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A survey of the 6.7 GHz methanol maser emission from IRAS sources

I. Data*

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Abstract. We report the first results of a search for 6.7 GHz methanol masers in the direction of 1399 IRAS objects north of declination $-20°$ with the flux densities greater than 100 Jy at 60 μm and the flux density ratio $F_{60}/F_{25} > 1$. Observations were made with the sensitivity of 1.7 Jy and the velocity resolution of 0.04 km s^{-1} using the 32-m Toruń radio telescope. Maser emission was found in 182 sources, including 70 new detections. 32 new sources were identified with objects of radio emission associated with star-forming regions. Comparison of the present data set with other observations suggests that about 65% of methanol masers exhibit moderate or strong variations on time-scales of about 4 and 8 years.

Key words: masers — surveys — stars: formation — ISM: molecules — radio lines: ISM — HII regions

1. Introduction

Interstellar methanol has been found in numerous transitions and several of them exhibit maser activity. The $5_1 - 6_0$ transition of A$^+$ methanol at 6.7 GHz discovered by Menten (1991) is of particular interest. The sources of this line show a variety of spectra, from a single to several blended features over the velocity range of 10 km s^{-1} or even exceeding 20 km s^{-1}, in a few objects. In a number of sources the flux density of several thousand Jy is observed and the linewidths of unblended maser features are $0.3 - 0.5$ km s^{-1} (Menten 1991; Caswell et al. 1995). The widespread occurrence and high intensity of this maser transition makes it a powerful tool to identify the massive early-type stars still embedded in their parental dense molecular clouds.

In many cases the 6.7 GHz methanol masers are associated with phenomena typical for environment of a newly formed massive star such as thermal and maser lines, radio continuum and far-infrared emission. A close association of the methanol sources with the known star-forming regions traced by OH or H_2O masers and/or ultracompact HII regions was established. Menten (1991) found 80 methanol sources among 123 molecular cloud regions. Caswell et al. (1995) found methanol emission in 184 out of 208 star-forming regions with OH masers and detected methanol masers at 56 sites without OH emission. Search for the 6.7 GHz methanol transition towards the southern 12.2 GHz methanol and 1.6 GHz OH masers resulted in the detection rates of 100% and 67% respectively (MacLeod et al. 1992; MacLeod & Gaylard 1992). Later on, several surveys of IRAS objects which satisfy the colour criteria for ultracompact HII regions (Wood & Churchwell 1989, hereafter WC) have also been successful, providing many new detections mostly in the southern hemisphere (Schutte et al. 1993; van der Walt et al. 1995, 1996; Walsh et al. 1997; Lyder & Galt 1997; MacLeod et al. 1998). Slysh et al. (1999) surveyed a sample of the northern hemisphere IRAS sources supplemented with several known ultracompact HII regions and bipolar outflows.

For each flux density measurement an associated quality flag is given in IRAS catalogue. Flags at four wavelength bands indicate whether the observation is of high or moderate quality, or only an upper limit. A significant number of IRAS sources, searched for methanol emission, have usually high quality flux density measurements. However, there is evidence that a quite large number of maser sources has IRAS counterparts with moderate quality of flux density measurements, or even upper limits (Cohen et al. 1988). It is likely that some of these IRAS objects are methanol sources.

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* Table 2 is only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/Abstract.html

van der Walt (1997) has shown that faint IRAS objects satisfying the WC criteria have a distribution in the galactic latitude that is completely different from that expected for embedded ionizing stars. He argues that the WC criteria can be too simple to identify all the massive stars with an associated methanol maser emission. Blind surveys of methanol masers in the narrow fields along the galactic plane (Caswell 1996; Ellingsen et al. 1996) yielded several new sources not associated with IRAS objects. It is suggested that some methanol masers may be associated with sources that have colours unusual for ultracompact HII regions (Ellingsen et al. 1996).

To clarify a relationship between far-infrared sources and the 6.7 GHz methanol masers we have undertaken a search for methanol emission in a large sample of IRAS objects selected with no restrictions imposed on flux density quality and less stringent criteria for colours. As our survey provided nearly two hundred detections it would be useful for statistical studies of maser properties and related phenomena in star-forming regions. This paper contains the observational results only whilst a full analysis will be presented in a subsequent publication.

2. Observations

The observations were made in several runs from 1999 January 30 to August 25 with the 32-m Toruń radio telescope. We used a dual-channel cryogenically cooled HEMT receiver to measure simultaneously two opposite circular polarizations. Typical system temperature was 60 K on cold sky. The backend was a 2^{14}-channel autocorrelation spectrometer operating in 2-bit mode. We used its two parts of 4096 channels each with a bandwidth of 4 MHz, yielding a velocity resolution of 0.044 km s^{-1} and a velocity coverage of 180 km s^{-1}. The radial velocities were measured with respect to the Local Standard of Rest. The band-centre velocity was generally chosen as 0 km s^{-1}, but for the region $18^h \leq \alpha \leq 19^h$ the velocity of 40 km s^{-1} was set. The absolute radial velocity may be a subject of an error of ± 0.4 km s^{-1} due to the use of experimental software of a new autocorrelator. The data were taken in the total-power position switching mode. The half-power beamwidth of the telescope was 5.5 arcmin at 6.7 GHz. The pointing checks and corrections were regularly done on strong point continuum sources. It was found that rms pointing errors were less than 25 arcsec in our observations.

The calibration was achieved by injecting a signal from a noise diode of known temperature into the system, at the start of each integration. The noise diode was calibrated against the extragalactic sources 3C 123 and Vir A, adopting the flux densities from Ott et al. (1994). Because the telescope gain versus elevation varies less than 2% (Katarzyński 1997), no corrections were applied to our spectra. The accuracy of the absolute flux density calibration was commonly better than 15%.

The data were reduced using the standard procedures. The instrumental baseline was fitted using the line emission-free channels. The 3σ noise level after 14 min on-source integration and averaging the two polarizations was typically 1.5 to 1.9 Jy. Hanning smoothing was only applied to noisy spectra. To confirm the reality of new detections we reobserved all of them with the same setup of spectrometer as during the initial search. Tentative detections were observed for a longer integration time of 28 min. We did not verify the positions of the detected masers, but if spectra of identical shapes and velocities were seen in several neighbouring IRAS positions, the observations were repeated to find the strongest source that is only considered as the detection in this paper. The maser profiles were frequently complex, therefore, we read off the line parameters using the cursor rather than fitting Gaussian components.

The targets were selected from the IRAS Point Source Catalog (1985). All of them satisfied the following criteria: (1) F_{60} >100 Jy, (2) $F_{60} > F_{25}$ and (3) $\delta > -20°$, where F_{25} and F_{60} are the flux densities at 25 and 60 μm respectively. No restrictions on the measurement qualities of infrared flux densities were imposed. The resulting sample included 1411 objects of which 1399 were searched for methanol maser emission.

3. Results

The survey yielded 70 new sources of 6.7 GHz methanol masers. A total of 182 sources were detected above the sensitivity limit of 1.7 Jy. Because some sources were reobserved, a few detections were made below this 3σ upper limit. The observed properties of the methanol sources are listed in Table 1. The IRAS name, the velocity interval of the maser emission ΔV, the velocity of peak emission V_p, the peak flux density S_p, the integrated flux density S_i, the epoch of observation and the discovery reference are given. Spectra of all the detected sources are shown in Fig. 1, where we also included already known sources, since most of them were previously observed with sensitivities and spectral resolutions lower than in our survey.

IRAS objects not detected to a 3σ limit are listed in Table 2. For each object the IRAS name, the rms level and the epoch of observation are given. In several cases we found emission that was identified as a contamination or a sidelobe response from nearby methanol sources; their names are listed in the last column of Table 2.

4. Notes on individual sources

4.1. New detections

Here we give brief notes on many individual sources. We have checked against existing surveys of maser and thermal lines, and surveys of 5 GHz continuum in the galactic plane in order to look for any associations.

Table 1. IRAS objects with the 6.7 GHz methanol maser emission

IRAS	ΔV (km s^{-1})	V_p (km s^{-1})	S_p (Jy)	S_i (Jy km s^{-1})	Epoch	Ref.
00338+6312	−27, −21	−22.4	14	7.6	Feb.	10
00494+5617	−37, −27	−29.1	24	19.5	Apr.	11
02232+6138	−48, −41	−44.6	3741	7602.0	Jun.	2
02455+6034	−46, −44	−45.1	21	11.1	Feb.	8
05274+3345	0, 6	2.1	94	56.8	Mar.	4
05358+3543	−16, −11	−13.6	256	198.6	Jul.	2
05382+3547	−25, −24	−24.1	7.5	3.0	Jan.	1
05480+2545	−16, −4	−4.8	18	19.3	Mar.	11
06053−0622	9, 13	10.5	166	155.7	Aug.	2
06055+2039	3, 6	5.5	17	10.3	Jul.	2
06056+2131	9, 12	9.2	19	11.7	Mar.	6
06058+2138	8, 12	10.4	553	461.5	Aug.	2
06061+2151	−9, −4	−5.5	4.8	3.6	Jul.	1
06099+1800	2, 7	5.1	64	48.8	Mar.	2
06117+1350	14, 17	15.3	68	37.9	Jul.	2
07299−1651	21, 24	22.6	217	100.5	Jul.	3
18056−1952	59, 77	72.5	19	68.1	Jul.	2
18056−1954	70, 75	73.4	9.8	23.3	Aug.	6
18061−1927	14, 18	16.8	4.5	8.2	Jul.	1
18067−1927	23, 25	23.9	15	10.6	May	5
18072−1954	−9, 0	−8.0	3.4	2.9	May	6
18089−1732	29, 40	38.9	61	85.2	May	2
18090−1832	105, 112	107.4	77	97.1	May	2
18092−1842	39, 44	42.6	49	41.2	May	2
18094−1840	46, 49	46.8	2.3	2.4	May	6
18096−1821	47, 54	48.7	9.2	15.8	Jul.	1
18097−1825	15, 30	19.1	7.9	20.3	May	2
18099−1841	60, 61	60.2	2.3	1.2	Mar.	9
18102−1800	22, 27	24.4	13	23.1	Mar.	11
18108−1759	50, 61	57.7	264	544.2	Mar.	2
18110−1854	30, 44	32.1	41	61.3	Mar.	2
18111−1746	58, 61	58.7	8.3	9.4	Jul.	1
18111−1729	48, 49	48.5	6.4	3.0	Apr.	1
18117−1753	35, 41	39.8	242	256.7	Jul.	2
18126−1705	42, 52	51.9	3.4	3.5	Aug.	1
18128−1640	4, 17	15.1	135	152.3	Jul.	11
18134−1942	4, 17	6.2	116	178.8	May	5
18141−1626	26, 28	27.0	3.0	1.2	Mar.	1
18141−1615	22, 28	24.8	2.9	5.3	Mar.	9
18144−1723	47, 52	51.0	33	49.8	Mar.	10
18151−1208	27, 29	27.7	65	40.0	Apr.	7
18155−1554	45, 46	45.8	3.1	1.1	Jul.	1
18174−1612	20, 23	20.9	19	8.8	May	2
18181−1534	−5, −2	−3.4	33	14.7	Jul.	1
18182−1433	56, 69	61.6	24	38.3	May	2
18184−1449	49, 53	52.1	10	10.1	Jul.	1
18193−1411	90, 91	90.8	1.3	0.7	Aug.	1
18196−1331	20, 21	20.5	20	4.9	Jun.	3
18207−1311	45, 57	55.2	3.9	8.9	Jul.	1
18208−1306	55, 59	57.9	11	7.4	Jun.	1

Table 1. continued

IRAS	ΔV (km s^{-1})	$V_{\rm p}$ (km s^{-1})	$S_{\rm p}$ (Jy)	$S_{\rm i}$ (Jy km s^{-1})	Epoch	Ref.
18217−1252	48, 50	49.2	14	7.5	Aug.	2
18220−1241	76, 83	80.2	22	34.5	Aug.	1
18224−1228	38, 39	38.2	3.7	1.6	Aug.	1
18224−1311	73, 80	75.2	13	26.3	May	1
18232−1154	18, 25	20.7	15	21.0	May	2
18236−1241	41, 44	41.1	2.3	1.9	Jul.	11
18236−1205	24, 29	26.3	6.7	10.1	Jul.	9
18244−1155	48, 58	56.3	8.6	8.0	Aug.	6
18249−1116	68, 76	71.4	94	74.1	Jun.	2
18251−1154	41, 44	43.6	10	11.2	Jun.	1
18264−1152	46, 47	46.8	2.3	1.3	Aug.	1
18265−1517	14, 19	14.6	23	14.7	Aug.	9
18277−1517	19, 24	23.3	3.7	2.9	Aug.	1
18278−1009	115, 119	116.6	14	12.2	Jun.	1
18278−0936	46, 54	53.4	5.5	5.4	Aug.	1
18282−0951	20, 22	20.4	2.9	1.8	Aug.	2
18282−1024	85, 92	88.8	3.7	5.9	Jul.	1
18290−0924	79, 85	79.7	12	6.8	Aug.	5
18302−0928	28, 39	29.0	3.2	5.2	Aug.	1
18305−0826	71, 77	74.1	17	31.0	Jul.	1
18305−0758	74, 78	76.4	9.6	8.1	Mar.	1
18310−0825	81, 89	87.4	12	9.2	Mar.	5
18316−0602	38, 44	41.9	178	69.5	Apr.	7
18317−0859	71, 84	75.0	29	59.6	Jul.	1
18317−0845	63, 65	64.1	4.4	4.5	Jun.	5
18319−0834	95, 108	102.6	40	92.8	Aug.	2
18321−0843	63, 76	63.8	2.2	1.5	Aug.	1
18321−0854	72, 83	81.8	12	43.4	Aug.	1
18321−0820	76, 87	82.1	11	30.0	Aug.	1
18322−0721	103, 111	106.2	15	26.0	Jul.	1
18324−0737	107, 120	109.9	4.6	7.4	Aug.	2
18324−0855	73, 83	75.2	9.2	27.0	Aug.	1
18324−0820	75, 85	79.0	9.2	26.6	Aug.	5
18326−0802	64, 72	70.9	17	12.7	Aug.	1
18326−0751	17, 19	17.7	40	24.1	Aug.	1
18334−0733	108, 116	114.4	29	24.6	Jul.	7
18335−0713	106, 115	113.0	97	141.6	Jul.	2
18337−0707	107, 118	109.3	13	16.1	Jul.	1
18341−0727	111, 114	113.1	3.5	2.5	Jul.	11
18345−0641	93, 100	94.7	8.0	12.6	Jul.	7
18353−0628	89, 101	95.5	364	346.7	Jul.	9
18361−0627	89, 94	91.2	20	26.0	Jul.	5
18372−0537	106, 108	107.1	5.9	2.5	Jul.	1
18372−0541	17, 25	24.6	13	13.1	Jul.	1
18379−0500	34, 37	34.9	21	13.9	Aug.	11
18379−0546	102, 115	103.2	19	20.4	Jul.	7
18391−0504	91, 102	99.7	23	35.8	Aug.	1
18392−0436	108, 113	111.8	1.9	2.6	Jul.	1
18402−0403	67, 81	71.1	3.4	8.0	Jul.	1
18403−0417	94, 104	100.8	56	30.6	Jul.	6

Table 1. continued

IRAS	ΔV (km s^{-1})	$V_{\rm p}$ (km s^{-1})	$S_{\rm p}$ (Jy)	$S_{\rm i}$ (Jy km s^{-1})	Epoch	Ref.
18403−0445	97, 98	97.9	3.0	1.5	Jul.	1
18416−0420	79, 93	80.7	62	54.0	May	5
18421−0348	81, 93	83.9	58	125.1	Apr.	2
18434−0242	95, 106	95.8	197	288.4	Feb.	2
18438−0222	32, 51	36.7	11	19.0	Mar.	1
18440−0148	104, 111	104.9	3.0	2.0	Aug.	2
18441−0153	47, 49	48.9	19	10.4	May	6
	76, 88	87.5	8.2	19.7	May	
18441−0134	78, 84	80.8	4.5	9.3	May	1
18443−0231	100, 114	108.1	18	26.6	May	2
18446−0209	40, 48	42.4	4.8	6.0	Aug.	2
18447−0229	108, 114	112.1	3.9	5.6	Aug.	6
18448−0146	98, 110	101.5	33	60.5	Aug.	5
18449−0158	87, 93	91.5	23	33.5	Aug.	6
18449−0115	91, 105	95.4	10	31.4	Aug.	5
18450−0205	85, 92	87.6	43	27.7	Aug.	6
18450−0200	85, 94	88.1	50	71.2	Aug.	6
18452−0141	15, 17	16.1	6.5	4.0	Aug.	5
18454−0156	101, 108	101.1	4.3	4.4	Aug.	2
18454−0136	40, 48	40.8	2.9	1.8	Aug.	1
18455−0149	73, 78	74.7	5.9	8.9	Aug.	1
18456−0129	102, 113	110.0	71	153.1	Aug.	2
18461−0113	95, 100	98.4	5.6	6.3	Aug.	1
18470−0050	92, 102	92.8	93	123.7	Aug.	7
18487−0015	28, 39	38.2	48	70.8	Jun.	2
18488+0000	89, 93	91.7	27	22.0	Jul.	7
18494+0002	95, 106	104.6	19	26.4	Mar.	6
18496+0004	72, 75	73.5	13	17.1	Mar.	2
18497+0022	96, 107	105.0	20	41.6	Aug.	11
18507+0121	55, 63	55.8	27	25.8	Jul.	5
18507+0110	55, 63	57.9	18	20.9	Aug.	2
18508+0052	58, 63	59.0	3.9	3.5	Aug.	1
18512+0029	58, 64	62.6	68	109.1	Aug.	1
18515+0157	40, 47	44.1	35	27.9	Aug.	2
18517+0437	40, 52	41.1	279	161.5	Aug.	5
18527+0301	70, 85	73.0	19	32.7	Aug.	1
18556+0136	26, 37	28.9	64	91.8	Jul.	2
18566+0408	78, 87	83.7	6.6	10.7	Aug.	11
18572+0057	43, 48	46.9	31	67.2	Jul.	7
18577+0358	49, 63	62.6	5.7	19.7	Jul.	1
18592+0426	69, 71	69.4	2.3	3.2	Jul.	1
18592+0108	40, 47	42.6	595	536.4	Jul.	2
19002+0654	5, 16	15.6	18	26.8	May	5
19012+0505	31, 34	32.3	5.4	3.9	Mar.	1
19031+0621	64, 81	74.0	18	39.4	Aug.	1
19035+0641	30, 36	31.0	15	6.5	Jun.	2
19048+0705	63, 64	63.4	3.7	1.7	Aug.	1
19049+0712	55, 58	57.1	3.2	3.4	Aug.	1
19078+0901	7, 22	9.1	31	87.1	Jun.	2
19092+0841	54, 57	54.8	10	7.2	Jun.	10

Table 1. continued

IRAS	ΔV (km s^{-1})	V_p (km s^{-1})	S_p (Jy)	S_i (Jy km s^{-1})	Epoch	Ref.
19095+0930	39, 44	39.5	79	54.7	Jun.	2
19097+0847	58, 60	58.8	5.5	3.1	Jul.	1
19110+1045	57, 59	57.8	45	21.8	Jul.	2
19117+1107	57, 67	65.8	10	10.5	Jul.	2
19120+1103	55, 66	56.1	4.1	8.0	May	2
19120+0917	47, 53	47.4	34	25.5	May	5
19186+1440	−27, −10	−12.4	13	34.3	Jul.	1
19189+1520	−10, −2	−5.0	6.5	6.6	Jul.	1
19191+1538	26, 33	29.9	2.8	4.9	Jul.	1
19211+1432	58, 66	62.8	29	75.9	Jul.	1
19216+1429	51, 62	59.3	482	428.7	Jul.	2
19230+1341	34, 41	35.5	21	22.0	Jan.	7
19266+1745	9, 11	10.0	3.3	1.3	Jul.	1
19270+1750	23, 25	23.8	1.9	1.1	Aug.	1
19282+1814	18, 19	18.7	6.3	3.0	Jul.	1
19366+2301	31, 36	34.0	2.8	4.8	May	1
19410+2336	14, 28	17.3	34	54.9	Apr.	2
19437+2410	3, 4	3.6	4.1	1.2	Jul.	1
19589+3320	−27, −26	−26.5	9.8	4.9	Jul.	11
20062+3550	−4, 7	−2.5	10	6.3	Jul.	11
20081+3122	0, 16	15.1	109	44.8	Mar.	2
20110+3321	3, 11	10.7	5.3	3.2	Jun.	1
20126+4104	−8, −5	−6.1	38	18.3	Apr.	3
20198+3716	−11, 1	−2.9	39	39.4	May	2
20350+4126	−5, −4	−4.1	4.3	2.2	Jul.	11
21074+4949	−72, −68	−70.5	27	17.3	Jul.	1
21381+5000	−44, −40	−40.9	7.0	10.5	Jul.	11
21413+5442	−62, −61	−61.6	3.3	1.5	Jul.	1
22272+6358	−13, −9	−10.9	91	47.4	Jul.	11
22543+6145	−5, −1	−2.5	815	812.5	Mar.	2
22566+5830	−46, −45	−45.7	2.8	1.3	Jul.	1
23116+6111	−62, −48	−56.3	296	475.3	Jul.	2
23139+5939	−42, −37	−38.5	4.0	6.5	Jul.	1

Discovery reference: 1 − this paper, 2 − Menten (1991), 3 − MacLeod & Gaylard (1992), 4 − Gaylard & MacLeod (1993), 5 − Schutte et al. (1993), 6 − Caswell et al. (1995), 7 − van der Walt et al. (1995), 8 − Lyder & Galt (1997), 9 − Walsh et al. (1997), 10 − MacLeod et al. (1998), 11 − Slysh et al. (1999).

05382+3547. We detected the 6.7 GHz methanol feature at velocity −24.1 km s^{-1}. The CO(1−0) emission was found towards this source at −19.2 km s^{-1} and possibly at −10.2 km s^{-1} (Wouterloot & Brand 1989).

06061+2151. The methanol features at velocities −8.7 and −5.5 km s^{-1} lie well within the velocity range −13 to 0 km s^{-1}, where strong water maser emission was observed (Wouterloot et al. 1993). The CO (1−0) line at velocity −1.6 km s^{-1} found by Wouterloot & Brand (1989) is slightly redshifted relative to the methanol line. Molinari et al. (1996) found the ammonia lines at −0.5 km s^{-1}.

18061−1927. We found the methanol emission in the velocity interval 14 to 18 km s^{-1}. Codella et al. (1995) detected the water maser line at 24.5 km s^{-1}.

18111−1729. Walsh et al. (1997) did not found the methanol emission with a 3σ detection limit of 1 Jy. We detected a 6.4 Jy feature at 48.5 km s^{-1}. This suggests that the source is variable. It is likely that the source is associated with CO emission at 54 km s^{-1} quoted by Jaffe et al. (1981). The water masers were found at quite different velocities of −21 km s^{-1} (Jaffe et al. 1981) and −1.6 km s^{-1} (Cesaroni et al. 1988).

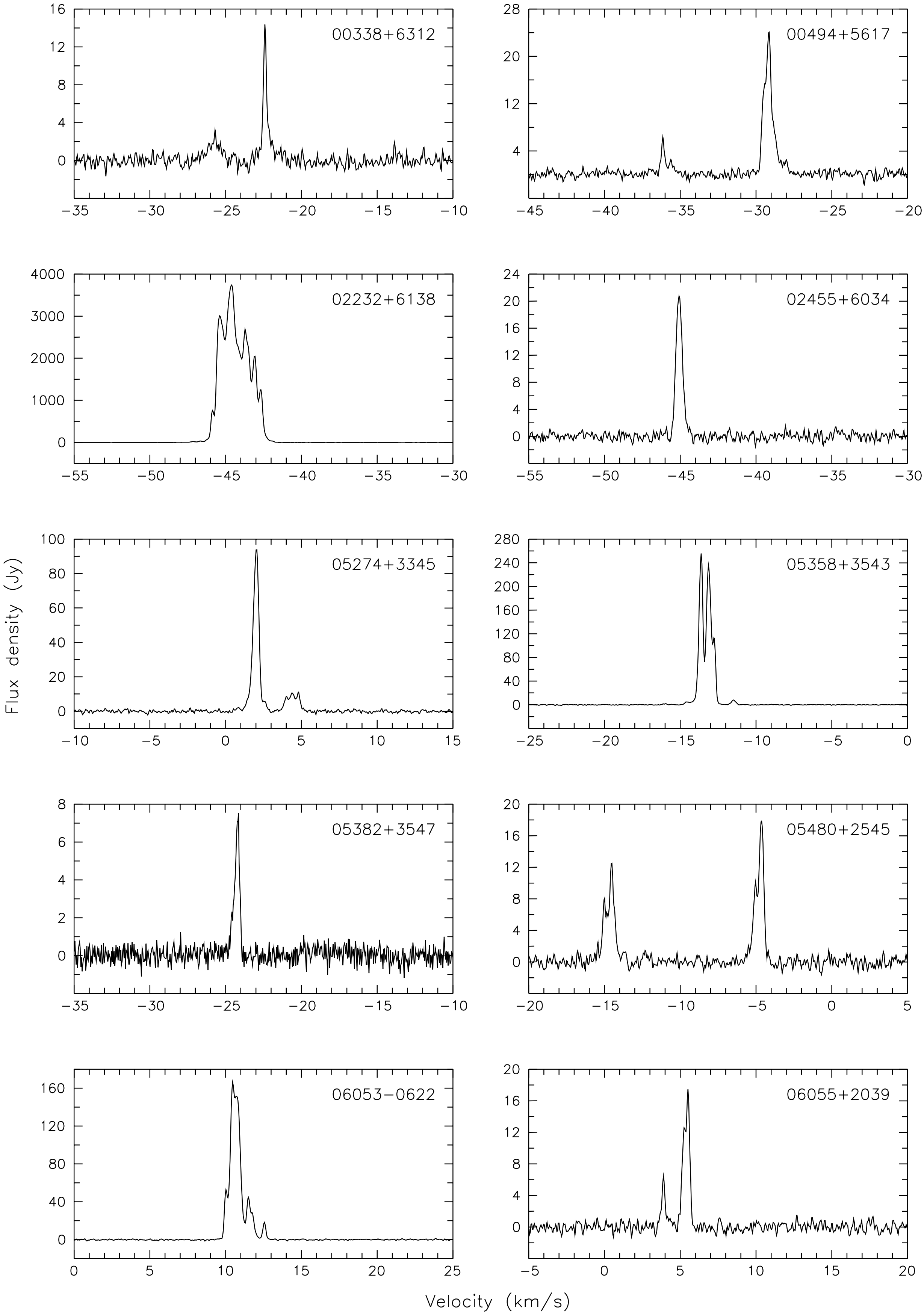


Fig. 1. The 6.7 GHz methanol maser spectra for all detections listed in the paper

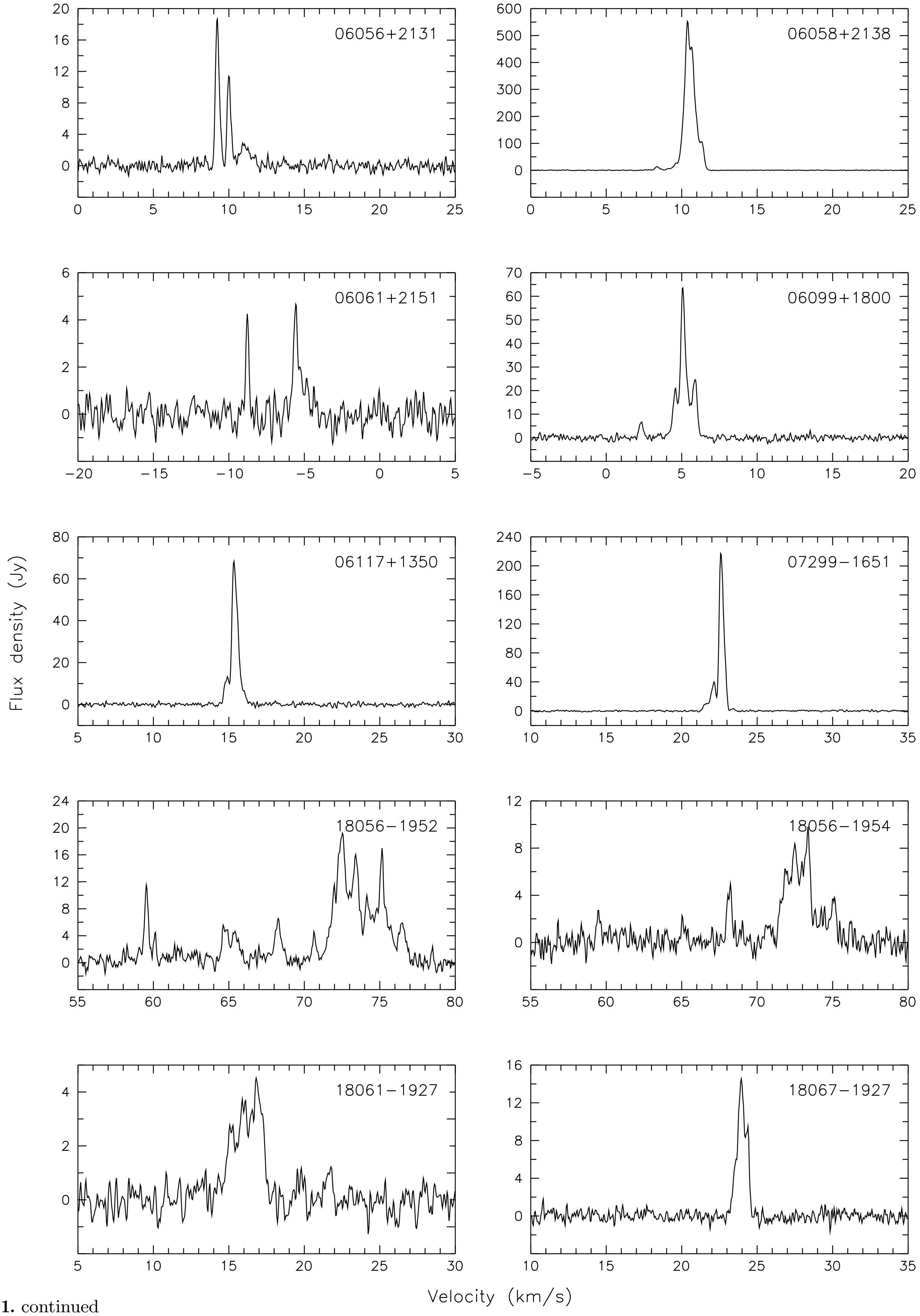
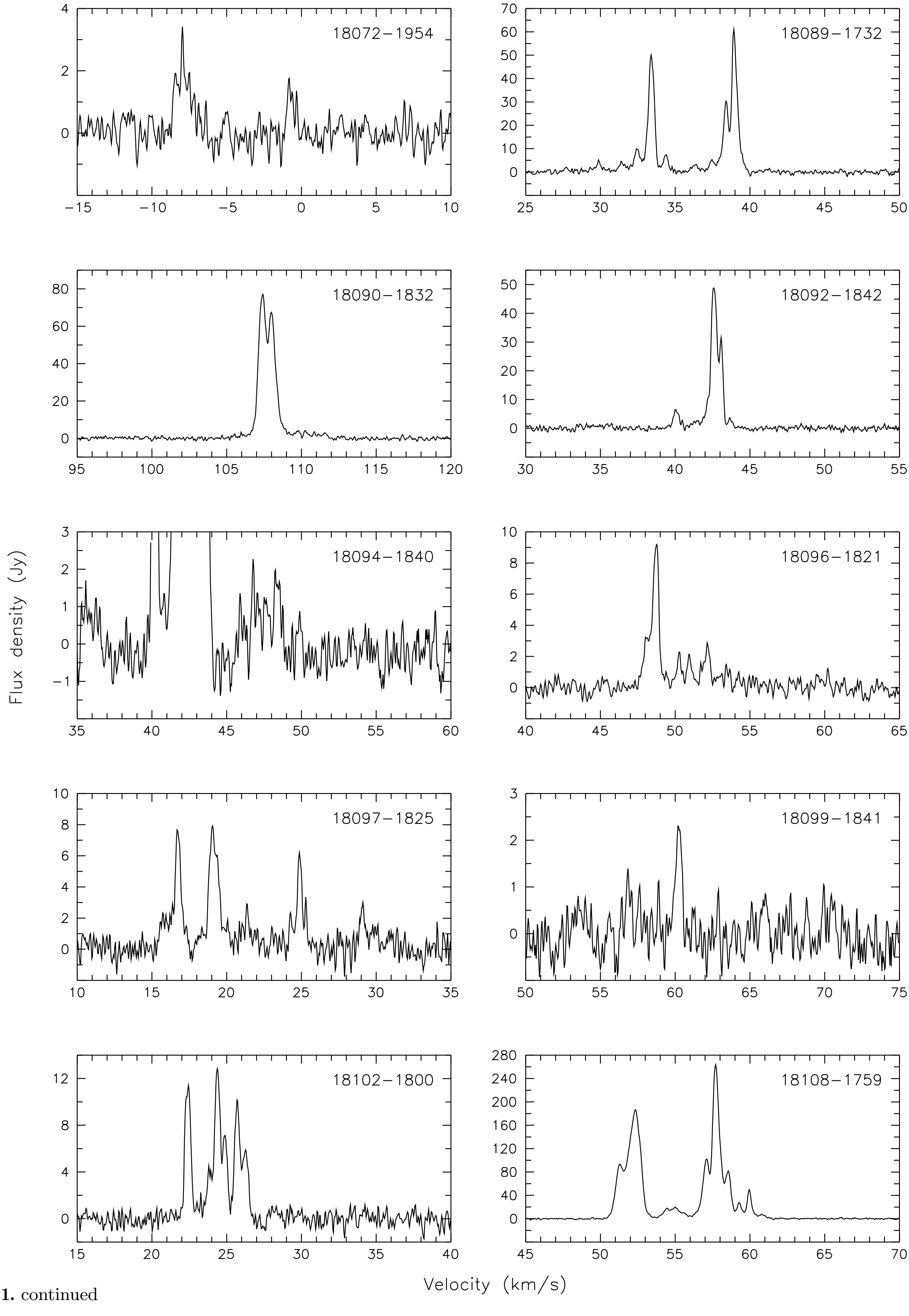


Fig. 1. continued



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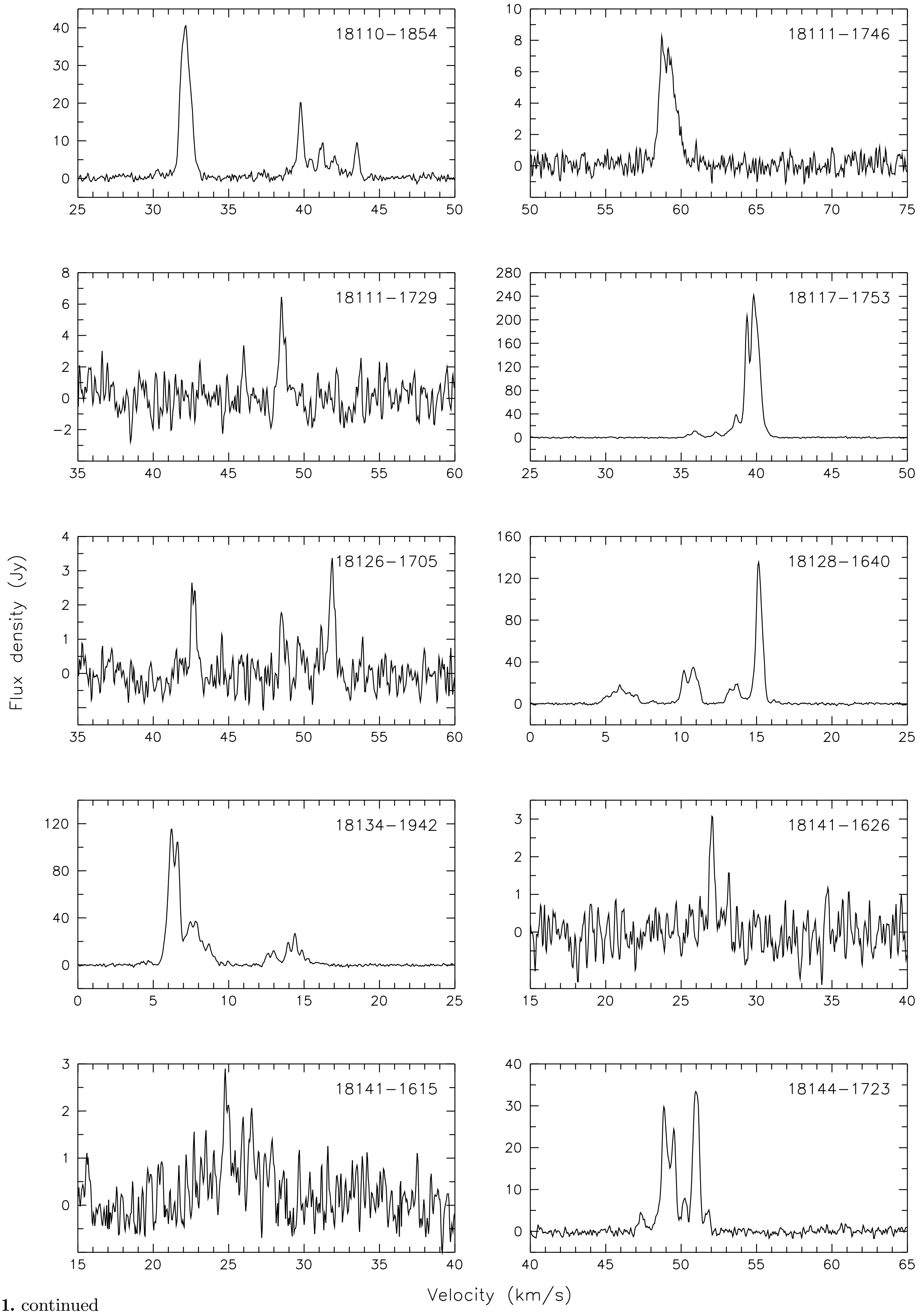

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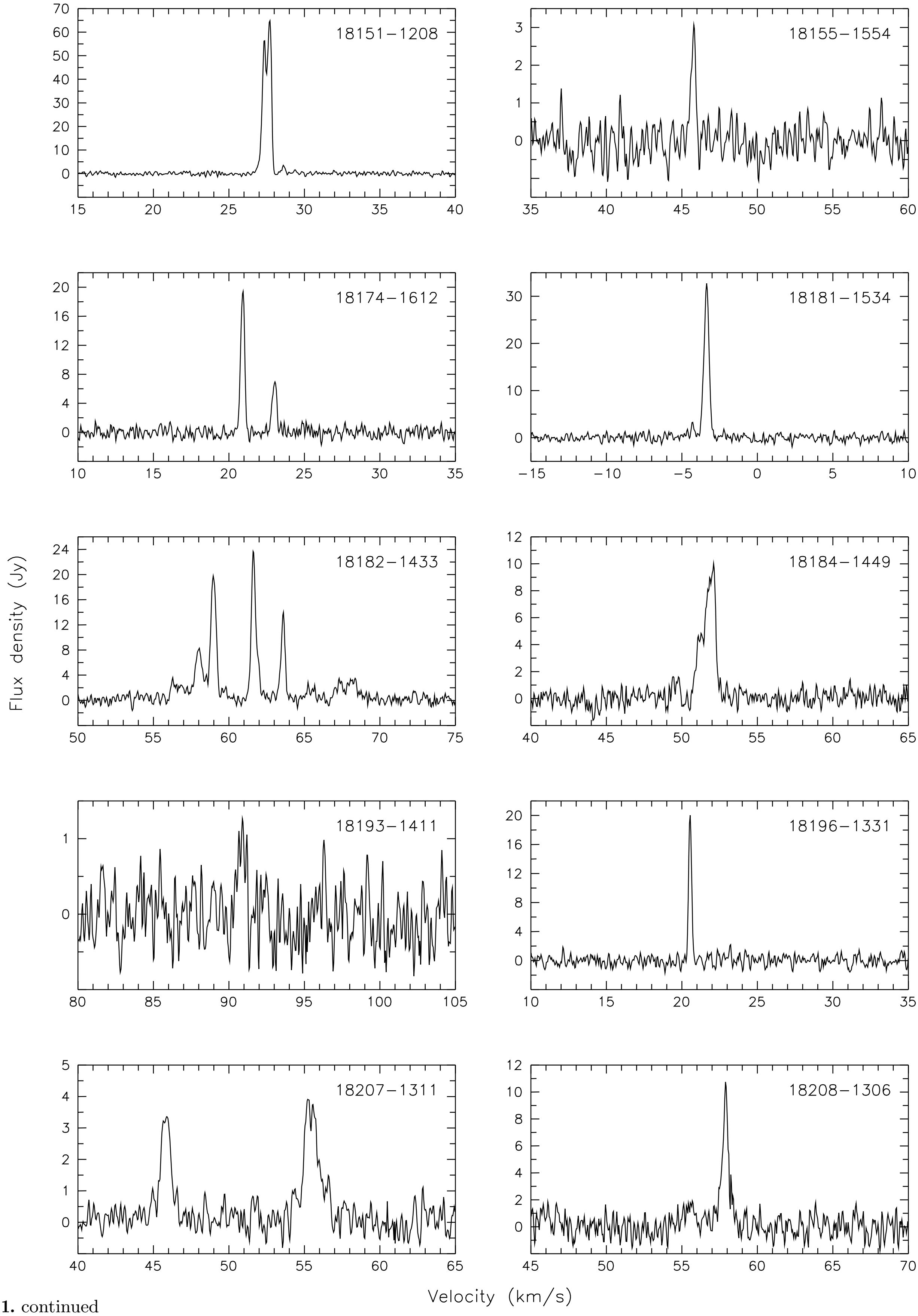

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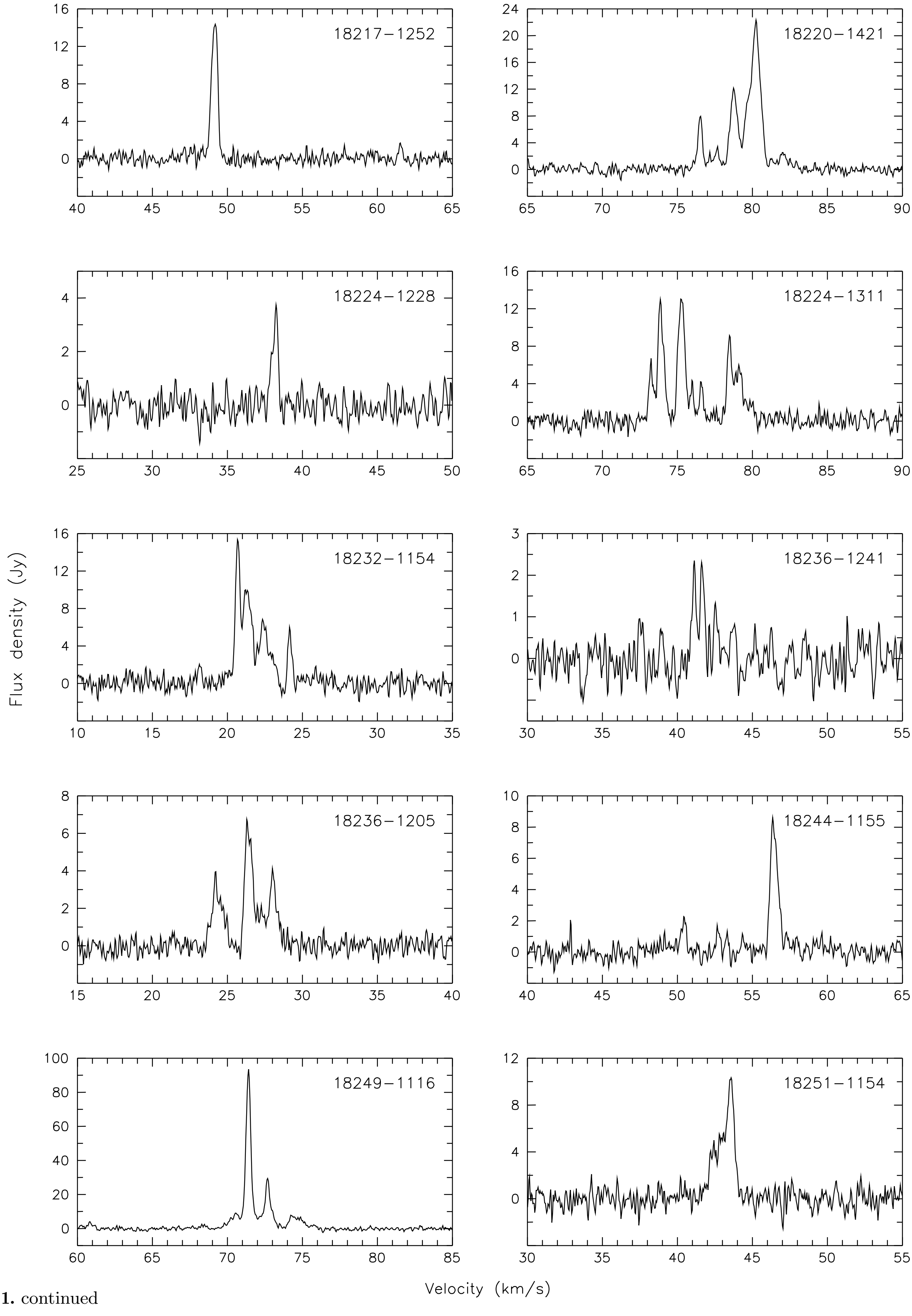

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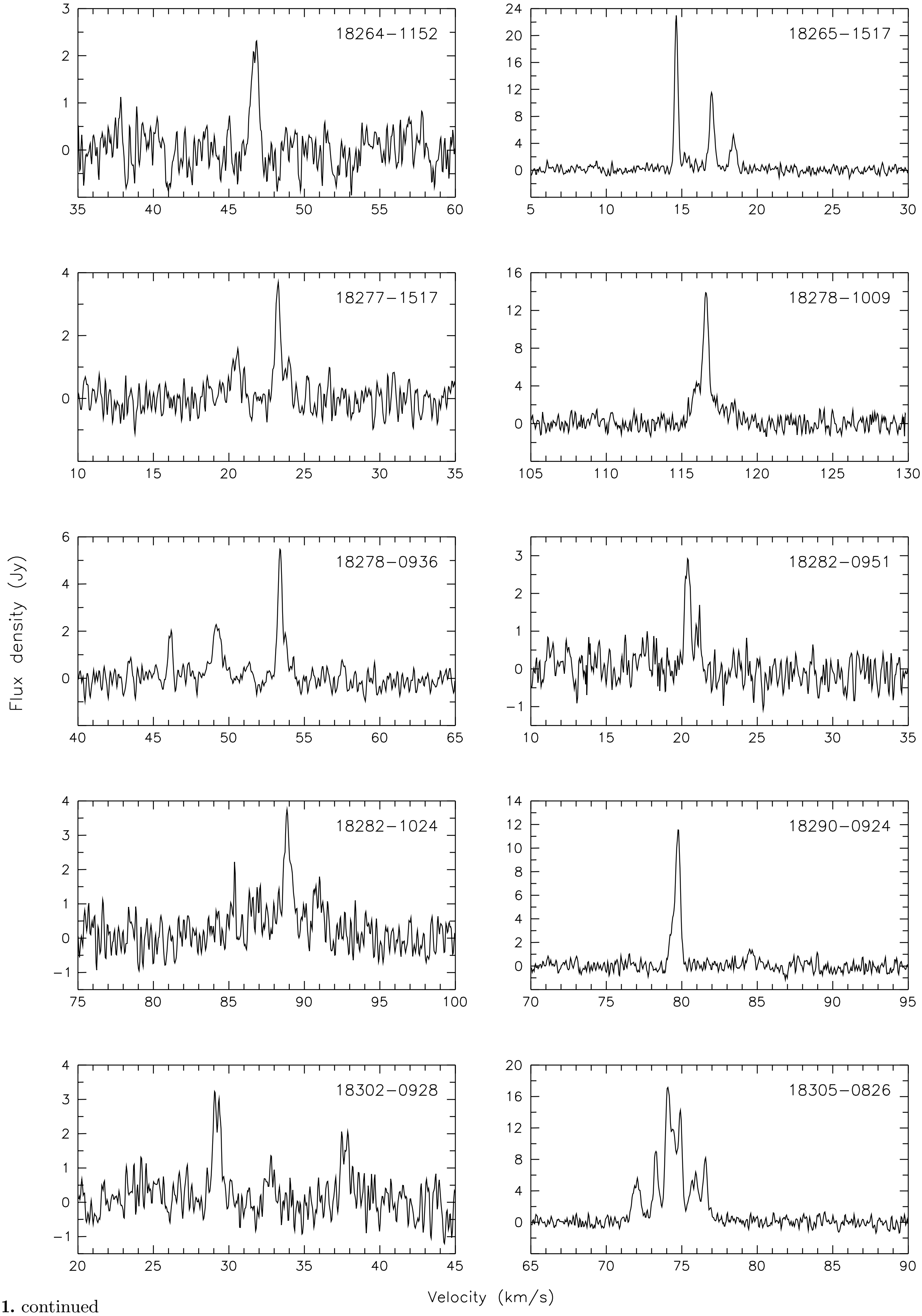

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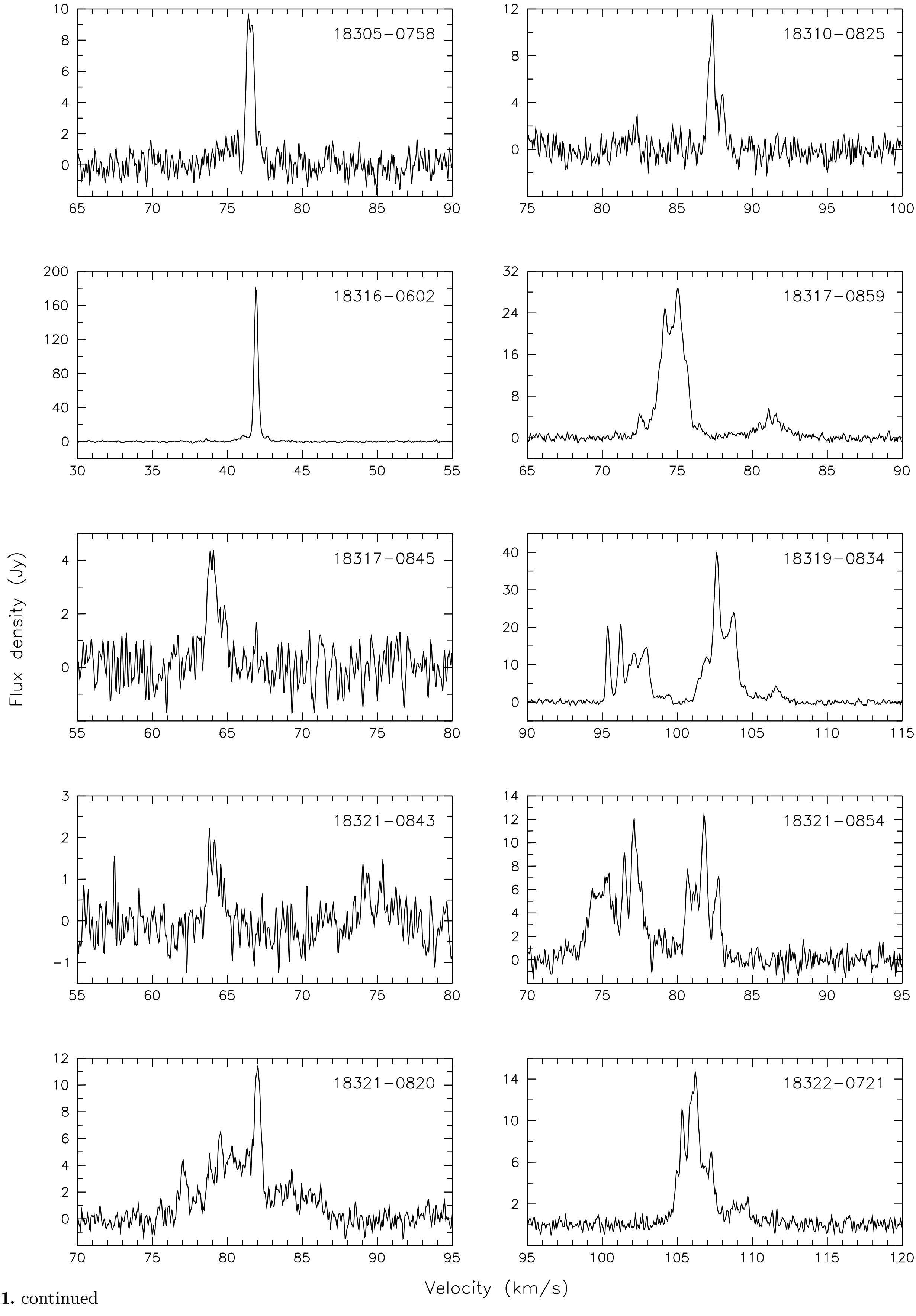

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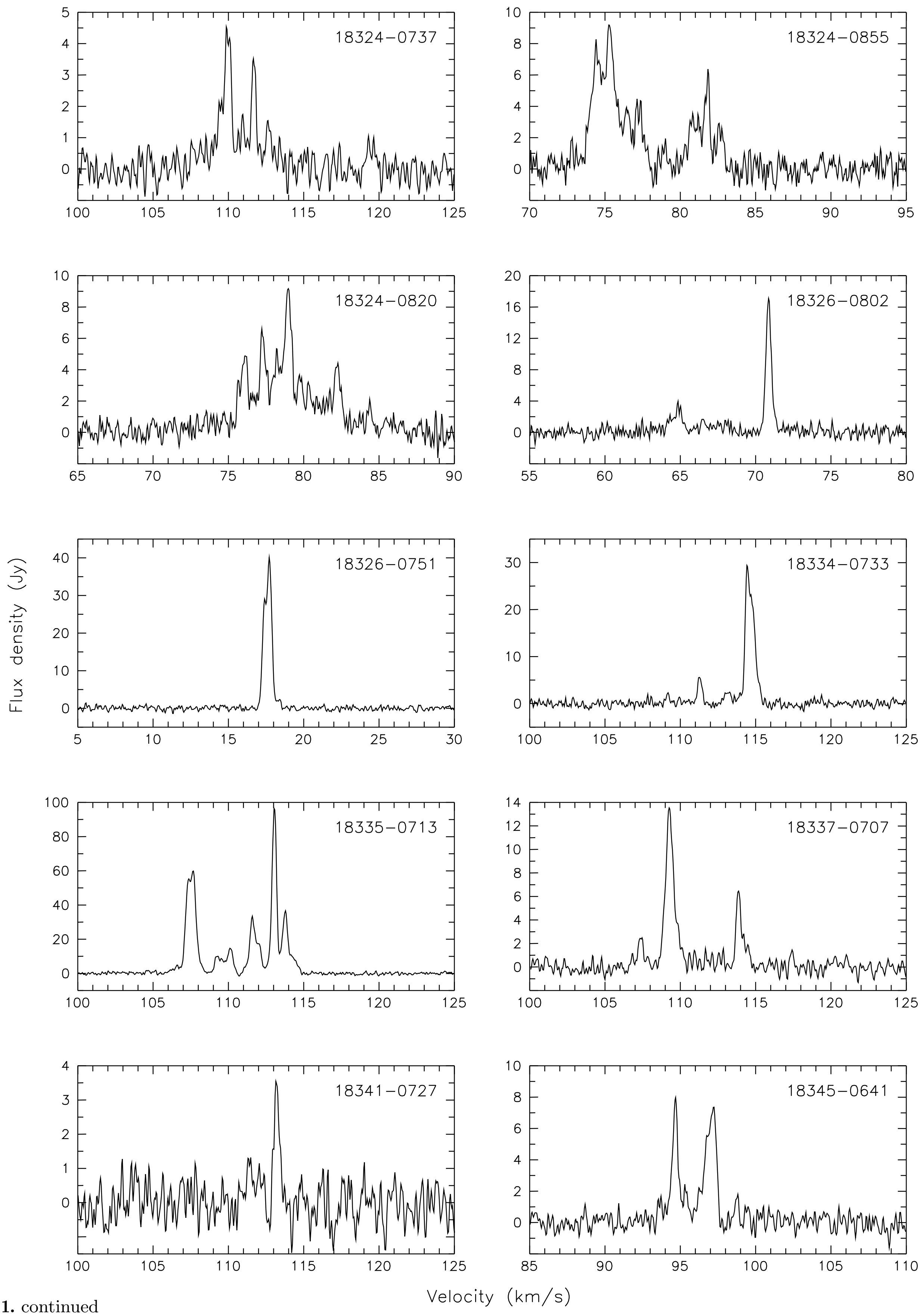

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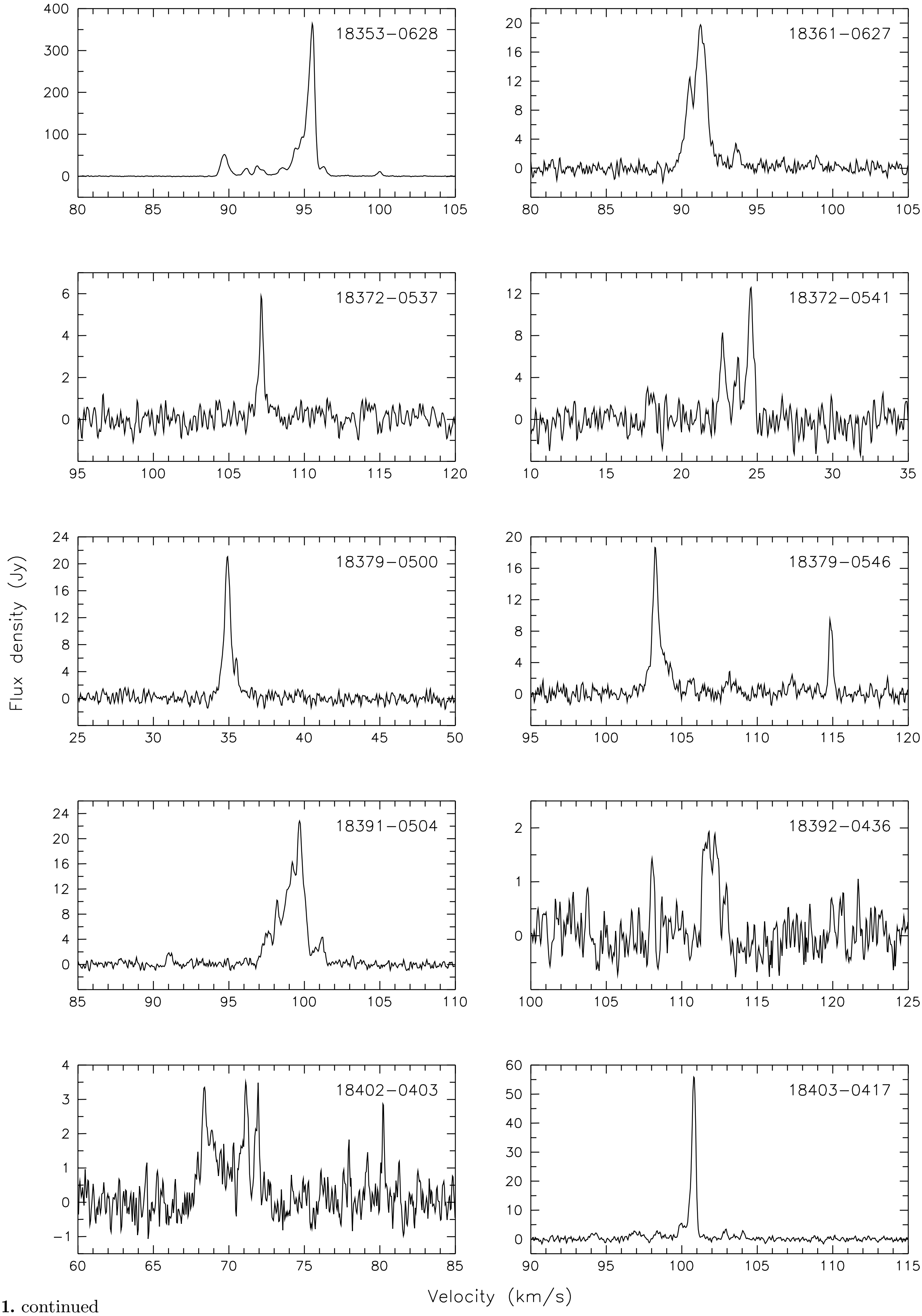

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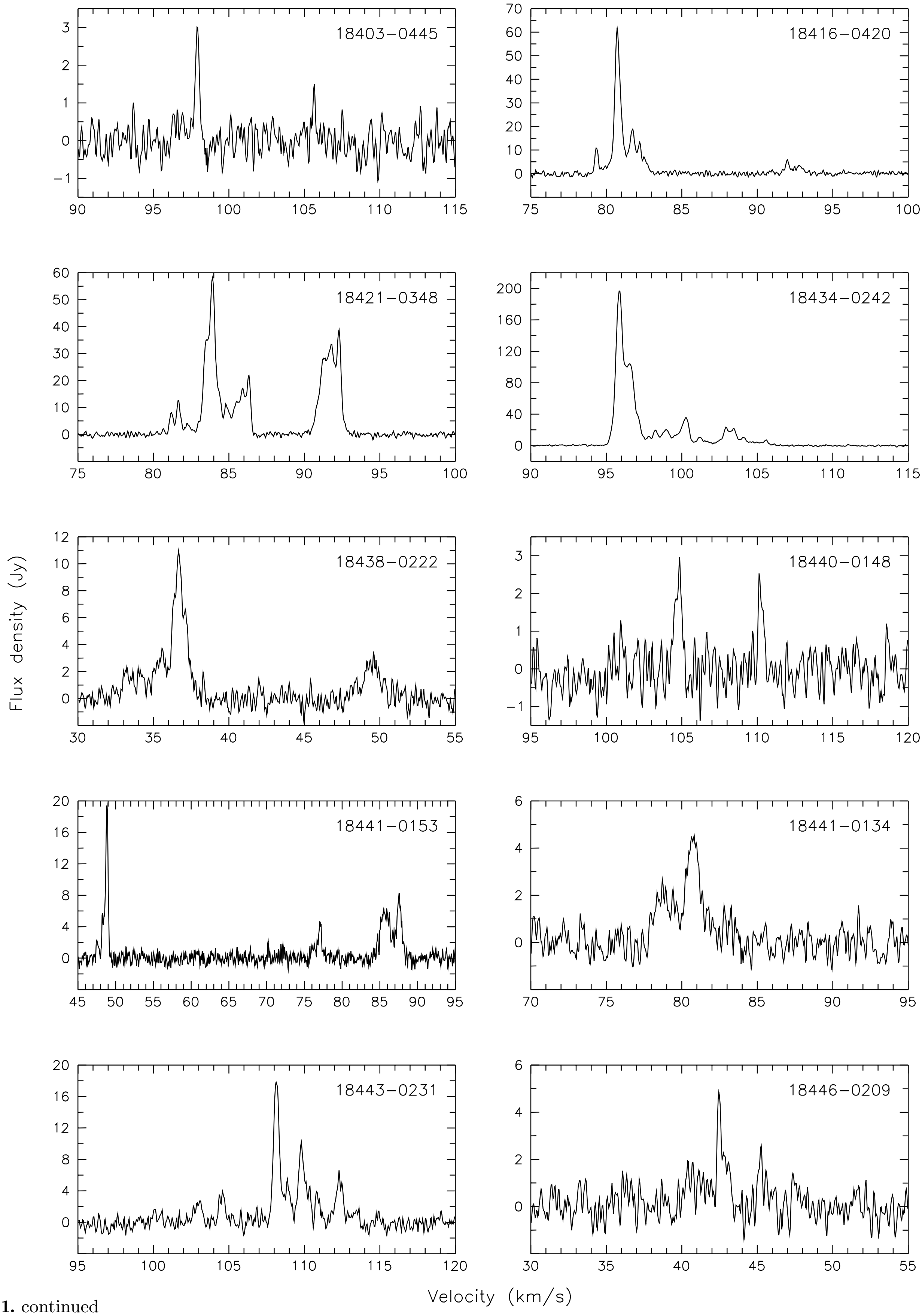

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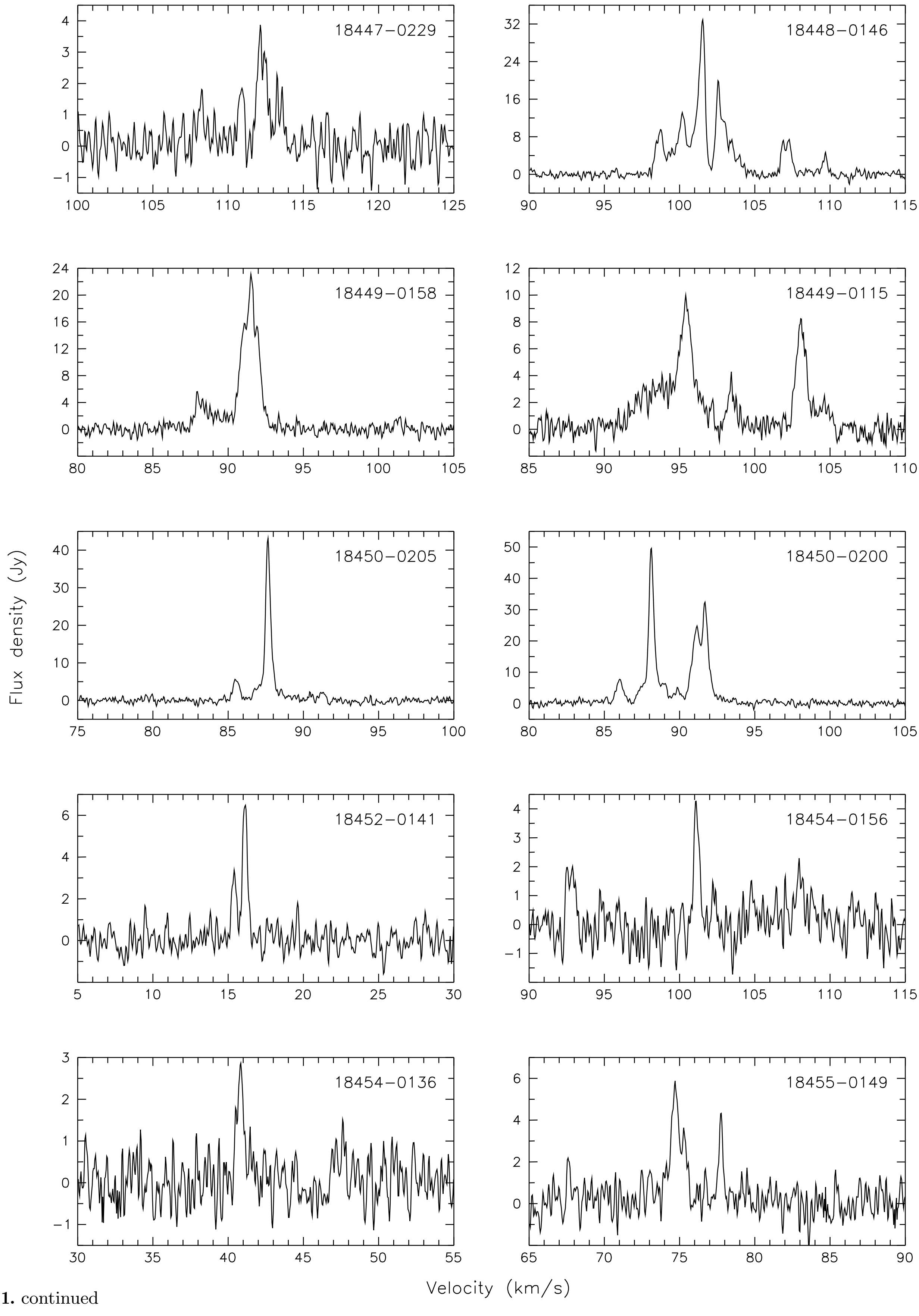

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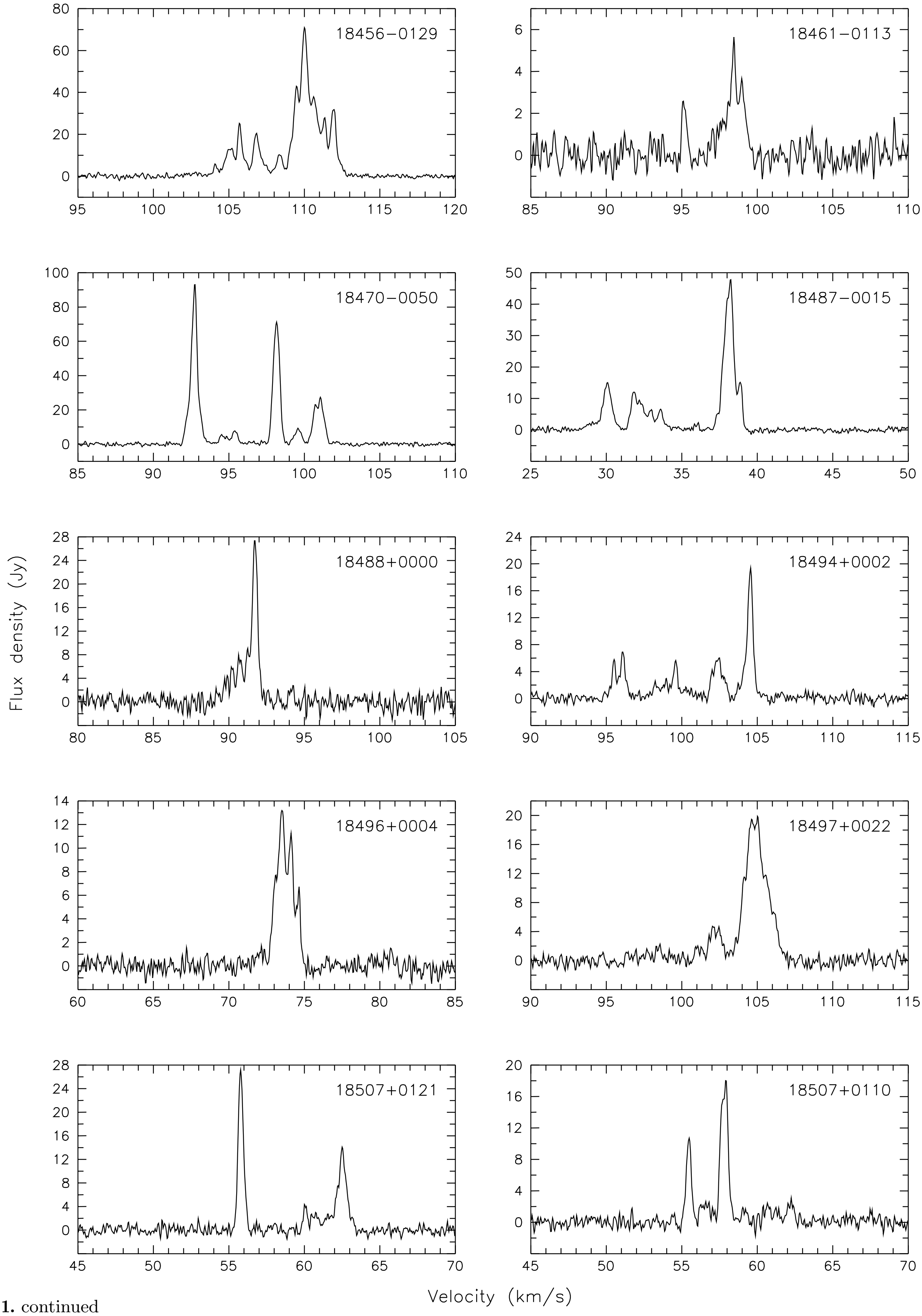

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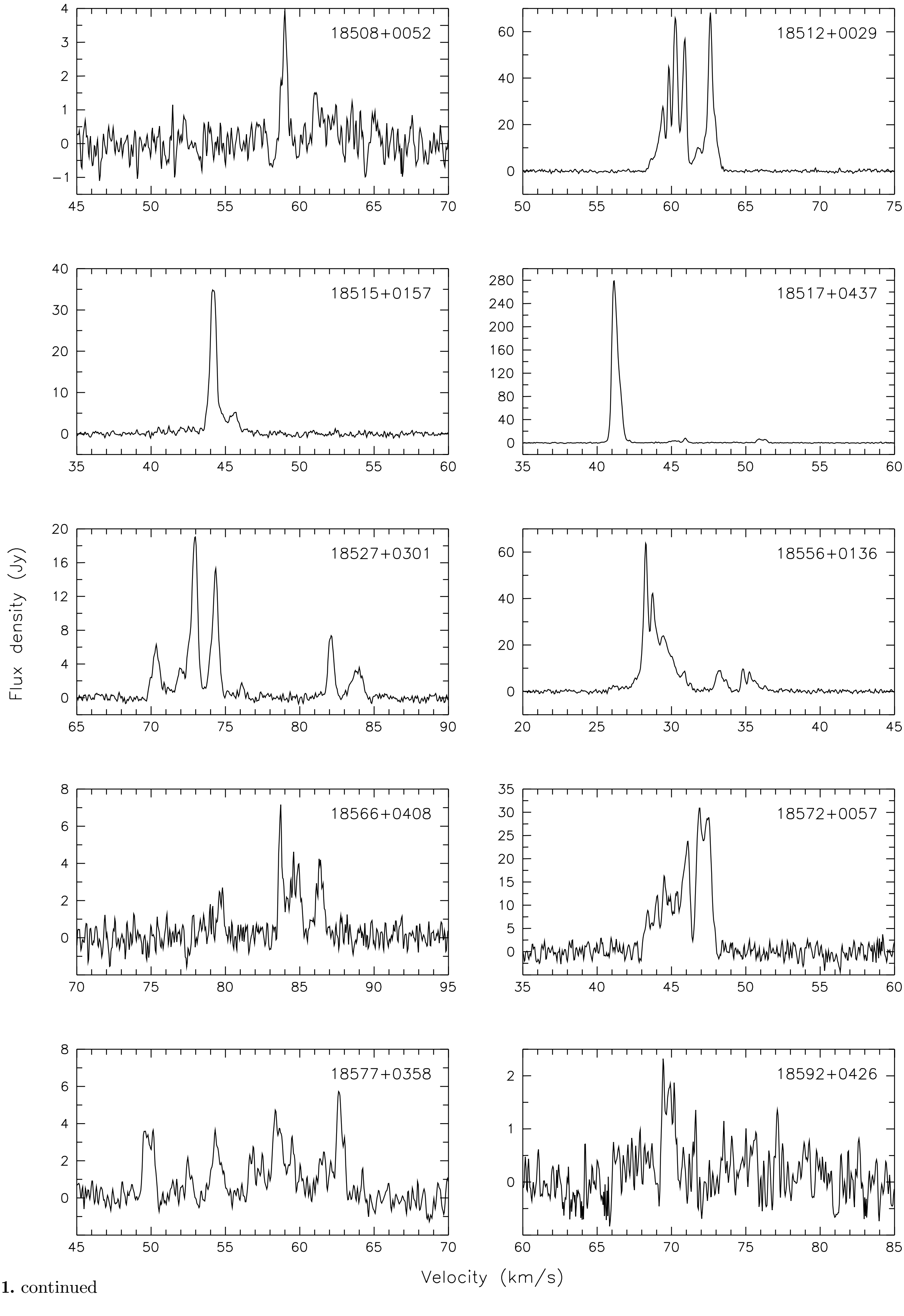

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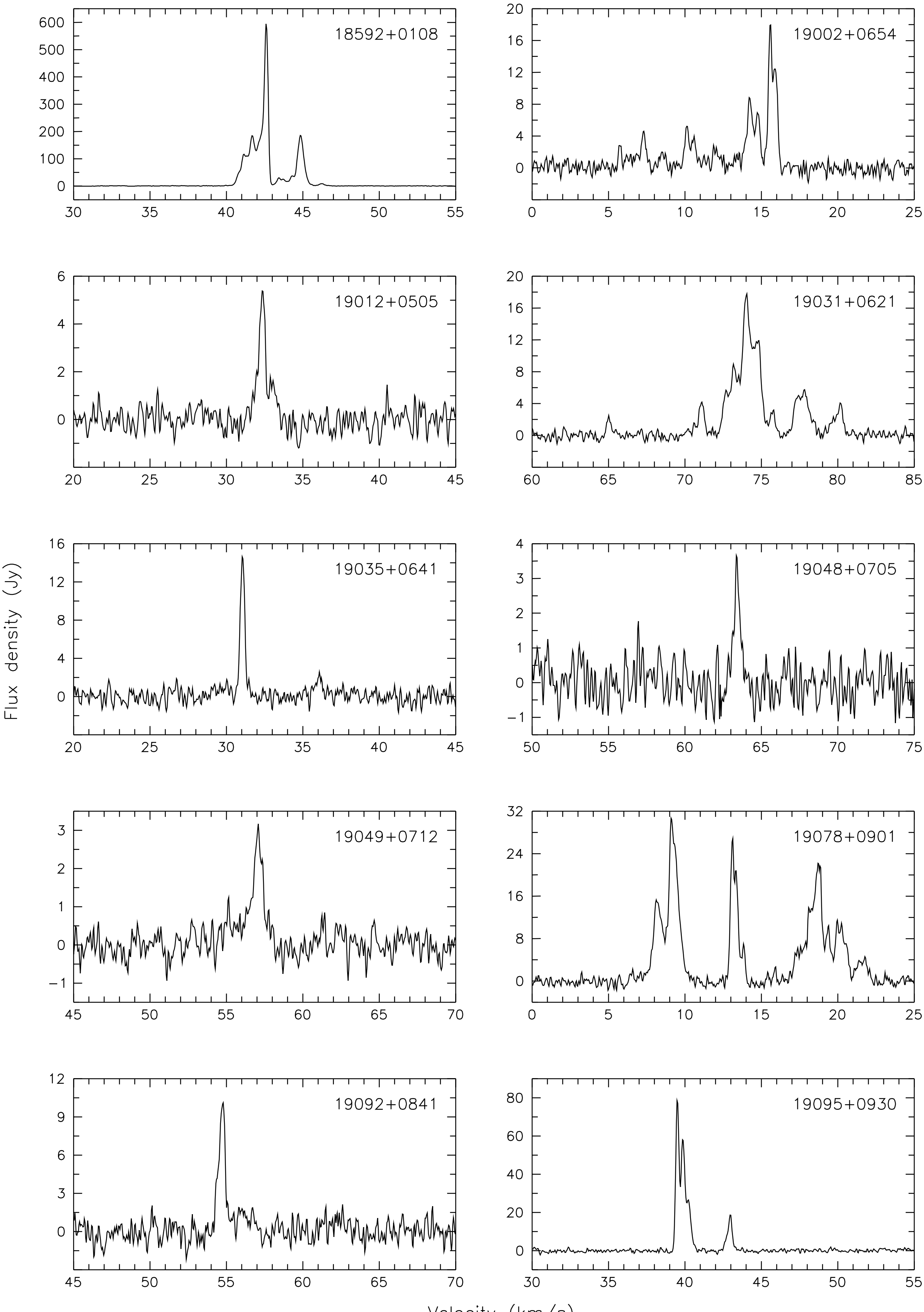

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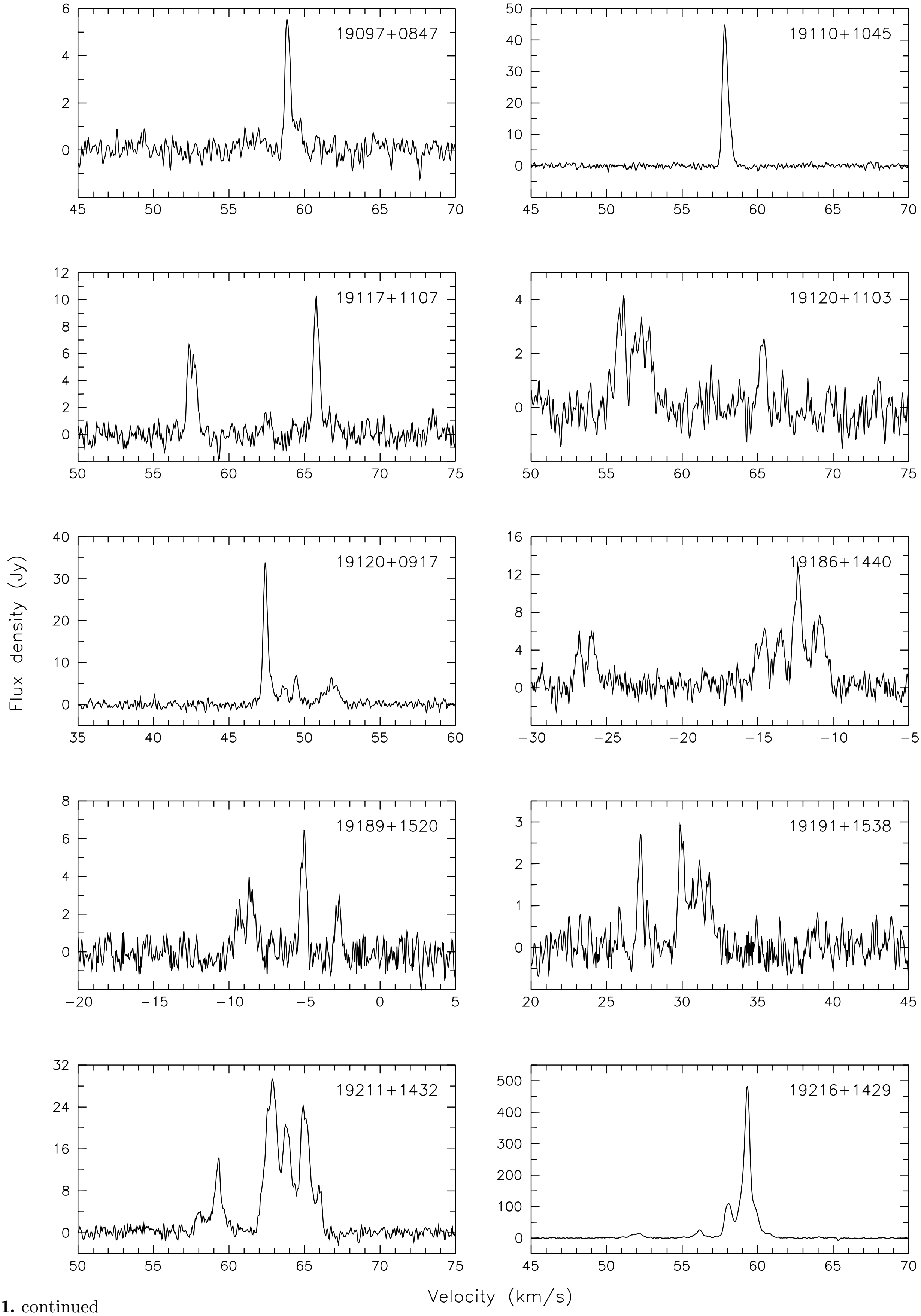

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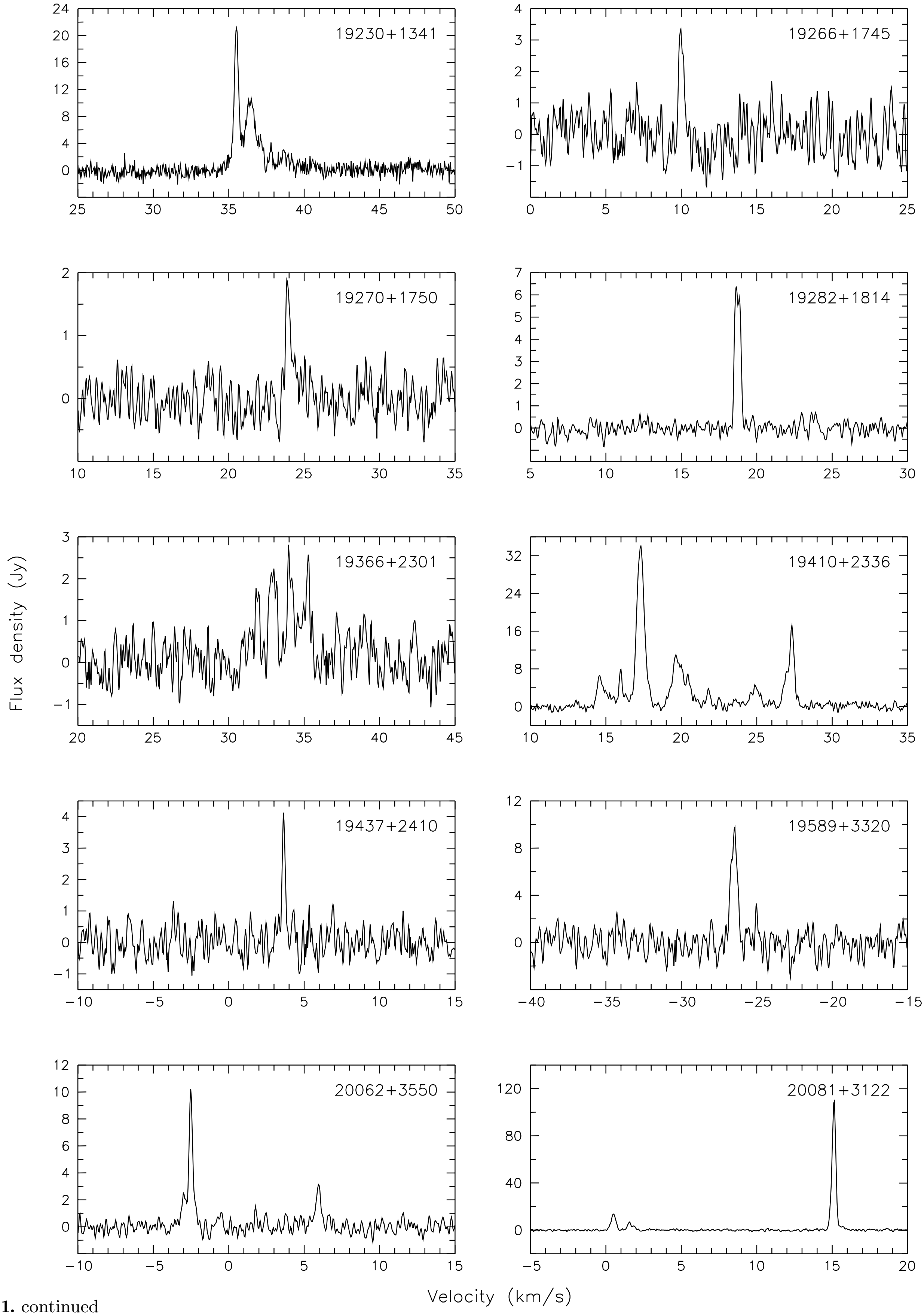

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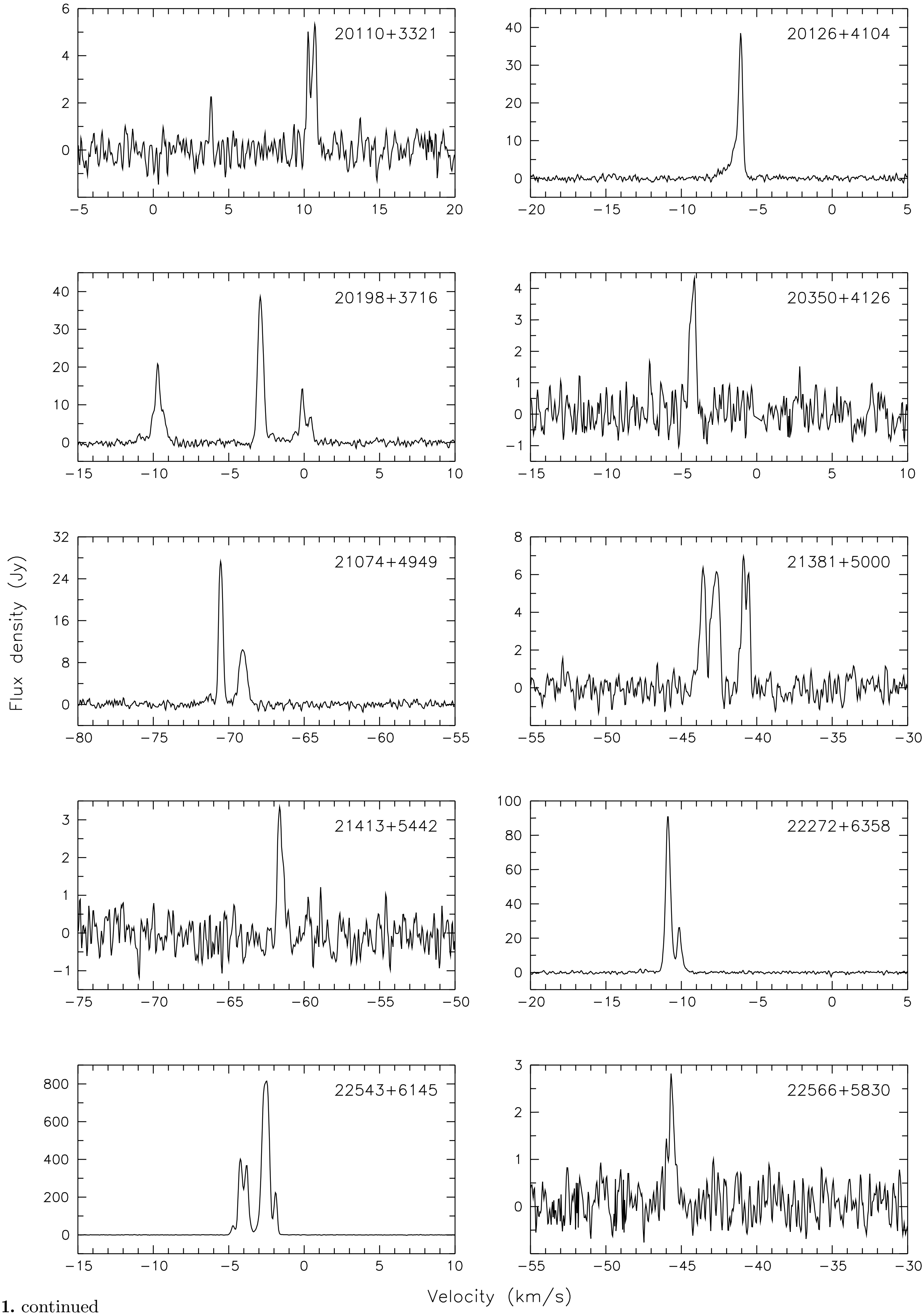

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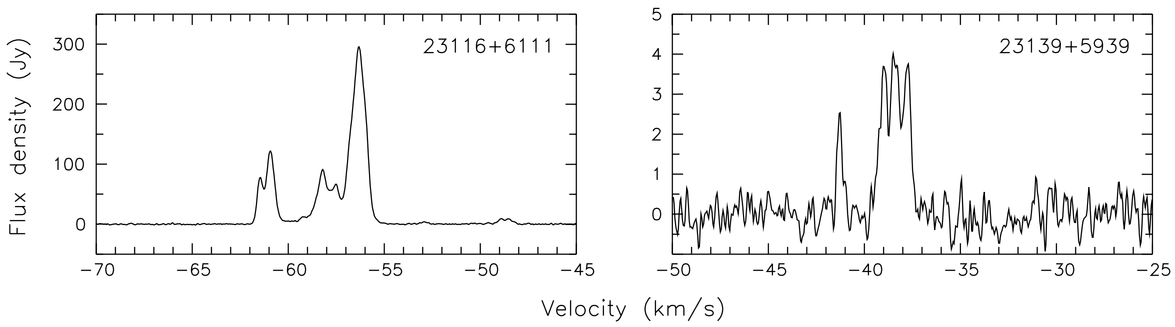

Fig. 1. continued

18141−1626. The methanol emission of this source is peaked at 27 km s^{-1} and is within the velocity interval of methanol emission from 18141−1615 located about 11′ away. At a position 3.′1 from the source, Jaffe et al. (1981) found H_2O maser with the main feature at 37 km s^{-1}.
18155−1554. van der Walt et al. (1995) failed to detect the methanol emission from this source to an upper limit of ∼5 Jy. Backer et al. (1994) found an ultracompact HII region with the flux density of 88.5 mJy at 5 GHz.
18264−1152. Bronfman et al. (1996) detected the CS(2−1) emission at 43.6 km s^{-1} that is close to the velocity of 46.8 km s^{-1}, where we found a single methanol feature.
18278−1009. We detected the methanol emission at 116.6 km s^{-1}. Molinari et al. (1996) found the ammonia lines at 94 and 98 km s^{-1}.
18282−1024. This source has an associated ultracompact HII region with the flux density of 96.2 mJy at 5 GHz (Backer et al. 1994).
18305−0826. van der Walt et al. (1995) did not detect the methanol emission to an upper limit of ∼5 Jy. Easy detection of the methanol maser in our survey suggests that the source is variable.
18321−0854. Towards this source Codella et al. (1995) found the water maser emission at 79 km s^{-1} that is well within the velocity range of methanol emission from 72 to 83 km s^{-1}. Methanol emission at velocities lower than 76 km s^{-1} appears to come from 18324−0855.
18324−0855. The methanol maser spectrum from this sources is contaminated by emission from 18321−0854. Both sources were observed at the same epoch and we conclude that only emission at velocities lower than 76 km s^{-1} comes from 18324−0855.
18326−0802. This source probably coincides with an ultracompact HII region with the flux density of 32.6 mJy at 5 GHz (Backer et al. 1994).
18337−0707. An ultracompact HII region with the flux density of 110 mJy at 5 GHz was found towards this source (Backer et al. 1994).
18372−0537. Bronfman et al. (1996) found the CS(2−1) line at 111.5 km s^{-1} that is near to the velocity of the methanol feature at 107.1 km s^{-1}. This source is associated with an ultracompact HII region with the flux density of 70.6 mJy at 5 GHz (Backer et al. 1994).
18372−0541. We detected the methanol emission at 24.6 km s^{-1} that is virtually the same as the velocity of CS emission (23.6 km s^{-1}) observed by Bronfman et al. (1996). The source has an associated ultracompact HII region with the flux density of 76.1 mJy at 5 GHz (Backer et al. 1994).
18391−0504. An ultracompact HII region with the flux density of 53.1 mJy at 5 GHz was possibly detected towards this source (Backer et al. 1994).
18402−0403. With a probability of 0.86 this source is associated with 5 GHz emission of 49.5 mJy (Backer et al. 1994).
18441−0134. This source has an associated ultracompact HII region with the flux density of 3.6 mJy at 5 GHz (Backer et al. 1994).
18454−0136. The CS(2−1) emission found at 38.9 km s^{-1} (Bronfman et al. 1996) is very close to the methanol feature detected here at 40.8 km s^{-1}. Backer et al. (1994) identified an ultracompact HII region with the flux density of 14.7 mJy at 5 GHz.
18527+0301. Towards this source the ammonia lines were found (Molinari et al. 1996) at 76 km s^{-1}, i.e. exactly within the methanol emission velocity range 70 to 85 km s^{-1}.
18577+0358. We detected the methanol emission in the velocity interval 49 to 63 km s^{-1}. The CS(2−1) emission was found at 52.9 km s^{-1} (Bronfman et al. 1996). The H_2O maser emission is centred at 45 km s^{-1} (Hofner & Churchwell 1996). Towards this source two ultracompact HII regions with flux densities of 42.5 and 345.3 mJy at 5 GHz were found (Backer et al. 1994).
18592+0426. The CS(2−1) emission was found at 83.5 km s^{-1} (Bronfman et al. 1996), whereas we observed the methanol emission in the velocity range from 69 to 71 km s^{-1}. An ultracompact HII region of the flux density of 21.3 mJy at 5 GHz was found (Backer et al. 1994).
19048+0705. H_2O maser was found at 66.7 km s^{-1} (Scalise et al. 1989), whereas we found a methanol feature at 63.4 km s^{-1}.
19097+0847. We detected the methanol emission at

58.8 km s^{-1}, while Bronfman et al. (1996) found the CS(2−1) emission at 57.3 km s^{-1}. The H_2O maser emission is centred at 50 km s^{-1} (Hofner & Churchwell 1996).

19191+1538. Bronfman et al. (1996) found the CS(2−1) emission at 25.8 km s^{-1} that is close to the velocity interval of methanol emission from 26 to 33 km s^{-1}.

19266+1745. The methanol line at 10 km s^{-1} is near to the CS(2−1) emission at 5 km s^{-1} found by Bronfman et al. (1996).

19282+1814. The methanol emission at 18.7 km s^{-1} is likely to be associated with a source of the CS(2−1) emission at 23.6 km s^{-1} (Bronfman et al. 1996) and the ammonia lines at 24.1 km s^{-1} (Molinari et al. 1996).

19366+2301. The CS(2−1) emission found at 32.9 km s^{-1} (Bronfman et al. 1996) is well within the velocity interval of methanol emission from 31 to 36 km s^{-1}.

19437+2410. The CS(2−1) emission found at 4.9 km s^{-1} (Bronfman et al. 1996) is near to the velocity of the methanol feature at 3.6 km s^{-1}.

20110+3321. We found the methanol emission at 4.0 and 10.7 km s^{-1}. The H_2O maser emission was detected in the velocity range from 13.6 to 18.6 km s^{-1} with the peak flux of 72 Jy at 16.4 km s^{-1}, whereas the 1667 MHz OH maser line was found at 7.4 km s^{-1} (Lewis & Engels 1993).

21413+5442. The methanol emission was found at −61.6 km s^{-1} in the survey. The 1612 and 1665 MHz OH emission was reported at −61 km s^{-1} (Cohen et al. 1988). The excited OH maser emission at 4765 MHz (Cohen et al. 1991) and at 6035 MHz (Baudry et al. 1997) was found near −62 km s^{-1}. Scalise et al. (1989) reported the H_2O maser centred at about −60 km s^{-1}. The CO(1−0) emission was found at −64 km s^{-1} (Wouterloot & Brand 1989). The CS(2−1) emission at the same velocity was reported (Bronfman et al. 1996).

22566+5830. We found a single methanol feature at −45.7 km s^{-1}. The CO(1−0) emission was detected at −50.5 km s^{-1} (Wouterloot & Brand 1989). The CS(2−1) line at nearly the same velocity of −50.3 km s^{-1} was reported by Bronfman et al. (1996). Wouterloot et al. (1993) found the H_2O maser emission in the velocity range from −67 to −40 km s^{-1}.

23139+5939. The 6.7 GHz methanol line was detected in the velocity range from −42 to −37 km s^{-1}. Bronfman et al. (1996) found the CS(2−1) line at −44.7 km s^{-1}. Wouterloot et al. (1993) found the H_2O maser emission in the velocity range from −57 to −31 km s^{-1}.

4.2. Known detections

Most of early observations of the 6.7 GHz methanol masers were carried out at different epochs in 1991 and 1992 (Menten 1991; MacLeod & Gaylard 1992; Gaylard & MacLeod 1993; Schutte et al. 1993; Caswell et al. 1995; van der Walt et al. 1995). Subsequent surveys were made in 1993−1994 (Lyder & Galt 1997; Walsh et al. 1997) and in 1995 (Slysh et al. 1999). Therefore, a comparison of those observations with our own data can provide some information on the variability of methanol masers on time-scales of 4 and 7−8 years.

00338+6312. MacLeod et al. (1998) first reported the methanol emission. They found a double-peaked spectrum with the main feature of 8.1 Jy at velocity −22.7 km s^{-1}. Slysh et al. (1999) reported the peak flux value of 10 Jy, but our value is 14 Jy. This suggests that the source is variable.

00494+5617. The 6.7 GHz maser was first reported by Slysh et al. (1999). Their peak flux density of a feature at −29 km s^{-1} was 12 Jy, whereas our peak value is 24 Jy. We found a new feature at −36 km s^{-1}. This suggests that the source is strongly variable.

02455+6034. The methanol maser with a double peaked spectrum was discovered by Lyder & Galt (1997). Our data indicate that the feature at −45 km s^{-1} decreased from 35 to 21 Jy, whereas that at −42 km s^{-1} disappeared after ∼4.5 years, suggesting that the source is strongly variable. This source was also observed by Slysh et al. (1999), who listed in their Table 1, a 24 Jy peak flux density for −45.3 km s^{-1} feature, but a lower value of 17 Jy is shown in their Fig. 1.

05274+3345. Our methanol spectrum of this source is only slightly different from that reported by Gaylard & MacLeod (1993). Comparison with data published by Slysh et al. (1999) suggests that at least the main feature at 4 km s^{-1} exhibits a strong variation.

05358+3543. Menten (1991) found the 6.7 GHz emission at the position of S231 that is 51″ away from the IRAS position. Our spectrum consists of 3 strong narrow features (0.10 − 0.14 km s^{-1} full width to half power (FWHP)). A weaker emission is present over the velocity interval of ∼5 km s^{-1}, similar to that reported by Menten (1991). He obtained the peak flux density of 208 Jy, whereas our value is 256 Jy, indicating that the source is variable.

05480+2545. We found two emission complexes in the same velocity range as reported by Slysh et al. (1999). However, their data on this source are uncertain as the peak flux density given in their Table 1 is obviously different from that shown in their Fig. 1.

06053−0622. Our peak flux density of 166 Jy is virtually the same as that reported by Menten (1991). Caswell et al. (1995) published the methanol spectrum that is completely different from ours. This suggests that the source is strongly variable.

06055+2039. The methanol feature at velocity 5.5 km s^{-1} appears to be non-variable as compared to the data published by Menten (1991) and Caswell et al. (1995). However, the intensity of the feature at 4 km s^{-1} measured by Caswell et al. (1995) was about twice as large as our value of 17 Jy. No methanol emission was found by Walsh et al. (1997) with a sensitivity limit of 5 Jy.

It appears that at least 4 km s^{-1} feature is strongly variable.

06056+2131. We detected the methanol spectrum composed of two narrow features (0.12 km s^{-1} FWHP) similar to those reported by Caswell et al. (1995). The maser feature at 11 km s^{-1} is a sidelobe response to 06058+2138 (Caswell et al. 1995; Slysh et al. 1999).

06058+2138. The intensity and shape of the methanol spectrum observed in our survey are almost unchanged as compared to the observations by Menten (1991) and Caswell et al. (1995).

06099+1800. The same comment as for **06058+2138**.

06117+1350. Menten (1991) found a methanol feature at 15 km s^{-1} about twice as strong as in our and in Caswell's et al. (1995) spectra. The source may be variable.

07299−1651. MacLeod & Gaylard (1992) reported a 42 Jy peak flux density of methanol emission, whereas Caswell's et al. (1995) value was 162 Jy. Walsh et al. (1997) observed the strongest feature of 180 Jy, but our value is 217 Jy. Evidently, the intensity is variable while the shape of the spectrum is almost unchanged since its discovery.

18056−1952. This source is 29″ and 22″ away from W31(1) (Menten 1991) and 10.47+0.03 (Caswell et al. 1995), respectively. Menten's observations gave the peak flux density of 823 Jy. Our methanol spectrum has a similar shape to that observed by Caswell et al. (1995), with an exception of the feature at 75 km s^{-1} which intensity decreased from 61 Jy to 17 Jy. The methanol spectrum is strongly confused by the emission of the nearby sources 10.45−0.02 and 10.48+0.03 (Caswell et al. 1995).

18056−1954. Caswell et al. (1995) obtained a similar methanol spectrum at the position of 10.45−0.02 that is 1.′5 away from the IRAS position, but the intensity was about twice as large as ours. The spectrum is strongly confused by the emission from 10.47+0.03 and 10.48+0.03 (Caswell et al. 1995).

18067−1927. A single methanol feature of 20 Jy at 24 km s^{-1} was discovered by Schutte et al. (1993). Its intensity of 18 Jy was reported by Walsh et al. (1997), while our value is 15 Jy. These differences may be due to variability but an effect of calibration uncertainties cannot be excluded.

18089−1732. Menten (1991) first discovered this methanol source. The spectrum published by Caswell et al. (1995) is quite similar to that obtained in our survey, but some individual features are considerably variable.

18090−1832. Within the calibration uncertainties the peak intensity of the methanol maser measured in our survey is the same as reported elsewhere (Menten 1991; Caswell et al. 1995).

18092−1842. The general shape of the methanol spectrum taken in our survey is similar to that reported by Caswell et al. (1995). When comparing our data with those published by Menten (1991) and Caswell et al. (1995), we note a gradual decrease of maser intensity.

18094−1840. A weak methanol emission detected in the velocity range from 45 to 49 km s^{-1} comes from this source (Caswell et al. 1995). At velocities lower than 45 km s^{-1} our spectrum is contaminated by the emission from 18092−1842.

18097−1825. We found the methanol emission in the same velocity range as observed by Menten (1991). Our spectrum taken with a larger beamwidth is strongly confused by emission from two nearby sources 12.20−0.11 and 12.20−0.12 (Caswell et al. 1995).

18099−1841. The main methanol feature at 60.2 km s^{-1} detected in our survey has the same intensity as reported by Walsh et al. (1997).

18102−1800. We detected at least 6 narrow methanol features (<0.20 km s^{-1} FWHP). The emission in the velocity interval 52 to 59 km s^{-1}, also reported by Slysh et al. (1999), comes from 18108−1759.

18108−1759. This methanol source is 3.′8 away from W33B discovered by Menten (1991) and 3.′4 away from 12.68−0.18 published by Caswell et al. (1995). In consequence, our peak flux density is lowered by a factor of about two.

18110−1854. Our methanol spectrum is similar to that published by Caswell et al. (1995). Within the measurement errors our peak value is the same as reported by Menten (1991).

18117−1753. The peak flux densities of methanol maser measured by Menten (1991) and Caswell et al. (1995) were 327 and 317 Jy respectively, but our value of 242 Jy is considerably lower. This suggests that the source is variable.

18128−1640. Our methanol spectrum is similar to that discovered by Slysh et al. (1999), but the intensity of the feature at 15.3 km s^{-1} decreased from 200 Jy to 135 Jy. This suggests that at least this main feature is variable.

18134−1942. The methanol maser was found by Schutte et al. (1993), who reported the peak flux of 248 Jy. Walsh et al. (1997) reported the peak value of 160 Jy, while our value is 116 Jy. Furthermore, the intensities of individual features in our spectrum differ significantly from those published by Schutte et al. (1993). This source is strongly variable.

18141−1615. This methanol source was undetected by van der Walt et al. (1995) with a sensitivity limit of about 5 Jy. Walsh et al. (1997) found a weak (2.3 Jy) emission in the velocity range from 19 to 35 km s^{-1}. We detected the methanol emission of similar intensity.

18144−1723. MacLeod et al. (1998) detected the methanol emission in the velocity interval 48 to 53 km s^{-1} with the peak flux density of 24 Jy. Our peak value of 33 Jy is higher, possibly due to a higher spectral resolution.

18151−1208. A single methanol feature of 46 Jy at 27.8 km s^{-1} was discovered by van der Walt et al. (1995). Slysh et al. (1999) reported the peak flux density of 72 Jy. Within the measurement accuracy our data give the same peak flux density, but the spectrum has three features. The source is likely variable.

18174−1612. We observed the main methanol feature of 19 Jy at velocity 20.9 km s^{-1}. Menten (1991) obtained the peak flux density of 49 Jy, while Caswell's et al. (1995) value was 39 Jy. This suggests that the maser intensity decreased. The shape of our spectrum is similar to that published by Caswell et al. (1995).

18182−1433. We detected a methanol feature with the peak flux density of 24 Jy similar to that reported elsewhere (Menten 1991; Caswell et al. 1995). However, we note significant differences in the relative intensities of individual features when comparing our spectrum with that published by Caswell et al. (1995).

18196−1331. The methanol feature of 20 Jy at 20.5 km s^{-1} detected in our survey has approximately the same intensity as that reported by MacLeod & Gaylard (1992) and Caswell et al. (1995). This suggests that the source is not variable.

18217−1252. Menten (1991) detected the methanol emission with the peak flux density of 28 Jy. During observations by Caswell et al. (1995) this peak was 23 Jy. Our value of 14 Jy suggests that the emission has decreased gradually over about 8 years' period.

18232−1154. This methanol source is offset by $1\farcm7$ to the position observed by Menten (1991), who found the methanol emission with the peak flux density of 24 Jy. Caswell et al. (1995) found two sources 19.47+0.17 and 19.48+0.15 with spectra contaminated by the emission from other nearby sources. Our spectrum is similar to that of 19.48+0.15.

18236−1241. The methanol emission discovered by Slysh et al. (1999) had a single feature with the peak flux density of 5 Jy. Our spectrum contains at least two narrow features of flux density of 2.3 Jy.

18236−1205. Walsh et al. (1997) found the methanol emission in the velocity range 24 to 31 km s^{-1} with the peak flux density of 26 Jy. We obtained quite different spectrum with the peak flux density of 6.7 Jy. This allows us to conclude that the source is strongly variable.

18244−1155. Comparing our methanol data with those published by Caswell et al. (1995) we note a decrease of intensity by a factor of about two.

18249−1116. Menten first detected this methanol source with the peak flux density of 112 Jy. Our spectrum with the peak flux of 94 Jy is similar to that published by Caswell et al. (1995) where the peak flux density was 100 Jy. The source exhibits only a weak variation of intensity, if any.

18265−1517. This methanol source was first detected by Walsh et al. (1997). Our measurements indicate that within the uncertainty of about 15% the methanol emission is unchanged.

18282−0951. The peak flux density (15 Jy) of methanol emission previously reported (Menten 1991; Caswell et al. 1995) was about a factor of 5 higher than that measured in our survey. This suggests that the source is variable.

18290−0924. The methanol emission had the peak flux density of 21 Jy during discovery observations (Schutte et al. 1993). Our value of 12 Jy is the same as reported by Walsh et al. (1997). This source may be variable.

18310−0825. Our data indicate that this source has the methanol maser with the peak flux density of 12 Jy that is nearly the same as reported by Schutte et al. (1993). However, data presented by Walsh et al. (1997) and Slysh et al. (1999) suggest that the source is strongly variable.

18316−0602. A prominent methanol feature at 42 km s^{-1} has the same intensity as published by Slysh et al. (1999). Previous observations gave its value of a factor of two lower (van der Walt et al. 1995; Walsh et al. 1997). We detected a broad emission from 38 to 44 km s^{-1} about twice as strong as that observed by Walsh et al. (1997).

18317−0845. Schutte et al. (1993) first detected the methanol emission with the peak flux of 12 Jy. Other observations indicate a significant decrease of intensity by a factor of two (Walsh et al. 1997; Slysh et al. 1999). Our data give the peak flux density of 4.4 Jy and confirm a gradual decrease of intensity.

18319−0834. We detected the methanol emission in the velocity range from 95 to 108 km s^{-1}, similar to that reported by Menten (1991). Our spectrum is quite different from that published by Caswell et al. (1995). A mean level of maser emission in the velocity range 95−100 km s^{-1} measured in our survey was comparable to that observed by Caswell et al. (1995), but emission at 101−108 km s^{-1} decreased about twice.

18324−0737. The methanol emission with the peak flux density of 3 Jy was first detected by Menten (1991). Observations by Caswell et al. (1995) provided the peak flux of about 11 Jy. In our survey the shape of the spectrum was generally similar to that published by Caswell et al. (1995), but the peak flux density decreased to 4.6 Jy. This suggests that the source is variable.

18324−0820. Schutte et al. (1993) first found the methanol emission in the velocity range 75 to 81 km s^{-1} with the peak flux density of 28 Jy. In the same velocity range a similar peak flux was reported by Slysh et al. (1999), but individual features appeared to be variable. Walsh et al. (1997) observed the maser emission in the velocity range 58 to 81 km s^{-1} with the peak flux density of 26 Jy. The present observations revealed the emission in the velocity range 75 to 85 km s^{-1} with the peak flux density of 9.2 Jy. We conclude that the source is strongly variable.

18334−0733. The methanol emission of 33 Jy at 114.5 km s^{-1} was first detected by van der Walt et al. (1995). Slysh et al. (1999) found the peak flux of 42 Jy at similar velocity. Our peak value of 29 Jy is nearly the same as measured by van der Walt et al. (1995). We detected two weak features at 111 and 113 km s^{-1} not seen in other observations. The source appears to be variable.

18335−0713. The source was first detected at 6.7 GHz by Menten (1991), who reported the peak flux density of 89 Jy. A similar value of 82 Jy was published by Caswell et al. (1995). We note that their spectrum is very similar to ours, with the peak flux density of 97 Jy.

18341−0727. We detected the methanol line at the same velocity as Slysh et al. (1999). Our peak flux of 3.5 Jy is a factor of 4.5 lower than their value. This suggests that the maser is variable.

18345−0641. van der Walt et al. (1995) found the methanol emission in the velocity range from 94 to 100 km s^{-1}. Our observations indicate that their main peak of ∼45 Jy at ∼99 km s^{-1} decreased to about 2 Jy, while a low intensity emission in the velocity range 94 to 98 km s^{-1} is now dominated by two well-separated features. We conclude that the source is strongly variable.

18353−0628. The shape of the methanol spectrum taken in our survey is generally the same as observed by Walsh et al. (1997). However, the main feature at 96 km s^{-1} increased from 225 Jy (Walsh et al. 1997) to 364 Jy at the time of our observations. This suggests that the source is variable.

18361−0627. Schutte et al. (1993) first detected the methanol emission from this source. They listed the peak flux density of 54.1 Jy, whereas their Fig. 2 indicates a value of ∼80 Jy. The intensity of the main feature at 92 km s^{-1} obtained by Walsh et al. (1997) was 7.4 Jy, while our value is 20 Jy. This suggests that the source is strongly variable.

18379−0500. This methanol source was first discovered by Slysh et al. (1999). In their Table 1 they listed the peak flux density of 41 Jy, but their Fig. 1 indicates a value of ∼27 Jy at velocity 35 km s^{-1}. We found a 21 Jy feature at the same velocity.

18379−0546. van der Walt et al. (1995) found a single methanol feature of 10 Jy at about 104 km s^{-1}. Slysh et al. (1999) found a similar intensity of this feature and detected another feature at 115 km s^{-1}. Our data indicate that the latter feature has the same intensity as reported by Slysh et al. (1999), whereas the intensity of the feature at 104 km s^{-1} increased by a factor of two. The source is likely variable.

18403−0417. Towards this source a weak (∼3 Jy) methanol emission was detected in the velocity range 94 to 102 km s^{-1} (Menten 1991; Caswell et al. 1995; Walsh et al. 1997). With our beamwidth the spectrum is contaminated by the emission from the nearby source 28.15+0.00 (Caswell et al. 1995), which is 4$'$.6 away from the IRAS position, nevertheless, our peak flux density is about twice larger than that reported by Caswell et al. (1995).

18416−0420. The methanol maser was first found by Schutte et al. (1993). Their spectrum had a single asymmetric feature at 81 km s^{-1} with the peak flux density of 59 Jy. Observations by Walsh et al. (1997) gave the peak value of 62 Jy, exactly the same as ours. The peak flux density of 75 Jy measured by Slysh et al. (1999) differs by about 18% from all previous values. This suggests that the methanol emission does not change at all. Our observations revealed that there are several weak features in the velocity ranges of 79−83 and 91−93 km s^{-1}.

18421−0348. The source was first detected at the 6.7 GHz maser line by Menten (1991), who reported the peak flux density of 85 Jy. Caswell et al. (1995) found a peak flux density of 73 Jy, while our value is 58 Jy. A comparison of our spectrum with Caswell's et al. spectrum indicates that individual features are variable.

18434−0242. The methanol spectrum obtained in our survey does not differ from that observed earlier (Menten 1991; Caswell et al. 1995). Emission at velocities higher than 102 km s^{-1} comes from two nearby sources (Caswell et al. 1995).

18440−0148. Menten (1991) first detected the methanol emission with the peak flux density of 4 Jy. Data published by Caswell et al. (1995) indicate that the main feature at 105 km s^{-1} decreased from 8 Jy to 3 Jy at the epoch of our measurements.

18441−0153. We detected the methanol emission in the velocity ranges of 47−49 and 70−89 km s^{-1} with the peak flux densities of 19 and 8 Jy respectively. With a smaller antenna beam, Caswell et al. (1995) found two separate sources 30.78+0.23 with the peak flux density of 24 Jy at 49 km s^{-1} and 30.79+0.20 with the peak flux density of 23 Jy at 86 km s^{-1}. A comparison of our observations with Caswell's et al. data suggests that the first source does not vary at all, but the intensity of methanol emission from the second source decreased by about a factor of three.

18443−0231. Menten (1991) reported the methanol emission in the velocity range 100 to 115 km s^{-1}, exactly the same as we observed. Caswell et al. (1995) found two sources; 30.20−0.17 with the methanol emission of about 18.7 Jy at velocities lower than 111 km s^{-1} and 30.22−0.18 at velocities greater than 111 km s^{-1}. Our peak value of the feature at 108 km s^{-1} is the same as reported by Caswell et al. (1995), whereas the intensity of 113 km s^{-1} feature is about twice lower.

18446−0209. The peak flux density of 5 Jy was reported by Menten (1991). The methanol spectrum published by Caswell et al. (1995) contains several weak features in the velocity range 36 to 49 km s^{-1} and the peak value of 7.5 Jy at velocity 42.4 km s^{-1}. We detected a 4.8 Jy feature at nearly the same velocity.

18447−0229. The maser emission from this source is uncertain. Caswell et al. (1995) found the emission in the velocity range 111 to 115 km s^{-1} with the peak of 11.7 Jy at 113 km s^{-1} at offset of 5$'$.3 to the IRAS position. We found emission at similar velocity; it was about four times weaker than that reported by Caswell et al. (1995).

18448−0146. The methanol spectrum towards this source is nearly the same as that reported by Schutte et al. (1993) towards 18446−0150. Angular separation between both sources is 3′. We observed 18446−0150 at the same epoch and obtained the intensity of the emission about three times lower than that measured from 18448−0146. Walsh et al. (1997) reported a 2.4 Jy methanol feature from 18446−0150. We conclude that the strongest methanol emission comes from 18448−0146.

18449−0158. We detected the methanol emission in the velocity range 87 to 93 km s^{-1}. 2.′1 away from the IRAS position, a maser source with the peak flux density of 68 Jy at 92 km s^{-1} was found (Caswell et al. 1995). The shape of the spectrum and the intensity measured in our survey are quite different from that published by Caswell et al.

18449−0115. The methanol emission from this source was first detected by Schutte et al. (1993). Our spectrum is quite similar to that published elsewhere (Schutte et al. 1993; Caswell et al. 1995). This suggests that the source is not variable.

18450−0205. The general shape of the methanol spectrum obtained in the survey is similar to that observed by Caswell et al. (1995), but the intensity decreased by a factor of two.

18450−0200. Our methanol spectrum is contaminated by the emission from 18450−0205. Only emission at velocities larger than 90 km s^{-1} comes from the source. The peak flux density published by Caswell et al. (1995) is about twice higher than ours.

18452−0141. The methanol spectrum first published by Schutte et al. (1993) had two narrow features in the velocity range 15 to 17 km s^{-1}. Our spectrum is quite similar, but a redshifted feature decreased in intensity by a factor of two. Walsh et al. (1997) reported that this feature had the peak flux density of 3 Jy. This suggests that the source is variable.

18454−0156. The methanol emission was found by Menten (1991) and Caswell et al. (1995) 3.′9 away from the IRAS position. Due to the offset position our peak flux density of 4.3 Jy differs significantly from values of 21 and 18 Jy reported in the papers above.

18456−0129. Menten (1991) found the methanol emission in the velocity range 104 to 114 km s^{-1} with the peak flux density of 87 Jy. The general shape of the spectrum published by Caswell et al. (1995) is similar to ours, but the intensities of some individual features are different. The source is possibly variable.

18470−0050. Our methanol spectrum is very similar to that obtained towards 18470−0044 by van der Walt et al. (1995). However, in their Table 1 they listed this source as non-detection, whereas in their Table 2 the methanol line parameters are given for 18470−0049. We made the observations of all three sources at the same epoch. It appeared that the strongest emission comes from 18470−0050.

18487−0015. The methanol emission first found by Menten (1991) had the peak flux density of 46 Jy. A similar value of 47 Jy was reported by Caswell et al. (1995). Our measurements give the same peak flux density and the spectrum similar to that published by Caswell et al. (1995). However, we note a considerable decrease of intensity of the features at about 33 km s^{-1}.

18488+0000. The methanol maser from this source was discovered by van der Walt et al. (1995). Our observations give a spectrum of the same shape as that reported by van der Walt et al. (1995) and Slysh et al. (1999). The peak flux density of the main feature at 92 km s^{-1} increased from 16 Jy (van der Walt et al. 1995) to 21 Jy (Slysh et al. 1999), whereas our peak value is 27 Jy. This suggests that the source is variable.

18494+0002. The methanol emission was found in the velocity range 95 to 106 km s^{-1} (Caswell et al. 1995). We found the emission at the same velocities but intensities of individual features are quite different.

18496+0004. We found the maser emission with the peak flux density of 13 Jy. Similar values of 10 and 12 Jy were reported by Menten (1991) and Caswell et al. (1995) respectively. We also note that the shape of the spectrum is the same as published earlier. This source is likely to be non-variable.

18497+0022. The general shape of the methanol spectrum obtained here is similar to that reported by Slysh et al. (1999). Differences in intensities of individual features between Slysh's et al. observations and our data can result from our higher spectral resolution and sensitivity.

18507+0121. Schutte et al. (1993) detected the methanol emission at velocities of 55−64 km s^{-1}. Comparing their spectrum with ours, we see that the relative intensities of two prominent features significantly changed.

18507+0110. Menten (1991) discovered the methanol emission with the peak flux density of 32 Jy. Observations by Caswell et al. (1995) provided the peak value of 29 Jy, while we obtained a lower value of 18 Jy. This suggests that the source is variable. Caswell's et al. data indicated that emission at 56 km s^{-1} comes from a nearby source.

18515+0157. We found the methanol emission in the velocity range 44 to 47 km s^{-1}, which is similar to that reported by Menten (1991). Our peak flux density is 35 Jy, which is significantly lower than 50 Jy and 56 Jy, measured by Menten (1991) and Caswell et al. (1995) respectively, suggesting that this source is variable.

18517+0437. Schutte et al. (1993) found the methanol emission with the peak flux density of 298 Jy at velocity 41 km s^{-1}. We obtained nearly the same value of 279 Jy. The present observations revealed a weak ($\sim$7 Jy) emission near 45−46 and 51 km s^{-1}.

18556+0136. Menten (1991) first detected the methanol emission in the velocity range 27 to 34 km s^{-1} with the peak flux density of 107 Jy. The methanol spectrum published by Caswell et al. (1995) is quite different from that obtained here. This suggests that the source is variable.

18566+0408. Slysh et al. (1999) first found the methanol maser in this source. Their spectrum is similar to ours, obtained with higher spectral resolution and sensitivity.

18572+0057. van der Walt et al. (1995) detected the methanol emission with the peak flux density of 21 Jy. Our data indicate that the spectrum is composed of several narrow features of intensities comparable to those reported by Slysh et al. (1999). This source may be weakly variable.

18592+0108. This source was detected in the 6.7 GHz methanol line by Menten (1991), who found the peak flux density of 556 Jy. The same value was found by Caswell et al. (1995). Our peak flux density is 595 Jy. This suggests that the main feature does not vary. However, other features show considerable changes.

19002+0654. The methanol maser was discovered by Schutte et al. (1993). They found two features in the velocity interval of 13−17 km s^{-1}. Our observations revealed much broader velocity range of 5−16 km s^{-1}, where several weak features are seen.

19035+0641. Menten (1991) discovered the methanol maser in the velocity range 30 to 37 km s^{-1} with the peak flux density of 14 Jy. Caswell et al. (1995) reported a similar peak value of 17 Jy. We found the emission in the same velocity interval with the peak flux density of 15 Jy. This source is non-variable.

19078+0901. We obtained a very similar methanol spectrum as that discovered by Menten (1991). His peak flux density of 28 Jy is close to our value of 31 Jy. Caswell et al. (1995) found a cluster of three sources with methanol emission in the velocity range 6 to 22 km s^{-1}. A comparison of our data with those quoted above suggests that the source is non-variable.

19092+0841. MacLeod et al. (1998) discovered the methanol emission with the peak flux density of 11.6 Jy at 55 km s^{-1}. We obtained a similar spectrum with the peak value of 10 Jy, which suggests that the source is non-variable.

19095+0930. Menten (1991) discovered the methanol emission in the velocity range 30 to 44 km s^{-1} with the peak flux density of 152 Jy. In the same velocity interval, Caswell et al. (1995) found the peak flux density of 144 Jy. The present survey indicates that the emission at velocity 40 km s^{-1} decreased by a factor of two, but that at velocity 43 km s^{-1} has the same intensity as reported by Caswell et al. (1995).

19110+1045. The methanol emission discovered by Menten (1991) had the peak flux density of 42 Jy. Observations by Caswell et al. (1995) revealed a decrease of the peak value to 33 Jy. Our data give the peak value of 45 Jy, which is very similar to that reported by Menten (1991). This suggests that the emission from this source is variable.

19117+1107. We found the methanol emission in the velocity range 57 to 67 km s^{-1} which is similar to that reported by Menten (1991). Our peak flux density of 10 Jy is by a factor of 1.5 lower than that listed by Menten (1991). The data published by Caswell et al. (1995) indicated that the emission at about 57 km s^{-1} comes from 45.47+0.05, which is located 45″ away from IRAS source 19120+1103.

19120+1103. The methanol emission from this source was first discovered by Menten (1991). Our data confirm that the emission at velocities larger than 59 km s^{-1} is confused by the source 19117+1107, named 45.47+0.13 by Caswell et al. (1995).

19120+0917. Schutte et al. (1993) first detected the methanol maser. They found a spectrum with two features at 48 and 52 km s^{-1} and flux densities of about 10 Jy. Our observations revealed a quite different spectrum with the peak value of 34 Jy at about 48 km s^{-1}. This suggests that the source is strongly variable.

19216+1429. The methanol emission detected towards this source is likely to be a sidelobe response to W51 (Menten 1991; Caswell et al. 1995) that is 6.′8 away from 19216+1429.

19230+1341. van der Walt et al. (1995) first detected the methanol maser towards this source. Although their peak value of 24 Jy does not differ significantly from ours, we note very large changes in the spectrum shape.

19410+2336. This source was discovered by Menten (1991), who found the methanol emission in the velocity range 15 to 28 km s^{-1} with the peak flux density of 103 Jy. Caswell's et al. (1995) observations revealed the peak flux density of 42 Jy at 25 km s^{-1}, whereas our data show the strongest feature of 34 Jy at 17.3 km s^{-1} and the spectrum is completely different. This suggests that the source is strongly variable.

19589+3320. The methanol emission with the peak flux density of 22 Jy at velocity −26 km s^{-1} was first detected by Slysh et al. (1999). We found the main feature of flux density of 9.8 Jy at the same velocity. This source can be variable.

20062+3550. Slysh et al. (1999) discovered the methanol maser with a single peak of flux density of 32 Jy at velocity −3 km s^{-1}. Our data indicate that the intensity of this feature decreased to 10 Jy and a new feature appeared at 6 km s^{-1}. This suggests that the source is variable.

20081+3122. The methanol emission with the peak flux density of 91 Jy was first detected by Menten (1991). Our peak value is 109 Jy, suggesting weak variations of this source, if any.

20126+4104. The methanol maser was first reported by MacLeod & Gaylard (1992) and their peak flux density was 7 Jy. Slysh et al. (1999) published the methanol spectrum with two prominent features with the peak flux density of 61 Jy. Our survey revealed a single asymmetric feature of the flux density of 38 Jy. This suggests that the source is strongly variable.

20198+3716. This source was discovered in the 6.7 GHz line by Menten (1991). His peak flux density of 54 Jy is higher than ours (39 Jy). This is possibly due to variability.

20350+4126. Slysh et al. (1999) first reported the methanol maser from this source. They found a feature of 10 Jy at velocity -4 km s^{-1}. We found a 4 Jy feature at the same velocity. This suggests that the maser emission is variable.
21381+5000. Slysh et al. (1999) found the methanol emission in the velocity range from -45 to -39 km s^{-1} with the peak flux density of 19 Jy. Our observations revealed quite different spectrum with the peak value of 7 Jy. This suggests that the source is strongly variable.
22272+6358. The methanol emission was first reported by Slysh et al. (1999), who found the peak flux density of 109 Jy at -11 km s^{-1}. Their spectrum is similar to ours, with the peak value of 91 Jy.
22543+6145. This is one of the strongest sources of the 6.7 GHz methanol emission discovered by Menten (1991). He reported the peak value of 1420 Jy, while our value is 815 Jy. This indicates that the intensity of the main feature at -2.5 km s^{-1} decreased, whereas the intensities of other features do not show notable variations.
23116+6111. Menten (1991) found the methanol emission in the velocity range from -62 to -54 km s^{-1} with the peak flux density of 346 Jy. Our peak value of the main feature at -56.3 km s^{-1} is 296 Jy. We found a weak ($\sim$4$-$9 Jy) emission at velocities -53 and -49 km s^{-1}. Individual features at velocities lower than -55 km s^{-1} appear to be variable.

4.3. non-detections

02219+6152. The 6.7 GHz methanol emission from this source was reported by Slysh et al. (1999). With our beamwidth we also detected a weak ($\sim$7 Jy) emission in the velocity range from -46 to -42 km s^{-1}. The spectrum shape and the velocity range of this emission are very similar to those observed towards 02232+6138 (W3(OH)). This emission appears to be a sidelobe response to W3(OH).
18021−1950. The methanol emission of 0.4 Jy reported by Walsh et al. (1997) lies below our sensitivity limit.
18067−1921. A weak (0.7 Jy) methanol emission at velocity 20 km s^{-1} detected by Walsh et al. (1997) lies below our 3σ upper limit. A single feature observed at 24 km s^{-1} is a sidelobe response to 18067−1927.
18248−1158. Caswell et al. (1995) found a weak (0.4 Jy) methanol emission that lies below our 3σ detection limit.
18335−0711. The methanol maser was reported by Caswell et al. (1995). With our beamwidth this source is badly contaminated by 18335−0713.
18443−0210. The methanol emission with the peak flux density of 0.6 Jy was reported by Walsh et al. (1997), but lies below our 3σ detection limit.
18470−0044. Slysh et al. (1999) reported the methanol emission towards this source. We observed several nearby IRAS sources and found that the strongest emission comes from 18470−0050.
19220+1432. Slysh et al. (1999) found the methanol emission with the peak flux density of 10 Jy at velocity 60 km s^{-1}. We did not find any emission above 3σ upper limit of 1.8 Jy. This suggests that the source is strongly variable.
19388+2357. Schutte et al. (1993) observed a 24.7 Jy methanol feature at velocity 38 km s^{-1}. The peak value measured by Slysh et al. (1999) was 31 Jy. No emission was found in our survey with 3σ upper limit of 1.5 Jy. This suggests that the source is strongly variable.
22551+6139. MacLeod et al. (1998) and Slysh et al. (1999) reported the 6.7 GHz methanol emission. We detected the methanol emission towards this source but its velocity range and the peak ratio of two features are exactly the same as measured for 22543+6145. We conclude that this emission is a sidelobe response to 22543+6145.

5. Remarks on associations and variability

32 out of 70 new methanol masers have now been associated with at least one of the following emitters: radio continuum, CO, CS, NH_3 lines, H_2O and OH masers. 12 of them have an associated ultracompact HII region (Backer et al. 1994) and 15 objects exhibit the CS(2$-$1) emission (Bronfman et al. 1996). We identified 5 new sources associated with both 5 GHz radio continuum and CS line. Those associations strongly confirm that the methanol emission is an indicator of dense gas in regions of recent formation of massive stars (Menten 1991). To our knowledge nearly half of our new detections were not searched for radio continuum or lines.

Although the present survey differs significantly in spectral resolution and sensitivity from previous studies usually performed in various conditions, the existing data sets appear to be valuable to assess the variability of methanol masers on the time-scale of the 4 and 7$-$8 year intervals between observing runs. We found 96 sources with the 6.7 GHz maser data taken at least at two epochs and their line parameters being published. In previous section we compared the peak flux densities for all of them, but in several cases when spectra were published we also estimated the relative intensities of individual features. Four groups of objects were distinguished. The first one contains 23 sources without recognizable variations of maser intensity within the measurement accuracy of about 15%. In the second group of 11 sources most of them show weak variations of about 20% or poorly documented variations. We classified 46 sources as variable assuming that their peak flux densities changed by more than 20% but usually less than 50%. Into this group we also included sources with weak variations of peak flux densities but with considerable (more than 20%) changes of relative intensities of maser features. The fourth group is composed of 16 sources with strong variations of peak flux densities or intensity ratios of individual features commonly higher than 50%. Into this group we included two objects 19220+1432 and 19388+2357 undetected in our survey but previously observed as quite strong masers. This crude classification indicates that more than 65% of objects exhibit moderate or strong variations of maser emission and about 15% of sources do not vary at all.

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