Astronomy with the WSRT

Deep observations of the radio sky

What does the radio sky look like?
Radio telescopes like the WSRT have produced deep radio images of regions of the sky to investigate the nature of the radio sources and how their properties change through the life of the Universe. The radio emission can originate from so-called Active Galactic Nuclei or from starburst galaxies. The first occur when relativistic particles accelerated by a strong magnetic field are emitted and launched from a super massive black hole in the centre of a galaxy. The latter arise via massive star formation and the death of giant stars (supernovae).

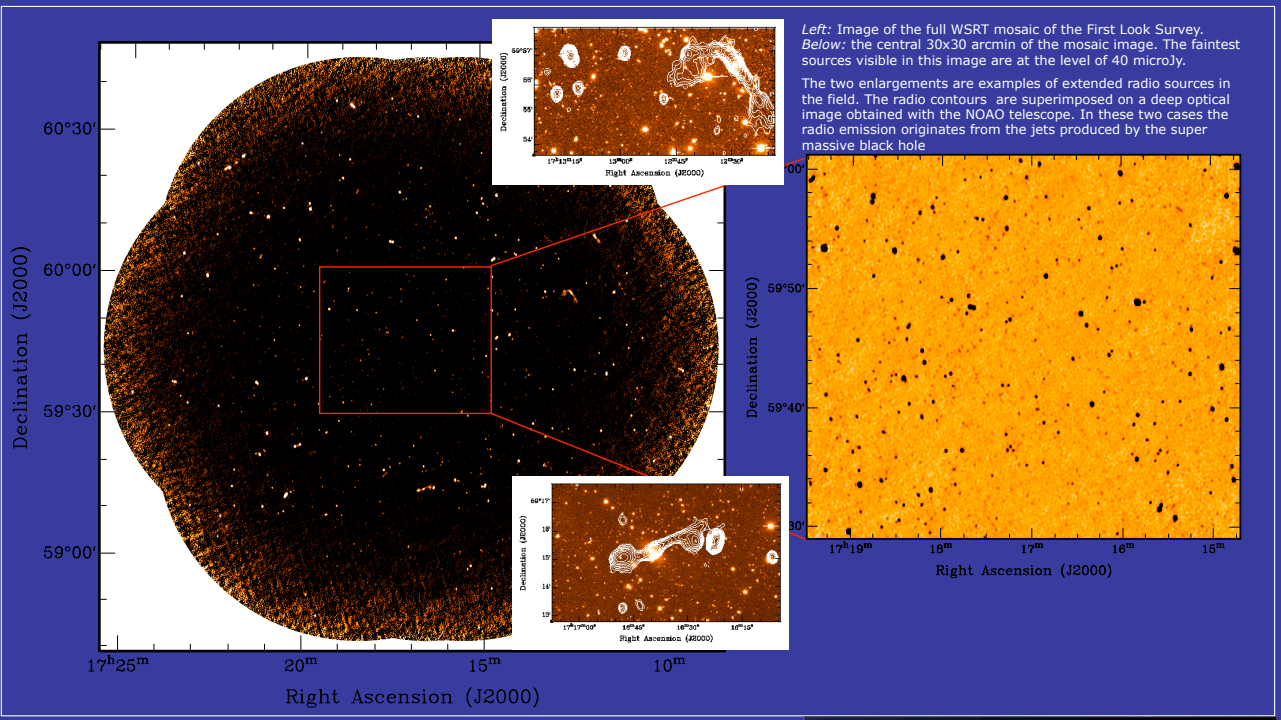
The WSRT is often used to produce these deep images. The deepest so far is a region of about one square degree centred on the First-Look "verification" strip of the Spitzer IR Space Telescope (see figure).

The observations made use of the 160 MHz broad-band IF system (8 bands of 20 MHz with 128 channels in each band) covering the frequency range 1311-1450 MHz.
The final image (a mosaic of seven fields) reaches a noise level of 8.5 μJy - the deepest WSRT image made to date. More than 1000 sources have been detected in the field.

What do we want to learn?

- What kind of galaxies inhabit the early Universe? How different was the Universe then?
- When did the first galaxies and massive stars form ?
- At what rate did these galaxies form stars in the early Universe?
- Do they have different characteristics than nearby galaxies?

A key factor to be able to fully exploit deep radio surveys is the need for multi-wavelength source identifications at other wavelenghts e.g. optical/near IR. The distance of the radio sources can also be obtained via the redshift information derived from optical spectra or from radio and sub-mm spectral indices.



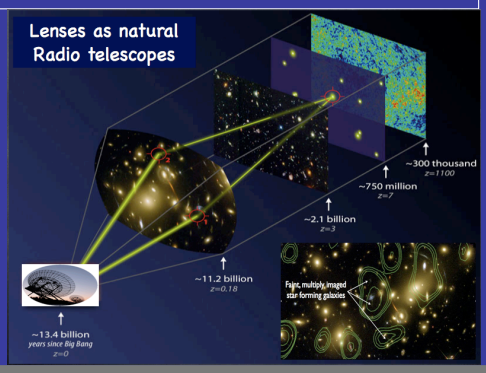
Left: Image of the full WSRT mosaic of the First Look Survey. *Below:* the central 30x30 arcmin of the mosaic image. The faintest sources visible in this image are at the level of 40 microJy.

The two enlargements are examples of extended radio sources in the field. The radio contours are superimposed on a deep optical image obtained with the NOAO telescope. In these two cases the radio emission originates from the jets produced by the super massive black hole

Under the magnifiying glass:
a trick to observe the most distant radio sources.

The magnification from gravitational lenses makes it possible to do a detailed study of extremely **distant** systems that otherwise would be too faint to observe.

Gravitational lensing (by individual galaxies and by massive galaxy clusters) can magnify the light of background galaxies and quasars by a factor of 10-100.
The WSRT has provided the first case of multiply lensed radio emission from a very distant star forming galaxy (see figure right). The radio emission that was detected was emitted when the Universe was only 700 million years old and shows that even at these very early epochs, galaxies were forming stars at rates that are 100 times greater than our own Milky Way!



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