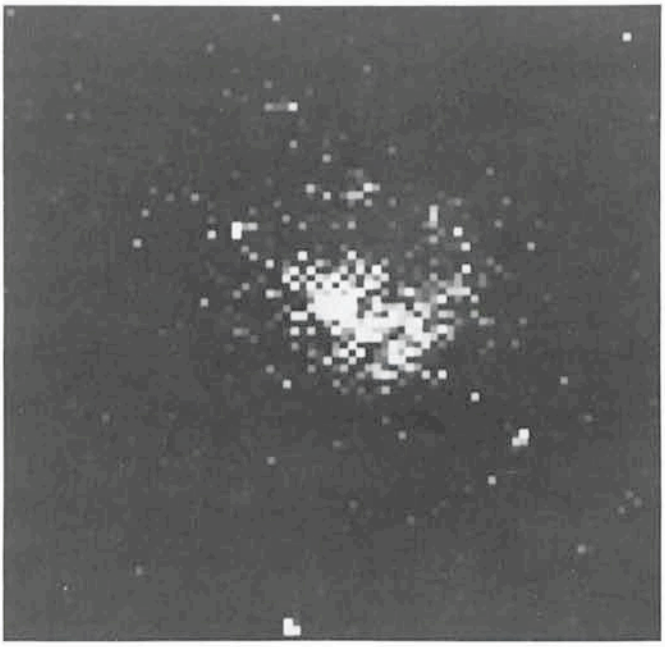

Fig. 4: *The [S II] exposure of NGC 4696. Same orientation and angular size as Fig. 2.*

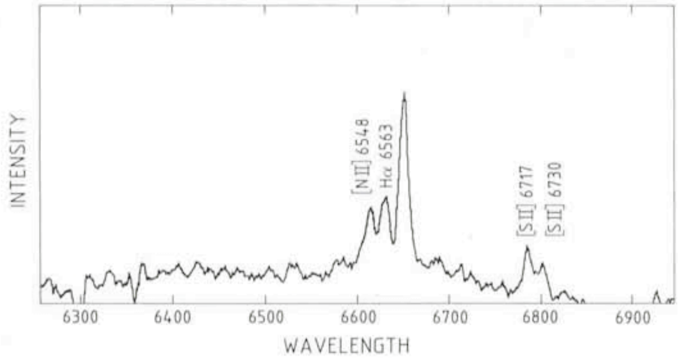

Fig. 5: *The IDS spectrum of the spectral region around H_α + [N II] and [S II] for the area of the "horse shoe" north-west of the centre of NGC 4696.*

ing is caused by an absorbing dust lane. The dust lane which extends more than 180° around the centre could be situated in gas compressed in a shock due to the motion of the galaxy through the hot intracluster medium. Numerical simulation of this phenomenon has been given by Gisler (1976, *Astron. Astrophys.,* **51,** p. 137), who obtained structures similar to the one we observe.

On May, 28–30, 1982, we observed NGC 4696 with the CCD camera on the Danish 1.5 m telescope through filters covering redshifted H_α + [N II] and [S II]. The band width of the filters was ~ 100 Å. A "continuum" band around 6900 Å was also observed.

In Fig. 3 we show the H_α + [N II] exposure of NGC 4696 with the continuum subtracted. Several filaments are clearly seen south and west of the nucleus. This agrees with results very recently obtained by A. Fabian and collaborators with the AAT (private communication). Fig. 4 shows the [S II] exposure of NGC 4696 again with the continuum removed. Filamentary structures south and west of the nucleus are evident also in the [S II] light.

The data in Fig. 2, 3 and 4 suggest a strong connection between the absorption feature and the filamentary structure since only very faint emission is seen outside the absorbing dust lane.

IDS spectra at a dispersion of 116 Å/mm were obtained in different positions of NGC 4696 on May 25–26, 1982, using the 3.6 m telescope. As an example we display in Fig. 5 the spectrum of a 4″ × 4″ region 5″ north-west of the centre where we noticed strong emission in Figures 3 and 4. The similarity to emission lines from filaments in M 87 as observed by Ford and Butcher is striking, indicating similar physical conditions in the filaments.

The optical observations, presented here together with the X-ray observations suggest that we are in fact observing cooling intracluster gas accumulating on the central galaxy of the Centaurus Cluster.

These observations make up the first part of a survey of clusters with a low temperature X-ray component.

Follow-up observations in the UV of NGC 4696 by IUE will be performed in the near future.

IUE Observations of Variable Seyfert 1 Galaxies

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Introduction

The emission spectrum of Seyfert 1 nuclei is similar to that of faint quasars. The ionization of the gas is attributed to a central source emitting a non-thermal radiation (X, hard UV). These spectra are characterized by broad hydrogen and other permitted lines; sometimes strong narrow forbidden lines and cores to the permitted lines are also seen.

The width of the broad permitted lines, typically 3,000 to 10,000 km s^{-1}, is due to high relative velocity of the emitting clouds (or filaments). Although the clouds, with a density > 10^9 cm^{-3}, are optically thick in the Lyman continuum, the whole nebula has only a small coverage factor of the central source (10 % at most). The permitted emission lines are thought to originate at a distance of ~1 pc, or less, from the central source, while the narrow line-emitting region, of considerably lower density (Ne ~ 10^4), is located at much larger distances, ~100 pc to 1 kpc (Fricke, K.J., and Kollatschny, W., *The Messenger,* **26,** 9).

Ultraviolet (UV) observations of Seyfert nuclei are interesting for several reasons. The study of highly ionized species, such as C IV, Si IV, NV, which are observed in the UV, but not in the optical, gives us some knowledge of the range of ionization in Seyferts. Furthermore, the stellar contribution in the UV is small, facilitating the study of the non-thermal continuum. Moreover, comparing with ground-based observations of highly ionized gas in high-redshift quasars, luminosity effects in the line ratio can be investigated (since quasars are more luminous than Seyferts).

The monitoring of NGC 4151, using the International

Ultraviolet Explorer (IUE), has shown that the nucleus of this galaxy has several interesting properties (see Bromage, G.E. *et al.*, 3rd European IUE Conference, 1982, ESA SP-176 and reference therein).

To investigate if these properties are common to all Seyfert 1 nuclei, we have selected seven objects, all known for their brightness variability at optical wavelengths: NGC 3516, NGC 5548, Akn 120, NGC 3783, NGC 4593, NGC 7213, ESO 113-IG45(F9). To our own IUE data of these objects, we have added some spectra from the data bank and examined those already published.

The Continuum

The IUE spectra, covering the interval λλ 1150 – 3200 Å, have been analysed chosing continuum points when emission or absorption lines, particle events or fiducial marks were expected to be absent. The reddening was assumed to be time-independent and to follow Seaton's law (Seaton, M.J., 1979, *MNRAS* **187,** 173p). The appropriate reddening correction cannot always be determined precisely: the maximum value is assumed to be the one producing a bump at 2200 Å in the reddening corrected continuum, the minimum value being obviously the galactic absorption. The dereddened continua were fitted in terms of power law $F \propto \nu^{-\alpha}$, using the minimum possible value for the absorption.

Our study of the continuum shows that NGC 4151 is not atypical, other Seyferts exhibiting similar properties, namely: (i) the UV continuum varies both in shape and intensity between different epochs, (ii) it hardens when the intensity increases. This behaviour was already seen in Akn 120 (Kollatschny *et al.*, 1981, *AA* **102,** L25), NGC 4593 (Clavel *et al.*, 1982, *MNRAS* in press) and NGC 7469 (Elvius *et al.*, 1982, ESA SP-176 proceedings).

In several instances, even after reddening correction, the continuum shows a break near 2000 Å. In this case two power

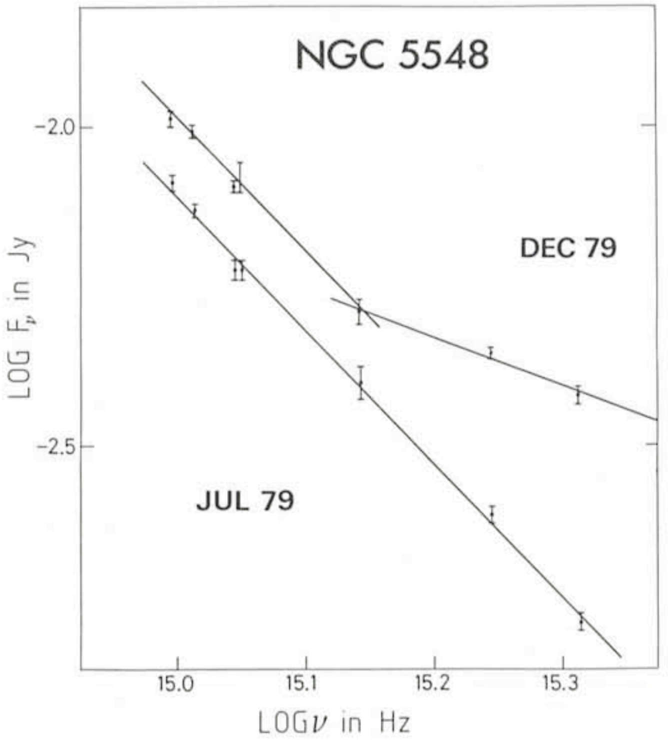

Fig. 1: *The UV continuum flux distribution for NGC 5548 at two epochs.*

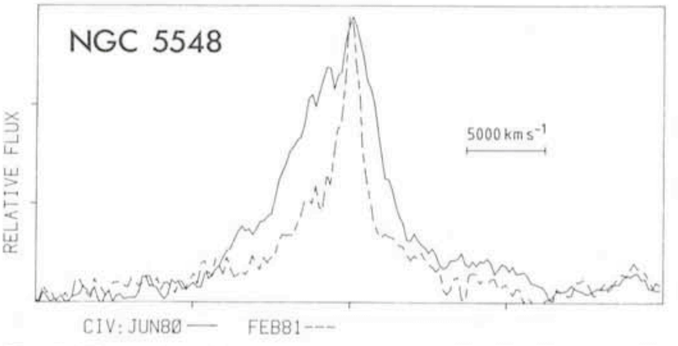

Fig. 2: *The profile of the C IV* λ 1549 line after subtraction of the continuum and normalization peak intensity.

laws are needed to fit the continuum, the spectrum being harder at λ < 2000 Å (e.g. NGC 5548, Fig. 1). This resembles the spectrum of many quasars and suggests that, longward of 2000 Å, the UV continuum, in Seyfert spectra, is part of the 3000 Å bump commonly seen in quasar spectra. As to the origin of this bump, several suggestions have been made, e.g. Balmer lines, optically thin Balmer continuum emission, two photon and Fe II emission (Grandi, 1982, *Ap.J.* **255,** 25; Malkan and Sargent, 1982, *Ap.J.* **254,** 22). When a break occurs, the temporal variation in the continuum shortward of 2000 Å is of greater amplitude than longward. For some objects, when the intensity of the continuum is very low, one power law is sufficient, the short wavelength component having faded (Fig. 1).

The nature of this last component is uncertain. In most quasars, an excess of ultraviolet continuum remains even after subtraction of a combination of the 3000 Å bump eventual constituents. It has been proposed that optically thick thermal emission (e.g. black-body) as well as partially thick Balmer continuum can contribute to the extra component. One possible interpretation of the optically thick thermal emission is that it comes from an accretion disk (Shields, 1978, *Nature* **272,** 706). Examples of such exceptional objects are 3C 273 among quasars and ESO 113-IG45 among Seyferts.

The fact that such a component is never seen in BL Lac spectra even far from their brightness minimum, suggests that (black-body or not) it is related to the existence of a broad line region.

Simultaneous observations in at least the UV and visible are required to give a more quantitative description of the continuum. Extending them at other wavelengths would be even better.

The Emission Lines

In the "classical photoionized model" of broad line formation in quasars, the side of the clouds facing the central ionizing source emits C IV λ 1549, whereas the back part shielded from the Lyman continuum, emits Mg II λ 2800, Fe II lines and the bulk of the Balmer lines. In this model, one of the most important parameters that govern the spectrum is the ionization parameter U_H, i.e. the ratio of ionizing photon flux to the medium density. This parameter is determined by using the intensity ratios of the three intense lines Lyα, C IV λ 1549, C III] λ 1909. The hypothesis underlying this computation is that these lines are formed at the same place in the medium and so they should have the same velocity profiles. Up to date this has been found to be true for quasars (see Davidson and Netzer, 1979, *Rev. Mod. Phys.*, **51,** 715, for more detail).

In NGC 4151, the emission line profiles and intensities vary

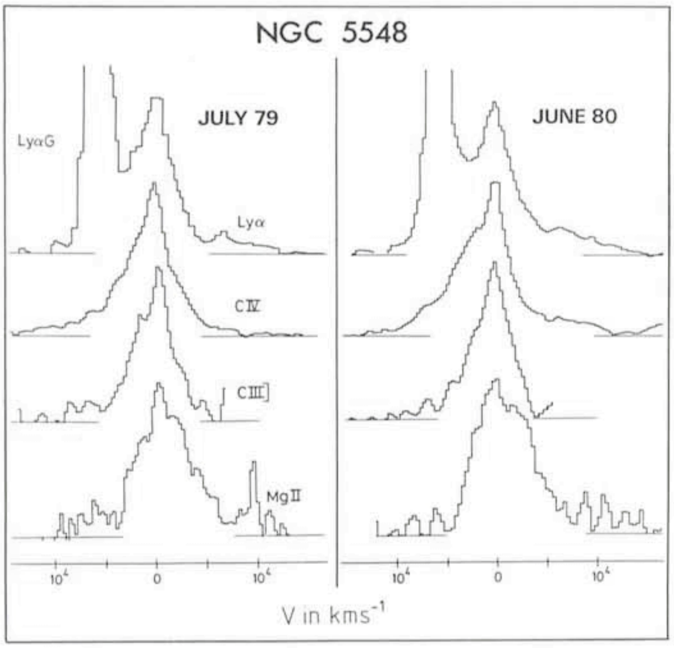

Fig. 3: *The profiles of the main UV lines in NGC 5548, June 1980 and July 1979 scaled in velocity.*

with the intensity of the continuum. The C IV λ 1549 intensities are well correlated with the continuum at 2500 Å, but show a time-lag of ~15 days between the variations of the continuum flux and the lines, this delay being due to light travel time in the C IV region. The C III] λ 1909 intensity remains constant, suggesting an emission region larger than a light year. There is only an insignificant correlation between Mg II λ 2800 and the continuum at 2500 Å (Ulrich *et al.*, 1983, preprint).

In all the objects we have looked at, there is a general trend for emission lines and widths (Fig. 2) to vary in the same sense as the continuum, those from highly ionized species varying more than those from less excited ions, but no tight correlations are found.

A striking point is that, at a given epoch, comparison of the profiles of the most intense broad lines (C IV, Mg II, C III]) with a good signal-to-noise ratio, reveals differences in the width of the lines (Fig. 3). For NGC 3516 and NGC 5548 (Ulrich and Boisson, 1983, *Ap.J.*, in press), as for NGC 4151, we can distinguish at least 3 regions:

(1) emitting the wings of C IV only, with the largest velocity dispersion (~2 10^4 km s^{-1});

(2) emitting Mg II and C IV of FWZI ~ 10,000 km s^{-1}, C III] not being detected;

(3) emitting the 3 lines of FWZI ~ 4000 km s^{-1}.

For the others, the subdivision in (2) and (3) is less clear. One should also note that sometimes, when the continuum is faint, all the lines are "narrow". It seems that, the emitting region being small, one is witnessing the lightening or the extinction of shells located at different distances from the centre.

From this point of view, Seyfert galaxies appear different from quasars. This difference could be an absolute luminosity effect and observations of faint quasars are needed to test this hypothesis.

Conclusion

In the 7 Seyferts analysed, as in NGC 4151, (i) the continuum becomes harder when it brightens; (ii) there is a general trend for emission lines and widths to vary in the same sense as the continuum, (iii) matter appears not to be distributed in the broad line region (BLR) of Seyferts as it is in quasars: for Seyferts we can distinguish regions where the gas has different physical conditions and velocities.

The Variability of RR Tel

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Introduction

In the course of its history, RR Tel has been described as a member of different stellar classes. In fact, it is a galactic nova for which only one outburst has been recorded and whose lightcurve before that outburst is one of the best known.

Spectroscopically, the star has also been extensively observed in the various wavelength ranges. Present infrared variations are well established and interpretations of the nature of RR Tel point to a symbiotic object containing a Mira variable and a dust component. A blue component is also believed to be present. We will show how simple photometric observations carried out at ESO, together with other sources of data, bring an interesting complement to this model.

First Observations

RR Tel was discovered as a variable by W.P. Fleming (*Harvard Circ.* **143,** 1908) from 19 Harvard plates spread over 13 years. At this time, she suggested the star (then named HV 3181) might be of the SS Cyg type, also called U Gem type.

In 1945, S. Gaposchkin derived a period of 386.73 days from 40 acceptable observations (*Harvard Ann.* **115,** 22) and this period of about 387 days was adopted by Kukarkin and Parenago in their 1947 catalogue where they presented the star as a semi-regular variable.

The outburst had occurred in November 1944, but it remained unnoticed until the South African amateur astronomers P. Kirchhoff and R.P. de Kock discovered in 1948 that the star had increased from fainter than twelfth to about the sixth magnitude.

The pre-outburst behaviour of the star can be appreciated in Fig. 1 reproduced from the work of M.W. Mayall (*Harvard Bull.* **919,** 1949, 15) who examined all Harvard plates available when the star brightening was discovered. This led to more than 600 positive observations of the star between 1889 and 1947 which pointed out the occurrence of the outburst at the end of 1944, as well as the stronger variations which preceded it.

Actually there is little evidence of periodicity in the variations from 1889 to 1930, where the observed amplitude was about 1.5 magnitude with a maximum varying between 12.5 and 14. Later, however, the periodicity became evident and the amplitude increased up to three magnitudes approximately.