Edinburgh astronomers deliver 'origins' camera

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Today the Science and Technology Facility Council's UK Astronomy Technology Centre (UK ATC) at the Royal Observatory Edinburgh shipped its biggest and most complex ever instrument. The giant camera known as SCUBA-2 will be transported to the James Clerk Maxwell Telescope (JCMT) on top of a 14,000 foot mountain in Hawaii where it is expected to make major discoveries related to the origins of galaxies, stars and planets.

Rather than detecting visible light, SCUBA-2 will detect submillimetre radiation, which is sensitive to the heat emitted by extremely cold dust in the Universe. This material is associated with the mysterious earliest phases of the formation of galaxies, stars and planets, hitherto largely undetectable. Typically the dust is at temperatures of about -200 Celsius and so detecting its extremely weak emissions presents a huge technological challenge.

Dr Wayne Holland, the project leader at the UK ATC said "Submillimetre astronomy is a relatively new science and one where the UK has led the world over the past two decades. Our latest camera is the most powerful yet: SCUBA-2 on the JCMT should detect the equivalent of the heat from a candle on the surface of the Moon."

In order to detect such low levels of heat, the detectors inside the camera must be as sensitive as possible. To achieve this they must be cooled to within a tenth of a degree above absolute zero (or about -273 Celsius). This is a huge technical challenge and to prevent the detectors being

swamped by heat from the camera itself, the internal optics of the camera must also be cooled. As a result, the complete camera is the size of a family car and weighs about 4 tons.

The superconducting detectors are the most sensitive thermal detectors ever built. Their design and construction was the result of a highly successful collaboration with the National Institute of Standards and Technology in Boulder, Colorado, and the Scottish Microelectronics Centre of the University of Edinburgh.

Professor Ian Robson, Director of the UK ATC, said "SCUBA-2 is an incredible achievement; it is almost certainly one of the most complex projects that UK astronomers have ever attempted but it is also a project that is expected to produce amazing results. After seven years of construction in Edinburgh, the world's most powerful submillimetre camera by a huge margin is poised to open up a new frontier in astronomical research."

One of the most exciting discoveries in astronomy over the past decade was made by SCUBA, the predecessor to SCUBA-2. Astronomers were surprised to detect a population of distant galaxies completely enshrouded in dust that had never been seen before. These galaxies are usually invisible to telescopes that detect visible light and can only be seen using submillimetre telescopes. They are known as primeval galaxies because they represent some of the earliest structures observable in the universe. Over it’s 8-year lifetime SCUBA was able to produce images of only a hundred or so of these galaxies with each one taking several nights of valuable telescope time. In contrast SCUBA-2 is expected to be able to pinpoint and image many hundreds of these in a single night.

Professor John Peacock, head of the Institute for Astronomy at the University of Edinburgh, is excited about the prospect of using the new

camera, "Earlier submillimetre cameras such as SCUBA have taught us that galaxies like the Milky May formed most of their stars in an early dust-rich episode that we can't study with visible light. SCUBA-2 will let us find thousands of galaxies in the earliest act of assembly, and study them in detail. It will be like moving from black-and-white film to 10-megapixel digital cameras. Astronomers can't wait for this wonderful machine to start producing results."

Professor Gary Davis, Director of the JCMT, said "We at the telescope are anxiously awaiting the arrival of this new camera. I expect it to revolutionise submillimetre astronomy, just as its predecessor SCUBA did. The JCMT's user community in the UK, Canada and the Netherlands has designed a joint, comprehensive Legacy Survey based on the enormous promise of this instrument, and we can't wait to get started."

Closer to home SCUBA-2 will survey giant molecular clouds, where stars are currently being born and, intriguingly, it will search for the imprints of planetary systems on the cold dusty debris found around many nearby stars. This will entail observing around 500 stars and searching for the tell-tale signs that that planetary systems exist. "One of the most exciting things SCUBA-2 will do is to probe regions similar in size to our own Solar System around nearby stars", Dr Holland says. "This will tell us if there are other such systems out there and whether our Solar System is unique".

For astronomical instruments pixel count is all important, particularly if you want to survey large areas of sky. Containing over 10,000 pixels SCUBA-2 will push back the boundaries of technology much further than has ever been done before. Professor Robson says "The closest rival camera has only a few hundred pixels. SCUBA-2 will survey the sky 1000 times faster than any other instrument out there, with the exciting prospect of producing the first detailed map of the sky - a true atlas of

the cold universe".

SCUBA-2 is a multi-million pound instrument. It has taken seven years to build and has been the result of a hugely successful collaboration between the UK ATC, the National Institute of Standards and Technology (Boulder, US), the University of Edinburgh, Cardiff University, the Joint Astronomy Centre, Hawaii, and a consortium of Canadian universities, including the Universities of Waterloo and British Columbia.

SCUBA-2 will arrive in Hawaii in mid-March and will begin initial science operations in the summer.

Source: Science and Technology Facilities Council