UK researchers are part of the team announcing four new gravitational wave detections

3rd December 2018 - Four new gravitational wave detections announced today include the most massive and distant source ever observed.

The work includes contributions from many UK researchers and a number of them had these comments to make about this latest breakthrough:

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Professor Sheila Rowan is director of the University of Glasgow's Institute for Gravitational Research. Professor Rowan said: "This remarkable crop of detections show just how valuable gravitational wave astronomy is in developing our understanding of the universe.

"In less than three years gravitational wave detections have given us direct evidence of the existence of black holes and binary neutron star collisions. Today we present a wealth of new data from LIGO and Virgo to stand alongside the ground-breaking discoveries already made during their initial observing runs. It took science a century to confirm Einstein's prediction of the existence of gravitational waves, but the pace of our discoveries since then has been exhilarating, and we're anticipating many more exciting detections to come."

Professor Martin Hendry is head of the University of Glasgow's School of Physics and Astronomy. Professor Hendry added: "The four new detections discussed in this paper are exciting, particularly the largest and most distant black hole collision we've seen to date, but what's equally significant is that we now have data from 11 detections collected together as a catalogue.

"That represents a big step forward in our understanding of the universe, and is a ringing endorsement of the effectiveness of gravitational wave astronomy."

Professor Alberto Vecchio, from the University of Birmingham's Institute for Gravitational Wave Astronomy, said, "It's a universe full of black holes: they pair up and collide, and they do it very frequently. Advanced LIGO has started to operate as an astronomical observatory providing us with a steady stream of new discoveries. The scene is now set to begin understanding the cosmos' black hole factories. Three years ago only a fool would have thought we would be under a deluge of binary black holes, but now this is an intoxicating reality. And it is just the beginning".

Professor Andreas Freise, from the University of Birmingham's Institute for Gravitational Wave Astronomy, said, "When black holes collide they create vibrations in space and time. Now we know that this happens often: the LIGO detectors regularly detect faint echoes that tell of the last seconds in the life of a pair of black holes. These whispers from dark skies tell us about the size and the location of the dying black holes. We have become gravitational wave astronomers, creating new maps of the Universe."

Riccardo Buscicchio, a Birmingham PhD student and member of the LIGO team, said, "We have a graveyard of 10 binary black holes that tells us a lot about their extreme violent last fractions of a second of life, and carry at the same time the signatures of their entire life both as individuals and as binary companions. As a PhD student, it has been a unique opportunity to have access to observations that are still so rare, and to study their characteristics as part of a clearly large population. You get so much enthusiasm, from learning a lot to being able to participate actively in the production of scientific results of such great relevance."

Dr Patricia Schmidt, a member of the Virgo Team who will be joining Birmingham's Physics faculty in January 2019, said, "At just 39 square degrees, the second triple-coincident binary black hole, GW170818, is the best localized binary black hole observed to date highlighting the importance of a global detector network. With almost a dozen confident gravitational-wave detections, we have truly established the field of gravitational-wave astronomy. The third observing run is on our doorstep. With an unprecedented number of gravitational-wave observations anticipated, the scientific prospects are enticing."

Professor Mark Hannam, from Cardiff University's School of Physics and Astronomy, said: "This is an exciting transition to making regular observations. With more than 10 detections, we are now starting to really understand the properties of the black holes in our universe."

Dr Vivien Raymond, from Cardiff University's School of Physics and Astronomy, said: ""After the wonderful achievement of the first detection, the new field of Gravitational Astronomy is delivering on its promises. This very first catalogue represents our knowledge of the gravitational-wave Universe. And it will from now on increase tremendously both in size and complexity."

Professor Hartmut Grote, from Cardiff University's School of Physics and Astronomy, said: "It is exciting to see the fruits of decades of hard work on the instruments that facilitated all the detections. The instruments are now undergoing further improvements, to be ready for a new data taking run with unprecedented sensitivity starting in spring of 2019."

Professor Nicholas Lockerbie from the University of Strathclyde said "The two LIGO detectors in the USA, and the Virgo detector in Europe, have been decades in their conception, construction, bringing into operation, and refinement, requiring the work of more than 1000 scientists and engineers, internationally. Indeed, in collaboration with the Institute for Gravitational Research at the University of Glasgow, my colleagues and I in the Department of Physics at the University of Strathclyde have contributed to this effort.

"However, it is only a little over three years ago now that the very first direct detection of gravitation waves was ever made - by LIGO— the gravitational wave signal from two colliding Black Holes. It is also only just over one year ago that the very first gravitational wave signal from two colliding neutron stars was seen.

"Subsequently, this event was recorded by telescopes and various types of detector right across the electromagnetic spectrum, and it marked the beginning of true 'multi-messenger' astronomy. It even provided a possible explanation for the origin of much of the gold and heavy elements in the Universe!

"The work which is about to be published, and which catalogues the results from the first two observing runs, demonstrates the unparalleled capability of this ground-breaking gravitational-wave network to make new science. The systematic exploitation of the scientific output from these gravitational wave Observatories is a now a reality."