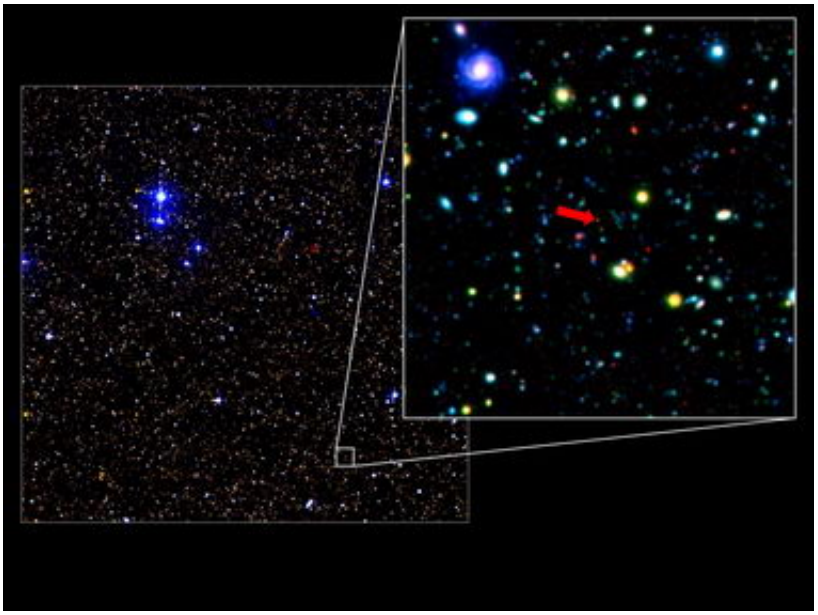
Dark and distant heavenly bodies revealing the secrets of star and galaxy formation

July 21 2006



Zooming into one tiny section of the UKIDSS Ultra-Deep Survey, revealing a faint red galaxy which is believed to be at a distance of 12 billion light years. The full survey covers a region approximately four times the area of the full moon. The colour image was produced by combining infrared data from UKIDSS with optical imaging from the Subaru telescope (courtesy Professor Kazuhiro Sekiguchi) Credit: UKIDSS Ultra-Deep Survey & the Subaru Telescope

Today (21 July), British astronomers are releasing the first data from the largest and most sensitive survey of the heavens in infrared light to scientists across Europe. The UKIRT Infrared Deep Sky Survey (UKIDSS) has completed the first of seven years of data collection,

studying objects that are too faint to see at visible wavelengths, such as very distant or very cool objects. New data on young galaxies is already challenging current thinking on galaxy formation, revealing galaxies that are massive at a much earlier stage of development than expected.

These first science results already show how powerful the full survey will be at finding rare objects that hold vital clues to how stars and galaxies in our Universe formed.

UKIDSS will make an atlas of large areas of the sky in the deep infrared. This survey will reveal more cool and faint objects than we have ever been able to see before. It will also detect objects at the very edge of our known universe. UKIDSS is being conducted by UK astronomers working with Japanese and ESO astronomers. The data is being shared with astronomers across Europe through ESO.

"Astronomers across Europe will jump on these exciting new data. We are moving into new territory - our survey is both wide and deep, so we are mapping huge volumes of space. That's how we will locate rare objects - the very nearest and smallest stars, and young galaxies at the edge of the universe." said Andy Lawrence from the University of Edinburgh, UKIDSS Principal Investigator.

The UKIDSS data was collected by the United Kingdom Infrared Telescope situated near the summit of Mauna Kea in Hawaii using the Wide Field Camera (WFCAM) built by the United Kingdom Astronomy Technology Centre (UKATC) in Edinburgh. WFCAM is the most powerful infrared imager in the world. It generates enormous amounts of data - 150 gigabytes per night (equivalent to more than 200 CDs) – and approximately 10.5 Terrabytes in total so far (or 15,000 CDs!!).

A small amount of data was released in January 2006 and already teams led by Omar Almaini at the University of Nottingham and Nigel Hambly

of the Institute for Astronomy at the University of Edinburgh are beginning to reveal some of the secrets of star and galaxy formation.

Omar Almaini, Ross McLure and the Ultra Deep Survey team have been looking at distant galaxies by surveying the same region of sky night after night to see deeper and to find these very faint objects. This survey will be one hundred times larger than any similar survey attempted to date and will cover an area four times the size of the full Moon. So far several hundred thousand galaxies have been detected and among the early discoveries, nine remarkable galaxies have been found that appear to be 12 billion light years away. As it has taken 12 billion years for the light to travel from these galaxies to Earth, we are seeing them as they were when they were very young – only a billion years after the Big Bang. The newly discovered galaxies are unusual as they appear to be very massive for their age. This challenges thinking on how galaxies form, since it was thought that large galaxies form gradually over billions of years as smaller components merge together.

"We're surveying an enormous volume of the distant Universe, which allows us to discover rare massive galaxies that were previously almost impossible to find. Understanding how these galaxies form is one of the Holy Grails of modern astronomy, and now we can trace them back to the edge of the known Universe" said Omar Almaini.

Nigel Hambly and Nicolas Lodieu have been using the UKIDSS data to discover more about very cold objects in our Galaxy called brown dwarfs. Brown dwarfs are formed in the same way as stars but typically they have less than 8% of the mass of the Sun (or approximately 80 times the mass of Jupiter). This is not large enough for core nuclear reactions to occur, and so brown dwarfs do not shine like normal stars. Brown dwarfs give off less than one ten thousandth of the radiation of a star like our Sun. This relatively tiny amount of heat can be detected by WFCAM and the UKIDSS survey hopes to find out how many of these

"failed stars" there are in our Galaxy.

Only a few hundred of these enigmatic objects have been found previously but the UKIDSS survey should establish if they are rare or a relatively common phenomenon. This large study of brown dwarfs will reveal the true scale of the link between the smallest normal stars and large gas planets, such as Jupiter.

Nigel Hambly, of the UKIDSS Galactic Clusters Survey said "There is every reason to suppose that the physical process leading to the formation of stars is continuous across the mass boundary that separates normal hydrogen-fusing stars like the Sun and the so-called failed stars, or brown dwarfs. With UKIDSS, we will find many thousands of brown dwarfs in many different star formation environments within our own Galaxy; furthermore we expect to find even cooler and much dimmer objects than are currently known. This will tell us how significant a role the brown dwarfs have in the overall scheme of Galactic structure and evolution."

Mike Irwin and his team at the Institute of Astronomy, University of Cambridge have automated the processing of the huge amount of data produced by the surveys. More than 2 million images have been analysed so far, with the team tasked with removing instrumental artefacts, cataloguing the thousands of objects visible on each frame and providing quality measures for the 10,000 images produced per night.

Source: Particle Physics & Astronomy Research Council