Peculiar ring galaxies: morphology and properties.

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Abstract. In this work we investigate a possible relation between visual morphology of the peculiar ringed galaxies and their photometric properties. Ringed galaxies are usually classified into five main types: Polar, Hoag, Elliptical, Irregular and Centrally Smooth Rings. We perform a reclassification of a sample of objects according to the proposed subcategories using up to date images. The images of each object have been analyzed independently by 10 trained volunteers. We also obtained from the literature all available data that could aid in the classifcation process as well as in determining photometric properties. For this, we obtained 2MASS, DSS2, WISE and GALEX photometry as well as redshifts from the NED database. From these data we investigate relationships in the color-color and redshift color diagrams to probe relations with the morphology.

Resumo. Neste trabalho investigamos uma possível relação entre a morfologia das galáxias peculiares aneladas e suas propriedades. Originalmente foi proposta na literatura uma classificação visual das galáxias aneladas, dividindo-as em cinco tipos principais: Polar, Hoag, Aneis Elípticos, Irregulares e Centralmente suaves. Partindo de imagens usadas previamente e incluindo novas imagens refizemos a classificação visual dos objetos segundo as subcategorias propostas, com exceção das polares, por serem já bem definidas. As imagens dos objetos, foram analisadas independentemente por 10 voluntários (treinados), afim de se ter um levantamento estatístico da classificação visual. Com a morfologia dos grupos definida obtivemos também da literatura todos os dados disponíveis que pudessem auxiliar em sua classificação, em particular a partir de diagramas cor-cor. Para tanto obtivemos dados de fotometria do 2MASS, DSS2 , WISE e GALEX. Coletamos também a partir da base de dados NED os redshifts. A partir destes dados investigamos as relações nos diagramas cor-cor e cor redshift para sondar relações com a morfologia.

Keywords. Ringed Galaxy – Morphology – Photometry

1. Introduction

The study of peculiar interactive galaxies is important for understanding the exotic nature of these objects. The present research proposal focuses on the relationship between morphological categories of "Peculiar Ringed Galaxies" and their observational properties in different spectral bands. The objects of study belong to Arp Madore's "Catalog of Peculiar Galaxies and Associations of the Southern Hemisphere" Arp & Madore (1986), which presents 25 morphological categories supposedly originated by processes of "collisions", "fusions" or results of "effects of tipe". In the article ("On the morphology of peculiar ring galaxies"), they divided the mofological types into five main classes, which could have subclasses. In this work, we analyze the classes: Elliptic ring, Hoag and Centrally smooth since the polar ones are established.

The peculiar ringed galaxies are poorly studied, possibly due to difficulties in obtaining observational data and the complexity of numerical simulations. In order to improve our understanding of these objects, we collected data from several databases covering ultraviolet to infrared bands. The objects of the present sample are of the local universe, however many objects in the sample lack data such as: redshift, distance, major and minor axis, mass and spectra. Most of the data comes from surveys of the entire sky. We intend, therefore, to determine if details of the interactive nature of the objects can be inferred from the data and if these point to the specific morphological classes, determined visually.

2. Methodology

The initial database contained 486 objects that were analyzed by a group of ten instructed volunteers, with the objective of making the visual morphological classification. The images used came from four missions 2MASS, WISE, SDSS and GALEX (Figure 1), thus giving information of near and far infrared, visible and ultraviolet. The images were manipulated to highlight structures in the various filters. From these missions, we use the public photometric data in order to verify if there is a relation between the visually determined morphologies and the photometric properties, the spatial distribution of the objects and their geometric parameters.

3. Results

As a result of the visual classification, 314 objects were divided into six morphological classes (Figure 1). In the graphs below we see some of the obtained relations of color indices, the spatial distribution and the geometric parameters.

4. Conclusion

Based on the integrated photometry data of the GALEX, 2MASS and WISE spectral bands obtained from VizieR and NED / NASA, a clear distinction between the visually determined morphological classes and possible details of the interactive process that formed each can not be inferred. One of the reasons may be the dominance of the object's bulge in integrated photometry. However, the six exposed classes reveal interesting and peculiar structures that need more detailed studies with observations
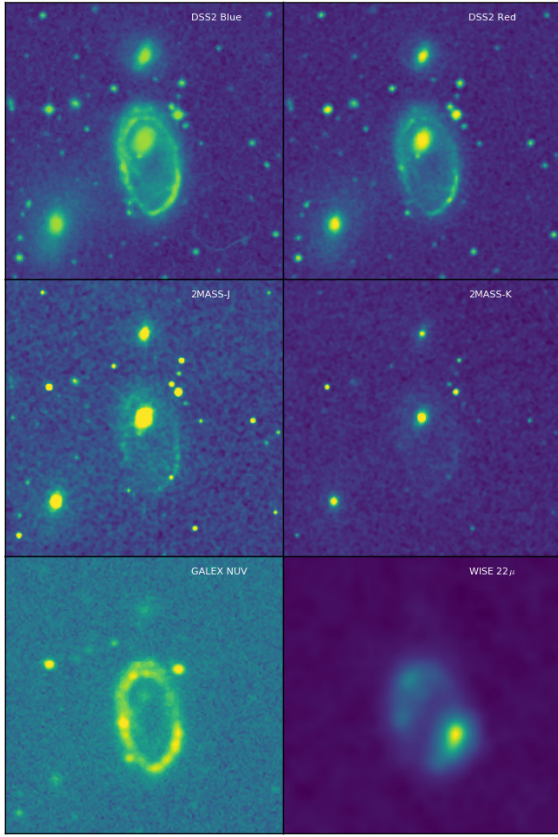
HRG 03401

FIGURE 1. Mosaic with examples of the analyzed images seeking to reveal structures and to understand the morphology.
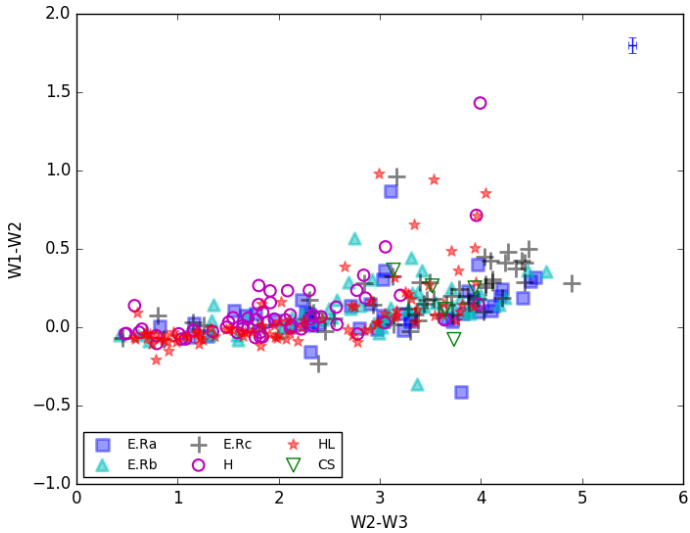

FIGURE 2. Distribution of the morphological types in the WISE color-color diagram. The purpose of this chart is to determine if there is a separation between classes and to allow the comparison of the normal objects with the peculiar ones. The diagram is related to the one of @@@ incluir a referencia do artgo.

and numerical simulations that may allow to distinguish between possible relevant physical phenomena that lead to the formation of each class.
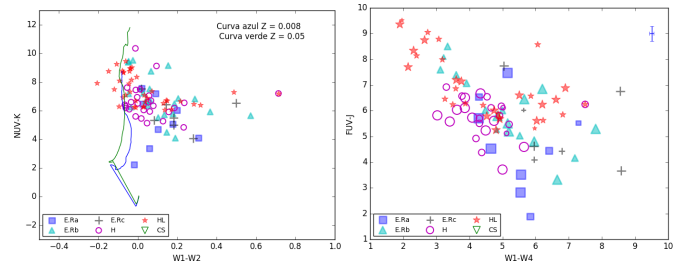
FIGURE 3. Left:We present the color-color diagrams, independent of the distance of the objects. The lines refer to models of "Single Stellar Poputation" obtained from the group of Padova (http://pleiadi.pd.astro.it/). Right:Color-color diagram of Fuv-J versus W3-W4. Point size is related to weather object nucleus appear in the GALEX image.
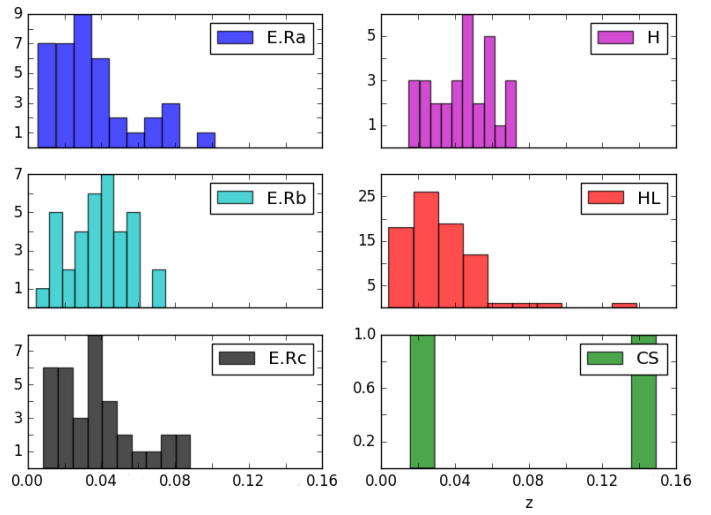

FIGURE 4. Distribution of morphological types by redshift.

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