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Summary of the Zadko Observatory's space related and industry partnerships and contracts involving MMA team members: D. Coward, B. Gendre, F. Panther & J. Moore

The 1.0 metre f/4 fast-slew Zadko Telescope, located approximately 70 kilometres north of Perth at Yeal in the Shire of Gingin, Western Australia is the only metre-class research grade optical facility at this southern latitude, being 31° 21' 27" South and longitude 115° 42' 50" East. The Zadko Telescope is situated between the east coast of Australia and South Africa, which allows rapid imaging of optical transients at a longitude not monitored by other similar facilities. Since the Zadko Telescope has been in operation it has proven its worth by detecting numerous Gamma Ray Burst afterglows, two of these being the most distant 'optical transients' imaged by an Australian telescope.

Participation in large international research projects that have highlighted 'The University of Western Australia' *(UWA)* as an excellent partner and research hub, include the Laser Interferometer Gravitational-Wave Observatory *(LIGO)*. LIGO is jointly operated by the California Institute of Technology *(Caltech)* and the Massachusetts Institute of Technology *(MIT)* and supported by the U.S. National Science Foundation for detection of Gravitational wave candidate events and discovery. NASA - Gamma Ray Burst *(GRB)* and solar system science, European Space Agency *(ESA)* – Fast Radio Bursts *(FRB)* in conjunction with Parke's radio telescope plus many more agencies.

The Zadko Telescope forms part of the ARC Centre of Excellence for Gravitational Wave Discovery *(OzGrav)* which has contributed significantly to the collaboration via supporting specialised research staff and the operation of key equipment - www.ozgrav.org

The Zadko Observatory is also strongly supported by the University of Western Australia's Office of Research and forms part of UWA's International Space Centre - www.internationalspacecentre.org

Contribution to The University of Western Australia's Research & Defence Capabilities

Another important use for the Zadko Telescope is the tracking and mapping of Space Debris which consist of all man-made objects, including their fragments or parts, other than active space vehicles larger than 10 microns and orbiting the Earth in outer space.

The Zadko Telescope's importance as a potential tool for education, training, and public outreach cannot be underestimated, as the global awareness of the importance of astronomy as a context for teaching science continues to increase. An example of this was the national media coverage of its contribution to the discovery of colliding neutron stars in 2017 capturing the imagination of the public. In the past twelve-month's Zadko Telescope science has been reported multiple times in the national TV, radio and print media.

Current projects / partnerships

- The Zadko Telescope is contracted by the European Space Agency *(ESA)* to track potentially hazardous bodies to provide data for impact hazard assessment. As a test of the tracking capability, the system was used to track a satellite flyby in April 2020.

  Media: http://www.news.uwa.edu.au/20200416119 96/international/uwa-zadko-telescope-helps-track-ambitious-space-mission-mercury

- The Zadko Telescope has been approached to initiate an initial survey of nearby active galaxies, in particular those that host massive black holes in their centres, to determine which will be targets for the Cherenkov Telescope Array *(CTA)*. The CTA is a multinational, worldwide project to build a new generation of ground-based gamma-ray instruments in the energy range extending from some tens of GeV to about 300 TeV.

- The Zadko Observatory hosts two fully autonomous ground based optical stations for space surveillance and space traffic management for French based Ariane Group SAS.

- The Zadko Observatory hosts one fully autonomous optical station used for Space Domain Awareness for USA based company Slingshot contracted to the US Defence Department.

- The Zadko Observatory hosts an autonomous, remotely operated, alt-azimuth mounted PlaneWave Instruments CDK500 Telescope aligned with an ASA-300 optical instrument used for Space Situational Awareness contracted to the Polish Space agency *(POLSA)*.

- The Zadko Observatory hosts an autonomous, remotely operated wide field of view optical telescope used for Space Domain Awareness *(SDA)* campaigns of Low Earth Orbit objects for the Space Debris team at the Japan Aerospace Exploration Agency *(JAXA)*.

- The Zadko Observatory team is currently in the process of installing three VHF antennas across northern Australia, used for the global Space-based multiband astronomical Variable Objects Monitor *(SVOM)* network. SVOM is a Chinese French space mission dedicated to the detection and study of gamma-ray bursts and their use for astrophysics and cosmology. Gamma-ray bursts are considered as the brightest and the most energetic events in the Universe since the Big Bang.

- The Zadko Observatory forms part of an international fully automated camera and radio network known as the 'Fireball Recovery and Inter-Planetary Observation Network' *(FRIPON)*. Mostly focused on the study of the physical and dynamic properties of the smallest bodies *(diameter ≤10 m)* of interplanetary matter, such as interplanetary dust particles *(IDPs)*, meteoroids, asteroids and comets which enter our atmosphere; small meteoroids give rise to visible meteors whereas large meteoroids produce fireballs *(i.e., meteors with a visible magnitude exceeding -4)*.

- The Falcon Telescope is a joint initiative between the United States Air Force Academy *(USAFA)* and the University of Western Australia *(UWA)*. The Falcon Telescope Network is a global network of small aperture *(20 inch)* telescopes developed by the Centre for Space Situational Awareness Research *(CSSAR)* in the Department of Physics at the U.S. Air Force Academy, in collaboration with educational partners. Falcon will be shared with U.S. and international university partners for the purpose of undergraduate space situational awareness *(SSA)* and astronomy research education as well as community STEM outreach.

- The Zadko Observatory team are currently in negotiation with the University of Arizona *(UA)* to collaborate in Planetary Defence *(PD)* and Space Domain Awareness *(SDA)* programs, which will encompass training on photometry, astrometry and spectroscopy and potential student exchange.

- To compliment the Zadko Telescope the Australian Space Academy *(ASA)* have recently installed within the Zadko Observatory a Celestron 14" *(C-14)* telescope which will be dedicated to the near-Earth space environment, with particular emphasis on space situational awareness and planetary defence.

Further information about any of the aforementioned initiatives can be directed to Associate Professor David Coward, Director Zadko Observatory via email at: david.coward@uwa.edu.au

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