Co-Evolution of Central Black Holes and Galaxies
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Submillijansky Radio-Quiet and Radio-Loud AGN in the *Chandra* Deep Field South

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Abstract. We report on some preliminary results on the evolution and luminosity functions of submillijansky (sub-mJy) radio sources, based on the VLA *Chandra* Deep Field South (CDFS) sample.

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We observed the CDFS with the NRAO Very Large Array (VLA) at 1.4 GHz and 5 GHz (Kellermann *et al.* 2008) and presented our results on the sub-mJy source population in Padovani *et al.* (2009). We study here the evolutionary properties of the VLA-CDFS sample through the $V_{\rm e}/V_{\rm a}$ test, a variation of the $V/V_{\rm max}$ test (Schmidt 1968), since the area of the sky covered at any given flux density is flux-density dependent. We find that star-forming galaxies (SFG) evolve at a very high significance level ($> 99.9\%$); for the simple case of pure luminosity evolution of the type $P(z) = P(0)(1+z)^k$ their evolutionary parameter is $k = 2.2 \pm 0.3$. AGN as a whole appear not to evolve. But once a distinction is made based on radio properties, radio-quiet AGN evolve relatively strongly ($\sim 97.5\%$) with $k = 1.8 \pm 0.5$, consistent with the evolution of SFG. Radio-loud AGN, on the other hand, display negative evolution, with $\langle V_{\rm e}/V_{\rm a}\rangle$ significantly below 0.5 ($\sim 99.5\%$) and $k = -3.7 \pm 1.5$. A maximum likelihood analysis shows also that the best-fit power-law slope of the luminosity function (LF) and evolutionary parameter k for each AGN sub-class are outside the 3σ contours of the other class, which suggests a very different origin for their radio emission (based on previous work and unified schemes, negative density evolution is a better explanation for the low $\langle V_{\rm e}/V_{\rm a}\rangle$ of radio-loud AGN; this distinction is irrelevant for a power-law LF). We are planning to calculate predicted number counts and redshift distributions for the μJy radio population. These will be very valuable for the planning of future deep radio surveys, e.g., those from the Square Kilometre Array (SKA), as all predictions so far have been based on much higher-flux samples.

References

Kellermann, K. I., Fomalont, E. B., Mainieri, V., Padovani, P., Rosati, P., Shaver, P., Tozzi, P., & Miller, N. 2008, *ApJS*, 179, 71

Padovani, P., Mainieri, V., Tozzi, P., Kellermann, K. I., Fomalont, E. B., Miller, N. A., Rosati, P., & Shaver, P. 2009, *ApJ*, 694, 235

Schmidt, M. 1968, *ApJ*, 151, 393