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BAR DETECTION IN ISOLATED AND PAIRS OF GALAXIES

H. Méndez-Hernández,[1] A. M. Magaña,[1] H. M. Hernández-Toledo,[1] and O. Valenzuela[1]

RESUMEN

Estudios recientes han buscado una posible relación entre las barras y las diferentes propiedades de la galaxia huésped, así como la influencia del medio ambiente local (grupos, cúmulos, supercúmulos). Hemos calculado la fracción de barras en dos muestras donde los efectos causados por el medio ambiente local están bien controlados: una submuestra de 180 galaxias aisladas del catálogo UNAM-KIAS obtenidas del SDSS DR5 y una submuestra de 160 galaxias en pares del catálogo KPG obtenidas con el telescopio de 1.5 m OAN-SPM. Presentamos resultados preliminares de la fracción de barras detectadas en ambas muestras así como una comparación con otros medio ambientes tales como grupos y cúmulos, lo cual pareciera indicar que dicha fracción no es el resultado de las interacciones entre galaxias o bien estas interaciones las debilitan o destruyen.

ABSTRACT

Recent studies have been carried out to find out the dependence between bars and different properties of the host galaxy, and the influence of the local environment (groups, clusters, superclusters). We calculated the fraction of bars in two samples where the environmental effects are well controlled: a subsample of 180 isolated galaxies from the UNAM-KIAS catalogue obtained from SDSS DR5 and a subsample of 160 galaxies in pairs from the KPG catalogue obtained with the OAN-SPM 1.5 m telescope. We present preliminary results of bar fraction detected between these controlled environments and other environments such as groups and clusters that points towards bars are likely not triggered by galaxy interactions or maybe they are destroyed/weakened by them.

Key Words: galaxies: evolution — galaxies: fundamental parameters — galaxies: structure

Bars are elongated stellar structures located in the central regions of disk galaxies (Blanton & Moustakas 2009) and they are present in a heterogeneous class of galaxies (Sellwood & Wilkinson 1993). Bars constitute a major non-axisymmetric component of the energy, mass, and angular momentum redistribution of the baryonic and dark matter components in the galaxy that plays an important role in their dynamic and secular evolution. In fact, the amount of angular momentum exchanged is related to specific properties of the galaxies (bar mass, halo density, and halo velocity dispersion) as well as bar parameters, length, strength, and pattern speed (Gadotti 2010; Sellwood & Wilkinson 1993; Marinova & Jogee 2007; Aguerri et al. 2009; van der Kruit & Freeman 2011).

Environmental dependences of galaxy properties other than morphology have also been studied to measure the environmental effects on various physical properties of galaxies. Simulations suggest that strong interactions can trigger the formation of a bar, in accordance with observations that show that bars are two times more likely to be present in perturbed galaxies (i.e., galaxies with a nearby companion), relative to isolated galaxies (Park et al. 2007), however, there are no publications describing a large-scale exploration of whether the detailed nature of the bulges or the presence of a bar is otherwise strongly related to environment (Blanton & Moustakas 2009).

We have used two samples for our analysis: images in the g, i SDSS system from a subsample of 180 isolated galaxies from the UNAM-KIAS catalogue (Hernández-Toledo et al. 2010) and B, I images in the Johnson-Cousin system obtained with the OAN-SPM 1.5 m telescope from a subsample of 160 galaxies in pairs from the KPG catalogue (Catalogue of Isolated Pairs of Galaxies, Karachentsev 1972).

The UNAM-KIAS catalogue is conformed by 1520 isolated galaxies from the Sloan Digital Sky Survey Data Release 5 (SDSS) (Stoughton et al. 2002) with a selection criteria that is a variation on the criteria developed by Karachentseva that guarantees isolation. Our sample of 160 pairs have morphologies of the (S+S) and (S+E) types and are selected from the KPG catalogue. It was selected with a strong isolation criteria where only very small neighbors are allowed around each component and

[1]Instituto de Astronomía, Universidad Nacional Autónoma de México, Apdo. Postal 70-264, 04510 México, D.F., Mexico (hmendez, mmagana, hector, octavio@astroscu.unam.mx).

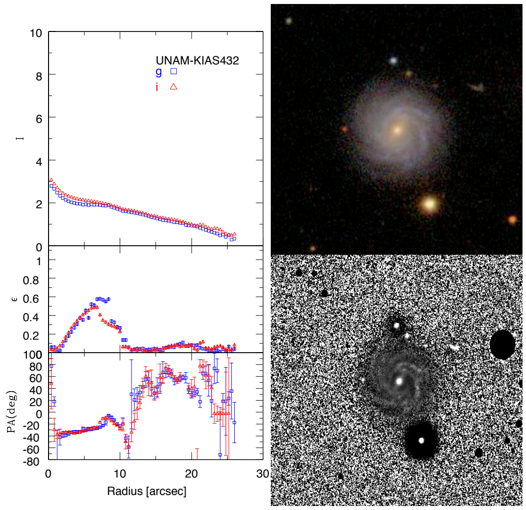

Fig. 1. UNAM-KIAS432. Left: Surface brightness, ellipticity (ϵ) and PA radial profiles after an isophotal analysis to the g and i images. Right: RGB color map image from SDSS and a 4.2×4.2 arcmin r-band filtered-enhanced image.

biased against the presence of major mergers, with a wide range of separations and morphological features, associated with tidal interactions

Historically, bars have been identified by eye using a variety of (presumably subjective) criteria, analysing the shape and orientation of the galaxy isophotes (Wozniak et al. 1995), or by studying the Fourier modes of the light distribution, however the most widely adopted quantitative technique for identifying bars is the ellipse-fitting method, in which a bar must exhibit a characteristic signature in both the ellipticity and position angle profiles (Marinova & Jogee 2007).

This samples have been analysed by fitting ellipses to the isophotes in the g, i,, B, I bands as described in Wozniak et al. (1995); Jedrzejewski (1987). We considered that a galaxy hosts a bar when: (1) the ellipticity radial profile shows a significant increase followed by a significant decrease ($\Delta\epsilon \geq 0.08$), and (2) the PA of the fitted ellipses is roughly constant within the bar region ($\Delta PA \leq 20°$) see Figure 1.

We have obtained a ≈43% bar fraction for isolated galaxies similar to that in other field galaxies (Gadotti 2010) but higher than the fraction found in Coma and Virgo clusters (Giordano et al. 2010; Marinova et al. 2010), see Figure 2. The bar fraction ≈20% found in pairs is the lowest value when compared against other environments (field Giordano et al. 2010; triplets Hernández-Toledo et al. 2011, and clusters Giordano et al. 2010; Marinova et al. 2010),

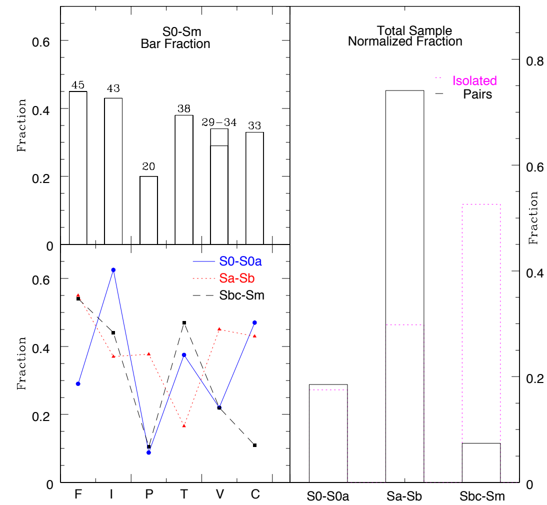

Fig. 2. Left: Total bar fraction (upper side) and morphological bar fraction (lower side) for S0-S0a (blue solid line), Sa-Sb (red dotted line) and (Sbc-Sm black dashed line) morphological types (lower side) for different environments: field (F), isolated (I), pairs (P), triplets (T), Virgo Cluster (V) and Coma Cluster (C). Right: Normalized Bar Fraction of isolated (magenta dotted line) and pair (black solid line) samples.

see Figure 2. If our results are confirmed, bars are likely not triggered by galaxy interactions or maybe they are destroyed/weakened by them. The morphological dependence show a higher bar fraction ≈74% in early-type spirals (Sa-Sb) in pairs while isolated galaxies show their maximum bar fraction ≈52% for late-type spirals (Sbc-Sm) see Figure 2.

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