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A SEARCH FOR "DWARF" SEYFERT NUCLEI. II. AN OPTICAL SPECTRAL ATLAS OF THE NUCLEI OF NEARBY GALAXIES

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ABSTRACT

We present an optical spectral atlas of the nuclear region (generally 2″ × 4″, or $r \lesssim 200$ pc) of a magnitude-limited survey of 486 nearby galaxies having $B_T \leq 12.5$ mag and $\delta > 0°$. The double spectrograph on the Hale 5 m telescope yielded simultaneous spectral coverage of ~4230–5110 Å and ~6210–6860 Å, with a spectral resolution of ~4 Å in the blue half and ~2.5 Å in the red half. This large, statistically significant survey contains uniformly observed and calibrated moderate-dispersion spectra of exceptionally high quality. The data presented in this paper will be used for various systematic studies of the physical properties of the nuclei of nearby galaxies, with special emphasis on searching for low-luminosity active galactic nuclei, or "dwarf" Seyferts. Our survey led to the discovery of four relatively obvious but previously uncataloged Seyfert galaxies (NGC 3735, 4395, 4639, and 6951), and many more galactic nuclei showing subtle evidence for Seyfert activity. We have also identified numerous low-ionization nuclear emission-line regions (LINERs), some of which may be powered by nonstellar processes. Of the many "starburst" nuclei in our sample, several exhibit the spectral features of Wolf-Rayet stars.

Subject headings: atlases — galaxies: nuclei — galaxies: Seyfert

1. INTRODUCTION

The advent of linear detectors with high quantum efficiency in the optical bandpass launched a number of extensive spectroscopic surveys of nearby galactic nuclei in the past 15 years (Heckman, Balick, & Crane 1980; Stauffer 1982; Keel 1983a, b; Filippenko & Sargent 1985; Véron-Cetty & Véron 1986; Phillips et al. 1986). Keel (1985) and Filippenko & Sargent (1986) summarize many of the principal findings of these works. Chief among these include the discovery of the high incidence of nuclei with emission-line spectra uncharacteristic of photoionization by normal, massive stars. Efforts to unravel the energy source of these low-ionization nuclear emission-line regions, or LINERs (Heckman 1980), sparked lively discourse which still persists. A viable interpretation (see Ho, Filippenko, & Sargent 1993, and references therein, hereafter HFS) considers LINERs as low-luminosity ("dwarf") active galactic nuclei (AGNs), physically similar to but fainter than "classical" AGNs such as Seyfert galaxies and quasars. If LINERs are indeed low-luminosity AGNs, a reliable census of their space density will have many important applications. For example, the faint end ($M_B \leq -18$ mag) of the local ($z \approx 0$) luminosity function of AGNs is very poorly constrained at the present time (e.g., Weedman 1986). Its uncertainty directly affects our understanding of several issues, including the evolution of the overall AGN luminosity function, the contribution of AGNs to the cosmic X-ray background, and the processes responsible for the formation and evolution of AGNs in galaxies.

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Regardless of the interpretation of the physical nature of LINERs, however, their sheer ubiquity demands an accurate quantitative assessment of their prevalence as well as a careful characterization of their observed properties. For these tasks one would benefit from a homogeneous, statistically complete set of reliable data on the nuclei of nearby galaxies. The detection, measurement, and modeling of nuclear emission lines, which are often very weak and heavily contaminated by the underlying starlight from the galactic bulge, require data with adequate signal-to-noise ratio (S/N) and spectral resolution (see HFS). The existing surveys cited above suffer from some of the following limitations: (1) insufficient wavelength coverage, (2) poor spectral resolution, (3) marginal S/N, (4) use of large (~10″) slit or aperture, resulting in severe starlight contamination and loss of spectral resolution, (5) inhomogeneous selection criteria, and (6) inadequate treatment of starlight removal in the analysis. Consequently, in 1984 we initiated an optical spectroscopic survey to largely overcome these shortcomings; our aim was to obtain high-quality, homogeneously calibrated spectra of a statistically complete sample of ~500 nearby galactic nuclei. The primary goals were to discover dwarf Seyfert nuclei and to determine their luminosity function.

Preliminary results of this study based on a biased subsample of 75 objects were presented in Filippenko & Sargent (1985, hereafter Paper I; 1986), and an updated summary was given in Ho, Filippenko, & Sargent (1994). A few individual objects of particular interest have been discussed in detail by Filippenko, Shields, & Sargent (1988, NGC 4496A,B), Filippenko & Sargent (1988, M81; 1989, NGC 4395; 1992, NGC 3079), and Sargent & Filippenko (1991, NGC 4214). Here, a summary of the selection criteria of the complete survey and a description of the data acquisition and reduction techniques are given in § 2, a spectral atlas of nearly all galaxies in the survey is presented in § 3, while § 4 contains a brief description of the salient features of some notable objects. Later papers in this series will provide measurements of emission-line intensities and profiles, discuss the excitation mechanisms of the various classes of emission-line objects observed, and quantify the luminosity function of low-luminosity AGNs.[2]

2. DESCRIPTION OF THE SURVEY

2.1. *Selection Criteria*

Our optical spectroscopic survey of the nuclei of nearby galaxies was conducted between 1984 and 1990, with a few objects observed in 1982 to test the feasibility of the program. We selected all galaxies from the Revised Shapley-Ames Catalog of Bright Galaxies (RSA; Sandage & Tammann 1981) and the Second Reference Catalogue of Bright Galaxies (RC2; de Vaucouleurs, de Vaucouleurs, & Corwin 1976) which satisfy the criteria $B_T \leq 12.5$ mag and $\delta > 0°$.

The chosen limiting apparent magnitude provides a fairly large, though logistically feasible sample of galaxies for the program. The statistical completeness of the sample is as defined for the RSA: the incompleteness of the catalog is thought to begin near $B_T = 12.0$ mag and becomes increasingly more severe by $B_T = 12.5$ mag. Twelve additional objects (NGC 1052, 1068, 1161, 1358, 1667, 2639, 3185, 3884, 4235, 4594, 5077, and 5548) of special or historical interest were also included, even though they did not satisfy one or both of the selection criteria of the survey. Similarly, three others (NGC 3115, 6501, and 6702) were observed only because they have absorption-line spectra suitable for removing the stellar component from the emission-line spectra (see HFS). The final sample consists of 503 galaxies.

There are a total of 17 galaxies for which we do not have data (Table 1). Of these, four were too diffuse to be observed during the mostly bright runs allocated to our survey; they are mainly low surface brightness dwarf ellipticals and dwarf irregulars which are either probable or definite members of the Local Group. The wrong target was observed for one object (UGC 7658), another (NGC 5350) was accidentally omitted, and spectra of the remaining 11 galaxies were lost after the data had been acquired. Table 2 provides a complete journal of observations for the 17 observing runs devoted to the survey and summarizes a few of the global properties of the final sample of 486 galaxies. We list the following information in the columns: (1) galaxy name, (2) UT date of observation, (3) exposure time, (4) position angle of the slit, (5) parallactic angle at the midpoint of the observation, (6) air mass at the midpoint of the observation, (7) a subjective estimate of the seeing, (8) a visual estimate of the transparency of the sky during the observation of the galaxy or standard star, (9) right ascension, (10) declination, (11) Hubble type, and, where appropriate, luminosity class, (12) apparent blue magnitude, (13) heliocentric velocity, (14) figure in which the spectrum of the galaxy is plotted, and (15) miscellaneous notes. Many of the properties listed were taken from the useful compilation of Kraan-Korteweg (1986), which in turn relies heavily on the RSA and occasionally on the RC2. The heliocentric velocities were taken from the updated Third Reference Catalogue of Bright Galaxies (RC3; de Vaucouleurs et al. 1991). (More accurate radial velocities of the galaxies will be measured and published in subsequent analyses.) See the notes to Table 2 for a full description of the columns. Several galaxies have B_T fainter than the formal limit of the survey ($B_T \leq 12.5$ mag) but are not included in the above list of additional objects; the discrepancy can be attributed to errors in the apparent magnitudes given in Appendix A of the RSA, from which the galaxies were originally selected.

The heliocentric velocity, apparent magnitude, and Hubble type distribution of the sample are shown in Figures 1*a*–1*c*, respectively. The distributions are very similar to those shown in the RSA (see Figs. 1–3 of the RSA).

TABLE 1
MISSING GALAXIES

Galaxy	B_T	Reason
Sex B	11.9	Too diffuse
Leo I	10.8	Too diffuse
Leo II	12.7	Too diffuse
IC 1613	9.9	Too diffuse
NGC 5350	12.2	Accidentally omitted
Ho II	11.1	Data lost
NGC 2805	11.8	Data lost
NGC 3206	12.5	Data lost
NGC 3381	12.5	Data lost
NGC 3614	12.2	Data lost
NGC 4116	12.4	Data lost
NGC 4498	12.6	Data lost
NGC 4519	12.3	Data lost
NGC 4571	11.8	Data lost
NGC 4632	12.2	Data lost
NGC 7541	12.5	Data lost
UGC 7658	11.2	Wrong target

2.2 *Observations and Data Reduction*

Two-dimensional (long-slit) spectra were obtained using the double spectrograph (Oke & Gunn 1982) mounted at the Cassegrain focus of the Hale 5 m telescope at Palomar Observatory. A dichroic filter located behind the slit reflected light with $\lambda \lesssim 5500$ Å to the "blue camera" and transmitted light with $\lambda \gtrsim 5500$ Å to the "red camera." The spectra were recorded on TI CCDs of 800 × 800 square pixels, with the exception of the 1984 July UT run, in which a 512 × 512 pixel RCA CCD was used in the blue camera. The spatial resolution of the red camera was 0″.58 pixel^{-1}, while that of the blue camera was either 0″.39 or 0″.78 pixel^{-1}, depending on the observing run. The blue spectra were obtained with a 600 line mm^{-1} grating blazed at 3780 Å, yielding a spectral coverage of ~ 4230–5110 Å with ~ 4 Å resolution; for the red spectra, we used a 1200 line

[2] We have also obtained spectra of a small subsample of galaxies covering the entire "optical" bandpass observable from the ground (~3100–10000 Å) in order to study a more complete set of emission lines and the stellar population. Full presentation of those data will be given in Ho, Filippenko, & Sargent (1995; see also HFS), but here we will allude to some of the results when appropriate.

TABLE 2

SUMMARY OF OBSERVATIONS AND GALAXY SAMPLE

Galaxy (1)	UT Date (2)	Exp. (3)	PA (4)	PPA (5)	sec z (6)	See. (7)	Phot. (8)	α(1950) (9)	δ(1950) (10)	Type (11)	B_T (12)	v_r (13)	Fig. (14)	Notes (15)
NGC 7814	24 Sep 1985	1500	44	129	1.16	1.8	yes	00 00 41	+15 52 00	S(ab)	11.3	1042	2	b
NGC 7817	24 Sep 1985	1800	51	130	1.08	1.5	yes	00 01 24	+20 28 24	Sbc: (spindle)	12.4	2157	2	a,i
NGC 63	24 Sep 1985	1200	100	149	1.11	1.5	yes	00 15 11	+11 10 18	S pec	12.3	1172	2	a
IC 10	26 Sep 1985	1000	104	61	1.24	1.3	yes	00 17 41	+59 00 54	Im? IV	11.7	−342	2	
	22 Feb 1987	3000	85	75	1.95	2.0	no							g
	23 Feb 1987	900	85	83	1.72	2.0	no							g
NGC 147	21 Feb 1987	2700	78	75	1.80	2.8	yes	00 30 28	+48 13 48	dE5	10.3	−160	2	g
	21 Feb 1987	600	78	70	2.10	2.8	yes							g
NGC 185	26 Sep 1985	1000	90	75	1.17	1.3	yes	00 36 11	+48 03 42	dE3 pec	10.1	−251	3	
NGC 205	25 Sep 1985	1400	90	56	1.03	1.8	yes	00 37 38	+41 24 54	dS0/E5 pec	8.8	−254	3	b
	30 Jul 1986	800	80	13	1.01	1.5	yes							j
NGC 221	25 Sep 1985	400	90	71	1.05	2.0	yes	00 39 59	+40 35 30	E2	9.0	−205	3	
	30 Jul 1986	300	35	34	1.01	1.5	yes							j
NGC 224	25 Sep 1985	400	90	73	1.06	2.0	no	00 40 00	+40 59 42	Sb I-II	4.3	−295	3	
	25 Sep 1985	350	90	80	1.09	2.0	no							
	28 Jul 1986	400	90	42	1.02	1.5	yes							j
	22 Feb 1987	300	77	76	1.60	1.8	no							g
	22 Feb 1987	900	77	74	1.70	1.8	no							g
NGC 266	26 Sep 1985	1300	96	100	1.01	1.0	yes	00 47 06	+32 00 23	SB(rs)ab	12.3	4682	3	a
NGC 278	25 Sep 1985	1000	90	31	1.04	1.0	yes	00 49 15	+47 16 48	S(s)bc II.2	11.5	622	4	
NGC 315	26 Sep 1985	1200	90	136	1.00	1.0	yes	00 55 06	+30 04 54	$S0^-$:	12.2	4936	4	
NGC 404	18 Jul 1982	1800	100	98	1.21	2.0	yes	01 06 39	+35 27 06	$S0_3$	11.1	−19	4	c,f
	26 Feb 1986	1200	74	73	1.58	1.0	yes							
NGC 410	25 Sep 1985	1100	90	94	1.01	1.8	yes	01 08 12	+32 53 10	SB0:	12.3	5296	4	
NGC 428	22 Jan 1987	3000	43	44	1.53	2.8	no	01 10 23	+00 42 54	S(s)c III	11.8	1045	4	
NGC 474	25 Sep 1985	1200	170	172	1.16	1.8	yes	01 17 32	+03 09 18	RS0/a	12.3	2315	5	
NGC 488	25 Sep 1985	1100	0	2	1.13	1.8	yes	01 19 11	+04 59 48	S(sr)ab I	11.1	2233	5	
NGC 507	26 Sep 1985	1200	90	94	1.00	1.0	yes	01 20 50	+32 59 42	S(r)0	12.1	4924	5	
NGC 514	24 Sep 1985	2600	140	138	1.15	1.5	yes	01 21 25	+12 39 30	S(s)c II	12.5	2527	5	i
NGC 521	24 Sep 1985	1800	160	171	1.18	1.0	yes	01 22 00	+01 28 12	SB(sr)c I	12.5	5028	5	a
NGC 520	24 Sep 1985	1200	146	3	1.15	1.0	yes	01 22 00	+03 31 54	I0	12.0	2059	6	a
NGC 524	24 Sep 1985	1000	160	155	1.12	1.0	yes	01 22 10	+09 16 42	$S0_2$/a	11.6	2421	6	
NGC 598	26 Sep 1985	1200	90	4	1.00	1.3	yes	01 31 03	+30 23 54	S(s)c II-III	6.2	−204	6	h,i
NGC 628	14 Jan 1985	1800	52	53	1.23	3.5	yes	01 34 01	+15 31 36	S(s)c I	9.7	632	6	e
	23 Feb 1987	1800	61	60	1.95	2.8	no							g
NGC 660	25 Sep 1985	1500	0	7	1.06	1.3	yes	01 40 21	+13 23 18	SB(s)a pec	11.6	823	6	
IC 1727	14 Jan 1985	1800	72	70	1.30	3.5	yes	01 44 41	+27 05 00	SB(s)m III-IV	12.1	393	7	e
NGC 672	15 Jan 1985	1800	73	70	1.18	2.0	yes	01 45 05	+27 11 06	SB(s)c III	11.4	390	7	a
NGC 676	25 Sep 1985	1200	105	14	1.14	1.3	yes	01 46 20	+05 39 36	S0/a: (spindle)	10.2	1506	7	o
NGC 697	26 Sep 1985	1500	106	12	1.02	1.3	yes	01 48 31	+22 06 36	SB(r)bc:	12.4	3117	7	a,i
NGC 718	15 Jan 1985	2000	31	33	1.24	2.5	yes	01 50 37	+03 57 00	Sa I	12.5	1762	7	
NGC 772	15 Jan 1985	1800	90	31	1.05	2.3	yes	01 56 35	+18 46 00	S(sr)b I	11.1	2454	8	
NGC 777	26 Sep 1985	1200	106	69	1.01	1.5	yes	01 57 21	+31 11 12	E1	12.3	4985	8	
NGC 783	26 Sep 1985	1500	90	78	1.02	1.5	yes	01 58 12	+31 38 28	Sc	12.5	5110	8	
NGC 784	22 Jan 1987	3600	2	71	1.25	2.8	no	01 58 25	+28 35 48	Sdm	12.2	221	8	a,i
NGC 812	24 Feb 1986	2700	152	83	1.41	1.8	yes	02 03 43	+44 20 12	S pec	12.5	5163	8	a,i
NGC 821	24 Sep 1985	1000	0	52	1.40	1.0	yes	02 05 41	+10 45 30	E6	11.9	1718	9	
NGC 818	23 Feb 1986	2700	78	78	1.41	1.5	yes	02 05 43	+38 32 24	SBc:	12.4	4457	9	
NGC 841	26 Sep 1985	1200	80	83	1.22	0.8	no	02 08 18	+37 15 43	RSBab	12.5	4463	9	h
NGC 864	24 Sep 1985	1800	0	8	1.13	1.0	yes	02 12 50	+05 46 12	S(r)bc II-III	11.5	1550	9	
NGC 877	25 Sep 1985	1800	127	21	1.07	1.3	yes	02 15 16	+14 18 54	S(s)c I-II	12.5	3983	9	
NGC 890	22 Feb 1986	1800	75	76	1.26	1.0	no	02 19 02	+33 02 18	$S0_1(5)$	12.4	4006	10	
NGC 891	26 Sep 1985	1200	112	104	1.08	1.0	no	02 19 25	+42 07 12	Sb (on edge)	10.9	528	10	b
NGC 925	15 Jan 1985	1800	100	78	1.22	2.0	yes	02 24 18	+33 21 06	SB(s)c II-III	10.5	562	10	a,g
NGC 959	24 Sep 1985	1800	90	93	1.03	1.0	yes	02 29 18	+35 16 29	Sdm:	12.2	664	10	
NGC 972	14 Jan 1985	1800	72	72	1.25	4.0	yes	02 31 17	+29 05 30	Sb pec	12.1	1550	10	b,e
IC 239	26 Sep 1985	1500	96	93	1.10	0.7	no	02 33 20	+38 45 10	SB(rs)cd	11.9	903	11	
NGC 1003	24 Sep 1985	1800	95	95	1.12	1.0	yes	02 36 06	+40 39 24	S(s)cd	12.0	585	11	a,i,q
NGC 1023	15 Jan 1985	1200	90	92	1.11	2.0	yes	02 37 16	+38 50 54	$SB0_1(5)$	10.3	601	11	
NGC 1052	13 Feb 1984	1069	33	30	1.52	2.8	no	02 38 37	−08 28 06	E3/S0	11.5	1474	11	
	14 Feb 1984	1800	30	30	1.52	2.3	no							
NGC 1055	25 Sep 1985	2200	104	18	1.22	1.3	yes	02 39 11	+00 13 42	S(s)bc II	11.4	958	11	a,i,q
NGC 1068	14 Feb 1984	600	40	39	1.43	2.8	no	02 40 07	−00 13 30	S(sr)b II	9.5	1093	12	
	14 Feb 1984	300	40	41	1.48	2.8	no							
NGC 1058	24 Sep 1985	1800	90	95	1.06	1.0	yes	02 40 23	+37 07 48	S(s)c II-III	12.1	492	12	

TABLE 2—*Continued*

Galaxy (1)	UT Date (2)	Exp. (3)	PA (4)	PPA (5)	sec z (6)	See. (7)	Phot. (8)	α(1950) (9)	δ(1950) (10)	Type (11)	B_T (12)	v_r (13)	Fig. (14)	Notes (15)
NGC 1073	25 Sep 1985	2200	62	30	1.27	1.2	yes	02 41 05	+01 09 54	SB(sr)c II	11.5	1209	12	a,g
NGC 1156	25 Sep 1985	1930	58	65	1.12	1.0	yes	02 56 47	+25 02 24	Sm IV	12.2	372	12	
NGC 1161	23 Feb 1986	2000	152	86	1.36	1.5	yes	02 57 54	+44 41 59	S0	12.3	1940	12	m
	23 Feb 1987	1132	87	89	1.30	2.8	no							g
NGC 1167	15 Feb 1984	1500	75	76	1.38	1.0	yes	02 58 35	+35 00 42	S0	13.3	4895	13	
NGC 1169	15 Feb 1984	1200	90	93	1.26	1.0	yes	03 00 10	+46 11 06	SB(r)a I	12.5	2342	13	
NGC 1186	24 Feb 1986	2700	120	86	1.30	2.0	yes	03 02 13	+42 38 29	SB(r)bc	12.2	2658	13	e
NGC 1275	15 Feb 1984	1200	90	94	1.14	1.3	yes	03 16 30	+41 19 48	E pec	12.3	5260	13	
NGC 1358	14 Feb 1984	900	30	32	1.46	2.5	no	03 31 11	−05 15 24	SB(s)a I	13.0	4021	13	
	15 Feb 1984	1000	22	22	1.34	1.5	yes							
IC 342	20 Feb 1986	1213	135	135	1.29	3.0	no	03 41 58	+67 56 24	S(B)(rs)cd I-II	9.4	−4	14	
	22 Feb 1987	1500	117	121	1.36	1.0	no							a,g
	22 Feb 1987	600	12	114	1.41	1.0	no							a,g
IC 356	21 Feb 1986	1688	120	122	1.38	2.5	no	04 02 34	+69 40 40	S(s)ab pec	11.4	888	14	e
	21 Feb 1987	2700	125	127	1.36	3.0	yes							g
NGC 1569	27 Feb 1985	1200	141	151	1.20	1.8	yes	04 26 05	+64 44 24	Sm	11.9	−74	14	
	28 Feb 1985	300	141	152	1.20	1.8	no							
NGC 1560	22 Jan 1987	3600	26	149	1.31	2.5	no	04 27 04	+71 46 12	S(s)d	12.2	−194	14	a
NGC 1667	14 Feb 1984	1150	18	19	1.35	2.3	no	04 46 10	−06 24 24	S(r)c I-II	12.7	4587	14	
	15 Feb 1984	1200	10	7	1.31	1.5	yes							
NGC 1961	28 Feb 1985	2000	170	103	1.53	1.8	no	05 36 34	+69 21 18	S(sr)b pec II	11.8	3983	15	
NGC 2146	15 Feb 1984	1200	160	158	1.43	1.3	yes	06 10 45	+78 22 30	Sb pec II	11.2	873	15	
NGC 2273	15 Feb 1984	1200	0	173	1.13	1.0	yes	06 45 38	+60 54 13	SB(rs)0/a:	12.3	1903	15	
NGC 2268	15 Jan 1985	1800	16	18	1.60	2.0	yes	07 00 49	+84 27 48	S(s)bc II	12.2	2304	15	
NGC 2339	24 Feb 1985	1500	63	176	1.03	1.8	yes	07 05 25	+18 51 42	SB(s)c II	12.3	2361	15	a
NGC 2342	22 Feb 1986	2700	140	141	1.04	1.0	yes	07 06 24	+20 43 03	S pec	12.2	5209	16	
UGC 3714	25 Feb 1986	2000	30	30	1.31	1.3	yes	07 06 48	+71 50 00	S? pec	12.5	3064	16	
NGC 2276	25 Feb 1985	1800	15	16	1.65	1.0	yes	07 10 31	+85 50 54	S(r)c II-III	11.9	2372	16	
NGC 2300	25 Feb 1985	1000	5	9	1.64	1.0	yes	07 15 47	+85 48 36	E3	12.1	1963	16	
NGC 2336	26 Feb 1985	1600	15	21	1.48	1.0	yes	07 18 28	+80 16 36	SB(r)bc I	11.1	2205	16	
UGC 3828	23 Feb 1986	2550	0	0	1.10	2.0	yes	07 20 22	+58 04 01	SB(rs)b	12.5	3510	17	e
IC 467	22 Jan 1987	3600	8	4	1.46	2.5	no	07 21 55	+79 58 30	SB(s)c:	12.5	2057	17	
NGC 2366	26 Feb 1985	1600	15	27	1.26	1.0	yes	07 23 37	+69 19 06	SBm IV-V	11.4	87	17	
NGC 2403	28 Feb 1985	2000	34	20	1.20	1.8	no	07 32 03	+65 42 42	S(s)c III	8.8	107	17	i
UGC 4028	26 Feb 1986	2700	30	34	1.37	1.0	yes	07 44 42	+74 29 04	SB(s)c?	12.5	3952	17	
NGC 2500	25 Feb 1985	1800	10	25	1.06	1.1	yes	07 58 08	+50 52 36	S(s)c II.8	12.2	437	18	a,i
NGC 2543	25 Feb 1986	2500	75	90	1.09	1.5	yes	08 09 43	+36 24 24	SB(s)b	12.4	2467	18	h
NGC 2537	27 Feb 1985	1000	142	47	1.05	1.3	yes	08 09 43	+46 08 42	Sc pec III	12.3	444	18	
NGC 2541	27 Feb 1985	1800	70	65	1.12	1.5	yes	08 11 02	+49 13 00	S(s)c III	12.2	628	18	
NGC 2549	27 Feb 1985	1300	35	43	1.15	1.3	yes	08 14 57	+57 57 36	$S0_{(1-2)}(7)$	12.1	1070	18	
NGC 2639	12 Feb 1984	900	75	72	1.18	2.0	no	08 40 04	+50 23 12	Sa	12.6	3198	19	
	13 Feb 1984	1200	136	29	1.06	1.8	no							a
NGC 2634	22 Feb 1986	1800	25	22	1.34	1.3	yes	08 42 56	+74 09 06	E1:	12.4	2268	19	h
IC 520	22 Feb 1986	1800	35	35	1.36	1.3	yes	08 48 21	+73 40 48	SB(rs)ab?	12.8	3528	19	
NGC 2655	26 Feb 1985	1200	30	30	1.45	1.3	yes	08 49 08	+78 24 48	Sa pec	10.9	1407	19	
NGC 2683	24 Feb 1985	1500	42	90	1.00	1.5	yes	08 49 35	+33 36 30	Sb: II-III	10.6	358	19	
NGC 2681	12 Feb 1984	900	85	78	1.25	2.0	no	08 49 58	+51 30 18	Sa	11.0	683	20	
	12 Feb 1984	600	85	84	1.33	2.0	no							
NGC 2685	15 Feb 1984	900	30	18	1.37	1.0	yes	08 51 41	+75 55 30	$S0_3(7)$ pec	11.9	869	20	a
NGC 2715	26 Feb 1985	1800	21	25	1.43	1.3	yes	09 01 50	+78 17 12	S(s)c II	11.9	1275	20	
NGC 2750	24 Feb 1986	2550	100	116	1.08	2.0	yes	09 02 48	+25 38 11	SBc	12.3	2644	20	
NGC 2742	25 Feb 1985	2000	30	28	1.15	1.5	yes	09 03 38	+60 48 54	S(sr)c II	12.3	1273	20	
NGC 2770	22 Jan 1987	3600	57	93	1.01	2.8	no	09 06 30	+33 19 42	S(s)c:	11.8	1955	21	
NGC 2775	14 Jan 1985	1500	148	149	1.17	2.8	yes	09 07 41	+07 14 30	S(r)a	11.2	1340	21	e
NGC 2768	13 Feb 1984	1200	40	42	1.17	1.5	no	09 07 45	+60 14 30	$S0_{(1-2)}(6)$	10.9	1335	21	
	15 Jan 1985	1200	62	62	1.26	2.0	yes							
NGC 2748	15 Jan 1985	1800	39	38	1.43	2.0	yes	09 08 01	+76 40 54	S(s)c II	12.4	1456	21	
NGC 2776	24 Feb 1985	1800	64	64	1.07	1.8	yes	09 08 56	+45 09 36	S(sr)c I	12.2	2618	21	
NGC 2782	15 Jan 1985	1800	80	77	1.07	2.0	yes	09 10 54	+40 19 18	S(s)a pec	12.1	2532	22	
	09 Apr 1988	900	80	151	1.01	1.0	yes							n
NGC 2787	15 Feb 1984	900	20	22	1.25	1.0	yes	09 14 50	+69 24 54	SB0/a	11.7	649	22	
NGC 2832	23 Feb 1986	2000	45	93	1.03	1.8	yes	09 16 45	+33 57 36	E3 (tides)	12.4	6869	22	h,m
NGC 2841	12 Feb 1984	1200	60	56	1.11	2.0	no	09 18 35	+51 11 18	Sb	10.1	635	22	
NGC 2859	27 Feb 1985	1000	80	91	1.05	1.5	yes	09 21 15	+34 43 42	$RSB0_2(3)$	11.8	1659	22	b
NGC 2903	14 Jan 1985	1200	10	134	1.05	3.0	yes	09 29 20	+21 43 12	S(s)c I-II	9.5	565	23	e

TABLE 2—*Continued*

Galaxy (1)	UT Date (2)	Exp. (3)	PA (4)	PPA (5)	sec z (6)	See. (7)	Phot. (8)	α(1950) (9)	δ(1950) (10)	Type (11)	B_T (12)	v_r (13)	Fig. (14)	Notes (15)
NGC 2911	13 Feb 1984	1233	165	164	1.10	1.5	no	09 31 05	+10 22 36	$S0_3(2)$	12.6	3167	23	
	15 Feb 1984	1500	155	155	1.11	1.0	yes			or S0 pec				
NGC 2977	22 Feb 1986	1042	28	30	1.37	1.3	no	09 38 51	+75 05 27	Sb:	12.5	3072	23	
NGC 2950	27 Feb 1985	1100	50	52	1.19	1.5	yes	09 38 59	+59 04 48	$RSB0_{(2-3)}$	11.8	1337	23	a,e
NGC 2967	14 Jan 1985	2000	165	165	1.21	4.0	yes	09 39 29	+00 33 54	S(sr)c I-II	12.3	2212	23	e
NGC 2964	26 Mar 1986	1500	90	100	1.06	1.5	yes	09 39 56	+32 04 36	S(s)c II.2	12.0	1311	24	g
	26 Mar 1986	200	90	100	1.03	1.5	yes							g
NGC 2976	25 Feb 1985	1800	44	24	1.24	1.8	yes	09 43 10	+68 08 54	Sd III-IV	10.8	11	24	
NGC 3003	29 Mar 1986	3000	86	92	1.01	1.0	no	09 45 37	+33 39 12	S(s)c II	12.1	1476	24	a,g,i
	29 Mar 1986	400	86	86	1.03	1.3	no							a,g,i
NGC 2985	12 Feb 1984	1200	35	32	1.33	2.0	no	09 45 54	+72 30 42	S(s)ab	11.2	1299	24	
NGC 3041	15 Jan 1985	1800	134	134	1.11	2.0	yes	09 50 23	+16 54 48	S(s)c II	12.2	1309	24	
NGC 3027	08 Feb 1988	3600	123	82	1.63	3.0	yes	09 51 17	+72 26 24	SB(rs)d: III	12.4	1046	25	a,i,l
NGC 3031	12 Feb 1984	600	65	63	1.41	2.0	no	09 51 30	+69 18 18	S(r)b I-II	7.8	−49	25	
	12 Feb 1984	1500	65	57	1.37	2.0	no							
	18 Feb 1986	950	45	47	1.32	3.5	no							
	25 Feb 1986	600	60	57	1.37	2.5	yes							d
	25 Feb 1986	1500	0	2	1.23	1.3	yes							c
	25 Feb 1986	1000	138	172	1.24	1.0	yes							c
	25 Feb 1986	1100	48	165	1.24	1.3	yes							c
	25 Feb 1986	400	65	160	1.25	1.3	yes							
	25 Feb 1986	1100	90	154	1.26	1.0	yes							c
	27 Mar 1986	300	65	47	1.32	1.0	yes							g
	27 Mar 1986	300	45	45	1.31	1.0	yes							d,g
	29 Mar 1986	960	65	164	1.24	1.3	no							g
	23 Jan 1987	475	65	172	1.24	1.5	no							
	24 Jan 1987	400	65	171	1.24	1.5	yes							
	22 Feb 1987	600	65	49	1.33	1.5	no							g
	22 Feb 1987	1200	65	43	1.30	1.5	no							g
	08 Feb 1988	400	65	80	1.77	3.0	yes							
	10 Feb 1988	400	65	70	1.46	1.0	yes							
	10 Feb 1988	200	65	68	1.45	1.0	yes							d
	06 Apr 1988	400	65	55	1.35	2.3	yes							
	07 Apr 1988	300	65	30	1.27	1.0	no							
	07 Apr 1988	200	65	30	1.26	1.0	no							d
	09 Apr 1988	400	65	30	1.26	0.7	yes							
	09 Apr 1988	300	65	30	1.26	0.7	yes							
NGC 3034	28 Feb 1985	2000	62	25	1.26	1.8	no	09 51 41	+69 54 54	I0	9.2	300	25	
	28 Feb 1985	100	62	17	1.25	1.8	no							
	09 Apr 1988	100	67	23	1.26	0.7	yes							a
NGC 3043	26 Feb 1986	2700	75	70	1.31	1.0	yes	09 52 42	+59 32 42	S pec	12.4	2934	25	a
NGC 3079	24 Feb 1985	1800	170	156	1.09	2.3	yes	09 58 35	+55 55 24	S(s)c II-III	11.2	1101	25	
	25 Feb 1985	2000	80	22	1.09	1.8	yes							b
	26 Feb 1985	2000	45	46	1.13	1.8	yes							
	27 Feb 1985	2200	135	42	1.12	1.5	yes							
	27 Feb 1985	3600	170	17	1.09	1.5	yes							
	28 Feb 1985	3000	170	5	1.08	1.8	no							
	28 Feb 1985	3000	170	135	1.12	1.5	no							
	09 Apr 1988	1802	170	177	1.08	0.7	yes							
NGC 3073	24 Jan 1987	1800	0	10	1.08	1.3	yes	09 58 35	+55 55 24	SB0	14.0	1176	26	
NGC 3077	28 Feb 1985	2100	45	45	1.31	2.0	no	09 59 22	+68 58 30	I0	10.6	−16	26	
	28 Feb 1985	600	45	37	1.28	2.0	no							
NGC 3115	15 Feb 1984	1000	0	179	1.33	1.3	yes	10 02 44	−07 28 30	$S0_1(7)$	9.9	670	26	
	25 Feb 1986	1000	27	26	1.45	1.0	yes							c
	26 Feb 1986	900	0	173	1.33	1.8	yes							
NGC 3162	28 Mar 1986	2000	134	27	1.02	1.3	no	10 10 45	+22 59 12	S(s)bc I.8	12.1	1456	26	a,g
NGC 3166	26 Feb 1985	1100	0	177	1.15	1.8	yes	10 11 10	+03 40 30	S(s)a	11.5	1326	26	
NGC 3169	15 Feb 1984	1200	0	6	1.15	1.3	yes	10 11 38	+03 43 12	S(r)b (tides) I-II	11.2	1261	27	
NGC 3147	23 Feb 1986	1300	28	27	1.34	2.0	yes	10 12 40	+73 39 00	S(s)b I-II	11.4	2721	27	
NGC 3185	15 Feb 1984	800	135	130	1.06	1.3	yes	10 14 54	+21 56 18	SB(s)a	12.9	1239	27	
NGC 3184	25 Feb 1985	1800	90	30	1.01	1.8	yes	10 15 17	+41 40 00	S(r)c II.2	10.4	404	27	
NGC 3190	15 Jan 1985	1800	114	128	1.07	2.0	yes	10 15 21	+22 05 06	Sa	11.9	1289	27	a
NGC 3193	15 Jan 1985	1500	90	142	1.03	2.0	yes	10 15 40	+22 08 48	E2	11.8	1379	28	
NGC 3198	25 Feb 1985	2000	45	163	1.02	1.5	yes	10 16 53	+45 48 00	S(s)c I-II	10.9	667	28	a
NGC 3226	26 Feb 1986	1200	136	133	1.07	1.0	yes	10 20 43	+20 09 12	E2/$S0_1(2)$	12.3	1322	28	

TABLE 2—*Continued*

Galaxy (1)	UT Date (2)	Exp. (3)	PA (4)	PPA (5)	sec z (6)	See. (7)	Phot. (8)	α(1950) (9)	δ(1950) (10)	Type (11)	B_T (12)	v_r (13)	Fig. (14)	Notes (15)
NGC 3227	13 Feb 1984	800	160	144	1.05	1.3	no	10 20 47	+20 07 06	S(s)b (tides)	11.5	1145	28	
	26 Feb 1986	600	136	140	1.05	1.0	yes							
	29 Mar 1986	600	62	62	1.39	1.5	no							g
NGC 3245	24 Feb 1986	1400	175	118	1.02	2.5	yes	10 24 30	+28 45 48	$S0_1(5)$	11.6	1348	28	e
IC 2574	06 Apr 1988	3600	50	20	1.24	1.0	yes	10 24 40	+68 40 18	S(B)(s)m IV-V	11.0	−4	29	a
NGC 3254	28 Mar 1986	1800	106	106	1.14	1.5	yes	10 26 32	+29 44 54	S(s)b II	12.2	1223	29	g
NGC 3294	27 Mar 1986	2500	89	93	1.16	1.0	yes	10 33 24	+37 35 06	S(s)c I.3	12.2	1436	29	g
NGC 3301	28 Mar 1986	1200	50	31	1.03	1.3	no	10 34 13	+22 08 24	Sa	12.2	1333	29	a,g
NGC 3310	28 Feb 1985	1200	133	0	1.07	1.8	no	10 35 39	+53 45 00	S(r)bc (tides)	11.2	1018	29	a
	28 Feb 1985	150	133	170	1.07	1.8	no							a
NGC 3319	08 Feb 1988	2702	105	103	1.62	2.5	yes	10 36 14	+41 56 48	SB(s)c IV.4	11.7	771	30	h
NGC 3338	14 Jan 1985	1800	160	158	1.07	3.0	yes	10 39 29	+14 00 36	S(s)bc I-II	11.3	1297	30	e
NGC 3344	14 Jan 1985	1800	138	125	1.04	3.0	yes	10 40 47	+25 11 06	S(sr)bc I.2	10.4	575	30	e
	08 Apr 1988	600	118	114	1.13	1.5	no							
NGC 3346	27 Feb 1985	2500	95	15	1.06	1.5	yes	10 40 59	+15 08 06	SB(sr)c II.2	12.1	1110	30	
NGC 3351	14 Jan 1985	1800	0	5	1.08	3.5	yes	10 41 19	+11 58 06	SB(r)b II	10.5	771	30	e
	08 Apr 1988	600	133	130	1.26	1.5	no							
NGC 3359	24 Jan 1987	3300	46	44	1.22	2.5	yes	10 43 21	+63 29 12	SB(s)c pec I.8	10.9	1008	31	
NGC 3348	26 Feb 1986	1200	73	56	1.44	1.0	yes	10 43 28	+73 06 12	E0	12.1	2837	31	
NGC 3367	20 Feb 1986	1800	167	161	1.07	2.0	yes	10 43 56	+14 00 48	SB(s)c II.2	12.0	2879	31	i
NGC 3368	22 Feb 1986	1200	132	132	1.23	1.3	no	10 44 08	+12 05 06	S(s)ab II	10.1	943	31	
NGC 3370	15 Jan 1985	1800	90	152	1.05	2.0	yes	10 44 23	+17 32 18	S(s)c I-II	12.2	1367	31	
NGC 3377	22 Feb 1986	1300	138	134	1.16	1.3	no	10 45 03	+14 15 00	E6	11.1	692	32	a,e
NGC 3379	15 Feb 1984	800	0	9	1.07	1.3	yes	10 45 11	+12 50 48	E0	10.3	889	32	
NGC 3384	26 Feb 1985	1000	0	168	1.07	1.1	yes	10 45 38	+12 53 42	$SB0_1(5)$	10.7	735	32	
NGC 3389	26 Feb 1985	1800	0	4	1.07	1.8	yes	10 45 50	+12 47 54	S(s)c II.2	12.3	1270	32	
NGC 3395	29 Mar 1986	1229	138	93	1.03	1.0	no	10 47 02	+33 47 42	S(s)c II-III	12.4	1634	32	g,m
	29 Mar 1986	153	138	94	1.00	1.3	no							g,m
NGC 3412	22 Feb 1986	1300	132	140	1.12	1.5	no	10 48 15	+13 40 30	$SB0_{(1-2)}(5)$	11.4	865	33	e
NGC 3414	24 Feb 1986	1850	130	108	1.21	2.8	no	10 48 32	+28 14 30	$S0_{(1-2)}/a$	11.7	1434	33	e
NGC 3423	23 Feb 1987	3600	150	154	1.17	1.5	yes	10 48 38	+06 06 18	S(s)c II.2	11.6	835	33	g
NGC 3430	24 Feb 1985	1800	37	96	1.04	1.5	yes	10 49 25	+33 12 54	S(sr)bc I-II	12.1	1570	33	a
NGC 3433	10 Feb 1988	3008	160	156	1.11	1.5	yes	10 49 27	+10 24 42	S(r)bc I.3	12.2	2591	33	h
NGC 3432	24 Feb 1985	1500	43	70	1.01	2.5	yes	10 49 43	+36 53 06	Scd (on edge)	11.7	619	34	i
NGC 3448	26 Feb 1986	2700	65	67	1.21	1.0	yes	10 51 40	+54 34 30	I0?	12.1	1388	34	a
NGC 3489	27 Feb 1985	700	68	142	1.11	1.5	yes	10 57 41	+14 10 12	$S0_3/a$	11.1	690	34	
NGC 3486	24 Feb 1985	1800	107	107	1.12	1.5	yes	10 57 42	+29 14 36	S(r)bc I.2	10.8	665	34	
	28 Mar 1986	1500	109	108	1.34	1.5	yes							g
NGC 3495	10 Feb 1988	3600	21	2	1.15	1.3	yes	10 58 41	+03 53 48	S(s)c II-III	12.4	1086	34	a
NGC 3504	24 Feb 1986	1260	160	116	1.03	2.5	yes	11 00 29	+28 14 30	SB(s)b I-II	11.8	1518	35	a,e
	24 Feb 1986	300	160	40	1.01	2.8	yes							a,e
NGC 3507	20 Feb 1986	1800	167	171	1.04	2.0	yes	11 00 48	+18 24 25	SB(s)b	11.0	940	35	
NGC 3521	26 Feb 1986	1000	158	152	1.27	1.3	yes	11 03 15	+00 14 12	S(s)bc II	9.6	782	35	a
NGC 3516	15 Feb 1984	500	125	130	1.40	1.3	no	11 03 23	+72 50 24	$RSB0_2$	12.4	2624	35	
	29 Mar 1986	600	117	121	1.44	1.0	no							g
	29 Mar 1986	600	117	118	1.46	1.0	no							g
NGC 3556	21 Jan 1987	2700	60	54	1.15	3.0	yes	11 08 37	+55 56 42	S(s)c III	10.7	682	35	
NGC 3583	26 Mar 1986	1500	80	73	1.16	1.5	yes	11 11 24	+48 35 24	S(s)b II	12.1	2098	36	b,g
NGC 3593	15 Jan 1985	1800	90	177	1.07	1.8	yes	11 12 00	+13 05 24	Sa pec III	11.7	624	36	
NGC 3596	15 Jan 1985	1800	90	160	1.06	2.0	yes	11 12 29	+15 03 30	S(r)bc II.2	11.6	1176	36	
NGC 3600	28 Mar 1986	2700	93	84	1.14	1.5	yes	11 13 00	+41 52 00	Sa?	12.3	1443	36	g
NGC 3607	27 Feb 1985	1000	122	35	1.06	1.5	yes	11 14 17	+18 19 42	$S0_3(3)$	11.0	935	36	a
NGC 3608	27 Feb 1985	1500	85	21	1.04	1.5	yes	11 14 21	+18 25 36	E1	11.8	1205	37	a
NGC 3610	26 Mar 1986	800	50	52	1.19	1.5	yes	11 15 31	+59 03 36	$E5/S0_1(5)$	11.5	1787	37	g
NGC 3613	23 Feb 1986	1030	50	52	1.18	2.0	yes	11 15 42	+58 16 18	$E6/S0_1(6)$	11.6	2054	37	
NGC 3623	15 Feb 1984	900	135	133	1.19	1.3	yes	11 16 19	+13 21 54	S(s)a II	10.2	775	37	
NGC 3626	26 Feb 1985	1300	170	7	1.04	1.8	yes	11 17 26	+18 37 48	Sa	11.7	1438	37	
NGC 3627	15 Feb 1984	900	135	137	1.15	1.3	yes	11 17 38	+13 15 48	S(s)b II.2	9.7	703	38	
NGC 3628	08 Feb 1988	2701	101	120	2.00	1.5	yes	11 17 40	+13 52 06	S (on edge)	10.3	809	38	a,h,i
NGC 3631	24 Feb 1985	1800	0	172	1.06	2.3	yes	11 18 13	+53 26 42	S(s)bc II	11.0	1143	38	
NGC 3640	22 Feb 1986	1200	7	5	1.16	1.5	yes	11 18 33	+03 30 36	E2	11.2	1314	38	
NGC 3646	22 Feb 1986	2000	60	152	1.03	1.3	yes	11 19 05	+20 26 42	S(r)bc II	11.8	4261	38	a
NGC 3642	12 Feb 1984	1500	60	62	1.24	2.0	no	11 19 25	+59 21 00	S(r)b I	11.5	1623	39	
	28 Mar 1986	1800	80	170	1.11	1.3	no							g,m
NGC 3652	21 Feb 1987	3600	96	96	1.22	3.0	yes	11 19 54	+38 02 23	SBcd: pec	12.3	2096	39	g

TABLE 2—*Continued*

Galaxy (1)	UT Date (2)	Exp. (3)	PA (4)	PPA (5)	sec z (6)	See. (7)	Phot. (8)	α(1950) (9)	δ(1950) (10)	Type (11)	B_T (12)	v_r (13)	Fig. (14)	Notes (15)
NGC 3655	28 Mar 1986	1500	105	33	1.07	1.5	no	11 20 17	+16 51 42	S(s)c pec III	12.3	1457	39	g,m
NGC 3666	25 Feb 1985	2000	95	2	1.08	1.5	yes	11 21 50	+11 37 06	Sc II-III	12.3	1047	39	a,j
NGC 3665	26 Mar 1986	1500	80	81	1.07	1.5	yes	11 22 01	+39 02 12	$S0_3(3)$	11.7	2061	39	g
NGC 3675	26 Mar 1986	1500	178	48	1.03	1.5	yes	11 23 25	+43 51 42	S(r)b II	10.9	724	40	a,g,j
NGC 3681	26 Feb 1986	2000	136	138	1.09	1.3	yes	11 23 54	+17 08 18	SB(r)b I-II	12.4	1299	40	h
NGC 3684	26 Feb 1986	2000	157	155	1.05	1.3	yes	11 24 35	+17 18 18	S(s)c II	12.3	1394	40	h
NGC 3686	08 Feb 1988	1200	120	119	1.60	1.5	yes	11 25 07	+17 30 00	SB(s)bc II	12.0	1033	40	h
NGC 3690	27 Mar 1986	1200	81	61	1.23	1.0	yes	11 25 42	+58 50 00	Sc (tides)	12.0	3033	40	g
	27 Mar 1986	100	81	56	1.21	1.0	yes							g
	27 Mar 1986	800	163	53	1.19	1.0	yes							g,m
	27 Mar 1986	100	163	49	1.17	1.0	yes							g,m
NGC 3692	07 Apr 1988	3600	94	132	1.30	1.0	no	11 25 48	+09 40 55	Sb	12.5	1726	41	a
UGC 6484	10 Feb 1988	3600	96	92	1.58	1.0	yes	11 26 24	+57 24 29	SB(rs)c	12.4	2429	41	h,j
NGC 3705	22 Feb 1986	1800	132	145	1.16	1.5	yes	11 27 33	+09 33 12	S(r)b I-II	11.7	1054	41	
NGC 3718	12 Feb 1984	1200	60	64	1.17	2.0	no	11 29 50	+53 20 42	Sa pec?	11.2	1031	41	
NGC 3726	28 Feb 1985	1800	130	124	1.07	1.5	yes	11 30 38	+47 18 24	S(sr)bc II	10.9	948	41	
NGC 3729	21 Feb 1987	2500	60	58	1.14	2.5	yes	11 31 04	+53 24 00	SB pec (ring)	12.0	1005	42	g
NGC 3738	10 Feb 1988	3600	107	82	1.36	1.0	yes	11 33 04	+54 47 54	Sd III	12.1	218	42	a
	06 Apr 1988	600	108	73	1.25	1.0	yes							a
NGC 3735	21 Jan 1987	2700	15	12	1.26	2.5	yes	11 33 06	+70 48 36	S(s)c (I)	12.5	2671	42	
NGC 3756	09 Feb 1988	2712	40	36	1.10	1.5	yes	11 34 05	+54 34 18	S(s)c I-II	12.1	1071	42	h
NGC 3780	09 Feb 1988	1500	15	16	1.09	1.3	yes	11 36 38	+56 33 00	S(r)c II.3	12.2	2361	42	h
NGC 3810	26 Feb 1985	1800	16	12	1.08	1.8	yes	11 38 24	+11 44 54	S(s)c II	11.3	958	43	
NGC 3813	09 Feb 1988	2082	100	96	1.18	1.5	yes	11 38 40	+36 49 24	S(s)c II.8	12.3	1470	43	
NGC 3838	27 Mar 1986	1200	45	51	1.17	1.0	yes	11 41 32	+58 13 30	S0/a?	12.5	1299	43	g
NGC 3877	21 Jan 1987	2000	60	58	1.08	2.5	yes	11 43 29	+47 46 12	S(s)c II	11.7	838	43	
NGC 3884	15 Feb 1984	1500	0	165	1.03	1.3	yes	11 43 36	+20 40 11	S0/a	13.5	6869	43	
NGC 3893	23 Feb 1986	2000	65	62	1.11	2.0	yes	11 46 01	+48 59 24	S(s)c I.2	11.1	944	44	
NGC 3900	24 Feb 1986	1800	178	116	1.05	2.3	yes	11 46 34	+27 18 06	S(r)a	12.2	1702	44	a
NGC 3898	13 Feb 1984	592	80	79	1.34	1.8	no	11 46 36	+56 21 48	Sa I	11.7	1163	44	
NGC 3917	10 Feb 1988	3600	77	74	1.22	1.0	yes	11 48 08	+52 06 12	S(s)c III	12.4	970	44	a,j
NGC 3938	23 Feb 1986	1800	20	42	1.03	2.0	yes	11 50 13	+44 24 00	S(s)c I	10.9	771	44	
NGC 3941	23 Feb 1986	1000	5	162	1.00	2.3	yes	11 50 20	+37 15 54	$SB0_{(1-2)}/a$	11.2	934	45	a
NGC 3945	23 Feb 1986	1200	5	7	1.13	2.0	yes	11 50 36	+60 57 18	$RSB0_2$	11.4	1220	45	
NGC 3949	08 Apr 1988	2201	76	76	1.17	1.3	no	11 51 05	+48 08 18	S(s)c III	11.4	681	45	h
NGC 3953	09 Feb 1988	1001	15	14	1.06	1.3	yes	11 51 13	+52 36 30	SB(r)bc I-II	10.7	987	45	a,h
NGC 3963	26 Mar 1986	2100	18	19	1.11	1.3	yes	11 52 22	+58 46 18	S(r)bc I.2	12.3	3204	45	g
NGC 3976	23 Feb 1987	1500	149	147	1.18	1.5	yes	11 53 23	+07 01 42	S(s)c I-II	12.2	2491	46	g
NGC 3982	27 Mar 1986	1800	50	48	1.13	1.0	yes	11 53 53	+55 24 00	S(r)bc II-III	11.9	924	46	g
NGC 3992	15 Feb 1984	600	125	121	1.15	1.3	no	11 55 01	+53 39 18	SB(sr)b I	10.6	1059	46	
NGC 3998	12 Feb 1984	1000	60	61	1.19	1.8	yes	11 55 20	+55 44 06	$S0_1(3)$	11.5	1066	46	
NGC 4013	28 Mar 1986	2400	155	77	1.12	1.5	yes	11 55 58	+44 13 24	Sbc:	12.0	694	46	b,g,p
NGC 4026	27 Mar 1986	1000	86	43	1.08	1.0	yes	11 56 50	+51 14 24	$S0_{(1-2)}(9)$	11.4	930	47	b,g
NGC 4036	12 Feb 1984	1200	48	46	1.21	1.5	yes	11 58 54	+62 10 30	$S0_3(8)/a$	11.5	1397	47	
NGC 4041	26 Mar 1986	2100	8	4	1.14	1.5	yes	11 59 39	+62 25 00	S(s)c II-III	11.6	1186	47	g
NGC 4051	14 Feb 1984	820	90	90	1.28	2.5	no	12 00 37	+44 48 42	S(r)bc II	10.9	688	47	
	15 Feb 1984	400	100	103	1.12	1.0	no							
	29 Mar 1986	1300	90	92	1.24	1.3	no							g
	29 Mar 1986	300	90	89	1.29	1.3	no							g
NGC 4062	22 Jan 1987	3000	98	102	1.14	2.5	no	12 01 31	+32 10 24	S(s)c II-III	12.0	742	47	
NGC 4064	24 Feb 1986	2700	166	174	1.03	2.8	yes	12 01 38	+18 43 18	SB(s)c:	12.2	1000	48	a
NGC 4088	23 Feb 1986	2000	47	163	1.05	2.0	yes	12 03 02	+50 49 06	SB(s)c II-III	11.1	723	48	a,j
NGC 4096	28 Feb 1985	1800	111	119	1.09	1.5	yes	12 03 29	+47 45 42	S(s)c II-III	11.0	492	48	b
NGC 4100	27 Mar 1986	2000	70	32	1.05	1.0	yes	12 03 37	+49 51 24	S(s)c I-II	11.6	1131	48	b,g
NGC 4102	28 Feb 1985	800	130	140	1.09	1.5	yes	12 03 52	+52 59 18	S(r)b pec II	12.3	877	48	
NGC 4111	12 Feb 1984	1000	70	65	1.06	1.5	yes	12 04 32	+43 20 42	$S0_1(9)$	11.7	815	49	a
	06 Apr 1988	600	148	160	1.02	1.0	yes							a
NGC 4124	20 Feb 1986	2400	0	179	1.09	2.0	yes	12 05 36	+10 39 30	$E6/S0_{(1-2)}(6)$	10.7	1631	49	
NGC 4123	24 Feb 1986	2000	31	32	1.25	2.5	yes	12 05 38	+03 09 00	SB(sr)bc I.8	11.8	1238	49	e
NGC 4125	15 Feb 1984	600	125	130	1.27	1.0	no	12 05 35	+65 27 18	$S0_3(6)$	12.0	1356	49	
NGC 4136	08 Feb 1988	3003	111	109	1.46	1.5	yes	12 06 46	+30 12 18	S(r)c I-II	11.5	445	49	h
NGC 4138	23 Feb 1986	1800	148	125	1.04	2.3	yes	12 06 59	+43 57 48	S(r)a pec	12.1	1039	50	
NGC 4143	26 Feb 1986	1000	95	95	1.15	1.3	yes	12 07 05	+42 48 48	$S0_1(5)/a$	12.0	784	50	h
NGC 4144	28 Feb 1985	2000	104	105	1.14	1.5	yes	12 07 28	+46 44 06	Scd III	12.0	267	50	i
NGC 4145	09 Feb 1988	2163	87	88	1.15	1.5	yes	12 07 30	+40 09 42	S(s)c II	11.5	925	50	h

TABLE 2—*Continued*

Galaxy (1)	UT Date (2)	Exp. (3)	PA (4)	PPA (5)	sec z (6)	See. (7)	Phot. (8)	α(1950) (9)	δ(1950) (10)	Type (11)	B_T (12)	v_r (13)	Fig. (14)	Notes (15)
NGC 4151	15 Feb 1984	1500	90	88	1.13	3.0	no	12 08 00	+39 40 54	Sab	11.1	956	50	
	15 Feb 1984	600	90	83	1.09	3.0	no							
	29 Mar 1986	600	80	82	1.31	1.5	no							g
	29 Mar 1986	120	80	81	1.34	1.8	no							g
NGC 4150	27 Mar 1986	1200	150	132	1.00	1.0	yes	12 08 01	+30 40 54	$S0_3(4)/a$	12.4	244	51	a,g
NGC 4152	22 Jan 1987	2000	151	146	1.07	2.8	no	12 08 05	+16 18 42	S(r)c I.4	12.4	2066	51	
NGC 4157	21 Jan 1987	3000	15	11	1.05	2.5	yes	12 08 35	+50 45 48	Sbc	11.5	901	51	
NGC 4162	22 Jan 1987	2000	61	119	1.08	2.5	no	12 09 20	+24 24 00	S(s)c I-II	12.2	2542	51	m
NGC 4169	24 Jan 1987	1200	72	73	1.10	1.8	yes	12 09 42	+29 27 30	S0	12.5	3783	51	
NGC 4168	20 Feb 1986	2000	155	155	1.08	2.0	yes	12 09 44	+13 29 00	E2	12.2	2284	52	
NGC 4178	10 Feb 1988	3600	30	43	1.20	2.0	yes	12 10 14	+11 08 48	SB(s)c II	11.8	240	52	a
NGC 4179	24 Feb 1986	1100	142	155	1.23	2.3	yes	12 10 19	+01 34 42	$S0_1(9)$	11.8	1256	52	a
NGC 4183	21 Feb 1987	3600	75	68	1.07	2.5	yes	12 10 47	+43 58 36	Scd (on edge)	12.4	932	52	a,g
NGC 4192	12 Feb 1984	1200	150	172	1.05	1.8	yes	12 11 15	+15 10 48	Sb II:	10.9	−126	52	a
NGC 4203	28 Feb 1985	700	76	78	1.19	1.5	yes	12 12 34	+33 28 42	$S0_2(1)$	11.6	1044	53	
NGC 4212	27 Feb 1985	1600	75	13	1.06	1.5	yes	12 13 07	+14 10 48	S(s)c II-III	11.8	−81	53	
NGC 4214	21 Feb 1987	1800	107	71	1.01	2.3	yes	12 13 08	+36 36 30	SBm III	10.2	298	53	g,m
	21 Feb 1987	300	107	49	1.00	1.8	yes							g,m
NGC 4216	25 Feb 1986	1000	51	53	1.31	1.0	yes	12 13 21	+13 25 24	Sb:	11.3	30	53	
NGC 4217	09 Feb 1988	2771	143	145	1.04	1.0	yes	12 13 21	+47 22 18	S(s)b	10.9	1026	53	b
NGC 4220	26 Mar 1986	1800	139	143	1.05	1.3	yes	12 13 43	+48 09 30	S(r)a	12.2	979	54	a,g
NGC 4236	08 Apr 1988	3600	163	163	1.25	1.3	no	12 14 22	+69 45 00	SBd IV	10.0	−5	54	a
NGC 4235	12 Feb 1984	1500	0	15	1.12	1.8	yes	12 14 37	+07 28 06	S(s)a	12.6	2343	54	
NGC 4244	09 Feb 1988	2202	139	98	1.05	1.0	yes	12 15 00	+38 05 12	Scd	10.6	240	54	b
NGC 4242	06 Apr 1988	3600	88	62	1.07	1.3	yes	12 15 01	+45 53 48	SBd III	11.5	661	54	h
NGC 4245	26 Feb 1986	1500	72	73	1.06	1.3	yes	12 15 05	+29 52 54	SB(s)a	12.2	890	55	h
NGC 4251	24 Feb 1986	1000	70	70	1.31	2.3	yes	12 15 36	+28 27 06	$S0_1(8)$	11.6	1014	55	e
NGC 4254	27 Feb 1985	1300	90	27	1.08	1.5	yes	12 16 17	+14 41 42	S(s)c I.3	10.3	2453	55	i
NGC 4258	12 Feb 1984	900	150	49	1.06	1.5	yes	12 16 29	+47 35 00	S(s)b II	8.9	480	55	
NGC 4261	22 Feb 1986	1200	0	1	1.13	1.5	yes	12 16 50	+06 06 06	E2	11.3	2210	55	
NGC 4262	22 Jan 1987	1200	162	159	1.06	2.5	no	12 16 59	+15 09 18	$SB0_{(2-3)}$	12.3	1368	56	
NGC 4267	22 Feb 1986	1300	173	167	1.07	1.5	yes	12 17 13	+13 04 36	$SB0_1$	11.7	1000	56	
NGC 4274	15 Feb 1984	900	0	134	1.00	1.3	yes	12 17 20	+29 53 18	S(s)a	11.3	927	56	
NGC 4273	24 Jan 1987	1800	0	177	1.13	1.8	yes	12 17 23	+05 37 18	SB(s)c II	12.3	2308	56	
NGC 4278	15 Feb 1984	900	0	126	1.01	1.3	yes	12 17 36	+29 33 36	E1	11.1	628	56	
NGC 4281	24 Jan 1987	1200	160	162	1.15	1.8	yes	12 17 49	+05 39 54	$S0_3(6)$	12.2	2685	57	
NGC 4291	26 Mar 1986	1200	175	175	1.35	1.3	yes	12 18 07	+75 38 48	E3	12.3	1757	57	g
NGC 4293	24 Feb 1986	2200	78	18	1.04	2.5	yes	12 18 42	+18 39 42	Sa pec	11.2	717	57	a,e
NGC 4298	24 Jan 1987	3600	135	137	1.12	1.5	yes	12 19 00	+14 53 06	S(s)c III	12.1	1122	57	
NGC 4303	15 Feb 1984	1000	0	3	1.14	1.3	yes	12 19 22	+04 45 06	S(s)c I.2	10.1	1607	57	
NGC 4314	24 Feb 1986	1200	72	71	1.38	2.3	yes	12 20 03	+30 10 06	SB(sr)a pec	11.3	963	58	e
NGC 4321	15 Jan 1985	1800	0	160	1.05	1.5	yes	12 20 23	+16 06 00	S(s)c I	10.1	1579	58	
NGC 4324	24 Feb 1986	1500	48	47	1.44	2.3	yes	12 20 34	+05 31 42	S(r)a	12.3	1686	58	a,e
NGC 4346	23 Feb 1986	1200	96	125	1.07	2.3	yes	12 21 01	+47 16 12	$SB0_1(8)$	12.1	783	58	a
NGC 4339	25 Feb 1986	1800	10	12	1.13	1.0	yes	12 21 02	+06 21 36	$S0_1$	12.3	1281	58	
NGC 4340	22 Feb 1986	1800	45	47	1.12	1.5	no	12 21 04	+17 00 00	$RSB0_2(5)$	11.9	915	59	a
NGC 4350	22 Feb 1986	1200	29	38	1.08	1.5	no	12 21 26	+16 58 18	$S0_1(8)$	11.8	1234	59	
NGC 4365	24 Feb 1986	1300	40	39	1.23	2.5	yes	12 21 56	+07 35 42	E3	10.6	1227	59	a,e
NGC 4369	26 Feb 1986	1000	156	96	1.09	1.3	yes	12 22 09	+39 39 42	S(s)c III-IV	12.2	988	59	a
NGC 4371	15 Jan 1985	1800	0	16	1.08	2.0	yes	12 22 23	+11 58 48	$SB0_2(3)$	11.7	950	59	
NGC 4374	22 Feb 1986	800	25	23	1.08	1.5	yes	12 22 31	+13 09 48	E1	10.2	1029	60	
NGC 4379	22 Feb 1986	1300	10	14	1.05	1.5	yes	12 22 43	+15 53 00	$S0_1(2)$	12.3	1056	60	
NGC 4378	25 Feb 1986	1500	170	179	1.14	1.0	yes	12 22 45	+05 12 06	S(s)a I	12.1	2563	60	
NGC 4380	23 Feb 1987	3600	150	150	1.13	1.8	yes	12 22 50	+10 17 42	Sab	12.3	935	60	a,g
NGC 4382	14 Jan 1985	1500	90	171	1.04	3.5	yes	12 22 53	+18 28 00	$S0_1(3)$ pec	10.1	722	60	e
NGC 4388	13 Feb 1984	1200	91	42	1.15	1.3	no	12 23 14	+12 56 18	Sab	11.8	2538	61	
	06 Apr 1988	300	91	27	1.09	1.5	yes							a
	06 Apr 1988	1800	91	16	1.11	1.5	yes							a
NGC 4395	07 Apr 1988	3600	100	98	1.12	1.0	no	12 23 20	+33 49 30	Sd III-IV	10.6	311	61	
	07 Apr 1988	400	100	95	1.06	1.0	no							
	07 Apr 1988	400	130	87	1.02	1.0	no							c
NGC 4394	14 Jan 1985	2200	143	147	1.05	3.5	yes	12 23 25	+18 29 24	SB(sr)b I-II	11.7	772	61	a,e
NGC 4405	28 Mar 1986	2500	17	40	1.09	1.5	yes	12 23 35	+16 27 30	S(s)c or S0	12.9	1751	61	a,g
NGC 4406	23 Feb 1986	1000	55	57	1.54	2.8	yes	12 23 40	+13 13 24	$S0_1(3)$/E3	10.0	−248	61	
NGC 4414	25 Feb 1985	1000	74	73	1.33	1.5	yes	12 23 57	+31 29 54	S(rs)c II.2	10.9	713	62	b

TABLE 2—*Continued*

Galaxy (1)	UT Date (2)	Exp. (3)	PA (4)	PPA (5)	sec z (6)	See. (7)	Phot. (8)	α(1950) (9)	δ(1950) (10)	Type (11)	B_T (12)	v_r (13)	Fig. (14)	Notes (15)
NGC 4417	27 Feb 1985	1000	48	47	1.28	1.5	yes	12 24 18	+09 51 42	S0$_1$(7)	12.0	852	62	a
NGC 4419	27 Mar 1986	1200	45	45	1.13	1.0	yes	12 24 25	+15 19 24	SBab:	12.1	−224	62	b,g
NGC 4421	26 Feb 1986	1800	0	163	1.06	1.3	yes	12 24 31	+15 44 18	SB0$_2$(3)	12.5	1692	62	a
NGC 4424	29 Mar 1986	171	106	23	1.12	1.5	no	12 24 40	+09 41 48	Sa pec	12.3	447	62	a,g
	10 Feb 1988	300	52	49	1.35	2.0	yes							
	06 Apr 1988	900	104	42	1.22	1.5	yes							a
NGC 4429	15 Jan 1985	1200	0	179	1.08	2.0	yes	12 24 54	+11 23 06	S0$_3$(6)/a pec	11.1	1137	63	b
NGC 4435	25 Feb 1986	1200	57	56	1.44	1.0	yes	12 25 08	+13 21 24	SB0$_1$(7)	11.7	781	63	
NGC 4438	12 Feb 1984	1200	25	27	1.09	1.8	yes	12 25 14	+13 17 06	Sb (tides)	10.9	20	63	a
NGC 4442	26 Feb 1985	1300	175	16	1.10	1.8	yes	12 25 32	+10 04 42	SB0$_1$(6)	11.3	530	63	
NGC 4448	26 Feb 1986	2000	90	60	1.02	1.3	yes	12 25 46	+28 53 48	Sa (late)	12.0	693	63	a,h
NGC 4449	21 Feb 1987	1500	35	5	1.02	1.8	yes	12 25 47	+44 22 18	Sm IV	9.8	211	64	a,g
	21 Feb 1987	300	35	165	1.02	1.8	yes							a,g
NGC 4450	13 Feb 1984	1200	124	123	1.25	1.5	no	12 25 59	+17 21 42	Sab pec	10.9	2048	64	
NGC 4460	21 Jan 1987	3000	136	179	1.02	2.3	yes	12 26 19	+45 08 36	S0 / Sc	12.1	528	64	b
NGC 4457	20 Feb 1986	1200	11	12	1.16	2.5	yes	12 26 26	+03 50 48	RS(rs)b II	11.6	738	64	
NGC 4459	14 Jan 1985	1500	90	14	1.06	2.8	yes	12 26 29	+14 15 18	S0$_3$(3)	11.4	1203	64	e
NGC 4461	27 Mar 1986	1200	8	35	1.11	1.0	yes	12 26 31	+13 27 42	Sa	12.0	1918	65	a,g
NGC 4469	25 Feb 1985	1800	86	168	1.10	1.5	yes	12 26 56	+09 01 30	Sab	12.2	576	65	a
NGC 4470	07 Apr 1988	3600	156	154	1.14	1.0	no	12 27 05	+08 06 00	Sc pec III	13.0	2358	65	
NGC 4472	25 Feb 1986	1000	53	53	1.66	1.0	yes	12 27 14	+08 16 42	E2/S0$_1$(2)	9.3	983	65	
NGC 4473	22 Feb 1986	1200	50	52	1.27	1.5	yes	12 27 17	+13 42 24	E5	11.0	2237	65	
NGC 4477	22 Feb 1986	1200	55	55	1.35	1.5	yes	12 27 31	+13 54 42	SB0$_{(1-2)}$/a	11.2	1348	66	
NGC 4478	26 Feb 1986	1500	171	148	1.11	1.3	yes	12 27 46	+12 36 18	E2	12.1	1382	66	h,m
NGC 4485	21 Feb 1987	3000	169	129	1.02	1.8	yes	12 28 05	+41 58 30	S (tides)	12.3	617	66	a,g
NGC 4490	21 Feb 1987	2000	169	107	1.06	1.8	yes	12 28 10	+41 54 54	Scd pec III	10.2	594	66	g,k
NGC 4486	12 Feb 1984	800	0	175	1.07	2.0	yes	12 28 17	+12 40 06	E0	9.6	1508	66	
	13 Feb 1984	1800	138	135	1.18	1.3	no							c
	13 Feb 1984	2000	110	146	1.11	1.3	no							c
	13 Feb 1984	2000	45	165	1.08	1.0	no							c
	13 Feb 1984	2000	80	9	1.07	1.5	no							c
	13 Feb 1984	2000	0	28	1.10	1.1	no							c
	25 Feb 1985	3600	35	21	1.08	0.8	yes							
NGC 4494	22 Feb 1986	1200	68	68	1.32	1.5	yes	12 28 55	+26 03 06	E1	10.7	1324	67	
NGC 4496A	06 Apr 1988	3002	55	44	1.41	1.5	yes	12 29 06	+04 12 56	SBc III-IV	11.7	1900	67	a
NGC 4496B	07 Apr 1988	3600	0	2	1.15	1.0	no	12 29 07	+04 12 00	IB(s)m	14.5	4546	67	
NGC 4501	12 Feb 1984	1200	35	37	1.10	1.8	yes	12 29 28	+14 41 42	S(s)bc II	10.2	2120	67	
NGC 4503	24 Jan 1987	1200	6	22	1.10	1.8	yes	12 29 34	+11 27 12	Sa	12.1	1364	67	a
NGC 4517	23 Feb 1987	3600	171	1	1.20	2.0	yes	12 30 12	+00 23 18	Sc	11.2	1185	68	b,g
NGC 4526	25 Feb 1986	1000	51	48	1.39	1.0	yes	12 31 31	+07 58 30	S0$_3$(6)	10.5	575	68	
NGC 4527	22 Jan 1987	1800	175	174	1.16	2.3	no	12 31 35	+02 55 42	S(s)b II	11.3	1727	68	
NGC 4532	10 Feb 1988	2706	153	178	1.12	1.5	yes	12 31 47	+06 44 42	Sm III	12.2	2154	68	a
	10 Feb 1988	300	153	44	1.33	2.0	yes							a
	06 Apr 1988	400	154	34	1.20	1.5	yes							a
NGC 4535	15 Jan 1985	1500	31	25	1.13	2.3	yes	12 31 48	+08 28 36	SB(s)c I.3	10.5	1973	68	a
NGC 4536	26 Feb 1986	1800	0	0	1.17	1.3	yes	12 31 54	+02 27 42	S(s)c I	11.0	1894	69	h
NGC 4548	26 Feb 1985	1500	62	51	1.22	1.8	yes	12 32 55	+14 46 24	SB(sr)b I-II	10.9	498	69	a
NGC 4550	28 Mar 1986	1800	177	12	1.08	1.5	no	12 32 59	+12 29 48	E7/S0$_1$(7)	12.3	429	69	a,g
NGC 4552	25 Feb 1985	1000	52	52	1.29	1.5	yes	12 33 08	+12 50 00	S0$_1$	10.8	311	69	
NGC 4559	08 Feb 1988	3002	108	109	1.34	1.5	yes	12 33 29	+28 14 06	S(s)c II	10.3	808	69	
	08 Apr 1988	3101	110	108	1.18	1.0	no							
NGC 4565	26 Feb 1985	1400	43	68	1.21	1.8	yes	12 33 52	+26 15 36	Sb	10.3	1181	70	b
NGC 4564	23 Feb 1986	1300	47	46	1.21	2.8	yes	12 33 55	+11 42 54	E6	11.8	1119	70	a
NGC 4567	26 Feb 1985	1800	15	27	1.11	1.8	yes	12 34 01	+11 32 00	S(s)c II-III	12.1	2213	70	
NGC 4568	26 Feb 1985	1800	23	40	1.16	1.8	yes	12 34 02	+11 30 54	S(s)c III	11.7	2260	70	a,i
NGC 4569	13 Feb 1984	1200	20	47	1.19	1.5	no	12 34 19	+13 26 24	S(s)ab I-II	10.2	−311	70	a
NGC 4570	10 Feb 1988	1007	158	161	1.13	1.5	yes	12 34 21	+07 31 24	S0$_1$(7)/E7	11.6	1730	71	a
NGC 4578	24 Jan 1987	1200	29	28	1.13	1.8	yes	12 34 59	+09 49 48	S0$_{(1-2)}$(4)	12.0	2287	71	a
NGC 4579	12 Feb 1984	1000	150	149	1.11	1.5	yes	12 35 12	+12 05 36	S(s)ab II	10.5	1627	71	
NGC 4589	26 Mar 1986	1600	140	141	1.38	1.5	yes	12 35 28	+74 28 00	E2	11.8	1980	71	g
NGC 4594	15 Feb 1984	600	0	2	1.41	1.3	yes	12 37 23	−11 21 00	Sab	9.2	1082	71	
NGC 4596	23 Feb 1986	1300	72	51	1.39	2.8	yes	12 37 24	+10 27 00	SBa	11.4	1874	72	b
NGC 4605	09 Feb 1988	2506	15	15	1.14	1.3	yes	12 37 47	+61 53 06	S(s)c III	10.9	149	72	h
NGC 4608	27 Feb 1985	1200	25	33	1.14	1.5	yes	12 38 42	+10 25 42	SB0$_3$/a:	12.0	1823	72	a
NGC 4612	24 Jan 1987	1500	8	3	1.11	1.8	yes	12 39 00	+07 35 18	RSB0$_{(1-2)}$	12.5	1821	72	

TABLE 2—*Continued*

Galaxy (1)	UT Date (2)	Exp. (3)	PA (4)	PPA (5)	sec z (6)	See. (7)	Phot. (8)	α(1950) (9)	δ(1950) (10)	Type (11)	B_T (12)	v_r (13)	Fig. (14)	Notes (15)
NGC 4618	28 Feb 1985	1200	64	91	1.17	1.8	yes	12 39 08	+41 25 36	SB(sr)bc pec	11.2	543	72	
	26 Jun 1985	2700	64	87	1.24	2.0	yes			II.2				
	26 Feb 1986	1800	64	94	1.14	1.3	yes							
NGC 4621	23 Feb 1986	1000	72	50	1.28	2.8	yes	12 39 31	+11 55 12	E4	10.6	430	73	b
NGC 4631	09 Feb 1988	2683	84	80	1.09	1.0	yes	12 39 41	+32 48 48	Sc (on edge)	9.8	632	73	a
NGC 4648	21 Jan 1987	1500	3	179	1.33	2.3	yes	12 39 55	+74 41 30	E3	12.4	1474	73	
NGC 4638	10 Feb 1988	601	35	46	1.21	1.8	yes	12 40 16	+11 42 54	S0$_1$(7)	12.0	1132	73	b
NGC 4636	24 Feb 1985	1800	0	2	1.16	2.3	yes	12 40 17	+02 57 42	E/S0$_1$(6)	10.5	927	73	
NGC 4639	24 Feb 1985	1800	172	23	1.08	2.3	yes	12 40 21	+13 31 54	SB(r)b II	12.1	898	74	a
	27 Mar 1986	1800	172	16	1.07	1.0	yes							a,g
NGC 4643	23 Feb 1986	1300	45	29	1.25	2.8	yes	12 40 48	+02 15 06	SB0$_3$/a	11.5	1399	74	a
NGC 4647	24 Feb 1985	2000	45	49	1.26	2.3	yes	12 41 01	+11 51 12	S(rs)c III	12.0	1421	74	
NGC 4649	24 Feb 1985	800	45	44	1.19	2.3	yes	12 41 09	+11 49 30	S0$_1$(2)	9.8	1114	74	
NGC 4651	24 Feb 1985	1800	64	159	1.05	2.3	yes	12 41 13	+16 40 06	S(r)c I-II	11.3	788	74	
NGC 4654	25 Feb 1985	1600	119	21	1.08	1.5	yes	12 41 26	+13 24 00	SB(sr)c II	11.1	1035	75	a
NGC 4656	25 Feb 1985	800	37	77	1.20	1.5	yes	12 41 32	+32 26 30	Im	10.8	648	75	i
NGC 4660	22 Feb 1986	1300	45	43	1.19	1.5	no	12 42 01	+11 27 36	E3/S0$_1$(3)	11.8	1095	75	
NGC 4665	24 Feb 1985	1300	40	37	1.30	2.5	yes	12 42 33	+03 19 48	SB0$_2$/a:	11.6	785	75	e
NGC 4688	08 Apr 1988	3600	145	144	1.25	1.0	no	12 45 14	+04 36 36	SB(s)c II	12.6	925	75	
NGC 4689	24 Feb 1985	2000	0	37	1.11	2.3	yes	12 45 15	+14 02 06	S(s)c II.3	11.5	1522	76	
NGC 4694	25 Feb 1985	1800	147	0	1.08	1.5	yes	12 45 44	+11 15 24	I0	12.1	1211	76	a
NGC 4698	26 Feb 1985	1500	170	173	1.10	1.8	yes	12 45 52	+08 45 36	Sa	11.5	1032	76	
NGC 4710	25 Feb 1985	1600	117	46	1.14	1.5	yes	12 47 09	+15 26 18	S0$_3$(9)	11.8	1119	76	b
	25 Feb 1985	400	27	50	1.18	1.5	yes							a
NGC 4713	22 Jan 1987	2500	19	20	1.16	2.3	no	12 47 25	+05 35 00	SB(s)c II-III	12.1	631	76	
NGC 4725	24 Feb 1985	1500	45	67	1.24	2.3	yes	12 48 00	+25 46 30	SB(r)b II	9.9	1180	77	
NGC 4750	26 Mar 1986	1600	150	153	1.33	1.5	yes	12 48 20	+73 08 48	S(r) pec	12.2	1614	77	g
NGC 4736	15 Feb 1984	400	100	102	1.08	1.0	no	12 48 32	+41 23 36	RS(s)ab	8.9	297	77	
NGC 4754	27 Feb 1985	1000	16	38	1.15	1.5	yes	12 49 47	+11 35 06	SB0$_1$(5)	11.4	1396	77	a
NGC 4762	25 Feb 1985	1100	32	28	1.11	1.5	yes	12 50 25	+11 30 06	S0$_1$	11.2	971	77	a
NGC 4772	22 Jan 1987	1800	5	0	1.17	2.3	no	12 50 56	+02 26 24	Sa:	12.4	1042	78	
NGC 4793	27 Mar 1986	1860	50	125	1.01	1.0	yes	12 52 16	+29 12 30	S(s)c II.2	12.3	2423	78	a,g,i
NGC 4800	26 Mar 1986	1400	104	140	1.04	1.5	yes	12 52 20	+46 48 00	S(sr)b II-III	12.3	747	78	g
NGC 4826	15 Feb 1984	500	180	22	1.02	1.3	no	12 54 17	+21 57 06	S(s)ab II	9.3	474	78	
NGC 4845	10 Feb 1988	1808	167	5	1.18	2.0	yes	12 55 28	+01 50 48	Sa	12.1	1125	78	b
NGC 4866	27 Feb 1985	1000	88	20	1.07	1.5	yes	12 56 58	+14 26 30	Sa	11.7	1910	79	
NGC 4900	08 Apr 1988	2401	147	159	1.20	1.3	no	12 58 06	+02 46 06	Sc III-IV	12.0	1021	79	
NGC 4914	26 Mar 1986	1600	90	87	1.13	1.5	yes	12 58 23	+37 35 00	E5/S0$_1$(5)	12.3	4678	79	g
NGC 5005	12 Feb 1984	1200	70	95	1.05	1.8	yes	13 08 37	+37 19 24	S(s)b II	10.6	992	79	a
NGC 5012	27 Mar 1986	2000	4	56	1.07	1.3	yes	13 09 12	+23 10 54	S(sr)c I-II	12.4	2661	79	g,m
NGC 5033	15 Jul 1982	2000	40	79	1.33	1.0	yes	13 11 08	+36 51 48	S(s)b I	10.6	861	80	c,j
	16 Jul 1982	2000	75	79	1.33	1.3	yes							c,j
	15 Feb 1984	900	165	86	1.13	1.0	no							a
	29 Mar 1986	900	82	83	1.19	1.5	no							g
NGC 5055	15 Feb 1984	400	90	109	1.06	1.0	no	13 13 55	+42 17 48	S(s)bc II-III	9.3	516	80	
NGC 5077	15 Feb 1984	1000	180	175	1.44	1.5	yes	13 16 53	−12 23 42	S0$_{(1-2)}$(4)	12.5	2832	80	
NGC 5112	06 Apr 1988	2508	126	81	1.06	1.3	yes	13 19 41	+38 59 48	S(sr)c II	11.8	937	80	a,h
NGC 5147	23 Feb 1987	3600	10	6	1.17	3.0	yes	13 23 47	+02 21 42	S(s)c III-IV	12.2	1097	80	g
NGC 5204	07 Apr 1988	3600	170	163	1.11	1.0	no	13 27 44	+58 40 42	Sd IV	11.7	202	81	
NGC 5194	15 Feb 1984	800	120	122	1.08	1.0	no	13 27 46	+47 27 18	S(s)bc I-II	8.9	463	81	
	09 Apr 1988	1502	166	85	1.44	1.3	yes							
NGC 5195	15 Feb 1984	600	120	117	1.09	1.0	no	13 27 53	+47 31 48	SB0$_1$ pec	10.5	570	81	
NGC 5248	06 Apr 1988	1800	45	44	1.26	1.5	yes	13 35 03	+09 08 30	S(s)bc I-II	10.8	1189	81	
NGC 5273	13 Feb 1984	2000	90	91	1.05	1.5	no	13 39 55	+35 54 30	S0/a	12.4	1054	81	
NGC 5297	28 Mar 1986	2000	156	118	1.05	1.5	no	13 44 19	+44 07 24	S(s)c I-II	12.2	2641	82	a,g
NGC 5308	28 Mar 1986	1000	150	159	1.14	1.5	no	13 45 21	+61 13 18	S0$_1$(8)	12.2	2041	82	b,g
NGC 5300	23 Feb 1987	3600	25	26	1.20	2.5	yes	13 45 44	+04 11 54	S(s)c II	11.9	1171	82	g
NGC 5322	26 Mar 1986	1000	107	107	1.34	1.5	yes	13 47 35	+60 26 24	E4	10.9	1915	82	g
NGC 5354	26 Mar 1986	1300	95	97	1.10	1.3	yes	13 51 21	+40 32 42	S0 (spindle)	12.4	2459	82	g
NGC 5353	26 Mar 1986	1500	95	92	1.14	1.5	yes	13 51 21	+40 31 30	S0$_1$(7)/E7	12.0	2107	83	g
NGC 5371	12 Feb 1984	1200	35	155	1.01	1.8	yes	13 53 33	+40 42 24	SB(sr)b I	11.4	2575	83	
NGC 5363	06 Apr 1988	601	60	42	1.33	1.5	yes	13 53 37	+05 30 00	[S0$_3$(5)]	11.0	1121	83	
NGC 5364	26 Feb 1985	1900	36	38	1.26	1.8	yes	13 53 42	+05 15 36	S(r)c I	11.0	1267	83	
NGC 5377	28 Feb 1985	800	41	119	1.08	1.8	yes	13 54 17	+47 28 54	SBa or Sa	12.0	1830	83	a
NGC 5383	26 Mar 1986	1400	88	90	1.20	1.5	yes	13 55 01	+42 05 36	SB(s)b II	12.0	2226	84	

TABLE 2—*Continued*

Galaxy (1)	UT Date (2)	Exp. (3)	PA (4)	PPA (5)	sec z (6)	See. (7)	Phot. (8)	α(1950) (9)	δ(1950) (10)	Type (11)	B_T (12)	v_r (13)	Fig. (14)	Notes (15)
NGC 5395	27 Mar 1986	2000	176	99	1.04	1.3	yes	13 56 30	+37 38 12	Sb II	12.3	3505	84	a,g
NGC 5448	27 Mar 1986	1800	107	117	1.11	1.3	yes	14 00 56	+49 24 48	S(s)a	12.2	1973	84	a,g
NGC 5457	21 Feb 1987	2000	163	157	1.08	1.8	yes	14 01 28	+54 35 36	S(s)c I	8.1	221	84	g
NGC 5473	27 Mar 1986	1000	108	109	1.24	1.3	yes	14 02 59	+55 07 54	SB0$_1$(3)	12.3	2040	84	g
NGC 5474	07 Apr 1988	3600	146	145	1.09	1.0	no	14 03 15	+53 54 00	S(s)cd pec IV	11.3	230	85	
NGC 5485	27 Mar 1986	1800	121	117	1.19	1.3	yes	14 05 27	+55 14 12	S0$_3$(2)	12.4	1985	85	g
NGC 5523	08 Apr 1988	3201	90	174	1.01	1.3	no	14 12 35	+25 33 00	S(s)c II-III	12.4	1044	85	a
NGC 5548	15 Feb 1984	500	180	130	1.03	1.3	no	14 15 43	+25 22 00	Sa	13.1	5026	85	
	29 Mar 1986	620	64	64	1.11	1.5	no							g
NGC 5557	28 Mar 1986	1200	150	95	1.04	1.5	no	14 16 20	+36 43 24	E2	12.0	3195	85	g,m
NGC 5566	27 Feb 1985	800	26	16	1.16	1.5	yes	14 17 49	+04 09 42	SB(r)a II	11.3	1457	86	a
NGC 5585	08 Apr 1988	3600	111	111	1.25	1.5	no	14 18 12	+56 57 30	S(s)d IV	11.3	303	86	
NGC 5576	23 Feb 1987	1300	31	29	1.23	2.5	yes	14 18 33	+03 29 54	E4 (tides?)	11.7	1509	86	g
NGC 5631	28 Mar 1986	1000	110	111	1.25	1.5	yes	14 25 00	+56 48 00	S0$_3$(2)/a	12.4	1979	86	g
NGC 5638	07 Apr 1988	1300	44	42	1.38	1.0	no	14 27 09	+03 27 18	E1	12.2	1667	86	
NGC 5660	08 Apr 1988	3301	130	123	1.10	1.3	no	14 28 04	+49 50 48	S(s)c I.2	12.3	2319	87	
NGC 5656	28 Mar 1986	2000	80	84	1.13	1.5	yes	14 28 18	+35 32 34	Sab	12.4	3192	87	g
NGC 5669	06 Apr 1988	1502	48	51	1.41	1.5	yes	14 30 17	+10 06 36	SB(r)c I-II	12.0	1338	87	a,k
NGC 5678	21 Feb 1987	2000	161	153	1.12	1.8	yes	14 30 38	+58 08 24	S(s)c II-III	12.0	2267	87	g
NGC 5668	08 Apr 1988	3200	14	14	1.15	1.3	no	14 30 54	+04 40 12	S(s)c II-III	12.1	1574	87	
NGC 5676	28 Mar 1986	2000	119	123	1.09	1.5	no	14 31 02	+49 40 48	S(s)c II	11.6	2141	88	g
NGC 5690	06 Apr 1988	2700	137	38	1.34	1.5	yes	14 35 09	+02 30 24	S(s)c II:	12.5	1778	88	m
NGC 5701	28 Jun 1985	2000	35	41	1.29	1.3	no	14 36 41	+05 34 48	(R)SBa	11.8	1556	88	
NGC 5746	28 Jun 1985	1800	45	48	1.64	1.3	no	14 42 23	+02 09 54	Sb	11.5	1774	88	
NGC 5775	07 Apr 1988	2003	56	43	1.40	1.0	no	14 51 27	+03 44 48	Sc (on edge)	12.2	1563	88	b,h
NGC 5806	27 Feb 1985	1700	175	9	1.18	1.5	yes	14 57 28	+02 05 24	S(s)b II.8	12.3	1351	89	
NGC 5813	28 Jun 1985	1200	40	40	1.38	1.3	no	14 58 39	+01 53 54	E1	11.6	1924	89	
NGC 5831	28 Jun 1985	2000	15	21	1.22	1.0	no	15 01 34	+01 24 54	E4/S0$_1$	12.5	1667	89	
NGC 5838	28 Jun 1985	2000	0	5	1.17	1.0	no	15 02 54	+02 17 36	S0$_2$(5)	11.7	1363	89	
NGC 5846	27 Feb 1985	1300	1	17	1.20	1.5	yes	15 03 56	+01 47 48	S0$_1$	11.1	1710	89	
NGC 5850	28 Jun 1985	1600	48	49	1.75	1.3	no	15 04 35	+01 44 12	SB(rs)b I-II	11.7	2483	90	
NGC 5866	26 Jun 1985	1200	33	134	1.13	1.8	yes	15 05 07	+55 57 18	S0$_3$(8)	10.8	769	90	b,h
NGC 5879	27 Jun 1985	1500	125	122	1.19	1.0	yes	15 08 29	+57 11 24	S(s)b II	12.1	791	90	h
NGC 5905	26 Jun 1985	1800	124	126	1.15	1.8	yes	15 14 02	+55 42 06	SB(sr)bc I	12.3	3331	90	
NGC 5907	28 Jun 1985	1800	85	84	1.65	1.8	yes	15 14 37	+56 30 24	Sc (on edge)	11.1	522	90	
NGC 5921	28 Jun 1985	1600	52	52	1.81	1.5	no	15 19 28	+05 14 54	SB(s)bc I-II	11.5	1457	91	
NGC 5962	27 Jun 1985	1500	54	55	1.22	1.0	yes	15 34 14	+16 46 24	S(s)c II.3	12.1	1993	91	h,i
NGC 5970	27 Jun 1985	2500	54	54	1.40	1.0	yes	15 36 08	+12 21 00	SB(r)bc II	12.1	2063	91	h
NGC 5982	26 Jun 1985	1800	106	116	1.25	1.8	yes	15 37 38	+59 31 06	E3	12.0	2904	91	h
NGC 5985	26 Jun 1985	1800	110	127	1.20	1.8	yes	15 38 36	+59 29 36	SB(r)b I	11.8	2467	91	a
NGC 6015	26 Jun 1985	2700	116	118	1.29	1.8	yes	15 50 39	+62 27 30	S(s)c II-III	11.7	682	92	h,i,o
NGC 6070	28 Jun 1985	1800	50	49	1.80	1.5	yes	16 07 26	+00 50 24	S(s)c I-II	12.3	2007	92	
NGC 6140	26 Jun 1985	2500	56	109	1.41	1.8	yes	16 20 36	+65 30 30	SB(s)c pec	12.4	793	92	a,h,i,o
NGC 6181	27 Jun 1985	2000	60	60	1.26	1.0	yes	16 30 10	+19 55 54	S(s)c II	12.5	2253	92	
NGC 6217	26 Jun 1985	900	150	109	1.62	1.8	yes	16 35 03	+78 18 00	RSB(s)bc II	11.8	1368	92	a
NGC 6207	27 Jun 1985	1500	75	77	1.42	1.0	yes	16 41 18	+36 55 42	S(s)c III	12.1	853	93	h
NGC 6236	27 Jun 1985	820	104	104	1.54	1.0	yes	16 45 00	+70 52 13	SB(s)cd	12.5	1280	93	
NGC 6340	26 Jun 1985	900	107	109	1.52	1.8	yes	17 11 16	+72 21 54	S(r)a I	11.9	1104	93	
NGC 6384	27 Jun 1985	2000	44	45	1.32	1.0	yes	17 29 59	+07 05 48	S(r)b I.2	11.2	1690	93	h
NGC 6412	26 Jun 1985	2100	100	109	1.58	1.8	yes	17 31 22	+75 44 18	SB(s)c I-II	12.3	1475	93	
NGC 6482	19 Jul 1982	600	51	64	1.22	1.5	yes	17 49 44	+23 05 00	E2	12.1	3922	94	f
NGC 6503	14 Jul 1982	100	122	133	1.34	1.8	yes	17 49 58	+70 09 30	S(s)c II.8	10.9	26	94	a,f,q
	17 Jul 1982	2400	122	129	1.35	2.0	no							f
NGC 6500	17 Jul 1982	1500	61	60	1.41	2.0	no	17 53 48	+18 20 42	Sbc:	12.9	2975	94	f
NGC 6501	19 Jul 1982	1200	55	54	1.16	1.5	yes	17 53 52	+18 22 48	S0$^+$?	13.2	2972	94	f,q
NGC 6643	27 Jun 1985	1800	125	125	1.45	1.0	yes	18 21 14	+74 32 42	S(s)c II	11.7	1454	94	h
NGC 6654	26 Sep 1985	1500	160	159	1.32	1.3	yes	18 25 14	+73 09 12	RSB(s)0/a	12.4	1891	95	
	28 Jul 1986	2000	155	155	1.33	1.5	yes							j
NGC 6689	26 Sep 1985	1800	168	151	1.28	1.3	yes	18 35 22	+70 29 06	Sc? (spindle)	12.4	488	95	
NGC 6702	15 Jul 1982	1800	110	107	1.11	2.0	yes	18 45 30	+45 39 00	E	13.2	4712	95	f,q
	16 Jul 1982	1500	110	117	1.07	1.8	yes							f
NGC 6703	27 Jun 1985	1200	95	93	1.24	1.0	yes	18 45 52	+45 29 42	S0$^-$	12.3	2365	95	
	29 Jul 1986	1600	120	123	1.06	2.0	yes							j
NGC 6946	24 Sep 1985	1800	27	29	1.14	1.8	no	20 33 48	+59 59 00	S(s)c II	9.6	7	95	
NGC 6951	14 Jul 1982	1800	90	162	1.20	1.8	yes	20 36 37	+65 55 54	SB(sr)b I.3	12.2	1331	96	a,f

TABLE 2—*Continued*

Galaxy (1)	UT Date (2)	Exp. (3)	PA (4)	PPA (5)	sec z (6)	See. (7)	Phot. (8)	α(1950) (9)	δ(1950) (10)	Type (11)	B_T (12)	v_r (13)	Fig. (14)	Notes (15)
NGC 6951	14 Jul 1982	1800	90	148	1.22	1.8	yes	20 36 37	+65 55 54	SB(sr)b I.3	12.2	1331	96	a,f
	16 Jul 1982	2000	90	155	1.21	1.5	yes							a,f
	18 Jul 1982	2100	180	1	1.19	2.0	yes							f
	26 Sep 1985	1800	90	0	1.19	1.3	yes							
NGC 7080	17 Jul 1982	2100	96	53	1.02	2.0	no	21 27 48	+26 30 00	SB(r)b	13.1	4806	96	a,f,q
NGC 7177	24 Sep 1985	1200	125	126	1.16	2.0	yes	21 58 18	+17 29 54	S(r)ab II.2	11.9	1112	96	
	30 Jul 1986	1600	174	168	1.04	1.5	yes							j
NGC 7217	15 Jul 1982	2000	90	108	1.01	1.8	yes	22 05 36	+31 07 00	S(r)b II-III	11.0	935	96	f
	16 Jul 1982	2000	90	102	1.03	1.5	yes							c,f
	19 Jul 1982	800	180	102	1.04	1.5	yes							f
	28 Jul 1986	1300	0	105	1.01	1.5	yes							j
	22 Jan 1987	1300	68	68	1.83	2.8	no'							
NGC 7331	18 Jul 1982	1500	170	89	1.02	2.0	yes	22 34 47	+34 09 30	S(sr)b I-II	10.3	835	96	a,c,f
	22 Jan 1987	1000	70	70	1.72	2.5	no							
	29 Jul 1986	1400	80	79	1.00	2.0	yes							b,j
NGC 7332	25 Sep 1985	1000	160	172	1.01	2.0	yes	22 35 01	+23 32 18	$S0_{(2-3)}(8)$	11.7	1202	97	
NGC 7448	26 Sep 1985	1500	163	165	1.05	1.3	yes	22 57 35	+15 42 48	S(r)c II.2	12.1	2419	97	a
NGC 7457	24 Sep 1985	1800	106	105	1.16	1.8	yes	22 58 37	+29 52 42	$S0_1(5)$	11.8	824	97	
NGC 7479	15 Jul 1982	3000	6	167	1.08	1.8	yes	23 02 26	+12 03 00	SB(s)bc I-II	11.7	2394	97	f,r
	16 Jul 1982	1800	6	159	1.08	1.5	yes							f
	18 Jul 1982	1500	100	5	1.07	2.0	yes							b,f
	19 Jul 1982	1000	51	134	1.19	1.5	yes							f
NGC 7619	24 Sep 1985	1500	136	135	1.29	1.5	no	23 17 43	+07 56 12	E3	12.2	3804	97	
NGC 7626	24 Sep 1985	1300	140	140	1.21	1.8	yes	23 18 10	+07 56 36	E1	12.2	3423	98	
NGC 7640	26 Sep 1985	1800	160	84	1.12	1.3	yes	23 19 43	+40 34 12	SB(s)c II:	11.4	389	98	i
NGC 7741	26 Sep 1985	1500	100	137	1.02	1.3	yes	23 41 23	+25 47 54	SB(s)c II.2	11.8	755	98	a
NGC 7742	17 Jul 1982	1850	160	160	1.10	2.0	no	23 41 43	+10 29 18	S(r)a	12.2	1661	98	f,r
NGC 7743	14 Jul 1982	1800	90	154	1.12	1.8	yes	23 41 49	+09 39 18	SBa	12.0	1722	98	a,f,r
	16 Jul 1982	1500	90	161	1.10	1.5	yes							a,f,r
NGC 7798	26 Sep 1985	1500	90	161	1.03	1.3	yes	23 56 52	+20 28 30	S	12.4	2662	99	a

NOTES.—Cols. (1) Galaxy name. (2) UT date of observation. (3) Exposure time (seconds). (4) Position angle of slit (degrees). (5) Parallactic angle at midpoint of observation (degrees). (6) Secant of zenith angle at midpoint of observation, approximately equal to the air mass. (7) Visual estimate of seeing disk (FWHM in arcseconds). (8) Visual estimate of the transparency of the sky. "No" is listed when conditions were not photometric during observations of either the galaxy or the standard stars. (9) Right ascension (epoch 1950) in hours, minutes, and seconds, usually from the RSA. (10) Declination (epoch 1950) in degrees, arcminutes, and arcseconds, usually from the RSA. (11) Hubble type and, when appropriate, luminosity class, usually from the RSA or the RC3 as compiled by Kraan-Korteweg 1986. The types are given in brackets or parentheses for objects whose plate material was inadequate. Types followed by ":" or "?" may be uncertain by more than a subtype or half a luminosity class. As with the RSA, various descriptive terms (e.g., spindle, tides, on-edge) are included where possible. (12) Apparent blue magnitude (uncorrected for either Galactic or internal extinction), usually from the RSA, as compiled by Kraan-Korteweg 1986. (13) Heliocentric velocity (km s^{-1}) from the RC3. (14) Figure in which the spectra of the galaxy are shown.

Col. (15) Notes to Table 2: (a) Slit oriented along the major axis of the galaxy; (b) slit oriented along the minor axis of the galaxy; (c) slit width = 1″ and extraction width = 1″ × 4″; (d) slit width = 4″ and extraction width = 4″ × 4″; (e) poor and variable seeing; (f) the white dwarf LDS 749B was used as the standard star; (g) the extreme blue end of the blue spectrum suffered from severe defocusing, resulting in degradation of spectral resolution and/or uncertainty in the shape of the continuum (see § 2.2); (h) the continuum shape of the red spectrum may be uncertain because of imperfect correction for spatial focus variations (see § 2.2); (i) sky subtraction was difficult because of contamination by H II regions; (j) the red spectrum was obtained with the 1200 line mm^{-1} grating blazed at 9400 Å; (k) slit oriented along the bar of the galaxy; (l) slit oriented to avoid bright foreground star; (m) slit oriented to include additional object(s) in the exposure (e.g., nearby star to monitor the seeing or regions of the galaxy of particular interest); (n) repeat observation with position angle of slit constrained to be identical to that used in previous observation; (o) Hγ emission is affected by imperfect sky subtraction; (p) extraction window used was 2″ × 16″ (see notes on NGC 4013 in § 4); (q) observed in the 1982 July run and not subsequently reobserved; lacks a blue spectrum; (r) reobserved with lower spectral resolution (~5–8 Å; see HFS); for completeness, we show the blue region from these data.

mm^{-1} grating blazed at 7100 Å to cover ~ 6210–6860 Å with a resolution of ~ 2.5 Å.

A long slit of width 2″ (in a few cases 1″) was generally placed across the nucleus of each galaxy; in some cases where the location of the nucleus was not obvious, the slit was aligned to intersect the brightest parts of the center of the galaxy in order to maximize the chance of detecting the nucleus. Otherwise, the slit was usually oriented along the parallactic angle to minimize light losses due to atmospheric dispersion (Filippenko 1982); however, if the air mass was low (sec $z \lesssim 1.1$) the slit was sometimes rotated to a more astrophysically interesting angle, such as along the major or minor axis.

We removed the bias level of each data frame by subtracting the overscan column. The dark current of the chips was negligible. Pixel-to-pixel variations in the response were removed through division by appropriatedly normalized exposures of

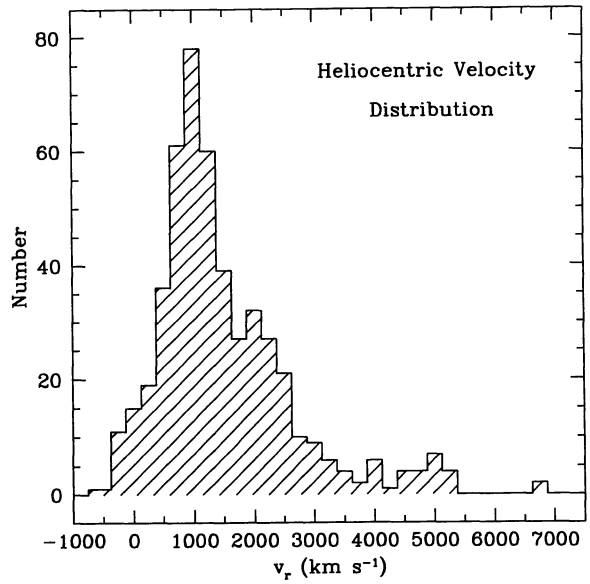

FIG. 1*a*

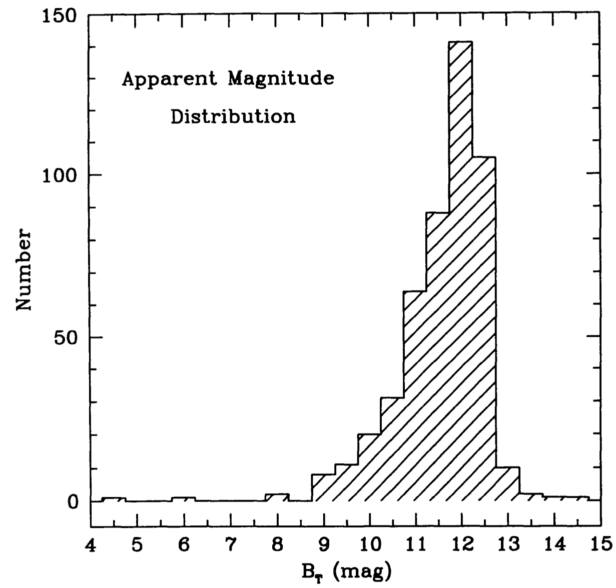

FIG. 1*b*

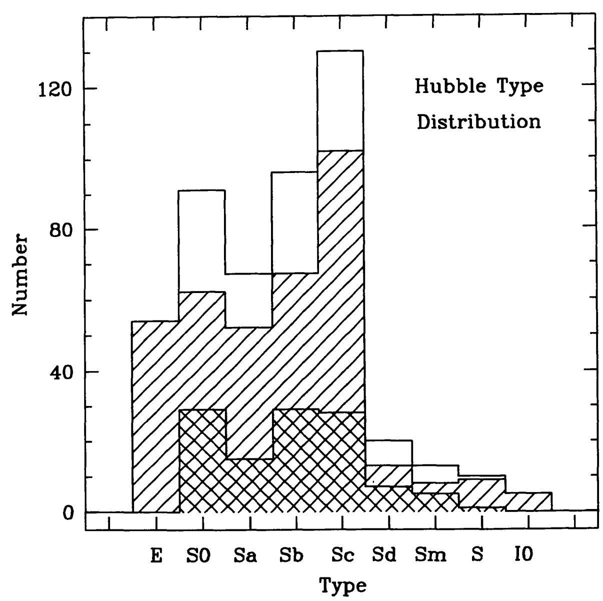

FIG. 1*c*

FIG. 1.—(*a*) Distribution of heliocentric velocities (v_r), taken from the RC3, for galaxies in the survey. The velocities have been binned to Δv_r = 250 km s^{-1}. (*b*) Distribution of apparent blue magnitudes (B_T), taken from Kraan-Korteweg (1986). The magnitudes have been binned to ΔB_T = 0.5 mag. (*c*) Distribution of Hubble types, taken from Kraan-Korteweg (1986). The types shown on the abscissa have been grouped as follows: "E" = E and E/S0, "S0" = S0 and S0/a, "Sa" = Sa and Sab, "Sb" = Sb and Sbc, "Sc" = Sc, "Sd" = Scd and Sd, "Sm" = Sm and Im, "S" = S and S pec, and "I0" = I0. Unbarred galaxies are shown in the single-hatched histogram, barred galaxies in the double-hatched histogram, and the total in the unhatched histogram.

the dome illuminated by a hot, spectroscopically featureless lamp. During the reduction procedure, slight tilts of the spectra with respect to the pixel columns were removed by fitting a cubic spline to the data. We extracted one-dimensional spectra of the nucleus of each object by summing over the central 5.1 or 10.2 pixels of the blue CCD (for a pixel scale of 0".78 or 0".39 pixel^{-1}, respectively), and the central 6.9 pixels of the red CCD. Thus, the effective aperture achieved was either 1" × 4" or 2" × 4". Whenever appropriate, we also extracted spectra of prominent emission-line regions along the slit. These regions are typically giant extragalactic H II regions in the inner spiral arms or circumnuclear star-forming regions. These additional spectra will be presented elsewhere.

The background sky level was determined from areas as close to the nucleus as possible, taking care not to include the contribution of emission from obvious H II regions along the slit or from bright, extended emission near the nucleus. Any spurious pixel values introduced by cosmic rays were automatically removed in the process. Since it was not always possible to find sky areas along the slit which were totally devoid of H II regions, negative residuals due to oversubtraction of emission lines with slightly different radial velocity were sometimes introduced next to features of interest in the nucleus. In practice, this does not significantly affect the measured strength of the emission lines. Occasionally, imperfect subtraction of the strong night-sky lines Hg I λ4358 and [O I] λλ6300, 6363 also introduced residuals in the spectra. The latter complication has little impact for galaxies with recessional velocities greater than ~250–300 km s^{-1}, since the spectral features most likely to be affected (Hγ, [O III] λ4363, [O I] λλ6300, 6363, [S III] λ6312, and [Fe X] λ6374) are redshifted away from the contaminated regions. However, for cosmetic purposes, we removed these residuals by interpolation in the final presentation of the spectra.

Spectra of bright secondary standard stars (Oke & Gunn 1983; Massey et al. 1988) were used to calibrate the relative fluxes (and, during photometric nights, the absolute fluxes) of the spectra. For the 1982 July run, the DB white dwarf LDS 749B (Oke 1974) was used instead; thus the spectral response for objects observed during this run may be less reliable. Whenever possible, we observed standard stars at different times during the night, usually the beginning, middle, and end. We often took short exposures of bright, foreground stars close to the position of program galaxies in order to monitor seeing variations. During most of the observing runs, we also observed at least one velocity dispersion standard star; the latter will be used to measure the velocity dispersion of some of the galaxy nuclei (e.g., Sargent et al. 1977). One-dimensional spectra of the standard and foreground stars were extracted in exactly the same manner as for the galaxy spectra, using an effective slit length of 4″.

In some of the observing runs, the spatial focus of the red camera varied temporally and as a function of wavelength over the course of each night; this effect introduced low-frequency variations (amplitude up to 10%) into the continuum shape of the spectra which could not be removed through simple application of the average response function derived from the standard stars. To correct for this effect, we adopted the following strategy. All spectra of both the program objects and foreground stars were independently calibrated with each of the standard stars observed during the night. Then, for each foreground star observed, we found the best linear combination of its spectra reduced with different standards which yielded approximately the "anticipated," intrinsic continuum shape of the particular star. Once determined, the same linear combination of standard star calibrations was applied to the program galaxies which were observed close in time to the foreground star. We found that this empirical method of correcting for the focus variations worked reasonably well in most cases, especially for galaxies whose nuclei resemble point sources. Although a certain amount of subjectivity is involved in this procedure, and changes in the focus sometimes occurred discontinuously in time, we believe that the resulting galaxy continuum shapes should generally be reliable. Nevertheless, we caution against deriving quantitative results using the spectral continuum shapes of the red spectra of some objects, in particular those whose nuclei are spatially extended. (Indeed, the adopted assumptions are not at all valid for objects having uniform surface brightness.) The last column of Table 2 indicates which objects might be suspect. Similarly, although the *relative* continuum shape between the blue and red spectra should in principle be trustworthy, since the spectra for the two spectral regions were obtained simultaneously, in some objects it may suffer from the uncertainty mentioned above. Of course, the variations in spatial focus also led to nonuniform contamination by off-nuclear light, possibly producing slight wavelength-dependent differences in the velocity dispersion and effective stellar population, but here we will not be concerned with this subtlety. Although the blue camera did not suffer large temporal focus variations, in some observing runs the spectral or spatial focus did flare out at the extreme blue end. Below ~ 4350 Å, the spectra of some objects show obvious degradation in spectral focus, or an unphysical upturn in the measured flux. (The latter problem is especially evident in objects with spatially extended nuclei; the reduction procedure assumes the nucleus is a point source, but spatial defocusing produces less light loss in an extended object.) As a general rule, the extreme ends of both the blue and red bandpasses should be viewed with caution.

Telluric oxygen absorption lines near 6280 and 6860 Å (the "B band") were removed through division by normalized, intrinsically featureless spectra of the standard stars. Large residuals caused by mismatches at the sharp, deep bandhead were eliminated by interpolation in the plotted spectra. The reduction procedure also corrected for continuum atmospheric extinction.

We established the wavelength scale by fitting a cubic or quartic polynomial to unblended emission lines of He, Ne, Ar, Hg, and Fe in the comparison lamp spectra. These spectra were also used to measure the spectral resolution as a function of position on the CCDs, which is necessary in order to remove the instrumental resolution from the measured line widths. Fine-scale adjustments to the zero point of the wavelength scale were made by comparing the observed and laboratory wavelengths of the night-sky emission lines.

For each galaxy, multiple exposures taken with the same setting, sometimes over several epochs, were combined in a weighted average, with the weights determined by the S/N. We did not combine multiple spectra of Seyfert galaxies showing obvious variability. Several galaxies (e.g., NGC 3079, 3034, and 3690) were observed with more than one slit orientation for different scientific purposes; we combined the multiple *nuclear* spectra for these objects only if they looked qualitatively similar.

3. THE SPECTRAL ATLAS

The blue and red calibrated spectra of the nucleus of each survey galaxy are presented in Figures 2–99. Blue spectra are not available for six galaxies, and three others only have blue spectra taken at lower spectral resolution (~5–8 Å); these are indicated in column (15) of Table 2. The objects are ordered with increasing right ascension, as in Table 2. The ordinate displays flux density in units of 10^{-15} ergs s^{-1} cm^{-2} $Å^{-1}$, and the abscissa wavelength (Å) in the rest frame of the galaxy, binned linearly to 1 Å $pixel.^{-1}$ Although we show the spectra on an absolute flux scale, it must be borne in mind that not all of the observations were taken under photometric conditions (consult col. [8] of Table 2 for an estimate of the transparency); moreover, even for those observations deemed to be photometric, the quoted fluxes are likely to be uncertain by ~30% (or even 50% with the 1″ slit) because of the narrowness of the slit and variable seeing conditions.

A quick perusal of the atlas reveals that the spectra are generally of exceptionally high quality. Choosing a slit width of 2″ for most objects and adhering to a consistent pair of high-dispersion gratings ensured moderate spectral resolution (~2.5–4 Å), while adequate integration times (generally up to 1 hr for faint objects) provided high S/N. The red spectra typically have an S/N of ~30–80 per resolution element in the continuum (e.g., NGC 520, 660, and 2276); the S/N of the blue spectra is lower (~20–30 per resolution element in the continuum for the three objects mentioned above) due to the diminished sensitivity of the CCD at shorter wavelengths and the bright night sky in which many of the observations were conducted. We emphasize that these two characteristics of our survey, namely, moderate spectral resolution and high S/N, distinguish it from previous work (§ 1) and are vital to the principal aims of our study—detection of weak, broad Hα emission and accurate measurement of emission-line intensities and profiles.

The spectral properties of the galactic nuclei can be broadly divided into the following categories: (1) absorption-line nuclei showing either an old or an intermediate-age stellar population, (2) nuclei dominated by emission lines from regions of active star formation ("H II" or "starburst" nuclei), (3) LINERs, which are widely believed to be manifestations of nonstellar activity, and (4) classical AGNs such as Seyfert nuclei. A complete discussion of the statistical properties and physical significance of these different classes of nuclei is reserved for a separate study.

4. NOTES ON INDIVIDUAL OBJECTS

This section will remark on notable features concerning some objects. These include special difficulties associated with the acquisition or reduction of the data, properties of the spectra that are unusual, or recent developments that are pertinent to the interpretation of the spectra. In an initial report of this survey, Paper I gave a detailed description of each of the 75 galaxies observed through 1984. For the sake of brevity, we will not repeat the description of those objects unless important recent findings so warrant; the reader may consult Paper I and references cited therein. Because of the scale of the figures, it is difficult to discern some of the details mentioned in the text below.

NGC 7814.—The nucleus of this galaxy is heavily obscured by a prominent dust lane, splitting the spatial profile into two peaks (the slit was approximately perpendicular to the dust lane). We extracted the more prominent of the two peaks to obtain the spectra shown in Figure 2.

IC 10.—This Im galaxy does not have an obvious nucleus. The brightest knot (Fig. 2) shows extremely strong emission lines. There may be a hint of features from Wolf-Rayet (W-R) stars; there is a low-contrast, broad emission complex near 4650 Å and a very faint broad base in the Hα profile. (See notes on NGC 1156 and NGC 4214 for more information.) Unfortunately, the region around 4650 Å happened to have landed on a defective portion of the chip; thus additional data are needed to confirm whether the apparent W-R features are real.

NGC 147.—The spectrum was taken across the geometrical center of the galaxy. The apparent nucleus (Fig. 2) has a pure A-star spectrum and $v_r \approx 0$ km s^{-1} (but we removed a recessional velocity of -160 km s^{-1}, as given by the RC3, in the spectrum shown in Fig. 2). It thus appears to be a foreground Galactic star; the stellar population of NGC 147 is old rather than young (Hodge 1989).

NGC 185.—The nucleus of NGC 185 is very ill defined, and the spectrum has low S/N. Nevertheless, the presence of faint H II region emission lines and Balmer absorption lines indicate some ongoing star formation. Like NGC 205, NGC 185 is a companion of M31; the star formation histories of the two appear very similar but not identical (Hodge 1989).

NGC 205.—The well-defined nucleus exhibits a blue continuum and prominent Balmer absorption lines, indicating a young stellar population. Emission lines are very weak or absent, however, implying that there is either not much gas present or a deficit of O-type stars in this dwarf elliptical system. Hodge (1989) cites additional evidence for a young stellar population in NGC 205 and discusses its probable star formation history.

NGC 278.—Intense H II regions fill the slit. The nucleus shows very strong Balmer absorption lines with narrow emission cores, a blue continuum, and H II region nebular lines, indicative of a young stellar population and ongoing star formation.

NGC 315.—The emission-line spectrum of NGC 315 has LINER characteristics. In addition, the presence of a weak broad Hα component (HFS) and a radio jet (Giovannini, Feretti, & Comoretto 1989) supports the classification of this object as a low-luminosity AGN.

NGC 404.—Noteworthy for a very young underlying stellar population, this LINER has atypically narrow emission lines that are unresolved in our spectra. The two-dimensional data show extended circumnuclear emission lines which have the spectral characteristics of H II regions. A Faint Object Camera (FOC) *Hubble Space Telescope* (*HST*) image taken at ~2300 Å (Maoz et al. 1995) reveals that the nuclear region contains a bright, unresolved ($r < 1$ pc) point source surrounded by several fainter sources, the latter presumably being star-forming regions responsible for both the extended nebular emission and the young stellar spectral features seen in the nucleus.

NGC 488.—[N II] is visible in the red spectrum, along with an emission core to the Hα absorption line. Both of these emission lines show a double-peaked profile, reflecting the steep rotation curve visible in the two-dimensional spectrum.

NGC 520.—This galaxy shows very obvious tidal features, a highly disturbed morphology, and prominent dust lanes. Numerical simulations suggest that NGC 520 is a merger remnant resulting from two disk galaxies colliding $\sim 3 \times 10^8$ yr ago (Stanford & Barcells 1991), thereby giving rise to the enhanced star formation observed (Stanford 1991). Our spectra, extracted over the brightest central knot, most likely coincides with the primary nucleus, which, according to Stanford (1991), has the most elevated star formation activity. The emission and absorption features seen in our spectra are consistent with a very young stellar population.

NGC 672.—No obvious nucleus can be discerned in this galaxy. The slit intersected a number of emission-line knots, all of which are high-excitation H II regions; the spectrum shown in Figure 7 is the brightest of the central knots.

NGC 784.—No obvious nucleus can be identified in this diffuse galaxy. The central knot has the spectrum of a high-excitation H II region, as do the remaining knots along the slit.

NGC 891.—Hβ emission is marginally visible in the blue spectrum, despite the presence of fairly prominent Hα emission in the red spectrum. The steep Balmer decrement, and the implied large reddening, undoubtedly reflects the conspicuous dust lane seen in this edge-on galaxy. No obvious nucleus was visible, and the spectra were extracted from the geometrical center of the dust lane. Pildis, Bregman, & Schombert (1994) discuss the extensive system of gas above and below the plane of NGC 891.

NGC 1003.—This is a diffuse galaxy with an ill-defined nucleus. The approximately central emission region has very low S/N.

NGC 1156.—Several bright emission-line knots occupy the length of the slit. The brightest of these, apparently coincident with the nucleus, shows emission features of W-R stars and a high-excitation H II region. The spectrum strongly resembles that of the "W-R galaxy" NGC 4214 (Sargent & Filippenko 1991). Like NGC 4214, a broad component is visible in the

Hα line, along with a broad emission feature near 4650 Å that can be attributed to N V λ4619, N III λ4640, C III λ4650, C IV λ4658, and He II λ4686; these lines are seen in WC and WN stars. Vacca & Conti (1992) argue that the number ratio of W-R stars to O stars inferred in W-R galaxies implies that star formation must be occurring on timescales $\lesssim 10^6$ yr; see also Sargent & Filippenko (1991).

NGC 1569.—The presence of a broad emission feature at ~4650 Å and a broad base to the Hα line indicates that W-R stars are present in the nucleus of NGC 1569 (see discussion concerning NGC 1156 above). Drissen & Roy (1994) recently detected emission lines commonly seen in late WN stars from a star cluster located in the outskirts of the galaxy.

NGC 1560.—We oriented the slit along the major axis of the galaxy to maximize our chance of finding the nucleus in this diffuse galaxy. The displayed spectrum was extracted from our best estimate of the location of the nucleus. Most of the emission visible comes from high-excitation H II regions.

NGC 2366.—The broad undulations seen in the blue and red spectra, as well as the absorption dip near 4955 Å in the blue spectrum, are caused by contamination from a superposed M-type star.

NGC 3003.—The blue spectrum shows a broad emission complex centered at 4650 Å, indicating that NGC 3003 is a W-R galaxy. Unlike other objects in this class (e.g., NGC 1156, 1569, and 4214), the Hα emission line does not show an obvious broad component.

NGC 3027.—The nucleus is very ill defined in this diffuse galaxy. Part of the emission lines seen in Figure 25 may be due to H II regions located near the nucleus rather than from the nucleus itself.

NGC 3031 (M81).—Filippenko & Sargent (1988) describe in detail the emission-line properties of this well-studied LINER. Among the characteristics which qualify M81 as one of the best low-luminosity AGN candidates include a broad Hα component (full width near zero intensity ≈ 7000 km s^{-1}) with a luminosity ~ 20 times smaller than that of the faintest "classical" Seyfert 1 galaxy (NGC 4051; Véron 1979), a compact radio core (Kellermann et al. 1976), a pointlike X-ray source as seen by *ROSAT* (Petre et al. 1993), and rapid X-ray variability (Barr et al. 1985).

NGC 3034 (M82).—The prototypical starburst galaxy M82 is the subject of numerous multiwavelength studies. H I synthesis observations (Yun, Ho, & Lo 1993) reveal many tidal features connecting M82 and M81, suggesting that these two galaxies have recently undergone a tidal interaction. In addition to the nuclear spectrum (Fig. 25; we assumed that the brightest knot corresponds to the nucleus), we also have several spatially resolved long-slit spectra taken parallel to the major axis of M82 with which we plan to study in more detail the kinematics and spatial variations in excitation (e.g., McCarthy, Heckman, & van Breugel 1987).

NGC 3079.—NGC 3079 belongs to a class of galaxies which display large-scale emission features emanating from the nucleus along the minor axis. These "superwinds" (Heckman, Armus, & Miley 1990) are thought to arise from the collective energy deposition and expulsion of matter from massive stars and supernovae in starburst systems. The center of NGC 3079 also harbors a LINER nucleus. Because of the complex geometry of the emission-line gas, the detailed spectrum of the nucleus depends on the orientation of the slit. The spectrum shown in Figure 25 (P.A. = 45°) was chosen simply because it has a fairly high S/N. Detailed analyses of NGC 3079 can be found in Filippenko & Sargent (1992) and Veilleux et al. (1994).

NGC 3073.—An H II region spectrum coupled with deep Balmer absorption lines indicates that the stellar population of NGC 3073 is very young. Filippenko & Sargent (1992, and references therein) postulate that the copious star formation observed in NGC 3073 might have been triggered by the superwind from NGC 3079 (see above), which, in projection, points in the direction of NGC 3073.

NGC 3245.—All the emission lines of NGC 3245 are double-peaked, resulting from its unusually steep rotation curve. The line profiles are reminiscent of those of NGC 488 and NGC 7479.

IC 2574.—No definite nucleus can be identified in the two-dimensional spectrum of this extremely diffuse galaxy. Spectra of several emission-line knots, all of which are H II regions, were extracted; the one shown in Figure 29 is the brightest among them.

NGC 3367.—The emission lines of NGC 3367 are unusually broad (FWHM ≈ 490 km s^{-1} for Hβ) and show a blue asymmetry; their intensity ratios suggest a mixture of an H II region and a LINER (as in NGC 3504—see below). A broad emission complex near 4650 Å is evident, suggesting the presence of W-R stars.

NGC 3432.—It is difficult to identify the location of the nucleus in the two-dimensional spectrum because NGC 3432 is an edge-on Scd galaxy. Emission from H II regions extends along most of the slit. The spectrum of the adopted position of the nucleus shows narrow emission lines superimposed on a blue continuum with broad Balmer absorption lines.

NGC 3489.—Multiple velocity components are responsible for the "boxy" structure of the emission lines of NGC 3489.

NGC 3504.—HFS identified NGC 3504 as a "transition object," based on its emission-line intensity ratios, which are intermediate between those of LINERs and H II nuclei. Such objects may owe their ionization to a composite source which is both stellar and nonstellar.

NGC 3628.—The location of the nucleus was very difficult to identify in the two-dimensional spectrum; a large dust lane obscures much of the light in this edge-on spiral.

NGC 3642.—A weak, broad Hα component is present in this LINER (Paper I), whose morphology in soft X-rays is largely unresolved (Koratkar et al. 1995). HFS present an optical spectrum covering a wide wavelength range.

NGC 3655.—The structure present in the emission lines of NGC 3655 results from the strong velocity gradient near the nucleus, as can be seen from the two-dimensional frame.

NGC 3690.—NGC 3690 is one of several W-R galaxies in our study. We oriented the slit along two different position angles, one in order to include the bright emission-line knot to the east of the nucleus (P.A. = 80°.7), and another to intersect additional features (P.A. = 163°.2). Emission lines from W-R stars are present in several regions; however, they are not present in the nucleus (Fig. 40). A detailed discussion of NGC 3690 and other W-R galaxies in our sample will be presented elsewhere.

NGC 3735.—The spectrum of NGC 3735 is that of a low-luminosity Seyfert 2 galaxy; to our knowledge, it has not been previously cataloged as an AGN (Véron-Cetty & Véron 1993).

In addition to having [O III] ≫ Hβ and [N II] ≈ Hα, weak He II λ4686 is present.

NGC 3982.—NGC 3982 can be classified as a Seyfert 2 galaxy based on its emission-line spectrum. In addition to the typical bright lines, the high S/N spectrum in Figure 46 shows [O III] λ4363, He II λ4686, and [S III] λ6312. The profiles of the bright lines have a noticeable blue asymmetry, a property common to many Seyfert galaxies (e.g., Whittle 1985).

NGC 3998.—This well-studied LINER has a weak, broad component of Hα emission (Paper I) similar to that of M81. Reichert et al. (1992) investigated the ultraviolet (UV) properties of NGC 3998 using spectra obtained with the *International Ultraviolet Explorer.* Although they find that the spectrum of the central region in the UV is still dominated by starlight, there may be an underlying power-law continuum whose UV flux is sufficient to produce the observed emission-line spectrum by photoionization. Reichert et al. detected a broad component in the Mg II λ2800 emission line with a width similar to that seen in the Hα line. Recent X-ray observations using *ROSAT* reveal that the 0.2–2.4 keV flux is concentrated in a point source; however, the limited spectral data are consistent with a variety of models and thus do not provide very useful constraints on the possible emission mechanisms (Reichert, Mushotzky, & Filippenko 1994).

NGC 4013.—A dark absorption lane cuts across this nearly edge-on galaxy, thereby hiding the nucleus. We extracted the spectrum by summing a large swath (16″) centered on the expected position of the nucleus in order to include some faint emission visible on either side of the dust lane. The interpolated region of the blue spectrum (~4630 Å, Fig. 46) was corrupted by a defective region of the CCD.

NGC 4051.—NGC 4051 is the lowest luminosity "classical" Seyfert 1 galaxy (Véron 1979). He II λ4686 and [Fe X] λ6374 are particularly noticeable in Figure 47. Relative to most other Seyfert 1 galaxies (e.g., NGC 5548 in Fig. 85), the permitted lines of NGC 4051 are conspicuously narrow.

NGC 4214.—Sargent & Filippenko (1991) discuss this W-R galaxy in some detail. Several luminous star clusters are present; the spectrum shown in Figure 53 is extracted from the brightest region ("knot 1" in the notation of Sargent & Filippenko), approximately centered on the galaxy. The weak, broad bump at ~4650 Å is a blend of several features (see discussion concerning NGC 1156) found in W-R stars of type WC and WN. As noted by Sargent & Filippenko, the Hα line exhibits a weak, broad base.

NGC 4261.—Based on images taken with the *HST,* Jaffe et al. (1993) report the discovery of an extended (dimensions 121 × 51 pc) disk in NGC 4261 with its major axis aligned perpendicular to the radio axis. After carefully removing the underlying starlight, we find that the emission-line spectrum is that of a LINER. Each of the emission lines, both permitted and forbidden, requires a two-component Gaussian fit. The narrower of the two components has FWHM ≈ 300–650 km s^{-1}, while the broader component has FWHM ≈ 700–1400 km s^{-1}. The FWHM varies from line to line; the broader of the two components of the forbidden lines appears to exhibit a critical density versus width correlation (e.g., Filippenko & Halpern 1984), but this effect is not evident for the narrower component. The FWHM of the deblended components we find are somewhat different from those quoted by Ferrarese et al. (1994); they find FWHM ≈ 450 km s^{-1} for the narrow component and FWHM ≈ 2500 km s^{-1} for the broad component. In addition, we do *not* detect very broad wings in the Hα line, unlike Ferrarese et al.

NGC 4388.—The discovery of a broad component to the Hα emission line in the nuclear spectrum of this Seyfert 2 galaxy was reported in Paper I. Subsequently, Shields & Filippenko (1988) revealed off-nuclear broad Hα emission which presumably is scattered radiation from a hidden Seyfert 1 nucleus, similar to the case NGC 1068 (Antonucci & Miller 1985).

NGC 4395.—NGC 4395 hosts the nearest ($d \approx 2.6$ Mpc), lowest luminosity ($M_B \approx -10$ mag) Seyfert 1 nucleus known (Filippenko & Sargent 1989). *HST* observations reveal a UV spectrum similar to those of normal Seyfert galaxies (Filippenko, Ho, & Sargent 1993). The widths of the narrow lines are extremely small, being unresolved in the present survey; high-resolution observations with an echelle spectrograph yield FWHM ≈ 40–50 km s^{-1} (Filippenko & Ho 1995). The narrowness of the lines undoubtedly reflects the shallow gravitational potential of the late-type spiral bulge (Sd III-IV). Stringent limits on the stellar content of the nucleus of NGC 4395 (Filippenko et al. 1993; Filippenko & Ho 1995) provide a powerful challenge to the hypothesis that the AGN phenomenon originates from starburst activity (Terlevich et al. 1992).

NGC 4485.—This galaxy is tidally interacting with NGC 4490. The spectra of the two look nearly identical: both exhibit extremely deep Hβ and Hγ absorption and a very blue continuum. Faint, narrow emission lines are also present. It appears that the tidal interaction triggered a recent burst of star formation in both of these galaxies. The relative strengths of the emission lines of these two galaxies are atypical compared to other H II nuclei (e.g., NGC 4449 and 4460 in Fig. 64); note that [O I] λ6300 is quite strong relative to Hα. Since shock excitation enhances the strength of low-ionization lines such as [O I] λ6300 (see discussion in HFS), it is plausible that shocks, possibly related to the interaction between the two galaxies or originating from supernova remnants, play some role in producing the emission-line spectra observed.

NGC 4490.—See NGC 4485.

NGC 4486 (M87).—The nuclear spectra of six separate exposures (taken at different position angles) were averaged in order to increase the S/N (Fig. 66). See Paper I for a brief discussion of this object.

NGC 4496A,B.—As discussed extensively in Filippenko et al. (1988), NGC 4496A,B (VV 76) form an optical, rather than a physical, binary system, with systemic velocities of cz = 1700 and 4510 km s^{-1}, respectively. The spectrum of NGC 4496A shown in Figure 67 is not of its nucleus (which was not observed); it was extracted from an emission-line knot located ~19″ south of the nucleus of NGC 4496B (P.A. = 180°; see Filippenko et al. 1988 for details).

NGC 4532.—Weak features due to W-R stars are present in the blue spectrum of NGC 4532 (Fig. 68), although this is not discernible because of the scale of the plot. A feature at λ ≈ 4650 Å can be identified with C III, and the broad complex on which it is superimposed with other features commonly seen in W-R galaxies (see discussion of NGC 1156). Several lines of He I are present, as is a very weak, broad component in the Hα emission line.

NGC 4569.—The UV morphology of the nucleus of NGC 4569 is best represented by a bright, unresolved point source plus fainter extended emission (Maoz et al. 1995). The emission-line spectrum resembles those of "transition objects" (LINER/H II), most likely reflecting the composite source of photoionization suggested by the UV imaging.

NGC 4579.—Comprehensive multiwavelength data are available for this galaxy and a few others in our survey. Collectively, the evidence makes NGC 4579 one of the best examples of a low-luminosity AGN. Relevant factors include the detection of broad Hα emission (Paper I), an emission-line spectrum typical of LINERs (Fig. 71), a UV continuum consistent with a power law (Goodrich & Keel 1986), an unresolved nuclear source in the UV (Maoz et al. 1995), a flat-spectrum radio core (Hummel et al. 1987), and X-ray emission (Halpern & Steiner 1983).

NGC 4631.—The location of the nucleus in this edge-on Sc spiral cannot be identified with certainty on the two-dimensional spectrum. The spectrum we adopt for the nucleus (Fig. 73) was extracted from an emission peak approximately near the center of the long slit. Spectra at other places along the slit look qualitatively similar.

NGC 4639.—Filippenko & Sargent (1986) reported the discovery of this low-luminosity Seyfert 1 galaxy. With a broad Hα luminosity of 6×10^{39} ergs s^{-1}, NGC 4639 is 4 times fainter than NGC 4051. Koratkar et al. (1995) discuss the X-ray properties based on *ROSAT* observations. The soft X-ray spectral slope, luminosity, and morphology of NGC 4639 are similar to those of more luminous Seyfert galaxies.

NGC 4736.—*HST* UV images reveal two unresolved point sources in the center of this galaxy, as well as three arcs shaped like bow shocks, suggesting that the system might be a merger remnant (Maoz et al. 1995). After careful starlight subtraction, the emission-line intensity ratios resemble those of "transition objects" (LINER/H II). The stellar component of the photoionization probably comes from young stars formed as a result of the merger.

NGC 4772.—The [N II], Hα, and [S II] lines have double-peaked profiles. Inspection of the two-dimensional spectrum shows that the emission lines in the nucleus are tilted with respect to the continuum, signifying a very steep rotation curve.

NGC 4866.—The emission lines are much broader than normal, having FWHM $\gtrsim$ 700 km s^{-1}. Inspection of the two-dimensional spectrum indicates that a very steep rotation curve produces most of the observed line width. In this respect, NGC 4866 is similar to NGC 5005, and more extreme than NGC 1052, 3884, and 6500, all of which have line widths significantly broadened by rotation (see Paper I for a more detailed discussion).

NGC 5033.—As mentioned in Paper I, the emission-line spectrum of NGC 5033 has characteristics of both a LINER and a Seyfert galaxy. A comparison of the spectra obtained at three different epochs (see Table 2) reveals that the fairly prominent broad Hα emission is variable. *ROSAT* observations detected emission consistent with an unresolved X-ray source (Koratkar et al. 1995).

NGC 5055.—The emission-line spectrum is very weak and difficult to measure. After removing the dominant stellar absorption spectrum, the emission-line intensity ratios indicate a composite source of photoionization, although the presence of a spatially resolved UV source (Maoz et al. 1995) suggests that most of the ionizing radiation originates from young stars.

NGC 5204.—The nuclear spectrum (Fig. 81) may be contaminated by a nearby, bright H II region ($\sim 5''$–$6''$ away), although it is unlikely that the nucleus of an Sd spiral could be completely devoid of emission lines. Similar to the case of NGC 4485 and 4490, [O I] λ6300 is unusually strong relative to Hα, indicating that shocks, perhaps due to supernova remnants, contribute significantly to the ionization of the line-emitting gas.

NGC 5273.—The red spectrum of this Seyfert galaxy resembles that of NGC 4639, showing very prominent broad Hα emission. In the blue, broad Hβ (and possibly Hγ) are visible, as well as a feature near 4560 Å which is due to Fe II. Unresolved X-ray emission was detected by Koratkar et al. (1995).

NGC 5690.—Lack of a strong continuum makes identification of the nucleus difficult in this highly inclined Sc galaxy. Emission from H II regions fills most of the slit.

NGC 5746.—A dark dust lane obscures most of the nucleus in this nearly edge-on spiral, making the spectrum heavily reddened.

NGC 5866.—A dark dust lane cuts across the nucleus. We extracted the spectrum by summing the light ($4''$ swaths) on either side of the dust lane; the final spectra shown in Figure 90 represent the average of the two extractions.

NGC 5907.—The nucleus of this Sc galaxy is partially obscured by a dust lane, causing the spectrum to be heavily reddened.

NGC 6951.—As noted in Paper I, the emission-line intensity ratios and profiles of NGC 6951 (Fig. 96) closely resemble those of NGC 5194 (Fig. 81). Both objects can be classified as Seyfert 2 galaxies based on their emission-line spectra. Filippenko (1984) further discussed similarities in the spatial variation of the [N II] λ6583/Hα ratio in these two galaxies. The radial gradients of the emission-line intensity ratios in NGC 5194 have been attributed to photoionization by a power-law radiation field (Rose & Searle 1982).

NGC 7640.—The location of the nucleus is somewhat ambiguous in this highly inclined spiral. Luminous H II regions fill most of the slit, complicating sky subtraction.

5. SUMMARY

An atlas of high-quality, moderate-resolution optical spectra is presented for a magnitude-limited survey of 486 bright, northern galaxies. The spectra shown sample the nuclear region (typically $2'' \times 4''$) of each object. A vast majority of the data were obtained with the same telescope and instrumental setup, and uniform procedures were followed during data reduction to ensure maximum homogeneity in the observational parameters. These data have a large number of scientific applications that will be of value to the general astronomical community. Subsequent papers will address a range of issues, with special emphasis on the luminosity function and physical nature of low-luminosity active galaxies.

We gratefully acknowledge the assistance and support of the director, Gerry Neugebauer, and the technical support staff at Palomar Observatory during the many years in which this survey was conducted. We are indebted to John Biretta and the late Peter Young for writing some of the software used in the data reduction, and to Joe Shields and Tom Matheson for upgrading and maintaining various portions of the code. The long course of this work was supported by NSF grants AST-8957063 and AST-9003829 to A.V.F., and by AST82-16544, AST84-16704, AST-8819792, and AST-92213165 to W.L.W.S. We thank Margaret Katz for making the finding charts.

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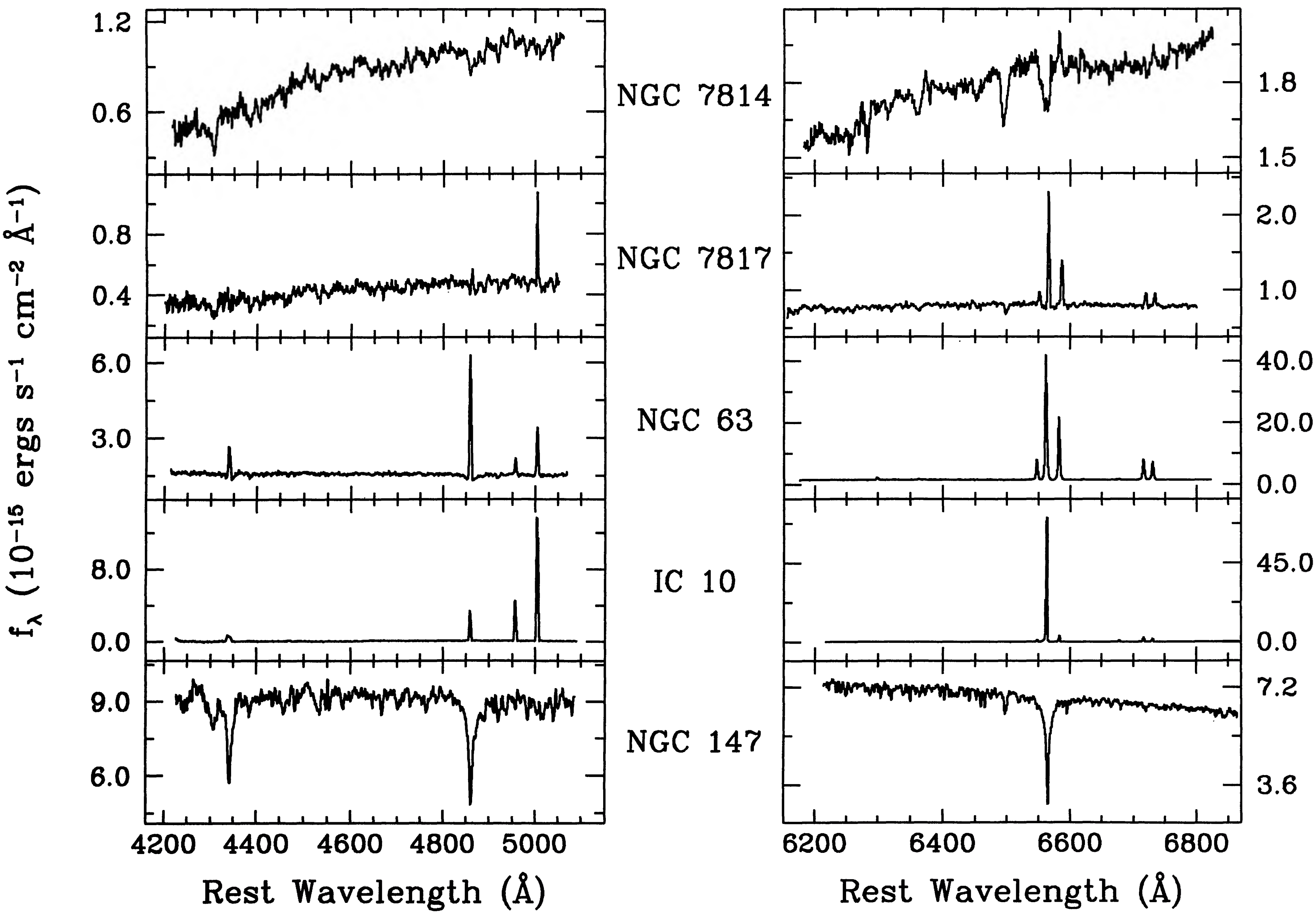
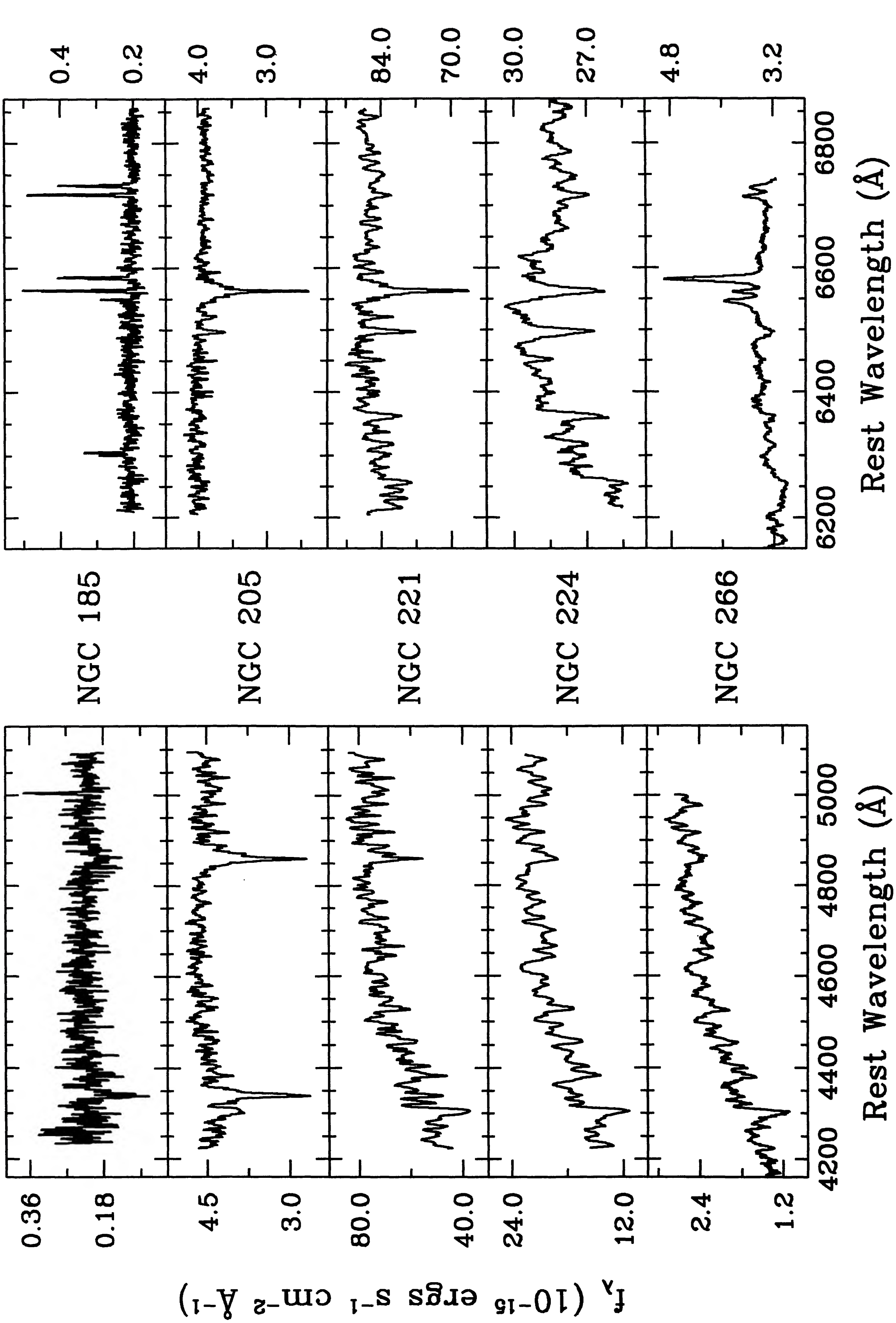


FIG. 2.—Calibrated spectra of the galaxies in the survey. In this and in all subsequent figures, the galaxies are arranged with increasing right ascension, from top to bottom, in the order shown in Table 2. Col. (14) of Table 2 lists the figure number in which each galaxy appears. Each figure (except Fig. 99) displays five galaxies. The left and right panels show spectra from the blue and red cameras, respectively. The name of the galaxy to which each row corresponds is given in the middle of the figure. The ordinate shows the intensity scale in units of 10^{-15} ergs s^{-1} cm^{-2} $Å^{-1}$, and the abscissa shows the rest wavelength in Å. The spectra have been binned on a linear scale, each pixel corresponding to 1 Å.



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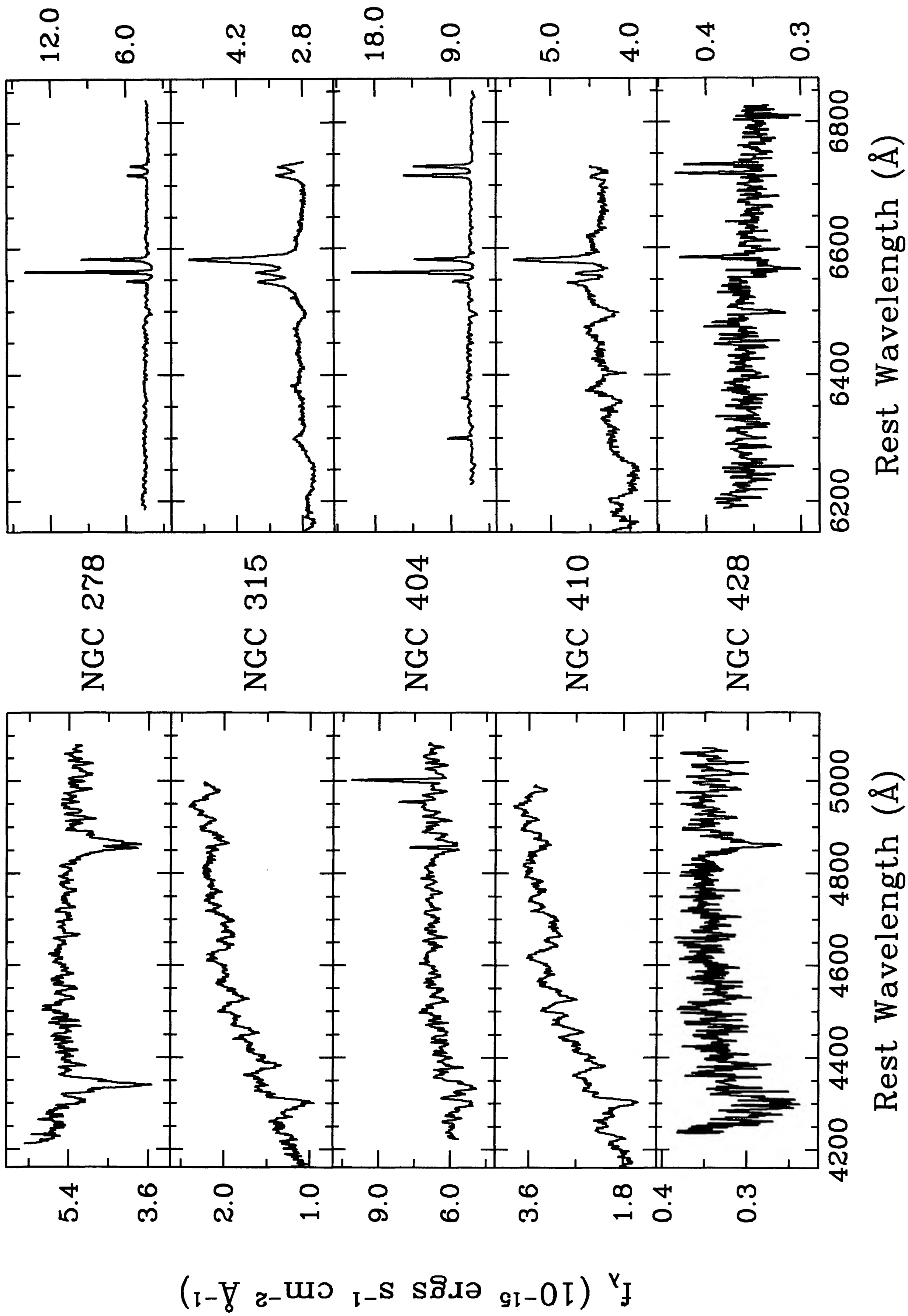

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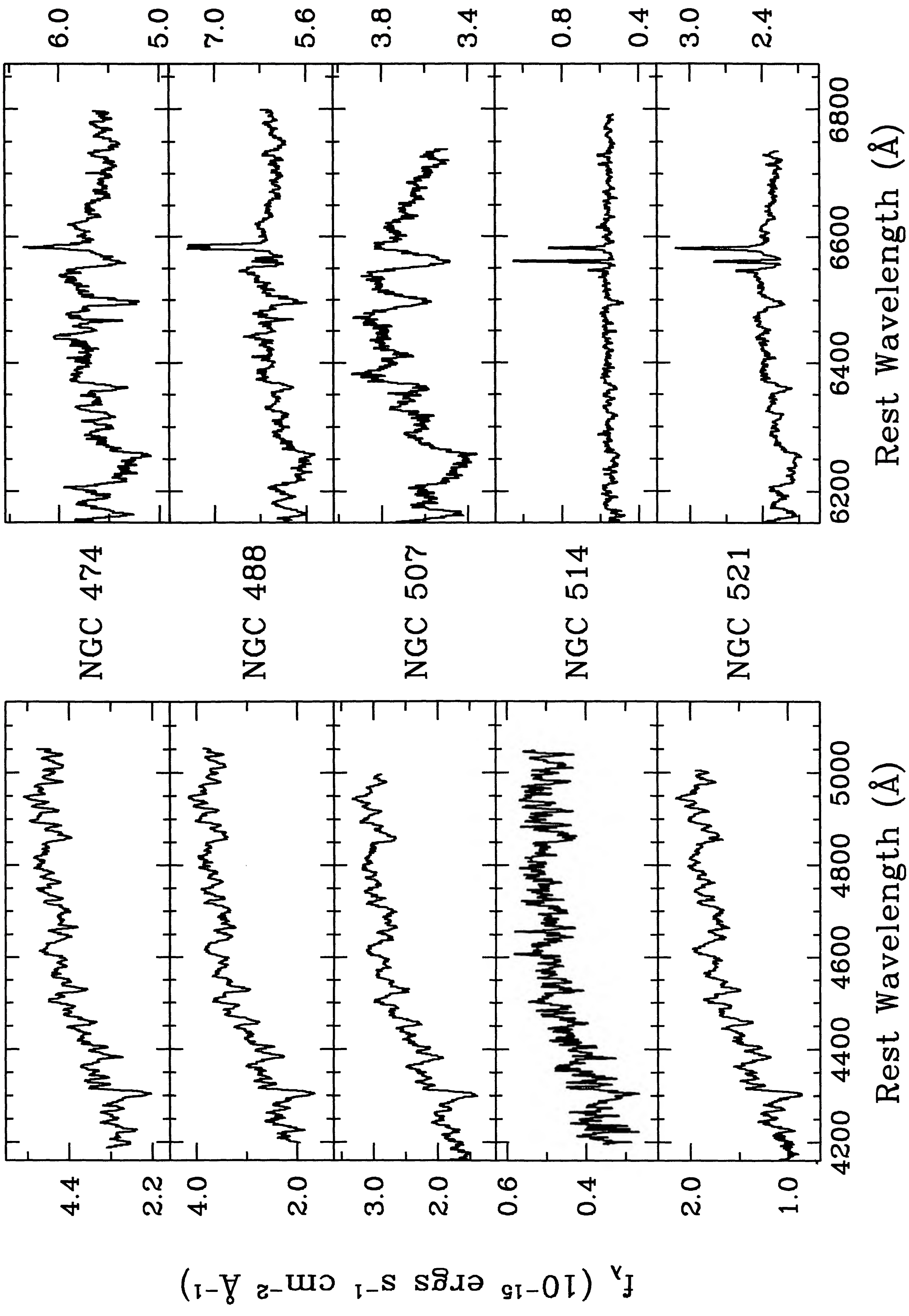

FIG. 5.—Same as Fig. 2

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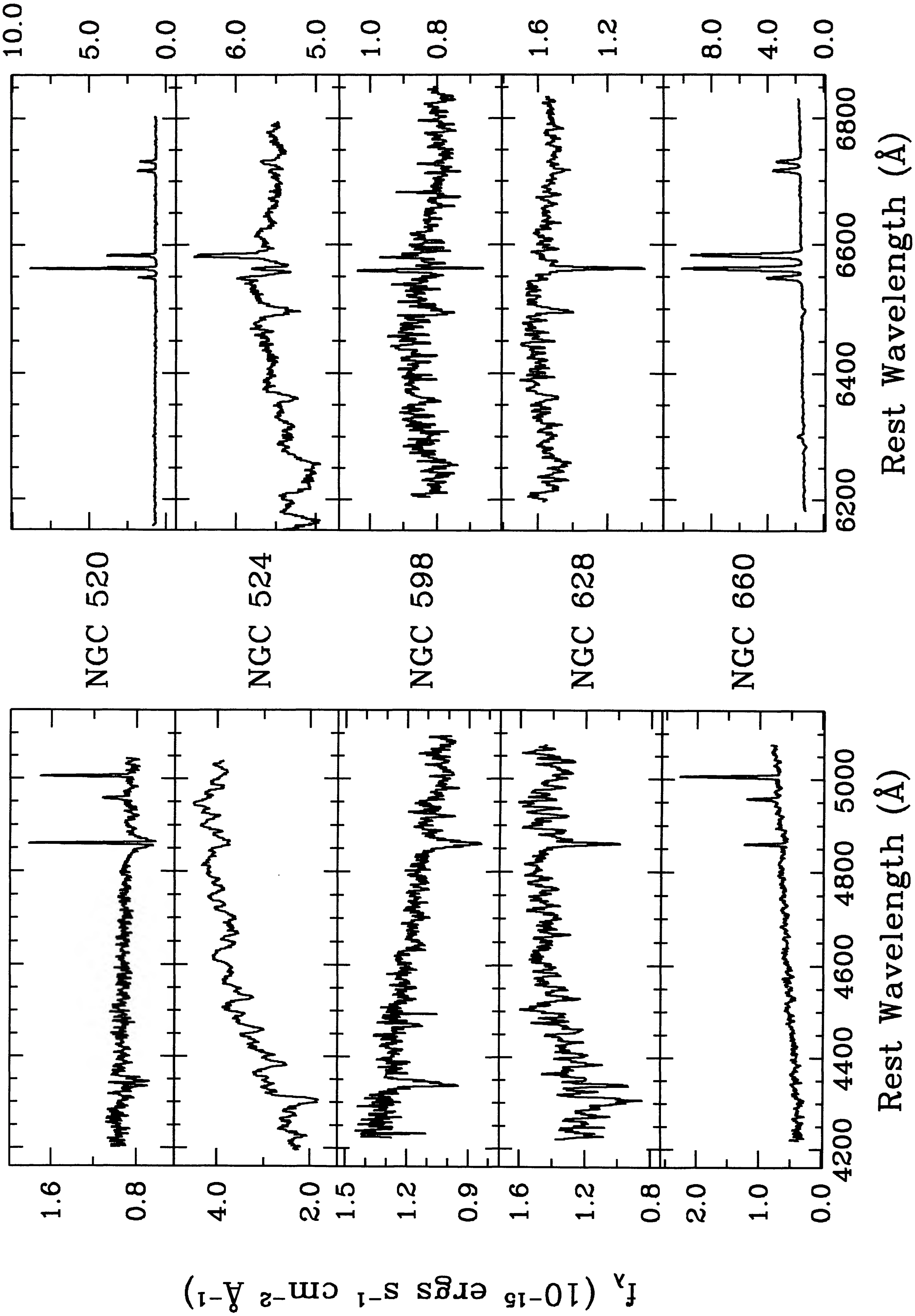

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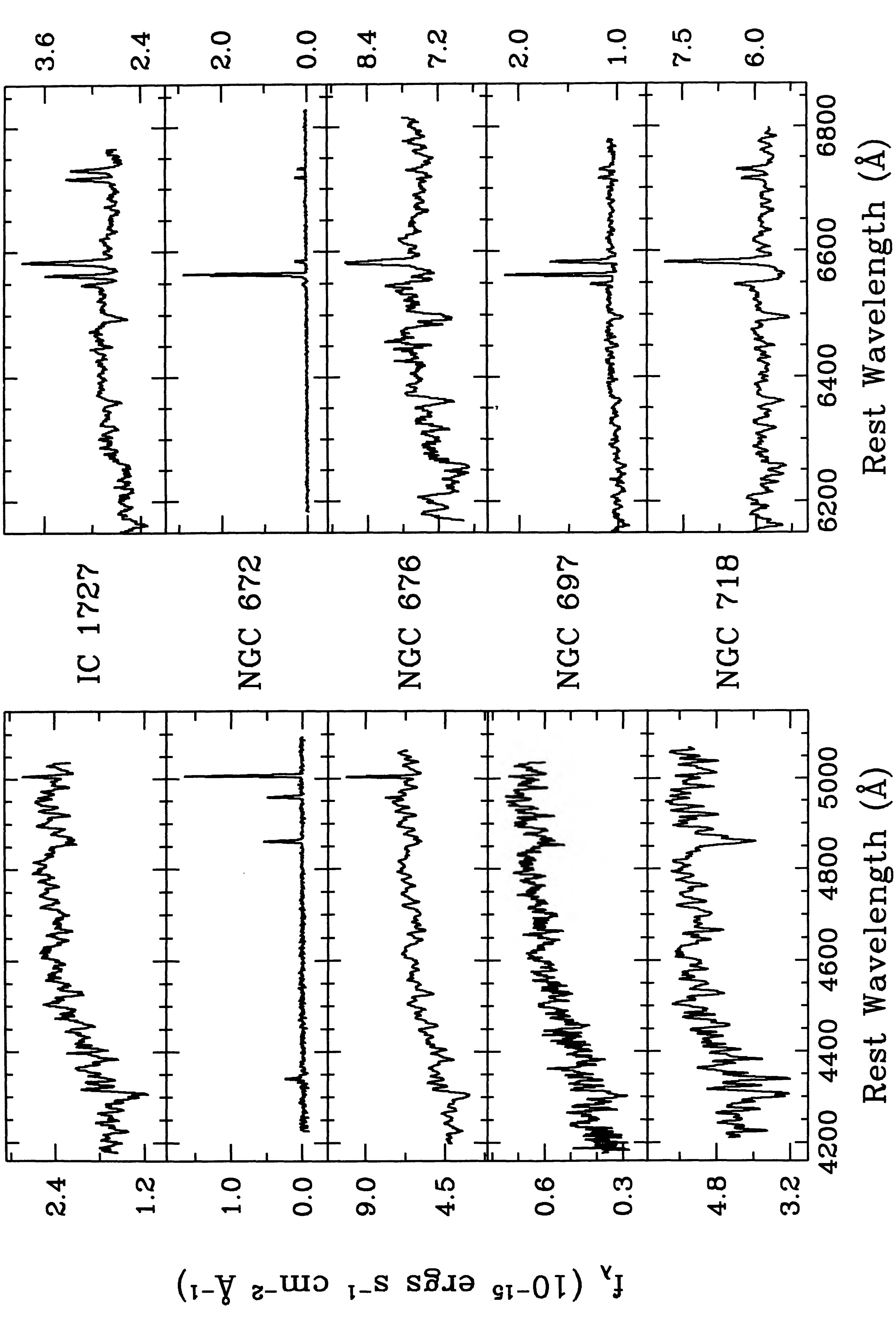

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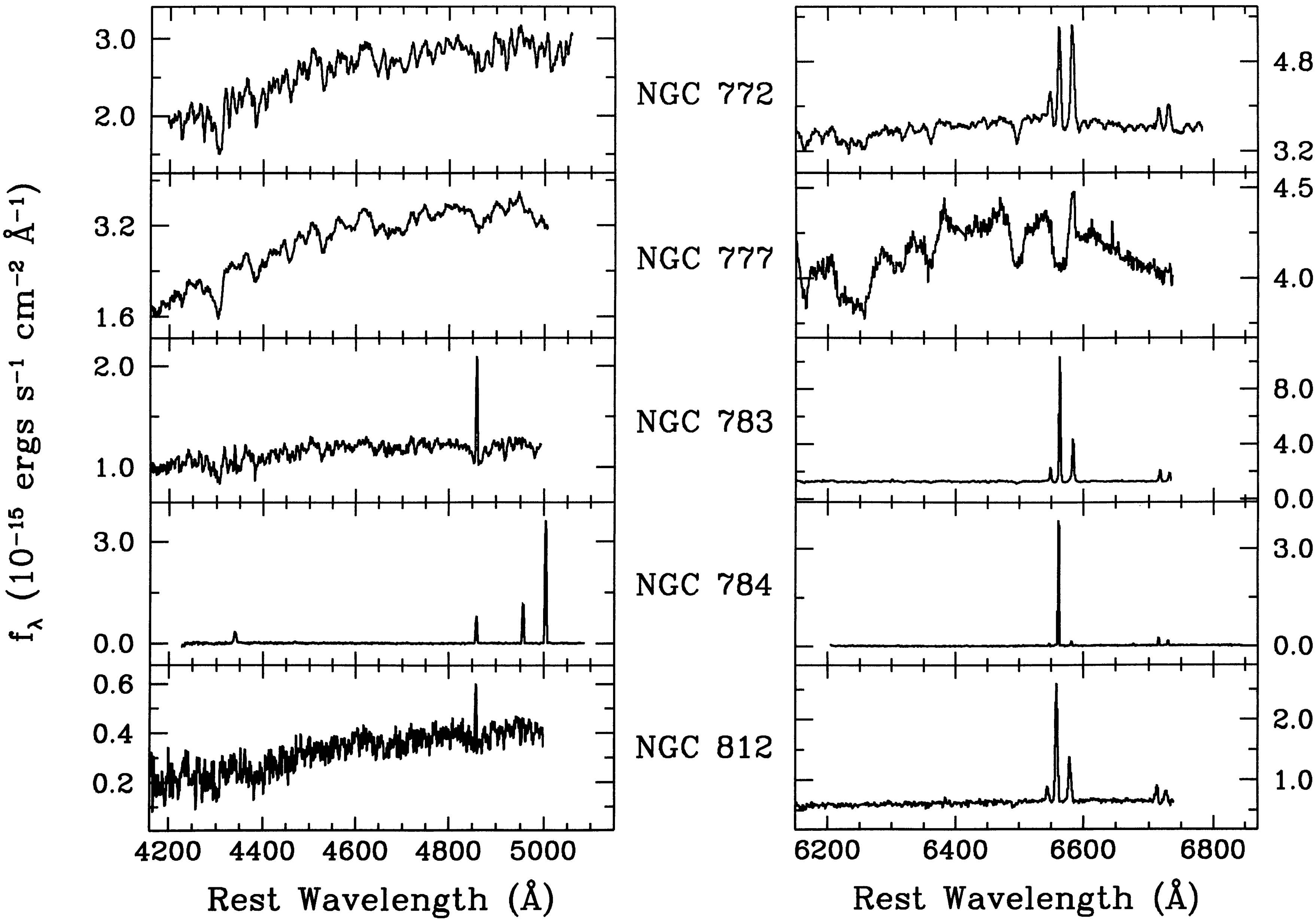

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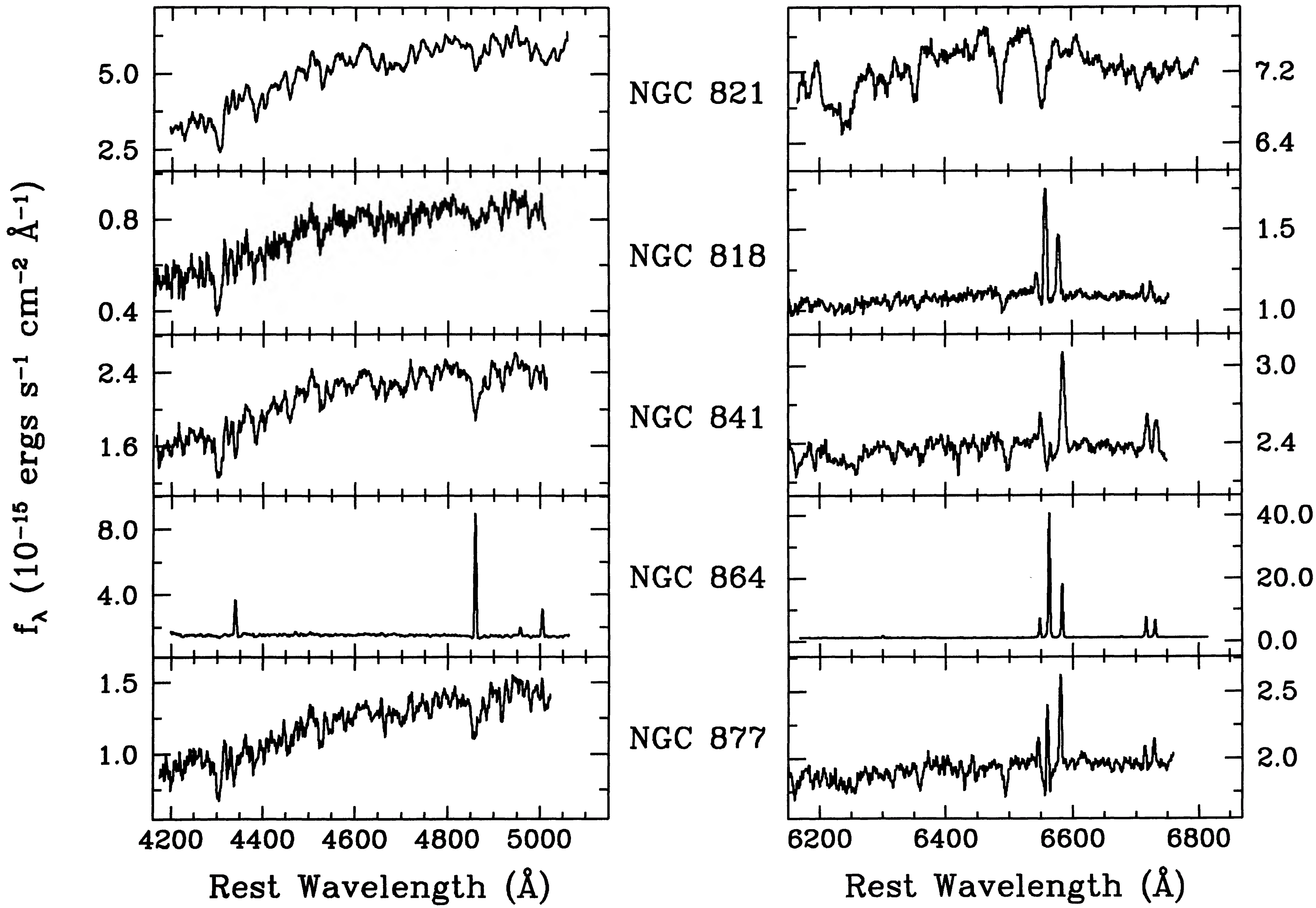

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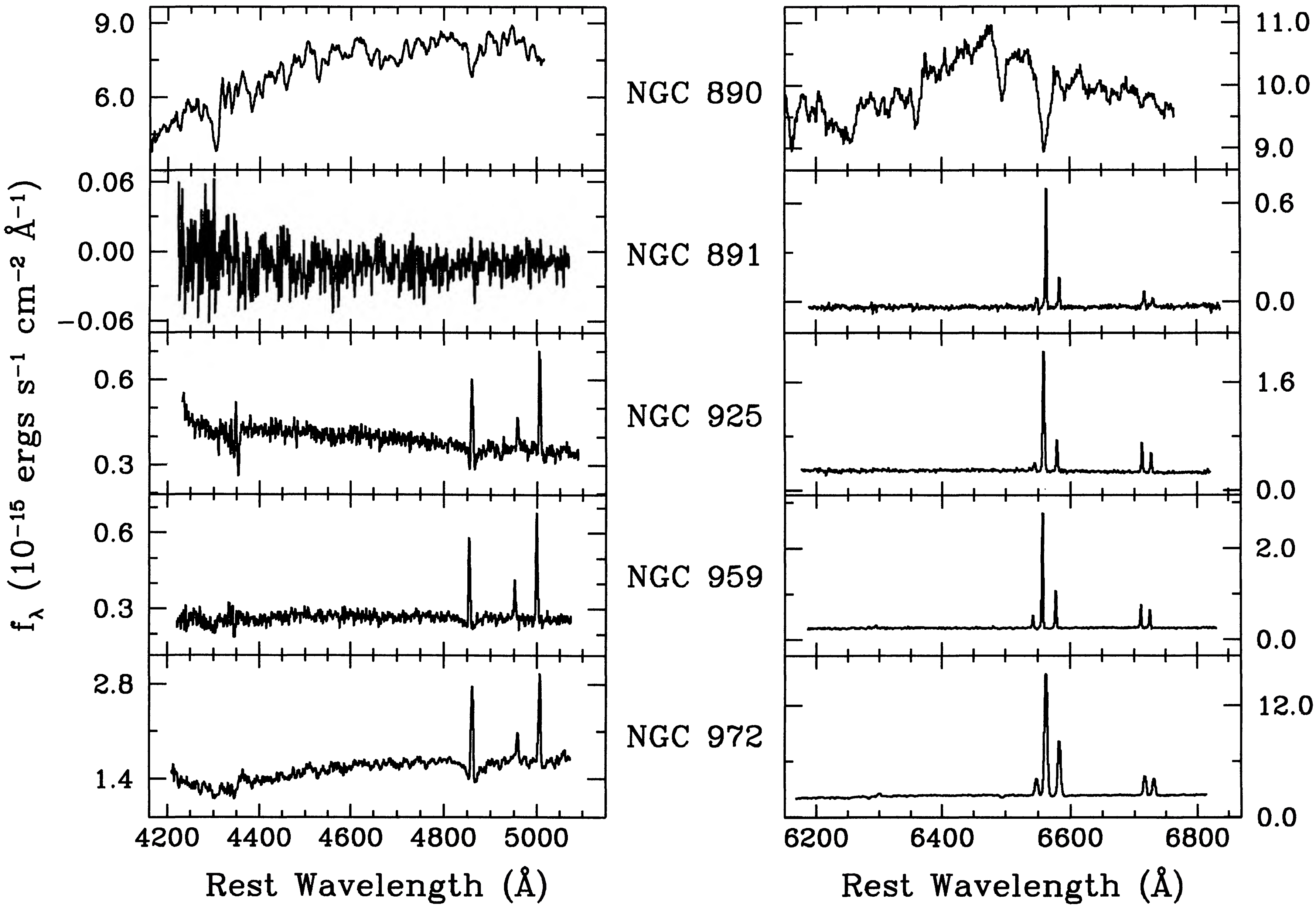

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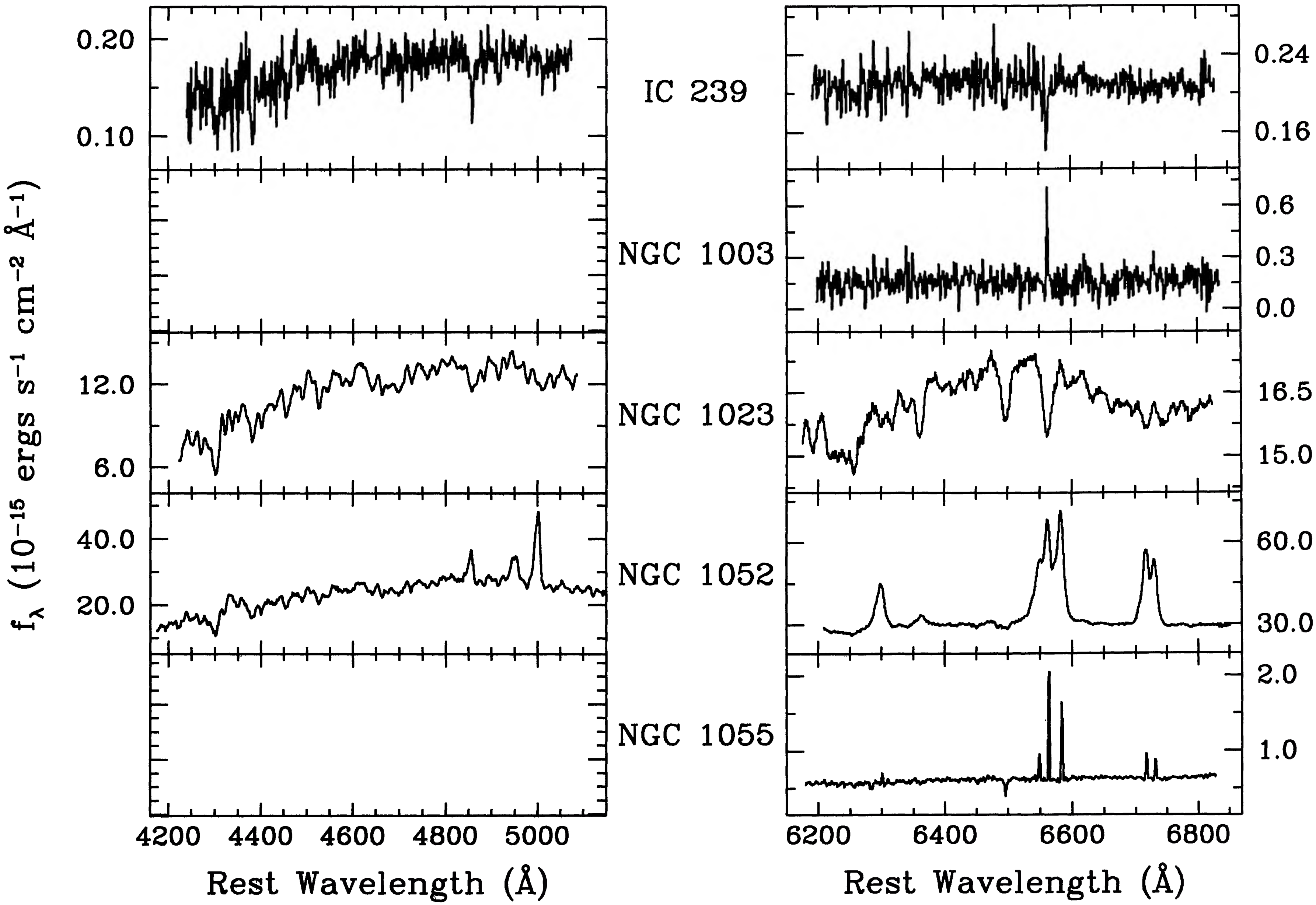

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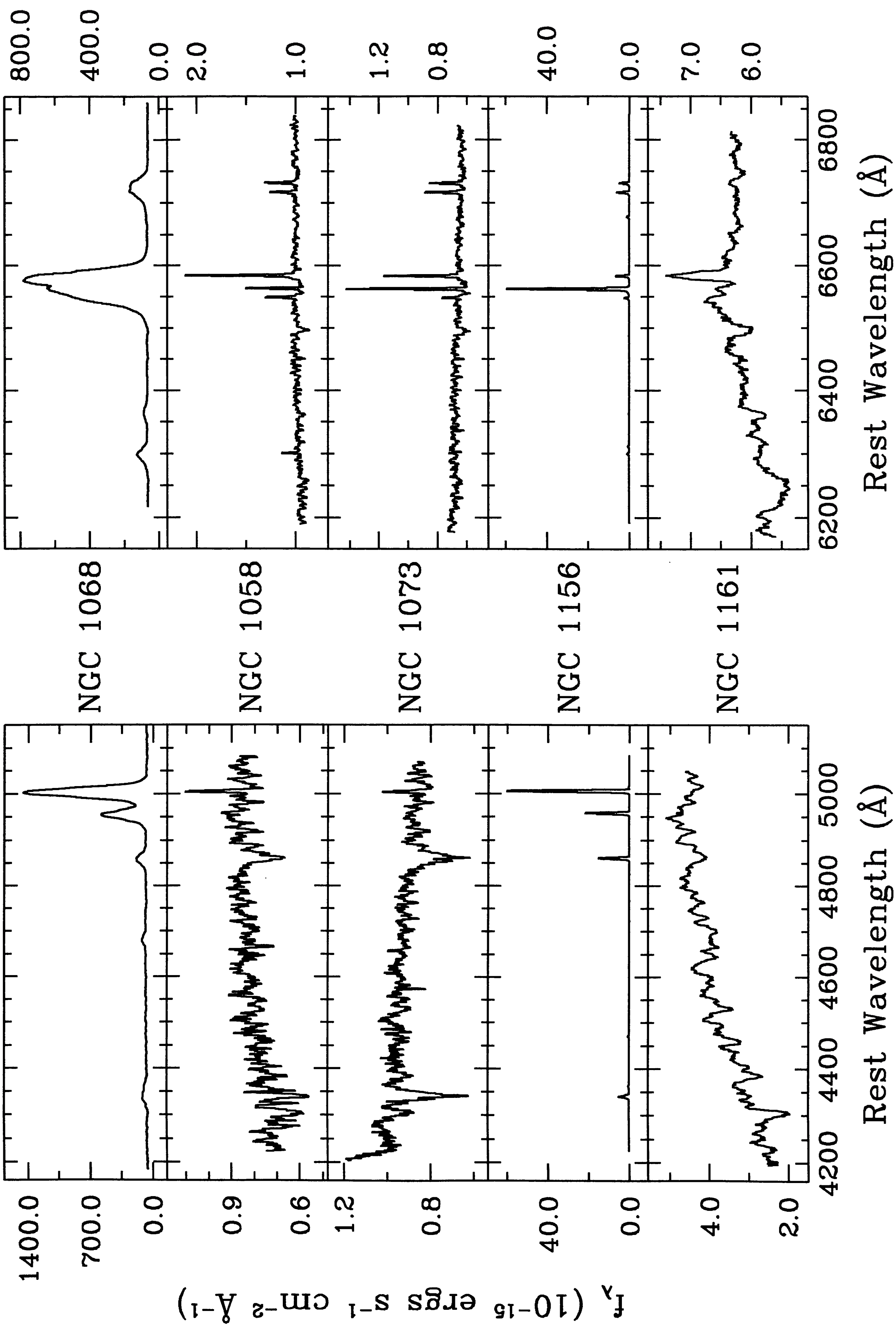

FIG. 12.—Same as Fig. 2

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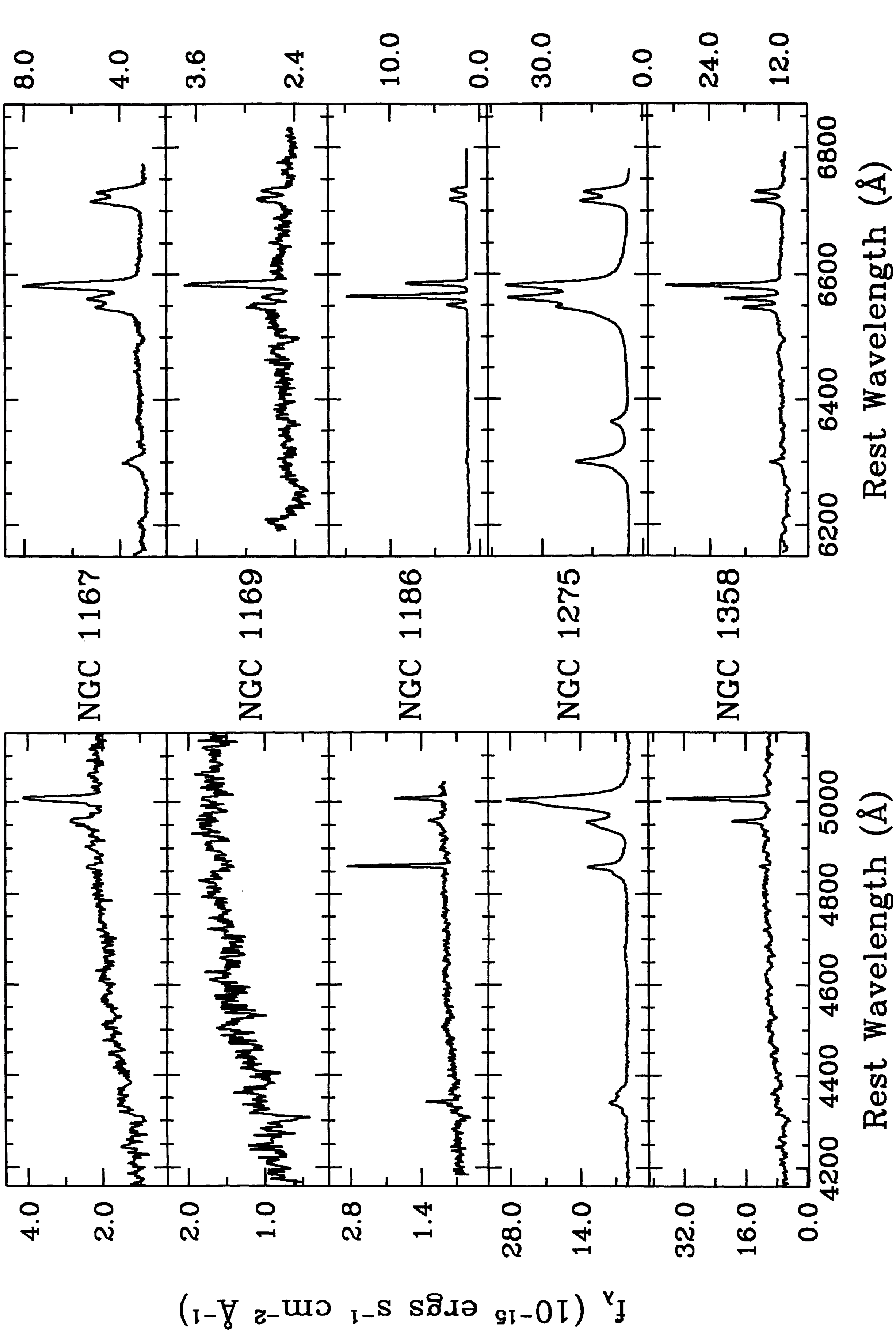

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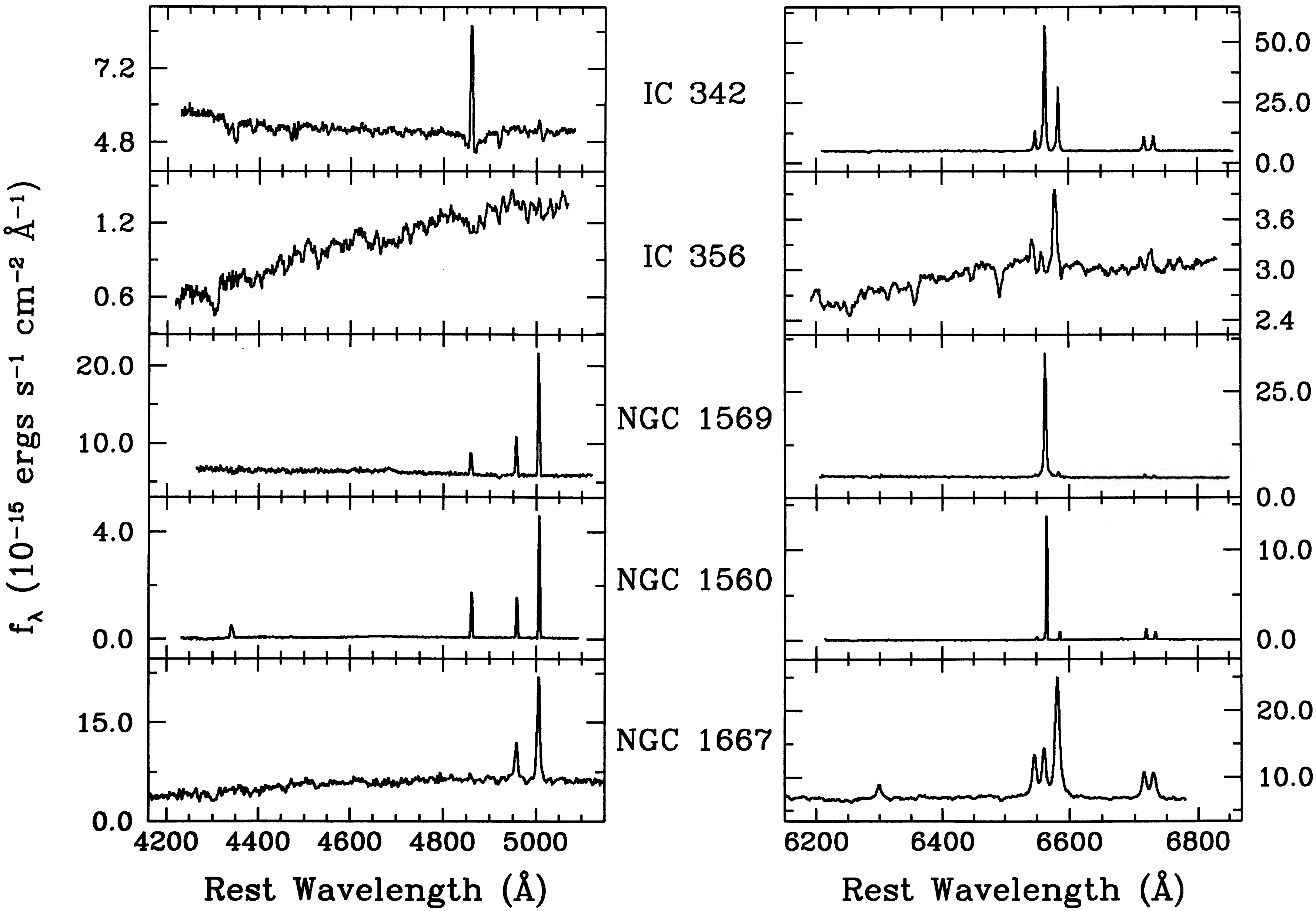

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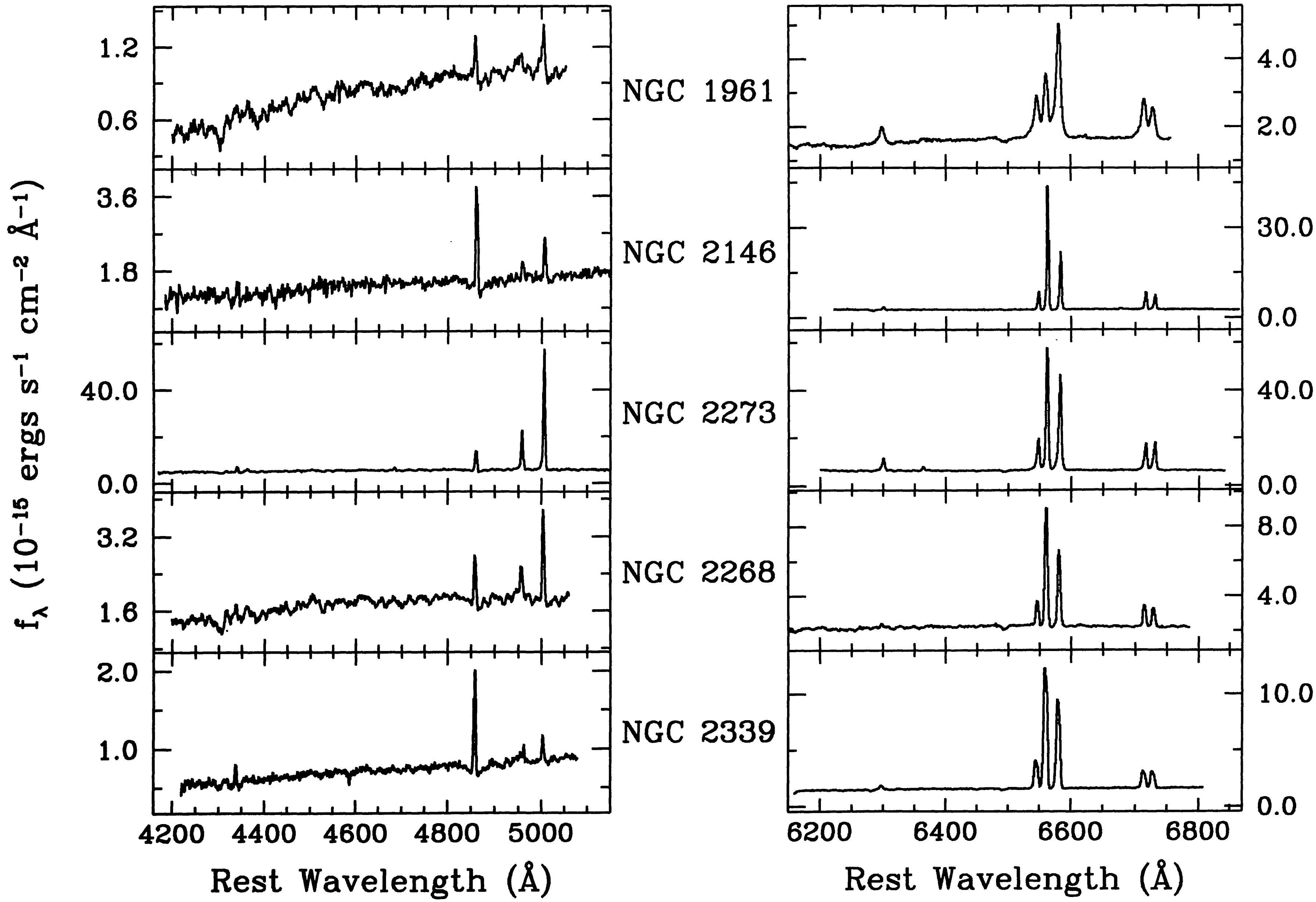

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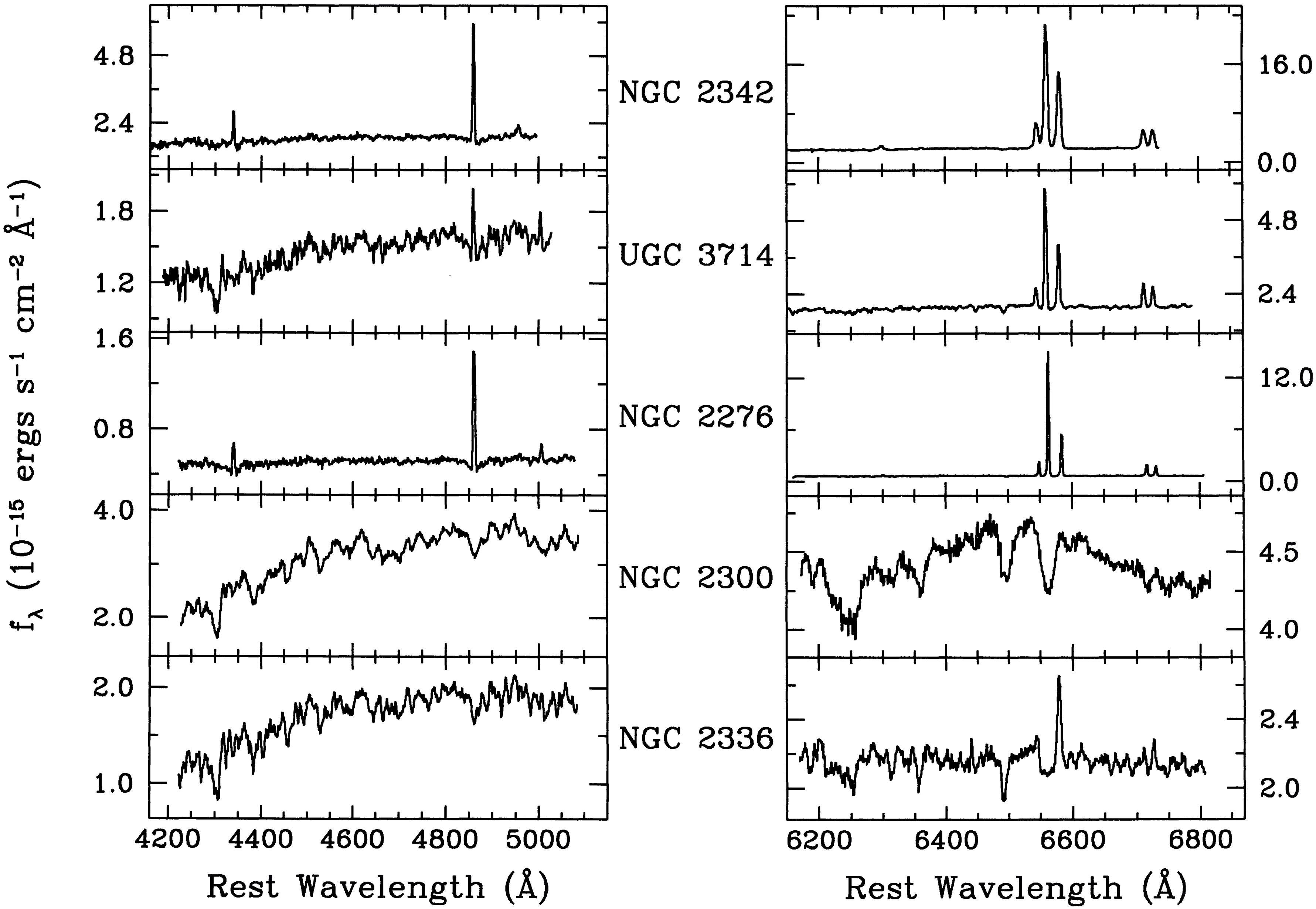

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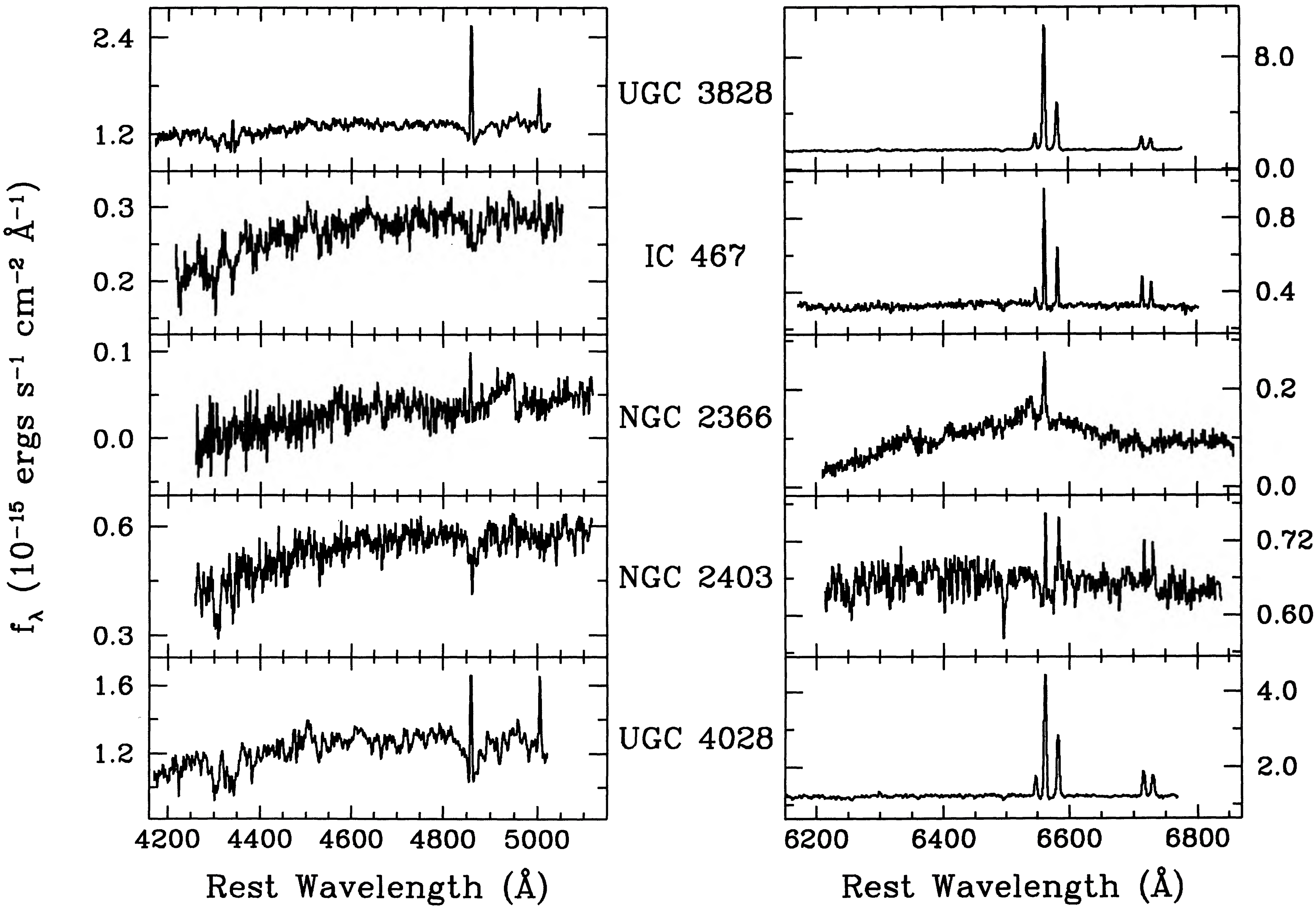

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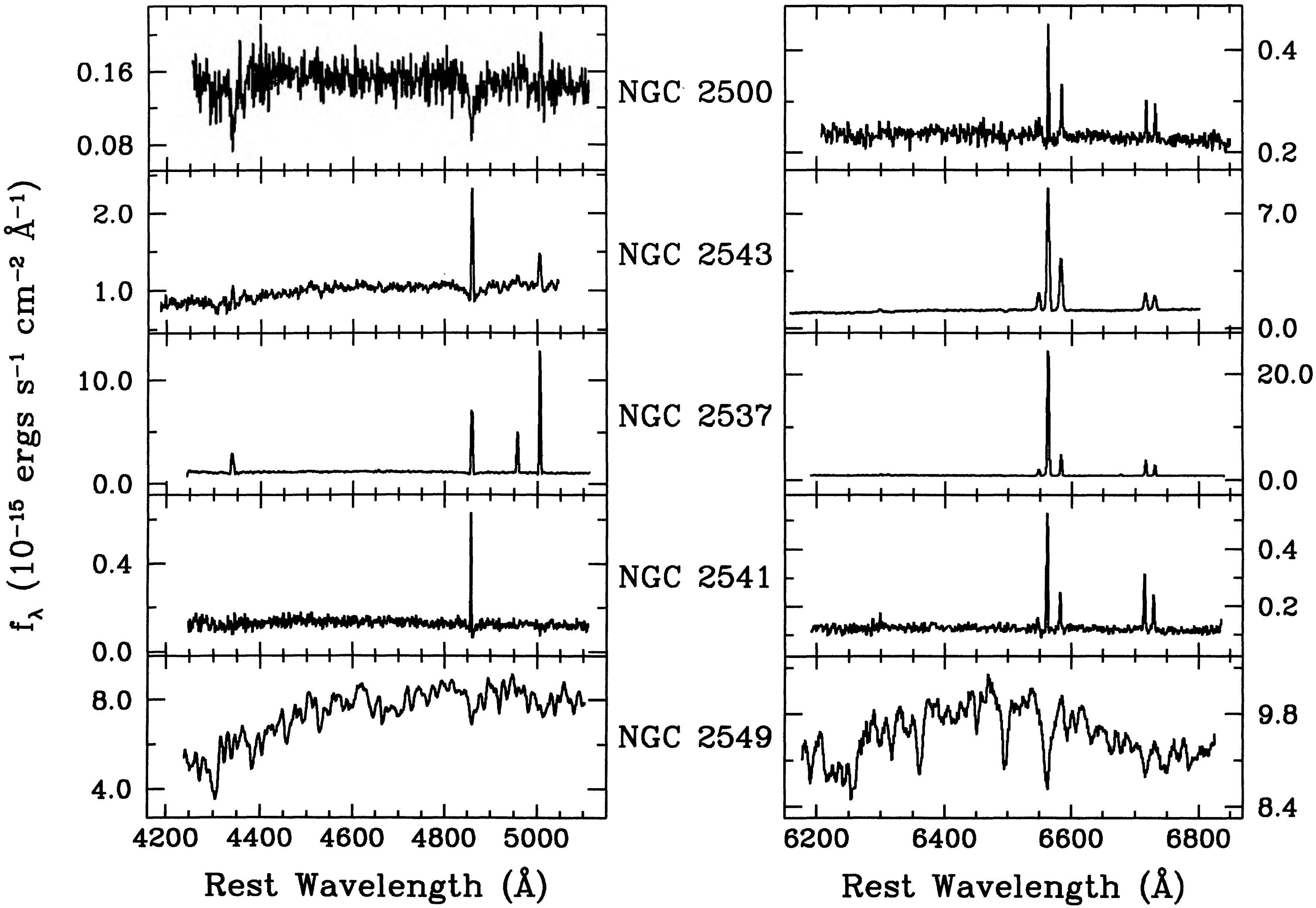

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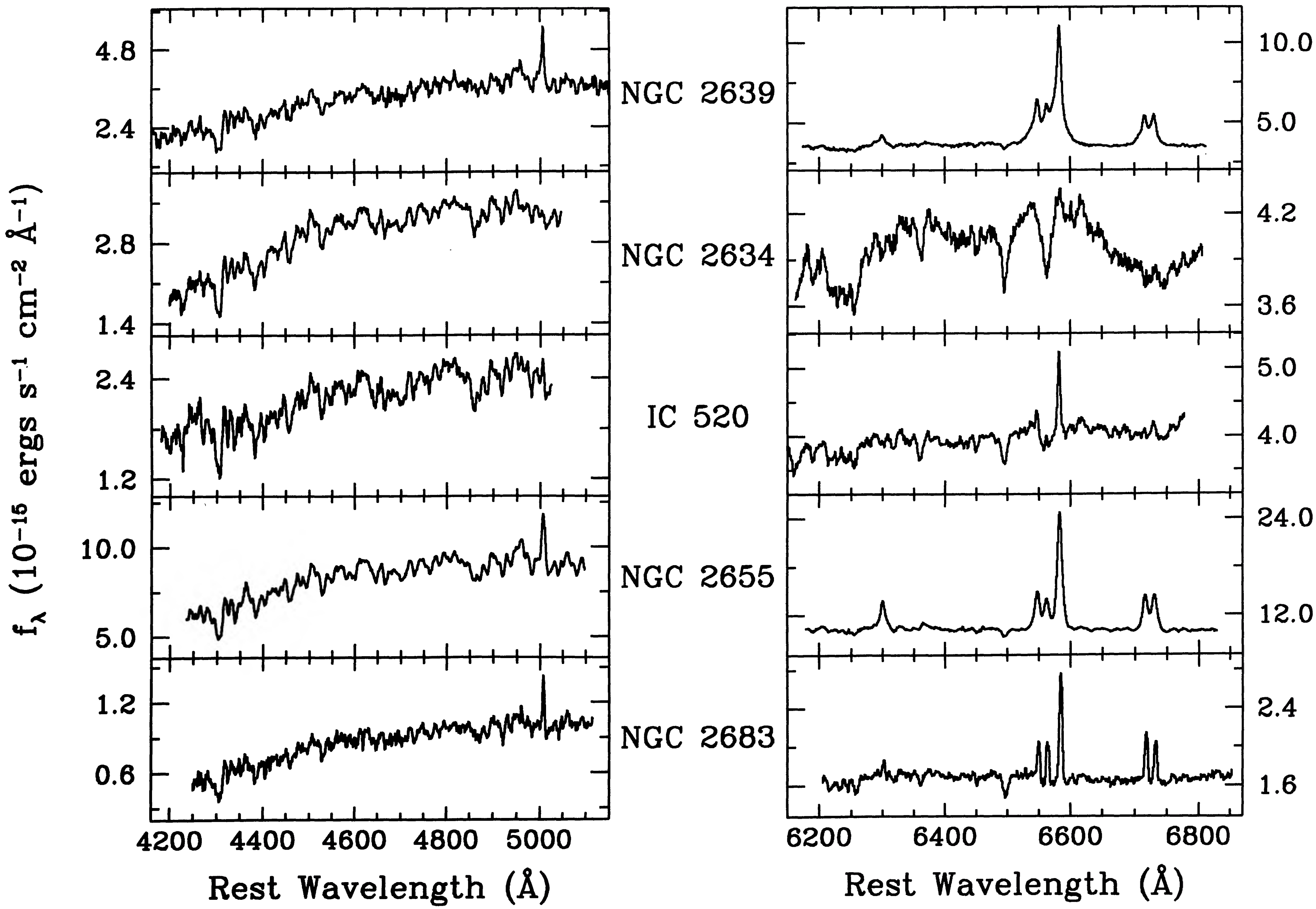

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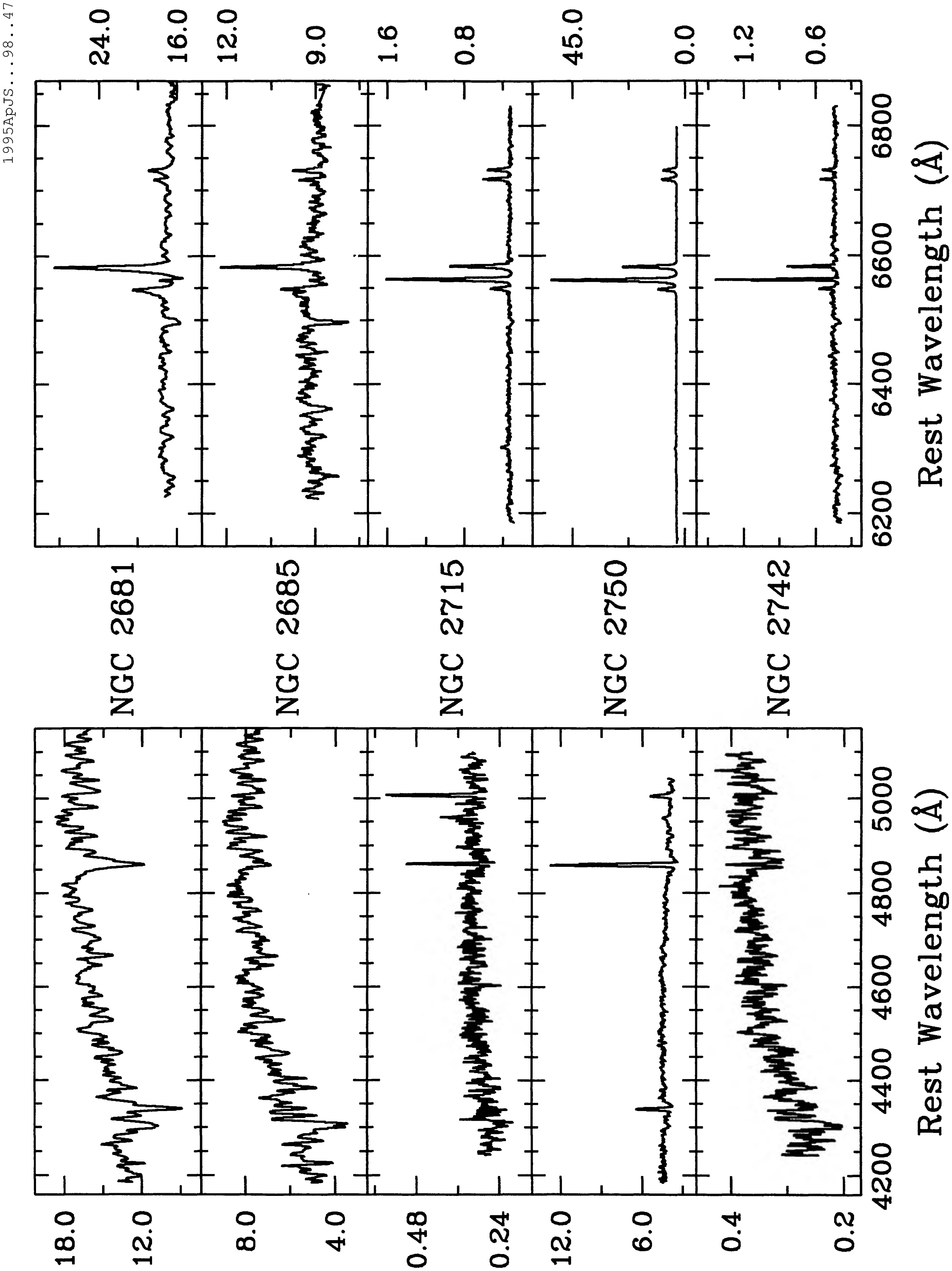

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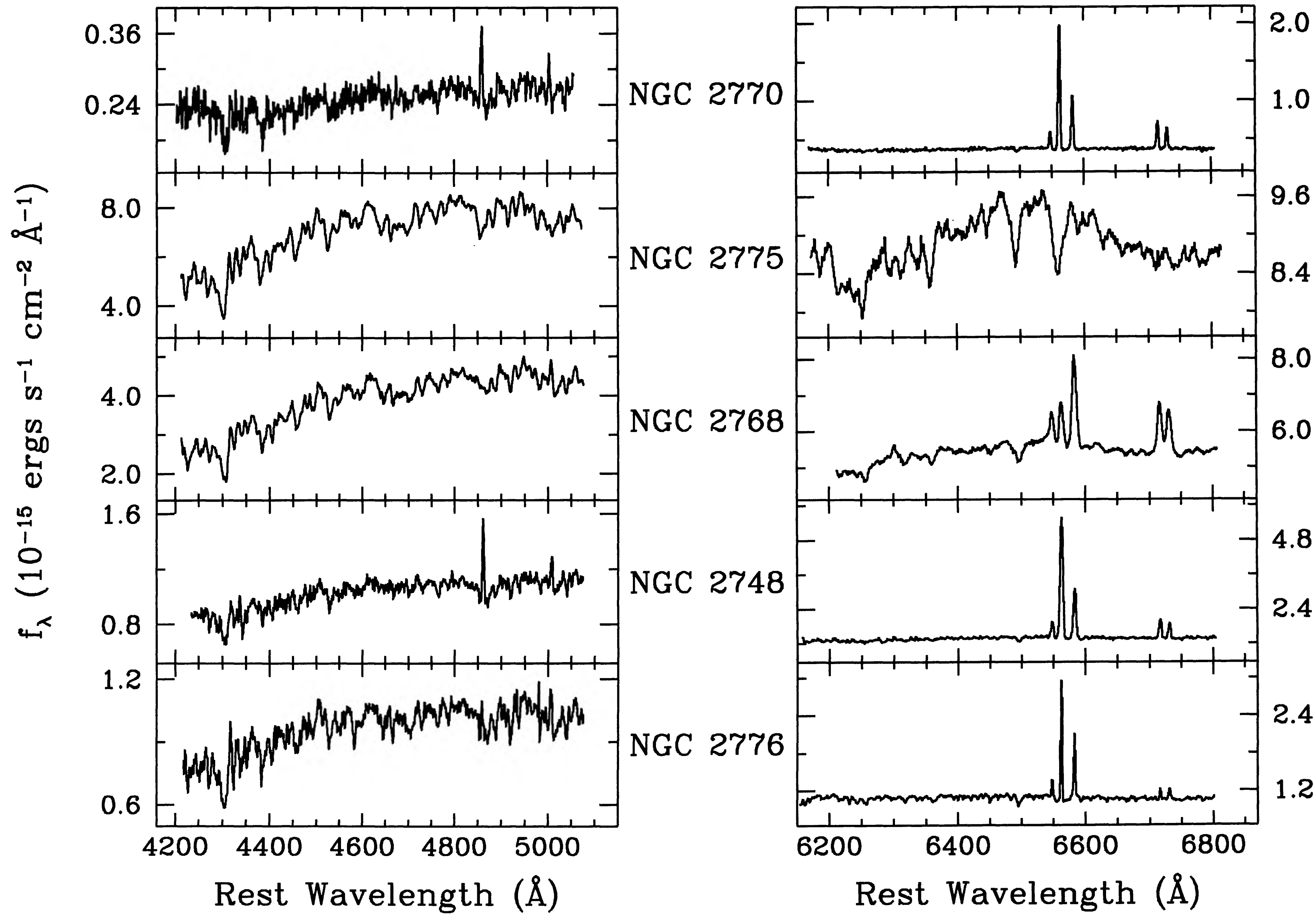

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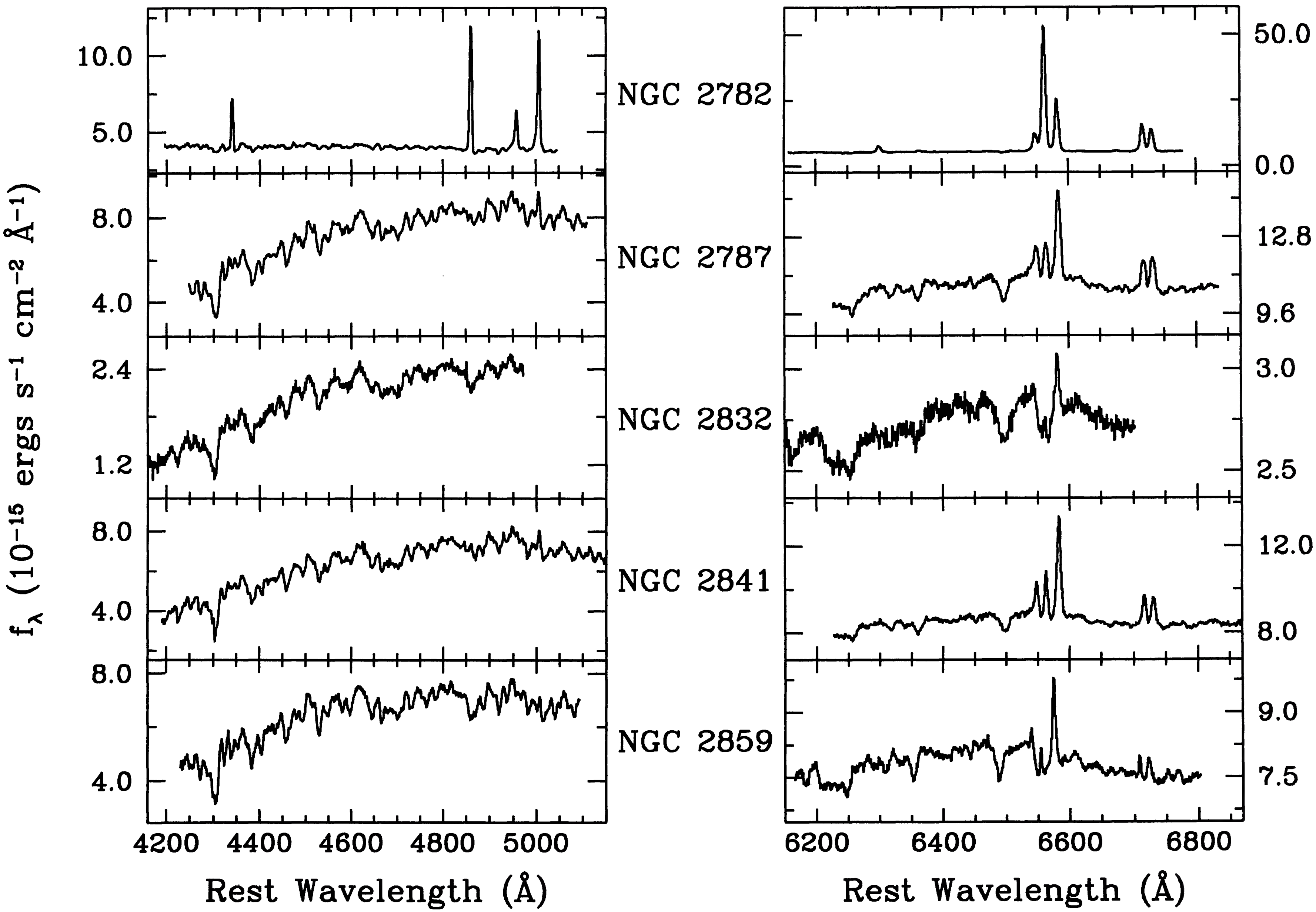

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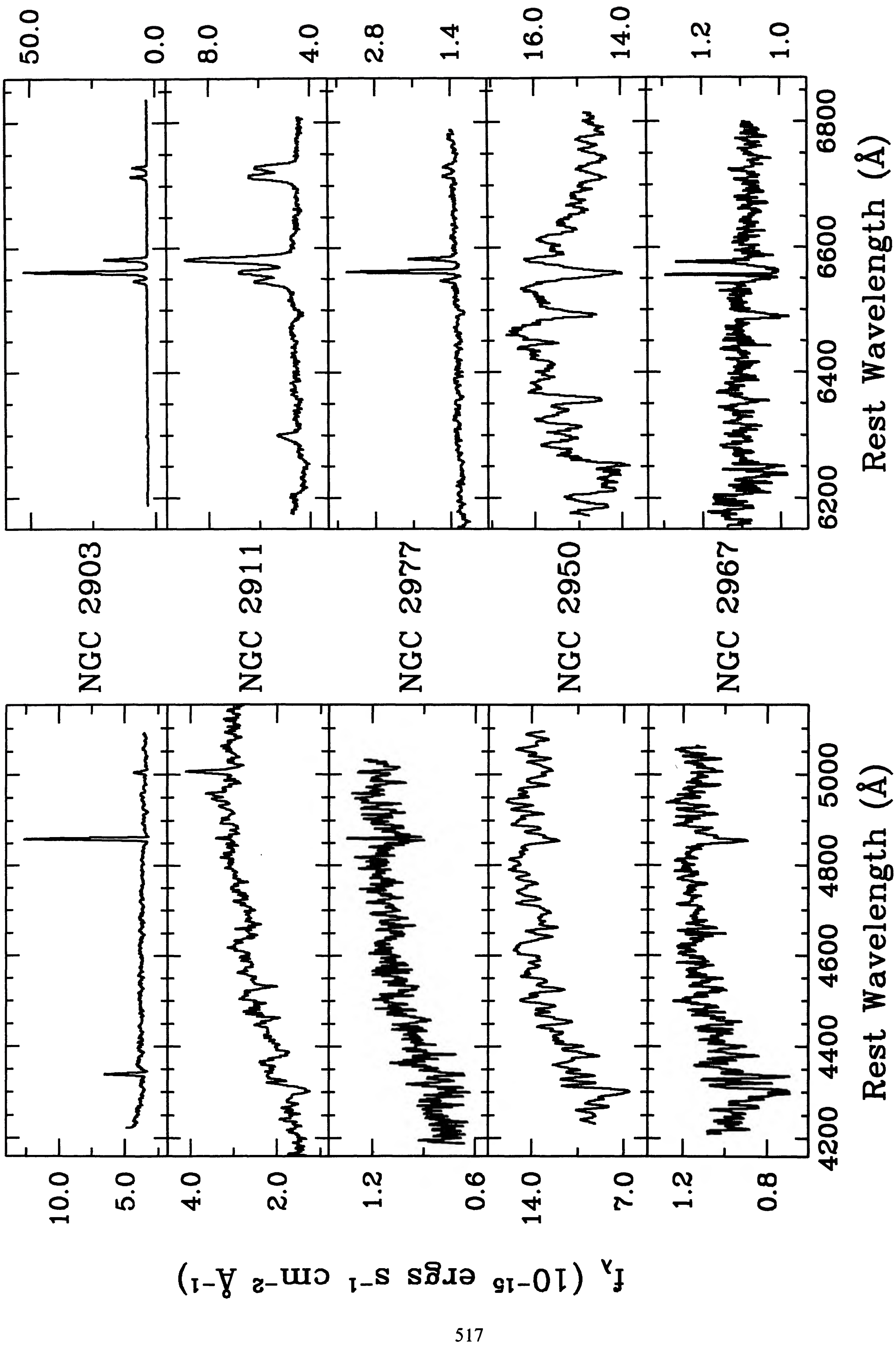

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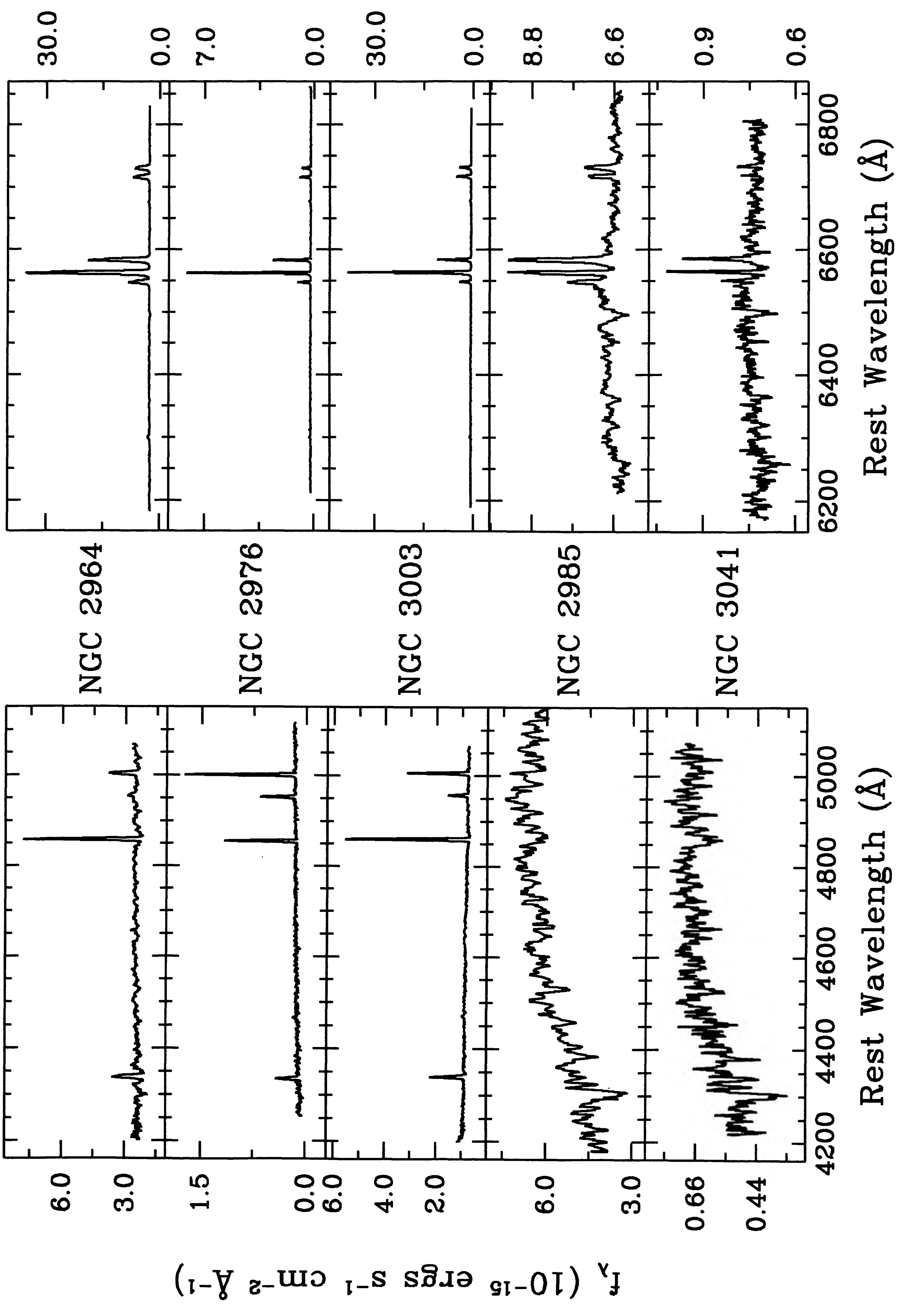

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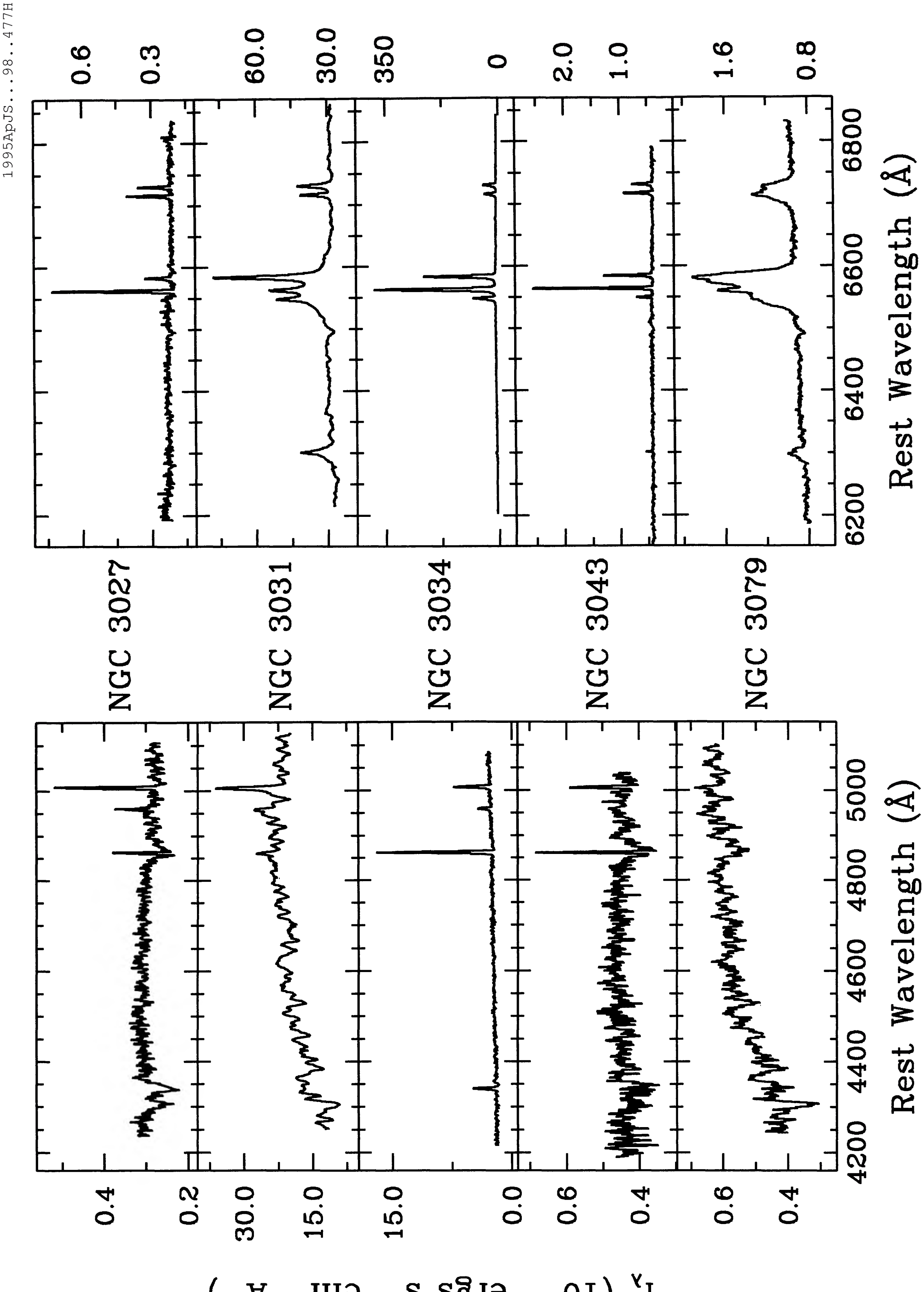

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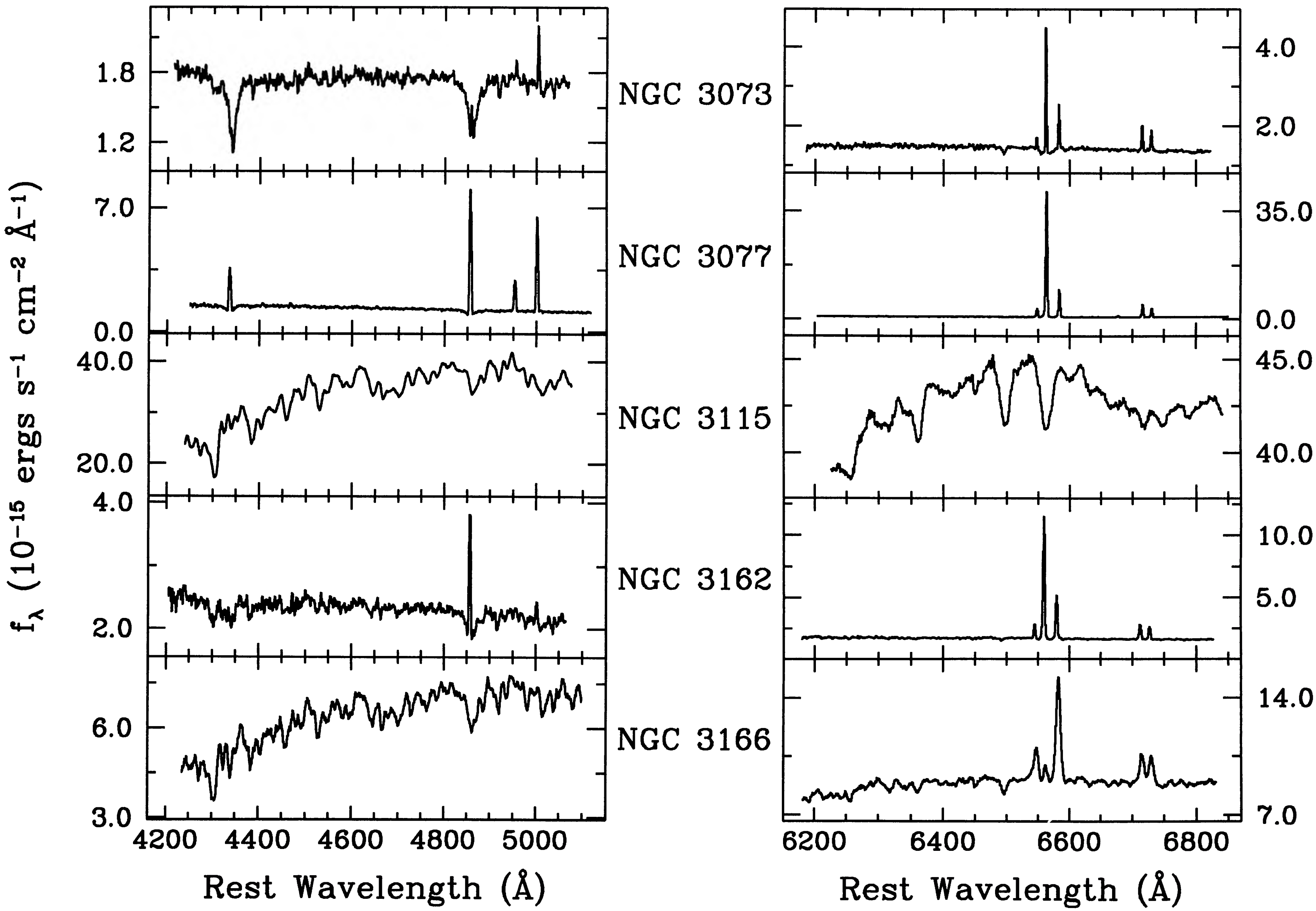

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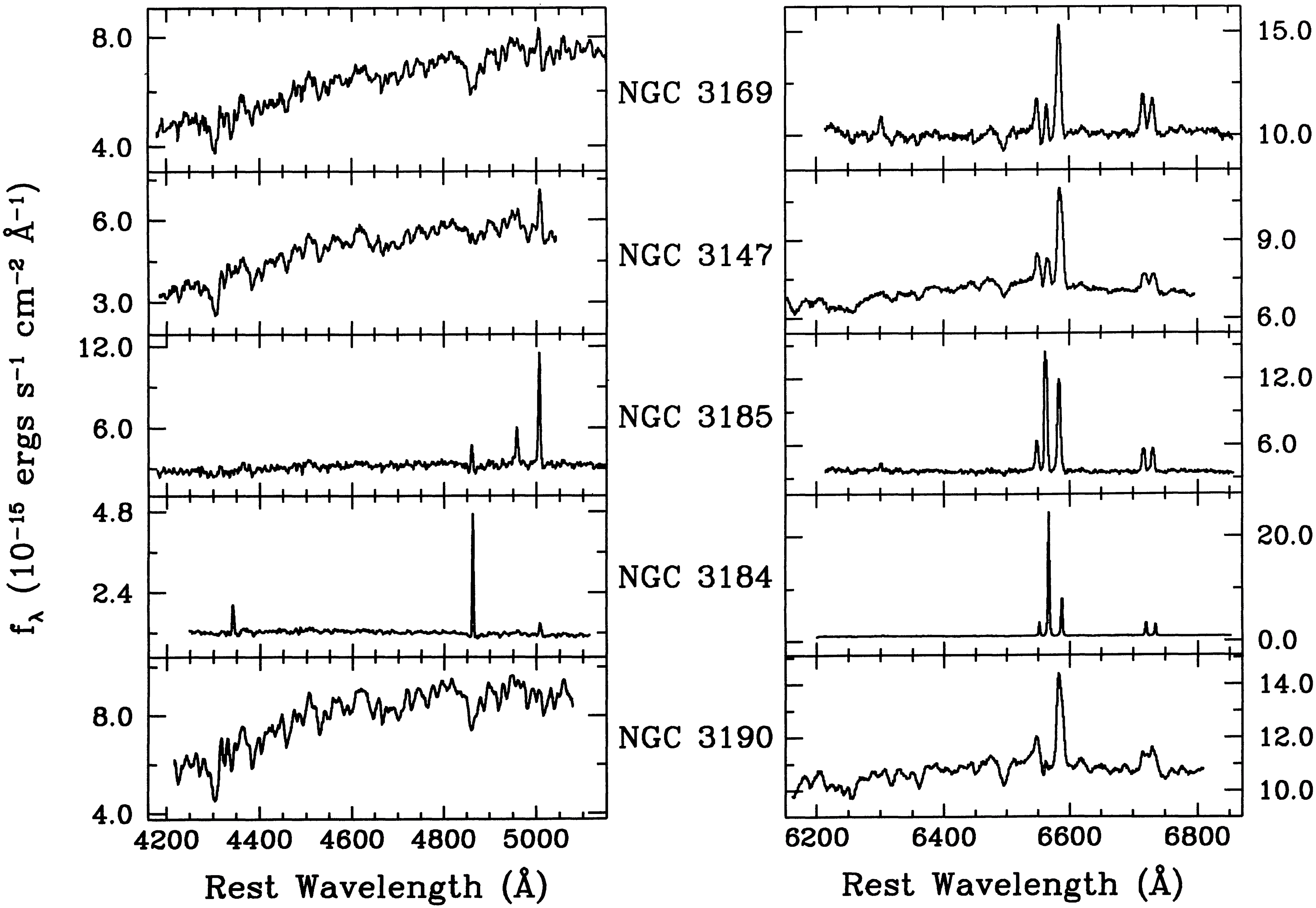

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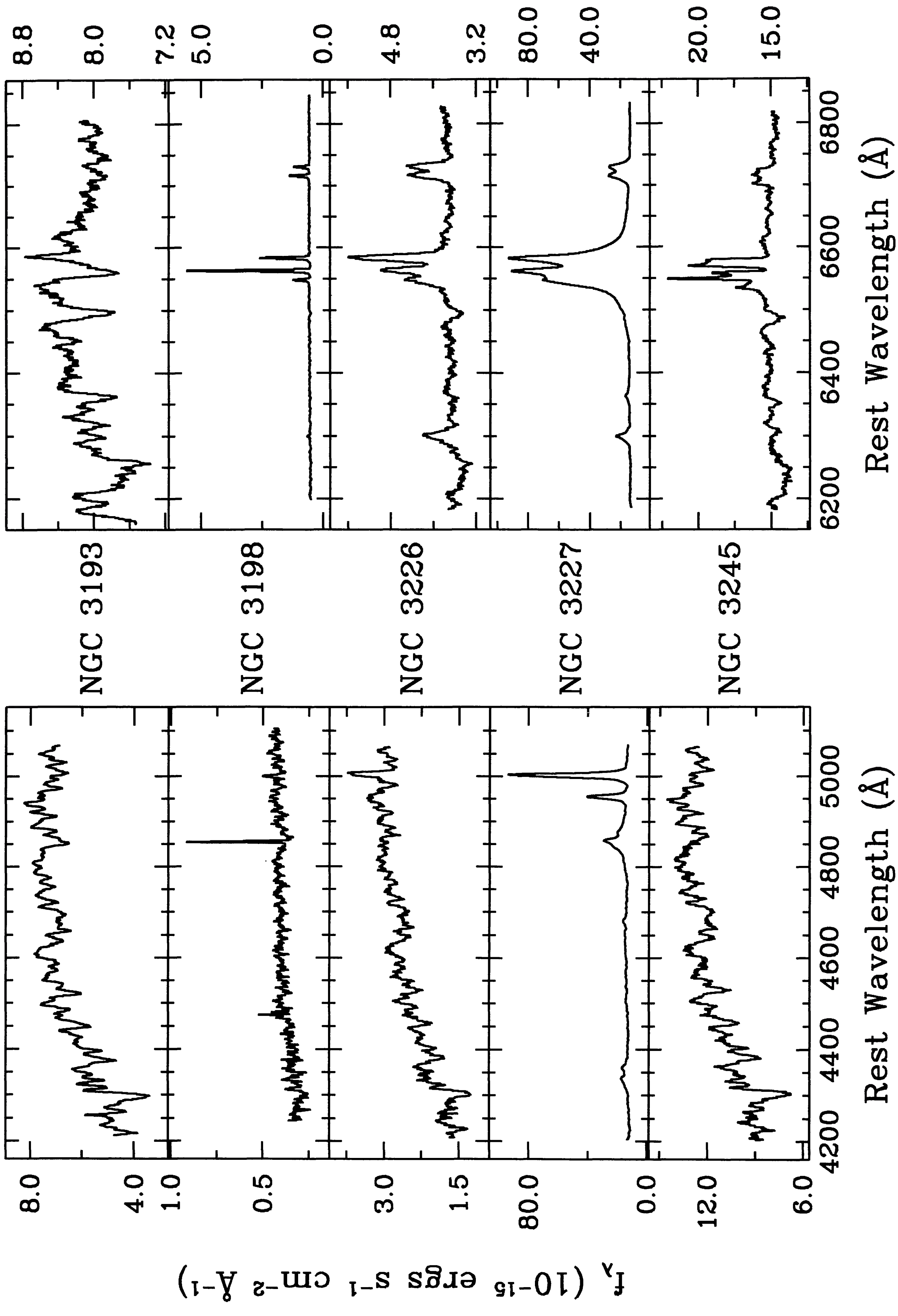

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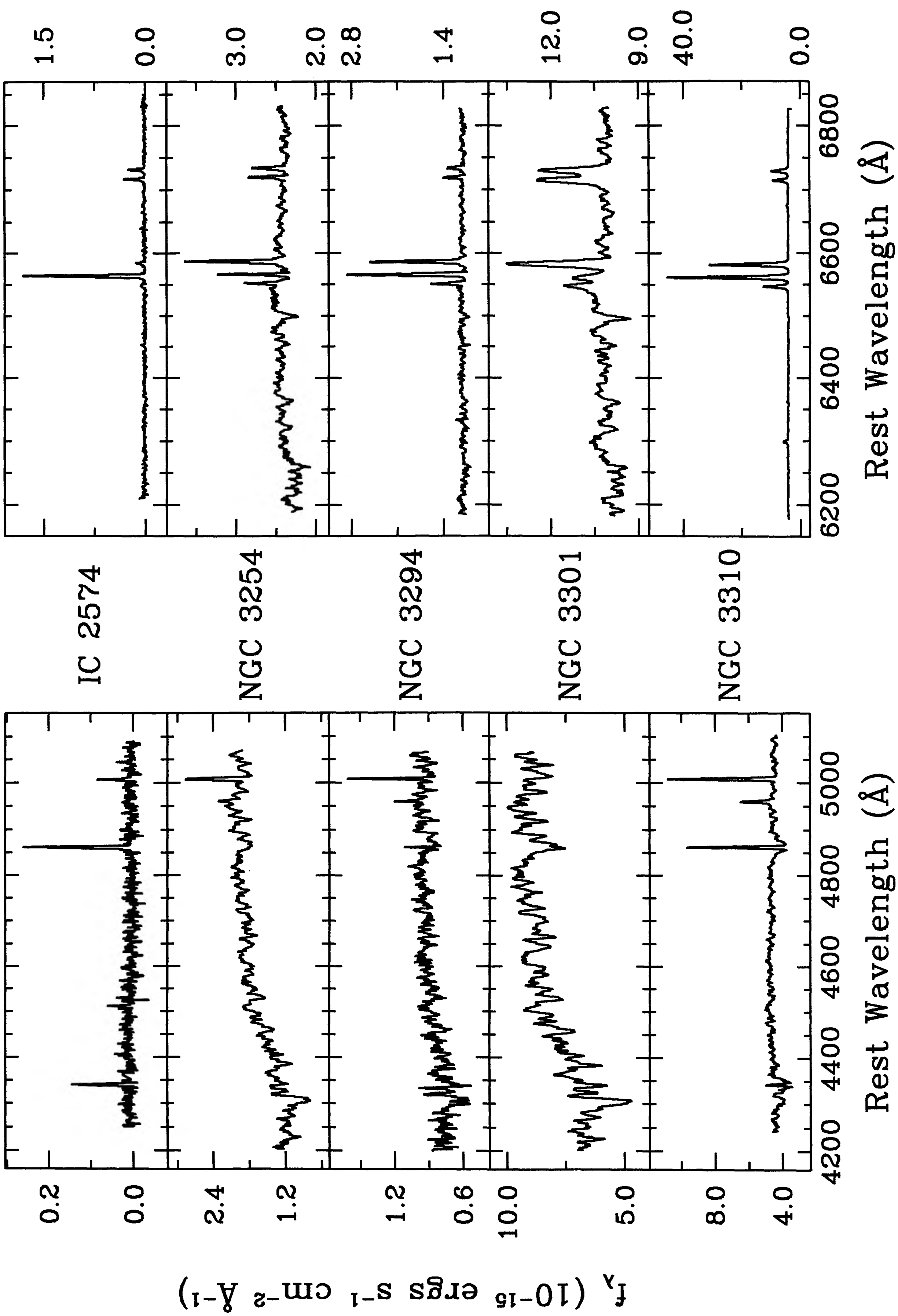

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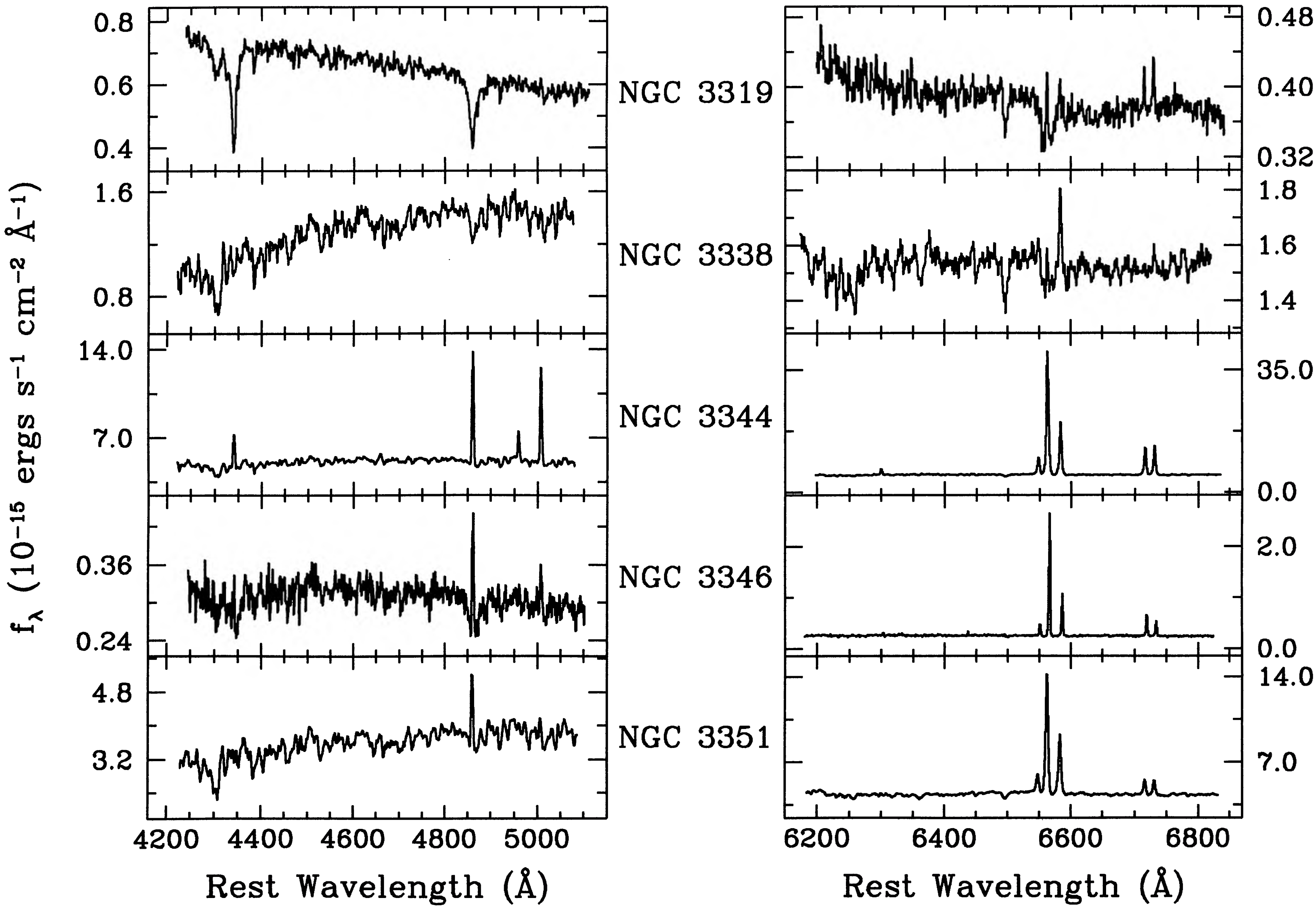

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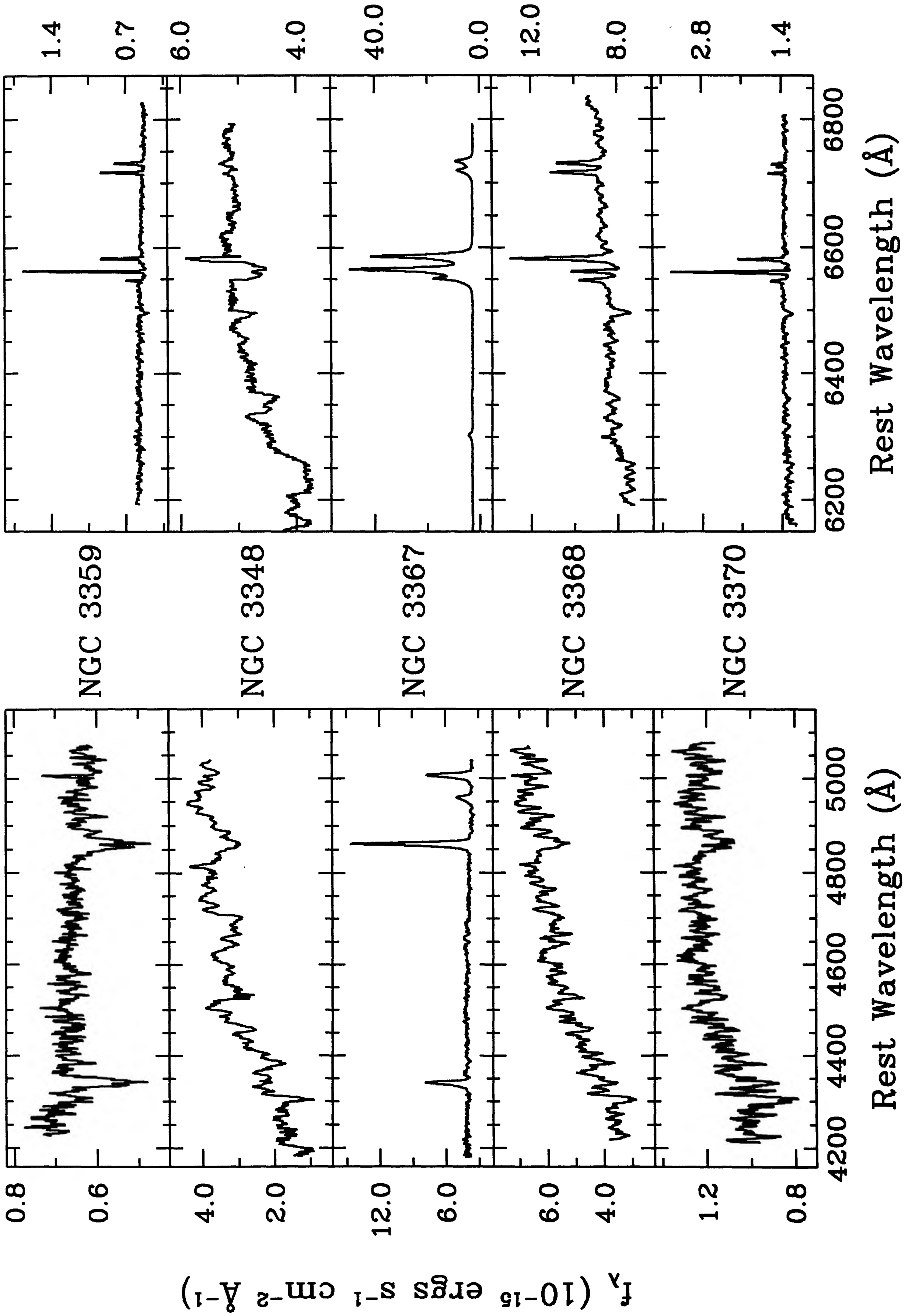

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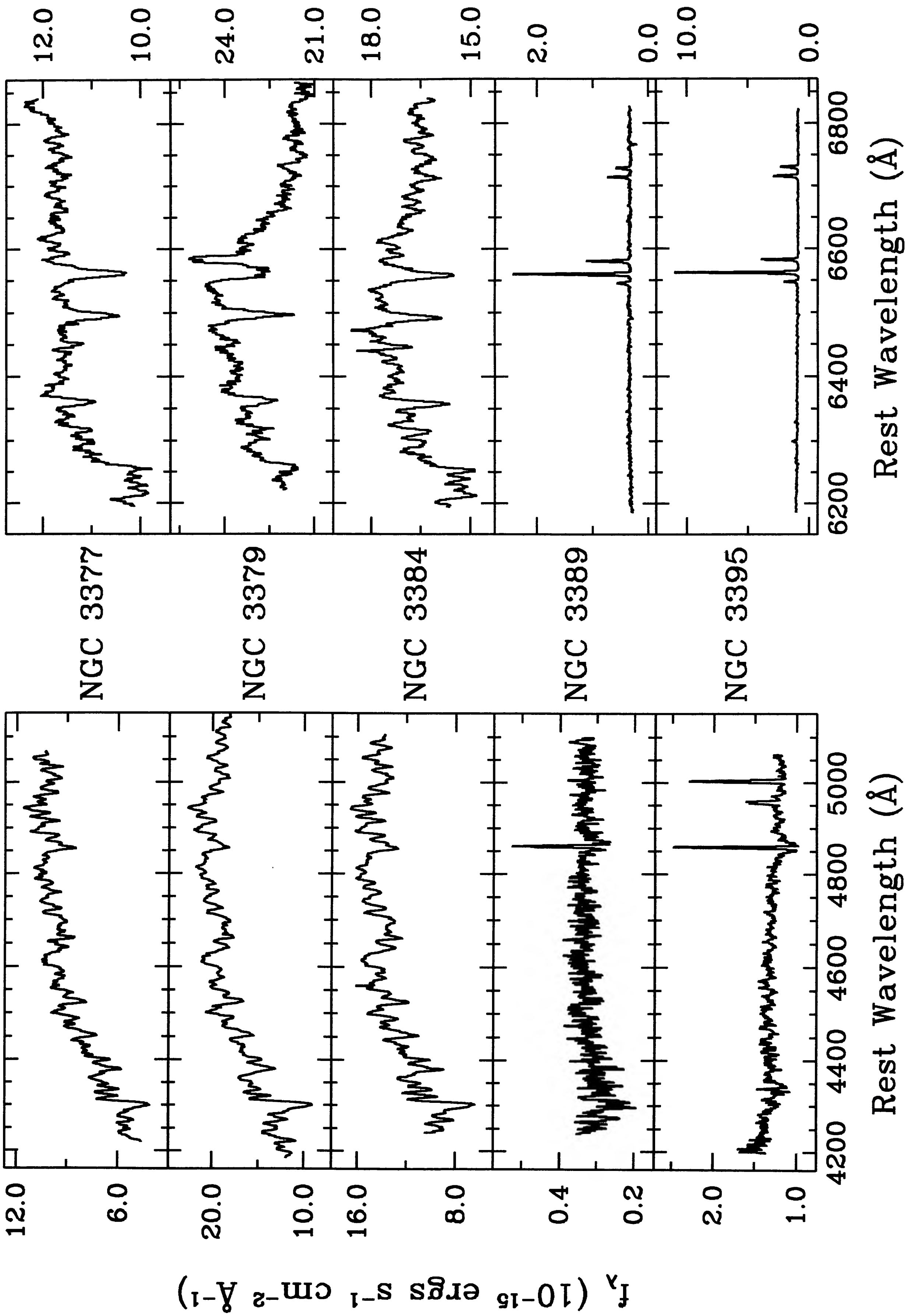

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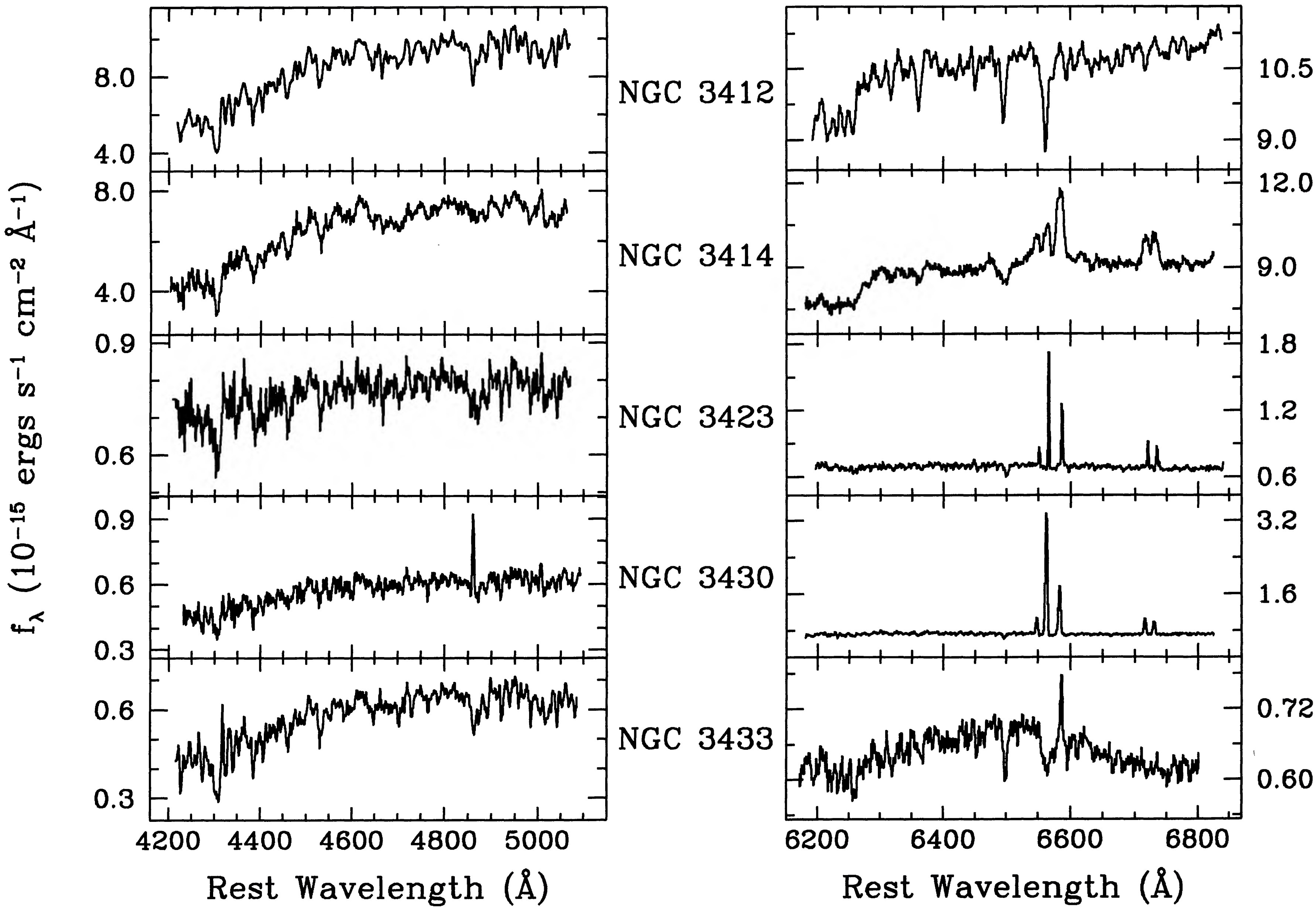

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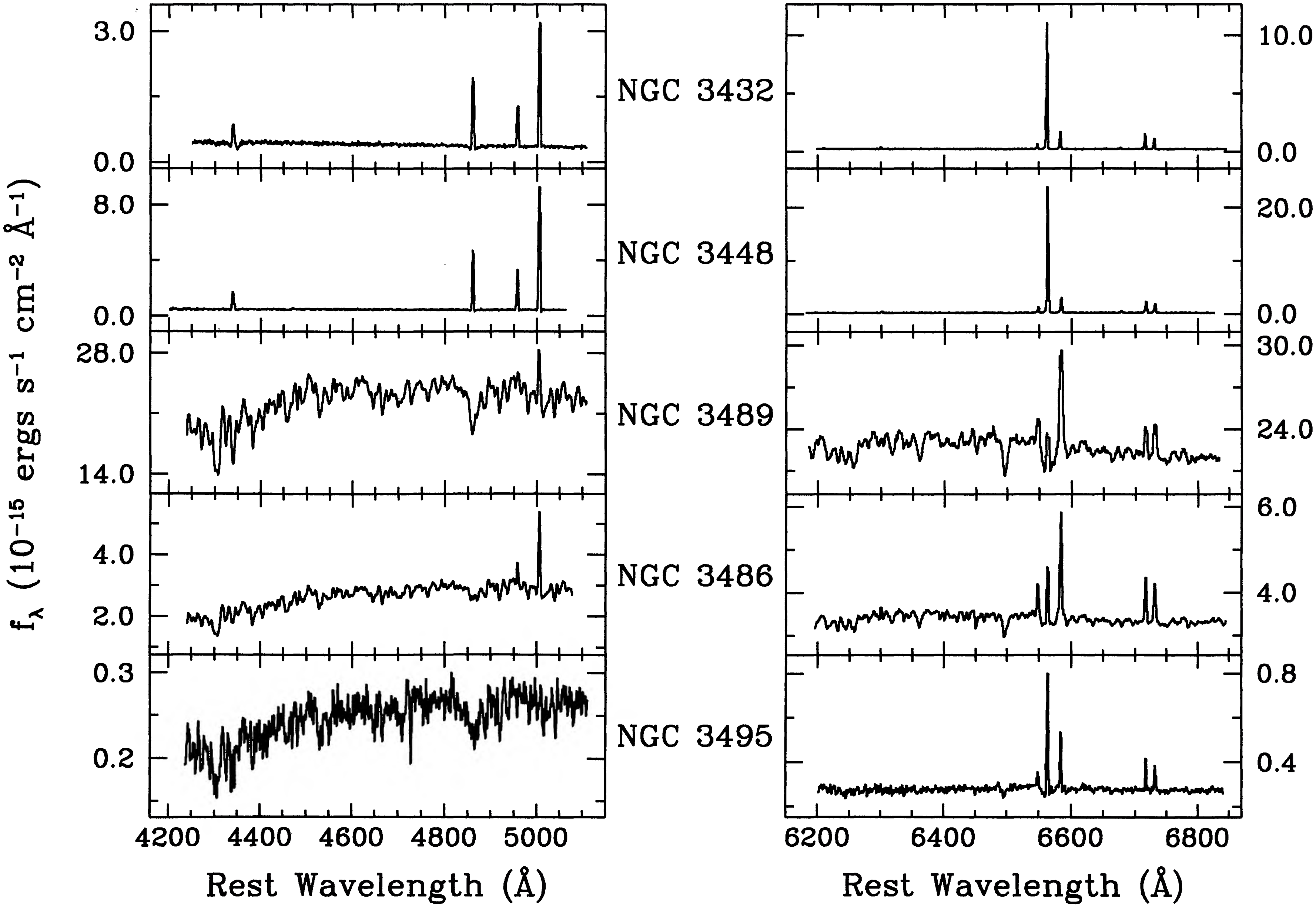

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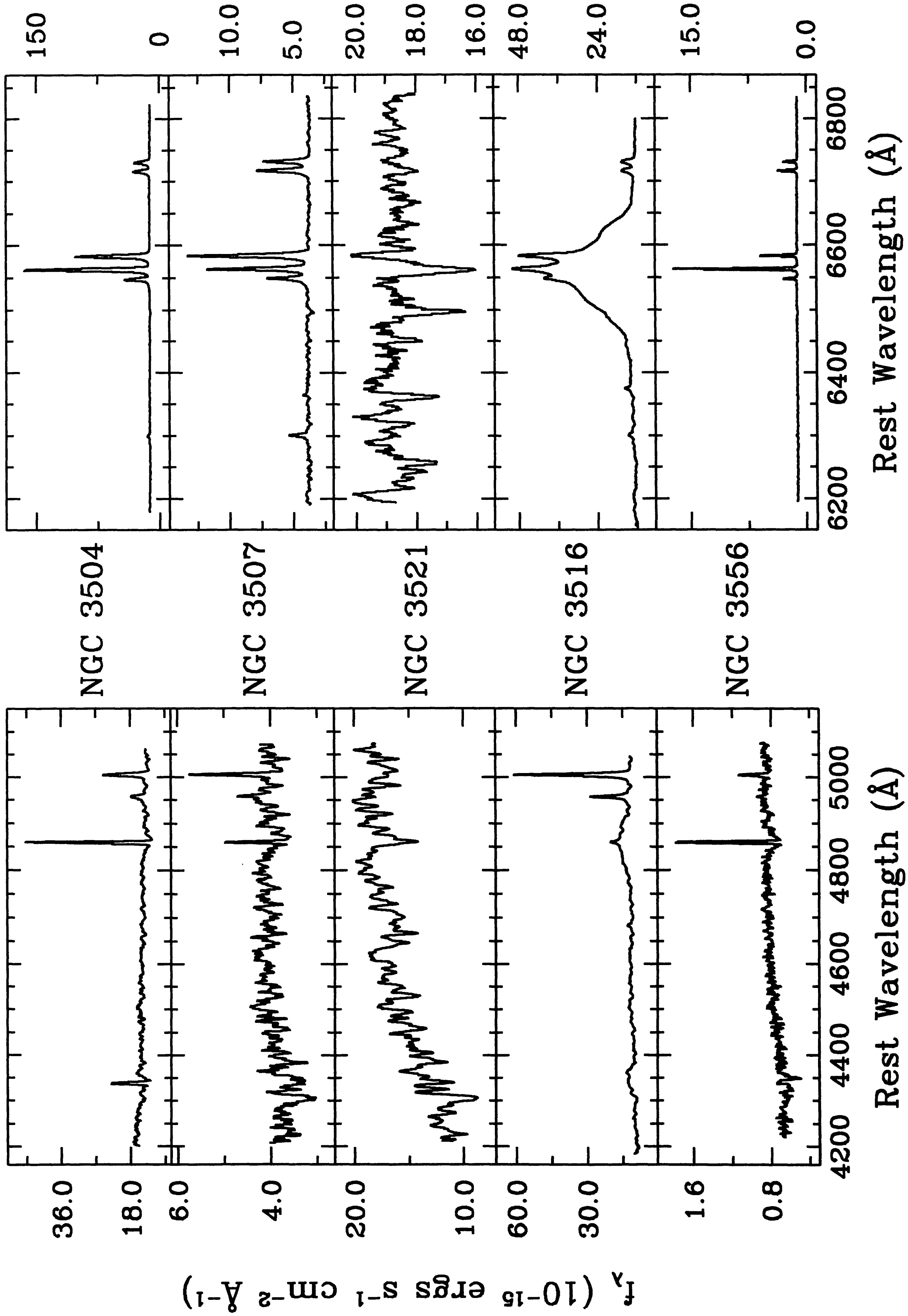

FIG. 35.—Same as Fig. 2

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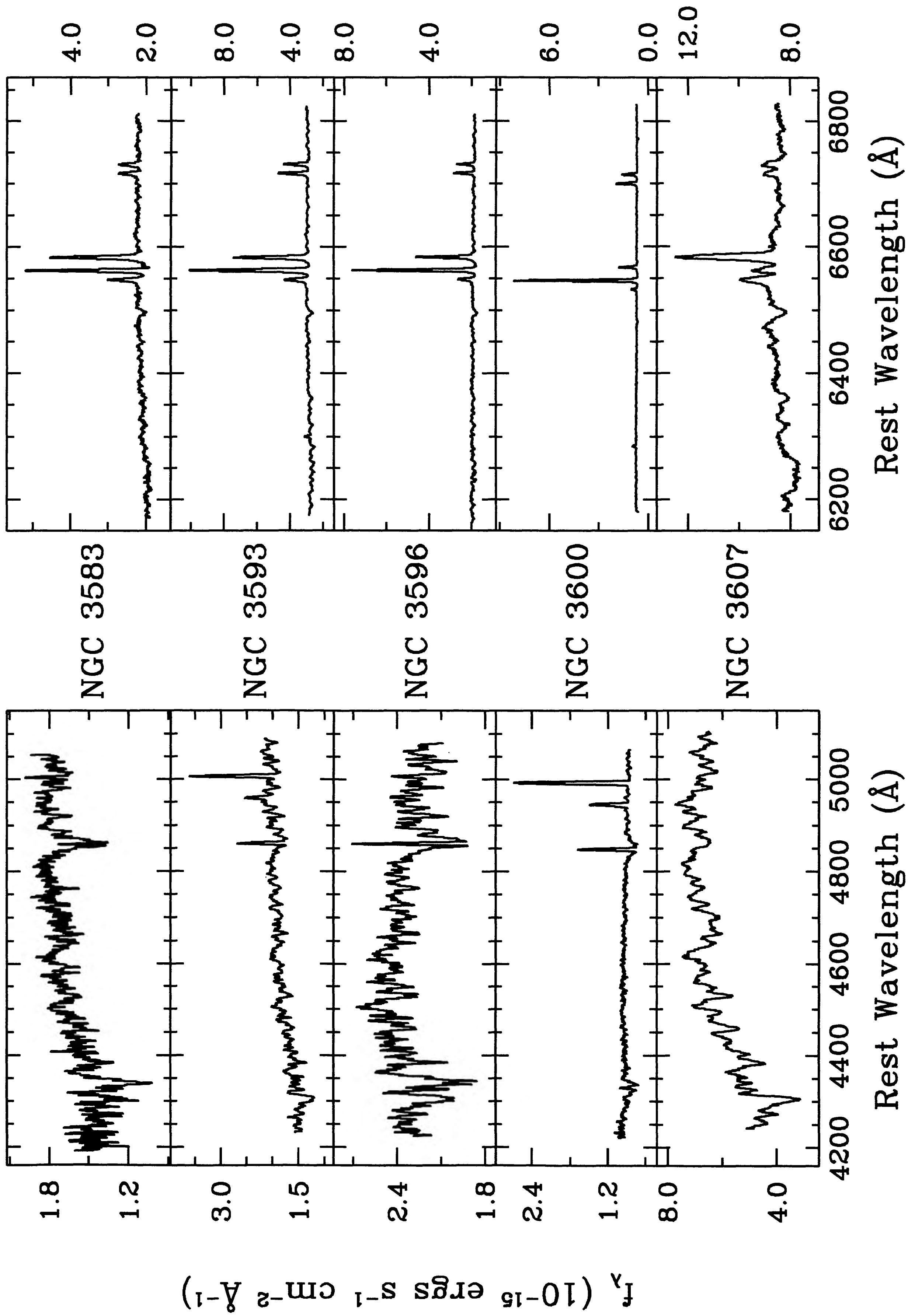


FIG. 36.—Same as Fig. 2

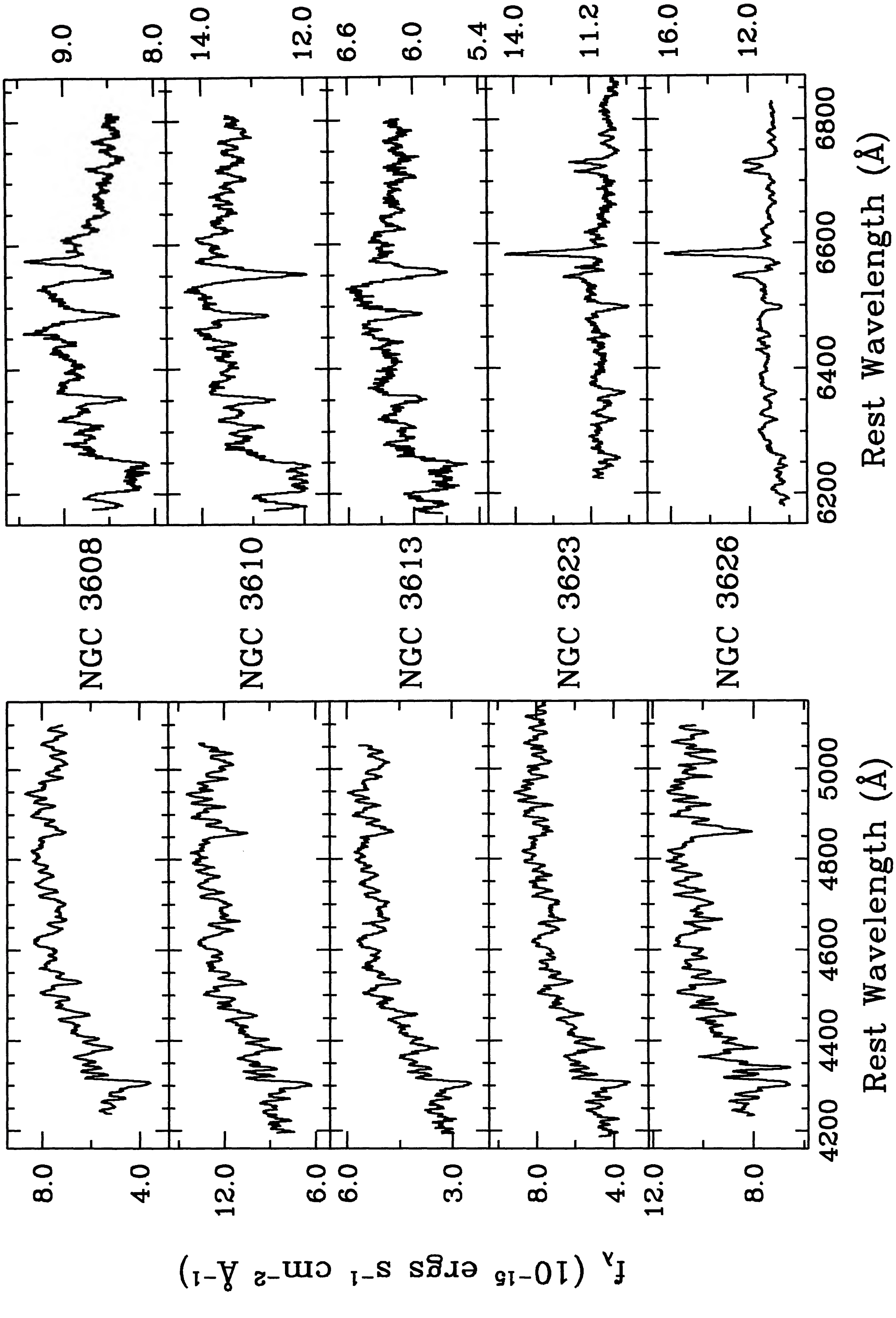


FIG. 37.—Same as Fig. 2

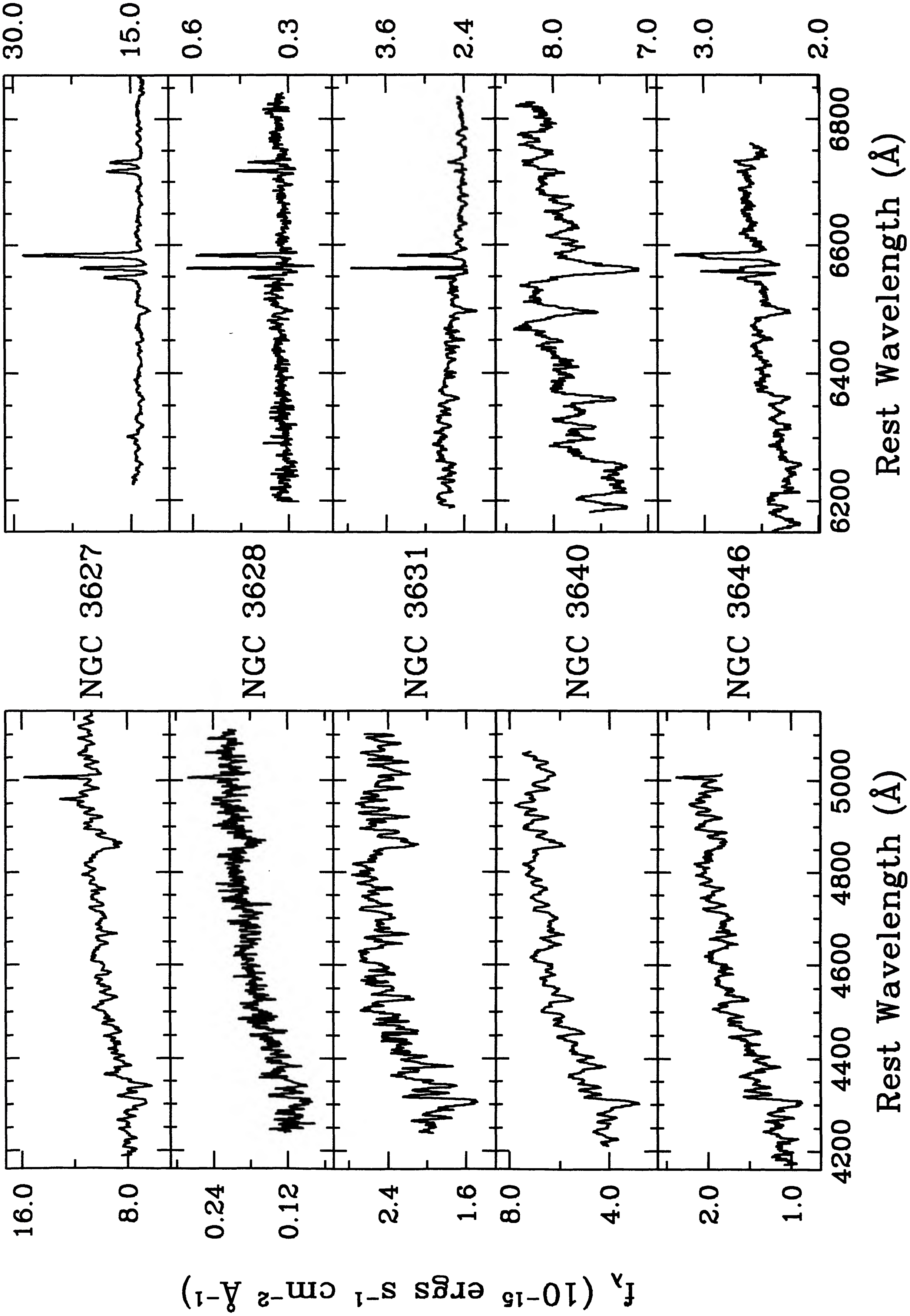


FIG. 38.—Same as Fig. 2

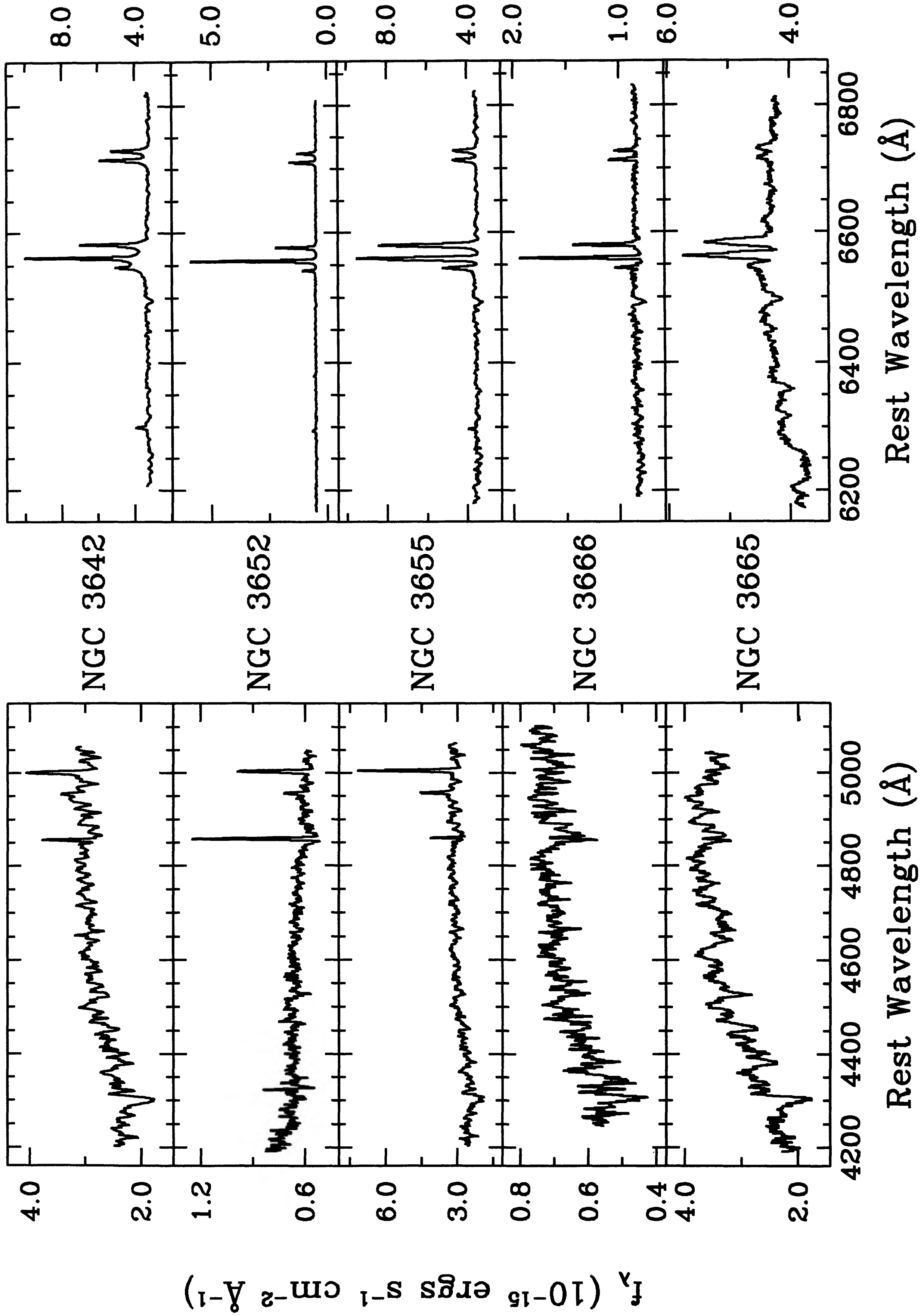


FIG. 39.—Same as Fig. 2

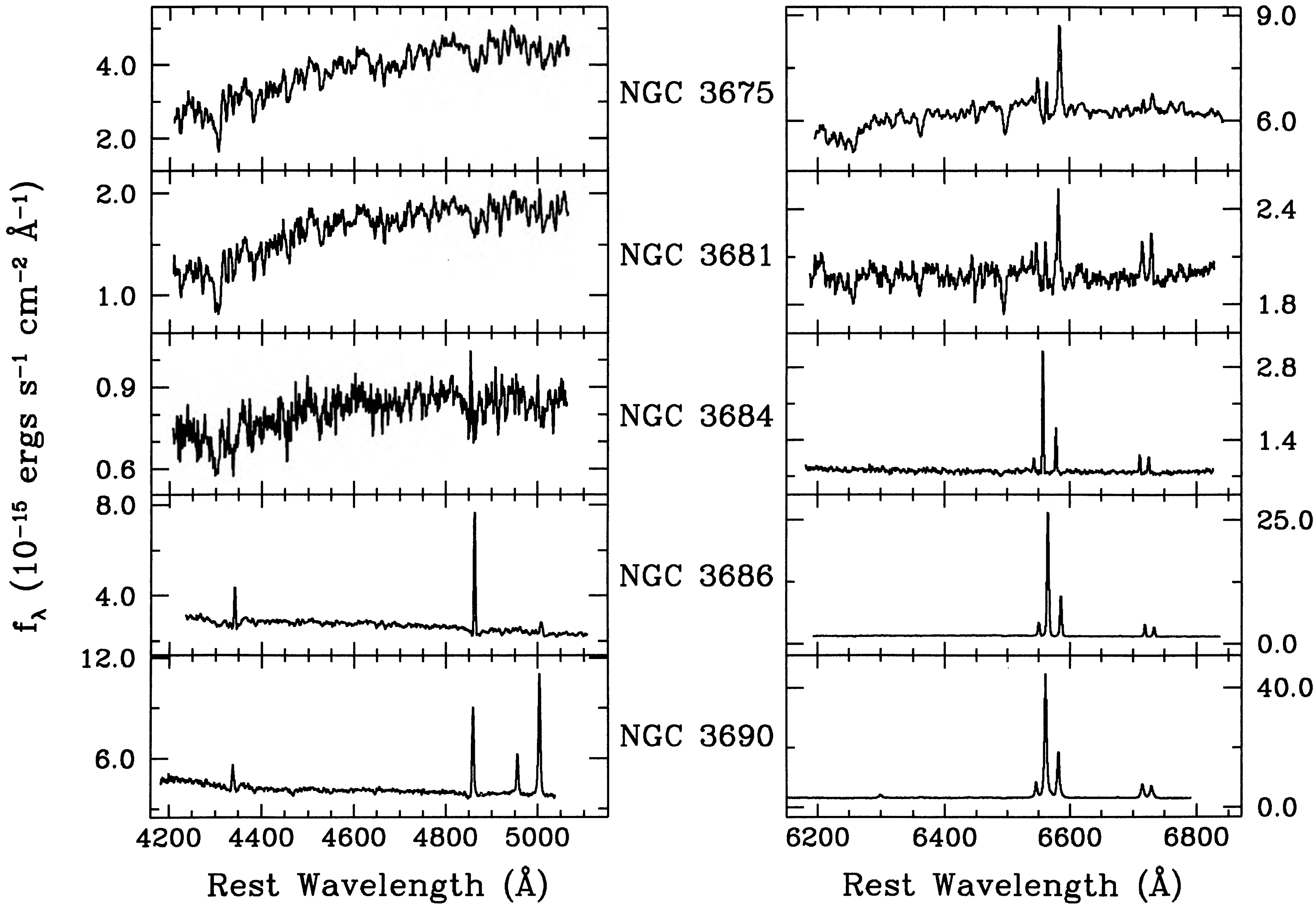


FIG. 40.—Same as Fig. 2

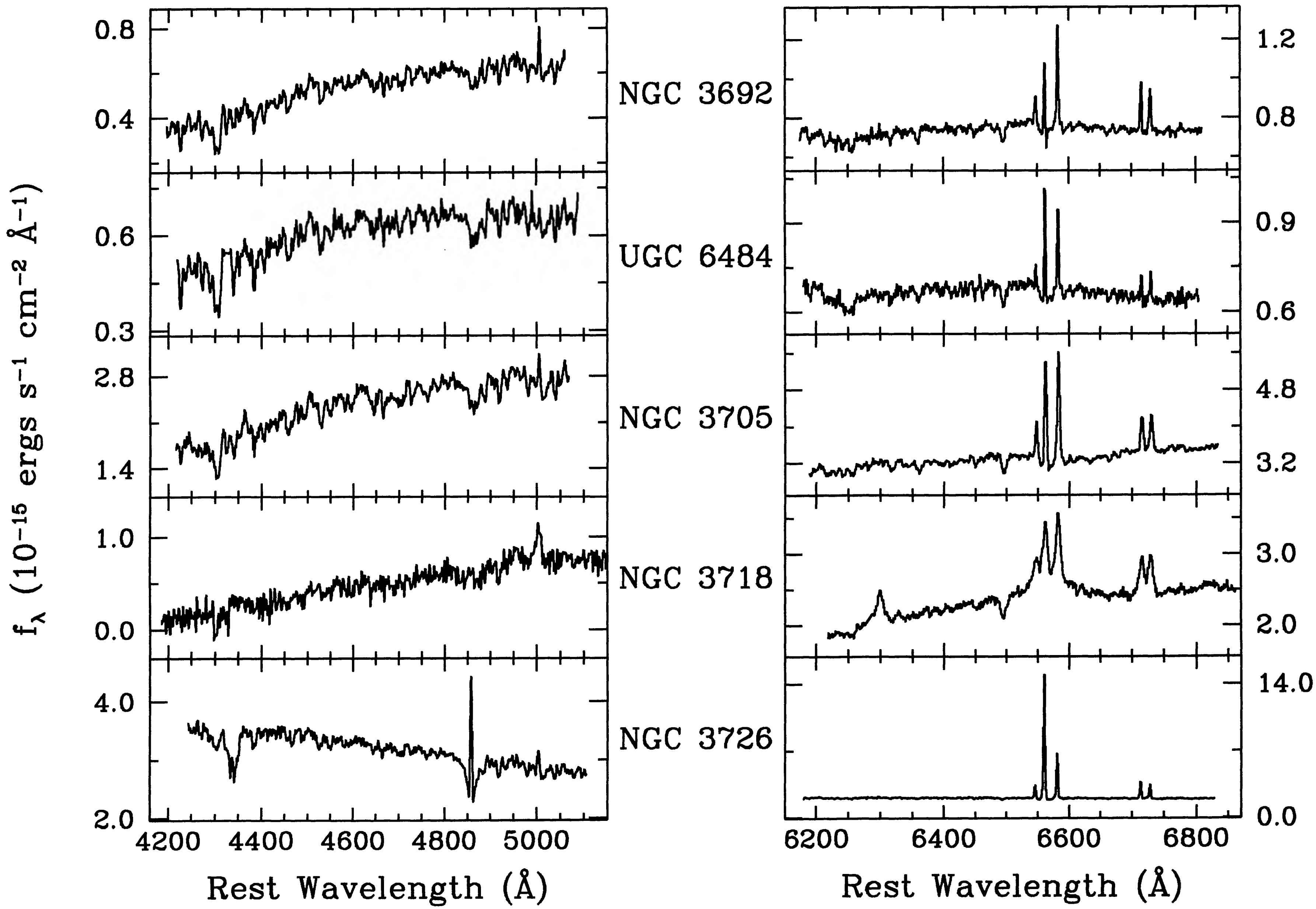


FIG. 41.—Same as Fig. 2

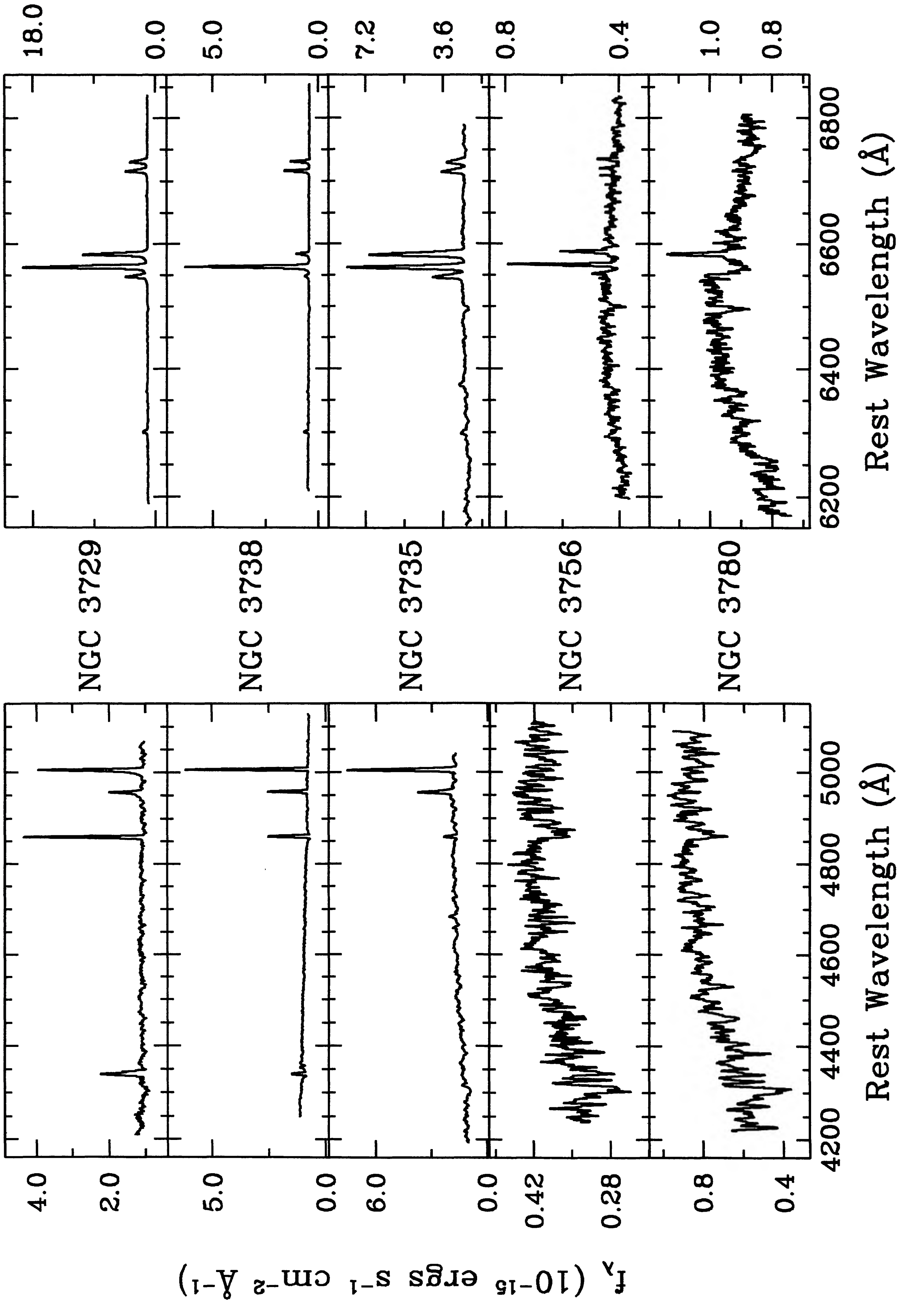


FIG. 42.—Same as Fig. 2

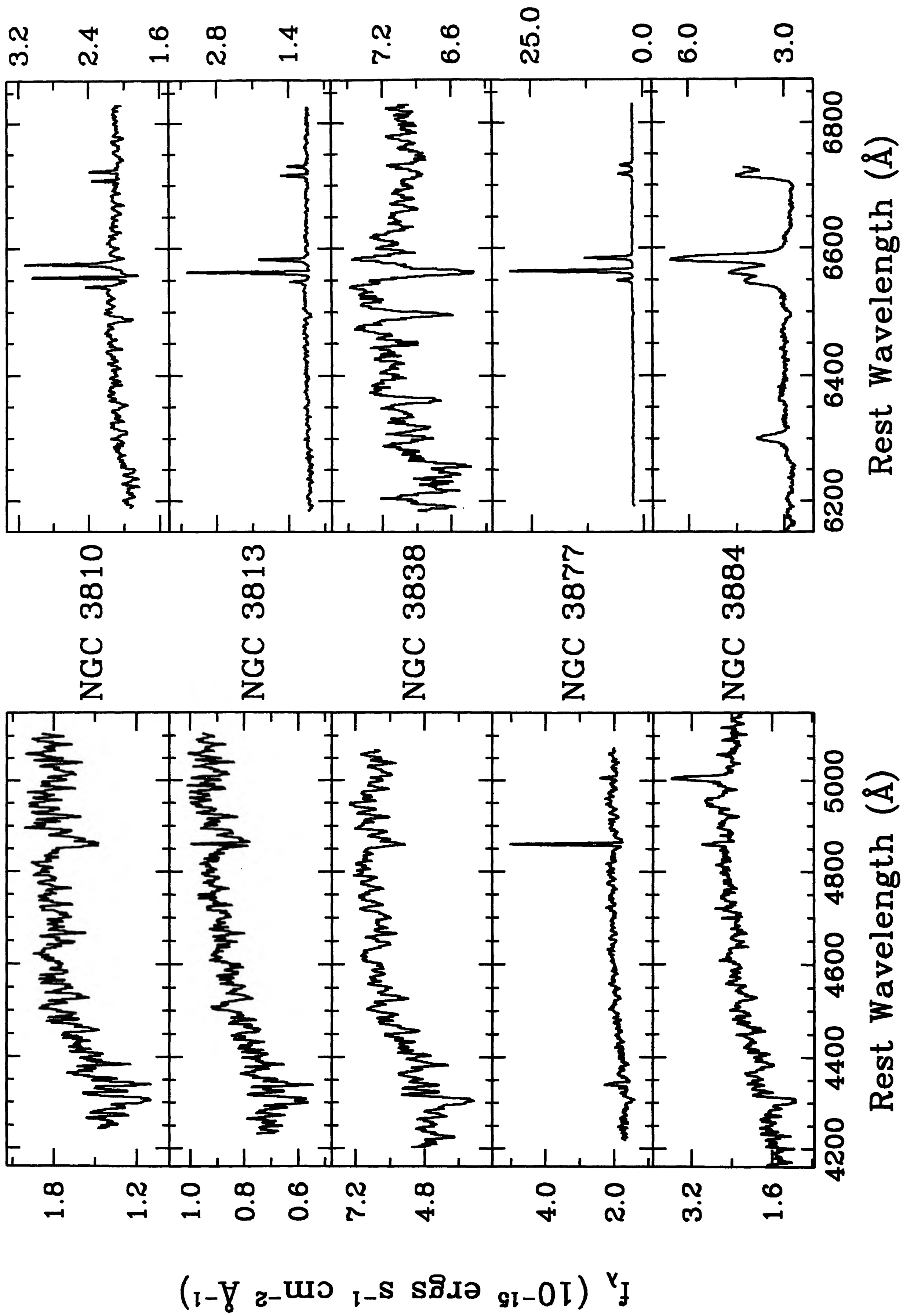


FIG. 43.—Same as Fig. 2

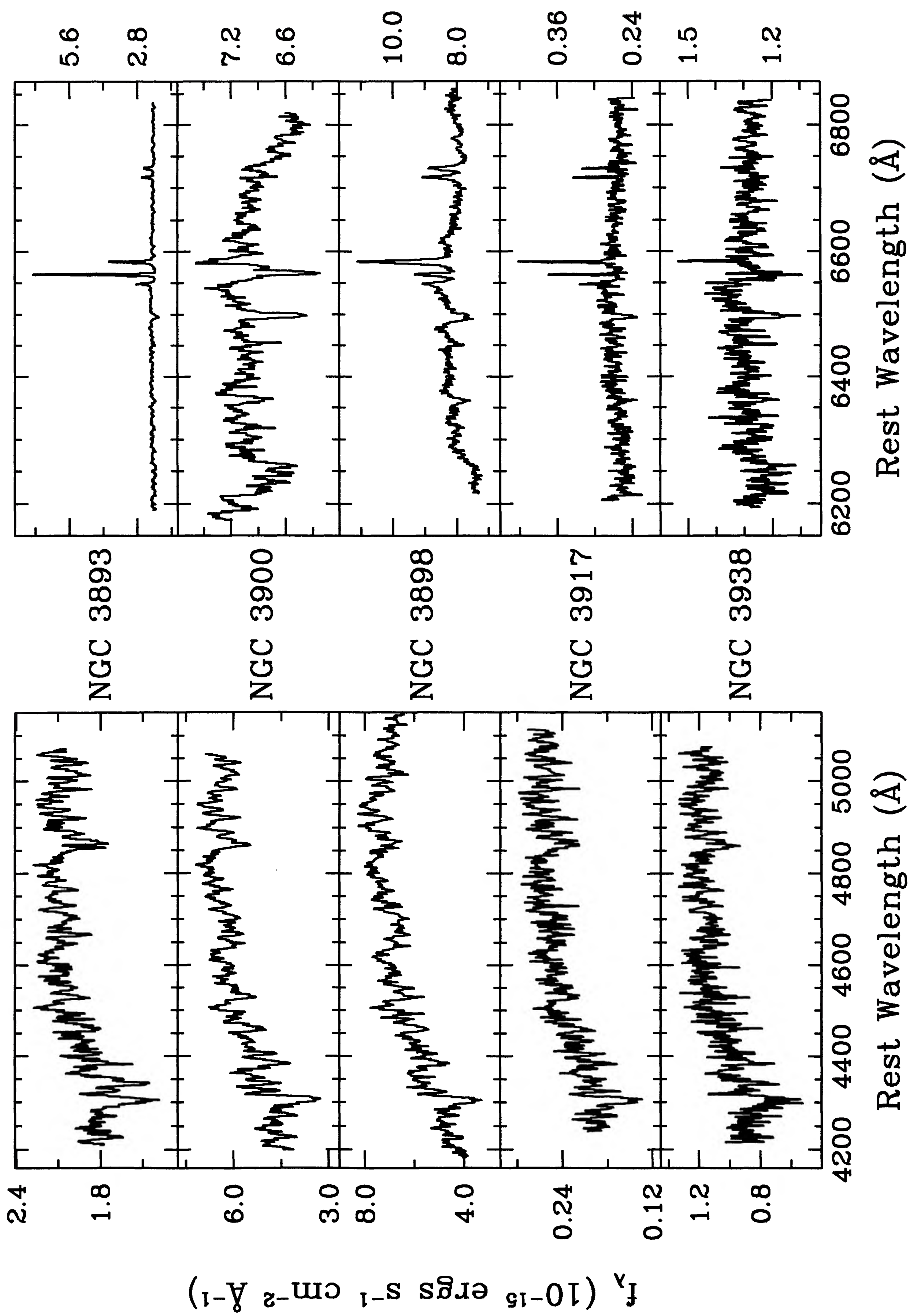


FIG. 44.—Same as Fig. 2

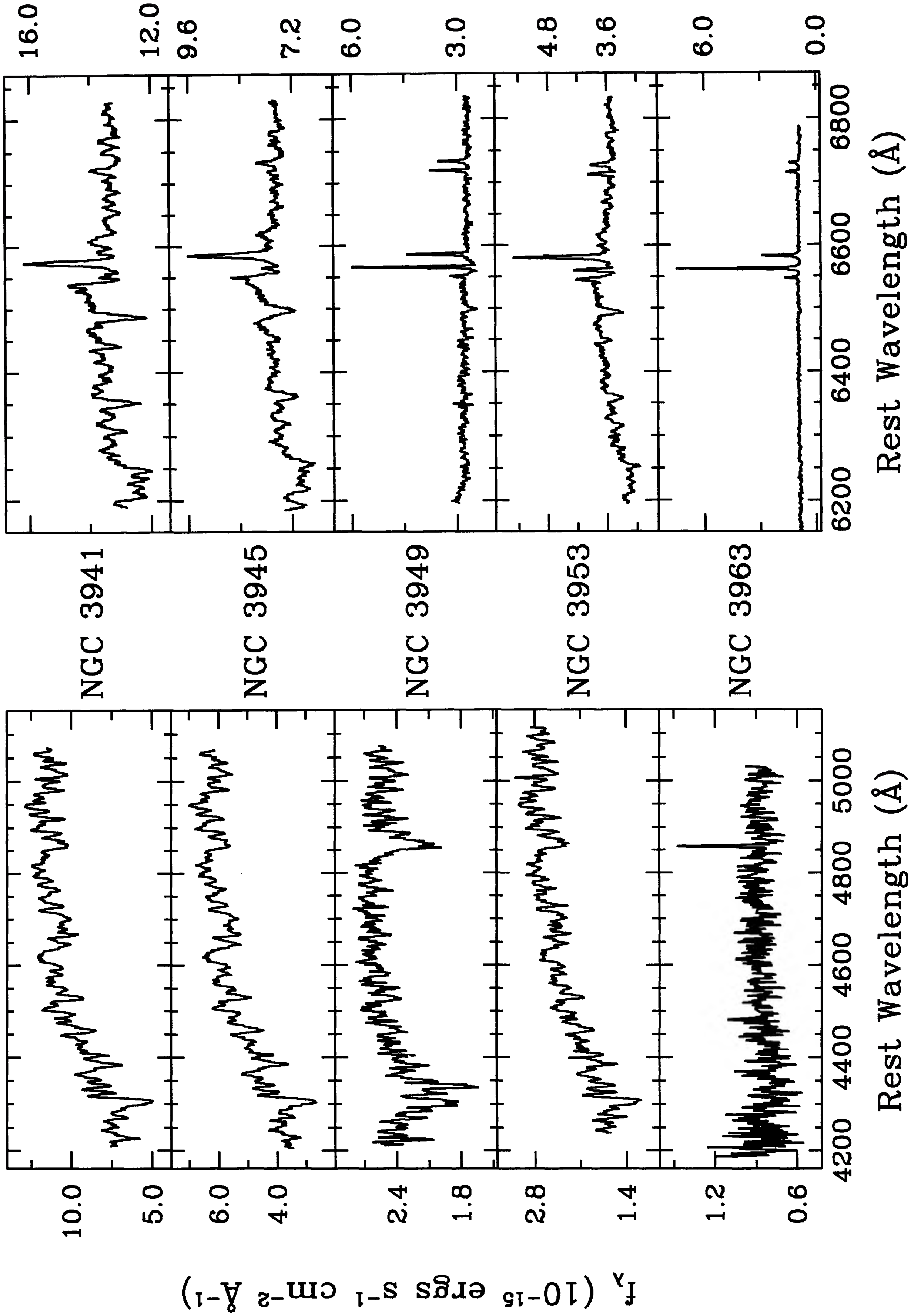


FIG. 45.—Same as Fig. 2

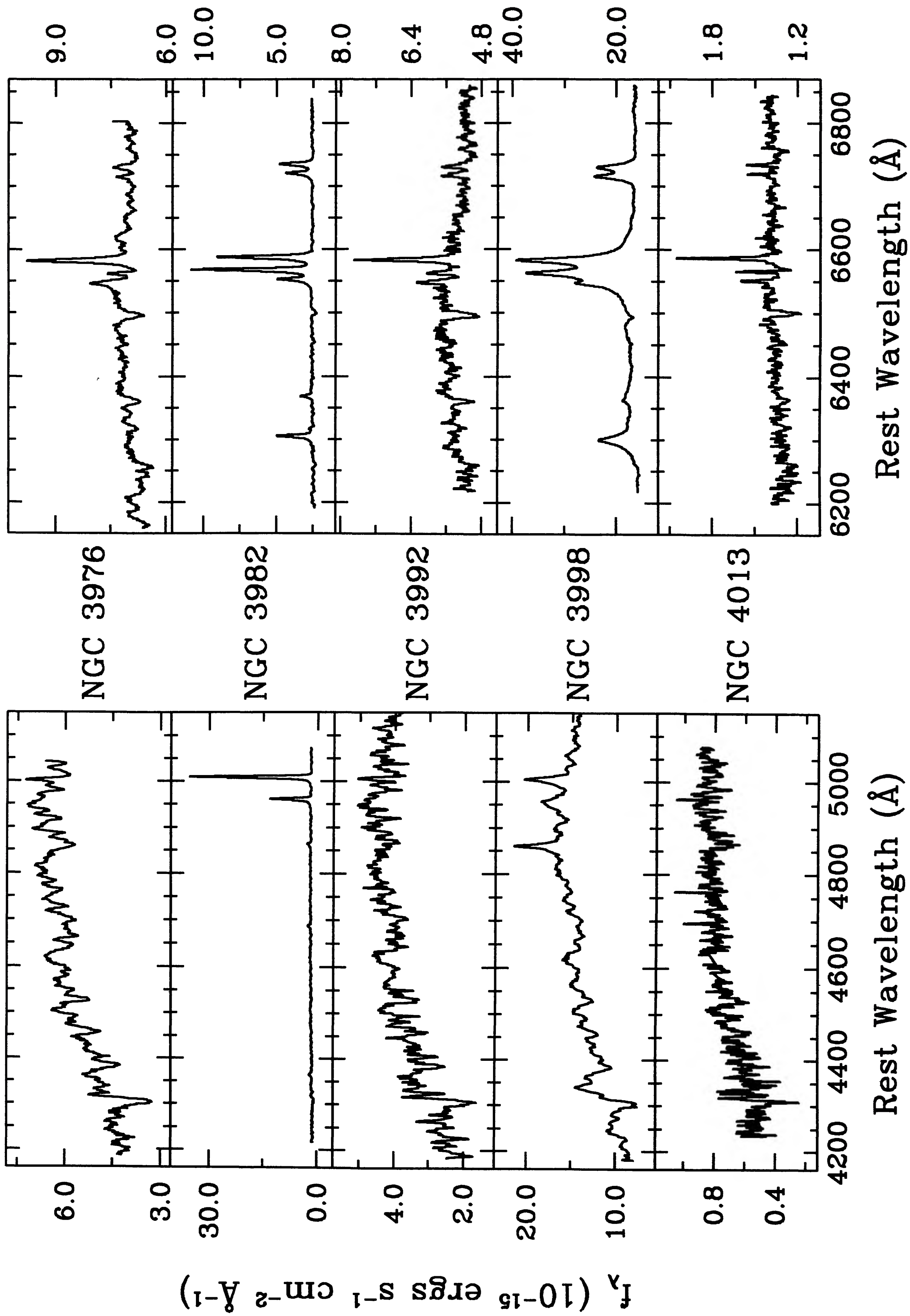


FIG. 46.—Same as Fig. 2

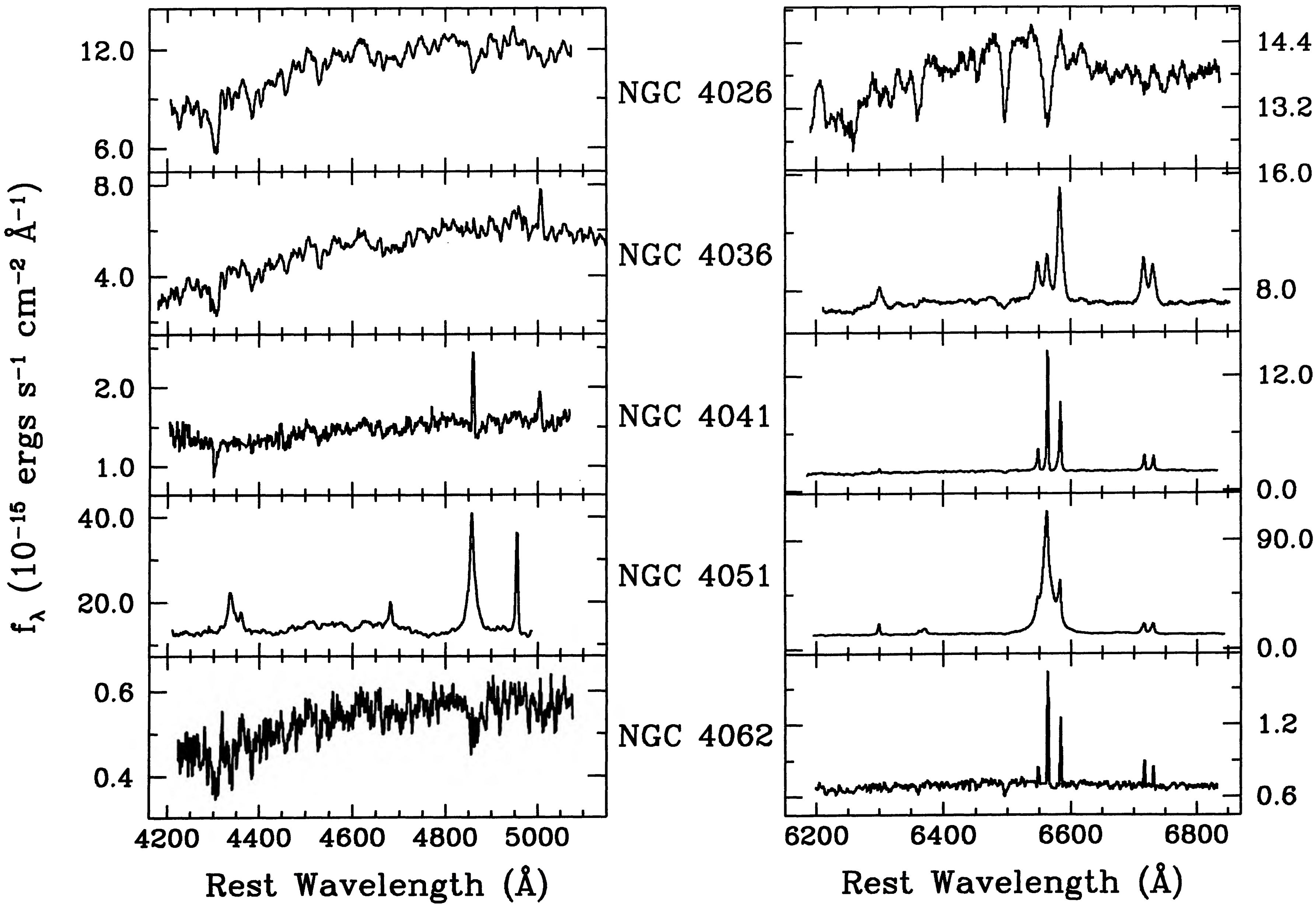


FIG. 47.—Same as Fig. 2

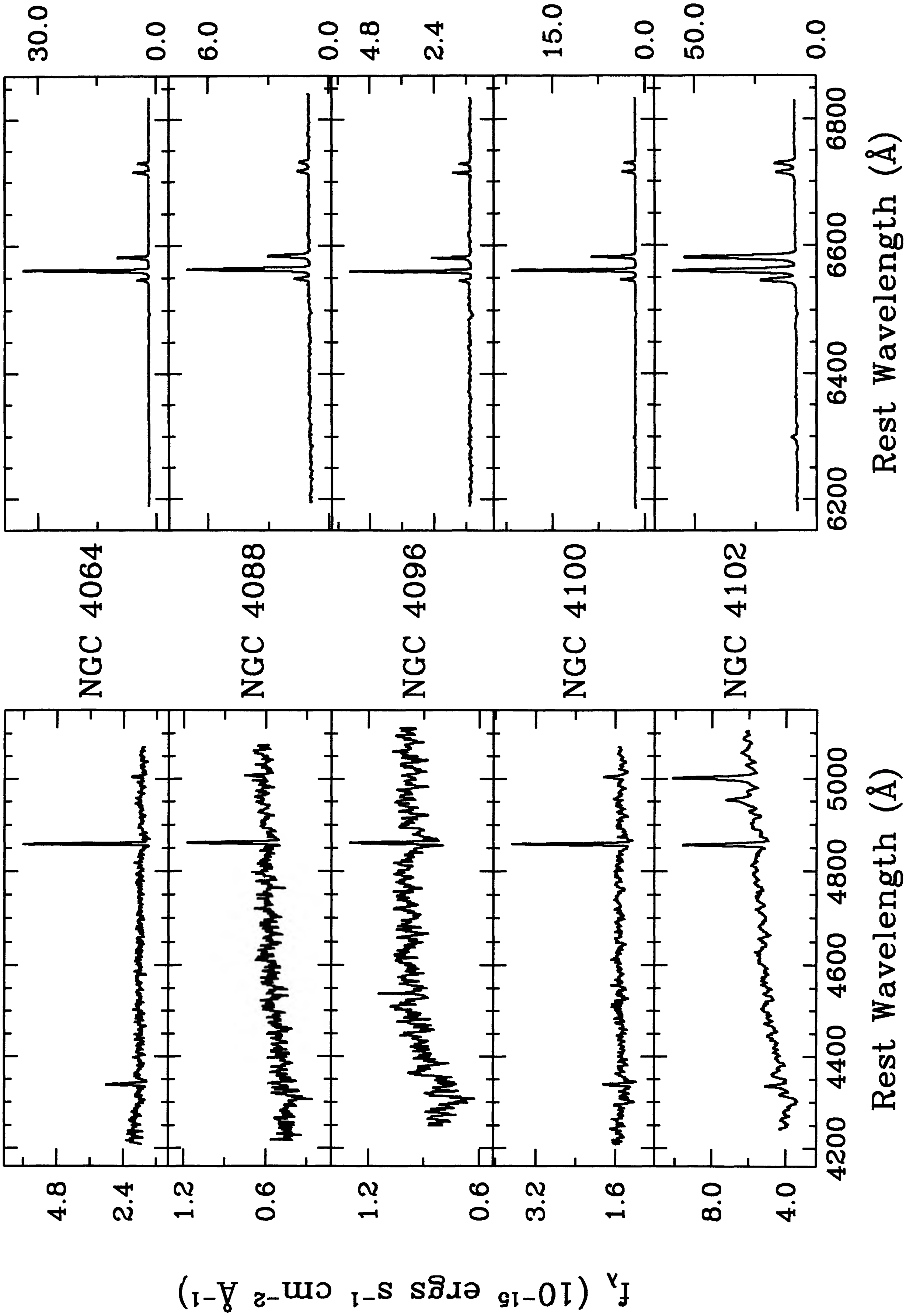


FIG. 48.—Same as Fig. 2

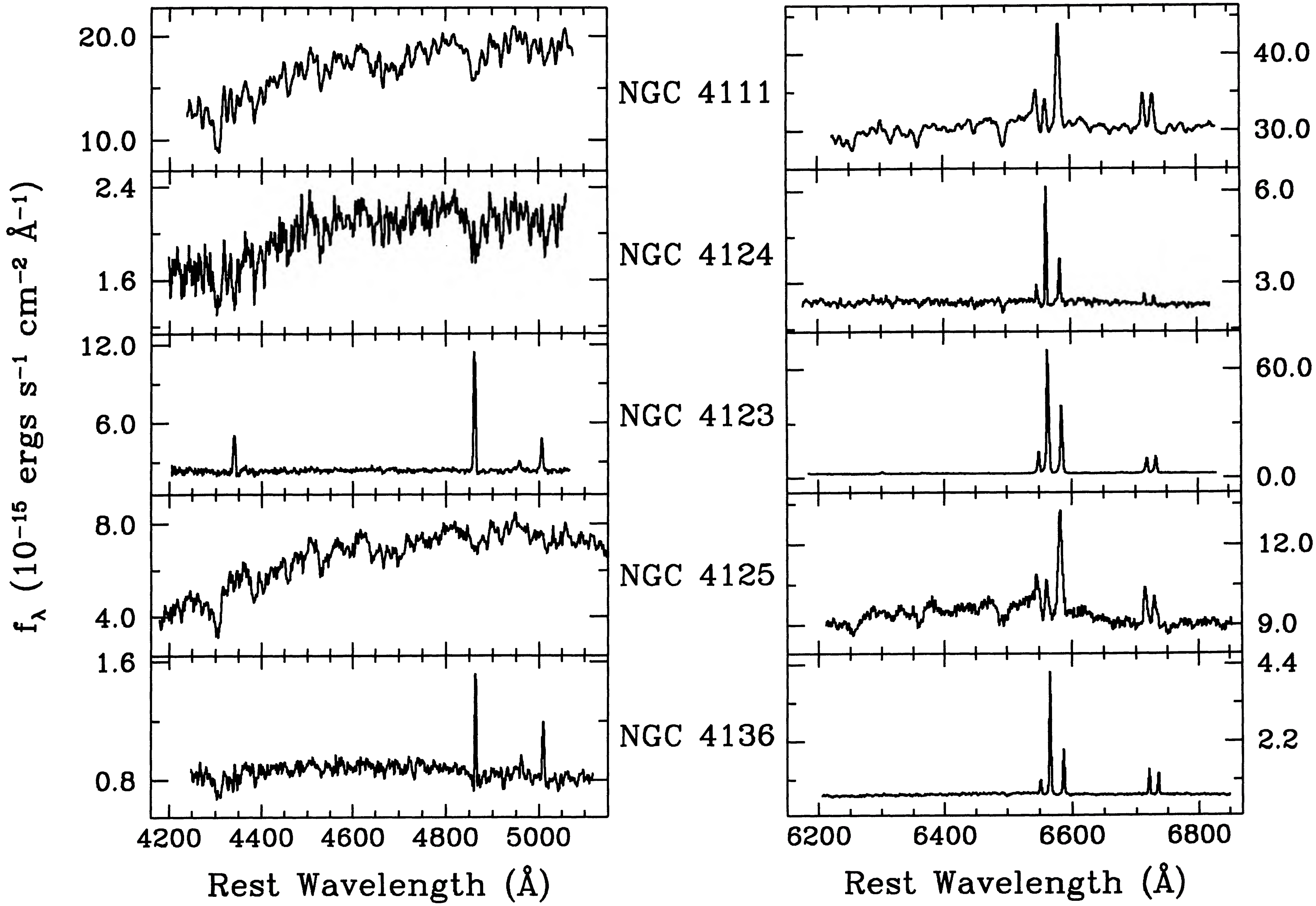


FIG. 49.—Same as Fig. 2

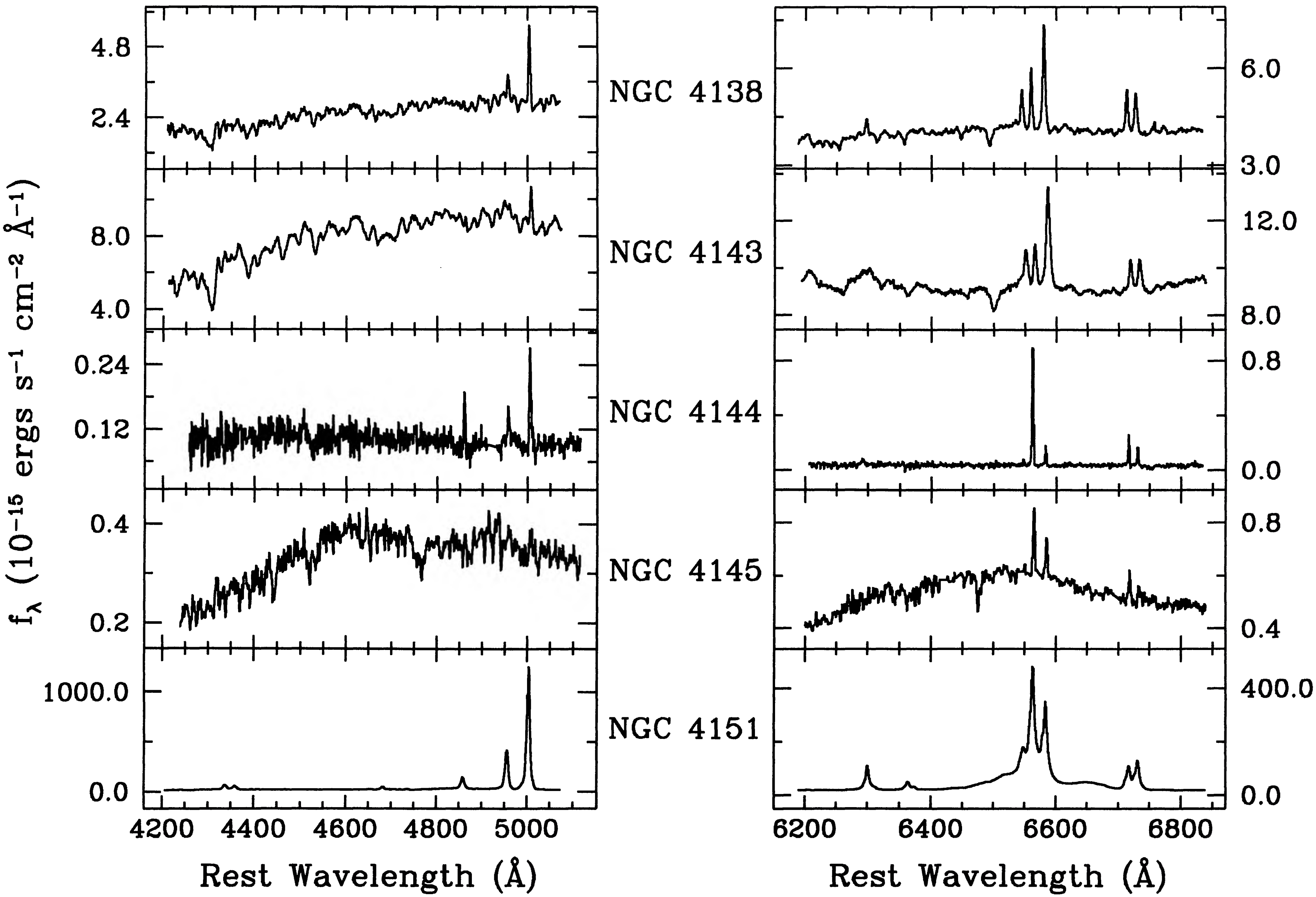


FIG. 50.—Same as Fig. 2

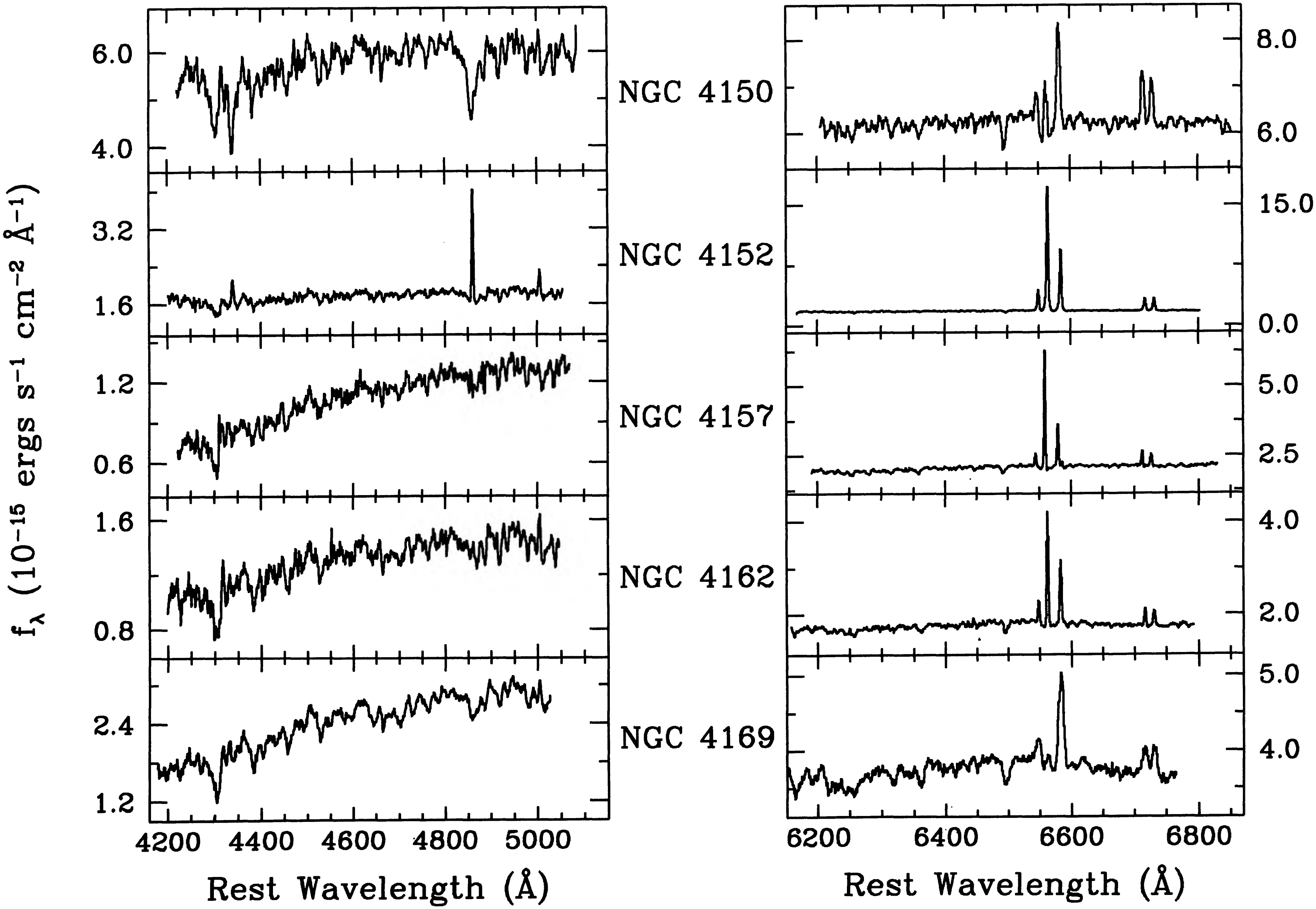


FIG. 51.—Same as Fig. 2

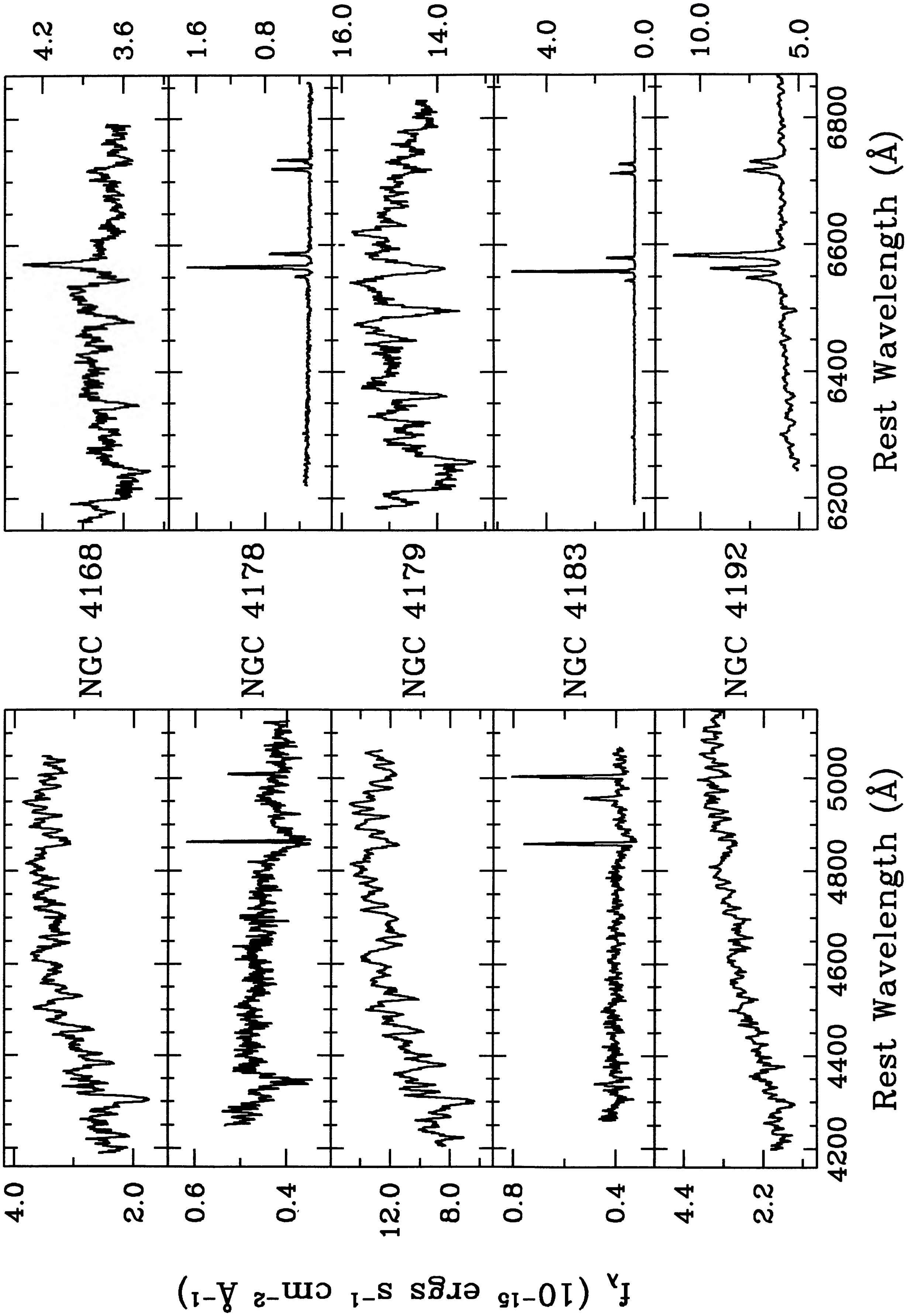
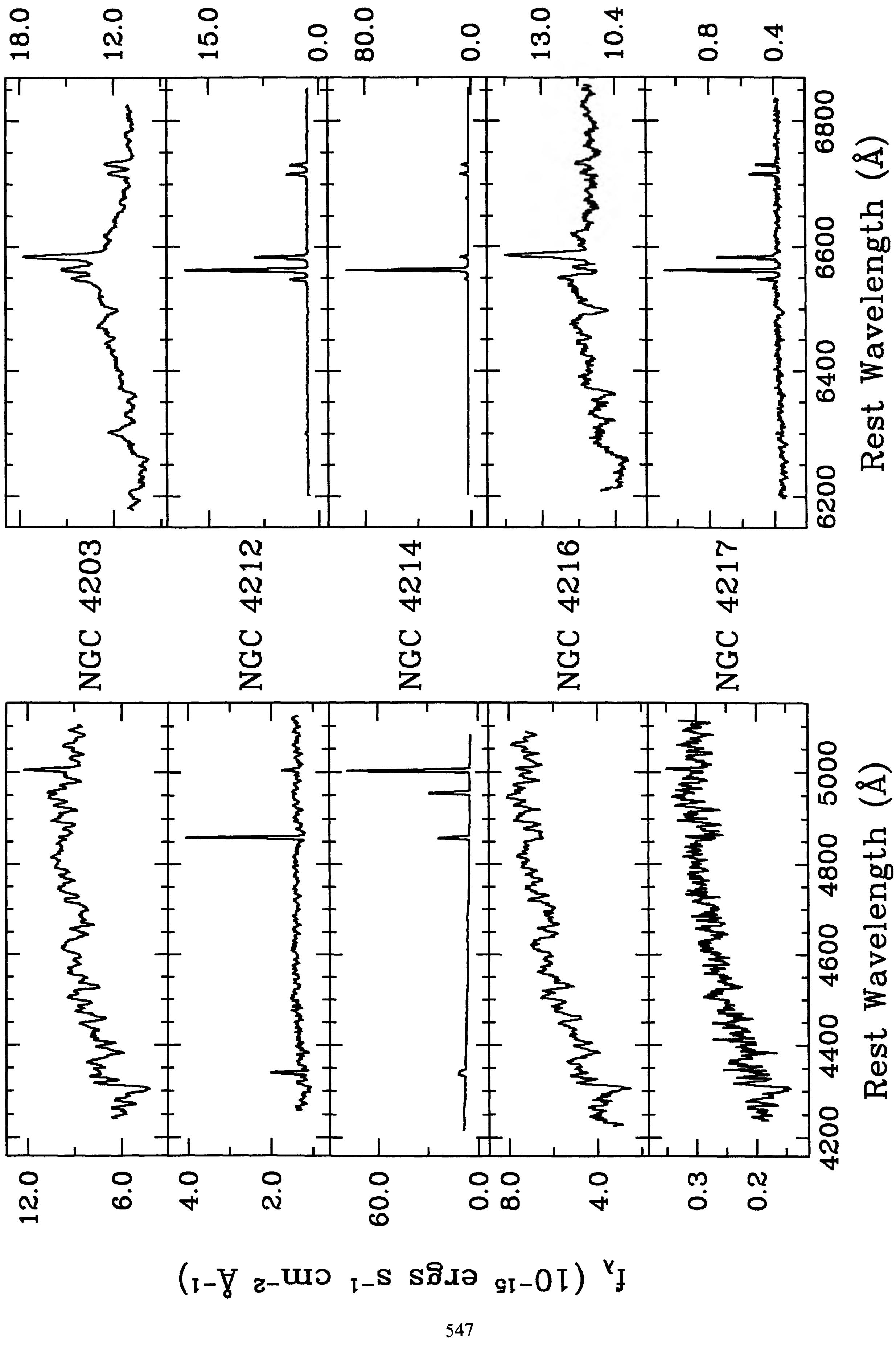


FIG. 52.—Same as Fig. 2



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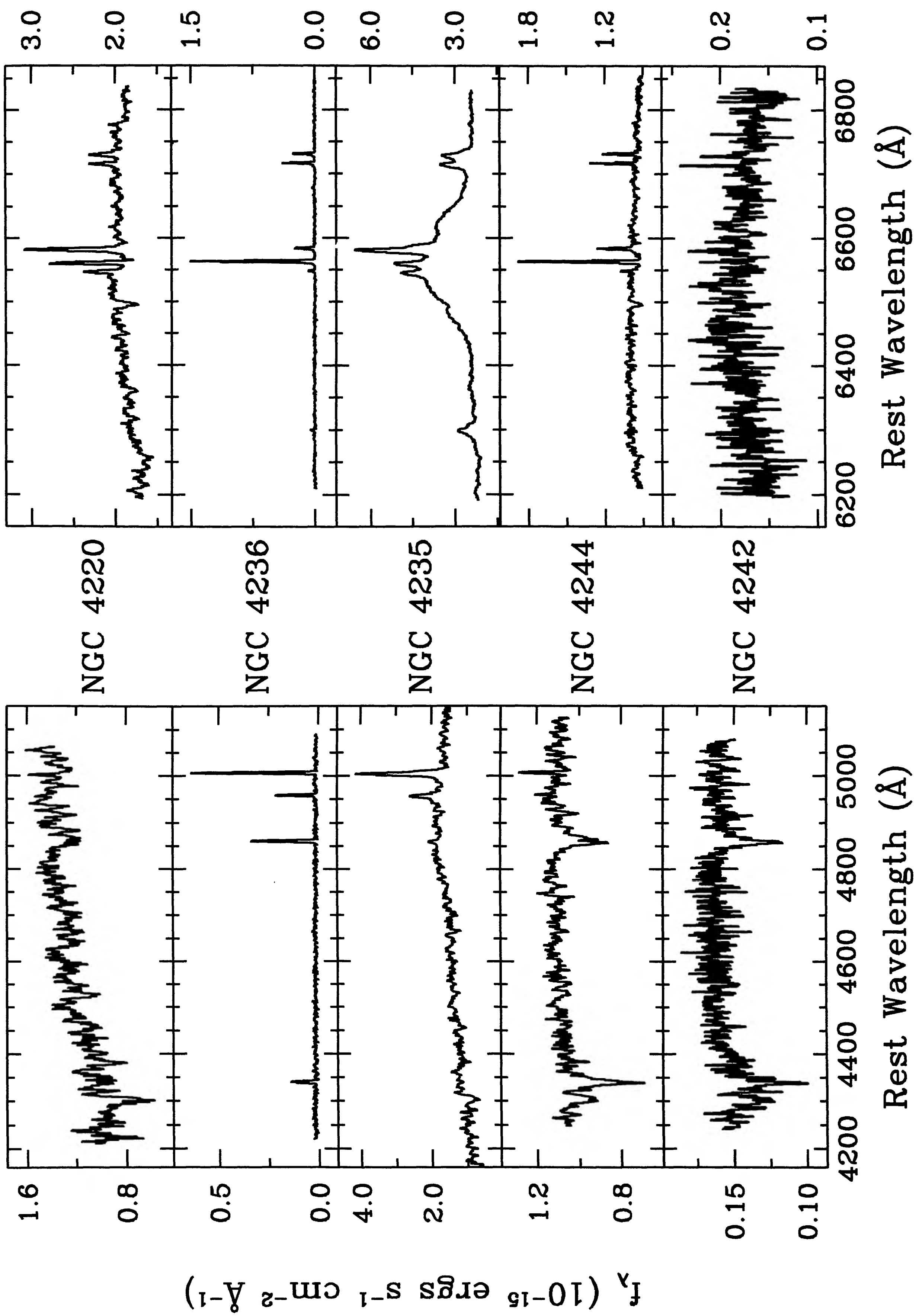

FIG. 54.—Same as Fig. 2

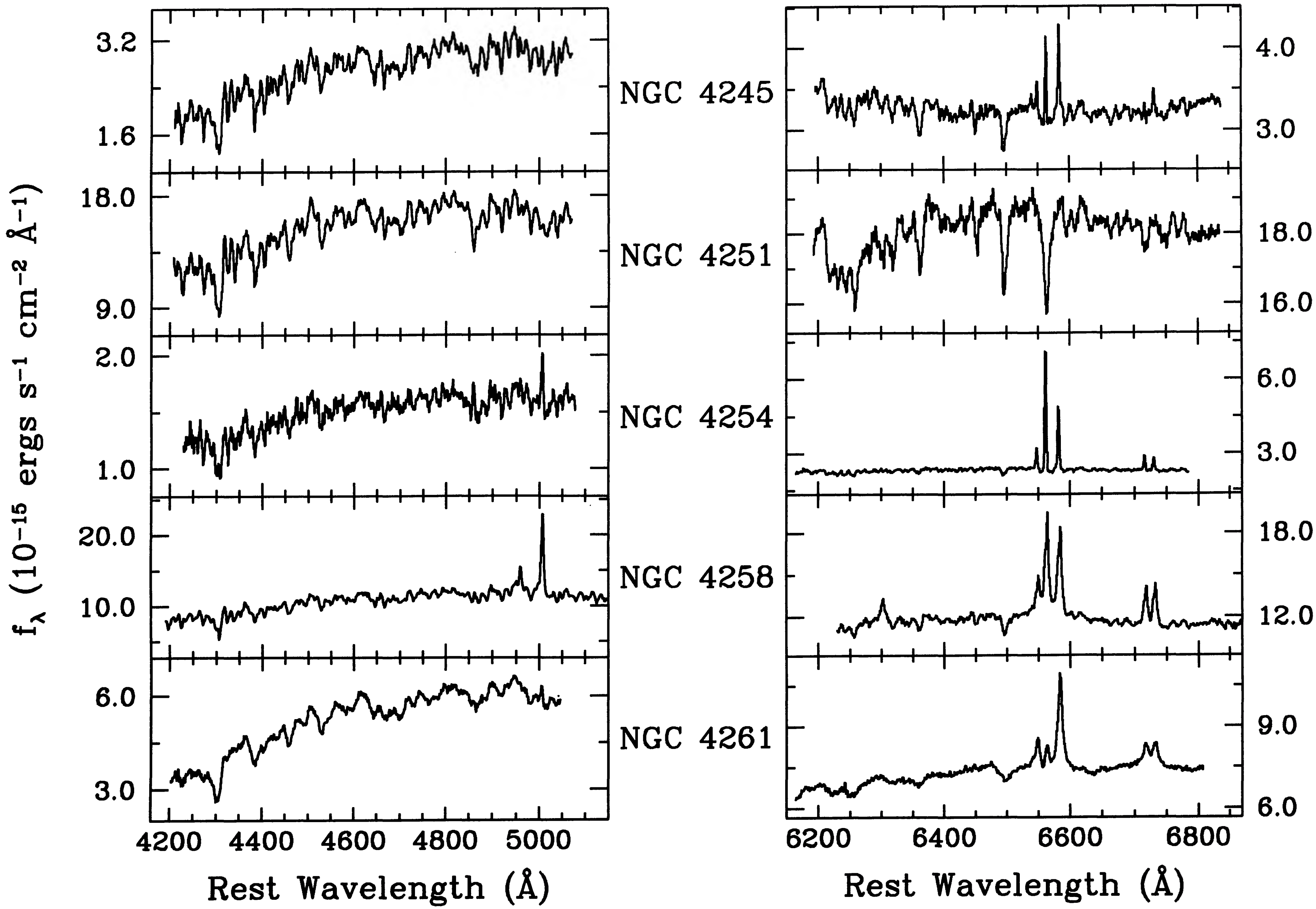

FIG. 55.—Same as Fig. 2

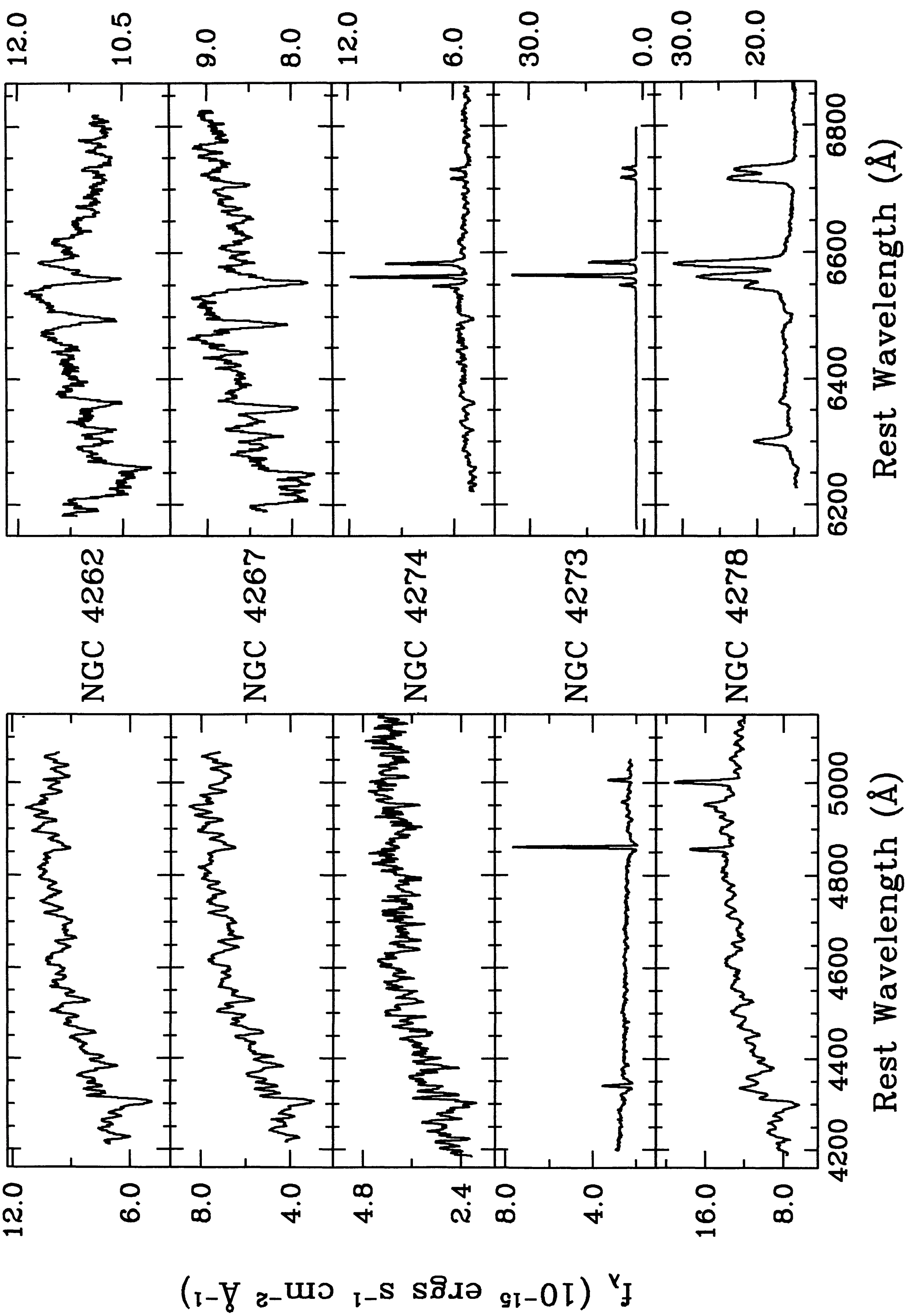

FIG. 56.—Same as Fig. 2

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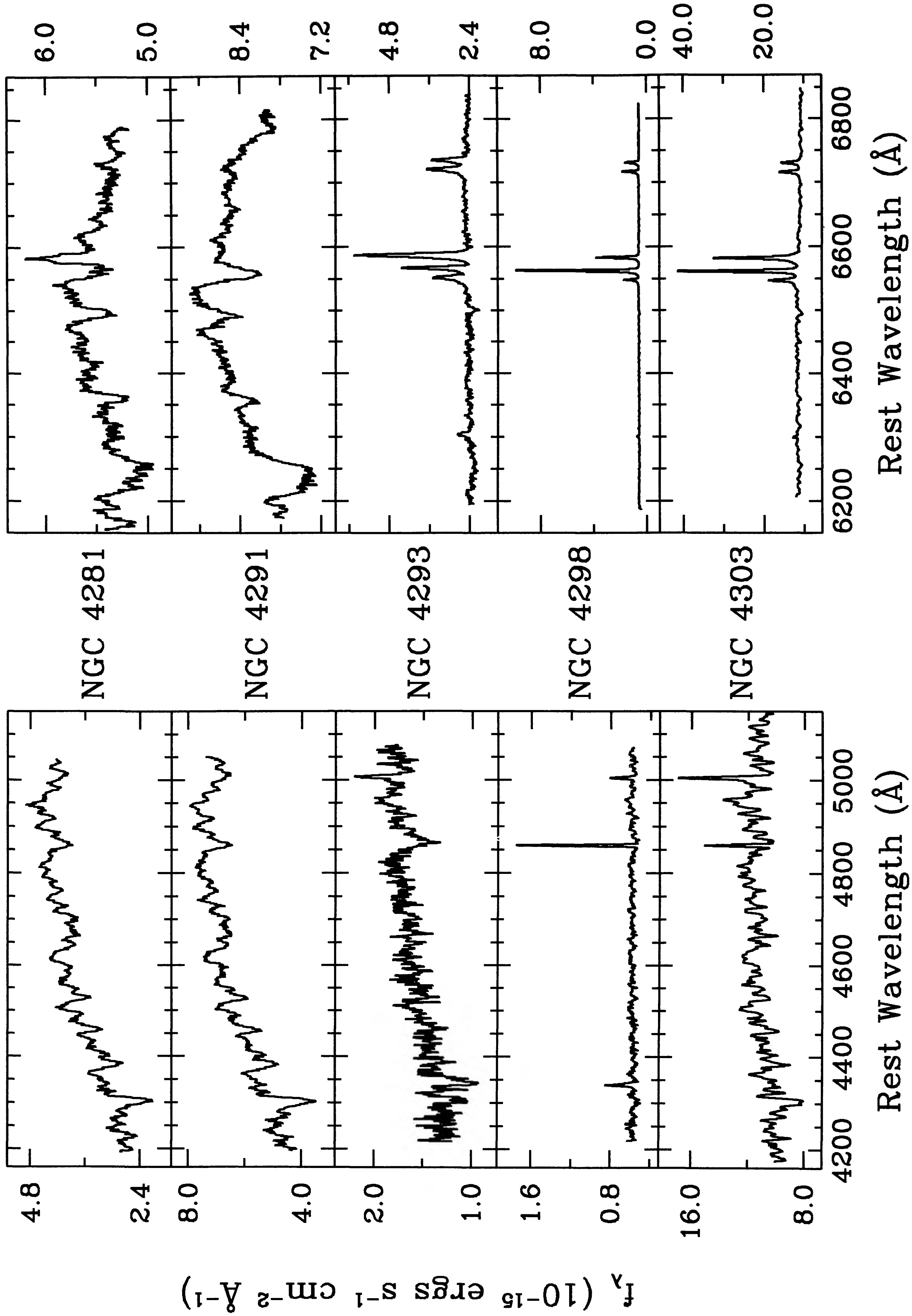


FIG. 57.—Same as Fig. 2

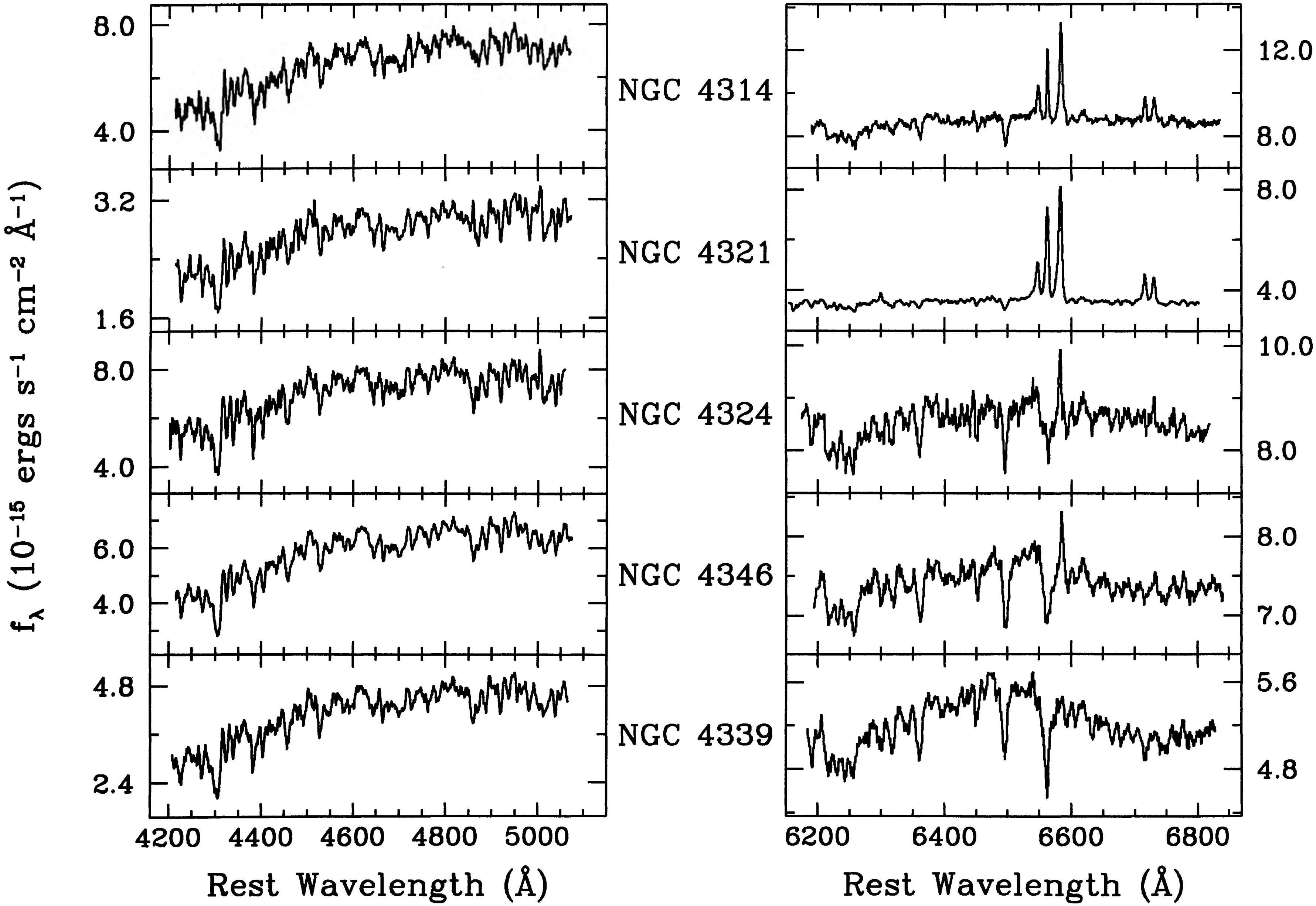


FIG. 58.—Same as Fig. 2

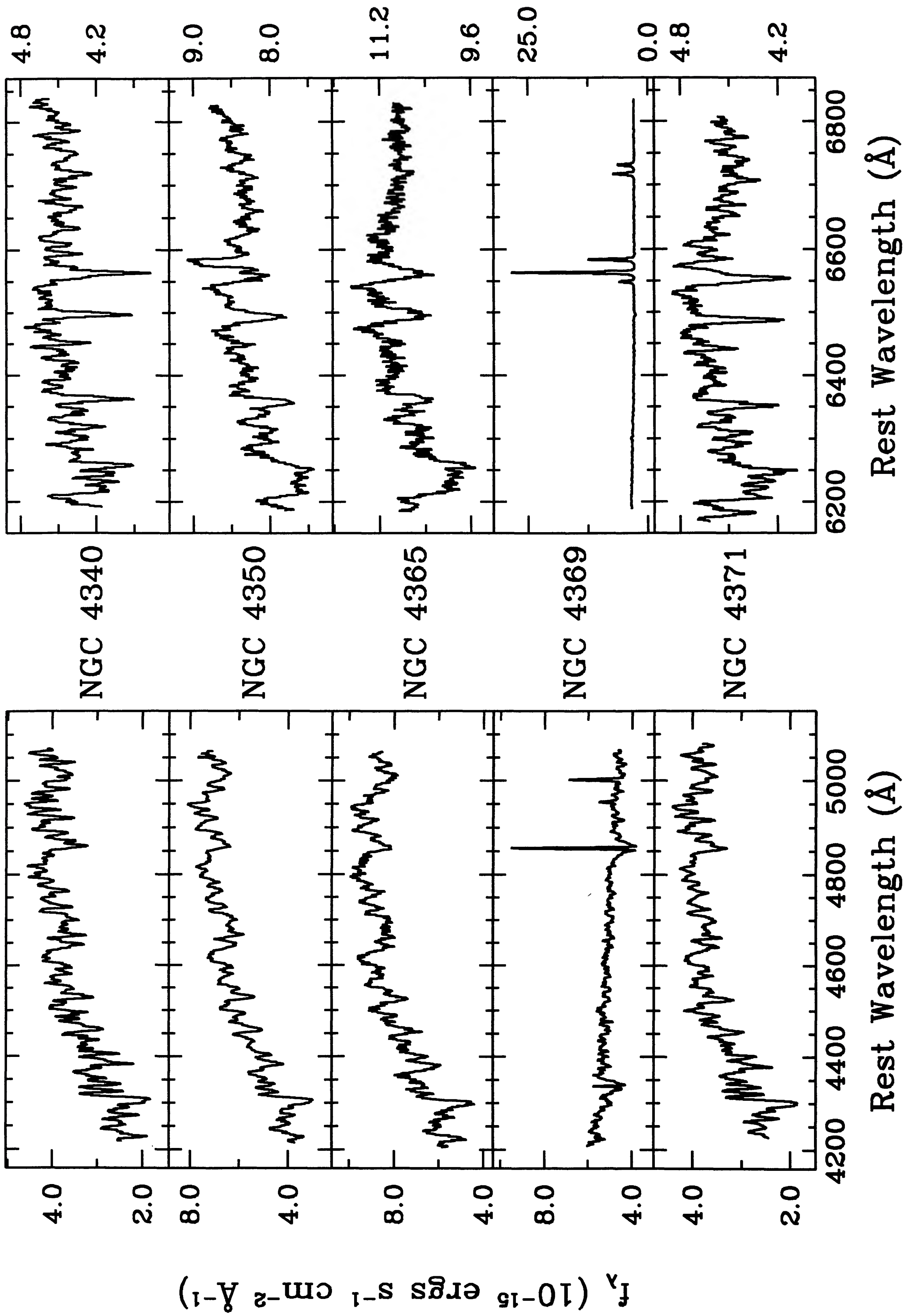


FIG. 59.—Same as Fig. 2

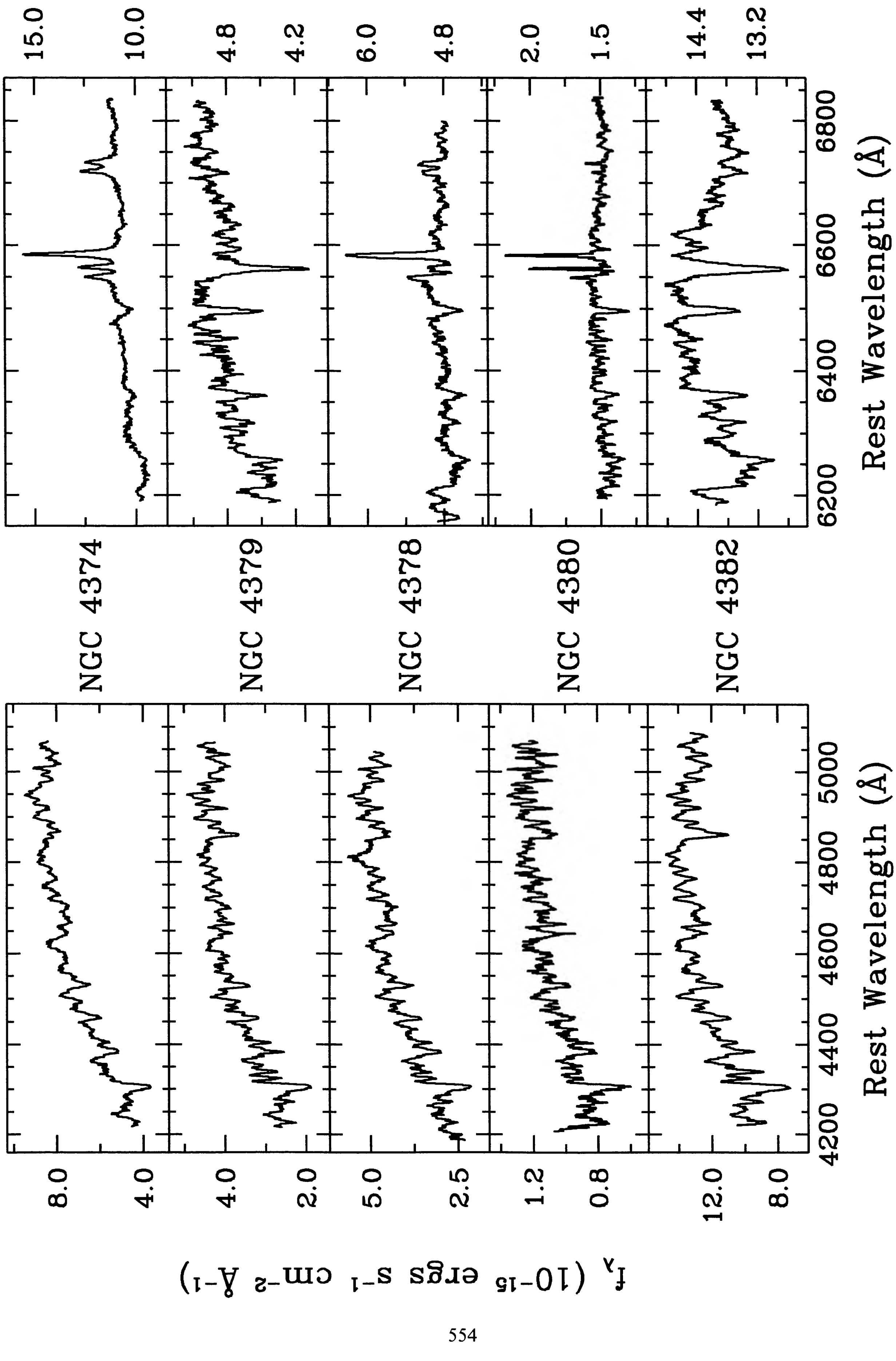


FIG. 60.—Same as Fig. 2

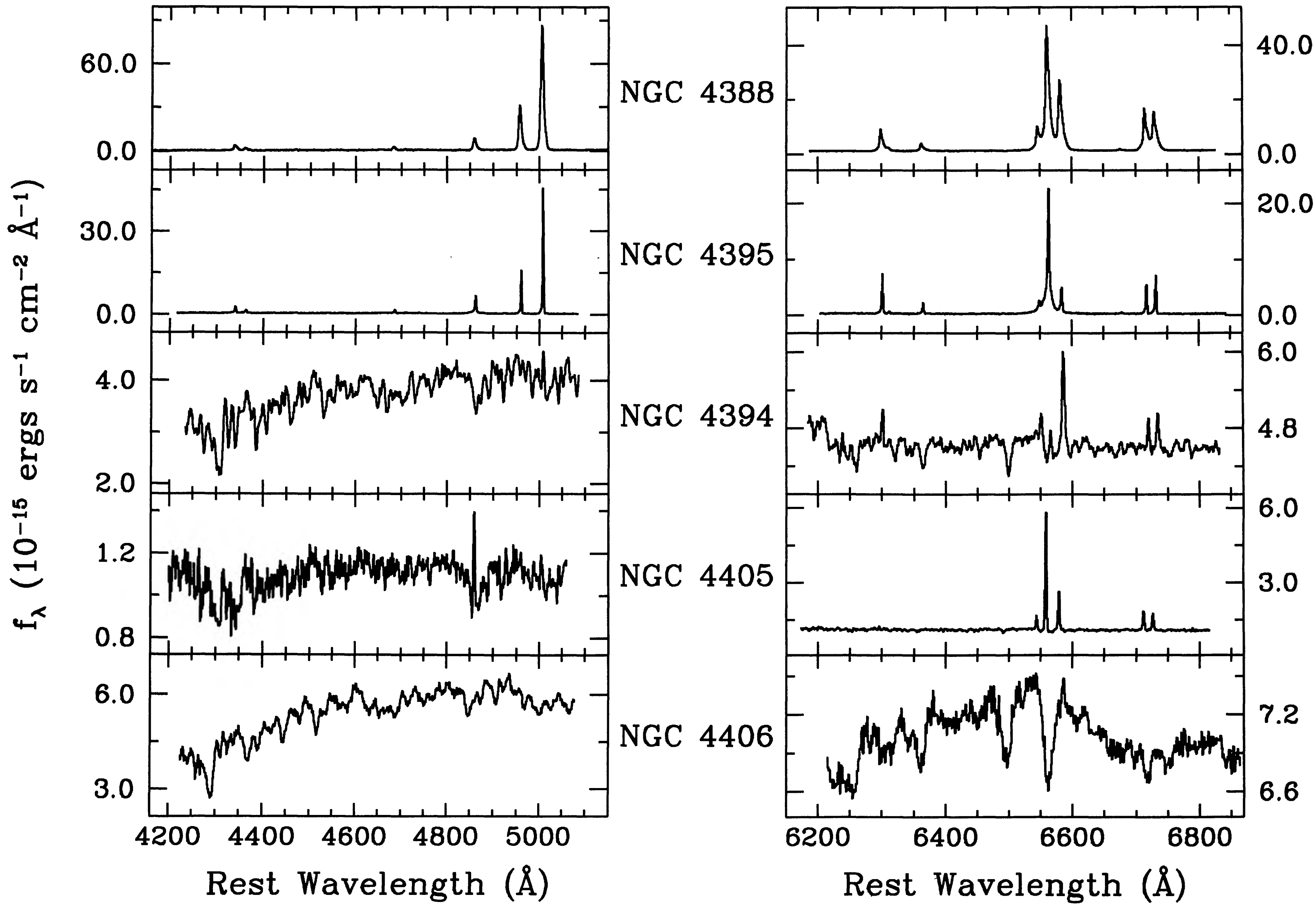


FIG. 61.—Same as Fig. 2

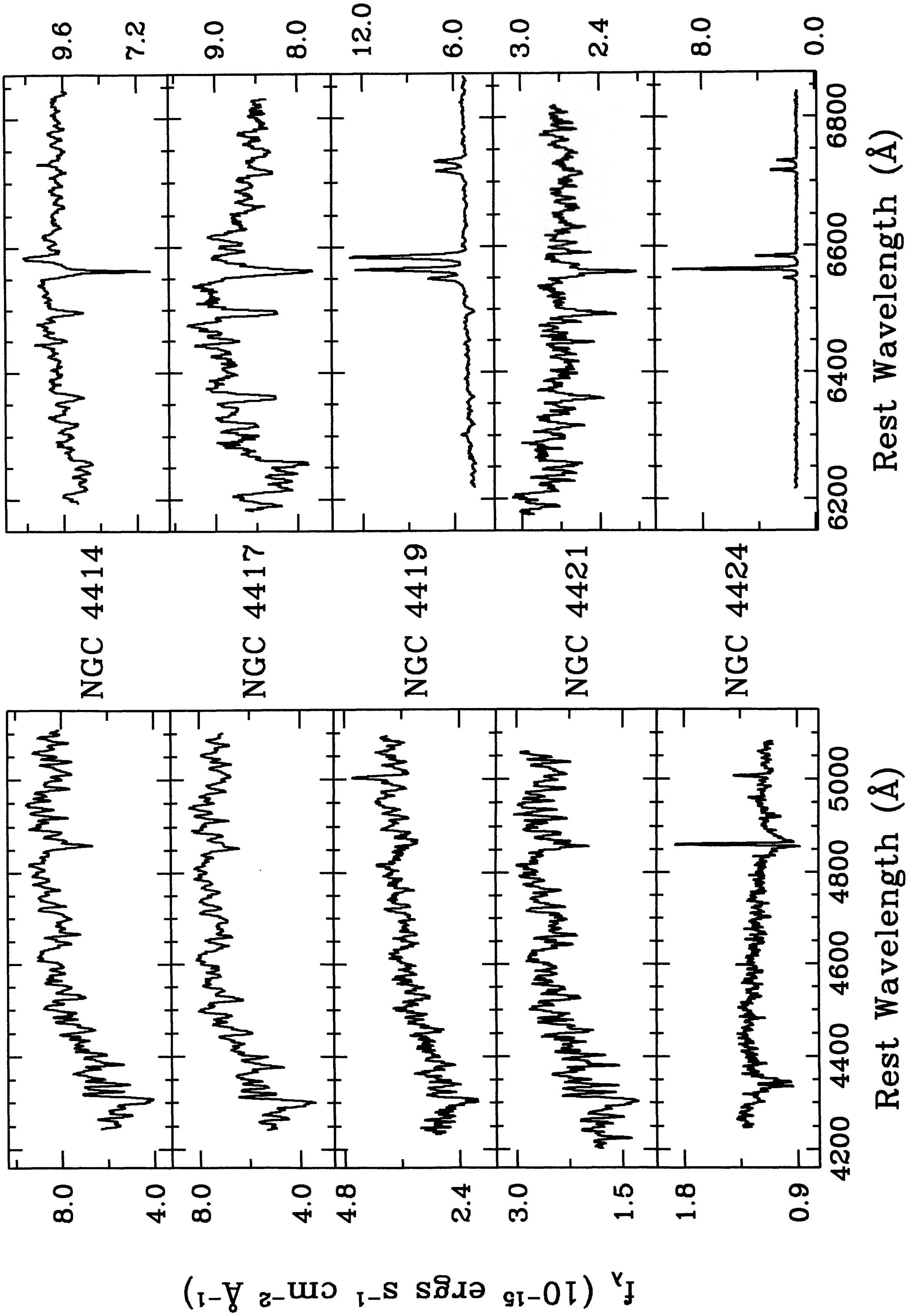


FIG. 62.—Same as Fig. 2

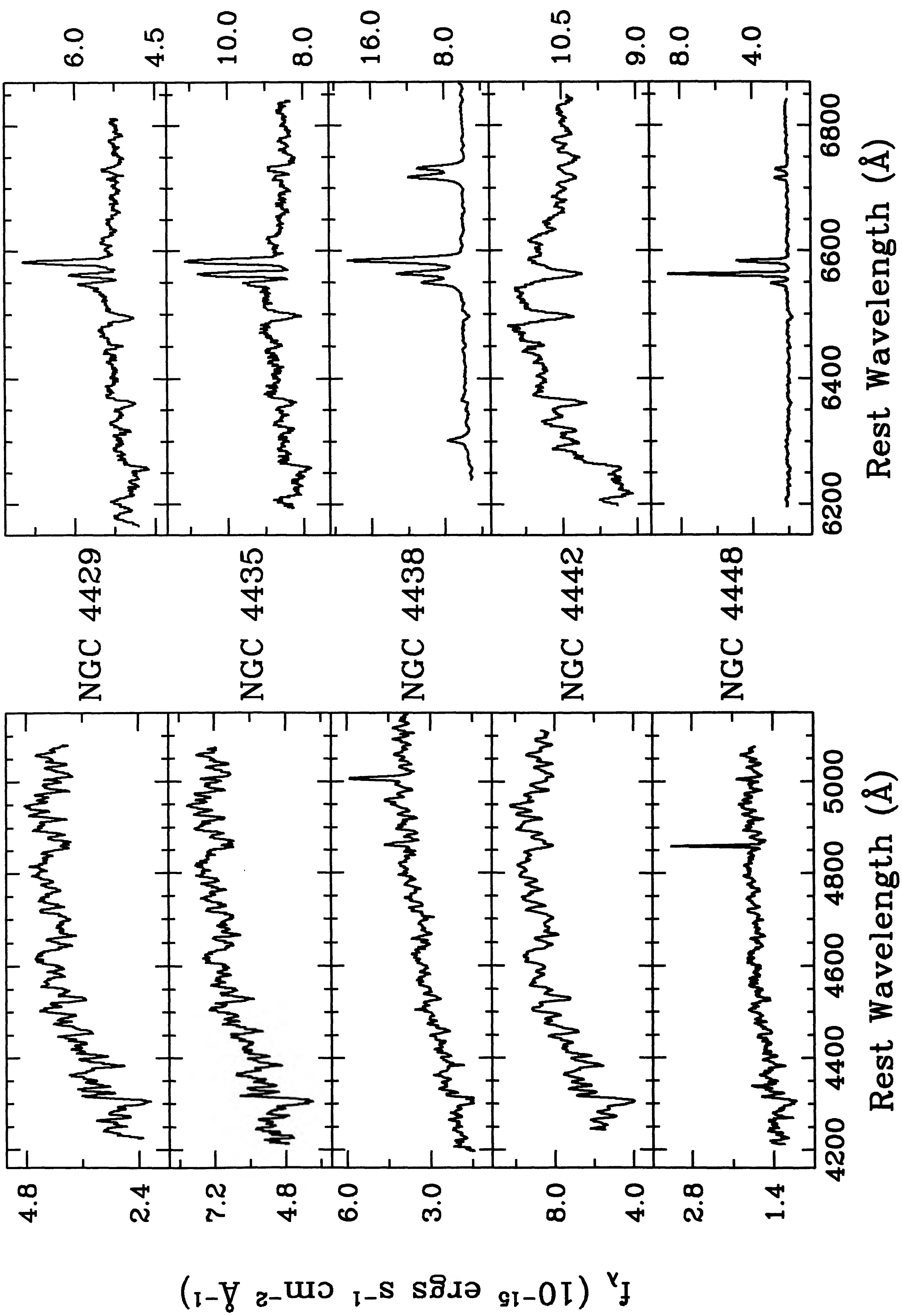


FIG. 63.—Same as Fig. 2

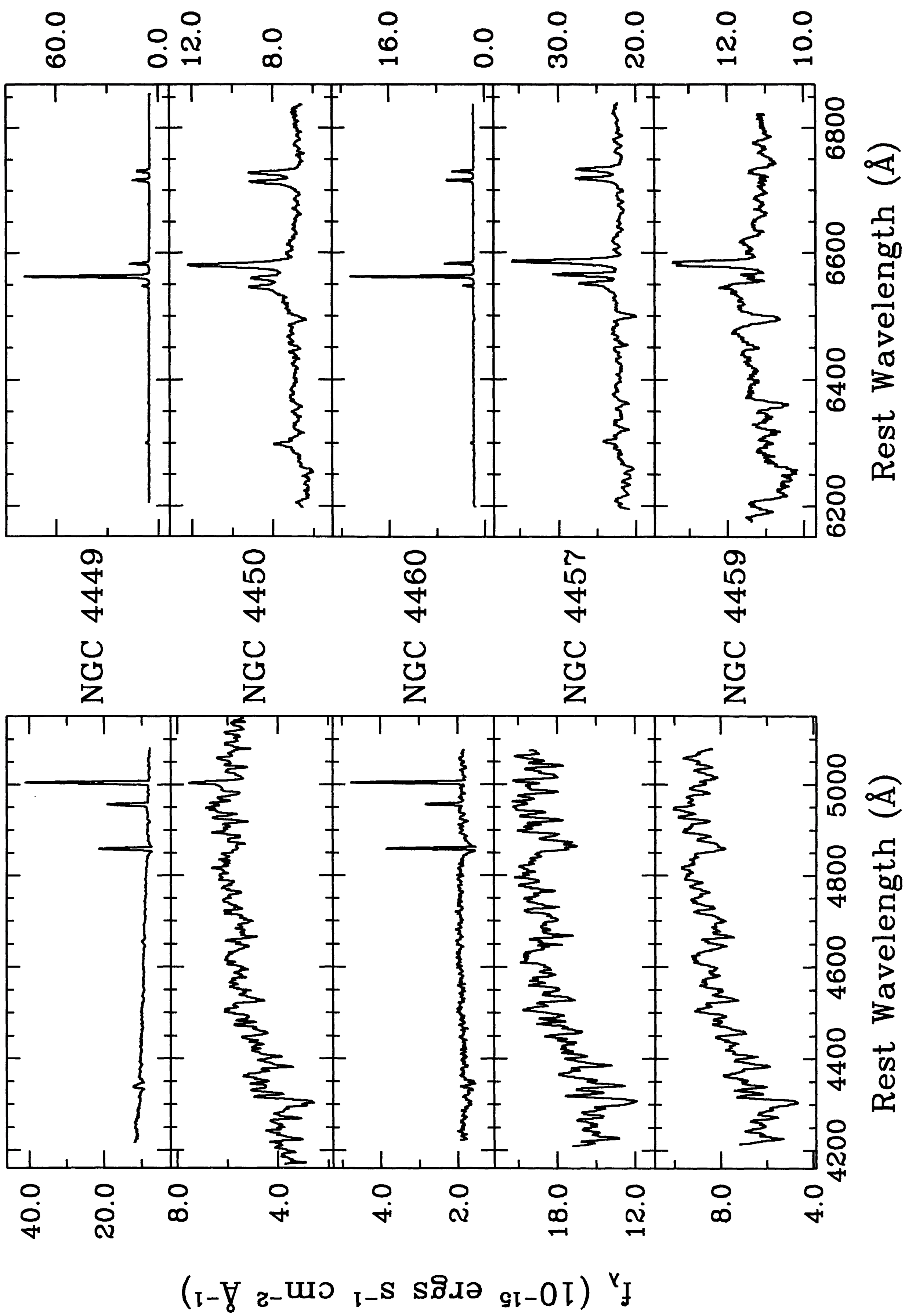
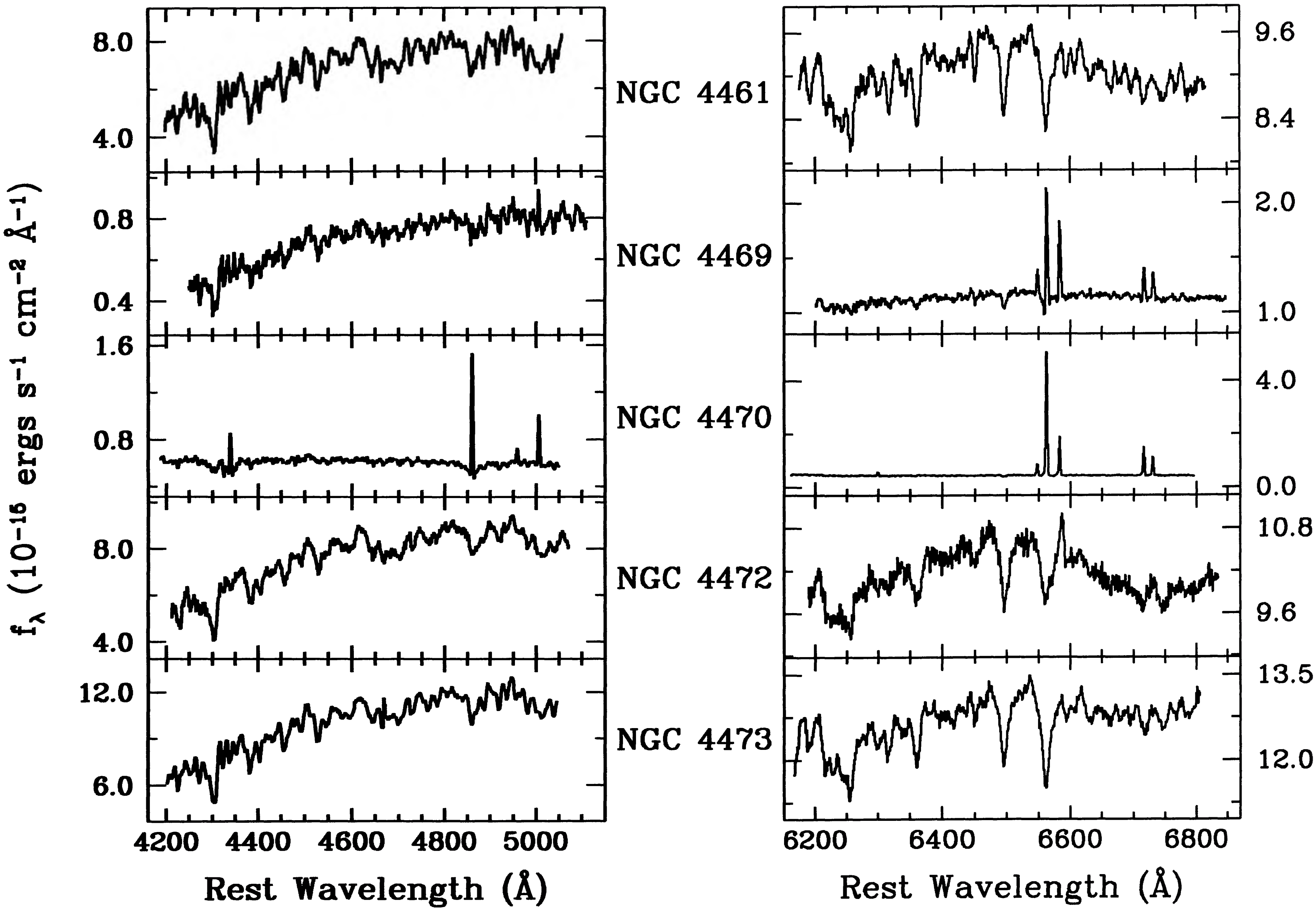


FIG. 64.—Same as Fig. 2



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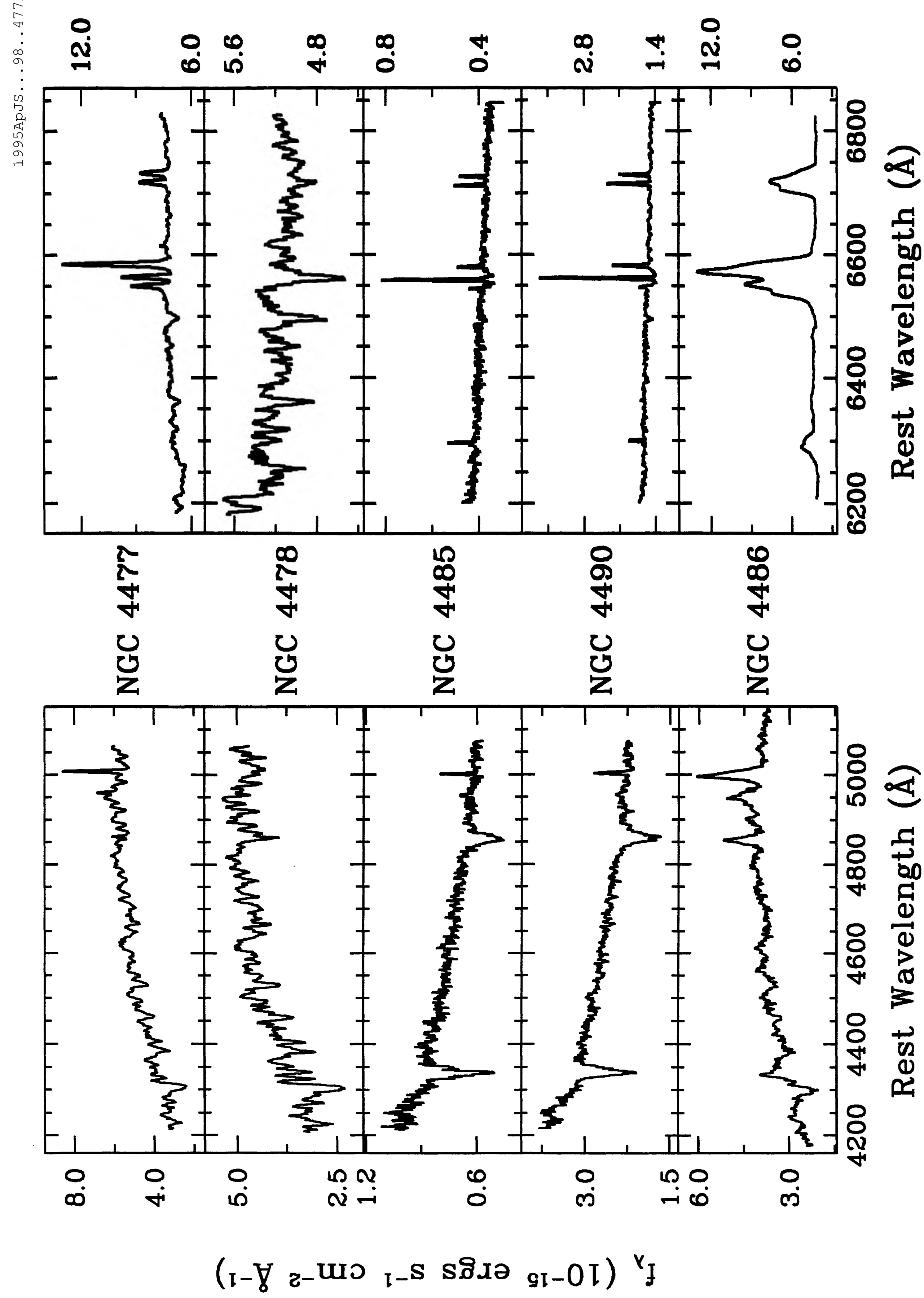

FIG. 66.—Same as Fig. 2

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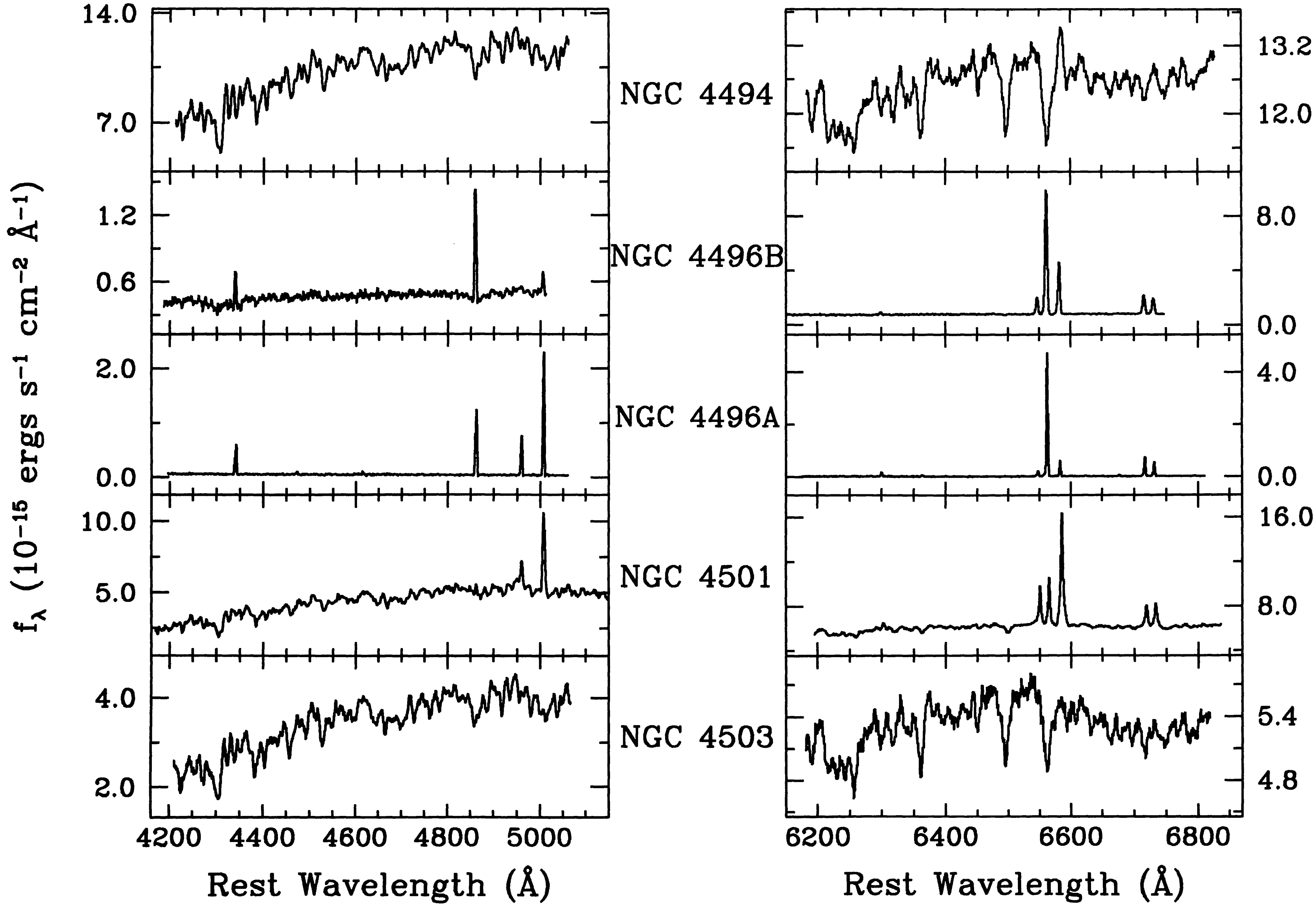

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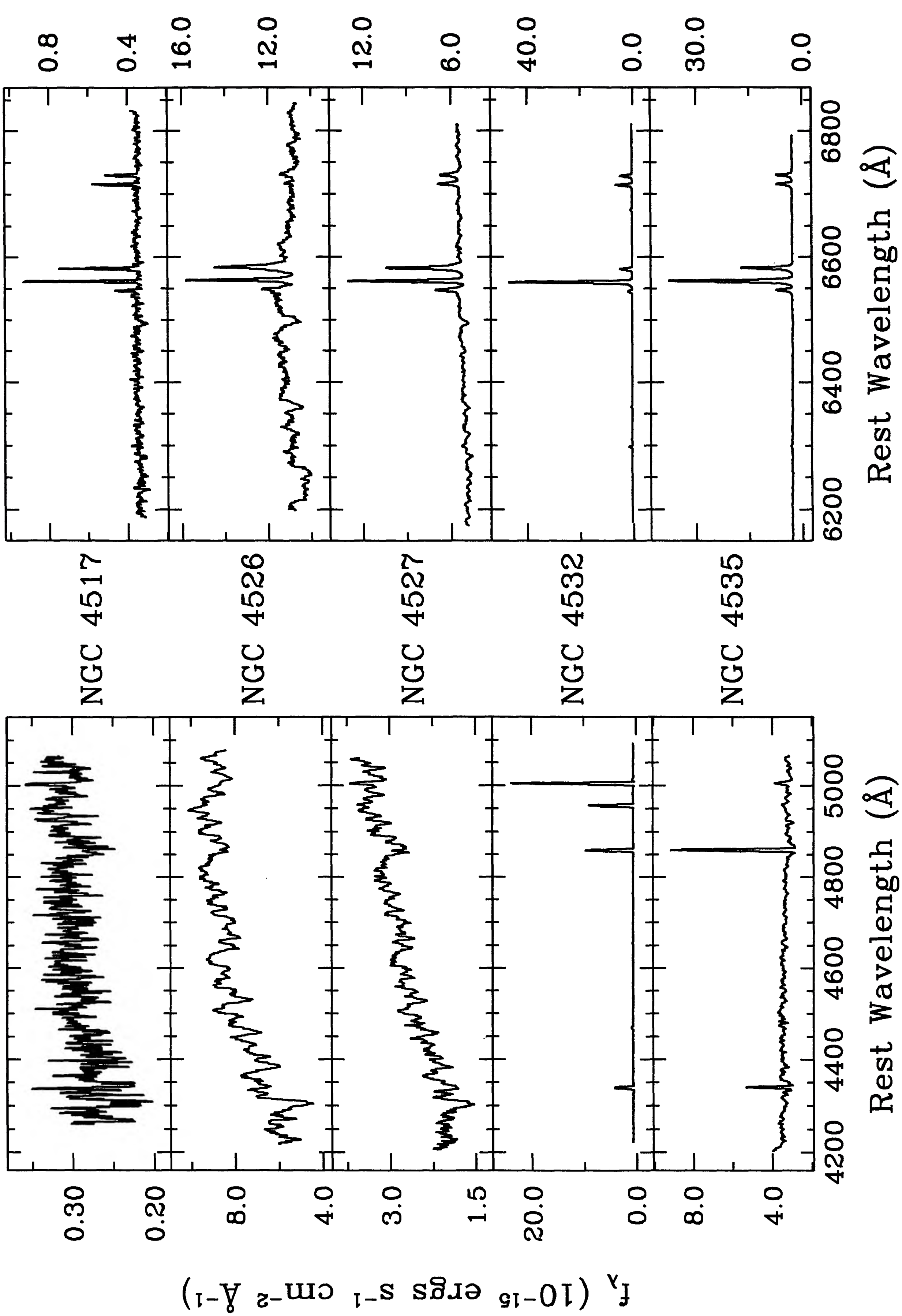

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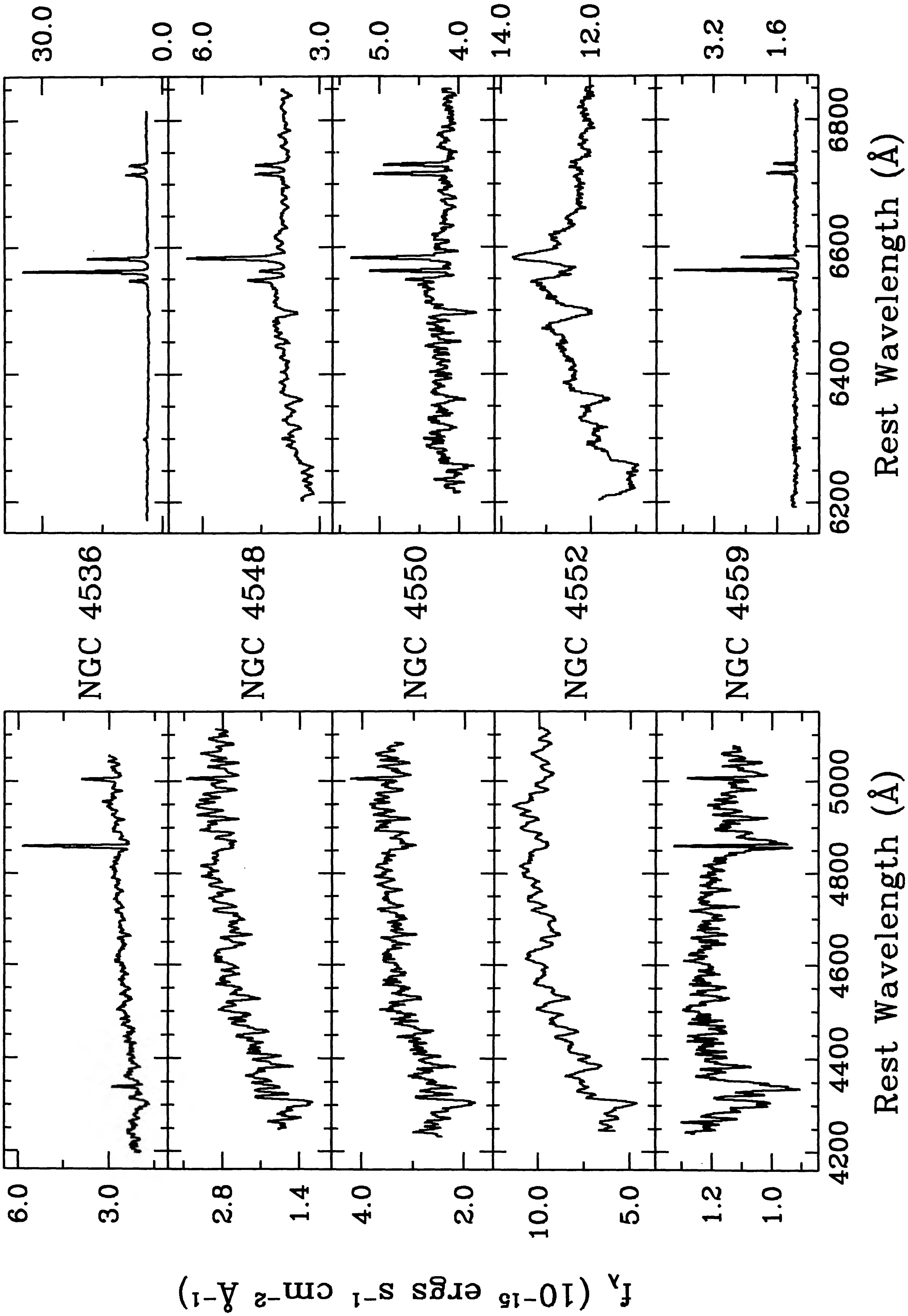


FIG. 69.—Same as Fig. 2

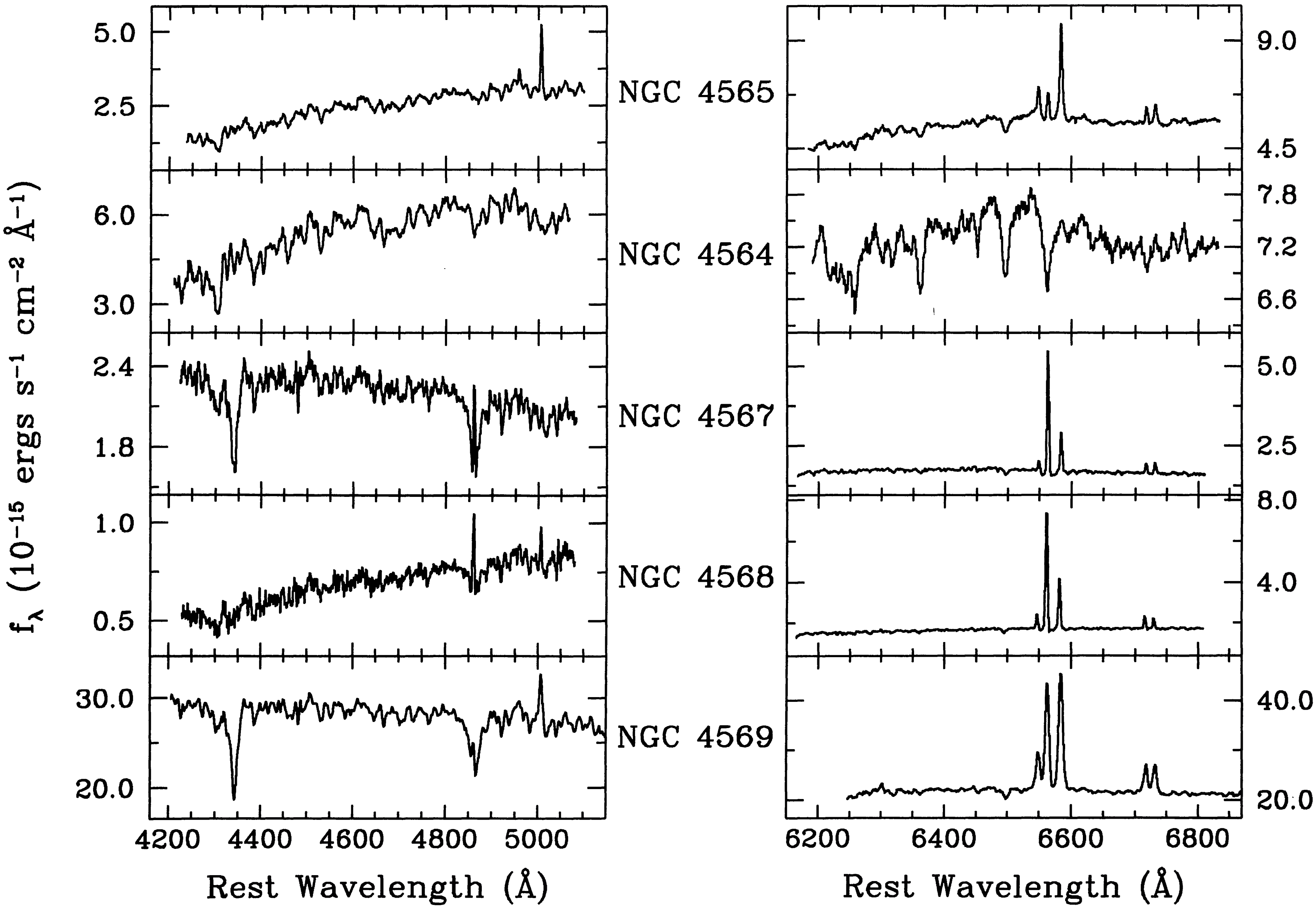
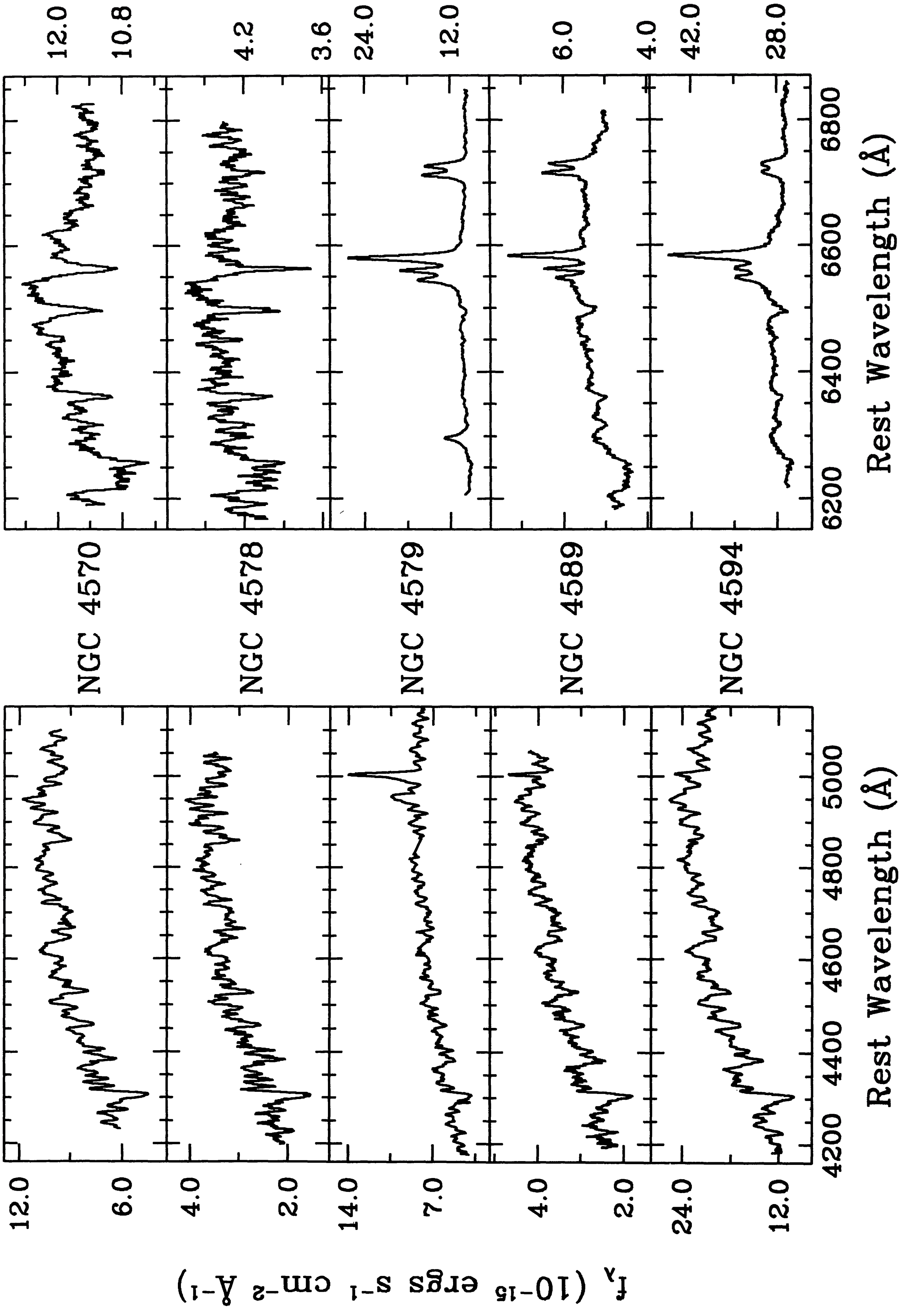


FIG. 70.—Same as Fig. 2



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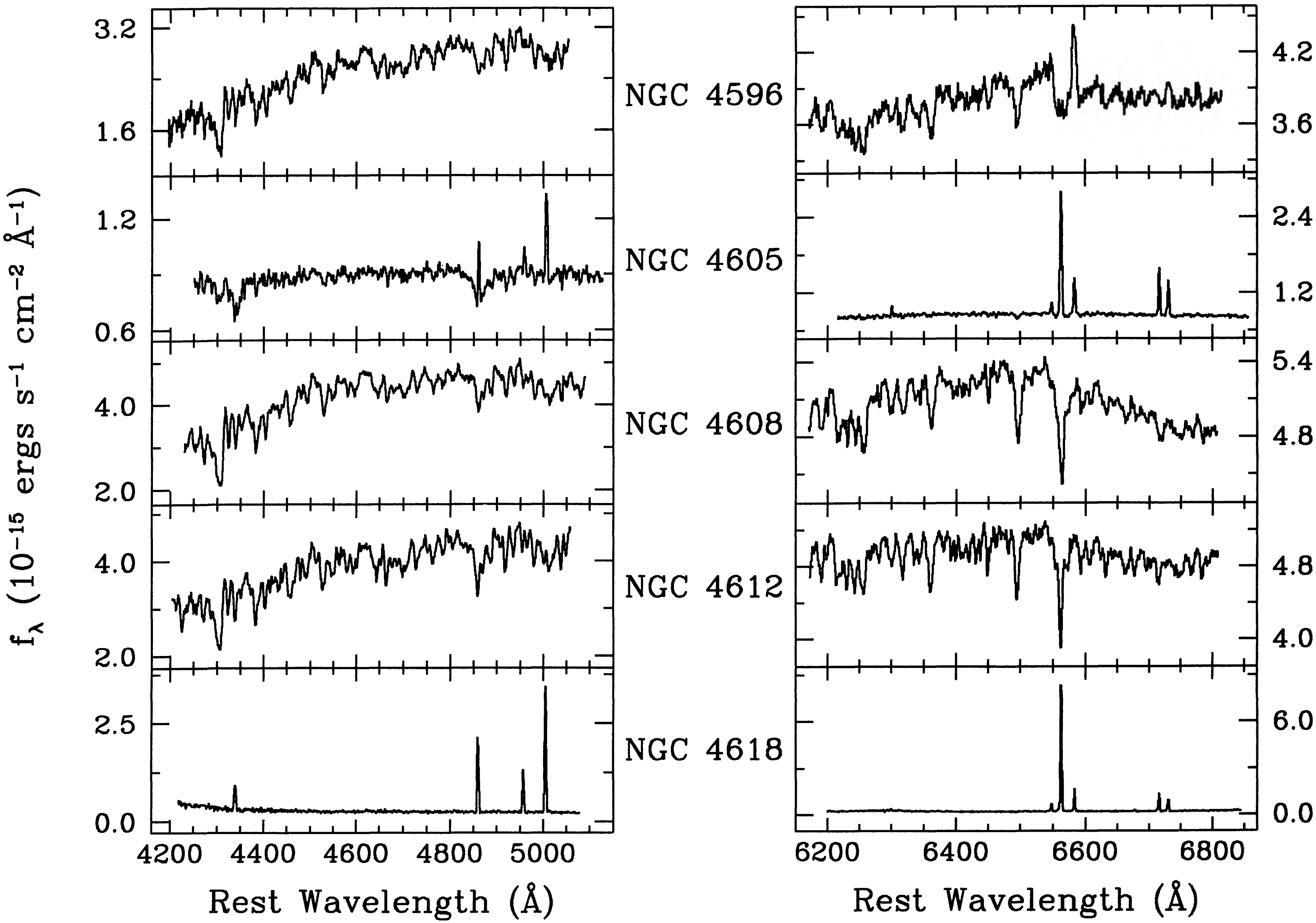

FIG. 72.—Same as Fig. 2

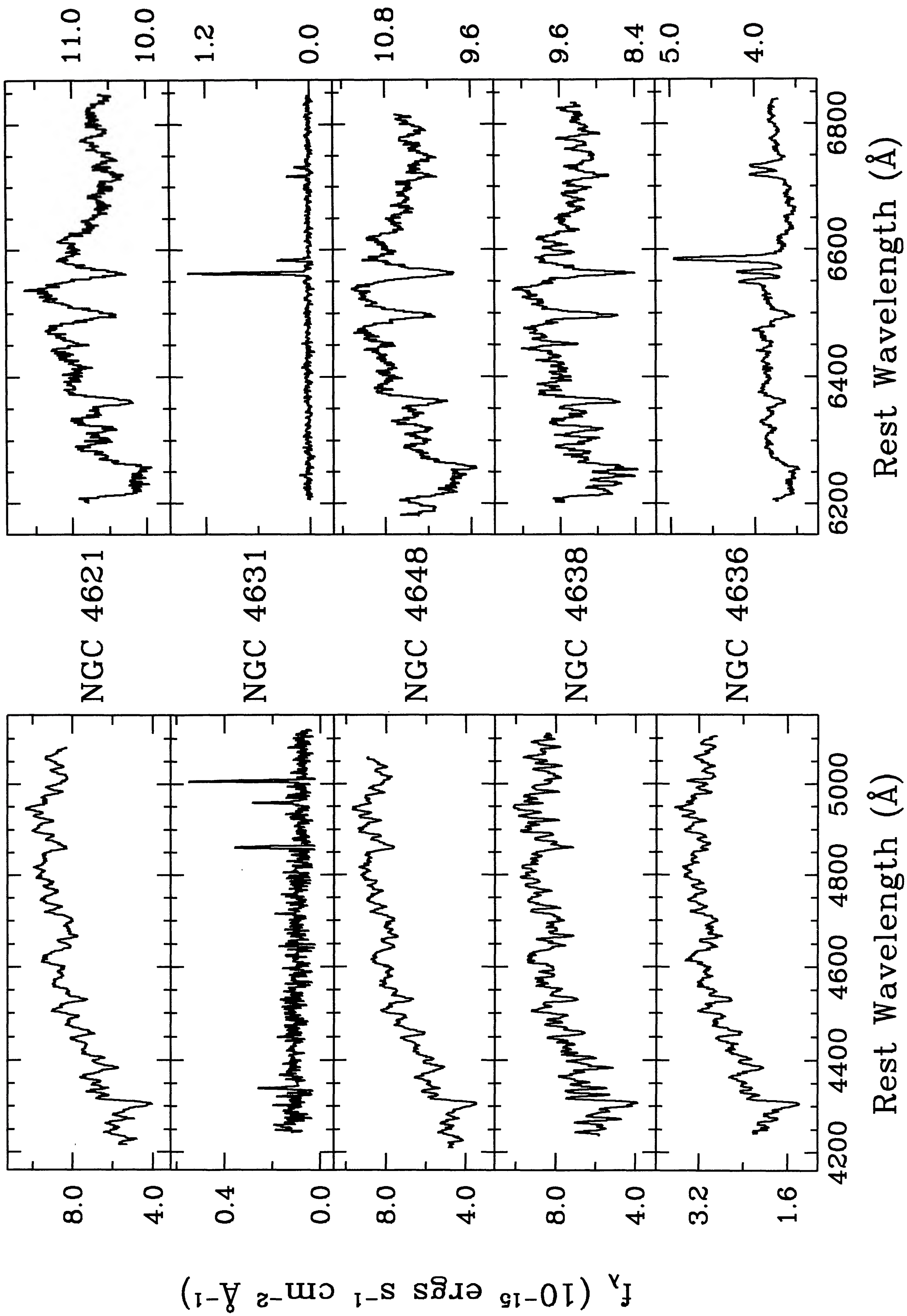

FIG. 73.—Same as Fig. 2

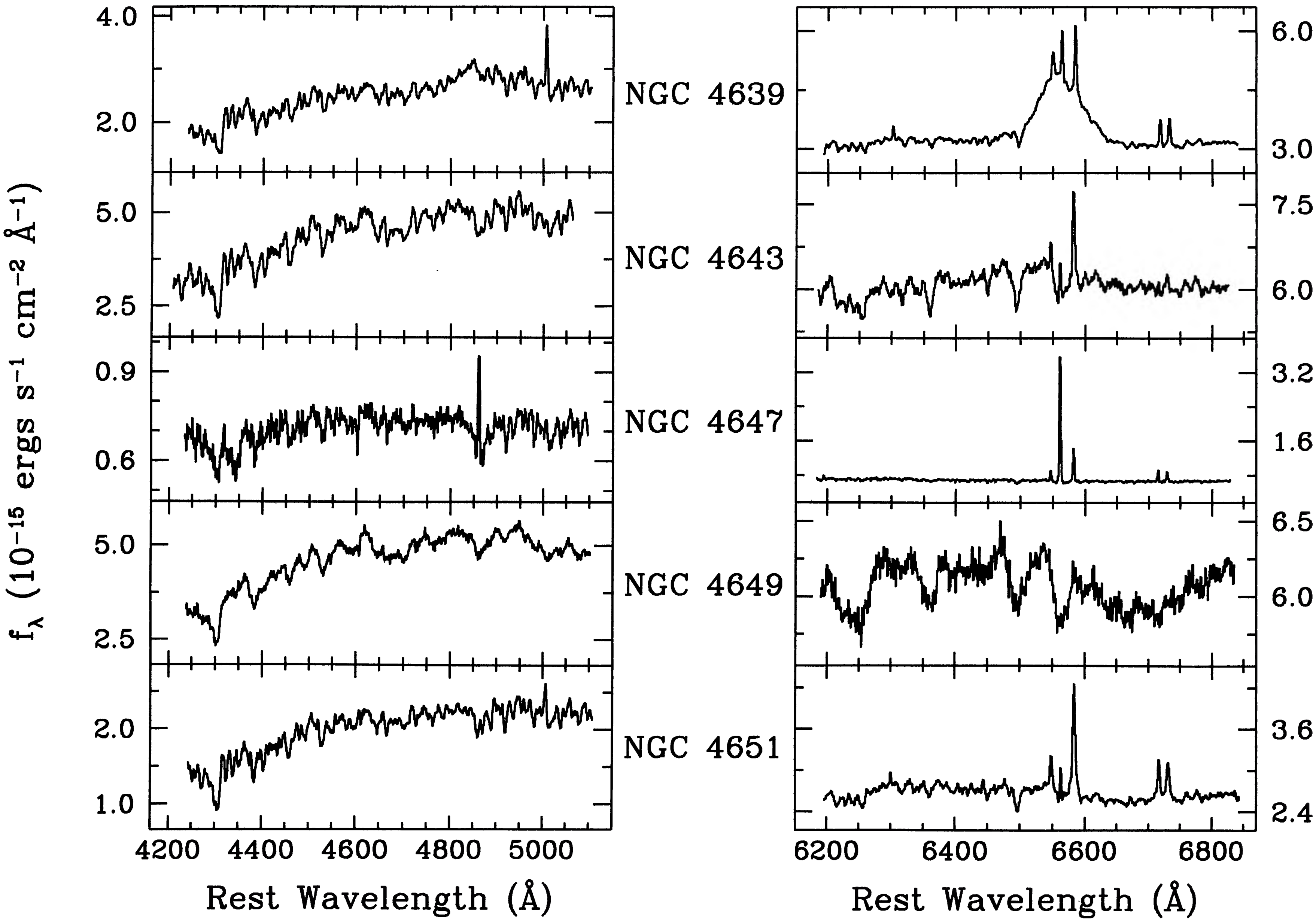

FIG. 74.—Same as Fig. 2

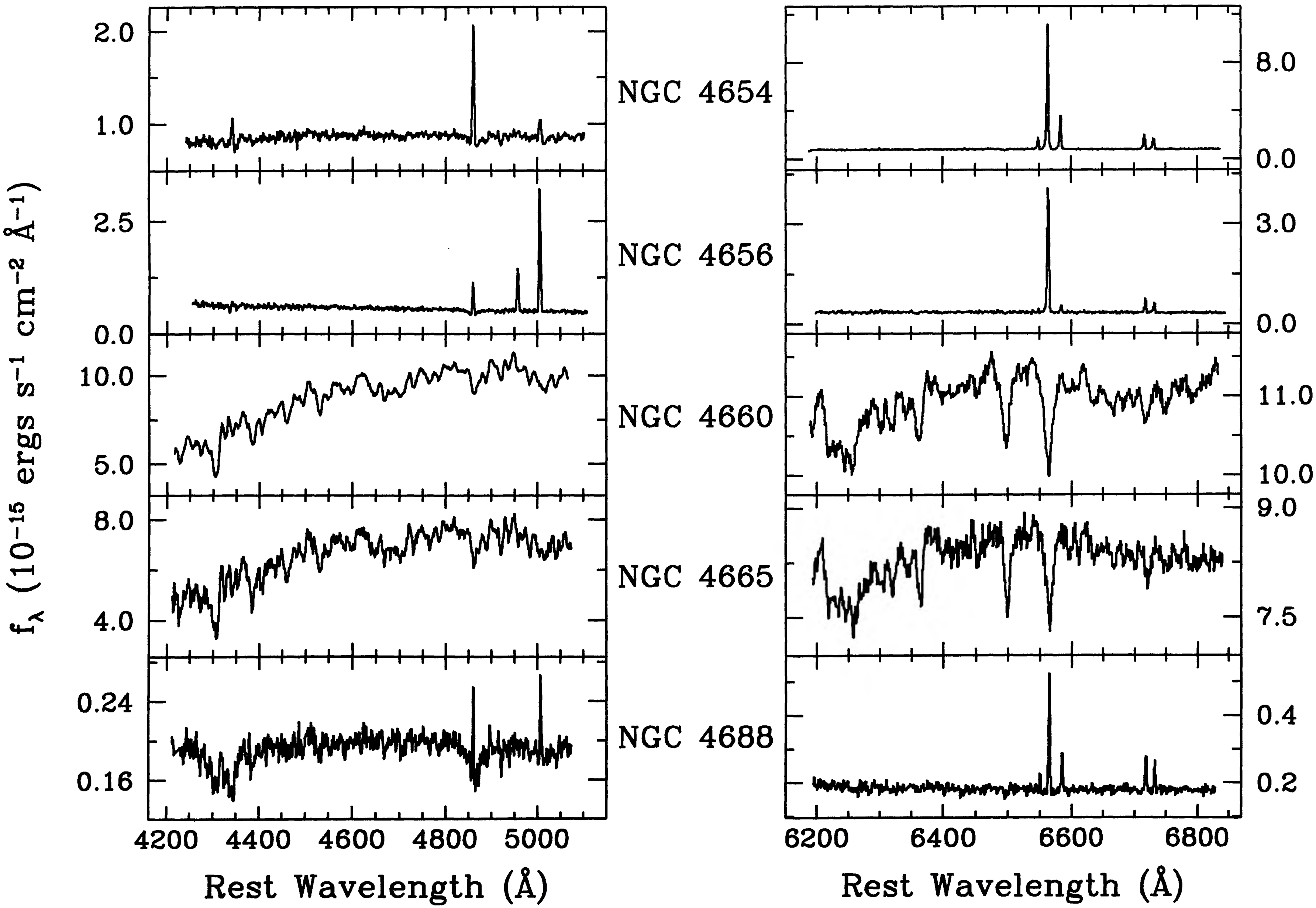

FIG. 75.—Same as Fig. 2

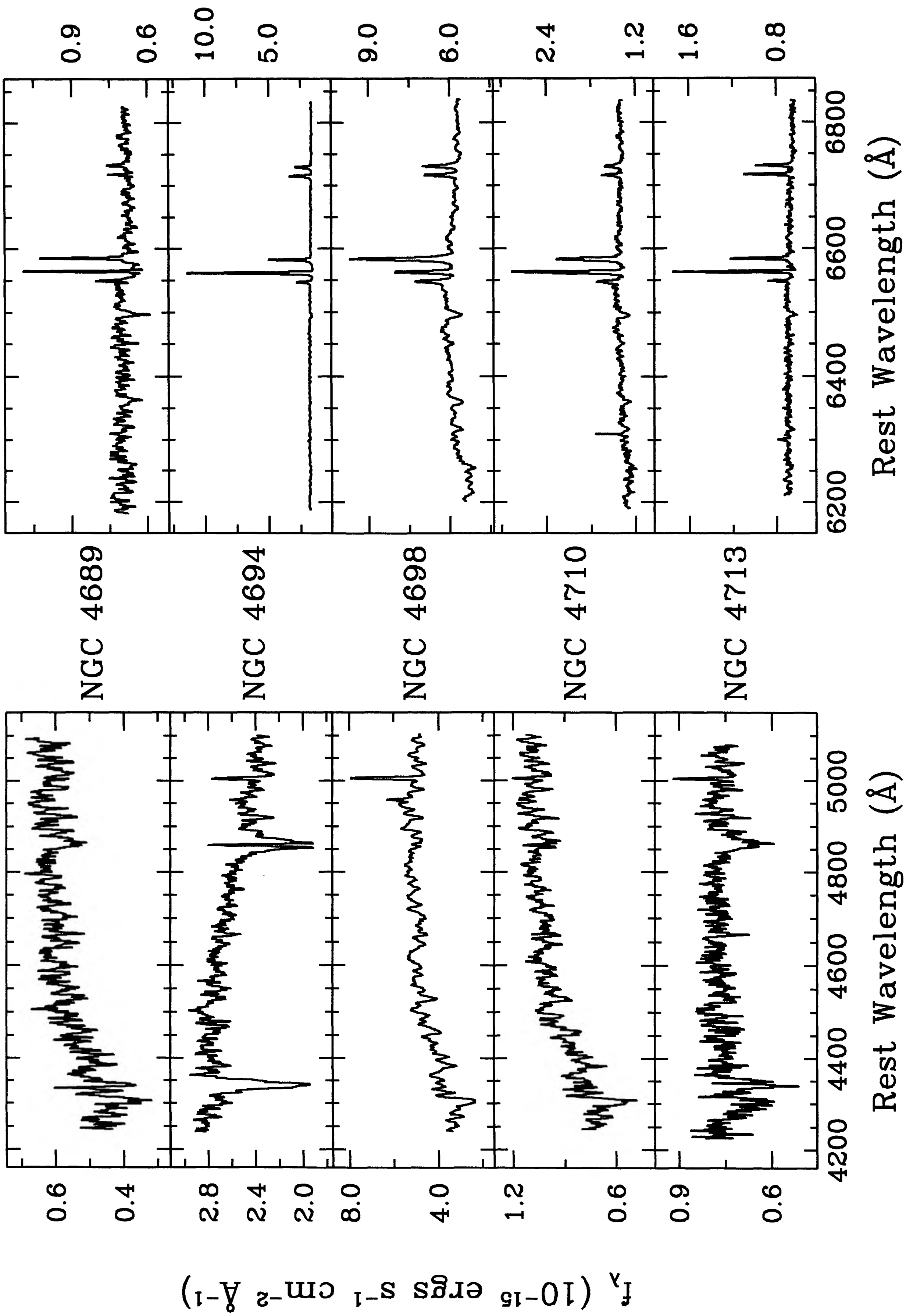

FIG. 76.—Same as Fig. 2

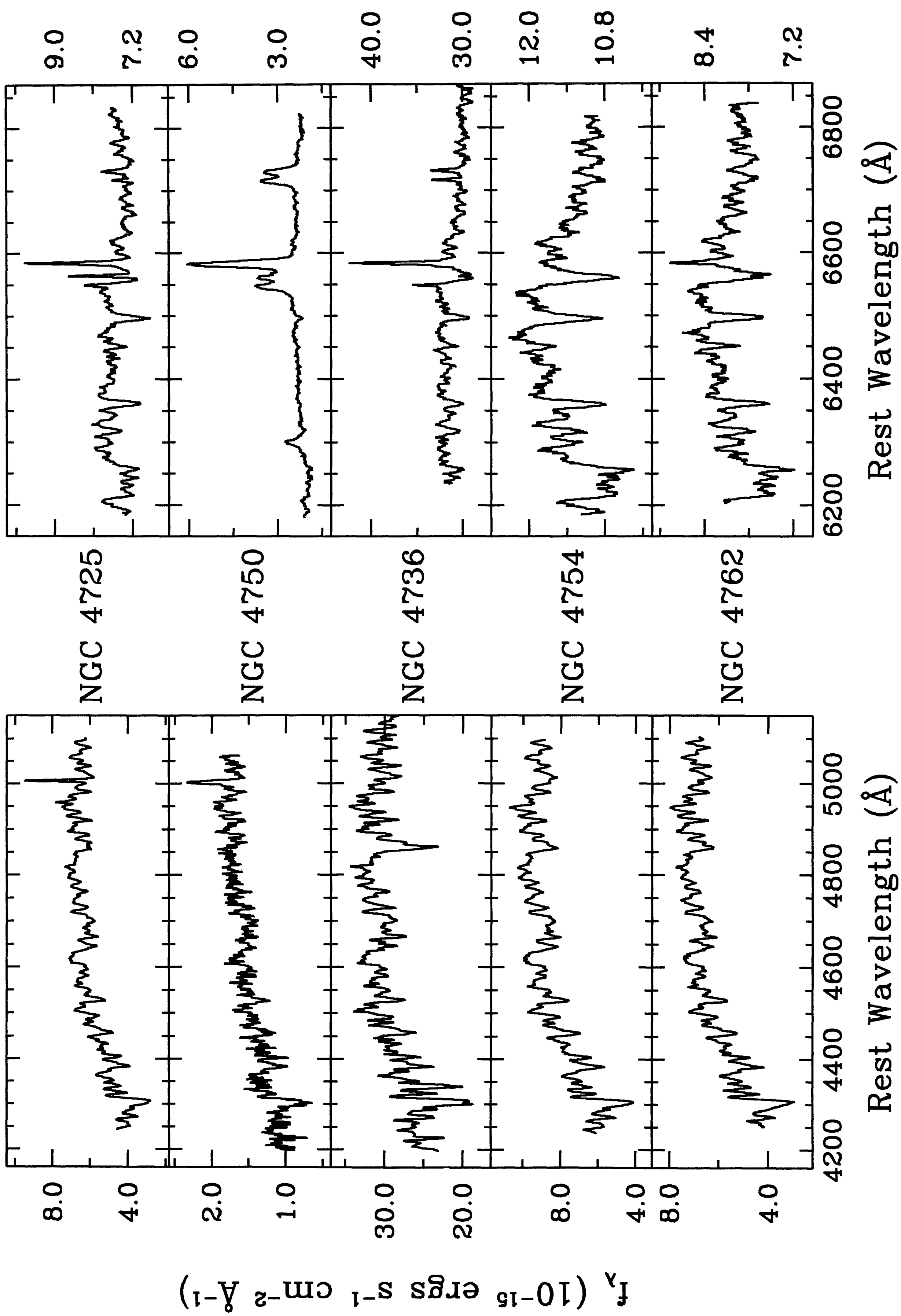

FIG. 77.—Same as Fig. 2

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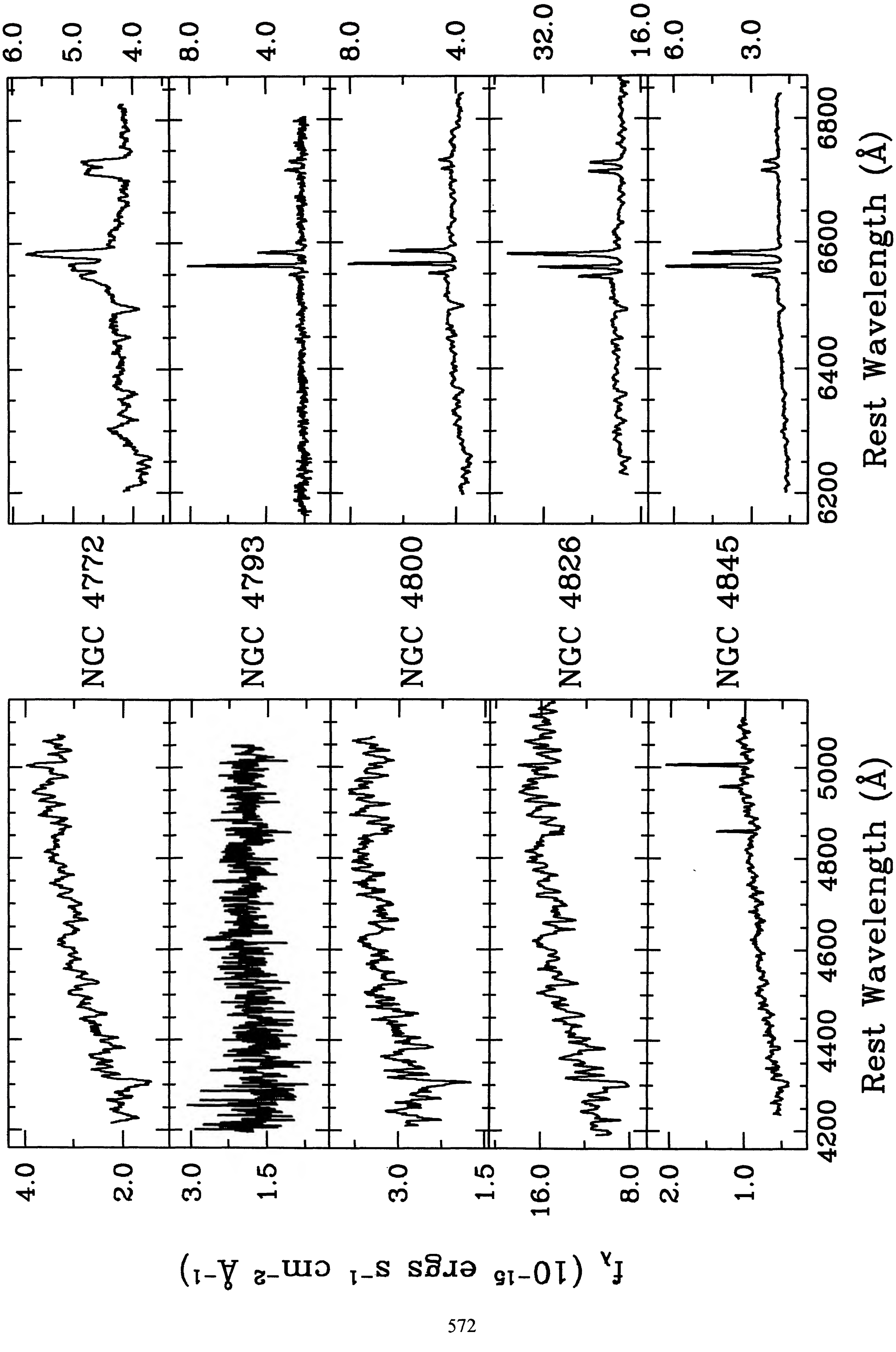


FIG. 78.—Same as Fig. 2

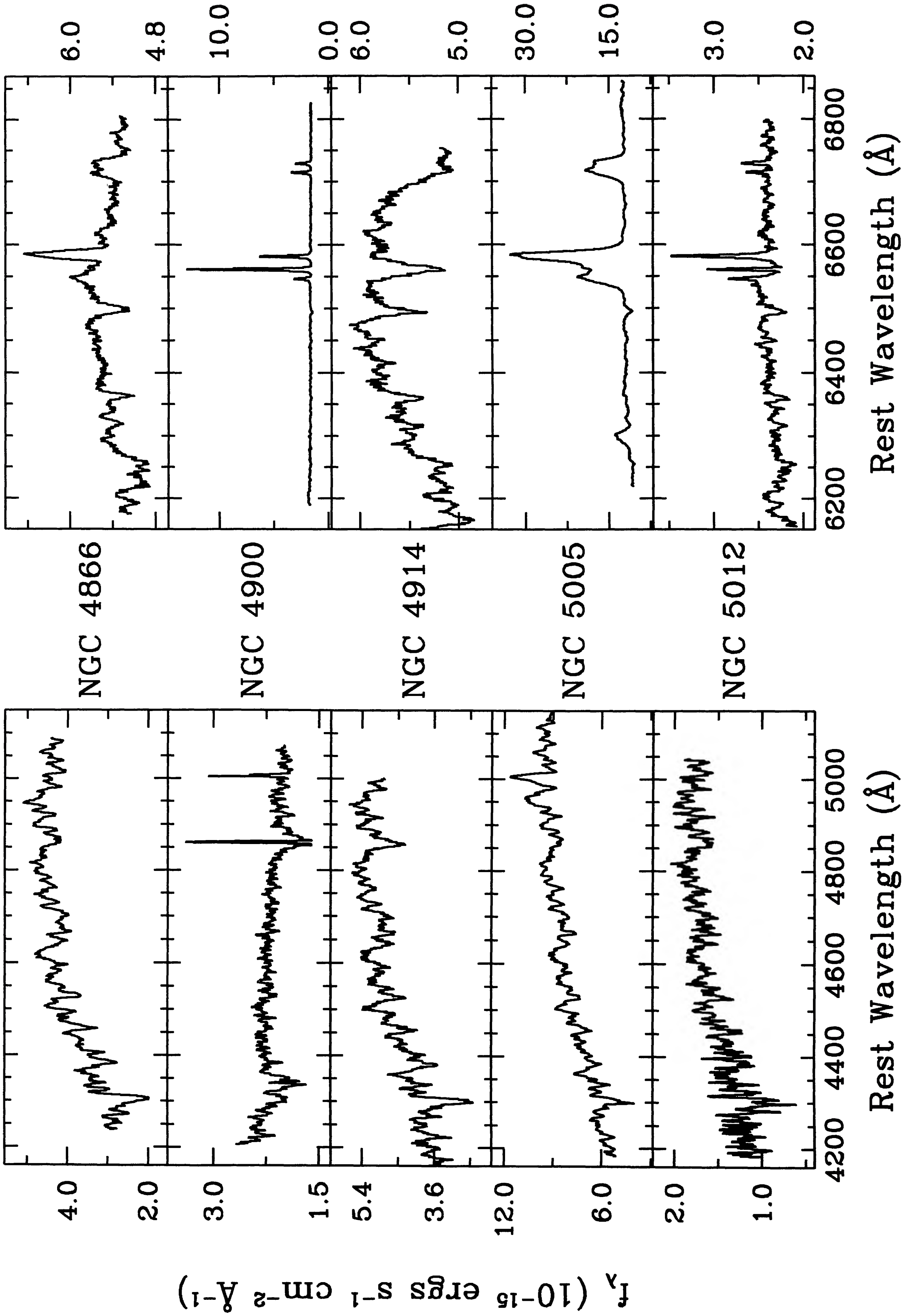


FIG. 79.—Same as Fig. 2

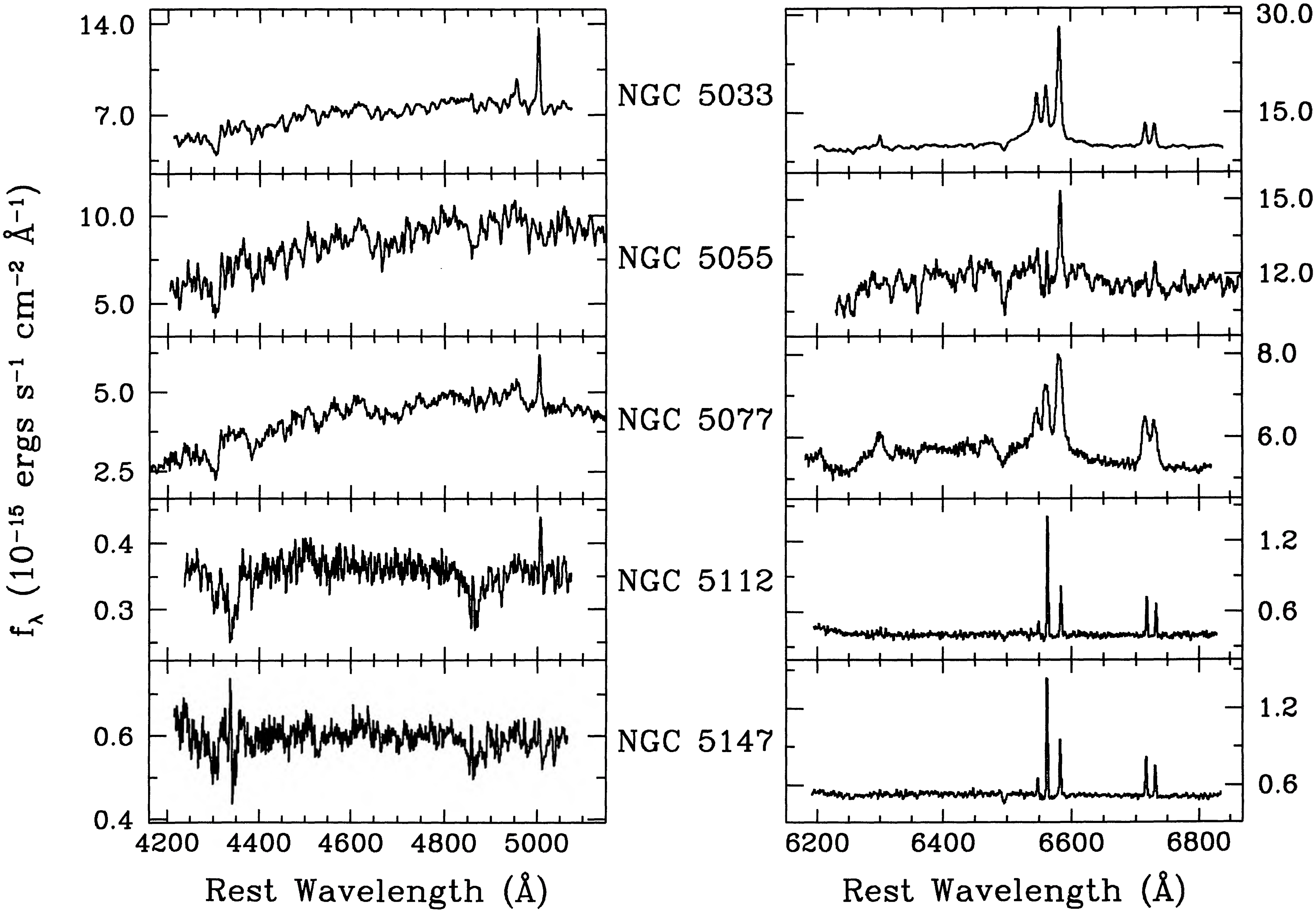


FIG. 80.—Same as Fig. 2

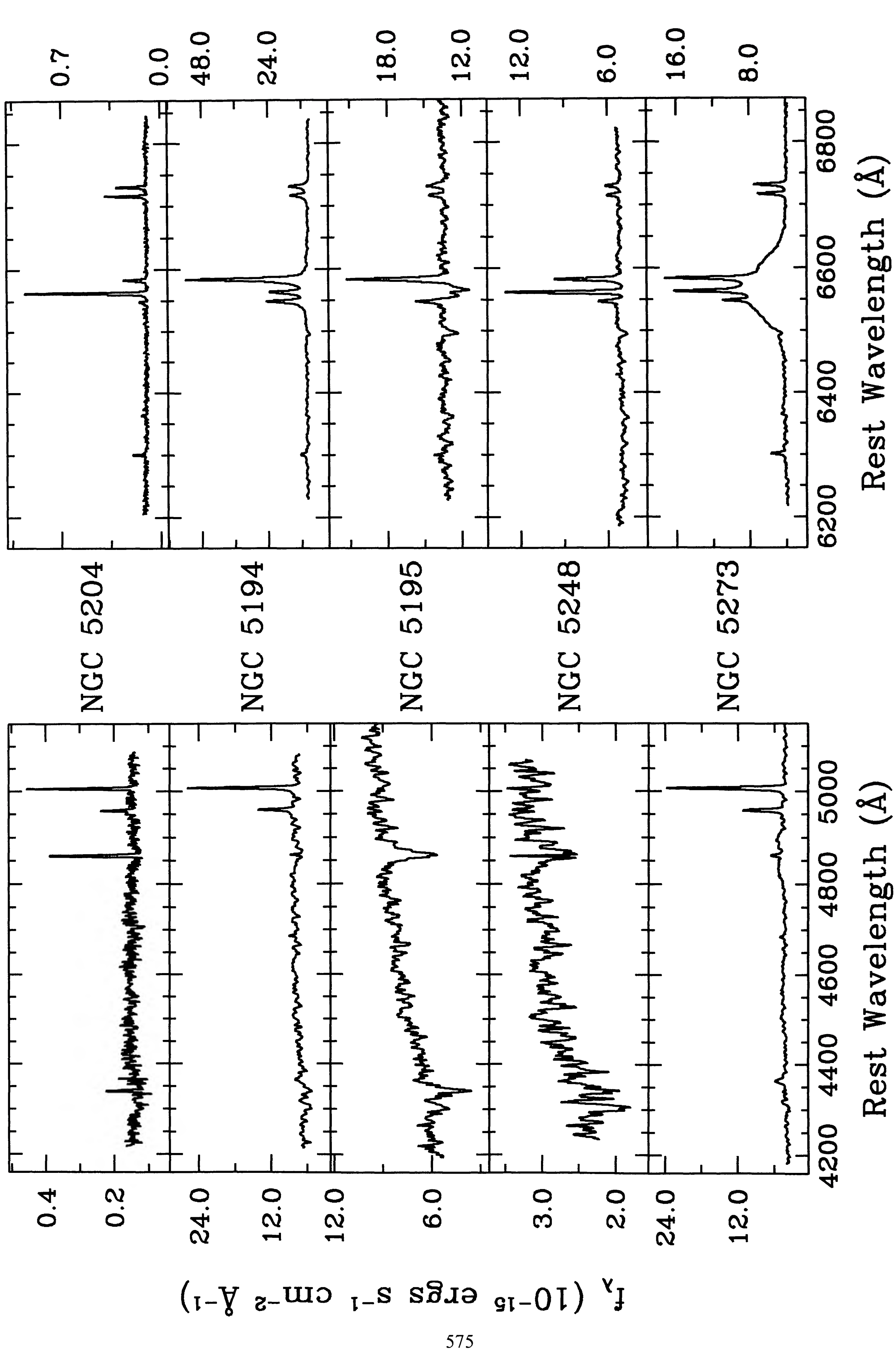


FIG. 81.—Same as Fig. 2

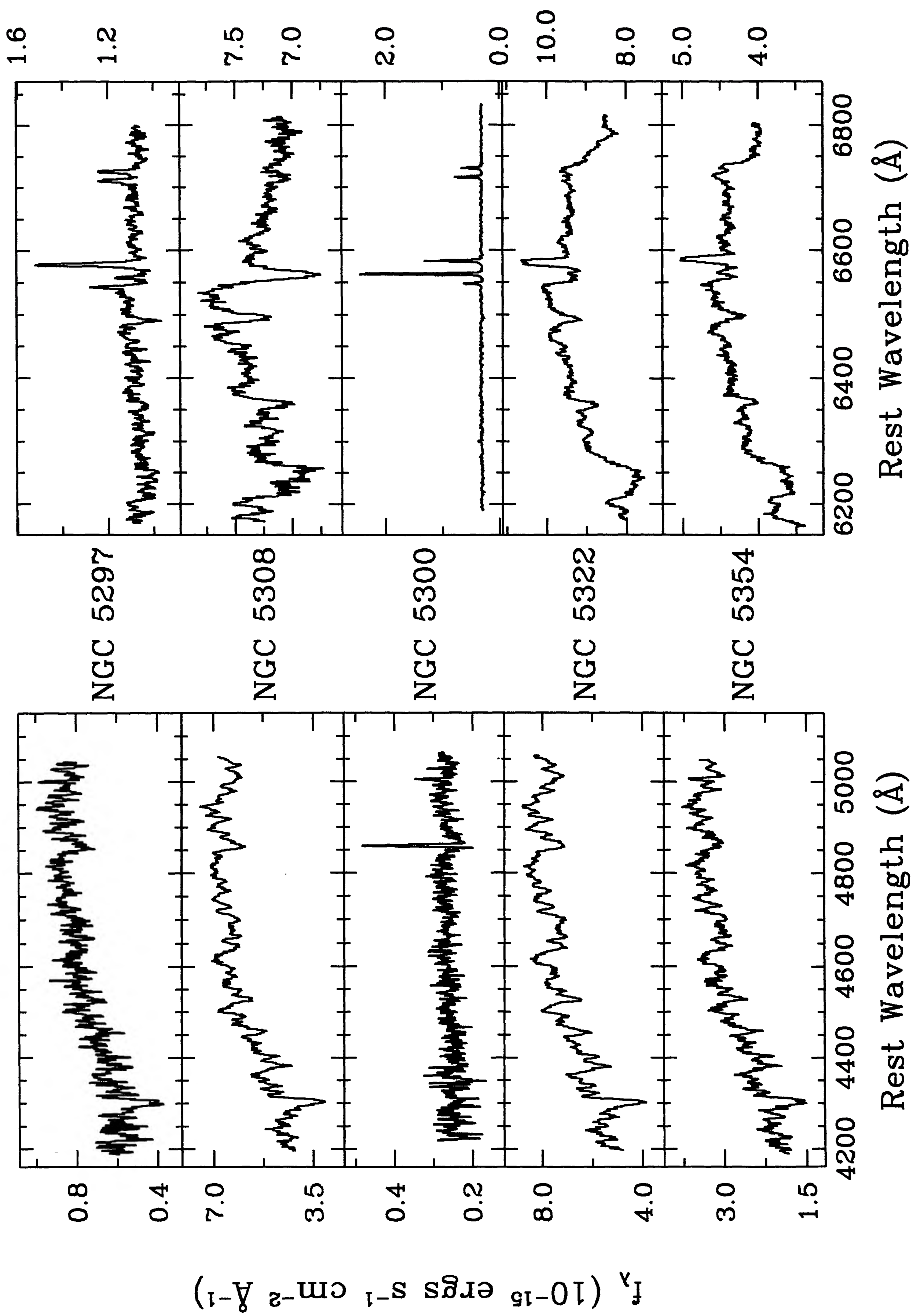


FIG. 82.—Same as Fig. 2

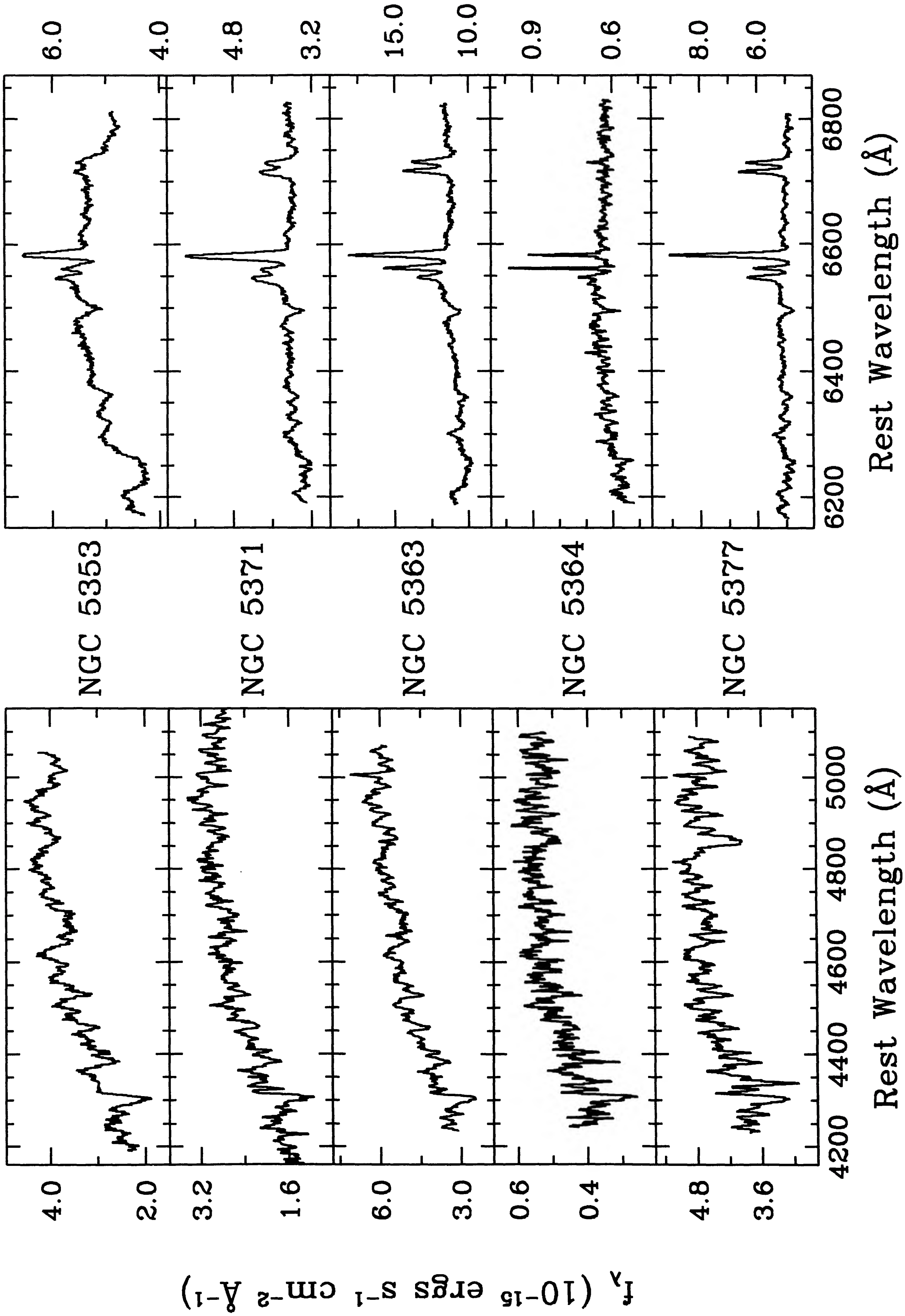


FIG. 83.—Same as Fig. 2

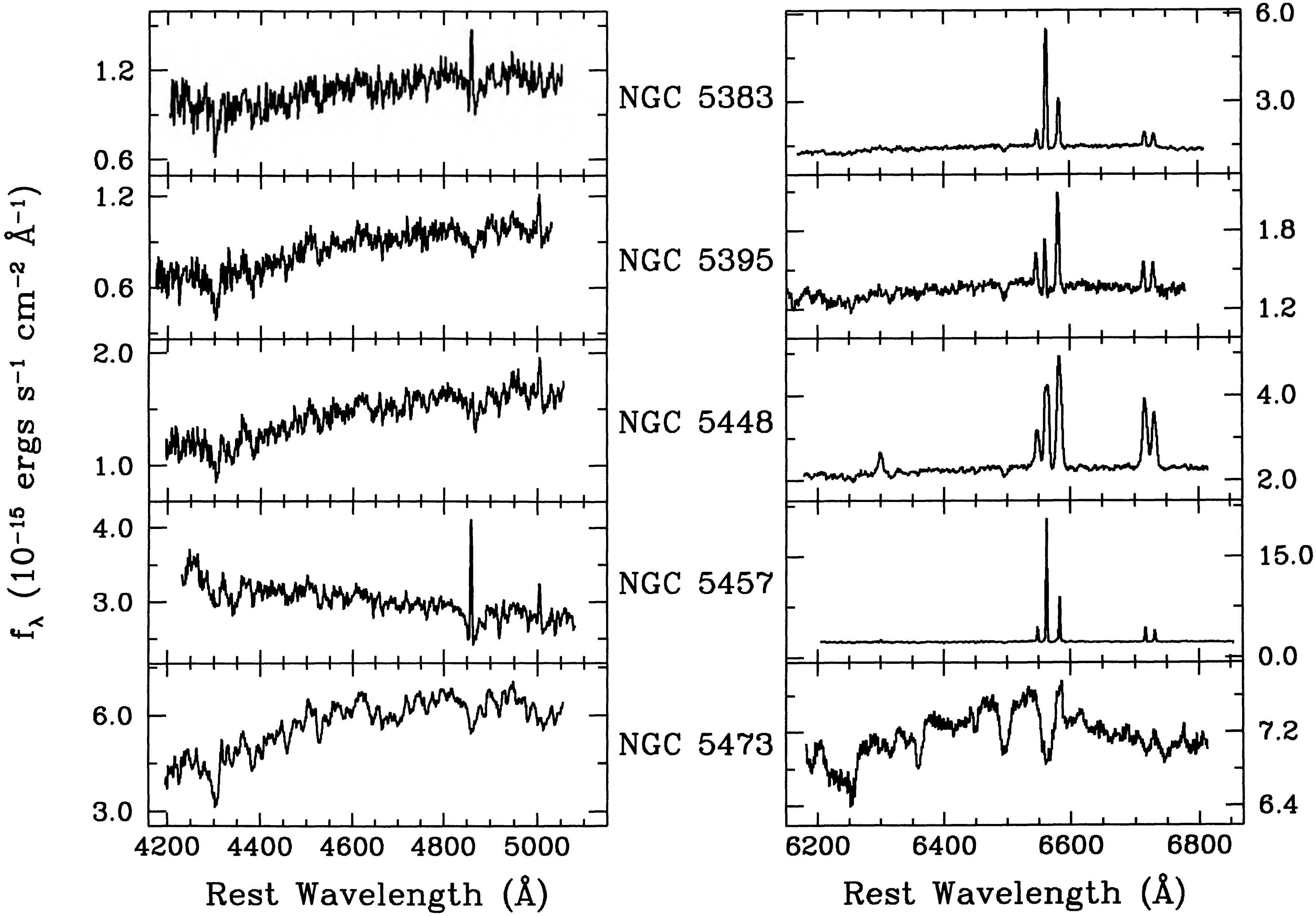


FIG. 84.—Same as Fig. 2

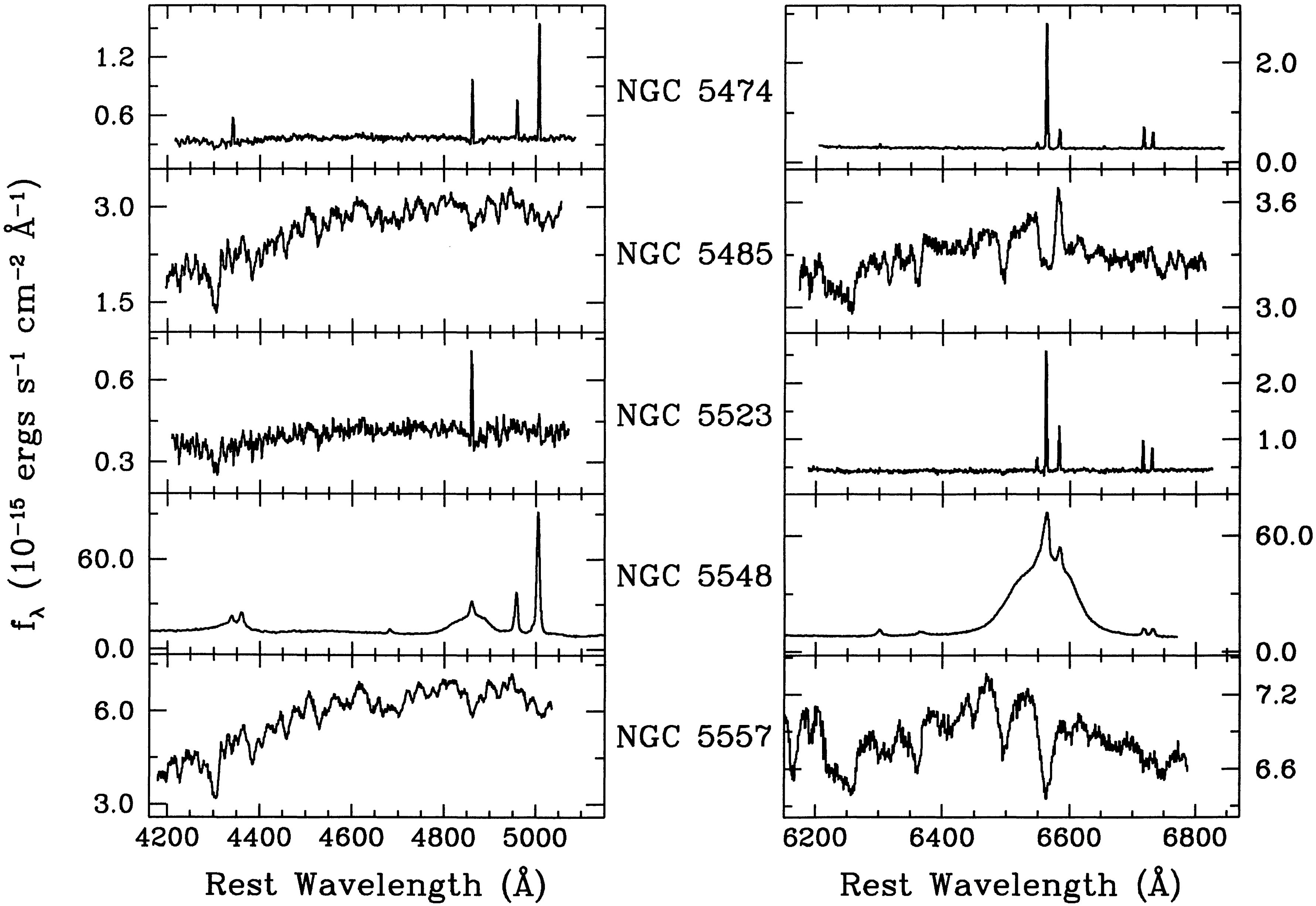


FIG. 85.—Same as Fig. 2

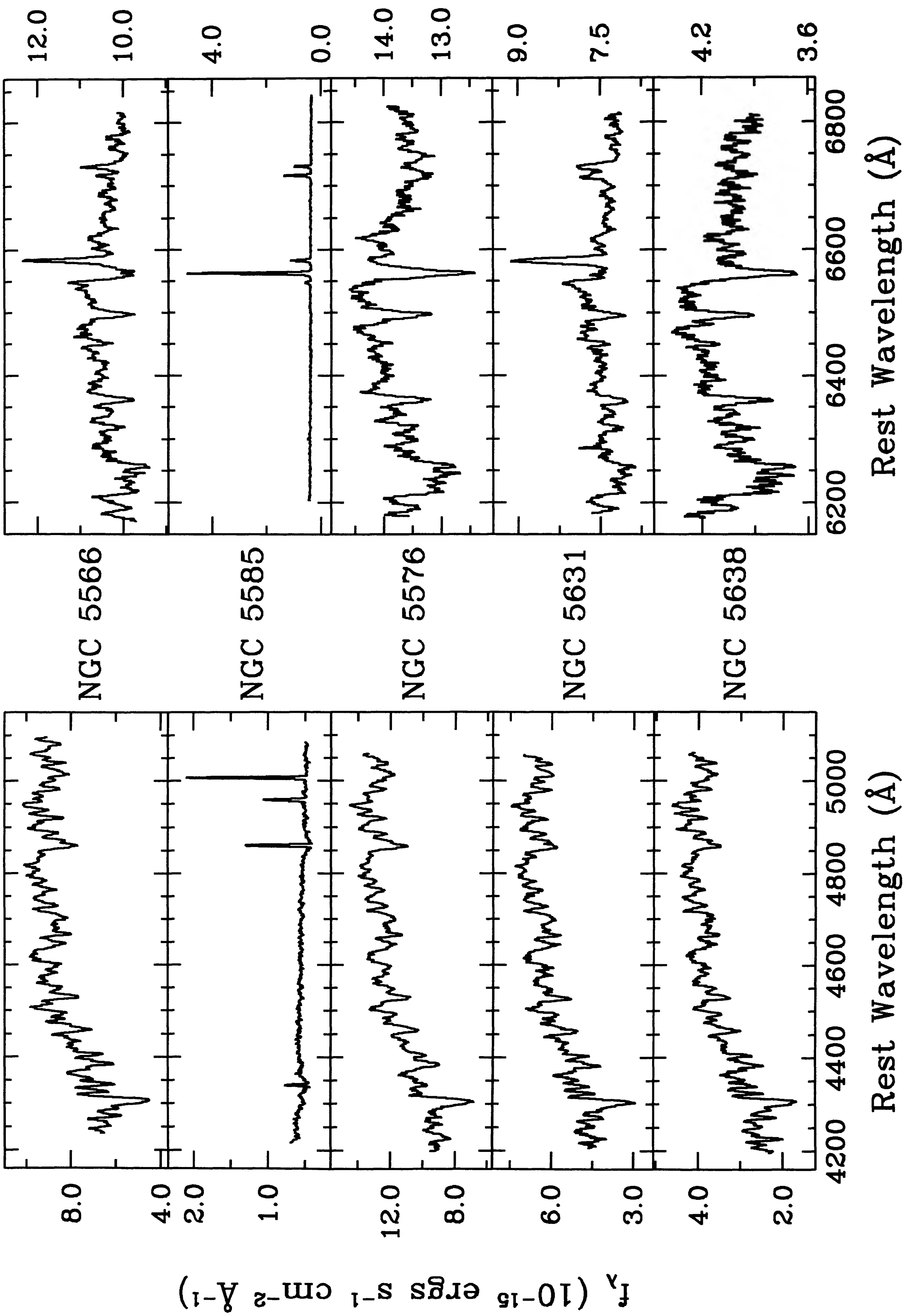
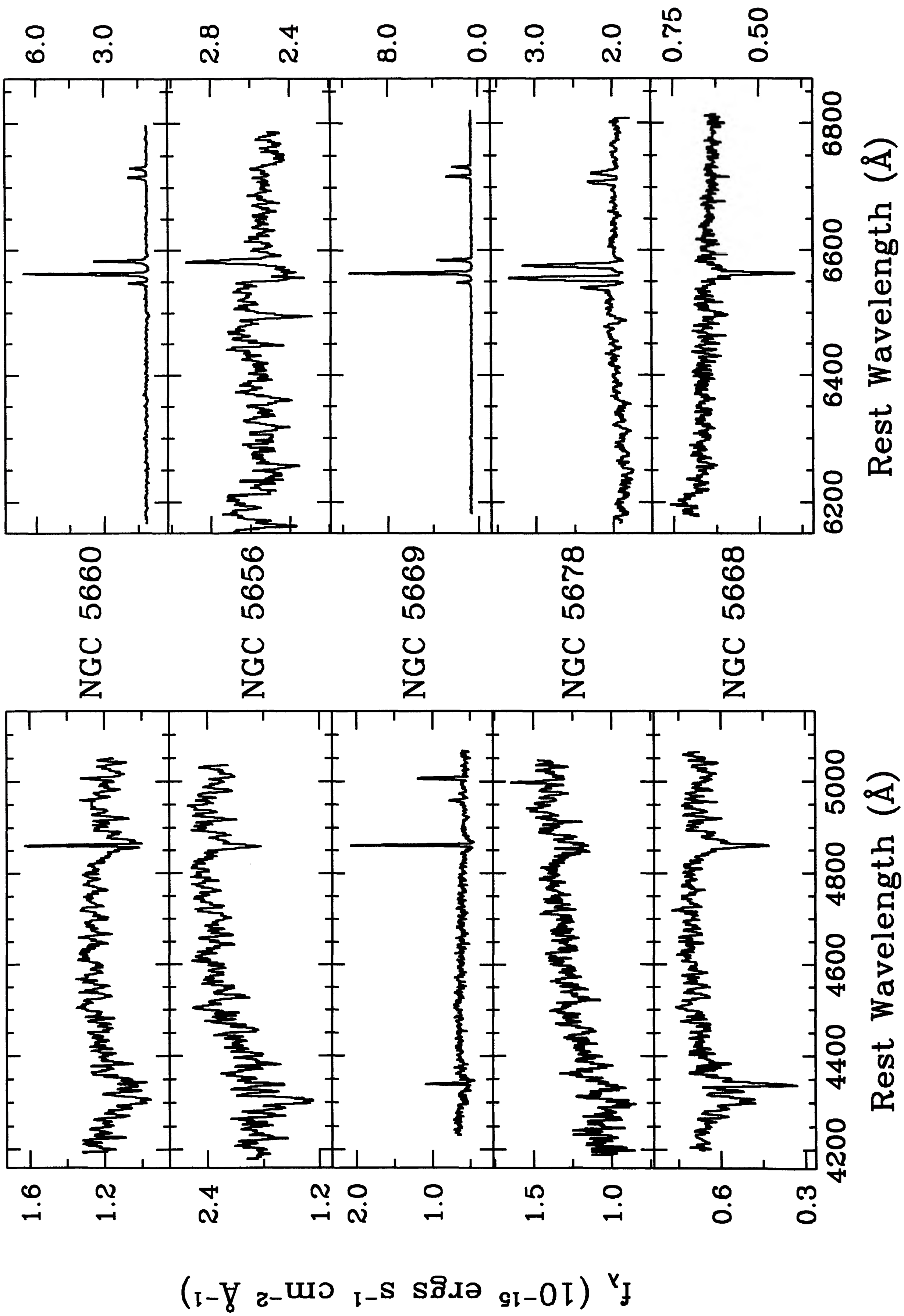


FIG. 86.—Same as Fig. 2



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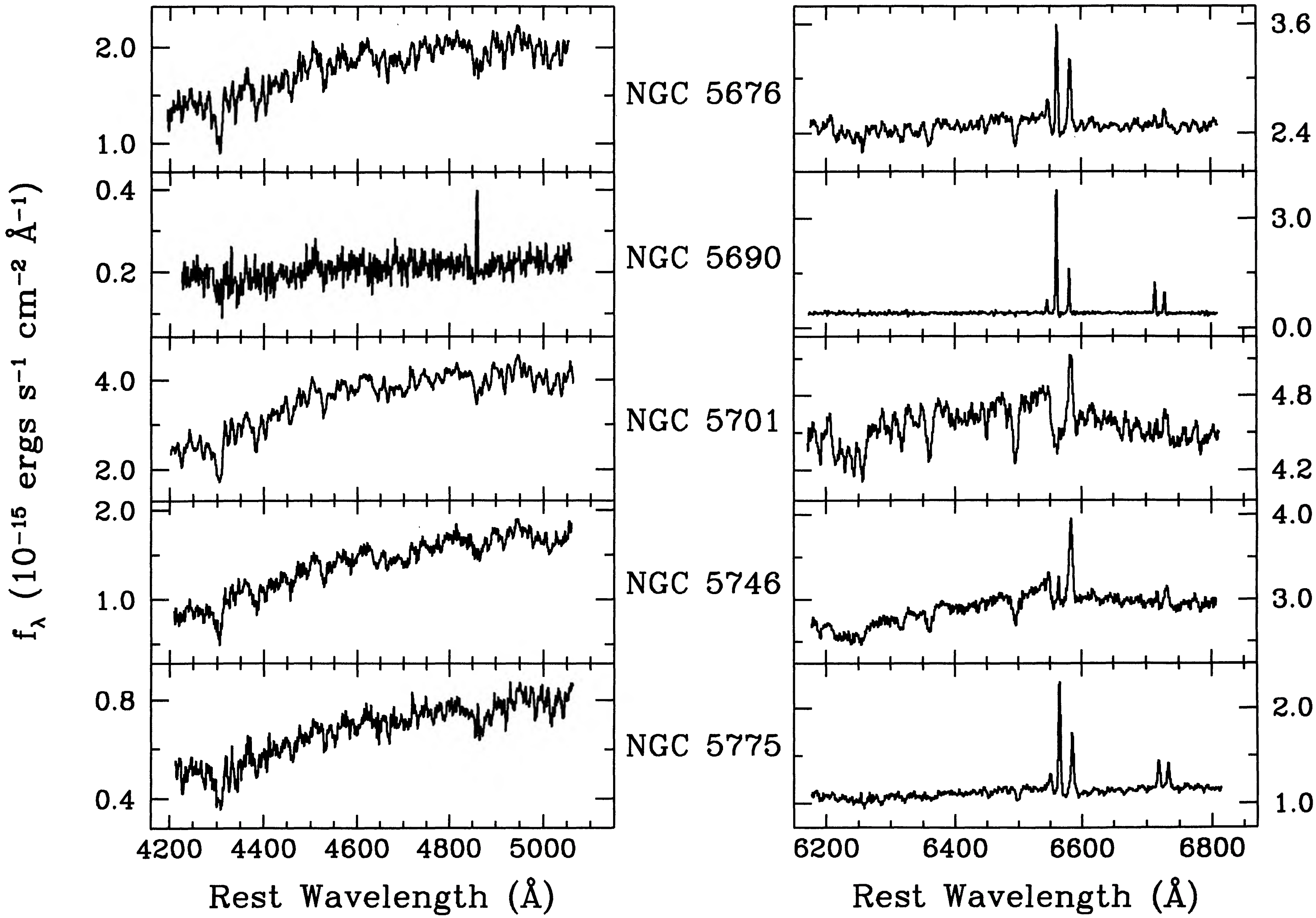

FIG. 88.—Same as Fig. 2

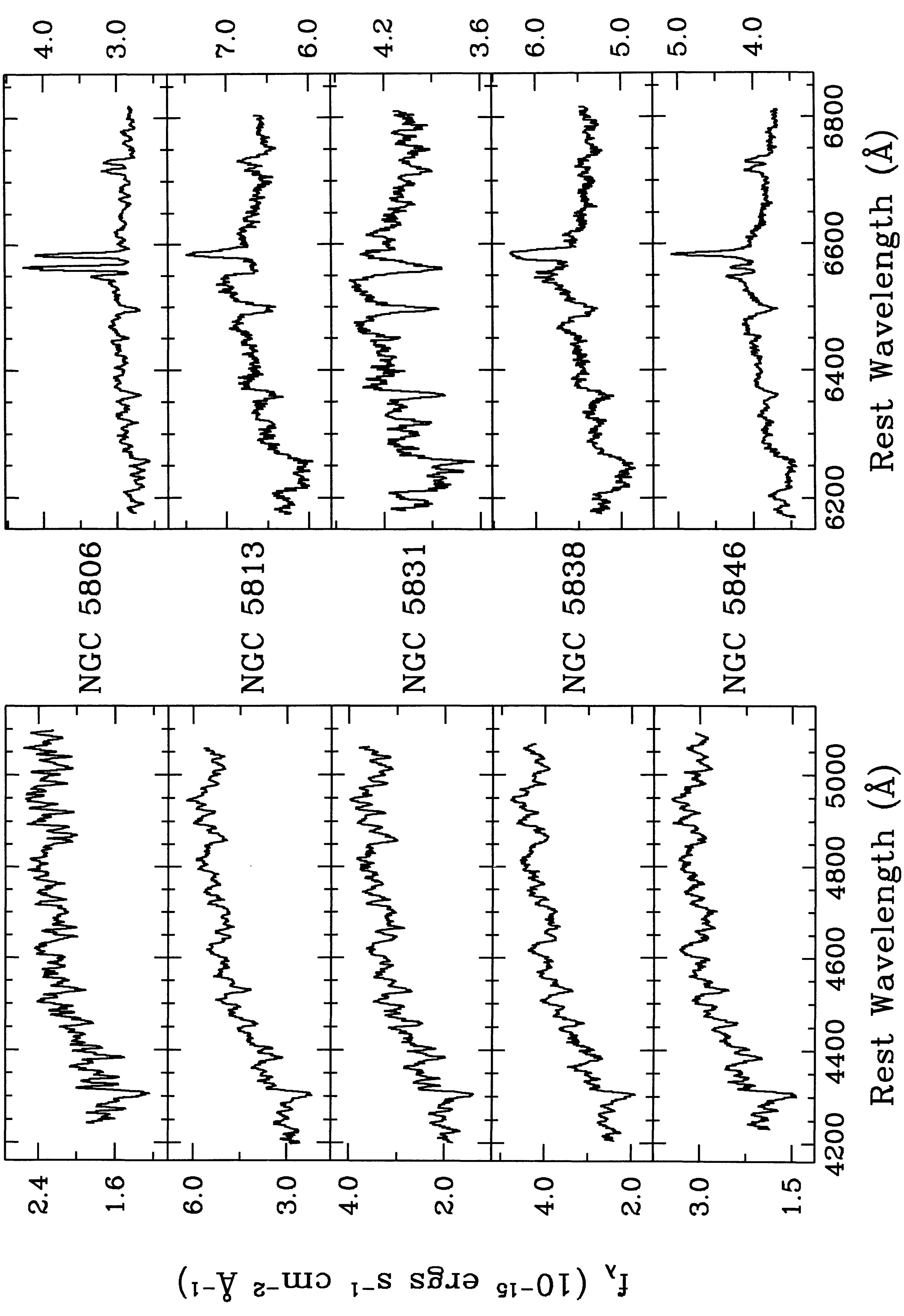

FIG. 89.—Same as Fig. 2

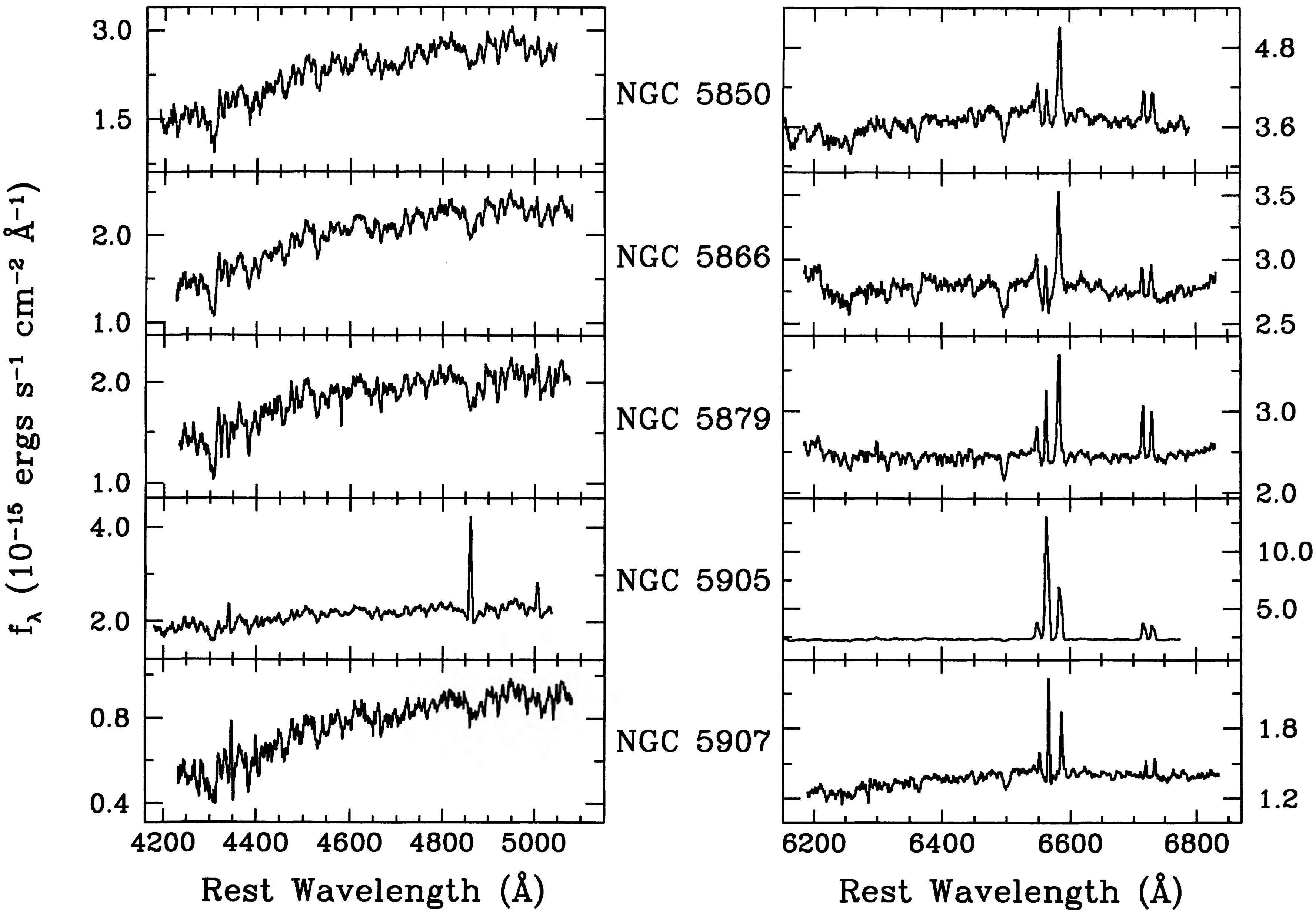

FIG. 90.—Same as Fig. 2

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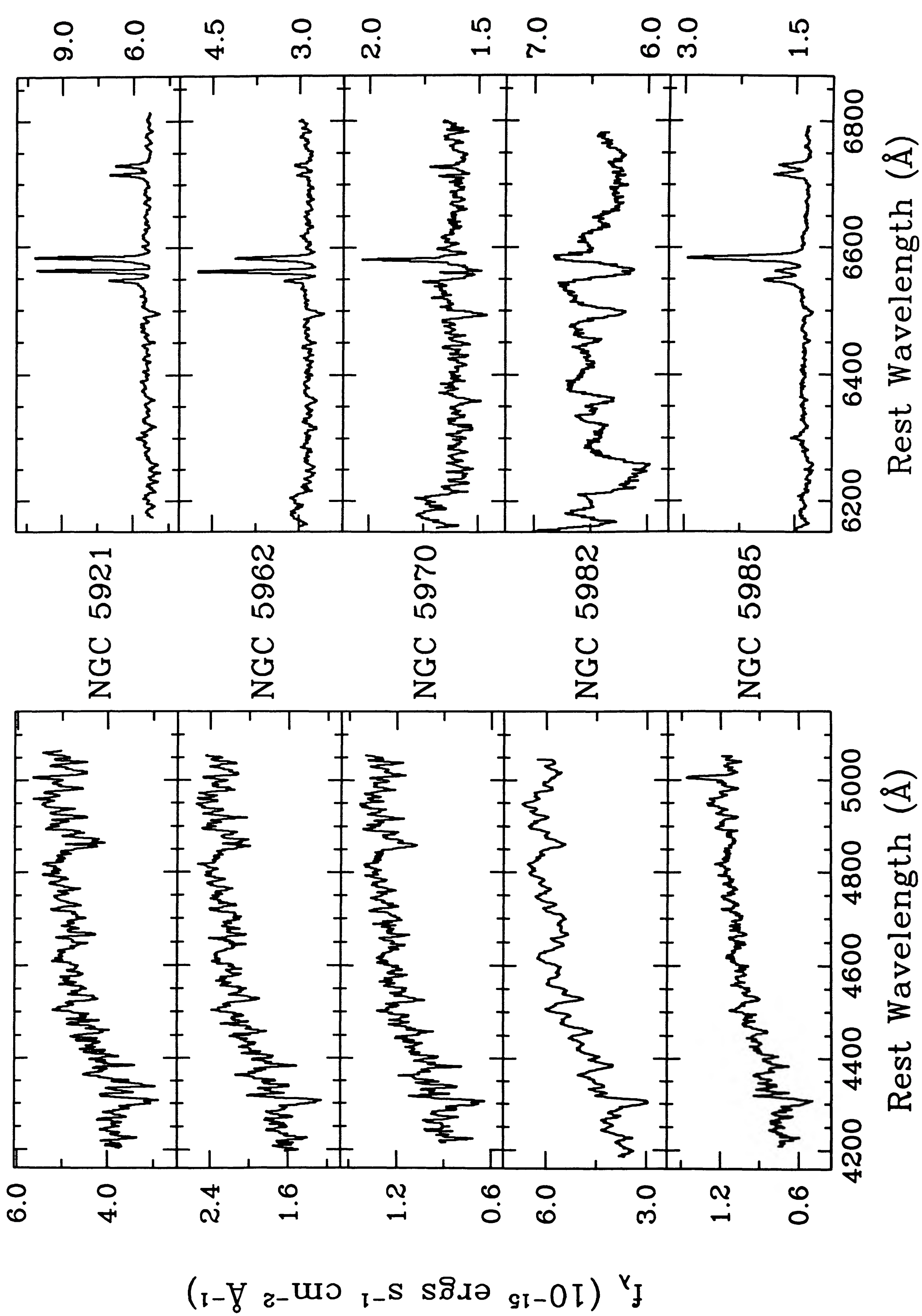

FIG. 91.—Same as Fig. 2

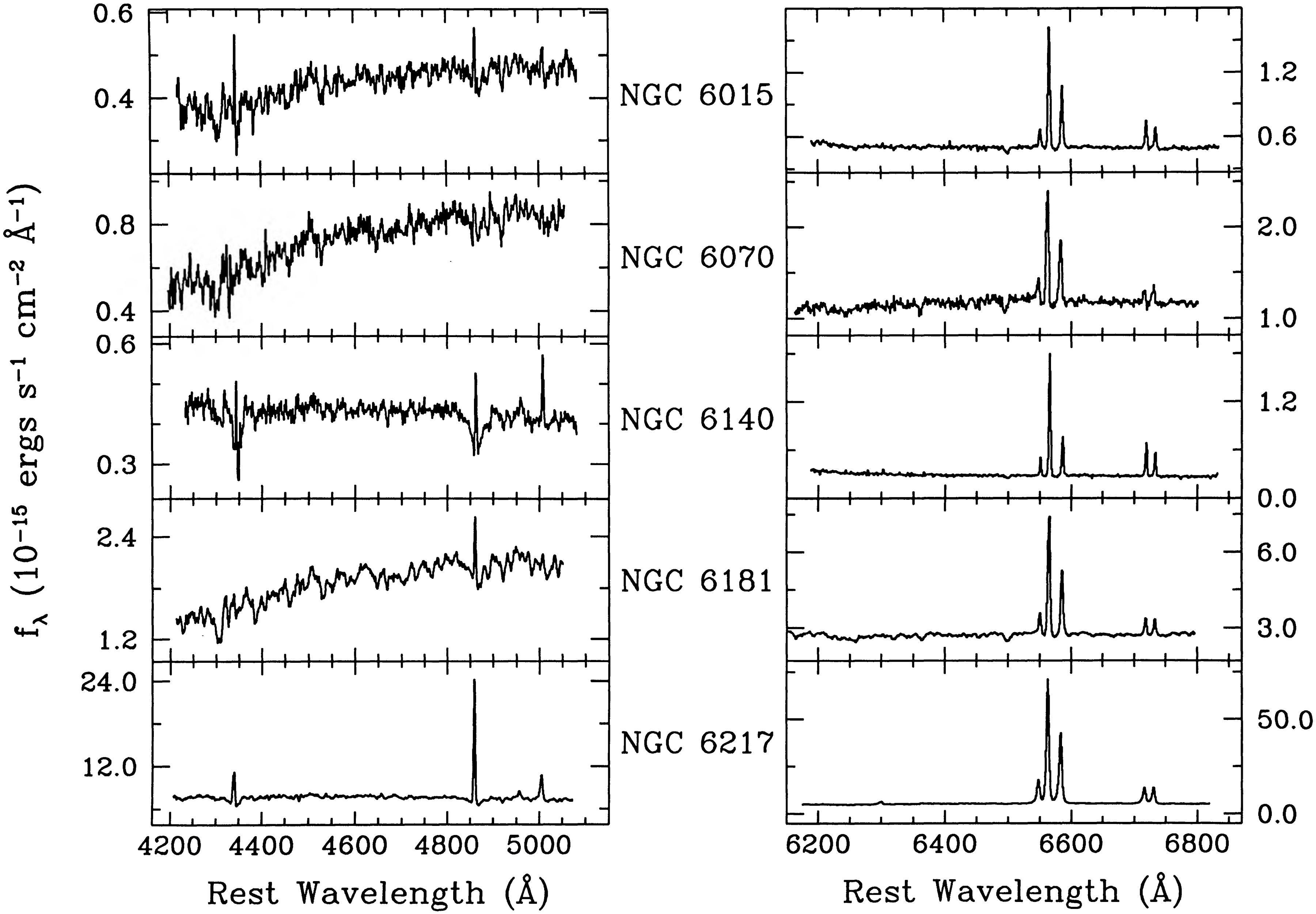

FIG. 92.—Same as Fig. 2

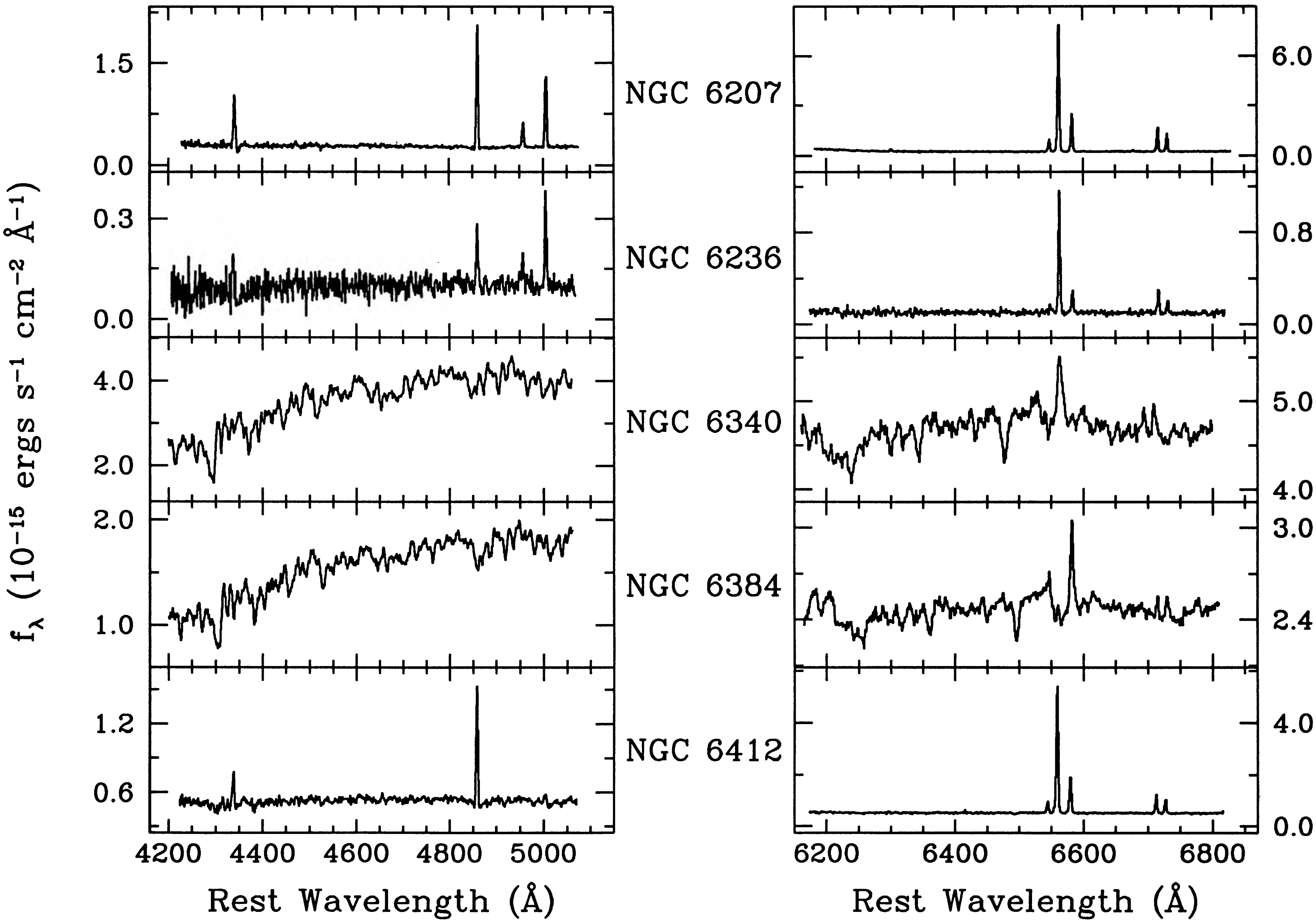

FIG. 93.—Same as Fig. 2

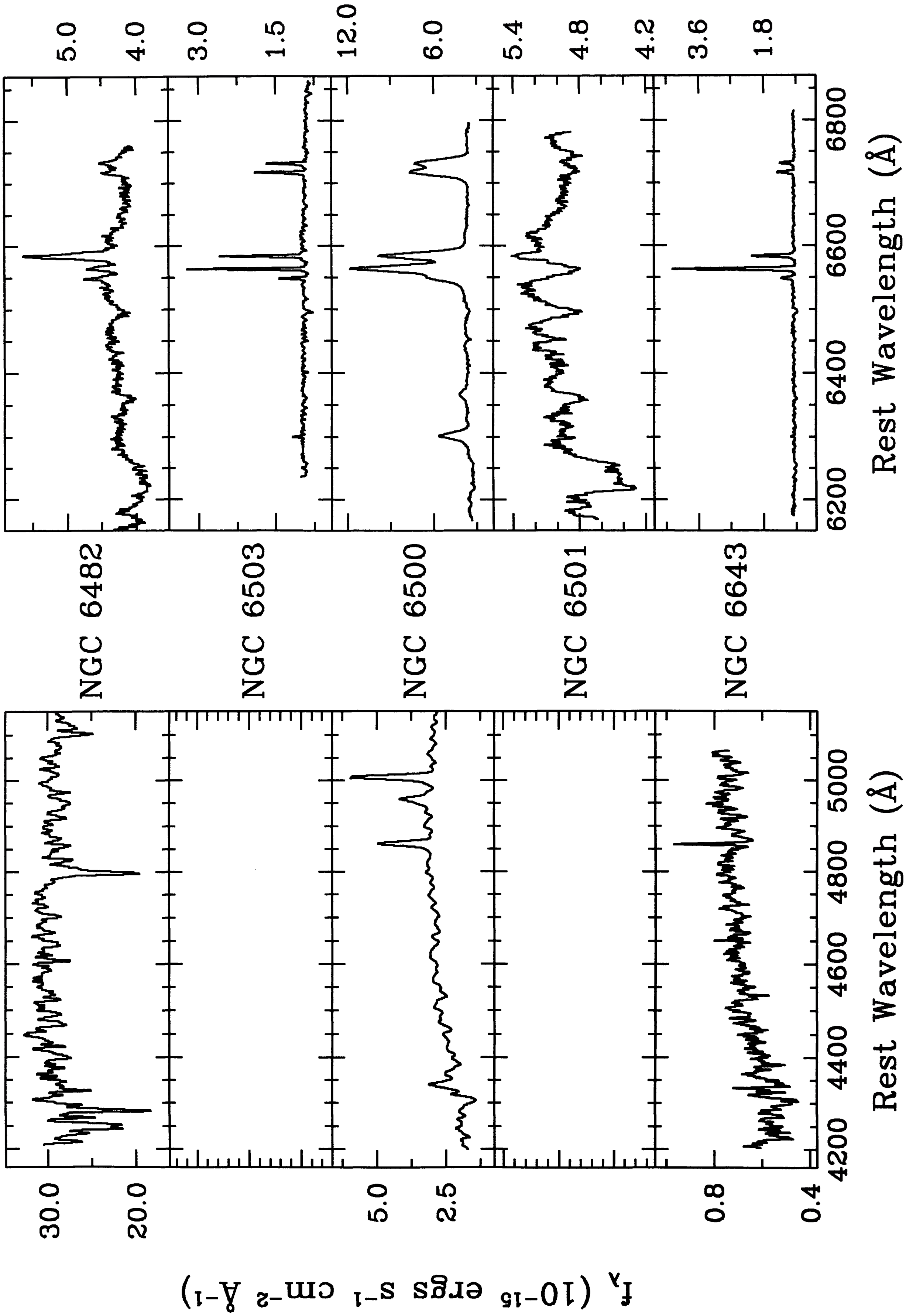

FIG. 94.—Same as Fig. 2

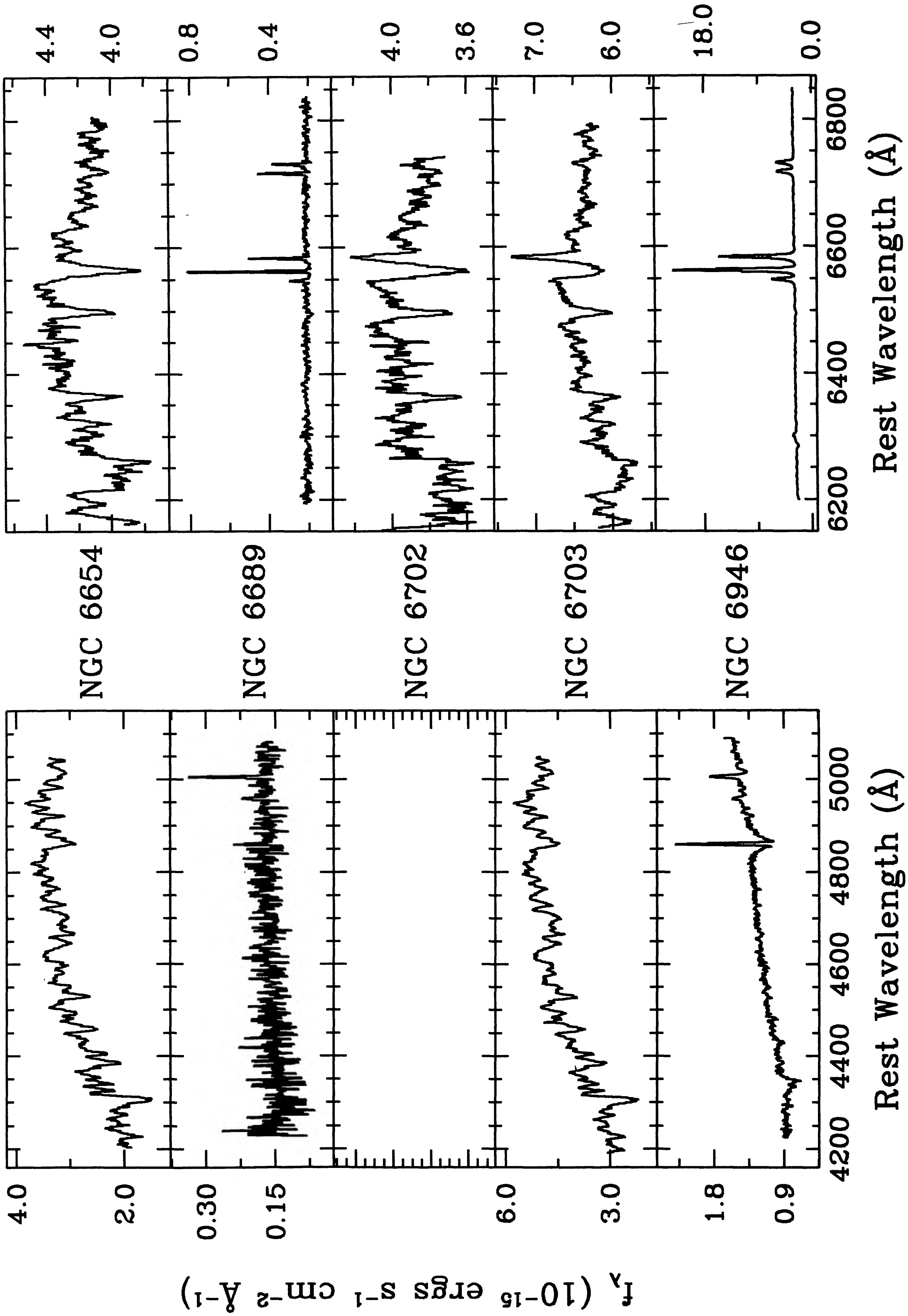

FIG. 95.—Same as Fig. 2

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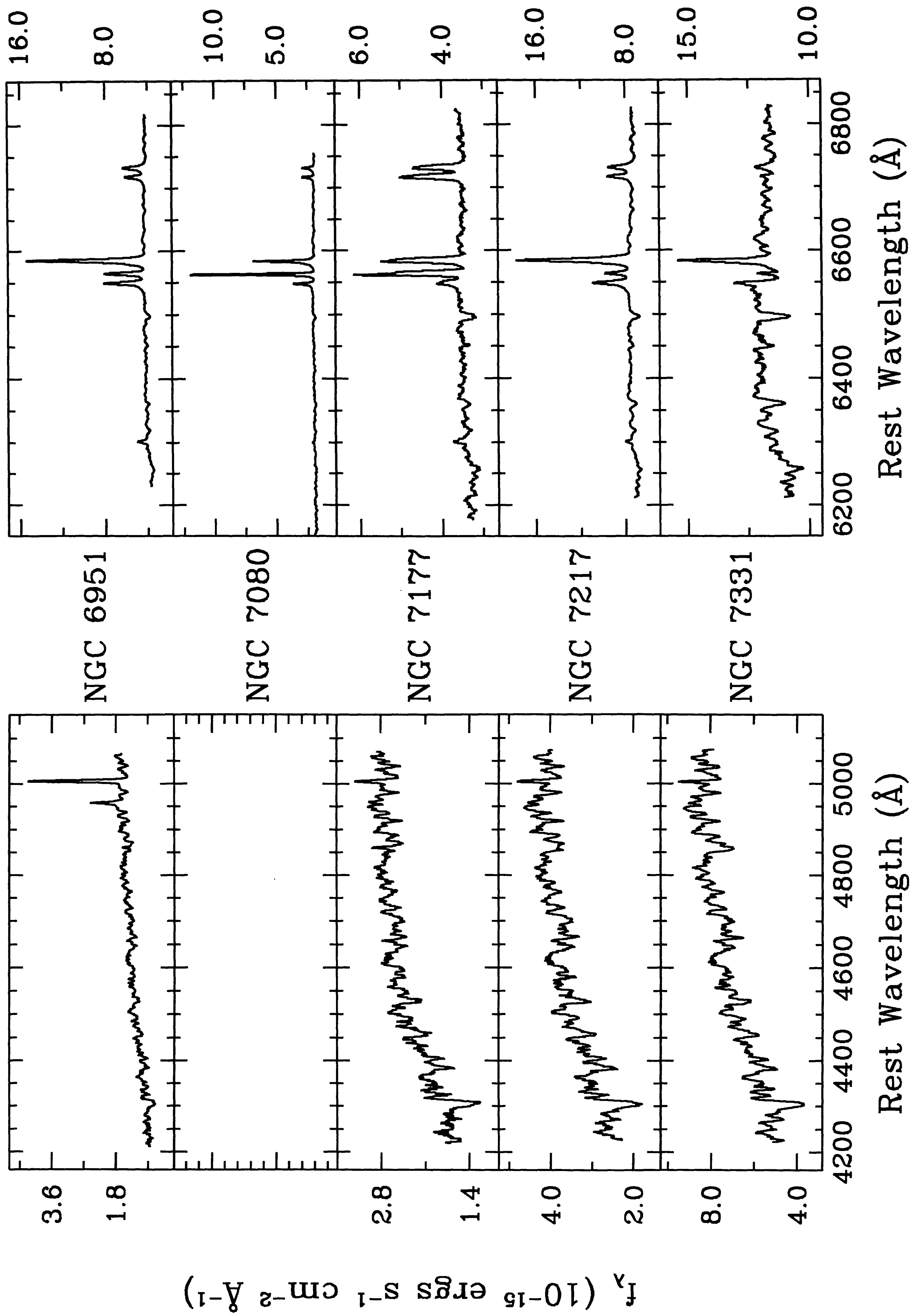

FIG. 96.—Same as Fig. 2

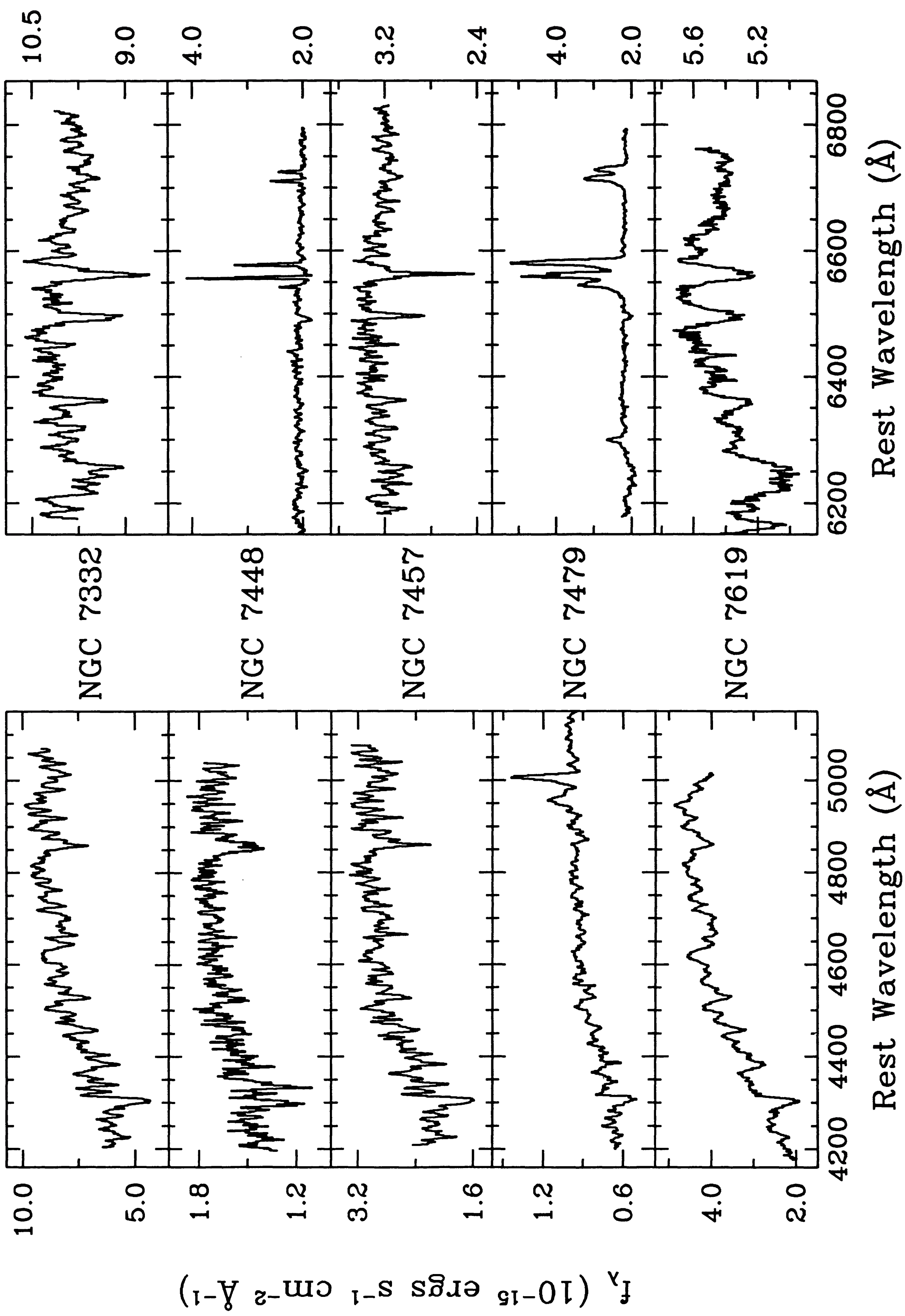

FIG. 97.—Same as Fig. 2

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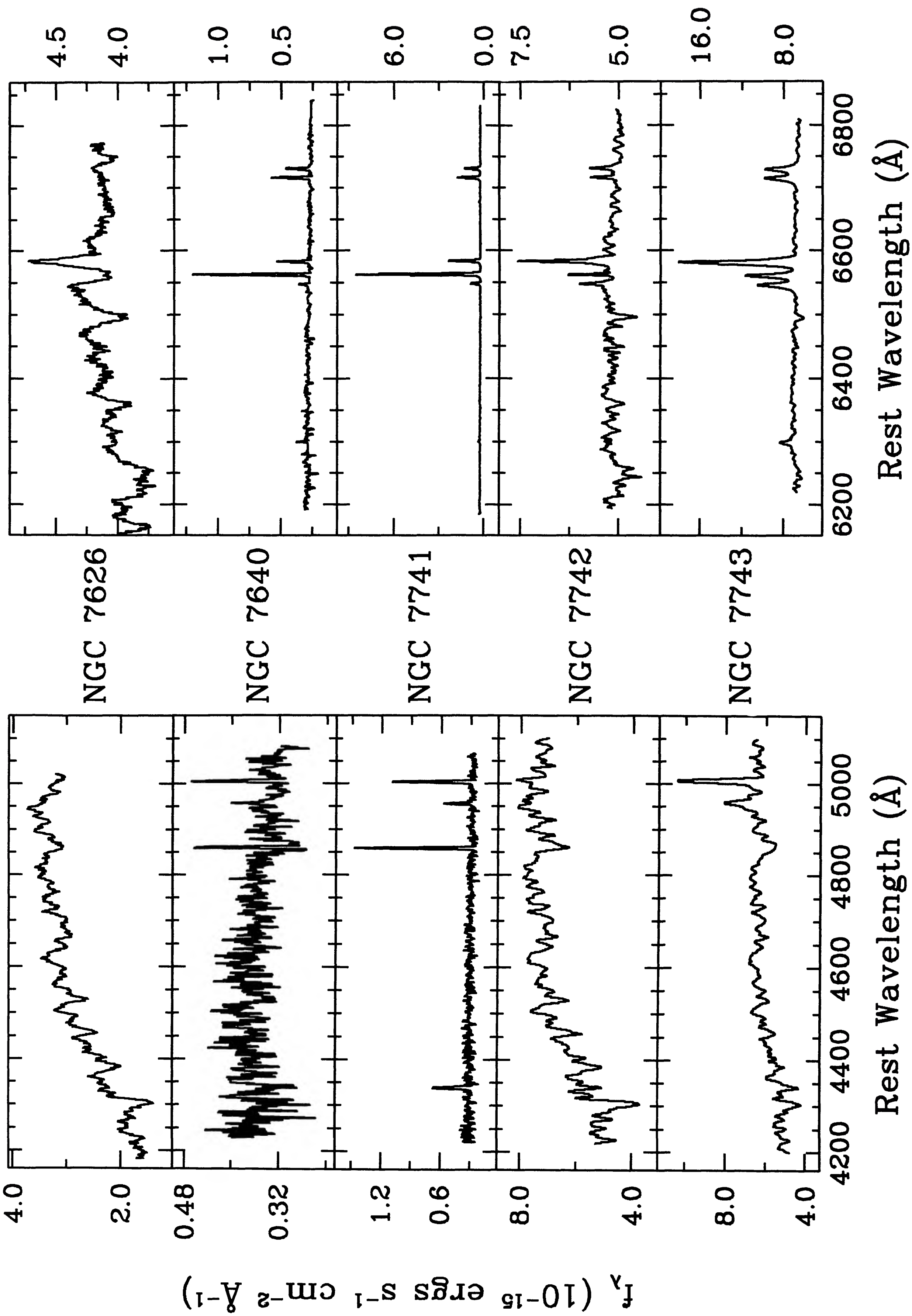

FIG. 98.—Same as Fig. 2

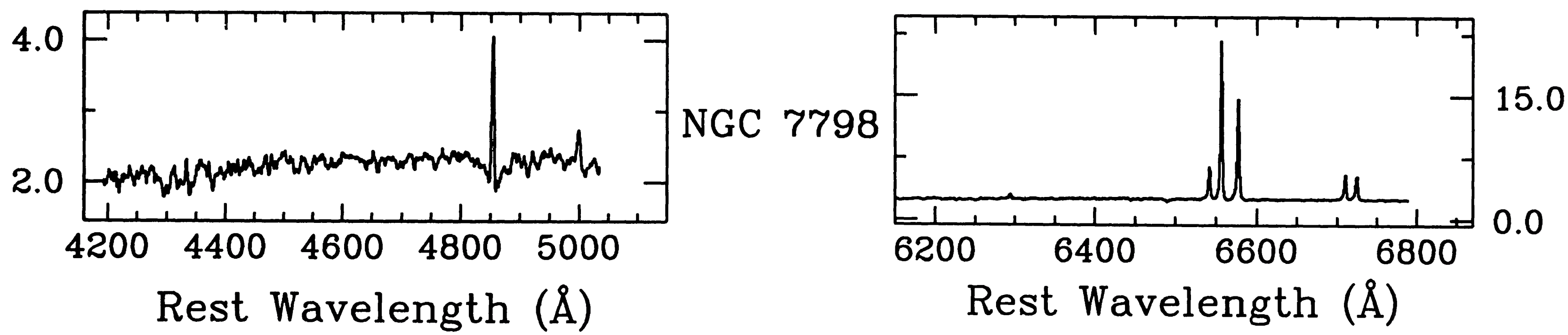

FIG. 99.—Same as Fig. 2