The Interplay among Black Holes, Stars and ISM in Galactic Nuclei
Proceedings IAU Symposium No. 222, 2004
T. Storchi-Bergmann, L. C. Ho & H. R. Schmitt, eds.

DOI: 10.1017/S1743921304002492

The energizing source of emission lines in LINERs and Transition-type galaxies

Lucimara P. Martins[1], Claus Leitherer[1], Roberto Cid Fernandes[2], Rosa M. González Delgado[3], Henrique R. Schmitt[4], Thaisa Storchi-Bergmann[5] and Timothy Heckman [6]

[1]Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA
[2]Universidade Federal de Santa Catarina, C.P. 476, 8804-900, Florianópolis, SC, Brazil
[3]Instituto de Astrofísica de Andalucia, PO.Box 3004, 18080, Granada, Spain
[4]National Radio Astronomy Observatory, 520 Edgemont Road, Charlottesville, VA22903, USA
[5]Instituto de Física, UFRGS, C.P. 15001, 91501-970, Porto Alegre, RS, Brazil
[6]Departament of Physics and Astronomy, Johns Hopkins University, Baltimore, MD, 21218, USA

Abstract. The emission line spectra of active galactic nuclei fall into three main categories: star formation nuclei (or HII regions), Seyfert nuclei and LINERs (low ionization narrow emission-line regions). A subset of these galactic nuclei has intermediate characteristics between LINERs and HII regions. These so-called transition objects were the subject of numerous studies in the past, but their true nature has remained elusive. It's almost impossible to explain these objects with models that take into account only one ionization mechanism, being it stars, an AGN or shocks. We show how the use of a set of elaborated photoionization models, that account consistently for these parameters (ionization by stars, shocks and/or AGN and dust), constrained by a detailed study of the stellar population properties, can help us understand the nature of these transition objects.

1. Introduction

Low Luminosity AGNs (LLAGN) constitute the most common form of activity in the nearby universe. They are as much as one third of all nearby galaxies (Ho et al. 1997) and nearly a half of all nearby early type galaxies. The ionization mechanism responsible for the line ratios observed in these objects is still controversial and remains on the forefront of astrophysics today. These objects can be roughly divided in two classes: LINERs (Low Ionization Narrow Emission Line Regions) and TOs (Transition Objects, with lines between LINERs and HII regions).

Despite of the general classification, it is known that it would be impossible to describe the gas ionization in these objects with a simple excitation mechanism. Processes that could be playing a role are: Photoionization by non-stellar UV/X-ray continuum (AGN); thermal photoionization by stars; shock waves, created by stellar winds from hot massive stars and supernova ejecta, or driven by radio jets or AGN winds.

It is very likely that, to describe the spectra of these objects, a combination of these processes will be necessary.

2. The Sample

We want to explain what is the main source of energy in these LLAGNs, by using photoionization models that can take into account, consistently, all processes described

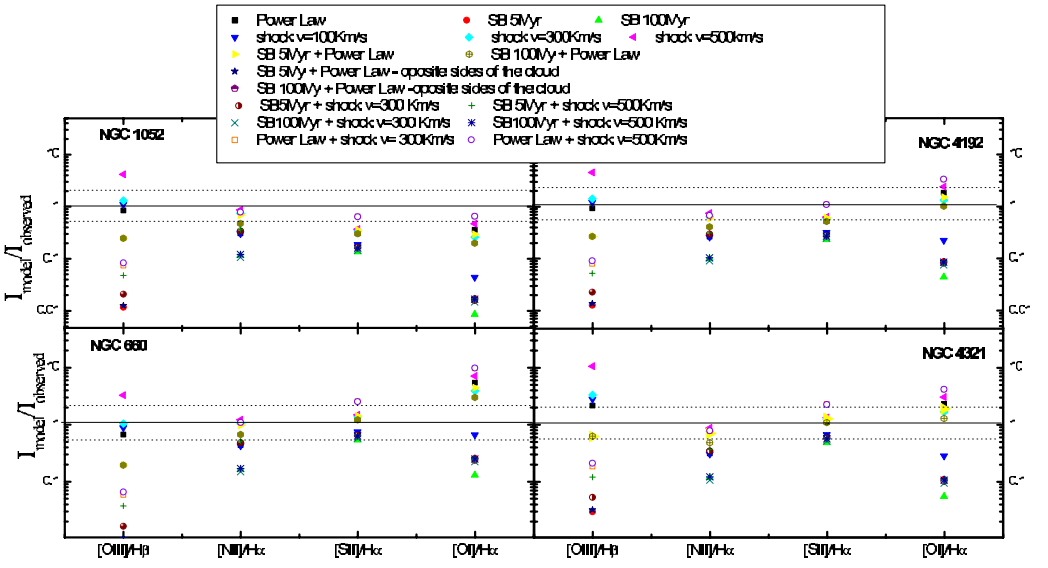

Figure 1. Comparison between a sample of photoionization models and LINERs.

previously, constrained by a detailed analysis of the stellar population. To do this we have a sample of about 60 LLAGNs from the Ho et al. (1997) sample, observed in the optical range (3600-5500 Å) with high spectral and spatial resolutions, at NOT (La Palma). These are long slit observations, which can be used to study the contribution of the mechanisms of ionization inside and outside the nucleus. An initial analysis of the stellar population can be found in Cid Fernandes et al. (2004) and González-Delgado et al. (2004).

3. Preliminary Results

A preliminary result of the possibilities of the models is shown in figure 1. The models were created with Mappings (Kewley et al. 2004), that consistently accounts for different mechanisms acting at the same time to ionize the gas. This is crucial, since simple ionization mechanisms cannot explain these objects.

To obtain a more precise result, the detailed analysis of the stellar population will be necessary, so we can extract, precisely, the emission lines of these galaxies, as well as constrain the SED for the photoionization models. Also, it will be necessary to carefully test all parameters involved.

Acknowledgements

We would like to thank IAU and AAS for financial support to the presentation of this work on this meeting.

References

Cid Fernandes, R., et al. 2004, ApJ, 605, 105
González-Delgado, R. M., et al. 2004, ApJ, 605, 127
Ho, L. C., Filippenko, A. V., & Sargent, W. L. W. 1997, ApJ, 583, 159
Kewley, L. J., et al. 2004, in preparation

https://doi.org/10.1017/S1743921304002492 Published online by Cambridge University Press