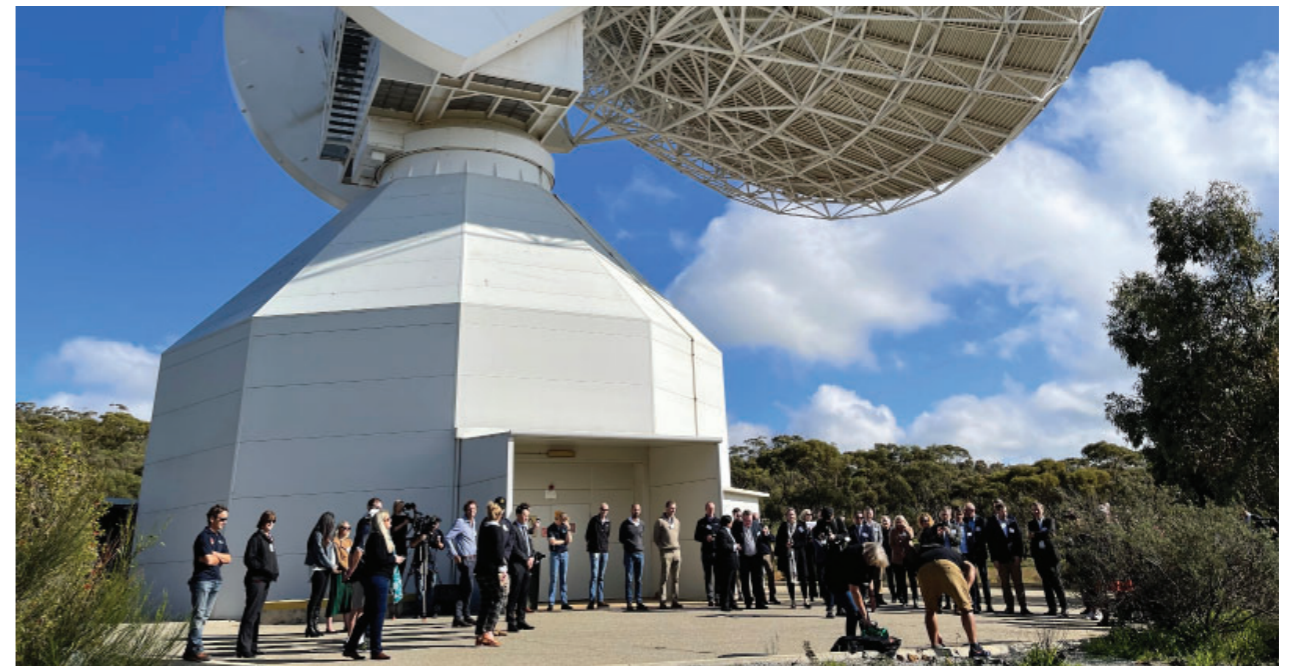
## → EUROPEAN SPACE AGENCY NN03 DISH

TO CELEBRATE THE STONE TURNING OF THE NN03 RADIO DISH AT ESA'S NEW NORCIA DEEP SPACE NETWORK, REPRESENTATIVES FROM ESA LED A VIP TOUR OF THE FACILITY.

The new antenna will support ESA's deep space missions, working together with antennas based in Argentina and Spain to provide uninterrupted communications with spacecraft exploring our Solar System, visiting asteroids or keeping close watch on our Sun. To make the most of the ESA dignitaries' trip, in collaboration with the Department of Jobs, Tourism, Science and Innovation, the International Space Centre hosted:

- an All Stakeholder meeting for the decision makers in the space community in WA;
- a tour of the ISC for Federal Minister Ed Husic and his team;
- a tour of the ISC for Head of ESA Ground-Station Infrastructure and Operations Yves Doat, Guillermo Lorenzo and Javier de Vicente; and
- an industry presentation and evening networking event at UWA. Guests and speakers included VIPs from the Australian Space Agency, UWA, Curtin University, CSIRO, Department of Jobs, Tourism, Science and Innovation, AROSE, and industry friends and partners.

**OPPOSITE, CLOCKWISE FROM TOP** VIPS FROM INDUSTRY AND GOVERNMENT ATTEND A SMOKING CEREMONY AT THE LAYING OF THE FIRST STONE OF ESA'S NN03 DISH IN NEW NORCIA; **ASSOCIATE PROFESSOR SASCHA SCHEDIWY** EXPLAINS GROUND-TO-AIR LASER COMMUNICATIONS TO **FEDERAL MINISTER FOR SCIENCE ED HUSIC** AND **DIRECTOR OF THE UWA DEFENCE INSTITUTE STEPHEN SMITH**; **ALL STAKEHOLDER MEETING** IN THE UWA SENATE ROOM; **ESA'S YVES DOAT** PROUDLY WEARS HIS ISC SHIRT **BELOW, CLOCKWISE FROM LEFT** **ESA'S GUILLERMO LORENZO** SPEAKS TO THE GUESTS ON ESA OPERATIONS AT THE JTSI-ISC INDUSTRY NETWORKING EVENT; **DEPUTY HEAD OF THE ASA PAUL TROTMAN, ASSOCIATE PROFESSOR SASCHA SCHEDIWY, CHAIR OF THE ISC BOARD PROFESSOR PETER QUINN, DVCR PROFESSOR ANNA NOWAK, FEDERAL MINISTER ED HUSIC, ISC ENGAGEMENT MANAGER PRU STEINERTS AND ISC BOARD MEMBER STEPHEN SMITH**; **INVITATION TO INDUSTRY AND NETWORKING EVENT COORDINATED BY THE ISC AND JTSI.**



**You are invited to**  
Industry Networking with the European Space Agency  
**Wednesday 15 June 2022**  
IOMRC Auditorium, 64 Fairway Nedlands  
RSVP Friday 10 June 2022 to [isc@uwa.edu.au](mailto:isc@uwa.edu.au)

Please come and hear updates and initiatives from the Australian Space Agency and the European Space Agency in this open evening.

**AGENDA**  
4.30pm Registration  
4.45pm ISC Welcome  
4.47pm JTSI Introduction  
5.00pm Australian Space Agency  
- Introduction  
5.10pm European Space Agency  
- Keynote  
5.30pm O&A  
6.00pm Networking  
7.00pm Close



# ENGAGEMENT HIGHLIGHTS



## COMMUNITY ENGAGEMENT

- Invitation by MySecurity Media to speak at WA Space Industry Sundowner at Optus Stadium (Plants for Space, Professor Harvey Millar), December 2022.
- NASA Space Apps Challenge. The ISC, in collaboration with *Space Hub* Perth, hosted the local version of NASA's Space Apps Challenge, encouraging a collaborative approach to problem solving where teams aimed to produce solutions to NASA-defined challenges that we currently face here on Earth and in space. This was a new partnering opportunity with *Space Hub* to pilot the value of reach to different audiences, September 2022.
- Dr David Gozzard delivered satellite presentation at Joseph Banks Secondary College (JBSC), September 2022.
- Dr Sabine Bellstedt also spoke to students at JBSC for National Science Week.
- Space Boot Camp was run for a second time in September 2022, which will become the usual timing of the activity. 80 students attended across three days.
- JWST First Light Images event at UniClub, July 2022, conducted by Professor Simon Driver, and Drs Elisabete da Cunha and Sabine Bellstedt.
- Professor Bill Morgan hosted a continued series of space talks in the realm of physiology.
- ISC partnered with ABC to support their Foodbank fundraising and programming, donating a tour of the ISC to encourage listeners to donate to Foodbank. During this hour ABC replayed interviews with Associate Professor Sascha Schediwy and Professor Harvey Millar. This is part of a wider strategy to strengthen relationships with media – including Associate Professor Sascha Schediwy as an available 'live space expert' – available to media in WA. The strategy was enabled with Nova FM, 6PR, and ABC. ICRAR keen to follow suit – discussions are continuing about how to coordinate this to enhance UWA's profile in the space media landscape.

## NODE SUPPORT

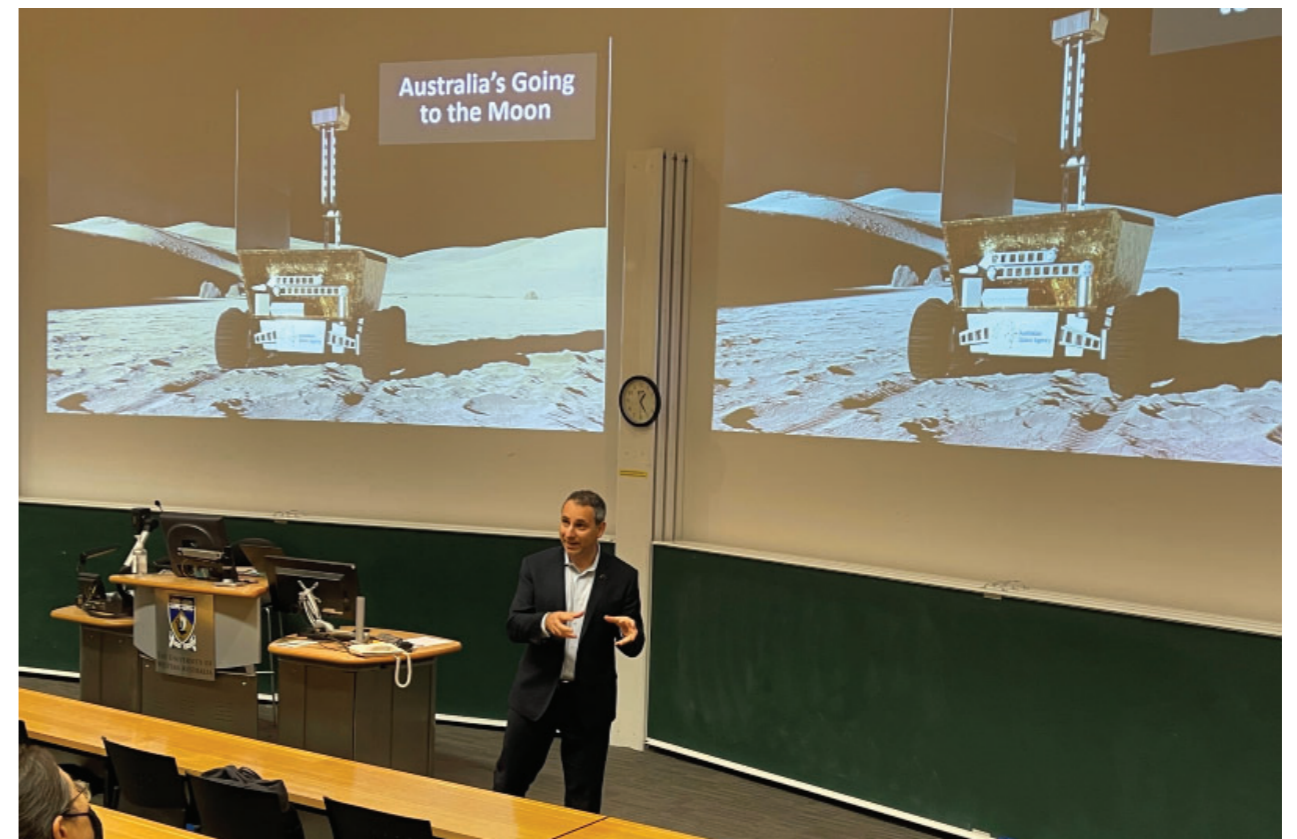
- Facilitated negotiations with the Department of Jobs, Tourism, Science and Innovation to secure \$500K matched funding for the Laser Communications and Timing Node's Moon to Mars Demonstrator bid with the Australian Space Agency.
- Worked closely with ICRAR (Astronomy from Space Node) to ensure smooth continuity of their media and PR during staff absences and training over the year.
- Invitation by MySecurity Media to speak at the Italian Chamber of Commerce. Professor Simon Driver framed as an ICRAR key speaker, promoting awareness of the Astronomy from Space Node.
- Professor Marco Fiorentini (Space Materials and Resources) applied for a Centre of Excellence in December – an industry/govt/academia aligned hub (ITTI), supported by the ISC.

## INTERNAL ENGAGEMENT

- ISC club for early career researchers established, *Mission Control*, launched in May 2022.
- MySecurity Media provided 20 passes for Mission Control to attend WA Space Industry Sundowner, December 2022.
- Workshops were held between ISC and other UWA Institutes (Data, Oceans, Agriculture, Marshall Centre and ICRAR) to discover opportunities for crossover in 2023.
- Established new Node with Space Crystallography - Professor Stephen Moggach.

## GOVERNMENT AND POLICY

- State Science Minister Cook visited UWA for a strategic meeting, attended by Associate Professor Danail Obreschkow and Professor Peter Quinn.
- The ISC provided JTSI with high quality footage of our capabilities for use in promoting WA's space industry.
- Submitted ISC Capability Statement to Austrade and AROSE.
- Decadal Plan 2021-2030 of the AAS National



ABOVE HEAD OF THE AUSTRALIAN SPACE AGENCY DR ENRICO PALERMO DELIVERS A SPACE SEMINAR AT UWA'S PHYSICS, MATHS AND COMPUTING SCHOOL, SHORTLY BEFORE TOURING THE AVIONICS LABORATORY.

- Committee for Space and Radio Science was published, and due to the ISC, optical communications are included as a priority area.
- Tour: JTSI visited Zadko Observatory on 7 September, 2022.
- Associate Professor Danail Obreschkow attended a space strategy meeting with government and industry as part of a series of five meetings, which informed a speech by Minister Roger Cook on October 28. At this meeting A/Prof. Obreschkow also met Minister for Defence (Paul Papalia), October 2022.
- Professor Peter Quinn has joined the Space Regulation Advisory Committee on behalf of the ISC, January 2022.

## INDUSTRY ENGAGEMENT

- Tour: ISC hosted KPMG Space Director Jacob Hacker and Benjamin Burridge.
- Tour: Aude Vignelles, Chief Technology Officer of the ASA, and Ed Betar, Space Technology Assistant Director at the ASA.
- Provided support to *Space Hub* reporting to JTSI

- on NASA Space Apps Challenge
- Participated in a two-day Space Mission Flight Design Workshop with AROSE and industry partners. Two projects were selected, including a joint project between Laser Communications and Timing Node and Phil Bland's team at Curtin, January 2022.
- Tour: Dion Wright (Defence Space Command) and Leanne Cunnold (AROSE), April 2022.
- Tour: ASA visited June 2022.
- Tour: ESA visited June 2022.
- Member of the WA Science Space Education Centre Steering Committee Joseph Banks Senior College.
- Second tour of ISC (Avionics) for Head of the ASA Dr Enrico Palermo, on his visit to receive a doctorate at UWA. Palermo gave a lecture at UWA Physics, Maths and Computing, which was attended by the ISC.
- Professor Peter Quinn and Pru Steinerts attended the Australian Space Agency Stakeholder Consultation Session 6 June for input to the next strategy.
- Tour: SmartSat (CEO Andy Koronios and Industry



**ABOVE PROFESSOR HARVEY MILLAR** (SECOND FROM RIGHT) OF THE ISC'S PLANTS FOR SPACE NODE SPEAKS ON A MYSECURITY MEDIA PANEL AT OPTUS STADIUM.

- Engagement Director Sarah Cannard) visited WAOGS 1 September 2022.
- Attended a ceremony hosted by UWA to sign the MOU with University of Arizona (Sr. Director for National Security Programs Nathaniel Gahr, President and CEO for the UA Applied Research Corporation Austin Yamada and Planetary Sciences - Space Defence Vishnu Reddy) regarding research collaborations for the next few years, then toured the guests through the WA Optical Ground Station.
- Facilitated meeting between LeoLabs Australian General Manager Terry van Haren and SSA Node Leader Associate Professor David Coward.
- Associate Professor Danail Obreschkow and Larissa Wiese met with Nick Carter, Space Research Group Lead of CSIRO, October 2022.
- Pru Steinerts and Larissa Wiese met Frontier SI to examine overlap, October 2022.
- ISC attended the commissioning of the LeoLabs' WA Space Radar (WASR) in Collie (LeoLabs is a Silicon Valley company that provides space surveillance radar data), January 2023.
- The ASA Advisory Board, chaired by Dr Megan Clark (original Head of the ASA), visited WA for an open discussion. Associate Professor Danail Obreschkow represented the ISC at this round table.

- Attended the 14th Andy Thomas Space Forum in Adelaide, 2022, where Associate Professor Sascha Schediwy participated in a public panel discussion on optical communications.

## SPACE ENGAGEMENT SUPPORT SCHEME

- Funding recipients included Lilian Paranhos Bitencourt (\$1000); Sharani Kodithuwakku (\$1000); Amri Md Shah (\$1000); Alistair McLeod (\$1000); Damon Beveridge (\$1000); Sarah Henbury (\$1500); Chris Geordas (\$1500); Sarah Henbury (\$1500); Eloise Moore (\$1500); Chayan Chatterjee (\$1000).
- Supported UWA Aerospace with annual sponsorship and travel grants.

## NEW ADJUNCT APPOINTMENTS

- Graeme Wren joined as Adjunct Associate Professor, May 2022.
- Dr Mark Micirie joined as an Adjunct Senior Research Fellow, October 2022.
- Pru Steinerts joined as an Adjunct Senior Lecturer following her departure as Engagement Manager in December 2022.

## AWARENESS

- Corporate film trailer made at the ISC (Red Empire Media) for promotion and awareness.
- ISC merchandise available year-round.
- Australian SPACE Outlook published a feature article on the ISC's activities that aligned with the ASA's priorities, July 2022. The ISC was featured on the front cover.
- UWA Media ran a Space Impact Series, and interviewed ECRs of ISC Nodes to profile (Plants in Space and Powering Spacecraft)
- UWA Media shot video on further JWST research outcomes through UWA to publish, such as Brent Groves' research on PHANG data.
- Dr Robin Cook worked with Dr Rebecca Rey (UWA Public Policy Institute) on a series of radio pieces on space astronomy.
- Associate Professor Sascha Schediwy participated in a media tour to address growing public interest in space due to the successful Artemis launch.
- Professor Harvey Millar spoke widely on the media on the role of Plants for Space following the awarding of the Centre of Excellence for Plants for Space by the Australian Research Council.
- Dr David Gozzard spoke on ABC to the 'Top Five in Space for 2022' and on Channel News Asia regarding the failed satellite launch from Virgin Orbit, and ramifications for the UK space industry, January 2022.
- UWA's Public Policy Institute released its WA 2050 vision with a significant ISC piece, written by Associate Professor Danail Obreschkow.



**ABOVE ASSOCIATE PROFESSOR SASCHA SCHEDIWY** SPEAKS TO BREAKFAST RADIO ON NASA'S ARTEMIS LAUNCH.



**ABOVE DR ENRICO PALERMO** TAKES A GOOD LOOK AT THE MOLECULAR BEAM EPITAXY MACHINE IN THE AVIONICS LAB.

# EDUCATION



## → MISSION CONTROL

Our Mission Control ECR network, launched this year, comprises postgraduate and early career researchers who, under the umbrella and funding of the ISC, choose to pursue their interests in space. Mission Control gives them access to industry events, cross collaborative projects social connection and volunteering opportunities, immersing them in the local space industry before they complete their studies.

Once a month, the International Space Centre hosts a Mission Control lunch as a social event. This is a way for these researchers to make friends with students who may be from a different school of study, yet could share similar interests. It also allows the researchers to meet people studying different degrees and expand their network, and also see what activity is happening in space research amongst their peers.

**CLOCKWISE, FROM TOP LEFT** OPPORTUNITIES FOR MEMBERS OF MISSION CONTROL OVER THE YEAR. MISSION CONTROL AT MYSECURITY MEDIA OPTUS STADIUM INDUSTRY SUNDOWNER; MISSION CONTROL'S SARAH HENBURY AT ASITII SPACE INDUSTRY SUNDOWNER AT SCITECH; LAUNCH OF MISSION CONTROL AT EZONE, UWA.



# EDUCATION



## → SPACE BOOT CAMP

Space Boot Camp (see page 9) is an opportunity for the ISC to expose space-interested secondary students to the possibilities available to them in the tertiary sector, should they wish to follow their hearts into space. Deliberately held before they make their final choices for Year 11 and 12, 80 students are brought on campus to hear from experts in cosmology, space law, rocketry, space biology, satellite technology and space architecture.

## → NASA SPACE APPS CHALLENGE

The NASA International Space Apps Challenge is an annual, international hackathon for coders, scientists, designers, storytellers, makers, builders, technologists, and others where teams engage the NASA's free and open data to address real-world problems on Earth and in space. The local initiative is led by Conrad Pires' *Space Hub*. The winning Perth team, Flat Moon Society, received an Honorable Mention in the global finals round.

## → STEM OUTREACH

The ISC performed many education and outreach events over the course of 2022/3 through our partnerships with like-minded educational institutions. As a member of the steering committee for the Joseph Banks Secondary College Space Science Education Centre, we have the unique opportunity to deliver quality education and industry touchpoints to students in their high school years, strengthening the education pipeline to space research at a tertiary level. Staff have also delivered programs to primary school students, sparking their interest in space education.

**CLOCKWISE, FROM TOP** DR LIES NOTEBART DISCUSSES LUNAR HABITATS; DR HUI CAO OF PLANTS FOR SPACE DEMONSTRATES USE OF A MASS SPECTROMETER FOR PROTEIN ANALYSIS WITH DR ELKE STRÖHER; STUDENTS FROM COTTESLOE PRIMARY SCHOOL RECEIVE A CRASH COURSE IN WA SPACE ACTIVITIES.



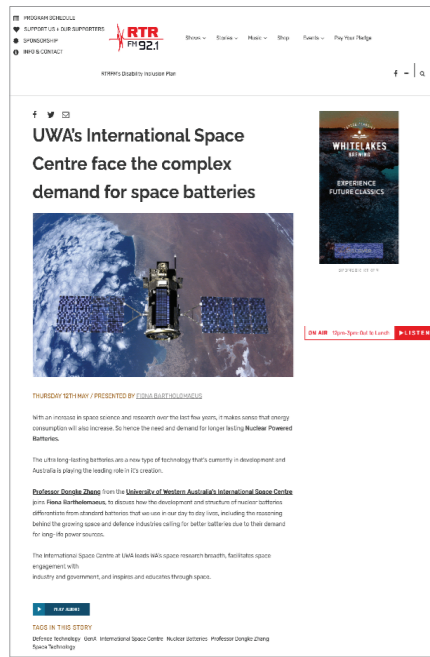


# MEDIA

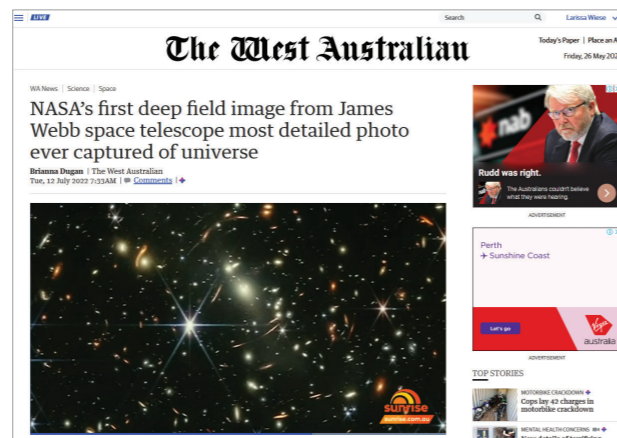


## → RAISING AWARENESS, ENABLING THE NODES

The International Space Centre promotes its Nodes through outreach and PR, in turn benefitting the Schools they belong to, raising awareness of their research and capabilities. Below are just a few examples of exposure the ISC has enabled over the 2022/3 year.



**12 MAY 2022**  
**RTRFM**  
THE COMPLEX DEMAND FOR SPACE BATTERIES



The full set of photos taken by the multi-billion-dollar telescope will be released late on Tuesday and astronomers at UWA's International Space Centre will be one of the first institutions across the globe to receive the groundbreaking images.

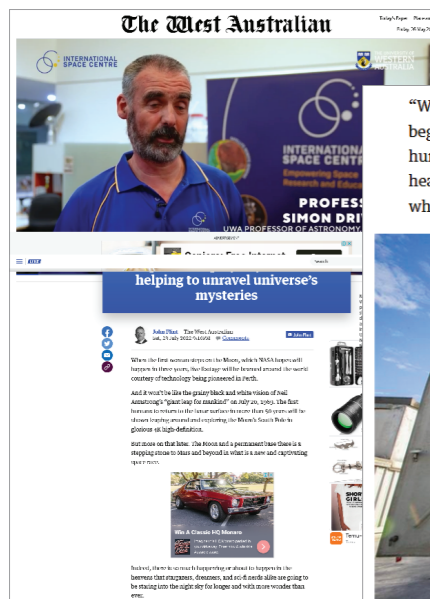
UWA Astronomy Professor Simon Driver said they have “no idea what the First Light images will be” but Webb’s telescope has already observed many of the team’s “target fields.”

“It is fantastic to be part of this and to know UWA students will be amongst the first in the world to work on the telescope’s data,” Professor Driver said.

The telescope was designed to probe the mysterious structures and origins of the universe and our place in it by detecting infra-red and mid-infrared wavelengths.

As part of an 80-person international team, Professor Driver said there had been a “frenzy of online meetings” to prepare codes and strategies for processing the data from space.

**12 JULY 2022**  
**THE WEST AUSTRALIAN**  
NASA'S FIRST DEEP FIELD IMAGE FROM JAMES WEBB SPACE TELESCOPE MOST DETAILED PHOTO EVER CAPTURED OF UNIVERSE



“We’ll be looking back to the point in time where the periodic table began, where carbon emerged. It will tell the story of when we, as human beings, were still stardust,” explained Professor Simon Driver, head of astronomy from space at the International Space Centre, which is based at the University of WA.



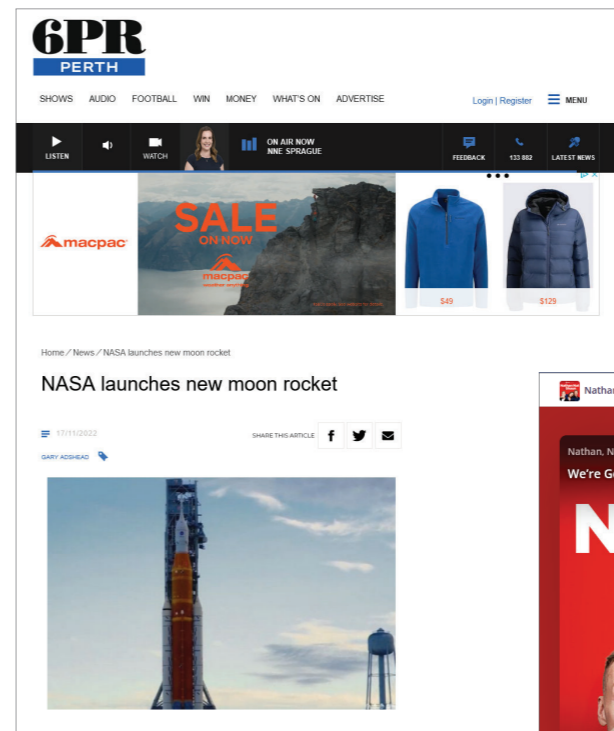
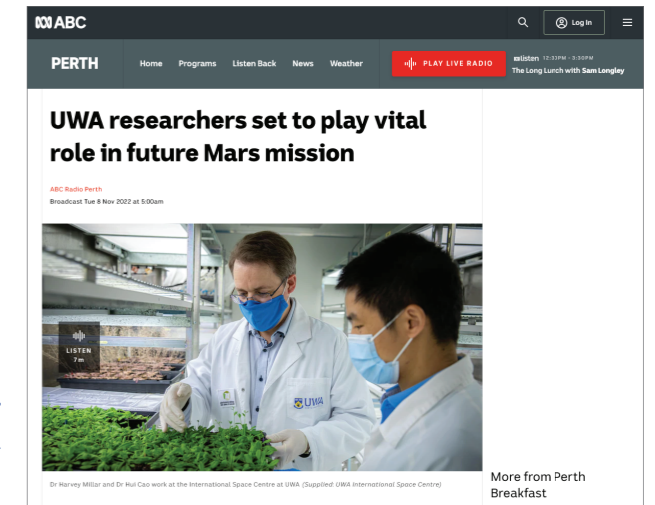
UWA Astronomy Professor Simon Driver. Credit: Andrew Ritchie/The West Australian

**23 JULY 2022**  
**THE WEST AUSTRALIAN**  
WA POISED TO PLAY KEY ROLE WHILE HELPING TO UNRAVEL UNIVERSE'S MYSTERIES.



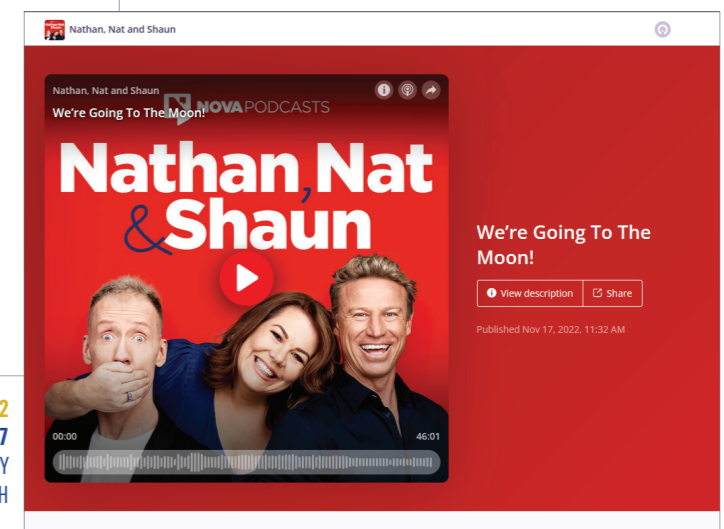
**16 AUGUST 2022**  
**NOONGAR RADIO**  
DR ROBIN ROOK SET UP WITH FORTNIGHTLY SEGMENT WITH HOST MARK PATRICK ON BREAKFAST.

**8 NOVEMBER 2022**  
**ABC BREAKFAST**  
UWA RESEARCHERS SET TO PLAY VITAL ROLE IN FUTURE MARS MISSION



**17 NOVEMBER 2022**  
**6PR**  
ASSOCIATE PROFESSOR SASCHA SCHEDIWIY COMMENTS ON THE ARTEMIS LAUNCH

**17 NOVEMBER 2022**  
**NOVA 937**  
ASSOCIATE PROFESSOR SASCHA SCHEDIWIY COMMENTS ON THE ARTEMIS LAUNCH



# Media Log 2022/3



**3 MARCH 2022**  
**PERTH NOW**  
INSPIRING NEXT GENERATION TO REACH FOR THE STARS.



**10 MARCH 2022**  
**PERTHNOW**  
OVER THE MOON AT ROCKET SIGHTING



**22 JULY 2022**  
**THE SUNDAY TIMES**  
IT'S WRITTEN IN THE STARS



28/07/2022, 12:24 pm



28/07/2022, 12:24 pm

**2/3/2022** A/Prof. Danail Obreschkow  
**PerthNow** with  
Jake Dietsch

<https://www.perthnow.com.au/local-news/perthnow-western-suburbs/uwa-astrophysicist-says-space-funding-will-inspire-a-generation-of-kids-c-5838587>

**12/07/2022**

the-wall-street-journal/biden-unveils-first-fullcolor-image-from-nasas-james-webb-space-telescope/news-story/4b009c99b6bf7e2612270b98d7a5d681

**Sky News** with  
Aylin Woodward

<https://www.skynews.com.au/business/science/james-webb-telescope-releases-images-of-the-cosmos/video/1bba713dfecfb18fe1786f68ba170401>

**12/07/2022**

**Dr Sabine Bellstedt**

**SBS Radio** with  
Biwa Kwan

*Note - to be translated into many languages*

<https://www.sbs.com.au/language/english/audio/the-image-revealing-secrets-of-the-universe>

**12/07/2022**

**Daily Telegraph**

Refer Sky News with  
Aylin Woodward

<https://www.dailytelegraph.com.au/business/james-webb-telescope-releases-images-of-the-cosmos/video/1bba713dfecfb18fe1786f68ba170401>

**12/07/2022**

**Dr Sabine Bellstedt**

**Sydney Morning Herald** (own authored)

<https://www.smh.com.au/national/exquisite-marvel-of-modern-engineering-reveals-our-cosmic-origins-20220712-p5b12w.html>

**12/07/2022**

**Dr Elisabete da Cunha**  
**6PR Mornings**

<https://www.6pr.com.au/first-image-from-worlds-most-powerful-space-telescope-revealed/?fbclid=IwAR1jnykVr27V02pSe3H4BTBvHWnsf7d9G6tambBFJrz1YhSv4rckagvQ>

**13/07/2022**

**Professor Simon Driver**  
**The West Australian** with  
Brianna Duggan

<https://thewest.com.au/news/wa/nasas-first-deep-field-image-from-james-webb-space-telescope-most-detailed-image-ever-captured-of-universe-c-7490610>

**13/07/2022**

**Dr Robin Cook**

**ABC Perth JWST Blog** with  
Jessica Riga and Peter Fuller

<https://www.abc.net.au/news/2022-07-13/james-webb-space-telescope-live-blog-updates-nasa/101230634>

**13/07/2022**

**Dr Sabine Bellstedt**  
**SBS (TV) World News** with  
Janice Petersen/Producer Maya Jamieson

**3/3/2022**

**Eloise Moore**  
**PerthNow** with  
Jake Dietsch

<https://www.perthnow.com.au/local-news/perthnow-western-suburbs/uwa-student-tracks-booster-on-course-for-collision-with-the-moon-c-5933616>

**July 2022**

**Media Commentary Lists**  
**Science in Public** with  
Nial Byrne

<https://www.scienceinpublic.com.au/other/webb-reactions>

**12/07/2022**

**Professor Simon Driver**  
**ABC Perth Breakfast** with  
Tom Baddeley

**Professor Simon Driver**  
**newsexplorer.net** with  
Brianna Duggan

<https://newsexplorer.net/nasas-first-image-from-james-webb-space-telescope-most-detailed-photo-ever-captured-of-universe-s2509835.html>

**12/07/2022**

**Professor Simon Driver**  
**PerthNow** with  
Brianna Duggan

<https://www.perthnow.com.au/technology/space/nasas-first-image-from-james-webb-space-telescope-most-detailed-photo-ever-captured-of-universe-c-7491081>

**12/07/2022**

**Professor Simon Driver**  
**Albany Advertiser** with  
Brianna Duggan

<https://www.albanyadvertiser.com.au/news/wa/nasas-first-deep-field-image-from-james-webb-space-telescope-most-detailed-image-ever-captured-of-universe-c-7490610>

**12/07/2022**

**Professor Simon Driver**  
**Sound Telegraph** with  
Brianna Duggan

<https://www.soundtelegraph.com.au/news/wa/nasas-first-deep-field-image-from-james-webb-space-telescope-most-detailed-image-ever-captured-of-universe-c-7490610>

**12/07/2022**

**The Australian**  
Refer Sky News with  
Aylin Woodward

<https://www.theaustralian.com.au/business/>

TEAMS\The University of Western Australia\ International Space Centre - Management -Administration\Media\Videos\Sabine Bellstedt SBS TV World News

**13/07/2022** Matt Woods (Perth Observatory. speaks to the ISC)  
**6PR**  
Nights with Tod Johnston

**13/07/2022** Professor Simon Driver  
**The Conversation**  
*Simon Driver and Karl Glazebrook*

**13/07/2022** UWA Media  
**UWA Impact**  
NASA Live Cross Crowd Video (Jarryd Gartner)

**13/07/2022** Dr Elisabete da Cunha  
**The Age**

**13/07/2022** Professor Simon Driver  
**Ten News First Perth (Cross)**

**14/07/2022** Dr Robin Cook  
**New Atlas** with Michael Irving

**14/07/2022** Dr Robin Cook  
**ABC Science** with Gemma Conroy, Emily Sakzewski, and Genelle Weule

**14/07/2022** Dr Robin Cook  
**Curtin FM**  
Afternoons with Jenny Seaton

**14/07/2022** Dr Sabine Bellstedt  
**ABC Perth (Radio)**  
Drive: 'What Just Happened' with Geoff Hutchison, Producer Kate Leaver

**14/07/2022** Dr Sabine Bellstedt  
**SBS Radio [German Radio]** with Julia Grewe

**16/07/2022** Dr Robin Cook  
**ABC Science** with Gemma Conroy, Emily Sakzewski, and Genelle Weule

**18/07/2022** Dr Robin Cook  
**ASITII/MySecurityMedia Space.TV** with Chris Cubbage

**23/07/2022** Professor Simon Driver, A/Prof. Sascha Schediwy, Professor Harvey Millar  
**The West**  
**Feature Article, Sunday Times** with John Flint

**29/07/2022** Enrico Palermo, Pru Steinerts  
**UWA Impact** with Cecile O'Connor

**30/08/2022** A/Prof. Sascha Schediwy  
**96FM**  
**Breakfast with Clairsy and Lisa**  
Producer: Suzanne Oldfield  
[On file]

**30/08/2022** Dr David Gozzard  
**ABC Breakfast** with Tom Baddeley

**16/08/2022** Dr Robin Cook  
**Noongar Radio**  
Breakfast with Mark Mark in the Morning

**01/09/2022** Dr Robin Cook

**14/09/2022** All Nodes  
**Australian Space OUTLOOK** Annual  
Gregor Ferguson/David Sanis

**16/10/2022** A/Prof. Sascha Schediwy  
**ABC Perth Breakfast** with Tom Baddeley [from 33.26]

**17/10/2022** A/Prof. Sascha Schediwy  
**6PR Mornings**  
Simon Beaumont

**17/10/2022** A/Prof. Sascha Schediwy  
**NOVA** with Nathan, Nat and Shaun  
Producer Amy Carter

**18/10/2022** Conrad Pires  
**Startup News Online**

**04/11/2022** Professor Harvey Millar  
**UWA Media**  
UWA Impact with Cecile O'Connor

**07/11/2022** Professor Harvey Millar  
**Seed Today**  
Newsfeed with Cecile O'Connor

**08/11/2022** Professor Harvey Millar  
**ABC Perth Breakfast**  
Tom Baddeley,  
Producer Jackson Worthington

**08/11/2022** Professor Harvey Millar  
**Horti Daily Newsfeed** with Cecile O'Connor

**01/12/2022** Various ICRAR speakers  
AusSMC Media Release  
Various Sources - RW shared with SS the AusSMC callout for expert response to SKA launch.

**14/12/2022** Dr Robin Cook  
**ABC Perth Breakfast**

**20/12/2022** Dr David Gozzard  
**ABC Perth**  
Breakfast with Ivo Da Silva

**09/01/2023** Dr David Gozzard  
**Channel News Asia**  
Nikhil Khattar



ABOVE  
AUSTRALIAN SPACE OUTLOOK  
SEPTEMBER 2022

# CAPABILITIES



## → LASER COMMUNICATIONS AND TIMING

THE ASTROPHOTONICS GROUP USES FREE-SPACE LASER COMMUNICATION TO REVOLUTIONISE A WIDE VARIETY OF APPLICATIONS.

Transmitting information to and from space is not as easy as the movies make it seem. We've become so used to instant communications on Earth that it may surprise you to know that there is not even a 4G data connection in space.

To communicate with spacecraft, you typically need the support of a Ground Station Network, whose antennae are ready to receive data as the spacecraft pass by. The WA Optical Ground Station at UWA is the first in a new planned network of optical ground stations across Australia and New Zealand.

As we want to improve the rate of communications with space, we need to look for a more solid bandwidth. The most common electromagnetic frequency used for space communications is radio – but optical bandwidths have a much higher capacity and can transmit data at rates much faster than before: in fact, tens of thousands of times faster. Using optical communications (also called laser or infrared optical communications) we can transmit 4K video from the Moon. Radio transmission would only give us the equivalent of the grainy videos we saw on the Apollo missions!

The challenge with optical communications is that the data transfer is easily disturbed by turbulence in the atmosphere. It's a little like making the change from a cassette to a CD – the quality is much better but they are more fragile and prone to contamination.

The Laser Communications and Timing Node of the International Space Centre has produced world record-breaking results by transferring data across great distances through turbulence with little loss. They use amplitude- and phase-stabilisation technology, which is achieved using a very fast steering mirror that corrects for turbulence hundreds of times per second. Last November, this group achieved a data transfer rate from ground to a drone of 100GB/s (or the equivalent of 100SD movies per second!). The drone was flown to simulate a low Earth orbit satellite passing overhead. Optical communications also have the advantage of greater security. They can be pinpointed to a position on Earth, making them much harder to intercept.

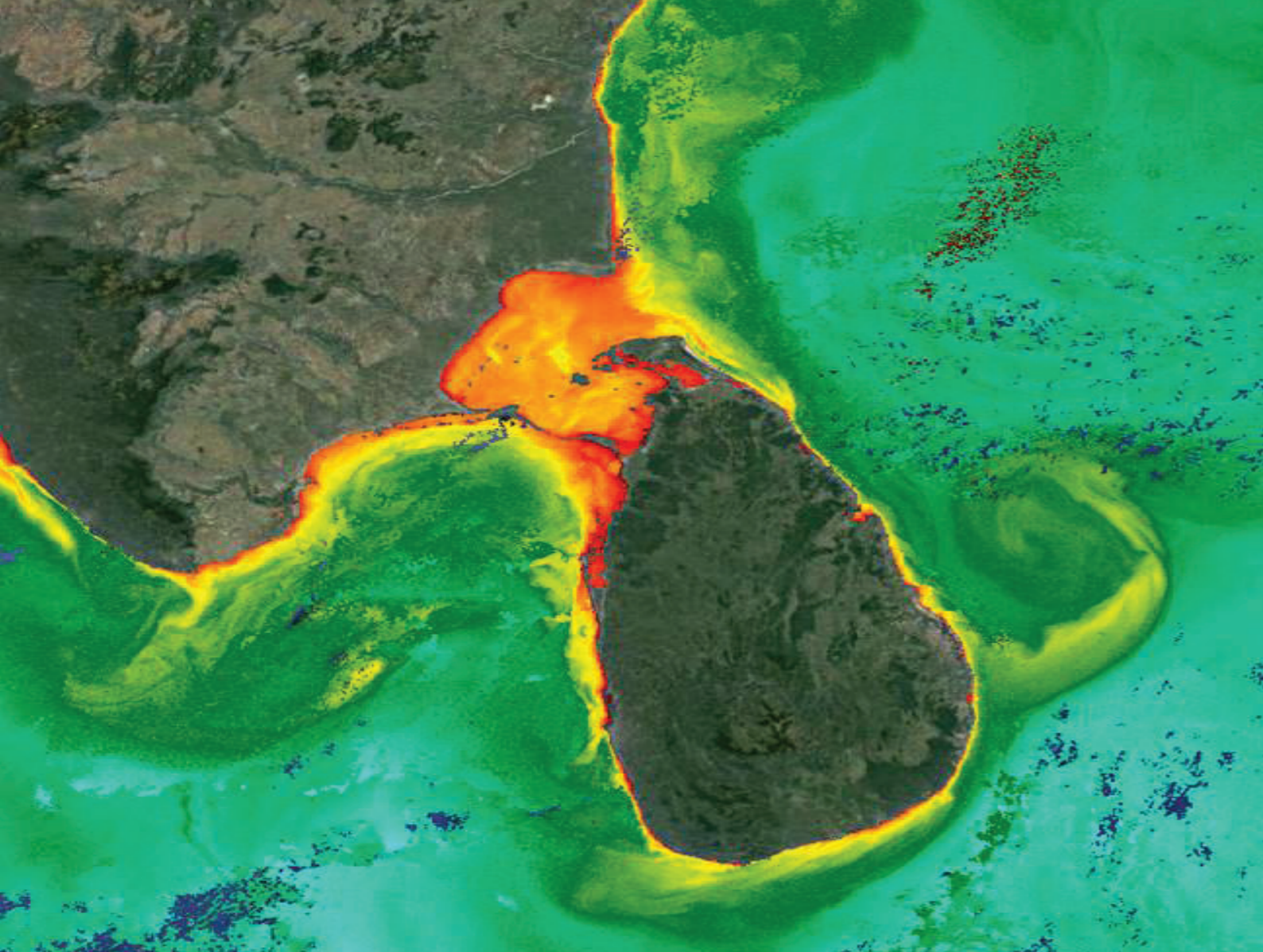
**ASSOCIATE PROFESSOR SASCHA SCHEDIWY** ([sascha.schediwy@uwa.edu.au](mailto:sascha.schediwy@uwa.edu.au)) "Last October, this group achieved a world record-breaking data transfer rate from ground to a drone of 100 gigabits per second - or the equivalent of 100SD movies per second!"

### Year in Review

- \$1.5M cash raised to provide matched funding for Moon to Mars Demonstrator Grant - (1 in 4 funding required from the ASA).
- Moon To Mars Demonstrator Mission bid submitted late July 2022.
- Published in the journal Nature Scientific Reports, demonstrating the highest ever free space data transfer rate involving an airborne vehicle – one moving at LEO satellite-like speeds.
- Conducted many tours of the astrophotonics laboratories and WA Optical Ground Station to increase visibility and awareness of their space capabilities.

**OPPOSITE** DR SHANE WALSH OPENS THE ROOF ON THE WA OPTICAL GROUND STATION.





## CAPABILITIES

### → SATELLITE REMOTE SENSING

SATELLITES PROVIDE A UNIQUELY EFFICIENT WAY OF MAKING REPETITIVE OBSERVATIONS OF EARTH'S LAND, COAST AND OCEANS THAT ALLOW FOR A WIDE RANGE OF APPLICATIONS, ESPECIALLY AS PAST OBSERVATIONS NOW PROVIDE DECADES OF DATA TO ANALYSE.

#### *Year in Review*

- IMOS publication on sampling NSW flood waters through satellite and oceanglidors (CP).
- Associate Professor Nicola Jones associated with validation of satellite data in the North West shelf near Scott Reef. NASA's SWOT (Surface Water and Ocean Topography) satellite launched on December 6 2022.
- DSTG are using Satellite Remote Sensing's gliders to validate the SWOT data in the north-west shelf.
- Three students received ISC Space Engagement Support Scheme grants.

#### **PROFESSOR CHARITHA PATTIARATCHI**

[charitha.pattiaratchi@uwa.edu.au](mailto:charitha.pattiaratchi@uwa.edu.au)

### → AVIONICS FOR SENSING AND IMAGING

The Avionics research team is developing world-leading electro-optic sensors, imaging devices, and electronic systems for space-based earth observation and space situational awareness.

They focus on:

- Material production for IR sensors and imaging arrays (Molecular beam epitaxy (MBE) growth of device-grade HgCdTe),
- Tuneable filters for IR spectroscopic sensing (MEMS-based),
- Design and fabrication of IR imaging arrays up to 640x512 pixels, and
- Modelling of atmospheric effects on optical propagation.

They are also active developers of cutting-edge quantum sensing technologies, working in collaboration with UWA Professor Michael Tobar of the Quantum Technologies and Dark Matter Research Lab.

#### *Year in Review*

- Conducted many tours of the Avionics laboratories including discussions of the Molecular Beam Epitaxy growth machine to increase visibility and awareness of their space capabilities. Notably hosted Dr Enrico Palermo, Head of the Australian Space Agency, in a personal tour when Palermo visited UWA to receive his doctorate.

#### **PROFESSOR LORENZO FARAONE**

[lorenzo.faraone@uwa.edu.au](mailto:lorenzo.faraone@uwa.edu.au)



**OPPOSITE TOP** SENTINE-3 COLOUR OCEAN IMAGE OF SRI LANKA, PROVIDED BY **PROFESSOR CHARITHA PATTIARATCHI** **BOTTOM** **PROFESSOR LORENZO FARAONE** DEMONSTRATES THE MOLECULAR BEAM EPITAXY GROWTH MACHINE AT UWA.

# CAPABILITIES



## → ASTRONOMY FROM SPACE

EXTRAGALACTIC ASTROPHYSICS AND GRAVITATIONAL WAVE PHYSICS ARE STAND-OUT STRENGTHS AT THE UNIVERSITY OF WESTERN AUSTRALIA. WHILE THESE RESEARCH FIELDS ARE PRIMARILY ABOUT STUDYING THE UNIVERSE FROM THE GROUND, THEY ALSO USE SPACE-BASED FACILITIES TO BYPASS FUNDAMENTAL LIMITATIONS SET BY THE EARTH'S SIZE AND ATMOSPHERE.

### GALAXY EVOLUTION

This group is heavily involved in many of the space telescopes operated by NASA and ESA, such as the James Webb Space Telescope (JWST), providing ground-based measurements of spectra as well as

the rapid analysis of space imaging data, which are then combine to produce both impactful research and advanced databases for use by astronomers around the world.

### Year in Review

- JWST First Light Image Release, 14 July 2022. NASA announced the formal global release of the first image. Astronomy from Space held a special event, including a live cross to NASA during the release of the remaining images from the ICRAR boardroom. This was the only known outreach event affiliated with NASA in Australia, and was the first one in the world registered.
- Astronomy from Space celebrated the First Images at the UniClub with a formal talk and panel discussion with the public to (Drs Sabine Bellstedt and Elizabete Lima da Cunha, and Professor Simon Driver) to a full house and a highly engaged audience.
- 20 papers published by Node members using JWST data from the PEARLs and PHANGs teams.
- ISC member Associate Professor Aaron Robotham now leading the data reduction pipeline for the JWST PEARLs team.
- Attended the ESA First Stone Ceremony for ESA/ASA's co-funded new dish at New Norcia (opened by Minister Ed Husic).
- Discussions continue with NASA and ESA around the establishment of a rapid alert capability for space-telescope data received at New Norcia.
- Time awarded on Hubble Space Telescope and/or JWST to Dr Elisabete da Cunha, Dr Brent Groves, and Professor Simon Driver.
- Australian Research Council Laureate Fellowship awarded to Professor Simon Driver, in part to help establish an Australian Space Telescope Institute.



## GRAVITATIONAL WAVE ASTRONOMY

This team is probing our Universe using the emerging astronomical messenger of gravitational waves (GW). They will transfer signal-processing technologies developed for ground-based gravitational wave detectors to observations from space, as well as combine gravitational wave and electromagnetic (EM) information for breakthrough science and for a better understanding of our astrophysical Universe.

Their strengths include:

- Methods and strategies to detect GWs from space;
- Studies of GW sources suitable for joint space ground detections;
- Joint GW-EM coincidence detection and astrophysical implications; and Cosmology using GW signals detected from space and the ground.

### Year in Review

The 'Binary Coalescence Project' is a unique collaboration between astrophysicist Professor Linqing Wen and the StoryBursts program created by Claire Bowen and Kevin Vinsen. Artists produced three audio-visual films representing their intuitive and creative responses to an interview with Professor Wen on the detection of gravitational waves from the coalescence of two extremely dense objects far away in the Universe.

**PROFESSOR LINQING WEN**  
linqing.web@uwa.edu.au

## RADIO ASTRONOMY FROM SPACE

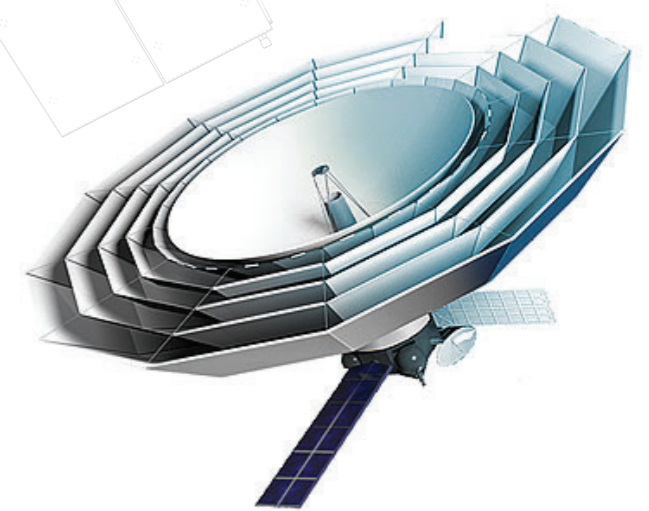
The group for Radio-astronomy Interferometric Observations from Space (RIOS), co-led by Drs Richard Dodson and Maria Rioja, is part of the UWA node of the International Centre for Radio Astronomy Research with strong international collaborations into next-generation observatories.

They are currently defining the instrumental specifications and requirements for the Russian Astro-Space Centre mission Millimetron. This extremely challenging mission proposes to improve the Event Horizon Telescope results by increasing the frequency by 50% and locating one antenna in space for joint observations with ground telescopes. Both of these two aspects introduce huge challenges, that can only be overcome with innovative observational and analysis methods.

**DR MARIA RIOJA**  
maria.rioja@uwa.edu.au

**DR RICHARD DODSON**  
richard.dodson@uwa.edu.au

LEFT OPPOSITE PAGE THE CARINA NEBULA, AS SEEN BY THE JAMES WEBB SPACE TELESCOPE (CREDIT NASA) FADED HUBBLE SPACE TELESCOPE RIGHT THE MILLIMETRON OBSERVATORY



# CAPABILITIES



## → SPACE SITUATIONAL AWARENESS ZADKO TELESCOPE TEAM

LED BY ASSOCIATE PROFESSOR DAVID COWARD, THE SSA NODE USES UWA'S ZADKO OBSERVATORY TO PURSUE A SPACE SITUATIONAL AWARENESS AND SPACE SURVEILLANCE PROGRAM INVOLVING INTERNATIONAL AGENCIES AND PARTNERS.

### Year in Review

- Joined the International Asteroid Warning Network. The IAWN is tasked with developing a strategy using well-defined communication plans and protocols to assist Governments in the analysis of asteroid impact consequences and in the planning of mitigation responses.
- Commenced a collaboration with the UNSW and Canberra Deep Space Communication Complex, ACT, in Planetary Defence.
- Significantly improved the capabilities of the Zadko Telescope with Dr Bruce Gendre and John Moore working with a French optical team.
- Addition of a dedicated robotic telescope for SSA and Space Defence. During commissioning it was used by Arie Verveer to obtain important data for the IAWN on a potentially hazardous asteroid passing near Earth (to be published).
- Student Benjamin Linsten invited to University of Arizona to work on Planetary Defence project.
- 2 new members: Arie Verveer (SSA and Planetary Defence), Benjamin Linsten (student - Planetary Defence).
- Major funding: ARC Linkage grant in SSA led by Associate Professor David Coward and ARC LEIF led by Dr Bruce Gendre.
- Associate Professor David Coward a finalist in the 2023 Australian Space Awards for Academic of the Year.

**ASSOCIATE PROFESSOR DAVID COWARD**  
[david.coward@uwa.edu.au](mailto:david.coward@uwa.edu.au)

LEFT TOP UWA PLANETARY DEFENCE TELESCOPE (C14@ZADKO) SSA LEFT BOTTOM POLISH SPACE AGENCY SSA RIGHT AUSTRALIAN SPACE AWARDS, DR URSULA LADZINSKI AND ASSOCIATE PROFESSOR DAVID COWARD.



## SPACE INTERFEROMETRY

DRS RICHARD DODSON AND MARIA RIOJA ARE INVESTIGATING HOW TO IMPROVE THE TRACKING AND PRECISE LOCATION OF EARTH-BOUND AND DEEP SPACE MISSIONS. THIS RESEARCH IS IN CONJUNCTION WITH THE AMERICAN NATIONAL RADIO ASTRONOMY OBSERVATORY AND THE NEXT GENERATION VERY LARGE ARRAY IN NEW MEXICO.

The tracking node is also heavily involved in designing the next-generation methods for the new observatories, and identifying potential spin-off opportunities from these instruments. They are exploring improving the atmospheric measurements from GPS satellite observations which are used in astronomical data reduction, in collaboration with the GPS division of KASI in Korea.

**DR MARIA RIOJA**

[maria.rioja@uwa.edu.au](mailto:maria.rioja@uwa.edu.au)

**DR RICHARD DODSON**

[richard.dodson@uwa.edu.au](mailto:richard.dodson@uwa.edu.au)

BELOW VERY LARGE ARRAY IN NEW MEXICO, US.



# CAPABILITIES



## → EXPERIMENTS IN VARIABLE GRAVITY ZERO GRAVITY

THE MICROGRAVITY RESEARCH PROGRAMME, LED BY ASSOCIATE PROFESSOR DANAIL OBRESCHKOW, REGULARLY PARTNERS WITH THE EUROPEAN SPACE AGENCY (ESA) TO CONDUCT EXPERIMENTS ABOARD THE AIRBUS A310 ZERO G, THE WORLD'S LARGEST SUBORBITAL MICROGRAVITY FACILITY.



NOVSPACE'S ZERO-G A310 AIRBUS, MODIFIED TO PERFORM SCIENCE EXPERIMENTS IN MICROGRAVITY.

These parabolic flights offer repeated phases of 20-25s of microgravity (~0.001g), as well as comparable phases of hypergravity (~1.8g). Depending on experimental design, it is also possible to request intermediate levels of gravity, such as lunar (0.17g) and martian (0.38g) gravity.

UWA Professor and private pilot Dongke Zhang has also led drop tower experiments, which offer even better levels of microgravity (~0.000001g) than parabolic flights but exhibit shorter phases of microgravity (<10s) and high accelerations (>5g) before and after.

### Year in Review

- Started investigating pathways towards WA-based microgravity facilities.
- Worked with Lions Eye Institute to develop a breakthrough method to measure the brain fluid pressure in humans, which may reduce vision damage experienced by astronauts on long-haul space flights.
- Article published in Nature (npj Microgravity).

**ASSOCIATE PROFESSOR DANAIL OBRESCHKOW**  
[danail.obreschkow@uwa.edu.au](mailto:danail.obreschkow@uwa.edu.au)

## → EXPERIMENTS IN VARIABLE GRAVITY HYPERGRAVITY

ISC'S RESEARCHERS MAINTAIN STRONG LINKS TO THE NATIONAL GEOTECHNICAL CENTRIFUGE FACILITY (NGCF), HOSTED AT THE CENTRE FOR OFFSHORE FOUNDATION SYSTEMS AT UWA AND DIRECTED BY PROFESSOR CONLETH O'LOUGHLIN.

The NGCF is the largest geotechnical centrifuge facility in the world, and the only such facility in Australia. It hosts three large centrifuges: a 1.2m drum centrifuge, as well as 3.6m and 10m diameter beam centrifuges, for hypergravity experiments up to 350g.



**PROFESSOR CONLETH O'LOUGHLIN**  
[conleth.loughlin@uwa.edu.au](mailto:conleth.loughlin@uwa.edu.au)

**ABOVE** 10M CENTRIFUGE HOUSED AT UWA'S CENTRE FOR OFFSHORE FOUNDATIONS SYSTEM **BELOW LEFT** PROFESSOR CONLETH O'LOUGHLIN EXPLAINING TESTING SYSTEMS IN THE NGCF **BELOW RIGHT** ADAM STUBBS DEMONSTRATING THE 3.6M CENTRIFUGE.



# CAPABILITIES



## → PLANTS FOR SPACE (P4S)

Humans rely on plants for food, oxygen, and psychological wellbeing. To support a long-term presence in deep space it will be essential to have plants as our partners. To achieve this we will need to breed and modify both plants themselves, as well as the habitats we grow them in.

### Year in Review

- Awarded a **Centre of Excellence**, in consortium, by the Australian Research Council.
- Conducted multiple engagement tours through the facility hosting media, industry, government and academia to demonstrate space capabilities.
- Achieved three travel grants (SESS) for P4S students.
- Spoke at Space Industry Engagement event at Optus Stadium on Plants in Space for MySecurity Media.
- Published new plant synthetic gene circuit technologies for controlling plant characteristics in space (Lloyd et al. 2022 Nature Biotechnology; Khan et al. 2022 bioRxiv).
- 3 new PhD students started in plant synthetic biology (synbio) research for space plant applications.
- Elliott Fourie awarded a Westpac Future Leaders Scholarship to undertake research in plant space synbio (<https://scholars.westpacgroup.com.au/Scholars/Profile?id=5236>).
- Sat as panellist at WestTech Fest Innovation Showcase – Australia, Space and Technology.
- Attended and contributed to Australian Space Agency Roundtable discussion in Perth - *National Plan for Space*.
- Interviewed on ABC Breakfast with Tom Baddeley on Plants for Space.
- Interviewed on science podcast *Smart Enough To Know Better* ([www.smartenough.org](http://www.smartenough.org)) with Gregory Rowbotham on Plants for Space.
- Won UWA collaboration award with University of Arizona for work on Plants for Space.
- Visited University of Arizona, USA, Lunar Mars Prototype Greenhouse and began collaboration.
- Conducted Space Boot Camp session on Plants for Space.
- Visited P4S collaborators at the NASA Kennedy Space Centre who specialise in space plant biology to further collaborations.
- Visited P4S collaborators at Axiom Space regarding future collaborative plant research in space.
- Participated in an AROSE Space Flight Mission Design workshop, establishing connections for P4S and ISC with actors within the Australian space sector and learning of mission launch design.

The Plants for Space Node was recently awarded a **\$35m Centre of Excellence** by the ARC, as part of a consortium of P4S universities, to create food and medicine for space explorers. This Centre aims to create on-demand, zero-waste, high-efficiency plants and plant products to address grand challenges in sustainability for space and on Earth. Significant advances in plant, food, and sensory science; process and systems engineering; law and policy; and psychology are expected to deliver transformative solutions for space habitation – and create enhanced plant-derived food and bioresources to capitalise upon emergent and rapidly expanding domestic and global markets. Anticipated outcomes include industry uptake of innovative plant forms, foods, technologies, and commodities; and an ambitious education and international co-ordination agenda to position Australia as a global leader in research supporting space habitation.

**PROFESSOR HARVEY MILLAR**  
[harvey.millar@uwa.edu.au](mailto:harvey.millar@uwa.edu.au)

**PROFESSOR RYAN LISTER**  
[ryan.lister@uwa.edu.au](mailto:ryan.lister@uwa.edu.au)



**TOP PROFESSOR RYAN LISTER** EXPLAINING THE IMPORTANT ROLE OF DUCKWEED IN MANIPULATING GENE EXPRESSIONS. **BOTTOM PROFESSOR HARVEY MILLAR AND DR HUI CAO** EVALUATE A CROP IN THE PLANTS FOR SPACE GROWTH CHAMBER.

# CAPABILITIES



## → SPACE PHYSIOLOGY AND LIFE SCIENCES

Changes in brain fluid pressure in astronauts can adversely impair their vision while in space. The research group, headed by Lions Eye Institute director Professor William Morgan, uses pulse wave properties of the eye's blood vessels to estimate pressures in the brain fluid.

The Node has been studying the relationship between brain fluid pressure, also known as intracranial pressure (ICP) and the eye for over twenty years. Recently, with collaborations with neurology and neurosurgery, they have found that the pulse waves that travel along the blood vessels at the back of the eye are produced by and travel from the brain fluid.

This discovery allows them to use sophisticated mathematical and imaging techniques to measure

these pulse waves and infer the ICP. Until now, ICP could only be measured by drilling a hole through the skull and into the brain or passing a needle into the lower back, both of which are quite invasive, prone to some risks and tend to be rarely performed.

They are currently refining this technique to make it useful in hospitals and clinics as well as potentially in space. The need for a small size and fast analytical speed in space should accelerate its development as an important health tool on Earth.

In space, they anticipate that this breakthrough will allow regular monitoring of astronaut ICP and allow testing of treatments to reduce or eliminate dangerous elevations in ICP. In parallel, we are working on techniques that should favourably alter orbital and ICP that can be applied in space.

### Year in Review

- Developed a breakthrough method to measure the brain fluid pressure in humans, which may reduce vision damage experienced by astronauts on long-haul space flights.
- Article published in Nature (npj Microgravity) on measuring the pressure in the brain fluid.
- Conducted regular ISC *International & Life Science Node Presentations* at the Harry Perkins Institute on topics such as Space Associated Neuro-Ocular syndrome (SANS), brain changes in space, thermoregulatory alterations in space, expertise in physiological changes in extreme environments and other space disorders.

BELOW PROFESSOR WILLIAM MORGAN IN A LABORATORY AT THE LIONS EYE INSTITUTE



**PROFESSOR WILLIAM MORGAN**  
[william.morgan@uwa.edu.au](mailto:william.morgan@uwa.edu.au)

# CAPABILITIES



## → IT, ROBOTICS AND AUTOMATION DATA INTENSIVE ASTRONOMY

The data intensive astronomy (DIA) research group, led by Professor Andreas Wicenec, brings a unique mixture of internationally recognised expertise in space-relevant computer science topics, including:

- Machine learning and deep learning on general image and video object recognition, detection and classification, also applied to more general problems like time series analysis and general optimisation problems.
- Development and operation of very large scale, globally distributed data management systems, including remote areas and space.
- Exa-scale distributed processing software systems: These systems have been deployed and processed data on the largest super-computers in the world and very diverse platforms, including small and large scale cloud systems.
- Development and optimisation of algorithms and generic solvers.

→ Development of large scientific software applications using modern professional software development practices and following strict delivery schedules. We have a pool of people practicing and certified in the Scaled Agile Framework (SAFe) for very large distributed agile development projects.

Space-relevant projects include:

- Various radio astronomy projects, related to the Square Kilometre Array (SKA), Murchison Widefield Array, Australian SKA Pathfinder as well as data reduction and support projects for the wider community.
- Projects in computer vision, object detection and classification.
- Ocean swell prediction improvement.
- Gravitational wave detection.
- Previous involvement in various satellite projects including HIPPARCOS, DIVA and GAIA.

**PROFESSOR ANDREAS WICENEC**  
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## AUTOMATION AND ROBOTICS

The robotics and automation lab has designed and built over 100 robots over the past two decades. Led by Professor Thomas Bräunl they have built mobile robots from a small scale to full size cars and buses, and robots that drive, walk, sail, dive or fly.

### Year in Review

- Conducted a full-week workshop on ROS with 40 participants.
- Using 5 (lunar) rover robots for student projects in unit AUTO4508 Mobile Robots.
- Started new full size planetary rover development.
- Cooperation with Woodside on Valkyrie biped walking robot.
- Participated in ISC's inaugural public tour.

**PROFESSOR THOMAS BRÄUNL**  
[thomas.braunl@uwa.edu.au](mailto:thomas.braunl@uwa.edu.au)



ABOVE PROFESSOR THOMAS BRÄUNL DEMONSTRATES AUTOMATION TO HIS STUDENTS.

# CAPABILITIES



## → LIVING AND WORKING IN SPACE

### WORKING AND THRIVING IN SPACE

SPACE EXPLORATION HAS AN ENORMOUS EFFECT ON HUMAN CULTURE. THE ISC'S RESEARCHERS STUDY VARIOUS FACETS OF THE 'HUMAN ELEMENT' IN SPACE, INCLUDING SPACE GOVERNANCE & LAW, COMMUNICATION, PSYCHOLOGY, TEAMWORK AND EMOTIONS OF SPACE CREW, AS WELL AS SPACE-RELATED ARTS.

Human activities in space requires rethinking the ways we work and live, and developing effective working and living environments to maximise human performance and wellbeing in space.

Working and Thriving in Space research crosses and extends a range of social science disciplines

including governance, law, policy, cultural studies, media and communications, architecture and design, ethics, management, psychology, and philosophy.

We focus on:

- Governance of human activities in space;
- Architecture and designed environments in space;
- Communications, media and public engagement with space;
- Moral and ethical dimensions of space and space travel;
- Research ethics and the regulation of space research;
- Mental health and resilience in space;
- Leadership in space;
- Optimising human work performance in space; and
- Optimising the balance between task automation and human manual control in space.

**DR LIES NOTEBAERT**

[lies.notebaert@uwa.edu.au](mailto:lies.notebaert@uwa.edu.au)

## TEAMWORK IN SPACE

Teamwork is a key driver of space crews and mission control teams to successfully deal with the complexity and unpredictability of events that occur in every space mission. The research focuses on several areas relevant for space crews and mission control teams:

Firstly, by highlighting how team adaptation is a central process through which teams and multi-team systems (i.e., teams of teams) respond to unanticipated changes in extreme environments.

Secondly, when operating in dynamic and unpredictable contexts, the role of leadership in enabling team adaptation is crucial. For that reason,

unraveling how team leaders adapt their leadership style to more accurately understand the situation and help the team to adapt to it, is a central topic of the research.

Finally, teams in space develop their activities by interacting with other teams and organisations to achieve their complex goals. For that reason, and because there is a lack of research focused on systems composed of such teams, we conduct research that improves the understanding of the coordination and motivational processes leading to performance in interdependent systems of teams.

**DR RAMON RICO**

[ramon.rico@uwa.edu.au](mailto:ramon.rico@uwa.edu.au)

## THE EMOTIONS OF SPACE

For most of human history our emotions about space have been embedded and embodied in our terrestrial experience. This node brings together historians of emotion, science and literature, archaeologists and linguists, with creative practitioners and performers to explore the history and future of emotions in space.

### Year in Review

→ Emotions of Space: Evening event "Heavenly Harmonies" took place on 7 April 2022 in the Lawrence Wilson Art Gallery. The sold out event was ISC-driven and received ISC financial support.

**DR ANDREW BROERTJES**

[andrew.broertjes@uwa.edu.au](mailto:andrew.broertjes@uwa.edu.au)

**THE UNIVERSITY OF WESTERN AUSTRALIA** Invitation

**Heavenly Harmonies: The Poetry and Music of Space**

You are invited to an evening of sublime poetry, music, and a glass of space bubbles to launch the Humanities and Creative Arts node of the UWA International Space Centre.

Led by Professor Yasmin Haskell (Classics and Ancient History), Head of the Humanities and Creative Arts node, members will read a selection of Renaissance, contemporary and original space poetry accompanied by images from the International Centre for Radio Astronomy. Associate Professor Suzanne Wijsman will introduce *Musica universalis*, the Music of the Spheres, and students from the Conservatorium of Music will play selections of space music from baroque to modern. Head of the International Space Centre, Associate Professor Danail Obreschow will introduce the International Space Centre which was formed at UWA in response to the federal government's investment in the civil space sector.

**Event details:**

**Date:** Thursday 7 April, 2022

**Time:** 5:30 for 6pm start. 6 - 7:30pm

**Venue:** Lawrence Wilson Art Gallery, UWA

**Parking:** Available off Fairway and in Carpark 20, next to the Gallery.

**RSVP:** Contact Dr Janice Lally, at [janice.lally@uwa.edu.au](mailto:janice.lally@uwa.edu.au) or 6488 3718

Light refreshments will be available

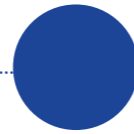
**Campus Partners:** Lawrence Wilson Art Gallery, UWA International Space Centre, School of Humanities, UWA Conservatorium of Music

**LAWRENCE WILSON ART GALLERY** | **THE UNIVERSITY OF WESTERN AUSTRALIA**  
OPEN TUES - SAT 12 - 5PM | 35 Stirling Highway, Crawley, WA, Australia 6009  
FREE ADMISSION | P +61 (0)8 6488 3707 W [uwa.edu.au/lwag](http://uwa.edu.au/lwag)  
@LWAGallery | CRICOS Provider Code: 00126G

Image: Composite image including ASKAP telescopes, CSIRO

ABOVE INVITATION TO HEAVENLY HARMONIES, A GATHERED EVENT TO EXPLORE HUMANITY'S RELATIONSHIP TO SPACE THROUGH MUSIC AND POETRY SINCE THE 16TH CENTURY.

# CAPABILITIES



## → POWERING SPACECRAFTS

### PROPULSION AND CRYOGENICS SPACE ENERGY

This research team focuses on studying the ignition, combustion and explosion characteristics of propellants used in rocket engines under different environmental conditions. We also investigate improving the efficiency, reliability and safety of long duration storage of large quantities of cryogenic fluids used for space missions.

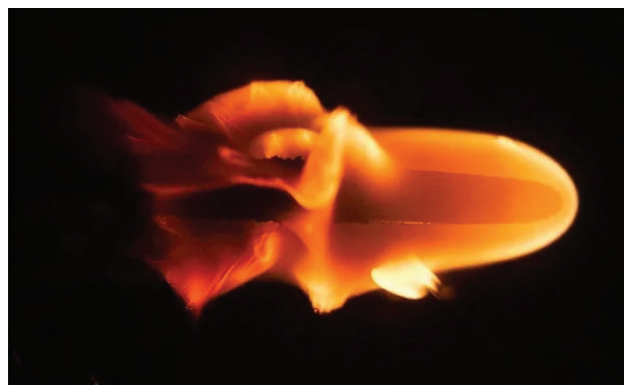
"Life is a process of combustion, often spontaneous, converting energy from one form to another." - Professor Dongke Zhang

Energy is essential to all forms of life and fundamental to any human activity. In space exploration, energy supply, conversion and use are critical in every step of the journey, from rocket propulsion to life support and maintenance. Energy will be a key factor in enabling off-Earth habitation, a sustained human presence and robotic operations in space. We will require the development of new energy technologies capable of delivering long-term, reliable power.

### Year in Review

- Published extensive liquid hydrogen review paper in the energy and environmental science (impact factor around 39): <https://pubs.rsc.org/en/content/articlehtml/2022/ee/d2ee00099g>,
- Assembled hydrogen liquefier and Boil-off gas setup; the facility is currently being commissioned,
- Node Leader Dr Saif Al Ghafri visited William Notardonato of Eta Space in December last year to learn more about their liquid hydrogen testing facility and their work with NASA on the cryogenic fluid management technologies in low Earth orbit, and
- Granted a discovery project (<https://research-repository.uwa.edu.au/en/projects/liquid-hydrogen-cold-energy>) on utilising the cold energy produced by the endothermic para to ortho hydrogen, with potential applications in space.

BELOW FLAME BEHAVIOUR IN ZERO GRAVITY



**DR SAIF AL GHAFRI**  
[saif.alghafri@uwa.edu.au](mailto:saif.alghafri@uwa.edu.au)

**DR ARMAN SIAHVASHI**  
[arman.siahvashi@uwa.edu.au](mailto:arman.siahvashi@uwa.edu.au)

### Year in Review

- Won a **\$2.4m CRC-P grant**, led by EntX Energy. The consortium includes the University of South Australia, the University of Adelaide, the ISC, as well as industry partners Duomer Products and DEWC Systems. UWA's share in this grant is \$197,380. Project started on 11 April, 2022
- Interview with Node Leader Professor Zhang on RTRM on the above-mentioned CRC-Project.
- A new partnership with infinite Green Energy (IGE) on renewable hydrogen production and sustainable aviation fuel synthesis demonstration in a joint IGE/UWA application to ARENA for HyGATE funding (\$29M).

BELOW CONCEPT IMAGE OF GEN-X BATTERY



**PROFESSOR DONGKE ZHANG**  
[dongke.zhang@uwa.edu.au](mailto:dongke.zhang@uwa.edu.au)

# CAPABILITIES



## → SPACE MATERIALS AND RESOURCES

MINERALOGY, GEOCHEMISTRY AND RESOURCING OF SPACE MINERALS. WE HAVE WIDE-RANGING EXPERTISE RELATED TO CHARACTERISING AND RESOURCING MATERIALS FROM AND IN SPACE, AS WELL AS IN UNDERSTANDING THE CONNECTION BETWEEN SPACE MATERIALS AND LIFE ON EARTH.

### PLANETARY GEOSCIENCE

#### GEOLOGICAL CHARACTERISATION OF SPACE MATERIALS AND EXTRA-TERRESTRIAL LIFE ENVIRONMENTS

The Planetary Geoscience research capability focusses on mineralogical and geochemical studies of geological materials from space that have been ejected from the lunar surface, Mars and the Asteroid Belt. The research projects span across planetary geology, petrology, microanalysis, geochemistry, geobiology, sedimentology and stratigraphy.

### Year in Review

- Provided expert mentoring in the 2022 NASA Space Apps Challenge held by *Space Hub* and the ISC. Professor Keep mentored teams focussed on volcanology on the surface of Venus to great success.
- Submission of ITTI ARC Application to support training for extraction of critical minerals.

**PROFESSOR MYRA KEEP**  
[myra.keep@uwa.edu.au](mailto:myra.keep@uwa.edu.au)

### PLANETARY MAPPING

#### UNDERSTANDING THE TECTONICS OF TERRESTRIAL PLANETS

This team uses Synthetic Aperture Radar (SAR) data to map planetary surfaces, and understand surface and tectonic processes on Venus and other terrestrial planets.

Earth is the only planet in our solar system that has plate tectonics as a driving process. Plate tectonics, driven by heat escaping from the core of our planet, drives everything else, and forms continents, mountains, oceans, volcanoes and affects climate.

### MINING AND MINERALS IN SPACE

#### MMS IS INTERESTED IN DEVELOPING NEW TECHNOLOGIES THAT APPLY TO OFF-EARTH MINING AND MINERAL PROCESSING.

Like on-Earth, a successful mine cycle requires proper exploration and prospecting, mine design and planning, mine construction, and production methods.

The focus for space is on:

- Water mining in space;
- Space mine optimisation, planning and scheduling;
- In-situ processing of precious metals; and
- Off-Earth construction and building materials.

**ASSOCIATE PROFESSOR ALI KARRECH**  
[ali.karrech@uwa.edu.au](mailto:ali.karrech@uwa.edu.au)



# CAPABILITIES

## → SPACE MATERIALS AND RESOURCES

### SPACE CRYSTALLOGRAPHY

LED BY PROFESSOR STEPHEN MOGGACH, THE SPACE CRYSTALLOGRAPHY NODE AIMS TO DETERMINE THE CRYSTAL STRUCTURES OF MOLECULAR CO-CRYSTALS THAT ARE LIKELY TO FORM ON THE SURFACE OF TITAN – SATURN’S LARGEST MOON.

Titan has geological features that are somewhat similar to those found on Earth, with seas, lakes and sweeping dunes. Unlike the Earth, however, the temperature hardly varies, sitting at a constant value of around 92K. In addition, the surface composition is quite different to the Earth, and dominated by molecular materials, much of which are photochemically produced in the moon’s atmosphere. These range from simple compounds such as ethane and acetylene, to more complex molecules (e.g. methylcyanoacetylene). These more complex molecular compounds first form as a haze layer in Titan’s atmosphere, before being deposited onto the surface.

Interestingly, because of the active weather system on Titan, these deposited ‘pure’ compounds can mix by being buried in subsequent layers of organic material, or by dissolution in the liquid hydrocarbon seas, and could lead to the formation of molecular co-crystals.

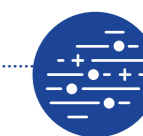
### Year in Review

- Recently awarded a LIEF grant to enable the purchase of a Differential Scanning Calorimetry (DSC), which will allow the team to look at materials between -170 to 600 degrees. This is a key piece of equipment allowing them to look at planetary science co-crystals on this Titan project.

#### PROFESSOR STEPHEN MOGGACH

[stephen.moggach@uwa.edu.au](mailto:stephen.moggach@uwa.edu.au)

BELOW PROFESSOR STEVEN MOGGACH DEMONSTRATES X-RAY CRYSTALLOGRAPHY



# CAPABILITIES

## → SPACE CIVIL ENGINEERING

DEVELOPMENT OF TECHNIQUES FOR IN-SPACE CONSTRUCTION USING SPACE MATERIALS.

This research aims to develop new methods of mortarless construction and mining extraction that are suitable for the low gravity and harsh environment found on extraterrestrial bodies. The team also

investigate methods for deflecting those bodies that are on a collision course with Earth.

### Year in Review

- Mechanics of thermal spallation – a method of rock drilling/cutting suitable for extraterrestrial use. Further development.
- Mechanics of fragmented solids, suitable for modelling of rubble -pile asteroids. Updating the existing apparatus.
- Topological Interlocking – a mortarless construction method. A new mould for block production is developed. Further development.
- New asymptotic models of crack growing parallel to a free surface.

- Journal paper published: Wong, R.X., E. Pasternak and A.V. Dyskin, 2022. Effect of partial asymmetric friction on fault sliding. Engineering Fracture Mechanics, 281, 109101; 1 abstract: Zhang, M., E. Pasternak and A.V. Dyskin, 2023. Rocks with rotating blocks: 1D displacement, rotation and wave propagation. NP7.1 “Non-linear Waves and Fracturing” at European Geosciences Union General Assembly 2023 (EGU2023).

#### PROFESSOR ARCADY DYSKIN

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#### PROFESSOR ELENA PASTERNAK

[elena.pasternak@uwa.edu.au](mailto:elena.pasternak@uwa.edu.au)

BELOW PROFESSORS DYSKIN AND PASTERNAK





## OUR TEAM



## ISC NODE LEADERS



**DR SAIF AL GHAFRI**  
POWERING SPACECRAFT



**PROFESSOR THOMAS BRÄUNL**  
ROBOTICS AND AUTOMATION  
SPACE IT AND ROBOTICS



**DR MARIA RIOJA CAPELLAN**  
RADIO ASTRONOMY FROM SPACE  
ASTRONOMY FROM SPACE



**A/PROF. DAVID COWARD**  
ZADKO TELESCOPE TEAM  
SPACE SITUATIONAL AWARENESS

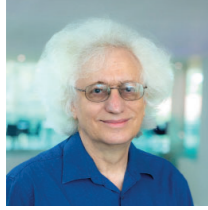


**DR RICHARD DODSON**  
RADIO ASTRONOMY FROM SPACE  
ASTRONOMY FROM SPACE

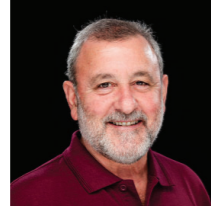


**PROFESSOR SIMON DRIVER**  
GALAXY EVOLUTION  
ASTRONOMY FROM SPACE

**OPPOSITE TOP** HEAVENLY HARMONIES AT LAWRENCE WILSON ART GALLERY. **BOTTOM** LIVE PRESS CONFERENCE WITH NASA FOR FIRST IMAGES FROM JWST. DR ROBIN COOK (LEFT) AND GREGORY ROWBOTHAM (IN ASTRONAUT COSTUME) **TOP** ASSOCIATE PROFESSOR DANAIL OBRESCHKOW SPEAKS TO INDUSTRY, GOVERNMENT, MEDIA AND THE PUBLIC ON THE FORMATION OF THE ISC.



■ **PROFESSOR ARCADY DYSKIN**  
SPACE CIVIL ENGINEERING



■ **PROFESSOR LORENZO FARAONE**  
AVIONICS FOR SENSING AND  
IMAGING  
SATELLITE REMOTE SENSING



■ **PROFESSOR MARCO FIORENTINI**  
PLANETARY GEOSCIENCE  
SPACE RESOURCES AND  
MATERIALS



■ **DR RAMON RICO MUNOZ**  
TEAMWORK IN SPACE  
LIVING AND WORKING IN SPACE



■ **DR LIES NOTEBAERT**  
WORKING AND THRIVING IN SPACE  
LIVING AND WORKING IN SPACE



■ **A/PROF. DANAIL OBRESCHKOW**  
MICROGRAVITY EXPERIMENTATION  
EXPERIMENTS IN VARIABLE  
GRAVITY



■ **PROFESSOR YASMIN HASKELL**  
EMOTIONS OF SPACE  
LIVING AND WORKING IN SPACE

*NOTE: DR ANDREW BROERTJES  
ACTING IN POSITION*



■ **A/PROF. ALI KARRECH**  
MINING AND MINERALS IN SPACE  
SPACE RESOURCES AND  
MATERIALS



■ **PROFESSOR MYRA KEEP**  
PLANETARY MAPPING  
SPACE RESOURCES AND  
MATERIALS



■ **PROFESSOR CONLETH  
O'LOUGHLIN**  
HYPERGRAVITY EXPERIMENTATION  
EXPERIMENTS IN VARIABLE  
GRAVITY



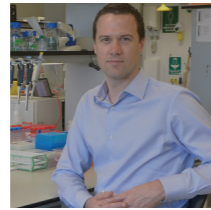
■ **PROFESSOR ELENA PASTERNAK**  
SPACE CIVIL ENGINEERING



■ **PROFESSOR CHARITHA  
PATTIARATCHI**  
APPLICATIONS OF SATELLITE  
REMOTE SENSING  
SATELLITE REMOTE SENSING



■ **A/PROF. ANTHONY KEMP**  
PLANETARY GEOSCIENCE  
SPACE RESOURCES AND  
MATERIALS



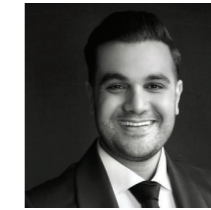
■ **PROFESSOR RYAN LISTER**  
PLANTS FOR SPACE



■ **PROFESSOR HARVEY MILLAR**  
PLANTS FOR SPACE



■ **A/PROF. SASCHA SCHEDIWY**  
LASER COMMUNICATIONS AND  
TIMING



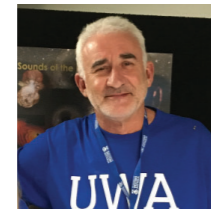
■ **DR ARMAN SIAHVASHI**  
PROPULSION AND CRYOGENIC  
FLUIDS  
POWERING SPACECRAFT



■ **PROFESSOR LINGQING WEN**  
GRAVITATIONAL WAVE  
ASTRONOMY  
ASTRONOMY FROM SPACE



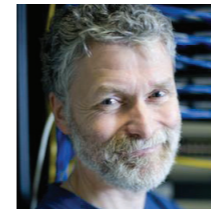
■ **PROFESSOR STEPHEN MOGGACH**  
SPACE CRYSTALLOGRAPHY



■ **MR JOHN MOORE**  
ZADKO TELESCOPE TEAM  
OPERATIONS MANAGER  
SPACE SITUATIONAL AWARENESS



■ **PROFESSOR BILL MORGAN**  
SPACE PHYSIOLOGY AND  
MEDICINE



■ **PROFESSOR ANDREAS WICENEC**  
SPACE INFORMATION  
TECHNOLOGY  
SPACE IT AND ROBOTICS



■ **PROFESSOR DONGKE ZHANG**  
SPACE ENERGY  
POWERING SPACECRAFT



# OUR TEAM

## BOARD OF THE INTERNATIONAL SPACE CENTRE



ABOVE DR ELISABETE DA CUNHA PRESENTING ON THE JWST FIRST LIGHT IMAGES AT THE UNIVERSITY CLUB (EVENT ALSO WITH DR SABINE BELLSTEDT, PROFESSOR SIMON DRIVER, COMPÈRED BY MS PRU STEINERTS, SUPPORTED BY DR ROBIN COOK).



PROFESSOR PETER QUINN  
CHAIR OF THE BOARD



PROFESSOR GIA PARISH  
AROSE REPRESENTATIVE



PROFESSOR JULIE LEE  
DVCR NOMINEE



A/PROF. DANAIL OBRESCHKOW  
HEAD OF THE INTERNATIONAL  
SPACE CENTRE



PROFESSOR SIMON DRIVER  
APPOINTED NOMINEE TO THE  
BOARD



PROFESSOR HARVEY MILLAR  
APPOINTED NOMINEE TO THE  
BOARD



PROFESSOR WILLIAM MORGAN  
APPOINTED NOMINEE TO THE  
BOARD



DR LIES NOTEBART  
APPOINTED NOMINEE TO THE  
BOARD



PROFESSOR SHAMIT SAGGAR  
APPOINTED NOMINEE TO THE  
BOARD



ABOVE "BINARY COALESCENCE PROJECT", BASED ON A UNIQUE COLLABORATION BETWEEN ASTROPHYSICISTS PROFESSOR LINQING WEN AND KEVIN VINSEN. AUSTRALIAN ARTIST PRODUCED THREE MUSIC VIDEOS REPRESENTING THEIR INTUITIVE AND CREATIVE RESPONSES TO WEN'S REACTION TO THE DETECTION OF TWO GRAVITATIONAL WAVES FROM THE COALESCENCE OF TWO EXTREMELY DENSE OBJECTS FAR AWAY IN THE UNIVERSE. PRODUCED BY CLAIRE BOWEN OF STORYBURSTS.

## EXECUTIVE COMMITTEE



A/PROF. DANAIL OBRESCHKOW  
HEAD OF THE INTERNATIONAL  
SPACE CENTRE



MRS LARISSA WIESE  
MANAGER OF THE INTERNATIONAL  
SPACE CENTRE



**INTERNATIONAL  
SPACE CENTRE**

[INTERNATIONALSAPCECENTRE.ORG](http://INTERNATIONALSAPCECENTRE.ORG)