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Studying the radio source distribution in TGSS – Using nearest neighbor and two point angular correlation function

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Abstract. We are presenting preliminary results on the nearest neighbor distribution (NND) and the two point angular correlation function (2pt ACF) of the radio sources detected by TGSS. The TIFR GMRT Sky Survey (TGSS) is a sky survey at 150 MHz, with an angular resolution of 20”, currently being done with GMRT. It will cover 90% of the entire sky down to declination of -55°. The technique of the NND allows one to distinguish if an apparent pair is indeed a single source or two physically independent sources. The 2pt ACF is fundamental to understanding the clustering properties of the sky compared to a random and homogeneous universe. The results presented here include all the TGSS fields released until DR5, the last data release. This analysis will continue until the TGSS survey is complete at which point we should get the global 2pt ACF function at 150MHz. This work, describes the project and the results so far.

1. Nearest Neighbor Distribution (NND)

We calculated the separation from each source in the sample to all the other sources, choosing the closest separation to build the NND. We see two peaks, the first one is ∼1.25’ and the second one is ∼4.24’ (Fig 1 - Left). It is interesting to note that the NND by Proctor (2011), calculated for The Faint Images of the Radio Sky at Twenty Centimeters (FIRST) survey, with a resolution of 5” (Becker, White & Helfand 1995) has a very sharp peak at ∼0.’16 (attributed to single physical sources, mostly nearby,

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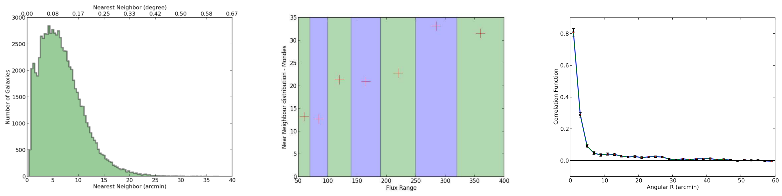

Figure 1. Left: NND for DR-5 [x axis: separation in arcmin, y axis: Number of sources]. Middle: Mode of NND for different flux ranges [x axis: flux range, y axis: modes of NND]. Right: 2pt ACF for DR-5 [x axis: Angular separation in arcmin, y axis: 2pt ACF].

being resolved into their various radio components such as lobes, hot spots, and cores), and a second peak near 2.4' (attributed to the distribution of nearest neighbors for physically unrelated systems). Note that the redshift of the sources are unknown; we have divided the sources according to their fluxes, and recalculated the NND. It shows that the higher the fluxes, larger are the separation of sources (Fig 1 - Middle).

2. Point Angular Correlation Function (2pt ACF)

The 2pt ACF, ω, is defined in terms of the probability of finding two galaxies separated by an angular distance with respect to that expected for a random distribution. We approached this analysis by using fractals in a realization, where each realization refers to a field of 1.5° and the amount of fractals will change depending on the bin size. In other words, we generated a random field, per each field, that contains 100 times the number of sources in the original field but with the same sampling geometry. We calculated the number of pairs up to a limiting separation of 1°, with a sampling of 2', for all the fields. We estimated the 2pt ACF as shown in Fig 1 (Right), using $\omega_\theta = \frac{DD-2CR+RR}{RR}$ (Landy & Szalay 1993). Excess correlation is seen at the smaller angular scales which quickly drops to small values. The angular scales at which the stronger correlation falls off, ie. the steeper power law, is 6'-10'. The amplitude of this component is a result of multiple component sources or local clustering. The flatter power law is a result of larger scale clustering. However more TGSS data is require to improve the S/N on these data points. Blake & Wall (2002) argue that the dominant scale at which the majority of the sources of NVSS pairs changes from multi-component, single source to independent sources is around 6' (0.1°), clear by the break in the measure of correlation function. The number of sources in DR5 is too small for making firm conclusions, but the correlation function clearly shows two power laws; including more data will improve these results.

References

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