THE COMPLEX STRUCTURE OF THE CIV EMISSION LINE IN THE SEYFERT 1 GALAXY NGC 4151 AT MINIMUM STATES

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1. THE NARROW AND VARIABLE EMISSION LINES IN THE UV SPECTRUM OF NGC 4151 - PREVIOUS RESULTS

NGC 4151 passes rather frequently through states of deep minima characterized by a weak UV continuum and a nearly complete fading of the broad components of CIV and other permitted lines. The phenomenon described in this short article is best observed during these minima [7]. Other properties of the UV and X-ray continuum and of the emission and absorption lines of NGC 4151 have been presented and discussed elsewhere [1-6].

Two campaigns in 1981 and 1984 during which NGC 4151 was observed every 4 days for several weeks happened to fall during two periods of prolonged minima and have enabled the discovery of two emission lines, L_1 and L_2, at 1518 and 1594 A respectively (in the frame of NGC 4151), with FWHM of < 7 and 16 A respectively. The intensities of these lines vary in the range < 5 to 35 for L_1 and < 20 to 80 for L_2 in units of 10^{-14} erg cm^{-2} s^{-1}, and have been observed to increase by a factor of three in < 10 days [7]. These fast intensity variations, together with the small FWHM, represent the most remarkable properties of these lines.

2. THE RECENT CAMPAIGNS - RESULTS WHICH THEY CONFIRM AND EXTEND

The campaigns of 1985, 1986, 1987 also fall in periods of minimum states. They confirm the behaviour of L_1: the line varies in the same intensity range and with a similar rate of variation as previously observed. It has the same width and the same wavelength (within ± 1 A) as in 1981 and 1984. Moreover, we find that the intensity variations of L_1 are accompanied by small amplitude variations of the continuum (possibly caused by large variations of a component of the continuum which contributes only a small fraction of the total continuum).

The line L_2, in contrast to L_1, displayed properties for which we had only hints.

With the benefit of a large number of campaigns we see now that the behaviour of L_2 is more complicated than could be deduced from the data collected during the campaigns of 1981 and 1984.

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3. NEW RESULTS: MORE COMPLEXITY IN THE STRUCTURE AND IN THE TEMPORAL BEHAVIOUR OF THE LINE L_2

In 1981 and 1984 [7], the line L_2 was strong and isolated. Its intensity and width were easy to measure. At those epochs the line L_2 varied in intensity together with L_1 and the ratio $I(L_2)/I(L_1)$ remained in the range 2 to 3.

In contrast, since 1984 the line L_2 has become weaker, with $I(L_2)/I(L_1)$ less than ~0.7, and is often accompanied by a line henceforth called L'_2 at 1576±2 A. Qualitatively, the behaviour of L_2 and L'_2 can be summarized as follows:

L_2 isolated, L'_2 absent	April-July 1981
L_2 isolated, accompanied by weak L'_2	March, June 1984
L_2 and L'_2 blended, with comparable intensities	November 1983
L'_2 isolated, L_2 weak or absent	2 June 85, May 86
L_2 comes back, L'_2 weak or absent	December 1987

Quantitative measurements of the width and intensity of the line L'_2, in the flank of the strong central component of CIV, cannot be easily carried out on spectra at the resolution of IUE. Profile fittings can be made [2] which suggest that it is $I(L_2 + L'_2)$ which is related to $I(L_1)$ and not the intensity of L_2 alone. But these fittings include uncertain assumptions as to the profile of the central component.

Considering the narrowness of L_1 (unresolved with IUE in low dispersion mode), of L_2, and possibly also of L'_2, it is clear that the study of these lines will greatly benefit from observations at higher wavelength resolution.

It has already been shown to be unlikely that these long-standing features are isolated clouds moving radially. Alternatively, the lines could be transitions, as yet to be identified, at zero redshift with respect to NGC 4151. We recall that the main objection here is that the line L_1 and the line L_2 (at least when it is isolated) are narrow and variable and cannot come from the entire broad line region. They must be emitted by a special local mechanism; thus the possibility already advanced in [7] that they are excited by a two sided jet. Another possibility is that they are due to a disk. In the latter two interpretations, the possible splitting of L_2 into 2 components and its irregular behaviour after 1984 makes the interpretation complicated. A more detailed discussion will be given elsewhere.

More observations with IUE are necessary to confirm qualitatively the behaviour of L_1, L_2 and L'_2. But a major step in understanding this phenomenon will come through observations at higher wavelength resolution. These will give the velocity structure and the precise wavelength of each line, a better separation of each line from the local continuum, and thus better measurements of the line intensities.

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