Radio Sources in the Local Universe

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Abstract

This thesis presents a census of radio sources selected from the NVSS[1] and SUMSS[2] catalogues which have also been observed in the first data release of the 6dFGS[3], a galaxy redshift survey of the local universe. Radio detections were found for 4 506 galaxies in the 6dFGS near-infrared-selected primary sample, a radio detection rate of 16%. A further 1196 radio sources were observed by 6dF which were missing from the 6dFGS primary sample either because their host galaxies were too blue in colour or they appeared stellar on optical plates. The full sample comprises the largest and most homogeneous set of spectra and redshifts of radio sources in the local universe ever obtained. Results from the study of these objects form an accurate benchmark from which their cosmic evolution may be understood.

6dF spectra of galaxies have been used to determine the physical cause of radio emission from each object as either star formation or an active galactic nucleus powered by a super-massive black hole. These two classes of radio source have been characterised via a determination of the local radio luminosity function at 1.4 GHz; plotting the variation in their space density with luminosity. The star-formation density of the universe at the present epoch has been determined, the value of which which turns out to be in excellent agreement with previously published values. Fractional luminosity functions have also been determined showing that more massive galaxies have higher star-formation rates and are more likely to host a radio-loud AGN.

The large-scale structure of star-forming galaxies and radio-loud AGN in the local universe has been studied by determining their clustering properties via the two-point correlation function. Radio-loud AGN are found to cluster more strongly than star-forming galaxies confirming that these objects are biased tracers of the underlying matter distribution. Both star-forming galaxies and AGNs cluster similarly to the underlying host galaxy population in which they reside.

This thesis also describes the 843 MHz SUMSS catalogue, made by fitting elliptical Gaussians to sources in images. The catalogue contains radio sources to a limiting peak brightness of 6 mJy beam^{-1} at $\delta \leq -50^{\circ}$ and 10 mJy beam^{-1} at $\delta > -50^{\circ}$. Image artefacts have been classified using a novel technique involving a decision tree, which correctly identifies and rejects spurious sources in over 96% of cases and has ensured the catalogue is more than 95% complete and 90% reliable over most of its flux density range.

[1] NRAO (National Radio Astronomy Observatory) VLA (Very Large Array) Sky Survey
[2] Sydney University Molonglo Sky Survey
[3] 6 degree Field Galaxy Survey

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This research has made use of data obtained from the following databases:

- The NASA/IPAC Extragalactic Database (NED) which is operated by the Jet Propulsion Laboratory, Caltech, under contract with the National Aeronautics and Space Administration. (nedwww.ipac.caltech.edu)
- The 6dF Galaxy Survey (6dFGS), observed with the 6 degree Field (6dF) facility built by the Anglo-Australian Observatory (AAO). Data were obtained from the 6dFGS public database at (www-wfau.roe.ac.uk/6dFGS)
- The NRAO VLA Sky Survey, observed with the Very Large Array (VLA). Data were obtained from the NVSS public database at (www.cv.nrao.edu/nvss)
- The SuperCOSMOS Sky Survey, maintained by the Wide Field Astronomy Unit at the University of Edinburgh. (www-wfau.roe.ac.uk/sss)

Declaration of Originality

This thesis contains no material which has been presented for a degree at this or any other university, and, to the best of my knowledge and belief, contains no copy or paraphrase of work published by another person, except where duly acknowledged in the text.

Note that chapter 2 is a reproduction of an article published in Monthly Notices of the Royal Astronomical Society in collaboration with other astronomers (Mauch *et al.*, 2003). Nonetheless, this work is still a valid part of my thesis because the majority of the work was done by me. Specific tasks undertaken by co-authours of this article as well as any contribution by others to any other parts of this thesis are outlined in the preamble to each chapter.

Thomas Mauch Date

Publications

Refereed Publications

SUMSS: a wide-field radio imaging survey of the southern sky - II. The source catalogue, **T. Mauch**, T. Murphy, H. J. Buttery, J. Curran, R. W. Hunstead, B. Piestrzynska, J. G. Robertson and E. M. Sadler, *Monthly Notices of the Royal Astronomical Society*, **342**, 1117-1130, 2003. Chapter 2 is a reproduction of this article with minor typographical changes for consistency with the rest of this thesis. The contributions of each co-authour are outlined in the preamble to Chapter 2.

Newsletter Articles

Radio sources in the 6dFGS - test data, **T. Mauch**, *Anglo-Australian Observatory - Newsletter*, **99**, 10-11, 2003. The text of this article is reproduced in Section 3.5.3 with some changes for consistency.

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