Barred Galaxies
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Non-Axisymmetrical Components in the Gravitational Potential of Isolated Spiral Galaxies and the Presence of Nuclear Activity[1]

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Abstract. From a detailed photometric analysis together with some kinematical information for a sample of isolated spirals, we conclude that most of them host rings or bars, features generally explained as originating from a non-axisymmetrical component of the gravitational potential. In a previous study, we have determined that all the isolated spirals hosting an active nucleus show these kinds of non-axisymmetrical components, the presence of which could be connected with the nuclear activity in the form that they can be very effective in transporting gas into the central parts. Therefore, as non-active spirals show a similar behavior, a detailed analysis of the possible differences between the central regions of active and non-active isolated spirals is motivated.

1. Introduction

The importance of the extranuclear properties of galaxies hosting an active nucleus has been claimed many times in order to understand the onset of nuclear activity (see the review by Balick & Heckman 1982). At the scale of the host galaxy, the morphology has been already proved to play a major role, since active nuclei appear mainly in early spiral galaxies (Heckman et al. 1980, Fricke & Kollatschny 1989, Moles et al. 1995, hereafter, Paper I). At near-extragalactic scales, the environments of the host galaxy seem to play a role in the sense that active nuclei are more commonly found among interacting and/or perturbed galaxies (Dahari 1985, Keel et al. 1985), although they seem to avoid violently interacting systems (Bushouse 1987). To get rid of the possible (and complicated) effects of tidal perturbations (which on the other side seem to exert a subtle influence on the triggering of nuclear activity, Keel 1995 and references therein), we only considered the case of isolated spiral galaxies.

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2. The Active Galaxy Sample

The active galaxy sample is taken from that of active galaxies with definite reported morphology in Moles et al. (1995). From the 1108 galaxies classified as Seyfert or LINER in Véron-Cetty and Véron's catalog (1991), only those with known morphology in the RC3 were selected (308 galaxies). Among them, 279 ones resulted to be spirals, and for 186 of them there exist the information on the presence or absence of a bar component (27% of them are non-barred). Considering as isolated those without companions (in the CfA catalog) within a projected distance of 1 Mpc (H_o = 75 km s^{-1} Mpc^{-1}) and a difference in radial velocity greater than $\pm$500 km s^{-1}, a sample of 67 isolated active galaxies is found. It is found that 11 of them (16%) are non-barred (just slightly less than for the total sample) but all of them do present morphological peculiarities and departures from pure axial symmetry, mostly in the form of **rings** (see Paper I for details).

3. The Non-Active Galaxy Sample

The isolated non-active sample used for comparison is taken from Márquez (1994) and Márquez & Moles (1995). The galaxies have been selected from the CfA catalog, among those spirals with $m_B \leq 13.0$, $\delta \geq 0$, $a \leq 4'$ and inclinations between 32° and 73°. They have no companions in 0.5 Mpc and 500 km s^{-1} in the automatic research, and there are no satellites in their neighborhoods (from the Palomar charts). The sample amounts to 16 galaxies. The data consist on Johnson *BVI* images and long slit spectra along the major axis. For some of them Hα images and/or minor axis spectra are also available. They were obtained with the 1.52m Spanish and 2.2m telescopes in Calar Alto, and with the JKT and INT in La Palma (Márquez 1994).

The analysis of the images (sharp dividing methods, simulated images through the bulge/disk isophotal profile decomposition, Fourier analysis) and the inspection of the rotation curves allows us to determine the presence of bars and/or ring components, either to compare with or to complete the morphological classification given by the RC3. Among the 16 galaxies, 11 are barred (SB or SX) and host inner rings. For the remaining 5 non-barred galaxies, all of them show the presence of an inner ring component (Márquez 1994, Márquez & Moles 1995).

4. The Results

It is shown that all the isolated active galaxies present components as bars and/or rings, which would be the evidence of the presence of asymmetries in the gravitational potential. Therefore, the existence of this kind of nonaxisymmetric perturbations appear as a *necessary* condition for the onset of nuclear activity.

Nevertheless, a similar result is found for the sample of isolated non-active spirals. Therefore, the relevant question now is to proceed with the determination of the *sufficient* conditions for nuclear activity to emerge, by means of a very detailed comparison of the properties of normal and active galaxies, in particular those of the central regions.

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Discussion

D. Elmegreen: It seems that it's getting harder and harder to tell when a galaxy is truly isolated, especially considering the poster here on Magellanics with HI companions having no optical counterpart. Do you have any information on the possible presence of HI companions for your isolated galaxies?

I. Márquez: The only information available was the optical one. We should have to proceed with a HI mapping of the neighborhoods of the isolated galaxies to look for possible HI companions.

L. Ho: AGNs in VCV are the brightest objects, therefore it is very incomplete in faint end of luminosity function. Is there a luminosity dependent effect?

I. Márquez: I agree with you that VCV is an inhomogeneous collection of objects, classified by different authors, and hence the analyzed sample cannot be considered complete. Nevertheless, the results given by your analysis and ours are exactly the same: a similar percentage of barred galaxies found for normal and AGN galaxies. The difference arises because we have also taken into account the role played by the presence of a ring component.