Astronomy with the WSRT
Deep observations of the radio sky

What does the radio sky look like?
Radio telescopes like the WSRT make deep radio images of regions of the sky to investigate the nature of the radio sources and how their properties have changed over cosmic times. The objects detected in such deep surveys can can either be so-called Active Galactic Nuclei (AGN) or be starburst galaxies. AGN objects contain a super-massive black hole that shoots particle into space with velocities close to the speed of light. The emission from starburst galaxies comes from supernova remnants, i.e. the leftovers of exploded stars.
The WSRT is often used to produce such deep images. The deepest so far is of a region of about four times the size of the full moon centred on the First-Look "verification" area of the Spitzer IR Space Telescope.
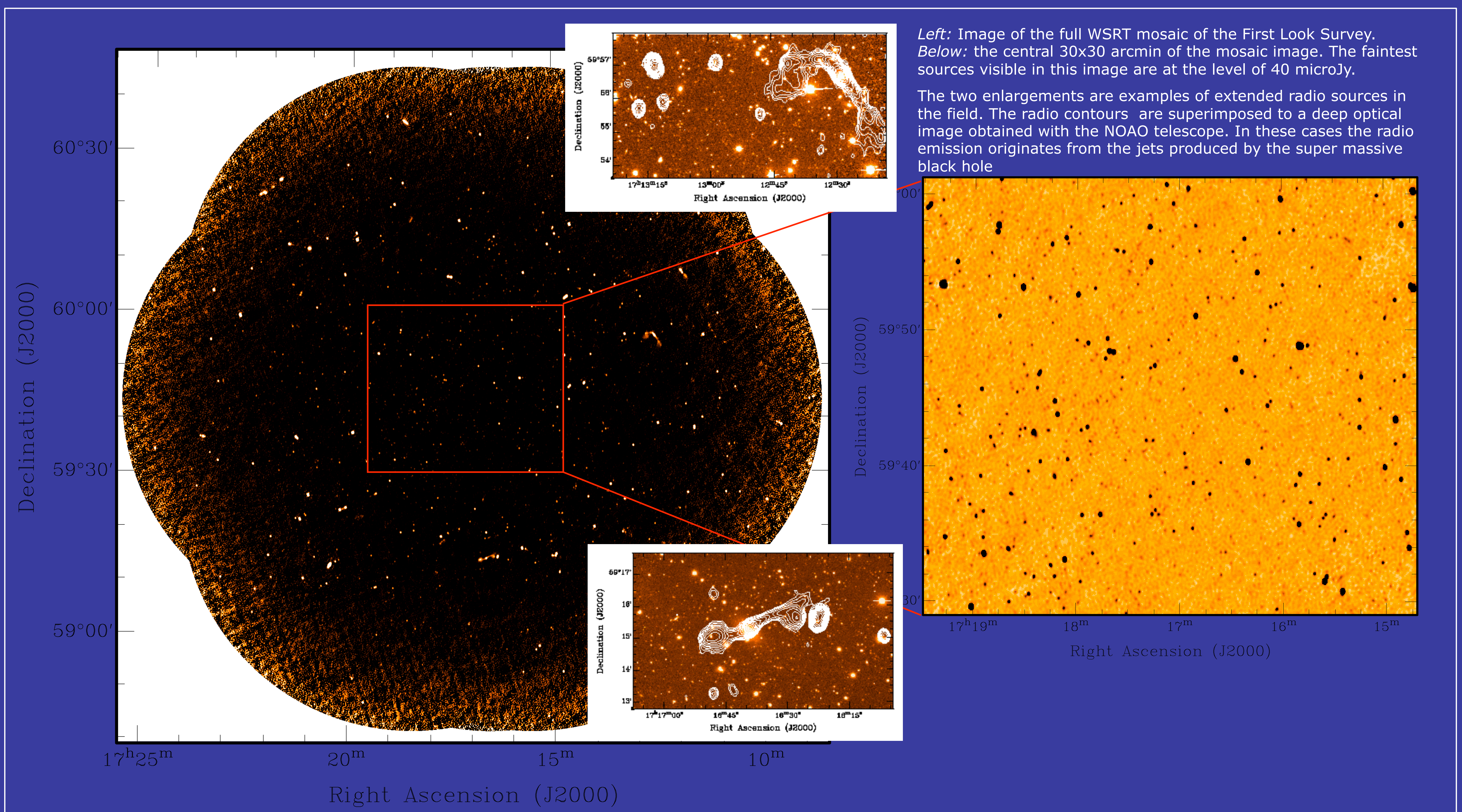
The observations made use of the 160 MHz broad-band IF system (8 bands of 20 MHz with 128 channels in each band) covering the frequency range 1311-1450 MHz.
The final image (that is in fact a mosaic of seven fields) reaches a noise level of 8.5 μJy - the deepest WSRT image made to date. More than 1000 sources have been detected in the field.

What do we want to learn?

- How different was the early Universe from how it is now?

- At which rate these galaxies are forming new stars?

- Do galaxies in the early Universe they have different characteristics from those nearby?

A key factor to be able to fully exploit deep radio surveys is that data from other wavebands (e.g. from optical telescopes) are available so that distances and other properties can be derived.

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 to a deep optical image obtained with the NOAO telescope. In these 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 by 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. The radio emission that was detected was emitted when the Universe was only 700 million years old.

Lenses as natural Radio telescopes