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Long Term UV Continuum and Line Variability in NGC 1275

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Abstract

The launch of International Ultraviolet Explorer (IUE) satellite in 1978 jointly by NASA, ESA & SERC provided us with an unprecedented opportunity to study the ultraviolet (UV) spectral characteristics of active galaxies in the wavelength region from 1150 Å to 3200 Å. During its most successful observational life in space from 1978 to 1996, IUE made a large number of spectroscopic observations of nearly 500 active galaxies in the redshift range z = 0.001 to z = 3. The archival data of IUE has been very much useful in characterizing the long as well as short timescale UV variability amplitudes in active galaxies. In this paper, we present our results for the first time on the long term emission line and continuum variability studies undertaken using the final archive of IUE's UV spectroscopic data on NGC 1275, a dust dominated BL Lac characterized by the relative variability amplitude (R_{max}) and normalized excess variance also known as F-variance (F_{var}) parameter. The UV continuum flux variability analysis presented in this paper covers more number of emission-line free continuum windows in the UV region which centered at 1710 Å, 1800 Å, 2625 Å, 2875 Å & 3025 Å. We have obtained a higher value of F_{var} ~ 45 % at 1710 Å and lower value of ~ 30 % at 1800 Å

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from F_{var} analysis for the IUE's observational period of 1978 - 1989 . The Lyα, C IV, C III] and Mg II emission lines have been observed as weaker emission line features on fewer occasions and intermittantly. The continuum and emission line variability parameters presented in this paper help in constraining the contemporary accretion disk structure and photoionization models of active galaxies apart from accounting for the variability amplitudes in general.

Keywords: Active Galactic Nuclei—active galaxies—continuum flux— emission line flux—Relative variability amplitudes—normalized excess variance—light curve.

1. Introduction

Our universe known to be only one so far, comprises of innumerable galaxies, each consisting of several million to billions of stars with their bolometric luminosity spread over many orders of magnitude. The process of formation and evolution of galaxies is one of the less understood yet, important astrophysical areas of research studied extensively. A minor fraction of these normal galaxies classified as "active galaxies" or "Active Galactic Nuclei" (AGNs) are characterized by their overwhelming luminosity from their compact nuclei and exhibit variability phenomenon. They are highly luminous galaxies with their active centers emitting luminosity exceeding 10^{42} erg/s. The field of AGNs research is a fast developing area in current astronomical research. In order to probe the physical processes taking place at the cores of AGNs, they are studied quasi-continuously in multiple regions of the electromagnetic spectrum. The physics of the variability activity in active galaxies is not yet well understood despite the quasi-continuous monitoring by photometric and spectroscopic observations of some bright and nearby active galaxies like NGC 4151 ([1], [2], [3], [4]), NGC 5548 ([5], [6]), 3C 273 ([7], [8]), NGC 3516 [5], Mrk 1501 [9], Mrk 335 [10] etc., over the past 70 years, or so. These studies have yielded the classification of the active galaxies broadly into several types such as Seyfert I & II galaxies, LINERS, radio loud and quiet galaxies, Optically Violent Variables (OVV), BL Lacs & Blazars, H II regions, starburst galaxies, quasi-stellar objects (QSOs) and Quasars. One of the important objectives of spectroscopic studies of active galaxies in the UV region is to characterize the UV variability in continuum flux with the associated variability in strong emission lines with occasional absorption lines. These absorption or emission line features may be broad and strong, permitted, forbidden or semi-forbidden with typical line widths of ~ 15,000 - 25,000 km/s covering wide ranging ionization states. The R_{max} and F_{var} parameters are seldom used for characterizing the variability phenomenon in active galaxies [11], [2], [12], [13]. In order to achieve better understanding of the physical processes within the centers of the active galaxies and their surrounding Broad Line Regions (BLR), Narrow Line Regions (NLR) and also on how the emissions by active galaxies affects the host galaxy environment, it is essential to study the variability in both line and continuum emissions. Ultraviolet spectroscopy gives an interesting opportunity to study the complex nature of physical processes of active galaxies through the measurement of line and continuum flux variations.

NGC 1275 is one of the central and brightest member of Perseus cluster of galaxies (Abell 426) and also called alternatively as Perseus A or 3C 84, a well-known X-ray and radio Seyfert galaxy. It is often debated if it should be considered a broad emission line (BEL) Seyfert galaxy, an obscured Seyfert galaxy, a narrow line radio galaxy or a BL-Lac object. X-ray observations by Johnstone & Fabian (1995) [14] and Punsly et. al. (2018) [15] indicate a softer ionizing continuum than expected for a broad line Seyfert galaxy with similar far UV luminosity and is found to be embedded in a complex, multi phase environment. NGC 1275 has been an active target of research by many investigators as it has been interpreted as a pair of colliding galaxies [16]. It has also been called an exploding galaxy by Burbidge et al. (1963) [17]. Studies by Oort (1976) [18] and Rubin et al., (1977) [19] suggested that NGC 1275 is a chance superposition of two non-interacting galaxies. NGC 1275 is one among the twelve galaxies studied by Seyfert (1943) since it had displayed strong emission spectra. Barnes (1968) [20] suspected the continuum variability in NGC 1275 which was later confirmed separately by Selove (1969) [21] and Peterson (1969) [22]. Since then, it has been proven as one of the highly variable nearby active galaxies In the past, UV continuum and emission line variability studies characterized by R_{max} and F_{var} parameters were undertaken using IUE's spectral data processed by old version of IUESIPS* tools. In this paper, we present our results on emission line and continuum variability amplitude studies for the first time in NGC 1275 using the final archival UV spectroscopic data processed by NEWSIPS† tools and importantly with carefully chosen line free continuum windows. NGC 1275 has been observed quasi-continuously by the IUE satellite for nearly 5 years from 1978 to 1987 with gaps in observations for the years 1980, 1984, 1985.

2. Data Reduction, Methodology and Analysis

The International Ultraviolet Explorer (IUE) is the longest-lived and the second most productive UV satellite after Hubble Space Telescope (HST) in the history of space astronomy. It has performed spectrophotometry in the wavelength region of 1150 Å to 3200 Å and low (6-7 Å) resolution spectrophotometry‡ covering a dynamic range of ~ 17 magnitudes. Over one million UV spectra were obtained with IUE telescope between January 26, 1978, and September 30, 1996. There were four cameras in IUE: Short-Wavelength Prime (SWP) and Redundant (SWR) cameras covering the 1150 Å - 2000 Å wavelengths§ and Long-Wavelength Prime (LWP) and Redundant (LWR) cameras covering the UV wavelength 1850 Å - 3200 Å range.

The spectral data used in the present study was obtained from the MAST** - IUE - NED†† NASA database. The flux-calibrated spectra archived for the present study were initially in the *filename.mxlo* format and were not readily analyzable using the IRAF‡‡ packages. Using IUETOOLS software package, these raw files were initially converted into the two dimensional standard *filename.fits* formats

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* IUE Spectral Image Processing System

† New Spectral Image Processing System

‡ See http://archive.stsci.edu/iue for detailed information on the IUE telescope and instrument

§ See http://archive.stsci.edu/iue for detailed information on the IUE telescope and instrument

** Multi mission Archive at STScI

†† NASA Extragalactic Database

‡‡ Image Reduction and Analysis Facility

compatible for further analysis using IRAF software. The raw spectral data was first reduced for "galactic reddening" using the E(B-V) value obtained using equation (1) by using the N_{HI} value estimated from NASA's HEASARC database available online [23] and the "dered" task of IRAF. The redshift corrections have been implemented using the "dopcor" task of IRAF in order to measure the continuous fluxes in the object's rest-frame wavelengths. To implement the "dopcor" task under IRAF we have employed the redshift z = (0.01756 ± 0.00004)[§§] instead of the less precise "z" values given in the IUE-ULDA Access guides 4A & 4B [24].

There were many techniques developed by the IUE project to improve the signal-to-noise ratio (snr), the wavelength assignment and flux calibration of the IUE spectra. At the time of ongoing observations by the IUE, only the old data processing system i.e. IUESIPS was available for spectral data processing and most of the earlier research works were carried out with these old processing tools. But in the present study, we have made use of NEWSIPS processed spectral data, which comes with an improved signal to noise ratio (snr). The IUE's final archival data is now processed with NEWSIPS tools and has resulted in a big increase in the snr by ~ 10 – 50 % as compared to the old spectra processed by IUESIPS tools ([25], [26]). Galactic reddening for NGC 1275 was considered to be zero since the HI column density was estimated to be NHI ~ 2.1×10^{20} cm^{-2} by Stark et.al., (1992) [27] resulting in the E(B-V) ≈ 0.17. Shields and Oke (1975) [28] have used the reddening value of 0.63, as this value was closer to the result obtained by Wampler (1971) [29] who originally estimated the reddening by comparing the line intensities of [SII] λ10320 and λ4072, whereas NED has listed the E(B-V) = 0.163 [30]. In this study, we have used equation (1) to calculate the galactic reddening E(B-V) parameter by taking the NHI value of 1.37×10^{21} as estimated from NASA's HEASARC database [23]

$$E(B-V) = N_H^G / 5.51 \times 10^{21} \qquad - (1)$$

§§ See https:// ned.ipac.caltech.edu/ byname?objname= ngc % 201275&hconst=67.8&omegam=0.308&omegav=0.692&wmap=4&corr_z =1 where N_H^G is the galactic hydrogen column density in the units of cm^{-2}. The spectra used in the present study, have been dereddened using E(B-V) = 0.25.

The UV continuum fluxes presented in this paper have been measured over several continuum windows of varying widths in the carefully chosen line-free regions 1690-1730 Å, 1775-1825 Å, 2600-2650 Å, 2850-2900 Å, 3000-3050 Å. This methodology has lead us to measure the continuum fluxes more accurately than before with higher snr. The continuum flux measurements considered for the variability analysis is the weighted mean over the window widths and the error in the continuum flux measurements is 1σ standard deviation of the mean over the width of the window [5]. To estimate the fluxes of the emission lines, we fitted single / multiple Gaussian profile by using the deblending IRAF task interactively and by visual inspection method for ascertaining the local continuum covering the broad wings of the emission lines.

The long-term and short term variability characterization results obtained in the present study by relative variability amplitude R_{max} and F_{var} parameters in NGC 1275 Seyfert 1 galaxies is the major outcome of the present study. The procedure and formulae used for the estimation of F_{var} are similar to Vaughan et.al. (2003) [31] and Vedavathi & Vijayakumar (2018) [6]. The global parameters along with the apparent R magnitude from NED*** of NGC 1275 are given in Table 1.

Table 1: Global Parameters of NGC 1275

R A	*Declination*	*z*	D_L	*E(B-V)*	*Apparent Magnitude (R)*
hh :mm :ss	*° : ′ : ″*		*Mpc*	*Mag*	*Mag*
03:19:48.2	+41:30:42.11	0.01756 ± 0.00004	75.29 ± 5.28	0.25	10.44 ± 0.02

The log of observational details of the IUE monitoring campaign for NGC 1275 is given in Table 2. A sample of IUE spectra obtained during the IUE's long term monitoring campaign for NGC 1275 chosen for the highest continuum flux is shown in Figure 1.

*** See https://ned.ipac.caltech.edu/ byname?objname=ngc% 201275 & hconst=67.8&omegam=0.308&omegav=0.692&wmap=4&corr_z=1

Table 2: Log of IUE's Observations for NGC 1275

Spectrum	Date of Obs.	UT Start Time	Exposure Time in Seconds	Spectrum	Date of Obs.	UT Start Time	Exposure Time in Seconds
LWR01283	06/04 /1978	05:42:21	7199.82	SWP21248	06/10 /1983	19:32:59	8039.50
LWR03015	23/11 /1978	21:21:00	14399.77	SWP27444	04/01 /1986	08:45:41	21719.73
SWP03430	24/11 /1978	01:27:00	10439.76	SWP27453	05/01 /1986	08:00:56	24359.60
SWP03452	25/11 /1978	22:04:00	20699.82	LWP07461	06/01 /1986	11:55:49	10319.75
LWR04033	16/03 /1979	05:03:43	8999.61	SWP30089	13/01 /1987	07:48:18	25199.69
SWP04658	16/03 /1979	07:37:11	14999.83	SWP30301	13/02 /1987	04:44:19	21179.47
SWP15343	29/10 /1981	15:20:00	22619.62	SWP30310	14/02 /1987	04:53:11	20639.61
SWP15346	30/10 /1981	14:54:00	24599.63	LWP10126	15/02 /1987	04:21:23	22559.83
LWR14475	24/10 /1982	15:16:14	8999.61	LWP16995	24/12 /1989	18:09:57	34199.31
SWP18384	24/10 /1982	17:52:30	13919.72	SWP37893	24/12 /1989	18:08:14	34499.53
SWP18392	25/10 /1982	19:23:10	8519.55	LWP17005	25/12 /1989	18:11:08	3599.85
SWP18447	01/11 /1982	13:24:04	8699.77	LWP17006	25/12 /1989	19:41:46	17399.68
SWP18488	06/11 /1982	12:57:13	12599.58	SWP37899	25/12 /1989	18:09:31	23999.56

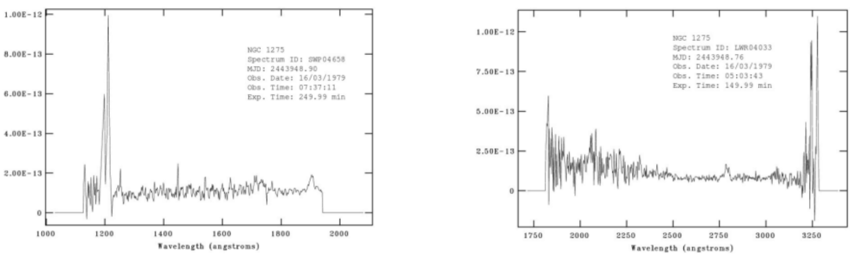

Figure 1: SWP and LWR spectra with highest continuum flux value of NGC 1275 obtained on 16 March 1979.

We have carried out the R_{max} and F_{var} analysis for the nearby active galaxies NGC 1275. UV continuum fluxes with snr ≥ 4.5 only have been chosen for estimating R_{max} and F_{var} parameters. The Lyα emission line is blended with strong geocoronal Lyα feature and we measured the line flux of Lyα feature successfully by employing double-gaussian fitting tool of IRAF and a sample of such fitting is shown in Fig.2.

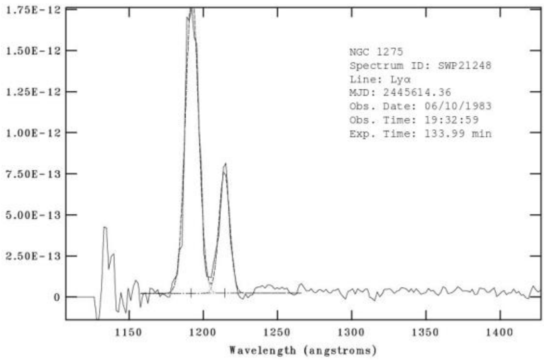

Figure 2: Measurement of line flux by fitting a double Gaussian to Lyα line in spectrum SWP21248.

The continuum fluxes have been measured at the following carefully chosen line free regions both in short and long wavelength windows: 1690-1730 Å, 1775-1825 Å, 2600-2650 Å, 2850-2900 Å, 3000-3050 Å which centred respectively at 1710 Å, 1800 Å, 2625 Å, 2875 Å & 3025 Å. In this paper, we present the variability in strong emission lines and the UV continua at more continuum windows compared to previous studies reported in the published literature. The estimated R_{max} and F_{var} variability parameters in NGC 1275 are given in Tables 3, 4 and 5.

To understand the variability in both UV continuum and lines, we have analysed the continuum and emission line fluxes on yearly basis with a minimum of 4 epochs of observations. Unfortunately, we have very few epochs of repeated observations in NGC 1275 with good snr values thoughout the IUE's observations over 11 years from 1978 to1989. Hence, no good set of data points are available to quantify the magnitude of annualized variability in NGC 1275. The light curves in Fig. 3 and 4 guide our eyes to see the variability in continuum fluxes and these variability amplitudes need to be accounted by theoretical models.

Table 3: Continuum variability characteristics of NGC 1275

Dates of Obser vations	Continuum Window Å	Continuum Flux (min) $F_\lambda \pm \Delta F_\lambda$	snr	Continuum Flux (max) $F_\lambda \pm \Delta F_\lambda$	snr	Mean Continuum Flux	R_{max}	Δt (days)	N
1	2	3	4	5	6	7	8	9	10
29-10-1981 / 16-03-1979	1690-1730	5.68±0.02	6.77	13.43±0.08	5.12	8.07±0.04	2.36	958.37	4
06-10-1983 / 16-03-1979	1775-1825	3.55 ± 0.02	4.58	10.43 ± 0.03	8.82	6.66 ± 0.02	2.94	1665.5 0	9
24-10-1982 / 06-04-1978	2600-2650	3.98 ± 0.02	6.42	8.31 ± 0.03	11.08	5.90 ± 0.03	2.09	1662.4 0	5
15-02-1987 / 16-03-1979	2850-2900	2.67 ± 0.02	5.71	8.51 ± 0.06	5.21	5.47 ± 0.03	3.19	2892.9 7	7
24-11-1978 / 06-04-1978	3000-3050	4.5 ± 0.04	4.64	9.43 ± 0.07	4.84	6.85 ± 0.05	2.10	231.82	4

Notes: Physical quantities under various columns:

Col. 1: Dates of Observation correspond to the continuum flux minima and flux maxima; Col. 3,5, 7: Continuum fluxes-minima, maxima and mean in units of 10^{-14} erg/s/cm^2/Å ; Col. 8: Relative Variability Amplitude; Col. 9: Δt in days; Col. 10: N is the number of epochs of observations considered for computing mean continuum fluxes and its error

Table 4: Line variability characteristics of NGC 1275

Dates of Observations	Line	Line Flux (min) $F_\lambda \pm \Delta F_\lambda$	Line Flux (max) $F_\lambda \pm \Delta F_\lambda$	Mean Line Flux $F_\lambda \pm \Delta F_\lambda$	Mean EW-Å	R_{max}	Δt (days)	N
1	2	3	4	5	6	7	8	9
16-03-1979 / 04-01-1986	Ly α	44.36 ± 0.09	67.55 ± 0.37	58.7 ± 0.27	22.04	1.52	2486.09	3
24-11-1978 / 29-10-1981	C IV	14.0 ± 0.17	16.99 ± 0.34	15.49 ± 0.25	36.27	1.21	1070.65	2
24-11-1978 / 24-10-1982	C III]	3.31 ± 0.14	17.77 ± 0.35	10.54 ± 0.25	24.69	5.36	1430.70	10
06-04-1978 / 24-10-1982	Mg II	22.04 ± 0.11	28.59 ± 0.09	25.53 ± 0.07	44.63	1.27	123.66	4

Note: Col. 1: Date of Observations corresponding to flux minima and maxima; Col. 2: Strong emission line features; Col. 3, 4, 5: Line flux and its errors in units of 10^{-13} erg/s/cm^2. ; Col. 6: mean equivalent width of the gaussian fit ; Col. 7: Relative Variability Amplitude ; Col. 8: Δt-Number of days elapsed between line flux minima and maxima occurrences; Col. 9: N-Number of epochs of observations involved in computing mean line flux values.

Table 5: F_{var} in continuum and emision line fluxes extimated for the observational period from 1978 to 1989

Cont. Window (Å)	$F_{var} \pm \Delta F_{var}$	N
	Continuum Flux	
1690-1730	45.00 ± 0.3	4
1775-1825	30.38 ± 0.12	9
2600-2650	33.26 ± 0.22	5
2850-2900	38.59 ± 0.26	7
3000-3050	38.58 ± 0.41	4
	Emission Lines	
C III]	39.03 ± 0.74	10
Mg II	12.29 ± 0.21	4

Note: Col. 1: continuum flux windows and emission lines;
Col. 2: F_{var} in percentage,
Col. 3: N - number of observations in the long-term monitoring period.

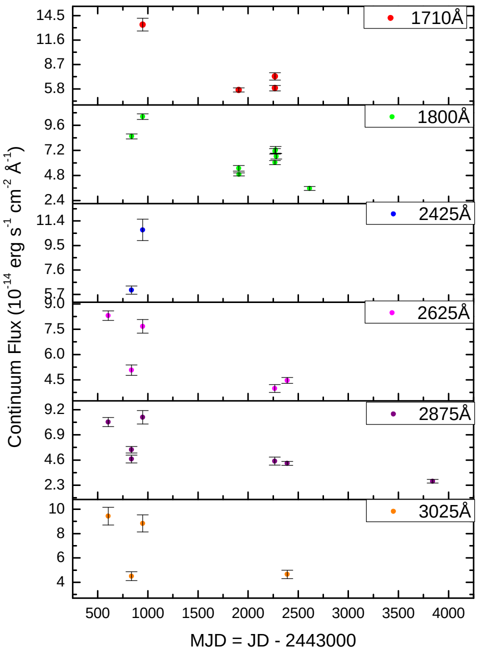

Figure 3: Light curves for the continuum fluxes for NGC 1275 for the quasi-continuous observations from the year 1978 to 1987. Continuum fluxes are in the units of 10^{-14} erg s^{-1} cm^{-2} $Å^{-1}$.

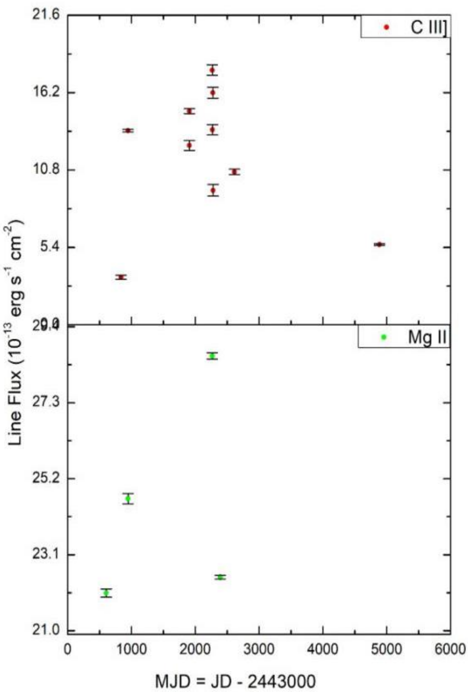

Figure 4: Light curves for the line fluxes for C III] and Mg II in NGC 1275 for the quasi-continuous observations from the year 1978 to 1987. Line fluxes are in the units of 10^{-13} erg s^{-1} cm^{-2}.

3. Results and Discussions

In the present study, we have analyzed 17 SWP and 9 LWP spectra obtained by IUE from 1978 to 1989. The mean UV continuum fluxes for the 1690 - 3050 Å window obtained in the present study range between (5.47 ± 0.03) x 10^{-14} and (8.07 ± 0.04) x 10^{-14} erg/s/cm2/Å. Kinney et al (1991) [32] have reported the continuum flux for the 1425 – 1525 Å window to be ~ 6 x 10^{-15} erg/s/cm^2/Å. Johnstone & Fabian (1995) [14] have reported the flux density to be (6.9 ± 0.3) x10^{-16} erg/s/cm^2/ Å between 1425 Å - 1525 Å and concluded that the continuum variability in the IUE data could be either twice as bright as the median value or it could be as faint as 80 % of the median value. They further suggested that the continuum flux in the UV wavelength is coming from the nucleus of NGC 1275. In the present study, we see that our UV continuum flux measurements are higher by one order of magnitude compared to Kinney et al (1991) [32] and by two orders of magnitude compared to Johnstone & Fabian (1995) [14] . One of the reason that might have lead to the significant discrepancy in the continuum fluxes could be the galactic reddening correction applied to the data in the present analysis. The other factor for orders magnitude change in the fluxes could be the different amplitudes of intrinsic variability exhibited by the NGC 1275 at different epochs of observations by IUE and HST. The relative variability amplitude (R_{max}) has varied between 2.1 to 3.19 for the UV-1690 - 3050 Å continuum windows in this study for quasi-continuous observations of nearly 5 years from 1978 to 1987.

It is evident from the visual inspection of all the IUE spectra of NGC 1275 that they do not contain Lyα (1216 Å), N V (1240 Å), Si IV (1399 Å), C IV (1549 Å), He II (1640 Å) as strong emission line features which are typical for Seyfert 1 galaxies and quasars, but Lyα, C IV, C III] and Mg II lines appear as weak lines. This observation confirms the earlier classification of NGC 1275 as BL Lac object. The presence of the emission lines such as Lyα, C IV, C III] and Mg II as weak lines shows that NGC 1275 is an intermediate type AGN in its nature between Seyfert 1 galaxy and BL Lac.

We have measured the line fluxes and the mean fluxes are Lyα $(58.70 \pm 0.27)10^{-13}$ erg/s/cm^2, C IV $(15.49 \pm 0.25)10^{-13}$ erg/s/cm^2, C III] $(11.75 \pm 0.25)10^{-13}$ erg/s/cm^2 and Mg II $(24.44 \pm 0.10)10^{-13}$ erg/s/cm^2. The emission fluxes as measured by Dixon (1996) [33] for Lyα (1216 Å) is $(66.0 \pm 3.8)x10^{-14}$ erg/s/cm^2 and for C IV broad and narrow components (1551, 1548) to be (4.2 ± 2.25) $x10^{-14}$ and (3.94 ± 2.81) $x10^{-14}$ erg/s/cm^2 respectively. They have also reported the flux for C IV (1548 +1551) to be (3.36 ± 0.15) $x10^{-14}$ erg/s/cm^2 and for He II 1640 Å to be (4.53 ± 2.39) $x10^{-14}$ erg/s/cm^2. We have not seen any broad components for C IV as reported by Dixon (1996) [33] in our present analysis. We do not see the presence of He II line in any of the IUE's observations of NGC 1275 during 1978 - 1987. Johnstone & Fabian (1995) [14] have extensively studied the nucleus of NGC 1275 using the Faint Object Spectrograph (FOS) on board HST and have reported the presence of only Lyα and C IV emission lines in the spectrum at cluster redshift.

We have also calculated the line flux ratios of C IV/ C III] to be ~ 1.31, C IV / Lyα to be ~ 0.26 and C IV / Mg II to be ~0.63. The calculation of line flux ratios help us in classifying the active galaxies into Seyfert 1, Blazars and Quasars according to the predictions of Kwan and Krolik (1981) model which has predicted the C IV/ C III] ratio for Seyfert galaxies to be ~ 5.

In an earlier paper, Johnstone & Fabian (1988), [35] have studied the nucleus in the optical region and reported that it shows a two-component structure with broader nuclear component joining the more spatially extensive narrow line emission regions. On fitting the 2 component model to the C IV line observed in the nuclear region, Johnstone & Fabian (1988), [35] found a total flux of 3.2 ± 0.2 $x10^{-14}$ erg/s/cm^2 while we have obtained a mean flux of (15.49 ± 0.25) $x10^{-13}$ erg/s/cm^2 C IV from IUE's observations on 24 November 1978 and 29 October 1981. Our C IV fluxes are nearly higher by an order of magnitude compared to the fluxes obtained by Johnstone & Fabian (1988), [35] from the HST observations. There are no continuum and emission line flux measurements reported in the literature from the IUE's data for comparison with our results. In most Seyfert 1 galaxies observed by IUE, it is observed that the R_{max} decreases with increasing wavelength, but we do not see such a trend very clearly. We have obtained a higher value of F_{var} ~ 45 % at 1710 Å and lower value ~ 30 % at 1800 Å from F_{var} analysis for the IUE's observations corresponding to the 1978 – 1989 period.

4. Summary and Conclusions

In this paper, we present the long term UV continuum and line variability study in NGC 1275 using complete sample of IUE observations with an aim to understand the UV continuum variability phenomenon in active galaxies and particularly in Seyfert 1 type. A non-trendy variability in continuum and emission lines is exhibited by NGC 1275 in both the R_{max} and F_{var} values for the IUE's observations corresponding to the period 1978 - 1982 and the same is also observed in the annual variability too. The object

NGC 1275 chosen for the present study is a nearby BL Lac AGN. We have attempted to compare their UV variability characteristics using the IUE's long-term observational data. Our studies validate the earlier classification of NGC 1275 as a BL Lac object, but we also report the presence of Lyα, C IV, C III] and Mg II emission lines as weak lines exhibiting strong variability. NGC 1275 has been found to have UV spectral characteristics intermediate to Seyfert 1 active galaxy and BL Lac since the emission lines are appearing as weak and ocassionally.

5. Acknowledgments

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References

[1] Ulrich, M. H., Boksenberg, A., Bromage, G. E., et al.,1991,"The Ultraviolet Spectrum of NGC 4151 from 1978 to 1990: General Characteristics and Evolution", ApJ, 382, 483

[2] Edelson, R. A., Alexander, T., Crenshaw, D. M., et al., 1996, "Multiwavelength Observations of Short-Timescale Variability in NGC 4151. IV. Analysis of Multiwavelength Continuum Variability", ApJ, 470:364.

[3] Crenshaw, D. M., Rodriguez-Pascual, P. M., Penton,S. V., et al. 1996, "Multiwavelength Observations of Short-Timescale Variability in NGC 4151. I. Ultraviolet Observations". ApJ, 470:322.

[4] Vedavathi, P., and Doddamani. V.H., 2018, "Short timescale UV variability study in NGC 4151 using IUE data", JAA, 39(5):55.

[5] Ulrich, M. H., and Boisson, C., 1983, "The ultraviolet spectrum of the Seyfert galaxies NGC 3516 and NGC 5548", ApJ, 267:515-527.

[6] Marshall, H. L., and Carone, T. E., Peterson, B.M. et al, 1997, "The Variability and Spectrum of NGC 5548 in the Extreme Ultraviolet". ApJ, 479 (1) : 222-230.

[7] Ulrich, M. H., Boksenberg, A., Bromage, G. E., et al.,1980, "Detailed ultraviolet observations of the quasar 3C 273 with the IUE", MNRAS, 192: 561-580.
[8] Ramos, E. , Kafatos, M., Fruscione, A., et al, 1997, "Contemporaneous IUE, EUVE, and high-energy observations of 3C 273", ApJ, 482(1):167-172.
[9] Huchra, J. and Geller, M. and Merton, D.,1981, The UV variability of the Seyfert I galaxies III Zw 2 and Markarian 509, NASA Conference Publication, 2171 743-749.
[10] Hyung, S., Kim, H., Lee, W.B.et al., 2000, IUE Spectra of the Seyfert 1 Galaxies Mrk 335 and NGC 4051. JKAS, 33(2):81-88.
[11] Edelson, R.A. and Krolik, J.H. and Pike, G.F., 1990, "Broad-Band Properties of the CfA Seyfert Galaxies. III. Ultraviolet Variability", ApJ, 359, 86.
[12] Turner, T.J. and George, I.M. and Nandra, K. ets., 1999, "On X-Ray Variability in Seyfert Galaxies", Astrophysical Journal, 542: 667-673
[13] Edelson, R., 2002 "Determining the Long-Term Variability and Characteristic Time Scales of Seyfert 1 Galaxies, RXTE Proposal", 70144
[14] Johnstone, R. M., & Fabian. A.C., 1995, "The HST ultraviolet spectrum of the nucleus of NGC 1275: Fermi-accelerated Lyalpha emission", MNRAS, 273, 625-631.
[15] Punsly, B., Marziani, P., Vardha, N., et al, 2018, "Revealing the Broad Line Region of NGC 1275: The Relationship to Jet Power", ApJ, 869, 143.
[16] Adams, T. F. 1977, "The main body of NGC 1275 in the visible ultraviolet", The Publications of the Astronomical Society of the Pacific, 89:488 – 490.
[17] Burbidge, G. R., Burbidge E. M., Sandage A. R., 1963, American Physical Society , "Evidence for the Occurrence of Violent Events in the Nuclei of Galaxies. Reviews of Modern Physics", 35(4):947 – 972.
[18] Oort, J. H. ., 1976, "Interpretations of Radio and Optical Observations of NGC 1275", PASP, 88, 591
[19] Rubin, V.C. and Ford, W.K., Jr., Peterson, C.J. et. al, 1977, "New observations of the NGC 1275 phenomenon"., ApJ, 211: 693-696
[20] Barnes, T. G. 1968, A Search for Optical Variability in Seyfert Galaxies. Astrophysics Letters, 1:171.
[21] Selove, D. M., 1969 "Variability of the Seyfert Galaxy NGC 1275", ApJL, 158:L19.
[22] Peterson, B. A., 1969, "Evidence of Light Variation in NGC 1275", Astrophysical Letters, 3, 103.
[23] HI4PI Collaboration, Ben Bekhti, N. & Floer, L. et al., 2016, HI4PI: A full-sky H I survey based on EBHIS and GASS, A&A, 594, A116.

[24] Courvoisier, T. J. L. & Paltani, S., 1992, "Active galactic nuclei. IUE-ULDA Access Guide Vol. 4A and B. International Ultraviolet Explorer - Uniform Low Dispersion Archive., volume 4A"
[25] Nichols, J. S., & Linsky, J. L., 1996, "The Final Archive and Recalibration of the International Ultraviolet Explorer (IUE) Satellite", ApJ, 111, 517.
[26] Massa , D. & Fitzpatrick, E. L., 2000, "A Recalibration of IUE NEWSIPS Low-Dispersion Data". ApJSS, 126(2):517-535.
[27] Stark, A. A., Gammie, C. F. and Wilson, R. W. et.al., 1992, "The Bell Laboratories H I Survey", ApJs, 79, 77
[28] Shields, G.A. and Oke, J.B.,1975, "The spectral energy distribution of NGC 1275", PASP, 87: 879-883
[29] Wampler, E. J., 1971, Photoelectric Spectrophotometry of Seyfert Galaxies, ApJ 164:1
[30] Johnstone, R. M., & Fabian. A.C., Ferland G.J. et.al., 2012, "Hydrogen two-photon continuum emission from the Horseshoe filament in NGC 1275", MNRAS, 425:1421-1429
[31] Vaughan, S., Edelson, R., Warwick, R. S., & Uttley, P., 2003, "On characterizing the variability properties of X-ray light curves from active galaxies", MNRAS, 345(4):1271-1284.
[32] Kinney et al , 1991, "An ultraviolet atlas of quasar and blazar spectra", ApJss, 75:645-717.
[33] Dixon, W. V. D., Davidsen, A. F. and Ferguson, H. C., 1996, "Observations of Far-UV Emission From NGC 1275 With the Hopkins Ultraviolet Telescope", The Astron.Jour., 111: 130.
[34] Peterson, B. A., 1969, Evidence of Light Variation in NGC 1275, ApJ Letters, 3, 103.
[35] Johnstone, R. M., & Fabian. A.C., 1988, Extended emission-line gas in NGC 1275 and the central galaxy in A 1795: evidence for a distributed rather than a central source of ionization, MNRAS, 233:581-599

Conflict of Interest statement

No Conflict of Interest

Author contribution statement

All authors are equally contributed at different levels.