e-MERLIN's deep radio survey of the Hubble Deep Field: first results

March 27 2012

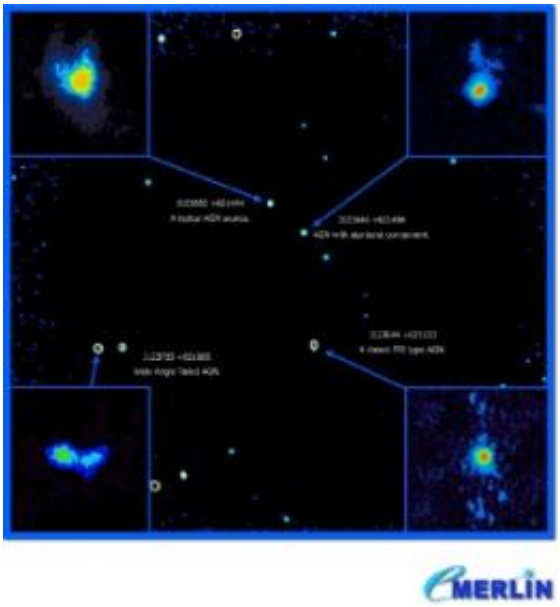

Image composed from e-MERLIN and EVLA observations in C-band. The width of the whole field is approximately 1/4 of a degree (the same diameter as half a full moon). The inset images illustrate the effectiveness of e-MERLIN's capabilities in revealing the structure of galaxies even at distances of billions of the light years. Bottom left: An interesting example of an AGN galaxy with large lobes thought to be caused by jets, emanating from a central black hole, interacting with interstellar material. Bottom right: An FR1 type AGN galaxy. Top left: A more typical AGN type galaxy. Top right: An AGN with star formation characteristic emission detected at an estimated distance of 7.5 billion light-years. Credit: N. Wrigley / Jodrell Bank Centre for Astrophysics

(PhysOrg.com) -- A team of astronomers at Jodrell Bank Observatory have begun the deepest ever high-resolution radio imaging of the region around the Hubble Deep Field (HDF), the images originally captured by the Hubble Space Telescope (HST) in the mid 1990s. The HDF led to the discovery of numerous galaxies billions of light years distant and provided direct visual evidence of the evolution of the Universe. First results from the new imaging, which uses observations from the UK's newly upgraded e-MERLIN radio telescope array together with the EVLA radio array based in New Mexico, show galaxies some 7 billion light years away in unprecedented detail. Graduate student Nick Wrigley will present the new results at the National Astronomy Meeting in Manchester on 27 March 2012.

e-MERLIN is an array of radio telescopes distributed across the United Kingdom connected together by optical fibres. Data from each telescope is sent across this network to Jodrell Bank where a device known as a 'correlator' processes them into a single image. This technique, known as interferometry, simulates a single radio telescope hundreds of kilometres across and produces exceptionally sharp images of astronomical objects.

EVLA is a similar more compact array in New Mexico in the United States that shows the coarser structure of objects and complements the e-MERLIN observations. The two arrays started to survey the HDF region in 2011 and the team expect the project to be completed in the next few years.

The first wide-band images of the whole HDF region capture the brightest objects in the field at sub-arcsecond resolution, equivalent to being able to distinguish a ten pence piece at a distance of over 5 kilometres. The pictures were assembled by Mr Wrigley under the supervision of Dr. Rob Beswick and Dr Tom Muxlow at the Jodrell bank Centre for Astrophysics in Manchester. The image in the background, observed using the EVLA, shows the unresolved emission from whole

galaxies, whereas the inset images produced using mapping in combination with e-MERLIN show the fine detail.

The high resolution provided by e-MERLIN allows astronomers to distinguish between the different types of galaxies, identifying those that have emission from material being dragged into supermassive black holes (so called Active Galactic Nuclei or AGNs) and those where the emission originates from rapid star formation or starbursts. The HDF galaxies are so far away that the light we see from them left as long ago as 12 billion years ago, so the new radio observations are giving us an insight into the formation of stars when the universe was less than 10% of its present age.

This new work is just the start of a multi-year survey of the HDF and provides a glimpse of the capabilities of wide-band (broadband data transmission) synthesis imaging now possible with simultaneous use of the e-MERLIN and EVLA arrays. Crucially, the e-MERLIN and EVLA correlators now generate compatible data allowing future observations to be combined like never before.

The first images were made with relatively short exposure times, but the whole project, named e-MERGE (led by Dr. Tom Muxlow (Manchester), Prof. Ian Smail (Durham) & Prof. Ian McHardy (Southampton)) will include long observations gathered at various wide-bands within the radio spectrum generating an unsurpassed combination of sensitivity and detail. The survey will ultimately measure massive star formation and AGN activity in very distant galaxies, tracing the development of the stellar populations and black hole growth in the very first large galaxies. Using the more accurate observations from e-MERLIN, it will be possible to produce more precise models of the physical process of star formation within star clusters in such galaxies and help to answer some of the many questions faced by cosmologists today.

Provided by Royal Astronomical Society