Morphological Study of Active Galaxies based on SDSS Images. Preliminary Results

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Abstract

Activity in galaxies has mainly two major forms: Active Galactic Nuclei (AGN) and Starburst (SB). Moreover, different types of AGN have different morphology. However, this question has not yet been properly investigated and due to old low-quality images, the morphology of many galaxies is not well described. SDSS images give a good possibility to homogeneously classify galaxies and investigate differences by the activity types. The concentration of the central part and the ratio between the central bulge and the total flux is a subject for detailed study. We use SDSS images to classify different types of active galaxies (both AGN and Starburst) and understand differences between QSOs, Seyferts 1 and 2, LINERS and Composites, as well as Starburst galaxies. The best expectation from our study will be the preliminary classification of active galaxies into activity types based on the images and before having their spectral types.

Keywords: *galaxies, active galactic nuclei, starburst galaxies, morphology*

Introduction

An Active Galactic Nucleus (AGN) is a compact and highly energetic region at the center of a galaxy, characterized by a high luminosity across the electromagnetic spectrum. AGNs are powered by the accretion of mass onto a Super Massive Black Hole (SMBH) located at the center of the galaxy. The intense radiation emitted from the AGN can outshine the combined light from the stars in the host galaxy.

Quasars are the most luminous objects in the Universe. Their luminosities can be thousands of times greater than that of an entire galaxy, making them visible across vast cosmic distances. Quasars exhibit high redshifts in their spectra, indicating that they are located at large distances from Earth. The high redshift is a result of the expansion of the universe and provides information about the quasar's age and the early stages of galaxy formation. Seyfert galaxies are a subtype of active galaxies, which have nuclei that emit much higher-than-expected energy levels. The activity is attributed to the presence of a supermassive black hole in the galactic center. Seyfert galaxies are more luminous than typical galaxies, but they are less luminous than quasars. The active nucleus contributes significantly to the total luminosity of the galaxy. Seyfert galaxies exhibit emission lines in their spectra. These lines arise from the ionized gas in the vicinity of the supermassive black hole. The emission lines in Seyfert galaxies are typically narrower than those observed in quasars.

Seyfert galaxies are classified into two main types based on the width of their emission lines:

Seyferts 1: These galaxies have broad emission lines, indicating high-velocity gas in the accretion disk around the central black hole.

Seyferts 2: These galaxies have narrower emission lines, suggesting that the line-emitting regions are more extended.

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Studied data

We selected 20 objects from Sy1 and 20 objects from Sy2 from the Catalogue of Quasars and Active Galactic Nuclei (VCV-13) and made up the isodenses for these objects using the "Aladin Sky Atlas[1]" software. We measured the ratio of the diameters of the images bounded by the largest and smallest isodenses and then calculated the average value of the obtained results.

Preliminary Results

The preliminary results show that most of the AGN have a strong concentration into their central parts; bulges or just the centre, whatever the central image is. There is a strict boundary between the central formation and the whole image, while for normal galaxies the transition is much smoother (gradual) and very often it is not easy to define the core at all. For the preliminary study, we used 20 Sy1 and 20 Sy2 type galaxies and obtained the average centre/total ratio around 0.12 and 0.13, respectively. We have tried to make a parallel study between the corresponding images and spectra where the core and stellar contribution is well defined (synchrotron continuum and emission lines on one hand and thermal continuum and absorption lines on the other). Further studies will involve much more statistics and will reveal the real morphological differences between different types of activity.

Summary

Active Galactic Nuclei (AGN) have different morphology. SDSS images give a good possibility to homogeneously classify galaxies and investigate differences by the activity types. The concentration of the central part is a subject for detailed study.

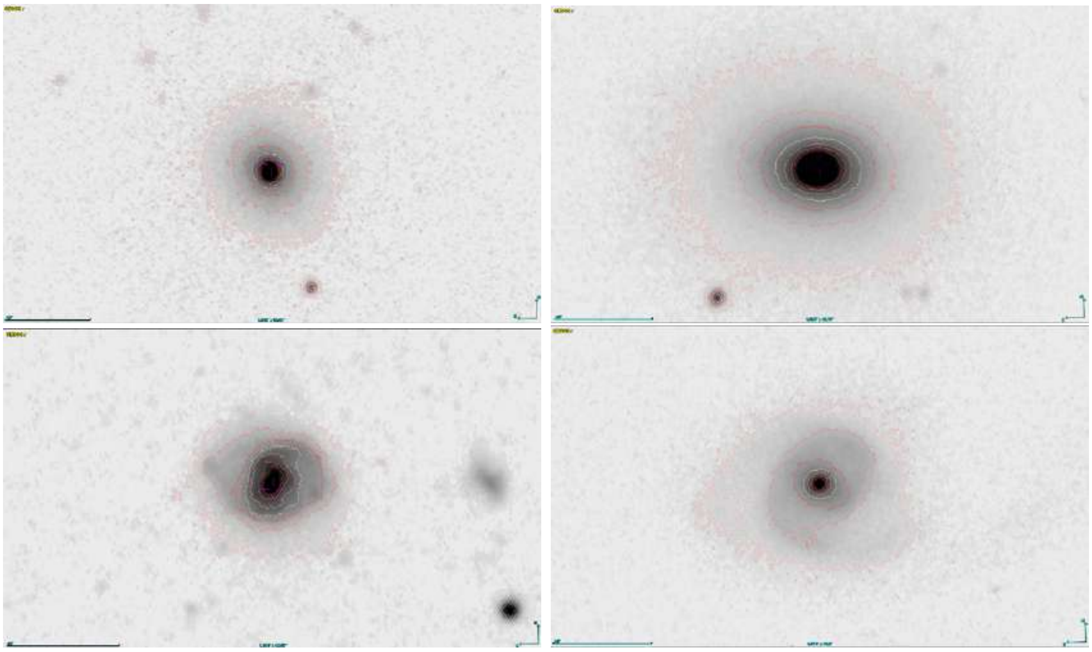

Figure 1. Isodenses for 4 Seyferts 1 galaxies using "Aladin Sky Atlas" software.

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We use SDSS images to classify different types of active galaxies (both AGN and Starburst) and understand differences between QSOs, Seyferts 1 and 2, LINERS and Composites, as well as Starburst galaxies. For that used "Aladin Sky Atlas" software. The best expectation from our study will be the preliminary classification of active galaxies into activity types based on the images and before having their spectral types.

[1] https://aladin.cds.unistra.fr/

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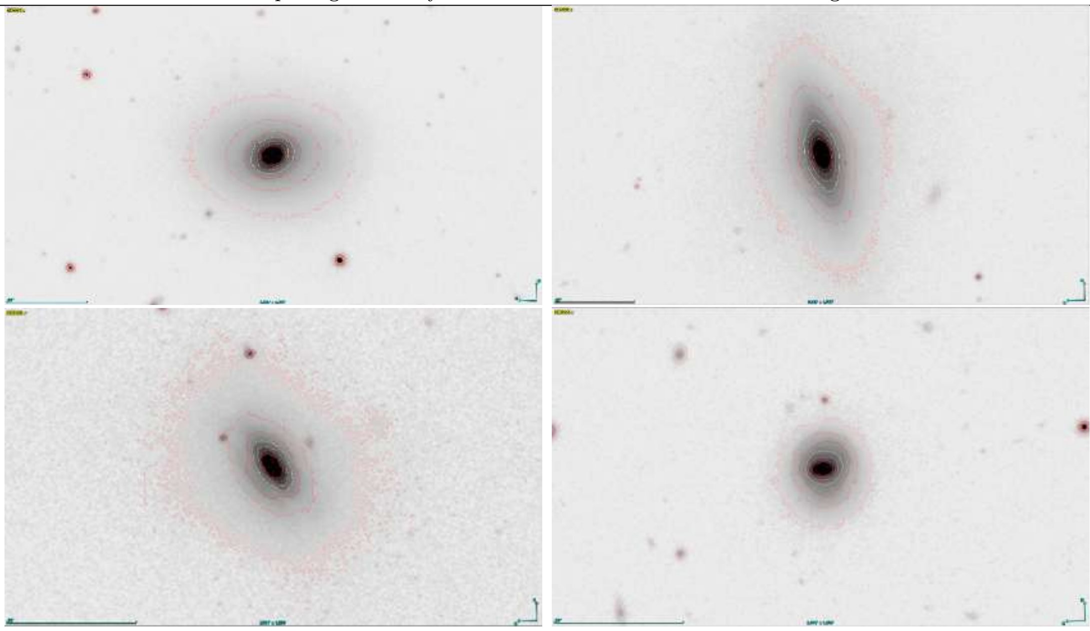

Figure 2. Isodenses for 4 Seyferts 2 galaxies using “Aladin Sky Atlas” software.

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