PROCEEDINGS OF SCIENCE

The role of Narrow Line Seyfert 1 galaxies in the frame of the AGN Unified Model

V. Cracco∗,[a] **S. Ciroi,**[a] **M. Berton,**[a] **E. Sissa,**[a] **F. Di Mille,**[b,c] **G. La Mura,**[d] **P. Rafanelli**[a]

[a]*Dipartimento di Fisica e Astronomia, Università di Padova,*
Vicolo dell'Osservatorio 3, I-35122 Padova, Italy
[b]*Sydney Institute for Astronomy, The University of Sydney,*
44-70 Rosehill Street, Redfern, NSW 2016, Australia
[c]*Australian Astronomical Observatory,*
P.O. Box 296, Epping, NSW 1710, Australia
[d]*Institut für Astro-und Teilchenphysik, Universität Innsbruck,*
Technikerstrasse 25/8, A-6020 Innsbruck, Austria
E-mail: valentina.cracco@unipd.it, stefano.ciroi@unipd.it, marco.berton.1@studenti.unipd.it, elena.sissa@studenti.unipd.it, francescodimille@gmail.com, giovanni.lamura@unipd.it, piero.rafanelli@unipd.it

The origin and intrinsic nature of the Narrow-line Seyfert 1 galaxies (NLS1s) still represent an open question. It is not yet clear whether NLS1s can be really considered a class of AGNs within the frame of the Unified Model. This project aims to investigate the NLS1s nature by means of three approaches. First, we will carry out a statistical study of the spectral properties of NLS1s, taking advantage of the Sloan Digital Sky Survey (SDSS) public archive to select an homogeneous sample of NLS1s up to redshift z=0.35. Then, we will select from this sample a sub-sample of nearby NLS1s, with z<0.05. We will analyze the *ugriz* images of these objects in order to study the morphology of the host galaxy and to estimate the bulge luminosities. Finally, we will study the circumnuclear star-forming regions in a low redshift selected sample of NLS1s, through the application of a deconvolution algorithm [2, 4] which allows to extract the spectrum of the host galaxy and study its stellar population.

Nuclei of Seyfert galaxies and QSOs - Central engine & conditions of star formation,
November 6-8, 2012
Max-Planck-Insitut für Radioastronomie (MPIfR), Bonn, Germany

∗Speaker.

PoS(Seyfert 2012)061

1. Spectrophotometric properties of NLS1 and their hosts

We selected a large spectroscopic sample of NLS1s from the SDSS-DR7 archive, according to the following criteria: (1) sources classified as "galaxy" or "QSO", (2) $0.02 < z < 0.35$ to have a spectral range from [O II]λ3727 to [S II]$\lambda\lambda$6716,6731, (3) 800 km s^{-1} $<$ FWHM(Hβ) $<$ 3000 km s^{-1}. The query result is a sample of 2372 galaxies. We found 360 NLS1 candidates out of the 2372 sources (15%), checking each spectrum by means of visual inspection. We are fitting and subtracting the continuum with STARLIGHT [1], using a power law + Fe II spectrum + stellar populations (See Fig.1). All the visible emission lines will be measured to study their profiles and ratios. Continuum and emission lines properties will be compared. The SMBH masses will be also estimated by means of the Kaspi relation [3].

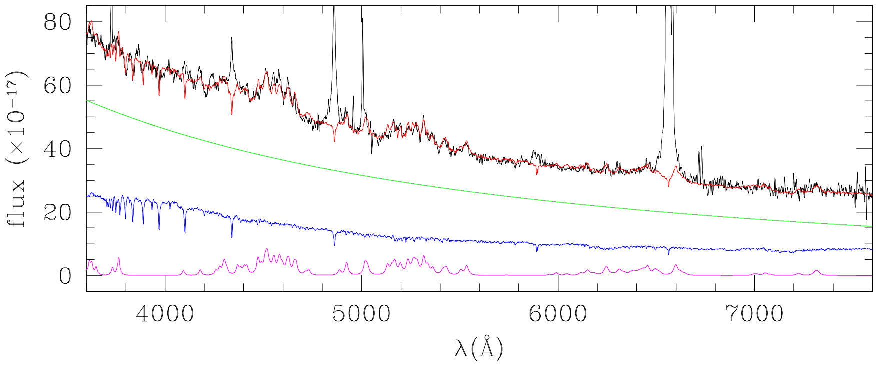

Figure 1: Example of fitting of continuum for SDSS J234054.28+151628.8, using a power law (green line), the iron spectrum (magenta line) and stellar populations (blue line). Black and red lines are the observed spectrum and the fitting, respectively.

From our NLS1 sample, we extracted a sub-sample with $z \leq 0.05$, to carry out a bulge/disc decomposition. We obtained *g* and *r* SDSS images of these objects. First, we applied the IRAF task ELLIPSE to calculate the surface brightness profile and the colour profile for each galaxy. Then, we fitted the surface brightness profiles with three functions, to account for AGN, bulge and disc contributions, and we derived their photometric parameters. These parameters are used as input for the 2D decomposition software GALFIT [5, 6]. In Fig.2, we show preliminary results of the application of this method to the NLS1 galaxy KUG1618+402. From the GALFIT best fitting, we obtained that the morphological parameter B/T is 0.66, indicating an early-type spiral morphology. This result could be affected by the disc faintness, and it shows the difficulties to obtain a correct morphology even at low redshift. Indeed, the residual image shows a clear spiral-like structure, and the colour image shows a blue galaxy, suggesting more likely a late-type spiral morphology.

Finally, we want to check if NLS1s have really a higher nuclear star formation than BLS1s. Indeed, if NLS1s are an early evolutionary stage of BLS1s, then the nuclear star formation in NLS1s would be higher than in BLS1s. To deconvolve the AGN contribution and extract the spectrum of the host galaxy, we use a software which works only under the condition that each target is observed at the same time of one or more stars. These stars are used to create the instrumental PSF

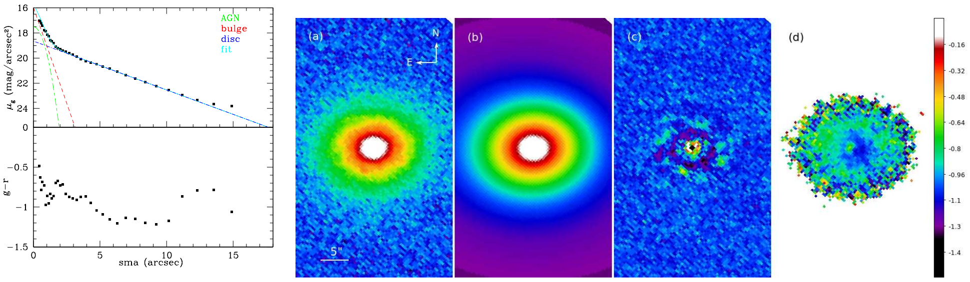

Figure 2: Preliminary results for KUG1618+402. First panel: the 1D surface brightness profile (top) with the AGN (green curve), the bulge (red line) and the disc (blue line) contributions. Observed data and the total fit are in black and cyan, respectively; and the colour profile (bottom). (a) The galaxy in g band, (b) the model obtained with GALFIT, (c) the residuals, (d) the $g-r$ colour image.

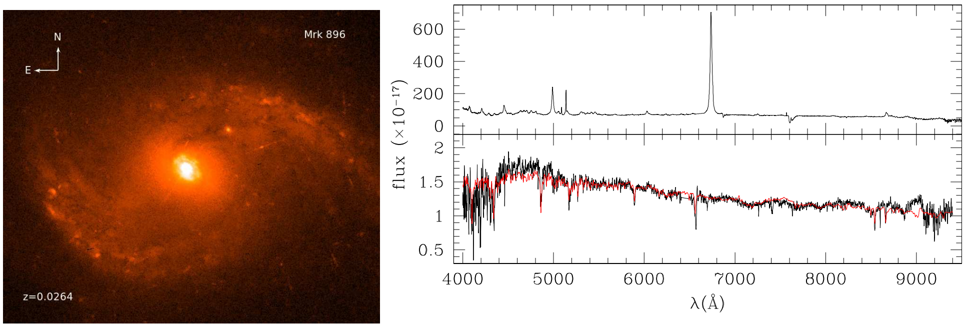

Figure 3: HST image of Mrk 896 (left panel). The nuclear spectrum (top-right panel), the host galaxy spectrum (black) compared to a synthetic spectrum (red) obtained with STARLIGHT (bottom-right panel).

as a function of the wavelength (Courbin et al. 2000; Letawe et al. 2007). Very recently, we successfully applied this method to Mrk 896. The spectrum was taken at Las Campanas Observatory (Chile) with IMACS mounted at the Magellan Telescope. Here we present preliminary results: the host galaxy spectrum is mainly made of a relatively young stellar population of 6.4×10^{8} yrs (80%) and an older population of 2.5×10^{9} yrs (12%).

References

[1] Cid Fernandes et al.: *Semi-empirical analysis of Sloan Digital Sky Survey galaxies - I. Spectral synthesis method* MNRAS **358** (2005) 363

[2] Courbin et al.: *A Method for Spatial Deconvolution of Spectra* ApJ **529** (2000) 1136

[3] Kaspi et al.: *The Relationship between Luminosity and Broad-Line Region Size in Active Galactic Nuclei* ApJ **629** (2005) 61

[4] Letawe et al.: *On-axis spectroscopy of the host galaxies of 20 optically luminous quasars at z 0.3* MNRAS **378** (2007) 83

[5] Peng et al.: *Detailed Structural Decomposition of Galaxy Images* AJ **124** (2002) 266-293

[6] Peng et al.: *Detailed Decomposition of Galaxy Images. II. Beyond Axisymmetric Models* AJ **139** (2010) 2097-2129