Galaxies and Their Constituents at the Highest Angular Resolutions
IAU Symposium, Vol. 205, 2001
R.T. Schilizzi, S. Vogel, F. Paresce and M. Elvis

The "Number – Flux Density" Relation for Milliarcsecond Structures in Extragalactic Radio Sources

L.I. Gurvits

Joint Institute for VLBI in Europe
P.O. Box 2, 7990 AA, Dwingeloo, The Netherlands

Abstract. "Number – flux density" distributions for total and correlated flux densities at various interferometer spacings in 355 extragalactic radio sources are analysed. Qualitative conclusions on the population of milliarcsecond components in these sources are presented.

The progress of Very Long Baseline Interferometry (VLBI) technology over the past decades made it possible to proceed from studying several "famous" sources (as in early VLBI days) to investigating milliarcsecond radio structures in thousands of extragalactic sources. In turn, this allows us to study the statistical properties of compact radio structures which bear imprints of both intrinsic source properties (their evolution in particular) and a manifestation of the cosmological model in the properties of the class of compact radio sources. One of the possible ways of investigating such statistics is based on the well established "number – flux density" apparatus widely used for studies of extragalactic sources (e.g. Condon 1988).

An illustration of the "number – flux density" relation for milliarcsecond radio structures in AGN is based on the data from the VSOP/VLBA Pre-launch Survey at 5 GHz (VLBApls, Fomalont et al. 2000). In this survey, 374 extragalactic radio sources, mostly quasars, were observed with interferometer spacings of up to 150 Mλ (corresponds to a synthesized beam of about 2 mas). The sample included all extragalactic sources with a total flux density at 5 GHz, $S_5 \gtrsim 1.0$ Jy; a spectral index $\alpha \geq -0.5$ ($S \propto \nu^{\alpha}$); and a galactic latitude $|b| \geq 10°$. In addition, the sample contained all extragalactic sources with $S_5 \geq 5.0$ Jy regardless of their spectral index and galactic coordinates. See Fomalont et al. (2000) for more discussion on the sample selection.

Of all the sources observed, 355 were detected. Fig. 1 shows the number count as a function of total ($S_{\rm tot}$) and correlated flux densities at 50 and 100 Mλ (S_{50} and S_{100}), respectively. The values of S_{50} and S_{100} were calculated from the selfcalibrated VLBI data as means over the range of projected baselines [45,55] Mλ and [90,110] Mλ, respectively. The entire range of flux density values, from 0 to ~ 50 Jy, was then divided into 20 nearly equally spaced (in logarithmic scale) bins. Fig. 1 represents the source counts in the 16 bins with non-zero number of sources for each of the three flux density values, $S_{\rm tot}$, S_{50} and S_{100}.

The oscillations of the $S_{\rm tot}$, S_{50} and S_{100} distributions at high ($\gtrsim 4$ Jy) and low ($\lesssim 0.1$ Jy) flux densities are due to the insufficient statistics (single digit number of sources in these high and low flux density bins) and is not significant.

The medium range of flux densities ($0.2 \lesssim S \lesssim 3$ Jy) enables us to draw the following qualitative conclusions:

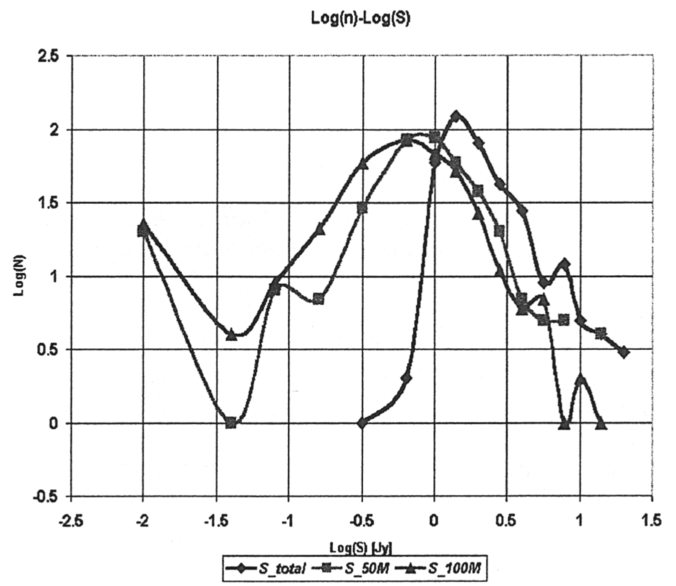

Figure 1. "Number – flux density" relations for total (S_{tot}, diamond-shaped markers), and correlated flux densities at 50 Mλ (S_{50}, squares) and 100 Mλ (S_{100}, triangles) in 355 extragalactic sources.

• In the range of $1 \lesssim S \lesssim 3$ Jy, the S_{50} and S_{100} distributions practically coincide, while the S_{tot} distribution shows roughly three times larger number of sources in each bin. This could indicate that the compact structures sampled at 50 and 100 Mλ correspond to the same population of radio components, distinctive from "whole" sources represented by S_{tot}.

• The sharp drop in S_{tot} distribution at $S \lesssim 1$ Jy is an obvious selection effect. Qualitatively, the S_{50} and S_{100} distributions behave in this range of flux densities as expected, with the peak of S_{100} curve at somewhat lower S than that of S_{50}. If proved significant, the flatter slope of S_{100} at $S \lesssim 1$ Jy might indicate a sub-population of extremely compact and weak ($S_{100} \lesssim 0.3$ Jy) components. However, the apparent small difference in the steepness of S_{50} and S_{100} distributions at $S \lesssim 1$ Jy indicate that the ultracompact components do not dominate the milliarcsecond radio structures in the sample of objects studied.

Acknowledgment. The author is grateful to the Leids Kerkhoven Bosscha Fonds for a travel grant supporting participation in the XXIV IAU General Assembly and related Symposia.

References

Condon, J.J. 1988 in Galactic and Extragalactic Radio Astronomy, eds. G.L. Verschuur & K.I. Kellermann (New York: Springer-Verlag), 641

Fomalont, E.B., Frey, S., Paragi, Z., Gurvits, L.I., Scott, W.K., Taylor, A.R., Edwards, P.G., & Hirabayashi, H. 2000, ApJS 131, 95

https://doi.org/10.1017/S0074180900220780 Published online by Cambridge University Press