*The Interplay among Black Holes, Stars and ISM in Galactic Nuclei*
*Proceedings IAU Symposium No. 222, 2004*
*T. Storchi-Bergmann, L. C. Ho & H. R. Schmitt, eds.*

DOI: 10.1017/S174392130400290X

# Active versus non-active galaxies: The seagull wings

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**Abstract.** We have compared galaxies hosting an active nucleus with non-active galaxies in the SDSS by analyzing their stellar populations. We conclude that the Seyfert 2 phenomenon appears in galaxies of intermediate masses ($\sim 2 \times 10^{10}$ $M_\odot$), while low mass galaxies do not produce active nuclei, and high mass galaxies tend to produce a low level of non-stellar activity. We also compared the environment of active and non-active galaxies of similar masses and concluded that there is no excess of close neighbors among the Seyferts when compared with non-active galaxies.

## 1. Introduction

We used the data from the SDSS (Data Release 1; Abazajian et al. 2003) to compare the hosts of Active Galactic Nuclei (AGN's) with non-active galaxies in a volume-limited sample containing 23717 objects defined by a redshift $0.05 < z < 0.1$ and an r-band magnitude $M(r) < -20.4$. We report here our preliminary results.

The most used diagram to distinguish AGN hosts from star-forming galaxies is the [OIII]$\lambda$5007/H$\beta$ vs. [NII]$\lambda$6583/H$\alpha$ diagram proposed by Baldwin, Phillips & Terlevich (1981). In this diagram, galaxies form two branches, which look like the wings of a seagull (Fig. 1). The left wing galaxies are star-forming galaxies and the observed sequence corresponds to a change in metallicity of the HII regions emitting the lines. The right wing appeared clearly only with the most recent galaxy surveys (2dFGRS, SDSS). Photoionization models show that galaxies in the right wing cannot be ionized only by radiation from massive stars; an additional heating/ionizing source is necessary to explain the observed line ratios.

## 2. Under the seagull's feathers: the stars

We analyzed the stellar content of all galaxies of the sample by fitting their spectra (excluding the wavelength intervals containing emission lines) with a combination of spectra from simple stellar populations (SSPs). These SSPs were computed with the Bruzual & Charlot (2003) synthesis code and span a wide range of ages (from 1 Myr to 11 Gyr) and metallicities (0.2 to 2.5 $Z_\odot$). The fitting procedure is described in Cid Fernandes et al. (2001).

Our fits yield estimates of intrinsic parameters of the galaxies such as: the total mass of the stars $M_\star$, the mean stellar age $< t_\star >$, the mean stellar metallicity $< Z_\star >$, the velocity dispersion $\sigma_\star$ and the stellar extinction $A_V$.

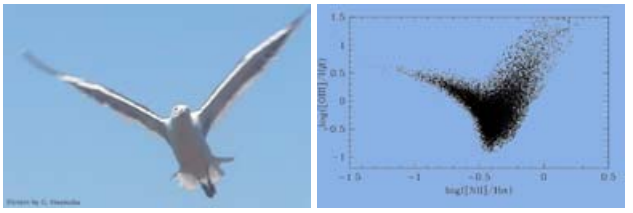

**Figure 1.** Left: A seagull. Right: The [OIII]$\lambda$5007/H$\beta$ vs. [NII]$\lambda$6583/H$\alpha$ diagram for galaxies.

## 3. Comparing AGN Hosts with non-active galaxies

We compared the intrinsic galaxy properties of the left and right wings of the seagull diagram. We found that the right wing corresponds to a much smaller range of values of $M_\star$, $< Z_\star >$, $< t_\star >$ and $\sigma_\star$ and that, on average, the values of $M_\star$, $< Z_\star >$, $< t_\star >$ and $\sigma_\star$ are larger in the right wing than in the left wing.

For AGN hosts, it is a priori not excluded that some young stars contribute to the production of the emission lines. At a given metallicity, young stars produce a much smaller [OIII]/H$\beta$ than an AGN. One could then think that AGN hosts with lowest [OIII]/H$\beta$ are more contaminated by massive star ionization. This, however, does not appear be the case since, in the [OIII]/H$\beta$ vs. EW(H$\beta$) diagram, high [OIII]/H$\beta$ active galaxies have on average higher EW(H$\beta$) than low [OIII]/H$\beta$ active galaxies.

We noted that there is a slight tendency for AGN hosts with high [OIII]/H$\beta$ (i.e. hosting Seyfert 2 nuclei) to have, on average, lower values of $M_\star$, $< Z_\star >$, $< t_\star >$ and $\sigma_\star$ than those with low [OIII]/H$\beta$.

We conclude that the Seyfert 2 phenomenon appears in galaxies of intermediate masses ($\sim 2 \times 10^{10}$ $M_\odot$), while low mass galaxies do not produce active nuclei, and high mass galaxies rather tend to produce a low level of non-stellar activity.

## 4. Seagulls and habitat

We also investigated whether the Seyfert 2 activity might be induced by interaction with neighbour galaxies. For this, we considered the entire volume-limited sample of galaxies (which also includes galaxies without emission lines). We selected two subsamples: one composed of Seyfert 2 galaxies (defined as having [OIII]/H$\beta > 3$) which contains 251 objects, and one made of non-active star-forming galaxies with diameters in the same range as found for the Seyfert 2 (to ensure that we are comparing galaxies of similar masses). The second subsample contains 5835 objects. We found that the median distance to the nearest neighbour is amazingly similar in the two samples: 0.83 Mpc and 0.84 Mpc for the Seyfert 2 and star-forming galaxies, respectively. Other statistics produce analogous results. Therefore, we conclude that the Seyfert 2 phenomenon does not appear to be produced by interactions of galaxies with close neighbours.

### Acknowledgements

This work was supported by FAPESP, CNPq, CCINT/USP and France-Brazil PICS.

### References

Abazajian, K., et al. 2003, AJ, 126, 2081
Baldwin, J. A., Phillips, M. M., & Terlevich, R. 1981, PASP, 93, 5
Bruzual, G., & Charlot, S. 2003, MNRAS, 344, 1000
Cid Fernandes, R., Sodré, L., Schmitt, H. R., & Leão, J. R. S. 2001, MNRAS, 325, 60

https://doi.org/10.1017/S174392130400290X Published online by Cambridge University Press