THE LOTSS VIEW OF RADIO-AGN IN THE LOCAL UNIVERSE. THE MOST MASSIVE GALAXIES ARE ALWAYS SWITCHED ON.

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INTRODUCTION

We present a study of the local radio source population, by cross-comparing the data from the first data release (DR1) of the LOFAR Two-Metre Sky Survey (LoTSS) with the Sloan Digital Sky Survey (SDSS) DR7 main galaxy sample.

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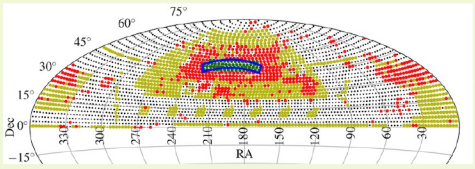
THE LOFAR TWO-METRE SKY SURVEY

LoTSS DR1 provides deep data (median rms noise of 71 μJy at 150 MHz) over 424 square degrees of sky, sufficient to detect 10615 (32 per cent) of the SDSS galaxies over this sky area.



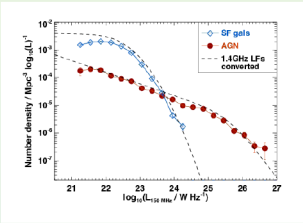
Sky coverage of the LoTTS survey. The DR1 area marked in blue.

SEPARATION OF AGN AND STAR FORMING GALAXIES

An improved method to accurately separate Active Galactic Nuclei (AGN) from sources with radio emission powered by star formation (SF) was developed and applied, leading to a sample of 2121 local ($z < 0.3$) radio-loud AGN.

AGN AND SF LUMINOSITY FUNCTION

The local 150 MHz luminosity function was derived for radio AGN and SF galaxies separately, and the good agreement with previous studies at 1.4 GHz suggests that the separation method presented is robust.

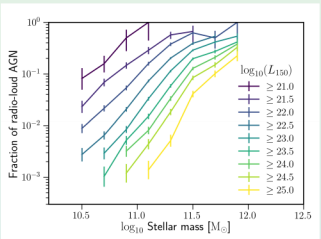


Luminosity functions for the radio-loud AGN and the star forming galaxies at 150 MHz. Also shown for comparison the luminosity functions at 1.4 GHz using the parametrization of Heckman and Best 2014.

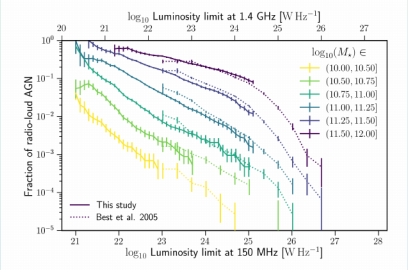
THE FRACTION OF RADIO-LOUD AGN

The prevalence of radio-loud AGN activity is confirmed to show a strong dependence on both stellar and black hole masses, remarkably reaching a fraction of 100 per cent of the most massive galaxies ($> 10^{11}$ $M_\odot$) displaying radio-loud AGN activity with $L_{150\ MHz} \geq 10^{21}$ W Hz^{-1}; **thus, the most massive galaxies are always switched on at some level**.

Stellar mass appears to be a more important driver of radio-AGN activity than black hole mass, suggesting a possible connection between the fuelling gas and the surrounding halo, in line with models whereby these radio AGN are essential for maintaining the quenched state of galaxies at the centres of hot gas halos.



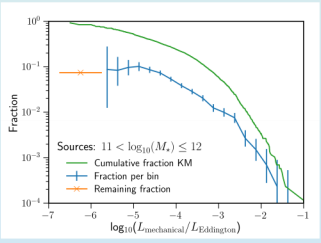
The fraction of galaxies that host a radio-loud AGN above a given luminosity limit, as a function of stellar mass, for different radio luminosity limits. At the lower luminosity limits the prevalence reaches a 100 per cent for the highest masses.



The fraction of galaxies hosting radio-loud AGN brighter than a given radio luminosity, separated by their stellar mass. Also shown (in dashed lines) the fractions obtained in the study of Best et al. 2005 at 1.4 GHz. The highest mass bins reach a 100 per cent prevalence.

DISTRIBUTION OF EDDINGTON-SCALED ACCRETION RATES

The results allow the full Eddington-scaled accretion rate distribution (a proxy for the duty cycle) to be probed for massive galaxies, which is found to peak at $L_{mech}/L_{Edd} \approx 10^{-5}$. More than 50 per cent of the energy is released during the ≈ 1 per cent of the time spent at the highest accretion rates, $L_{mech}/L_{Edd} \approx 10^{-2.5}$.



Distribution of Eddington-scaled accretion rates for radio-loud AGN (solid blue line). The error bars correspond to the 95 per cent confidence interval. The cumulative distribution obtained from the Kaplan-Meier estimator (solid green line) running from higher towards lower accretion rates is shown. The orange cross represents the remaining fraction of galaxies spread over the following 4 bins

These results will be published together with the DR1 release of LoTSS in a special issue of Astronomy and Astrophysics later this year