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3D VISUALIZATION OF EVOLUTIONARY DIAGRAMS FOR QUASARS IN THE PARAMETERS SPACE 4DE1

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RESUMEN

Sulentic et al. (2007) definieron el 4DE1, el cual es un espacio de parámetros de cuatro dimensiones que usa mediciones en el óptico, UV y rayos-X para discriminar entre distintas clases de NAG. Usando nuevos datos en rayos-X obtenidos del satelite XMM-Newton, presentamos una manera de visualizar todos los parámetros en una gráfica 3D hecha con el software libre TOP CAT. Las diferentes correlaciones han sido enmarcadas en el contexto de un esquema evolutivo y hacemos una interpretación de la física subyacente.

ABSTRACT

Sulentic et al. (2007) defined the 4DE1, which is a four dimensions parameter space that uses optical, UV and X-ray measures to discriminate between different classes of AGN. Using new X-ray data from the satellite XMM-Newton, we present a way to visualize all the parameters in one 3D graph made by the open source software TOP CAT. The different correlations have been framed in the context of an evolutionary scheme and we make an interpretation of the underlying physics.

Key Words: galaxies: active — X-rays: galaxies

1. INTRODUCTION

As an attempt to find a spectroscopic unification for broad-line emitting AGN, Sulentic et al. (2007) defined a parameter space in four dimensions, 4DE1. The Eigenvector 1 (E1), is a principal component analysis (PCA) of the correlation matrix for quasars in the Palomar-Green (PG) sample made by Boroson & Green (1992). The 4DE1 is a 4D parameter space that uses optical, UV and X-ray measures to discriminate between different classes of AGN.

The current best E1 parameters are: (1) FWHM Hβ, (2) $R_{\rm FeII}$ = EW(FeII$_{\rm optical}$)λ4570 blend / EW($H\beta_{\rm BC}$), (3) soft X-ray photon index $\Gamma_{\rm soft}$, and (4) c(1/2) = centroid shift at FWHM of CIV$_{\rm BC}\lambda$1549, this last parameter were added by Sulentic et al.

In simplest terms they can be said to measure: (1) the dispersion in BLR cloud velocities, (2) the relative strengths of FeII and Hβ emission, (3) the strength of a soft X-ray excess, and (4) the amplitude of systematic radial gas motions.

2. 3D VISUALIZATION OF 4DE1

We have a 118 objects sample (private comunication), then we divided it in two populations, Pop A (FWHM(H$\beta_{\rm BC}$) $<$ 4000 km s^{-1}), filled figures, and Pop B (FWHM(Hβ_{BC}) $>$ 4000 km s^{-1}), open figures. We also make difference between Radio Loud (triangles) and Radio Quiet (circles). The soft excess photon index is represented by the size of the point. The open source software TOP CAT was used to plot. See Figure 1.

3. X-RAY SOFT EXCESS

We have new data obtained from spectra of the satellite XMM-Newton, which represent a great improvement since the old ones were taken from ROSAT satellite.

3.1. *Data reduction*

The raw data from the *EPIC* instrument *pn* were processed using the standard Science Analysis System (SAS) (Loiseau 2003) to produce linearized event files. Only events with single and double patterns were used for the spectral analysis. Furthermore, periods of background flaring in the *EPIC* data were excluded using the method described in Piconcelli et al. (2004).

3.2. *Analysis of the spectra*

A simple redshifted power law model has been fitted to the hard X-ray band, 2–12 keV. But the extrapolation of the power law to energies lower than 2 keV revealed the presence of large deviations, with the most common residual feature being a smooth excess of soft X-ray flux. See Figure 2.

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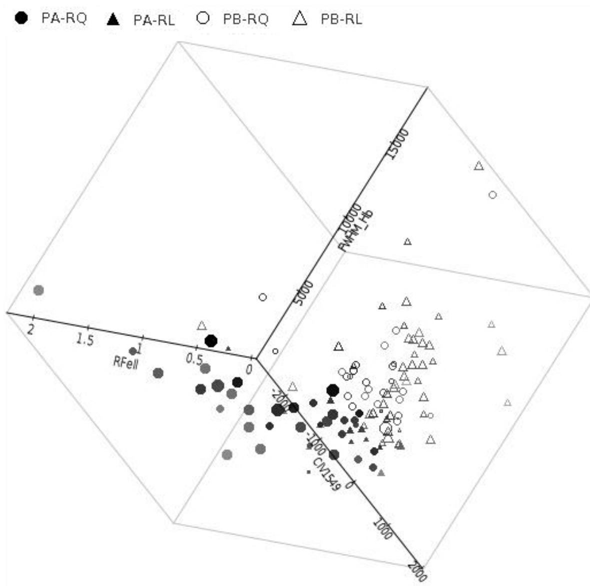

Fig. 1. 3D graphic; Pop A, filled figures, Pop B, open figures, Radio Loud, triangles, Radio Quiet, circles. The figure size represents de soft X-ray photon index.

TABLE 1

Pop A	Pop B
FWHM(Hβ_{BC}) < 4000 km s^{-1}	FWHM(Hβ_{BC}) > 4000 km s^{-1}
Radio Quiet objects	Radio Loud objects
$R_{FeII} \geq 0.5$	$R_{FeII} < 0.5$
Excess of soft X-ray	No excess of soft X-ray
CIV$_{BC}$ blueshifted	CIV$_{BC}$ no blueshifted

3.3. *Analysis of the spectra*

We'll model the soft excess emission by four diferent two-component continua: (A) blackbody + power law; (B) multicolor blackbody + power law; (C) bremsstrahlung + power law; (D) power law + power law. We'll fit a warm absorber when necessary. This last component is important because it has been found warm absorber emision in 50% of AGN and is located in winds, the same as the CIV line.

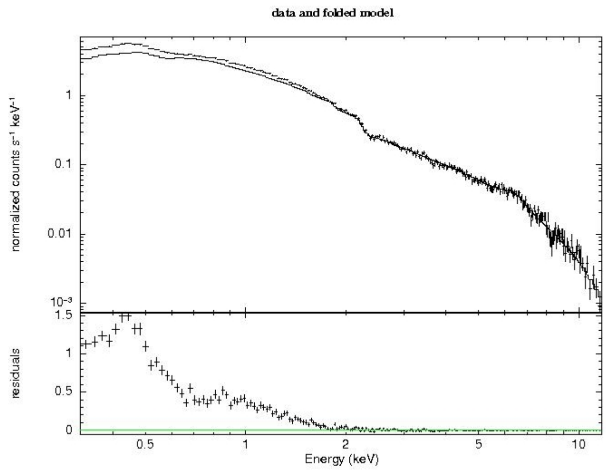

Fig. 2. Spectra with a power law fitted in the 2–12 keV band, showing the soft excess residuals below 2 keV.

4. CONCLUSIONS AND FURTHER WORK

The soft excess is an emision that is found in almost all the AGN.

There isn't an unique model to fit it, so the soft excess is not an universal QSO property.

The parameter space 4DE1 contains important information about the Quasars, with L/L_{EDD} and M_{BH} as key physical parameters. See Table 1.

We'll complete the sample in order to better study the soft excess emision in the 4DE1 context.

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