GALAXIES AND THEIR ENVIRONMENTS: CONNECTIONS WITH NUCLEAR ACTIVITY

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Abstract: One of the main issues concerning Nuclear Activity in galaxies (AGNs) is to understand the triggering mechanisms for the onset of non-thermal emission in their nuclei. Both the origin of the gas accreted onto the black hole and the physical mechanisms for the loose of angular momentum required for this funnelling to be effective, have to be elucidated. In other words, the goal is to understand the needed conditions to switch on the AGN activity. But still many aspects of the investigation are a matter of debate. Among them, the rôle played by gravitational interactions and the relevance of the host galaxy need to be clarified. In this review, the different relationships between AGN activity, the morphological type of the host galaxy and the environment are discussed, in order to understand whether the AGN activity is more related to interacting effects or otherwise can be due to the secular evolution in the hosting galaxies.

Keywords: Active Galaxies – Structure – Environment.

1 Introduction

Most galaxies in the nearby universe belong to one of the Hubble morphological types, with two main groups of regular systems: elliptical galaxies, supported by the velocity dispersion of their stellar components, and disk galaxies, characterized by a bulge and a disk component (and very frequently also a bar), supported by circular rotation. There still exists a rather ill defined family: irregular dwarf galaxies. They are generally smaller, with low velocity rotation if any, and undersolar metallicities. Althought they are very numerous in the Universe, dwarfs are irrelevant for the AGN nuclear activity population. AGNs are mostly related to the accreting processes taking place in the close environments of the black holes in the center of some galaxies [1], which is almost completely restricted to massive galaxies, i.e, to ellipticals and spirals.

The phenomenon of nuclear activity in galaxies have received much attention since its discovery, and already in the 80s the possible relationship of this kind of activity with the host galaxy has been raised [2]. The connection seems to be related with the shape of the gravitational potential: earlier galaxies, with larger contributions from elliptical-like components, host AGN activity more frequently than galaxies with smaller such contributions (disk-like galaxies with small bulges). The properties of galaxies have long been known to depend on the environment in which they are located, with ellipticals mostly residing in rich clusters, and spirals mainly found in their outskirts (i.e. [3, 4]). Therefore, special care is needed when trying to disentangle internal from external drivers. The use of control samples matching both in morphology and environmental status will be crucial at this respect.

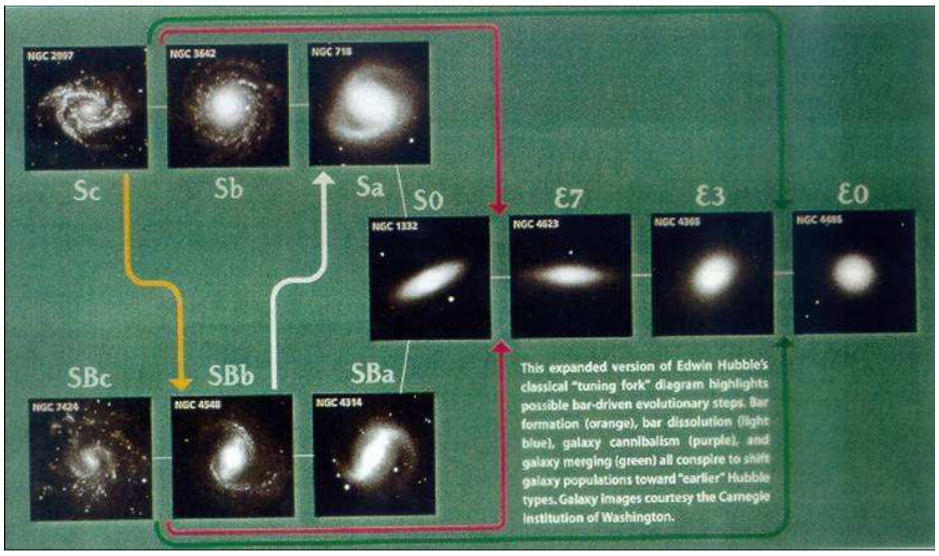

Figure 1: This figure has been taken from Martin & Friedli (1999) [5]. It illustrates how galaxies can change their morphological type by secular evolution, from later to earlier types. The formation of a bar due to disk instabilities provides the path from an Sc to an SBc. The rôle played by the bar in enlarging the bulge component and producing central mass accumulation, that destroys the bar itself, is responsible for the SBb to Sa transformation. The alternative path for transforming galaxies is given by the merger of two spirals, which ends up in an elliptical galaxy.

Galaxies have been proven to be dynamically evolving entities, whose properties can change with time both by secular processes and by the effects of interactions with neighbours or with the surroundings. Secular evolution has been suggested as a possible mechanism to make galaxies evolve from later to earlier types; this could be the case specially within the group of spiral galaxies. The response of the disk to an initial, small external perturbation would produce gravitational instabilities in the disk giving rise to the formation of a bar , whose evolution gives rise to the transfer of material to the center; eventually, the bar itself will be destroyed due to the huge accumulation of gas. This effect is nicely illustrated in the figure by Martin & Friedli [5], reproduced here in Figure 1. Strong gravitational interaction can produce similar effects, but at more violent levels and, depending on the relative masses of the systems involved, giving rise to the formation of elliptical galaxies ([6, 7]).

AGN activity has to be sustained by some processes fuelling the nucleus and producing the plethora of properties observed at all wavelengths. Angular momentum loose have to operate in order to make the material to be funnelled to the center. The large scale processes driving material to the central regions have been explored as eventually related to those required much closer to the nuclear black hole. In this review, we analyse how AGNs are related to nature, i.e, the properties of the galaxy hosting an AGN, and how AGNs relate to nurture, i.e, with externally triggered modifications. All in all, we will keep in mind that the power of the AGN is another parameter to consider, as clearly illustrates the case of the strongest AGNs (quasars) corresponding to the most massive galaxies or the strongest interactions.

2 The rôle of the local/large scale environment

Many studies have dealt with the environments of AGNs, from few kiloparsecs to some hundred megaparsecs, with the aim of analysing whether these local or large scale environments are similar to those of inactive (those without AGNs, hereinafter non-active) galaxies. The analysis of the relation between AGN and environment has pointed to differing results. [9, 10, 11], among others, have concluded that no difference is found for the environment of active and non-active galaxies. Whereas other investigations suggest that the number of companions is higher for Seyfert galaxies than for non-Seyferts ([12, 13], with clear differences between Seyfert 1 and Seyfert 2 ([14, 15, 16, 17, 18]) and even depending on the power of the AGN ([19, 20]). The main limitations of these studies are related to the way the samples have been selected, how complete they are, how the different host properties are represented and, as it is also the case for other projects that need the definition of well defined control samples, how well these control samples (of non-active galaxies in this case) match with those of active galaxies. UV selected AGN samples could be biased against Seyfert 2 galaxies, since the obscuration expected to be more important in these objects would avoid or impede the detection of the nuclear source. This explanation was offered by [10] to explain the results by [14, 15, 16, 17, 18], that would contradict the predictions of the unified model (Antonucci 1993 [21]). They suggest that IR or X-ray selected samples would appear as more appropriated. In fact, very recently [22]

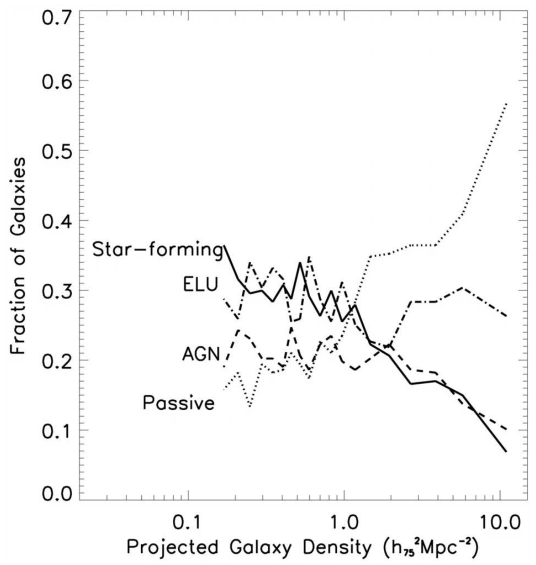

Figure 2: Fraction of the different galaxy classes (Star-Forming, Elusive, AGN and Passive), as a function of density. An increase in the fraction of passive galaxies with density is seen, together with a decrease in the fraction of star-forming galaxies with density. The fraction of galaxies possessing an AGN is statistically consistent with a constant over all local galaxy densities. Taken from Miller et al. (2003) [8].

have reported that the frequency of AGNs in X-ray selected clusters is much higher that previously found, explaining the paucity of AGN at optical wavelengths as due to obscuration.

The recent dramatic increase in the number of AGNs from several hundreds to several thousands, mainly from the SLOAN Digital Sky Survey (SDSS) has resulted in the possibility of approaching this study with statistical significance. The main result from the pioneering works with the first data release by [8] is that the fraction of AGN is found to be constant with projected galaxy density. In contrast, for higher densities the fraction of passive galaxies is enhanced and that for star forming galaxies decreases (Figure 2). This result is confirmed for different ranges in the relative velocity of the companion galaxies and for different redshift bins in the redshift range sampled, from z=0.078 to z=0.05.

Kauffman et al. (2003) [23] analyse the properties of the host galaxies of a sample of 22.000 galaxies, through the stellar surface brightness (μ^*), the stellar mass (M$*$), the concentration index (C=R90/R50) and D_{4000} as a proxy for the age of the stellar population. They found that galaxies can be grouped into two families, corresponding to early types (ellipicals, lenticulars and Sa) characterized by 3×10^8 M$\odot$ kpc^{-2} < $\mu^* < 3 \times 10^9$ M$\odot$ kpc^{-2}, C > 2.6 and older stellar populations, and late types with $\mu^* < 3 \times 10^8$ M$\odot$ kpc^{-2}, C < 2.6 and younger stellar populations. The galaxies hosting an AGN, type 2 since broad line AGNs are not considered in this study, are almost exclusively massive galaxies, with the AGN fraction strongly declining for M* < 10^{10} M$\odot$. They have similar sizes and stellar masses than normal early-types but show slightly different stellar ages than the parent general population. Depending on the power of the AGN source measured by the luminosity of the [OIII] emission line, $L_{[OIII]}$, they found that high power AGNs (those with $\log(L_{[OIII]}) > 7.0$) show somewhat younger stellar populations (see Figure 3).

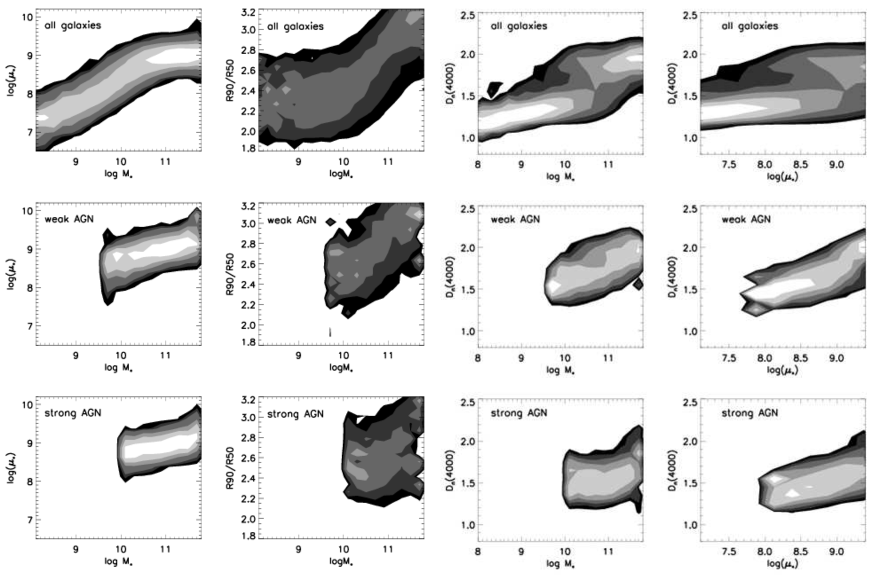

Figure 3: Conditional density distributions showing trends in the surface mass density μ^* as a function of the stellar mass M* for all galaxies (top), for weak AGN with $\log(L_{[OIII]}) < 7.0$ (middle) and for strong AGN with $\log(L_{[OIII]}) > 7.0$ (bottom). Taken from Kauffman et al. (2003) [23], Figures 9 and 13.

With respect to the environment of AGNs, Kauffmann et al. (2004) [24] obtain a larger fraction of high power AGN in lower density environments, whereas at a fixed AGN power, the hosts are similar for any density (see Figure 4).

Sorrentino et al. (2006) [25] also consider the case of broad-line AGNs, analysing

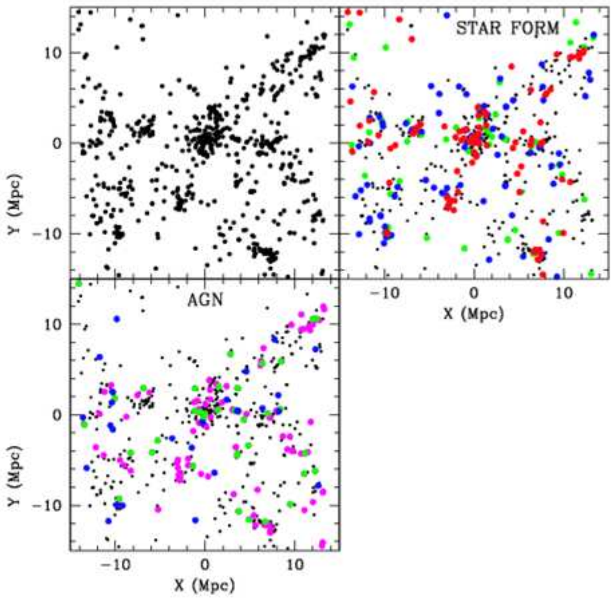

Figure 4: The distribution of all galaxies in a slice at z=0.05. Top right: galaxies with $10^{10}M\odot < M^* < 3 \times 10^{10}$ $M\odot$ are colour-coded according to their measured D_{4000} break strengths. Bottom: galaxies hosting AGNs are colour-coded according to $L_{[OIII]}$. Magenta is for $\log(L_{[OIII]}) < 6.5$, green is for $6.5 < \log(L_{[OIII]}) < 7$, and blue is for $\log(L_{[OIII]}) > 7$. Galaxies with no AGN are shown with small black dots. Taken from Kauffmann et al. (2004) [24], Figure 13.

a sample of 90,886 galaxies with $0.05 < z < 0.095$ and $M_r < -20$ from the SDSS, from which 2% are AGNs, 7% star-forming galaxies and 18% are considered passive galaxies. Based in the number density of neighbours in a volume with $r_{max} < 100$ kpc, they conclude that Sy1 and Sy2 galaxies have similar large scale environments with a higher percentage of Sy2 appearing in close pairs (see Figure 5). Therefore, some of the conflicting previous results could be a consequence of not taking into account the necessity to distinguish between close and large scale environments when studying the eventual effects of the gravitational interactions as related to AGN activity.

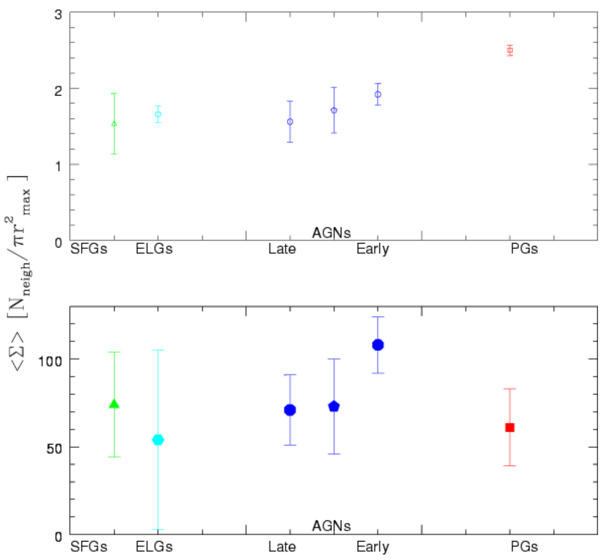

Figure 5: Mean surface density parameter for PGs (passive galaxies), SFGs (Star-forming galaxies) and AGN. Top: All systems with $r_{max} < 100$ kpc. Bottom: Close systems ($r_{max} < 100$ kpc). Taken from Sorrentino et al. (2006) [25], Figure 7.

3 AGNs and hosts

Previous to studies of huge samples in the last three years, the connection between the presence of AGN activity and the morphology of the host galaxy had been stressed from earlier studies ([2]). AGN hosts are more frequently found in early types, with a peak of the morphology distribution in Sb spirals ([2, 26, 27, 28, 29, 30, 31, 24]. Already in these works the necessity of explaining the internal mechanisms to be related to the onset of nuclear activity in galaxies was one of their first aims, and the presence of an asymmetric component of the gravitational potential was invoked as a main driver. Whereas in the case of interacting galaxies the departure from the symmetry is immediately provided by the tidal forces, the case of isolated galaxies deserved closer inspection, since the asymmetry should come from the host itself. But, at least in spirals, the presence of such internal asymmetric component is very frequent. Two thirds of spiral galaxies are barred ([32, 33, 34]) or even a higher proportion (up to 95%, [35]).

The importance of the presence of a bar in a spiral galaxy has been established already in the pioneering numerical simulations of barred galaxies, in which they unavoidedly appeared to stabilize the disk ([36, 37]). A bar is described as a component that ridigly rotates over a differentially rotating disk, what gives rise to different resonances usually associated to ring features (see Figure 6).

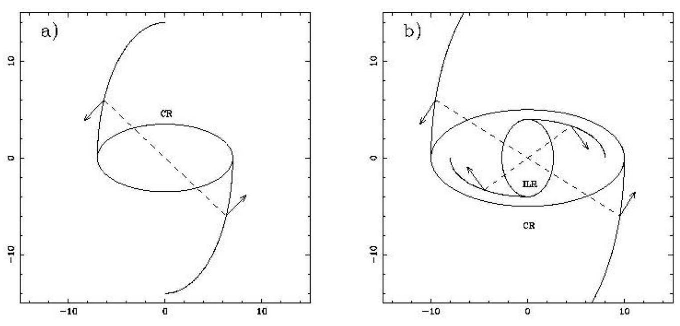

Figure 6: Illustration of Lindblad resonances in a barred spiral galaxy and the net flows they can produce: a) outflow between corotation (CR) and the Outer Lindblad Resonance (OLR); b) inflow between the CR and the Inner Lindblad Resonance (ILR). OLR and ILR are usually supposed to be traced by Outer and Inner rings, respectively.

Bars are easily formed in minor mergers ([38, 7]), and among their effects on the host galaxy, it is to note that they dynamically heat the disk, generate the development of spiral structure and produce net inflows to the central regions. Such inflows directly explain the observed flatness in metallicity gradient in barred galaxies, since the central, more metal rich, regions are contaminated by less metallic material coming from the outer disk. The infalling processes also relate to the various star forming features observed in barred galaxies, since they are expected to be different for old/young and strong/faint bars. Some of the important effects of bar secular evolution are discussed in [39], and summarised in Figure7. The final stages of the infalling process, those of material accumulated unto the central region and bar destruction, have been explored, by means of numerical simulations, to possibly inducing the evolution in morphological types. Starting from a late type spiral that respond to a small perturbation of the disk, a bar is generated, which provokes the transport of some disk material to the center; this enhances the bulge component and destroys the bar itself, so that the galaxy finally ends up as an earlier unbarred galaxy (see Figure 1).

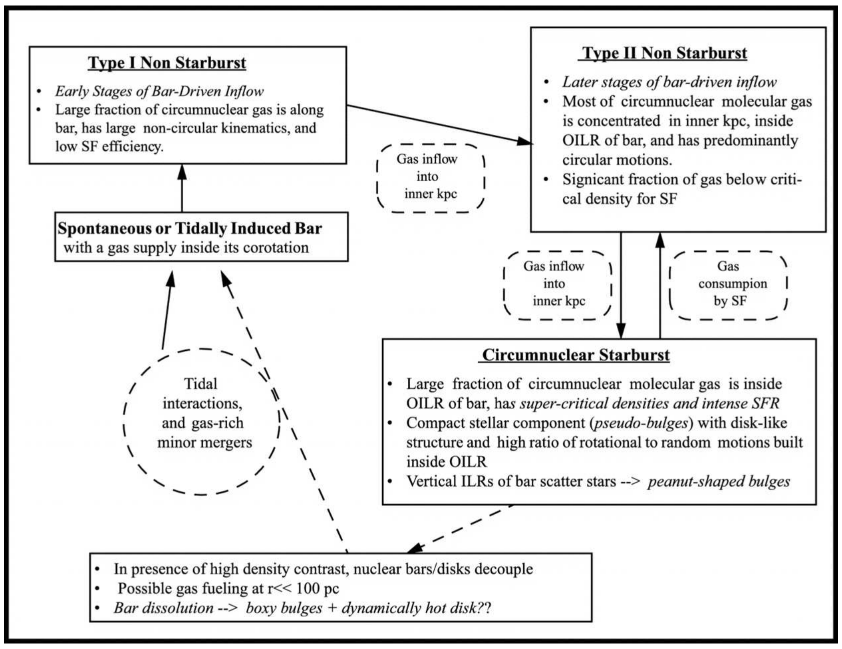

Figure 7: Type I nonstarburst: where large fraction of the molecular gas is still infalling toward the inner kpc, along the leading edges of the bar, exhibiting large noncircular motions and not forming stars efficiently. Type II: where most of the molecular gas has already settled into the inner kpc of the barred potential and no longer shows extreme noncircular motions. This figure sketches possible scenarios for bar-driven dynamical evolution and postulates potential evolutionary connections between the barred starbursts and nonstarbursts. It suggests that a strongly barred galaxy would show up as a type I nonstarburst in the early stages of bar-driven inflow. In the later stages where most of the circumnuclear gas has piled up inside the OILR of the bar, a type II nonstarburst or even a circumnuclear starburst is seen if most of the gas exceeds a critical density. Taken from Jogee et al. (2005) [39]).

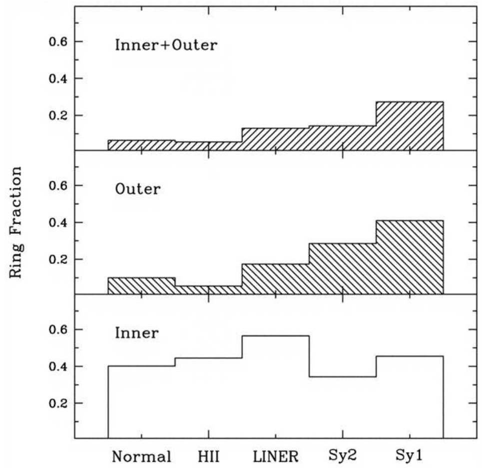

Figure 8: Fraction of ringed galaxies as a function of activity class. Lower panel: Inner rings. Middle panel: Outer rings. Upper panel: Galaxies with both inner and outer rings. Taken from Hunt & Malkan (1999) [40], Figure 4.

But still the question was whether there was a clearcut relation between the presence of a bar and the AGN activity. Whereas a consensus has not been reached at this respect (see [29, 41, 42, 43]), most works conclude that there is not an excess of bars among Seyfert galaxies ([27, 32, 28, 33]). Since bars evolve with time, some complications are expected in such a simple scenario, what could be related to the result by Hunt & Malkan (1999) [40] of a higher percentage of outer rings in Seyfert 1 galaxies (see Figure 8). The main concerns of all these works are related to the sample numbers, the sample selection procedures, and the way the control samples are defined. But in addition to all these eventual biases, the mechanism that is expected to drive the feeding material to the nuclear source has to operate down to the scales close enough to the nucleus, and large scale bars seem to be limited to produce such transport only till the region of the innermost resonance, at scales of about 1 kpc, where the material is trapped and no more inflow occurs. Several mechanisms have been proposed that could help in getting rid of the angular momentum at this point and drive the material closer to the center ([44, 45]). One of the first mechanism proposed as the required second step was that of nuclear bars, nested with respect to the large scale, primary bar ([46, 47, 48, 49, 50, 51]). Nevertheless, the results provided by the observations agree that no more nuclear bars are found in Seyfert galaxies ([52, 53, 54]) but on the contrary there seems to exist an excess of nuclear spirals ([55, 56, 57]) or nuclear disks ([58]) that can be stellar and decoupled from the

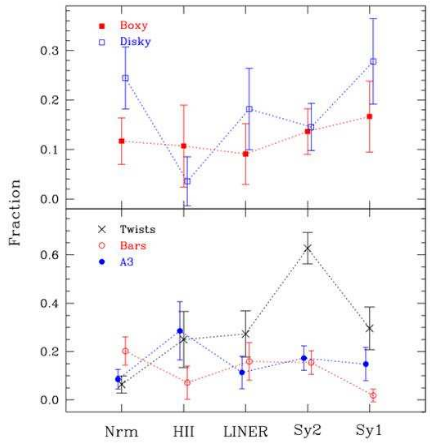

Figure 9: Fractions of nonaxisymmetric features as a function of activity types. A clear peak is found for twists in Seyfert 2 galaxies. Taken from Hunt & Malkan (2004) [60], Figure 8.

main galactic disk ([59]). Only when the presence of elongations is considered instead of that o a well defined bar, a slight excess (at 2σ level) is found: central region of galaxies hosting HII, Syfert 2, Seyfert 1 and LINER nuclei are progressively less asymmetric ([60]) a result that is interpreted in terms of an evolutionary scenario. It may be operating in such a way that these different types of nuclear activity would be connected in a temporary sequence (see Figure 9). Such evolutionary scheme seems to agree with that based on the results of the stellar population synthesis, which appear to be older when going from HII to Seyfert 2 to LINERs ([61, 62, 63, 64]).

Coming back to the possibility that interactions can provide the required asymmetry of the gravitational potential, and in an attempt to clarify the rôle played by the internal structure of the host galaxies, we started a project devoted to the characterization of ISOLATED Seyfert galaxies and its comparison with a matched control sample of ISOLATED spirals. The project DEGAS (Dynamics and nuclear Engine of Galaxies of Spiral type) was aimed at constructing a sample of nearby Seyfert galaxies from the Véron-Cetty & Véron (1993) [65] catalogue, with intermediate inclinations, with no reported belonging to any group or pair, with no companion at a projected distance of 600 kpc and with redshift difference smaller than 500 km/s, and with no projected companion in the DSS plates. The control sample was selected from the RC3 catalogue, imposing the same conditions for the absence of companions, and matching in redshift distribution, inclination and morphological type (including the percentage of barred galaxies). The final samples amounted to 18 and 15 Seyfert and control galaxies, respectively. We analysed their NIR J and K images, better suited than optical images for tracing the gravitational potential, less contaminated by dust and with an expected smaller relative contribution of the AGN itself. The main results were that Seyfert and non-Seyfert hosts share similar bulges and disk properties (sizes, luminosities and surface brightnesses), but primary bars are also equivalent in both samples; secondary bars are found both in Seyferts (9 out of 12) and control (6 out of 10) galaxies. To characterize the gas kinematics, we obtained long slit spectroscopy along several position angles mainly in the wavelength rage of Hα (see Figures 10 and 11). The kinematical properties of Seyfert and control galaxies appeared to be indistinguishable from those of early spiral types: same rotation curve shape, same position in the Tully-Fisher diagram, same disk metallicities, same kind of kinematical peculiarities in the central regions (Márquez et al. 2002 [66], 2004 [67]).

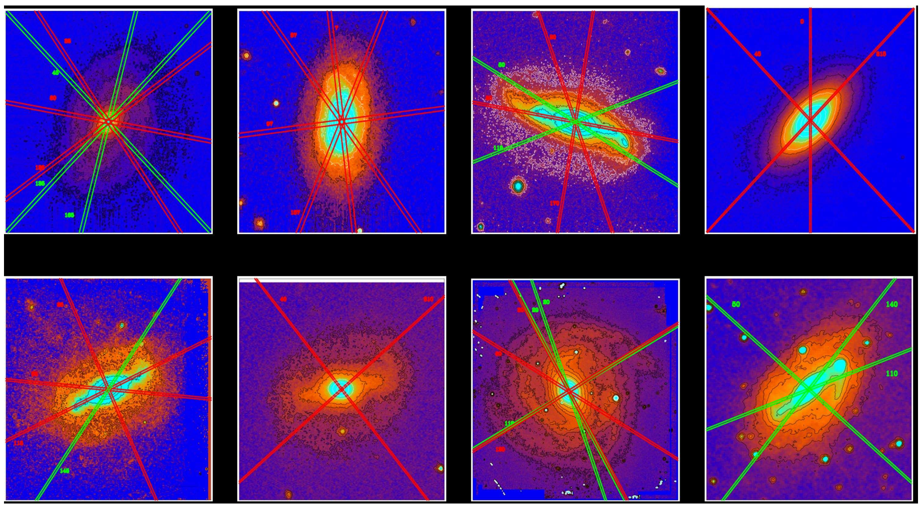

Figure 10: NIR images of some of the sample galaxies in the DEGAS proyect with the different observed position angles superimposed.

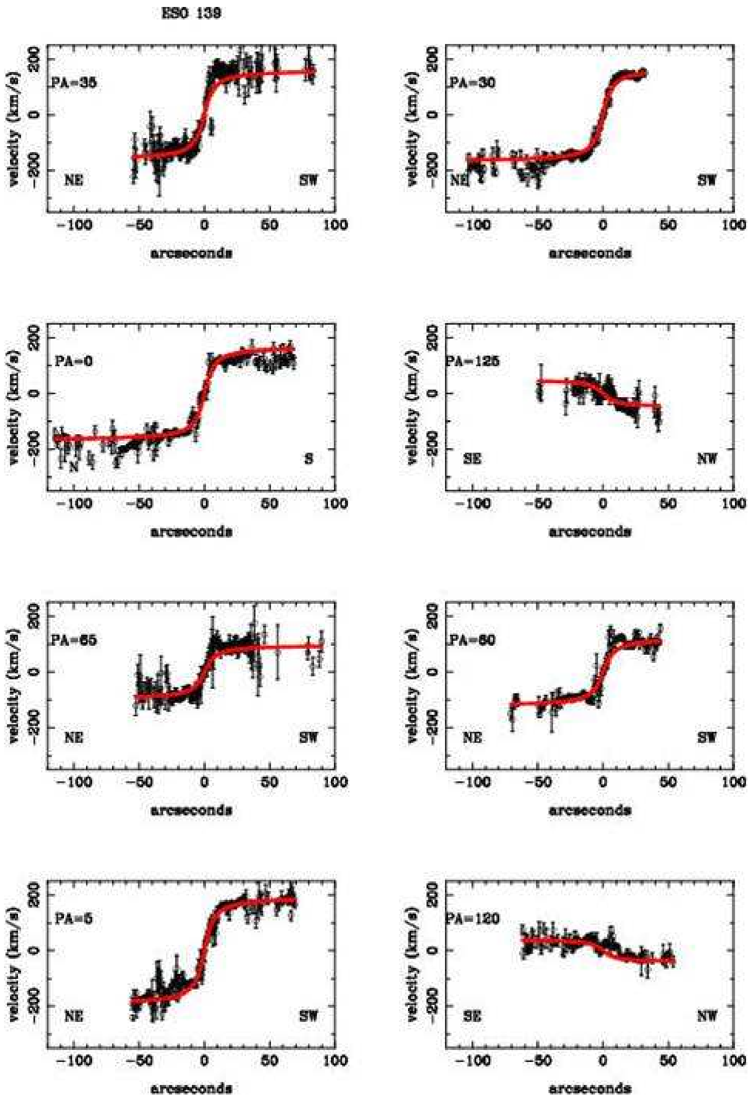

Figure 11: Velocity distributions obtained for one of our sample galaxies (ESO139-G12) along several position angles. A model for the disk rotation is plotted as the red line.

For deeper investigating how matter gets down into the nuclear region, a subsample was selected to study their morphological properties and the stellar and gaseous kinematics. We characterize the main properties of the host by using optical and/or NIR images from HST. The stellar kinematics was characterized with additional long slit spectroscopy along several position angles in the region of CaT, for obtaining stellar rotation curves and velocity dispersions and a stellar population tracer through the equivalent with of the CaT absorption lines, EW(CaT). Such study allowed us to detect the presence of a stellar velocity dispersion drop in the central 1-3 arcseconds in 5 galaxies, spatially coinciding with an increase in EW(CaT), that could hint the presence of young stars (red supergiants). Nine other galaxies in our sample had previously found to show such a drop. The analysis of the HST imaging of the total 14 galaxies showed that most of them showed a nuclear disk-like structure, spatially coinciding with the region where the velocity dispersion drop and the peak in EW(CaT) occur (Márquez et al. 2003 [68], see an example in Figure 12). This result was interpreted in terms of the models by Wozniak et al. (2003) [69], that predict the formation of velocity dispersion drops once the gas coming from the outer, cooler disk, is driven to the center by the large-scale bar effects, giving rise to a decoupled nuclear disk . The gas velocity dispersion is hence smaller, so is that of the stars formed from it. Wozniak & Champavert (2006) [70] have recently updated the results from this modelling, and provided time scales for the whole process (less than 500 Myr for the formation of the drop, and lifetime dependent on the availability of fuel).

4 A general picture for low-luminosity AGN hosts

A relatively recent consensus has been achieved on the presence of a black hole (BH) in the center of any massive galaxy ([71, 72, 73]), irrespective of whether it hosts an AGN or not. In addition, the properties of such BHs seem to be shared by both active and non active galaxies. Both types show the same relationship between the mass of the BH and the mass of the large scale spheroid hosting it ([74]). From the preceding discussion the properties of the host galaxies seem to be equivalent, both morphology and kinematics, at least the properties at scales of the order of the disk, bulge and/or bar components. The differences, if any, are expected to occur at scales much closer to the center, not still resolved by present day observations of the analysed samples. If even at much smaller scales no differences are found, an alternative explanation would be that the AGN activity can be switched on and off. This may be the case explored by the numerical simulations by Bournaud & Combes (2002) [75], that reproduce the evolution of galaxies, moving along and across the Hubble diagram, with any galaxy being able to become barred, or active, or both, and spend some time as an early type or late type. Nevertheless, a number of complications appear when trying to analyse in depth the different mechanisms related to the fuelling of low-luminosity

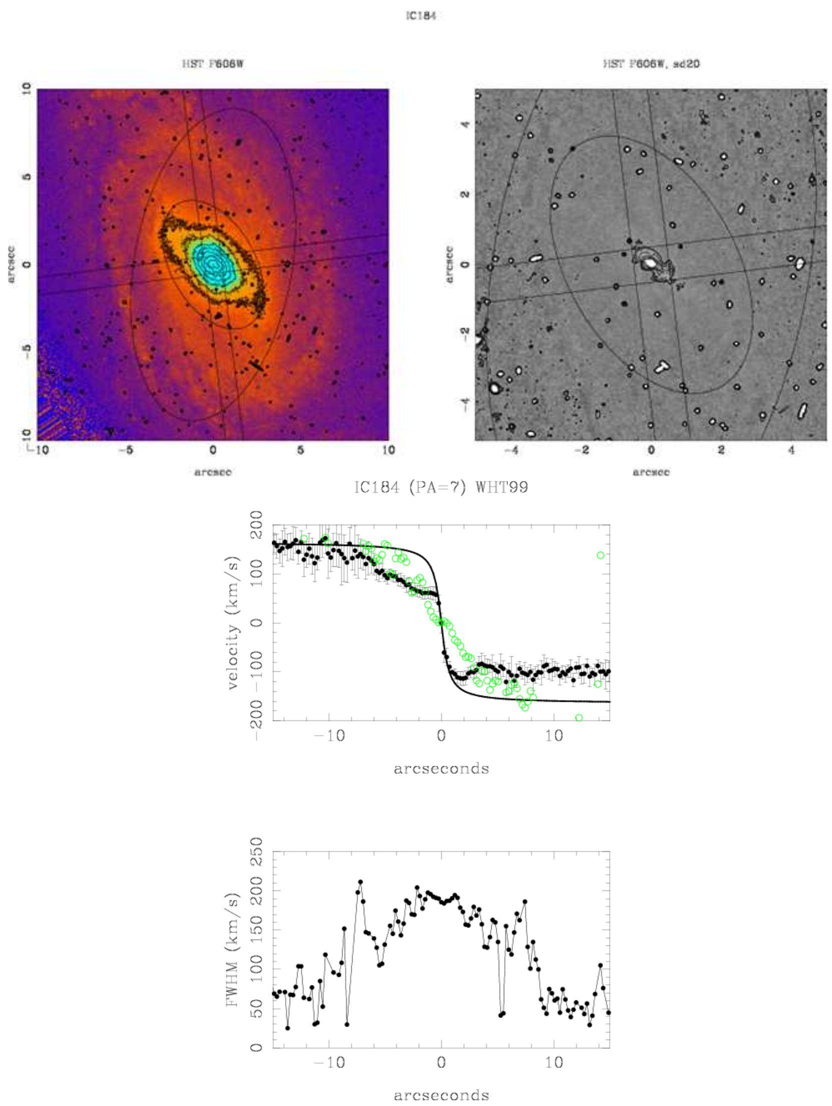

Figure 12: Top left: HST of IC184 in the F606W band with the two slits superimposed, the ellipses correspond (PA and ellipticities) to the two bars detected in the NIR. Top right: Sharp divided image of the center. Middle: Velocity curve of the gas (open, green circles) and stars (black circles) along PA=7 . Bottom: FWHM of the stellar component along PA=7. Taken from Márquez et al. (2003) [68].

AGNs. Martini (2004) [76] proposed four reasons to explain why surveys have been unsuccessful up to now in resolving this question: (a) the current classifications for fuelling mechanisms are too broad, and additional refining is required, in particular for describing bars, since strong or faint bars are expected to produce different effects, (b) there are correlations between the fuelling mechanism and the fuelling rate, that are easier to identify for higher accretion rates (related to mergers), but deserves much closer inspection of the central parsec region at the lowest accretion rates (where other processes like dynamical friction on molecular clouds, stellar disruptions, many forms of turbulence, mass loss, etc, have an increasing relative importance), (c) multiple fuelling mechanisms may be operating, as it is the case for bars and interactions (but even when only isolated galaxies are considered, as it was the case for the DEGAS project, the results are not conclusive), (d) the two main time scales operating are the AGN lifetime and the fuelling time, so the time dependence is important and has to be taken into account before reaching any conclusions from the observations. The analysis therefore requires a broader description of the physical situation of the central regions, and the dynamical information is crucial at this respect.

The approach of the NUGA (Nuclei of Galaxies) consist on a very detailed analysis of the dynamical properties of a sample of nearby active galaxies using, in addition to the morphology, the 2D kinematics of the molecular gas with high spatial resolution. See two of their sample galaxies in Figures 13 and 14.

García-Burillo et al. (2005) [77] present such analysis for a small sample of galaxies, which allows them to derive an scenario for self-regulated activity in low-luminosity AGNs: an initial asymmetry in the disk would produce the formation of a bar, therefore a nuclear ring , where the infall of gas produced by the bar would accumulate gas; when massive enough, this circumnuclear ring would produce auto-destructive effects, weakening the bar, and allowing the viscosity in the ring to be responsible for additional inflow, the process finally ending in an axisymmetric configuration, again.

5 Future prospects

Both the detailed study of nearby galaxies and the statistical approach of massive surveys will be complementary in the study of the relationship between the structure of the galaxy, the environment and the power of the AGN it hosts. On one hand, detailed, high resolution studies of individual galaxies, with the requirement of providing dynamical clues of the different phases are still needed. For nearby galaxies, projects like NUGA are expected to produce fruitful results in the near future. High resolution imaging of a large number of distant galaxies has recently started to allow the exploration of how frequent single or even double bars are at z=0.1 (see

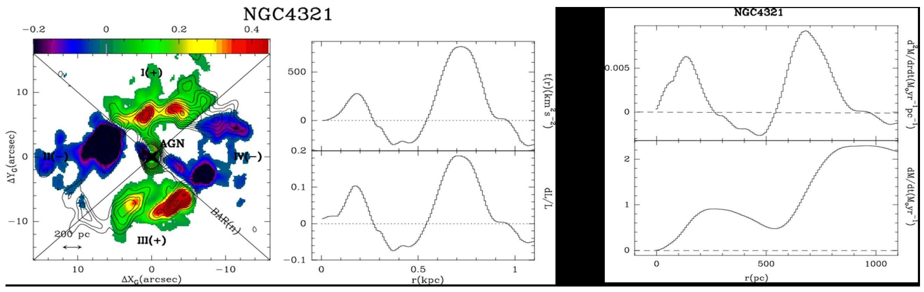

Figure 13: Left. 12CO(1-0) contours overplotted in the map of the effective angular momentum variation in the nucleus of NGC 4321. The derived torques change sign as expected from the action of the nuclear bar . Middle. The torque per unit mass averaged over azimuth - t(r) (top) - and the fraction of the angular momentum transferred from/to the gas in one rotation - dL/L (bottom)- are plotted. Torques are strong and positive for the bulk of the molecular gas, including the vicinity of the AGN. Torques are negative but comparatively weaker on intermediate scales (r=250-550 pc) and in the outer disk r>900 pc. Top right. Radial variation of the mass inflow(-) or outflow(+) rate of gas per unit radial length in the nucleus of NGC 4321 due to the action of stellar gravitational torques. Units are yr^{-1} pc^{-1}. Bottom right. Mass inflow/outflow rate integrated inside a certain radius r in yr^{-1}. The overall budget in NGC 4321 is clearly positive at all radii. From García-Burillo et al. (2005) [77]

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[78], within the GOODS survey), what opens the possibility of studying evolutionary effects. On the other hand, a precious information remains to be extracted from existing massive surveys like SDSS, in terms of a much more detailed characterization of the morphology, not only with respect to the determination of precise morphological types instead of the rude parametrization by concentration indexes, but also on the presence and strengths of bars (see [79, 80] and EFIGI project, [81]) and the characterization of the interaction state for AGN hosts and for comparable samples. Finally, focused numerical simulations with all the required ingredients, as those provided by Wozniak et al. for reproducing velocity dispersion drops, both for small (host) to large (environment) scales will help to understand the physical processes that give rise to the presence and onset of AGN activity in galaxies.

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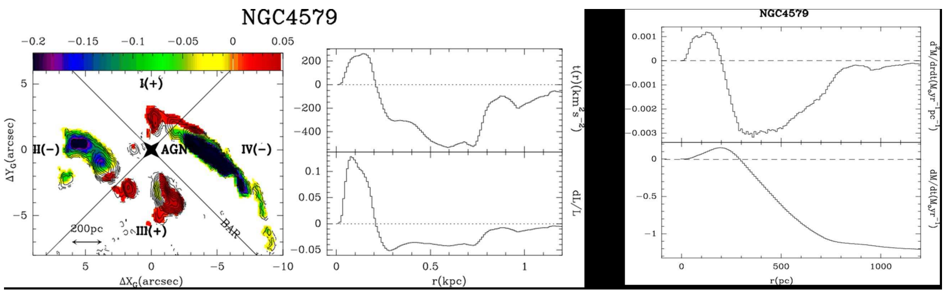

Figure 14: Same as Fig. 13 but for NGC 4579. The torques change sign as expected if the butterfly diagram, defined by the orientation of quadrants I-to-IV, can be attributed to the action of the large-scale bar. Torques are systematically strong and negative for the bulk of the molecular gas from r=200 pc out to r=1200 pc. In the vicinity of the AGN, however, torques become positive and AGN feeding is not presently favored. The overall mass inflow budget is clearly negative down to r=300 pc due to the action of the large-scale bar. Inside this radius, stellar torques do not favour AGN feeding in this LINER/Seyfert.

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