The Effelsberg Deep Field: Radio Continuum Observations of the Cosmological Evolution Survey at High Frequencies

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AGN11, Trieste 23-26 September 2014

Abstract

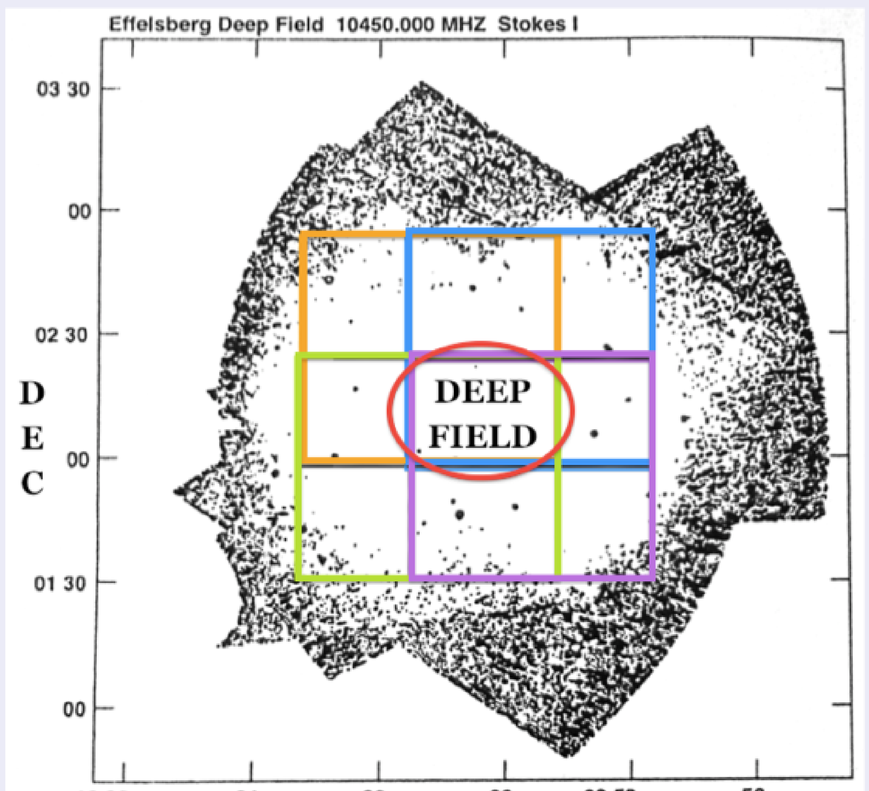
This project is concerned with the Effelsberg Deep Field (EDF), a high frequency (10.45 GHz) survey obtained with the 100-m Effelsberg telescope that covers the COSMOS field of $1.^{\circ}4 \times 1.^{\circ}4$. Our deep 2.8-cm map ($1\sigma \sim 0.5 mJy$) now complements the already available data at 20 cm, adding more information at shorter radio wavelength. Besides, a sample of 71 radio sources with the best signal to noise ratio at 10.45 GHz was extracted. Here we present aspects of the data analysis and the final map, as well as the list of extracted sources.

Scientific background

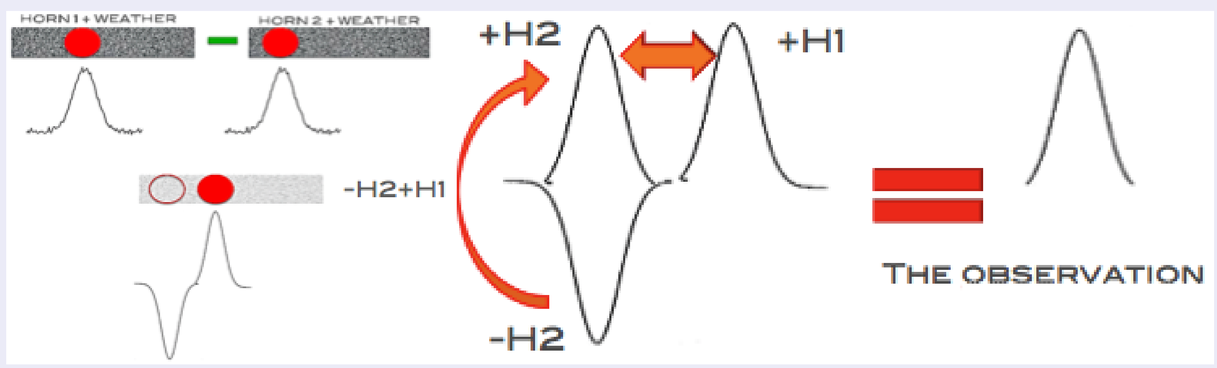
The COSMOS field is a large project that aims to probe the formation and evolution of galaxies in an important redshift range between z$\sim$0.5 and z$\sim$3. This work aims at enriching the COSMOS database, introducing information at 10.45 GHz of the field using the 100-m Effelsberg telescope. With its 183 exposure hours the survey reaches a detection limit of 1.5 mJy (3σ) and a noise level under 0.5 mJy at 10.45 GHz. Cross correlation with the NVSS catalogue and the COSMOS-VLA catalogue were made and a follow-up programme on the detected sources at 10.45 GHz was carried out to confirm their flux density map.

The observations and data reduction

The observations were carried out between December 2007 and March 2011, using the 100-m Effelsberg telescope at 10.45 GHz. The four-horn system receiver has a bandwidth of 300 MHz and an angular resolution of 69″ . Different field sizes were mapped to cover the entire COSMOS field. The field was thus splitted in four quadrants to be observed separately.

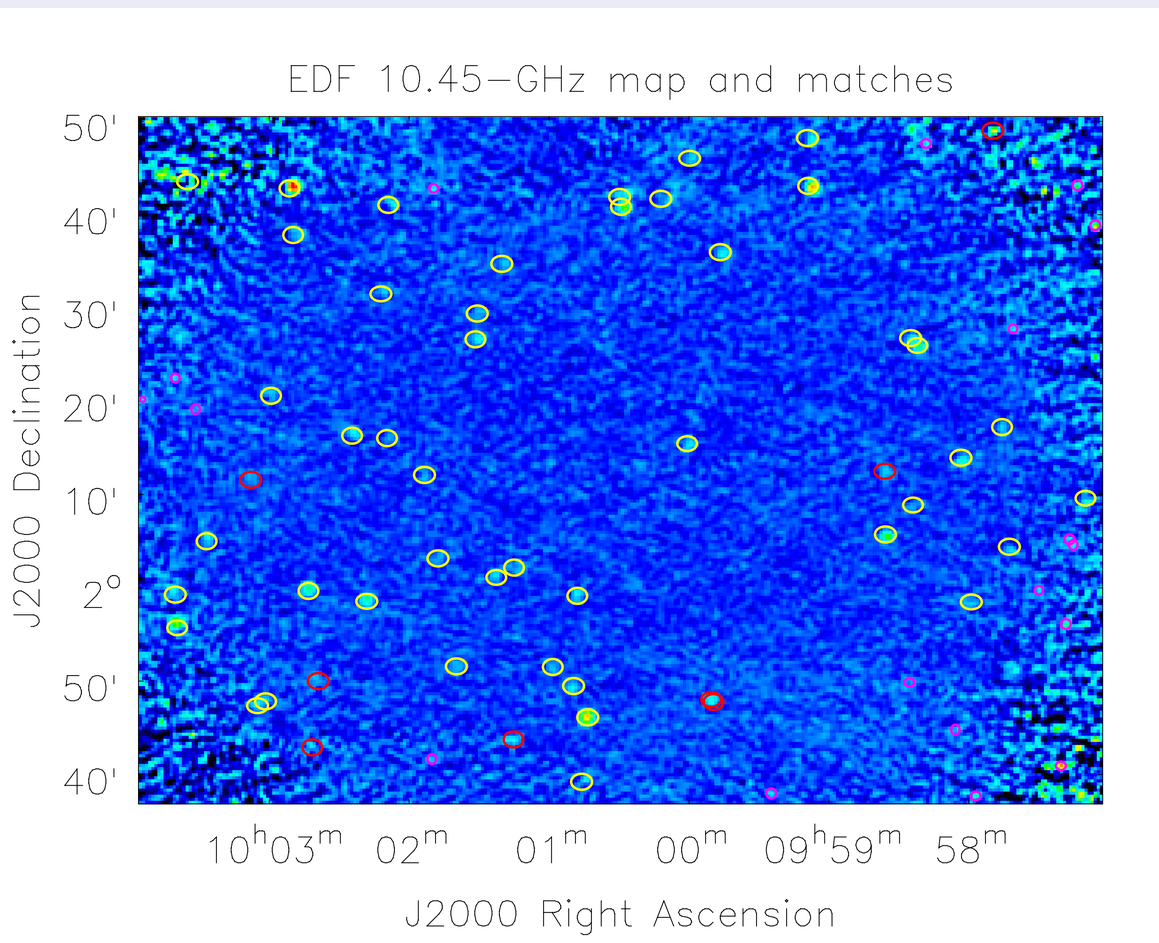


Two analysis modes have been performed: a pure stacking method and the multi-beam method. The first is the superposition of all the coverages, the second makes use of differences formed using all permutations of the four horns and then restored properly. The best reduction method was chosen for each scan before combining them to obtain the final map.



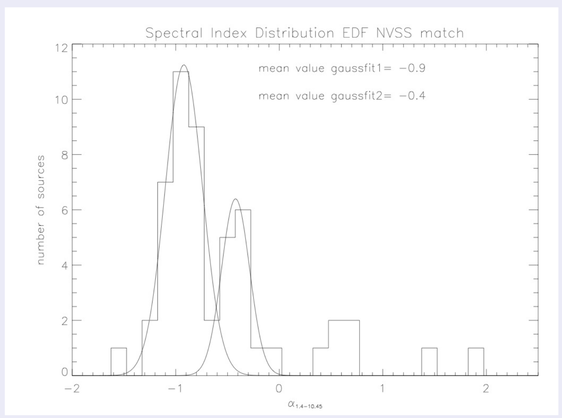
Final map

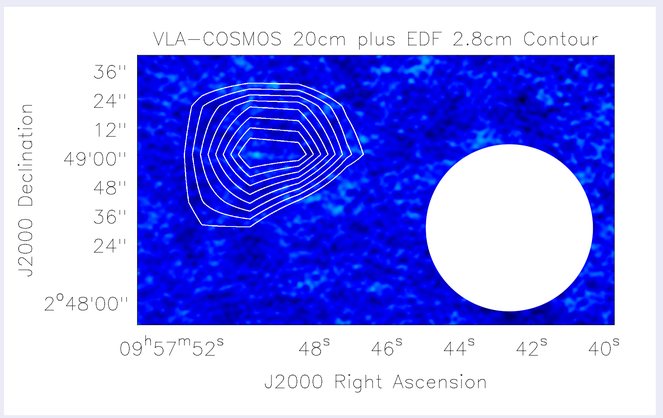
Final map: a zoom in of the area of interest; the edges were cut because of the high noise due to the lack of coverages. The noise level reached in the central part ($40' \times 60'$) is 500 μJy/beam. In the figure: the yellow circles are the targets with NVSS counterpart, the red circles are the targets with COSMOS-VLA counterpart and the magenta circles are the sources without any counterpart.



The map catalogue

The map catalogue contains 70 targets. A cross correlation of the detected objects with the NVSS catalogue and with the VLA-COSMOS catalogue was done. The result is a list containing 45 sources with NVSS counterparts. For those without NVSS counterpart, we found 7 with COSMOS-VLA counterparts. Eighteen sources remained not detected; for these sources we could only give a COSMOS-VLA 5σ upper limit of 0.05 mJy.





The histogram clearly shows:

- steep spectrum sources with α = -0.7,
- steep/flatish spectrum sources with α = -0.4
- few inverted spectrum sources with α_{mean} = 1.1

These last could be good candidates to be High-Frequency-Peakers (HFP) In order to add another indicator of their HFP nature, we check their compactness looking at the VLA-COSMOS map superimposing our EDF contour map (an example is shown in the figure above).