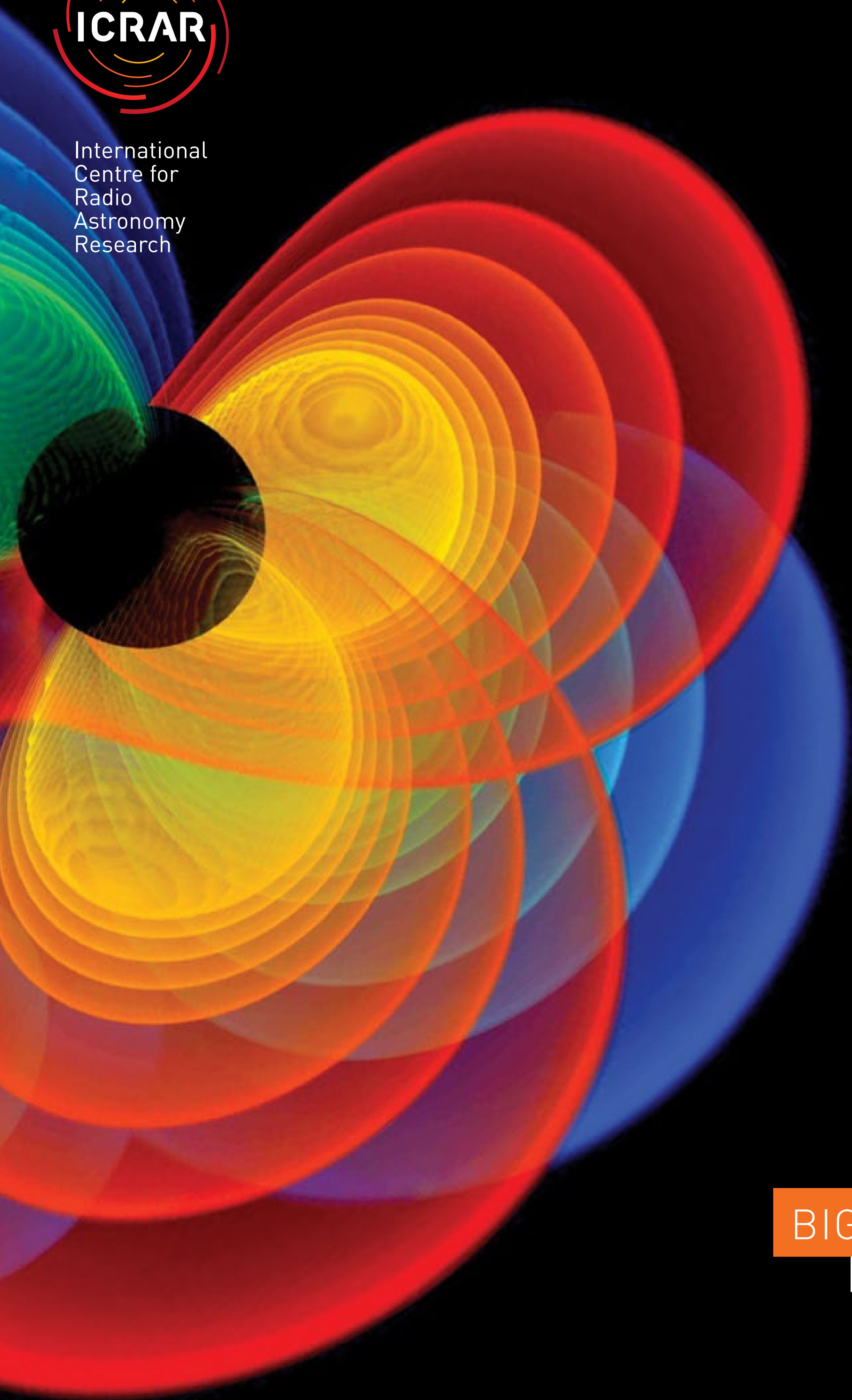
International
Centre for
Radio
Astronomy
Research



BIG SCIENCE

CASE STUDY

BIG SCIENCE

ICRAR is recognised by its scientific peers as having undertaken some of the most impactful work in astronomy this decade. Its research has been acclaimed globally with several publications in the two most prestigious journals in the world—Nature and Science.

These high-impact, multidisciplinary scientific journals are notoriously difficult to be published in and are reserved for only the most influential research. Despite being less than ten years old, ICRAR already has nine Nature papers, nine Science papers and two Nature Astronomy papers to its name, underscoring the magnitude of the discoveries made by its researchers.

Nature publishes only eight per cent of the already high quality manuscripts it receives, while Science claims to have an acceptance rate below seven per cent. Publication in these journals puts ICRAR's research alongside some of the most important scientific discoveries of all time, including Watson and Crick's description of the structure of DNA, the Apollo 11 mission and the cloning of Dolly the sheep.

In 2014, ICRAR's research featured on the cover of Science when work led by Dr Roberto Soria resulted in the finding of a new fast and furious black hole. This small, superpowered black hole in the nearby galaxy M83 is surrounded by a bubble of hot gas. The gas is heated by two jets launched by the black hole, powerfully shooting out energy and acting like cosmic sandblasters. Although the black hole itself is only 100 kilometres wide, the jets around it extend about 20 light years either side. By using the bubble to measure the total energy output from the jets, the researchers found them to be many times more powerful than previously expected.

Another ICRAR study, this time led by Associate Professor James Miller-Jones, was published in Science in 2013 after it shed light on the way compact objects such as black holes and white dwarf stars interact with nearby stars. The research solved a decade-old puzzle by making an extremely precise measurement of the distance between Earth and the white dwarf system SS Cygni.

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The distance to SS Cygni had previously been measured using the Hubble Space Telescope in the 1990s. But Hubble had produced a puzzling conclusion that the distance was much further than permitted by a key physical model for how gas falls onto dense objects such as a white dwarf or a black hole, which would have forced a rethink into the physics of how such star systems worked. Associate Professor Miller-Jones and his team measured the distance to SS Cygni to be 372 light years, much closer than the Hubble Space Telescope result, and sufficient to vindicate the original model. This new result was

Cover A simulation of black holes merging. Credit Michael Koppitz / AEI

Right Nearby spiral galaxy M83 and the MQ1 system with jets, as seen by the Hubble Space Telescope. The blue circle marks the position of the MQ1 system in the galaxy (shown inset). Image Credits: M83 – NASA, ESA and the Hubble Heritage Team (WFC3/UVIS, STScI-PRC14-04a). MQ1 inset – W. P. Blair (Johns Hopkins University) & R. Soria (ICRAR-Curtin)

later confirmed by the European Space Agency's Gaia satellite.

That same year, ICRAR Professor Lister Staveley-Smith was a co-author on a Nature paper about the detection of enormous outflows of energy from the centre of our galaxy. These 'galactic geysers' are made up of charged particles that move almost at the speed of light. They stretch more than halfway across the sky and represent an incredible amount of energy—equivalent to a million supernova explosions.

The research was able to show that the galactic geysers are driven by many generations of stars forming and exploding at the centre of the Milky Way over the last hundred million years. While the outflows extend 50,000 light years from the centre of the galaxy, our Solar System is perfectly safe as the jets are moving in a different direction to us.

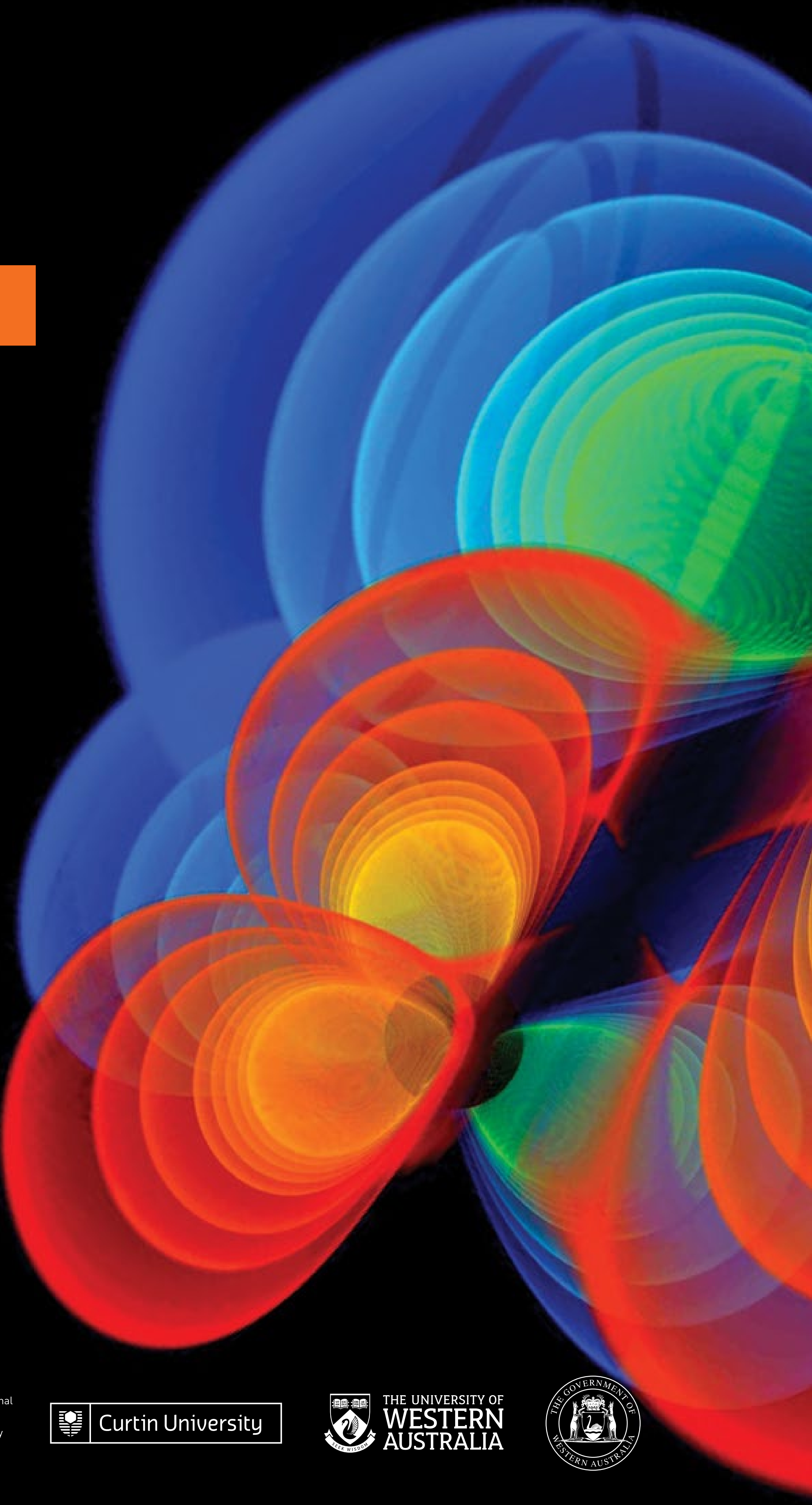
In 2015, ICRAR research published in Science forced another rethink of our understanding of black holes and their evolution. The work, led by Dr Ryan Shannon, saw an 11-year search with CSIRO's Parkes telescope for a background 'rumble' of gravitational waves predicted by Einstein's general theory of relativity. But the waves were not detected. This goes against theoretical expectations and throws our current understanding of how black holes come together into question. The world-first research has caused scientists to think about the Universe in a different way.

More recently, ICRAR astronomer Paul Luckas was published in Nature Astronomy in 2017 when he helped observe a nova—a nuclear explosion on the surface of a white dwarf star. About 50 novae are predicted to occur in our galaxy every year but only a dozen or so are actually discovered. Some of these are so bright they were beyond explanation using standard theories.

Mr Luckas was able to help researchers at Michigan State University observe a super-luminous nova in unparalleled detail and prove a theory that explains the phenomenon. The results indicate that powerful shockwaves amplify the explosions beyond any traditional scale for nuclear explosions.

ICRAR's researchers are changing the way we think about our Solar System, the Milky Way and the Universe around us. In its short life, the Centre has grown to become a mature and competitive research organisation, publishing in excess of 200 peer-reviewed papers a year. ICRAR has strong research collaborations in the US and Europe, and its publication output sees it ranked amongst the top radio astronomy research institutes in the world.

Top The new-found outflows of particles (pale blue) from the Galactic Centre. The background image is the whole Milky Way at the same scale. The curvature of the outflows is real, not a distortion caused by the imaging process. Image Credit: Radio image – E. Carretti (CSIRO); Radio data – S-PASS team; Optical image – A. Mellinger (Central Michigan University); Image composition, E. Bressert (CSIRO).



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