Warm and cold gas in low-mass protostars : Herschel Space Observatory and ground-based surveys

Yildiz, U

A

Central source spectra

A.1 L1448MM

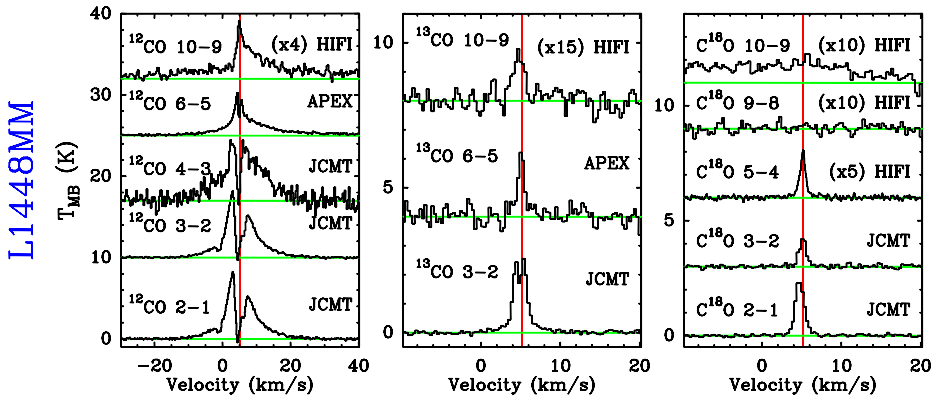

Figure A.1 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for L1448MM

Table A.1 – Observed line intensities for L1448MM in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	59.7	8.3	0.10
	3–2	JCMT-HARPB	0.63	32.1	4.2	0.09
	4–3	JCMT	0.38	87.5	7.5	0.77
	6–5[a]	APEX-CHAMP$^+$	0.46	46.1	5.7	0.12
	10–9	*Herschel*-HIFI[b]	0.64	21.5	...	0.15
^{13}CO	2–1	JCMT-RxA	0.74	9.8	6.5	0.07
	3–2	JCMT-HARPB	0.63	5.7	2.7	0.07
	6–5	APEX-CHAMP$^+$	0.48	2.9	2.7	0.34
	10–9	*Herschel*-HIFI[b]	0.74	0.3	0.1	0.02
C^{18}O	2–1	JCMT-RxA	0.69	3.5	2.4	0.06
	3–2	JCMT-HARPB	0.63	1.5	1.5	0.10
	5–4	*Herschel*-HIFI[b]	0.76	0.4	0.4	0.02
	9–8	*Herschel*-HIFI	0.74	<0.05	...	0.02
	10–9	*Herschel*-HIFI[b]	0.74	<0.06	...	0.02

[a]Gomez-Ruiz et al. in prep. [b]Only H-polarization observation is used.

A.2 IRAS2A

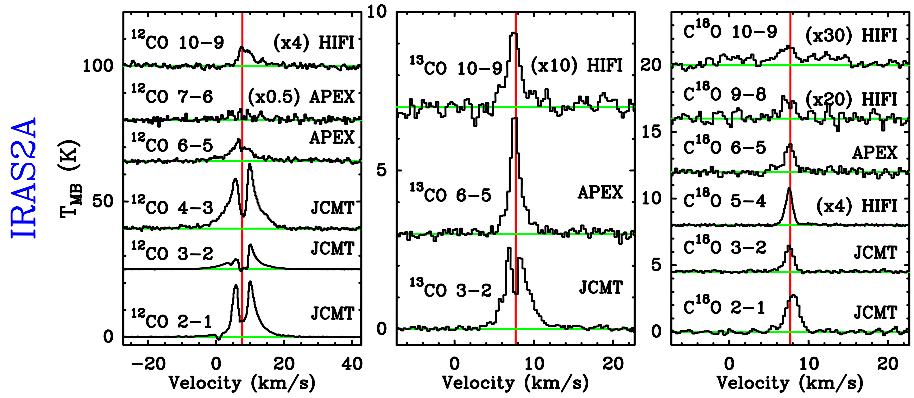

Figure A.2 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for IRAS 2A

Table A.2 – Observed line intensities for IRAS2A in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	129.7	20.5	0.08
	3–2	JCMT-HARPB	0.63	46.9	9.4	0.06
	4–3	JCMT[a]	0.38	180.0	23.7	0.55
	6–5	APEX-CHAMP$^+$	0.52	55.0	8.9	0.60
	7–6	APEX-CHAMP$^+$	0.49	37.4	6.3	1.29
	10–9	*Herschel*-HIFI[b]	0.64	9.2	1.8	0.14
^{13}CO	2–1	JCMT-RxA	0.69	19.3	3.9	0.10
	3–2	JCMT-HARPB	0.63	8.5	2.7	0.08
	6–5	APEX-CHAMP$^+$	0.52	7.1	3.9	0.15
	8–7	APEX-CHAMP$^+$	0.49	3.0	1.5	0.28
	10–9	*Herschel*-HIFI[b]	0.74	0.6	0.3	0.03
C^{18}O	2–1	JCMT-RxA	0.69	6.0	2.8	0.15
	3–2	JCMT-HARPB	0.63	2.8	2.1	0.10
	5–4	*Herschel*-HIFI[b]	0.76	0.8	0.7	0.01
	6–5	APEX-CHAMP$^+$	0.56	3.6	2.1	0.27
	9–8	*Herschel*-HIFI	0.74	0.2	0.09	0.02
	10–9	*Herschel*-HIFI[b]	0.74	0.1	0.05	0.01

[a]Taken in 11" beam. [b]Only H-polarization observation is used.

A.3 IRAS4A

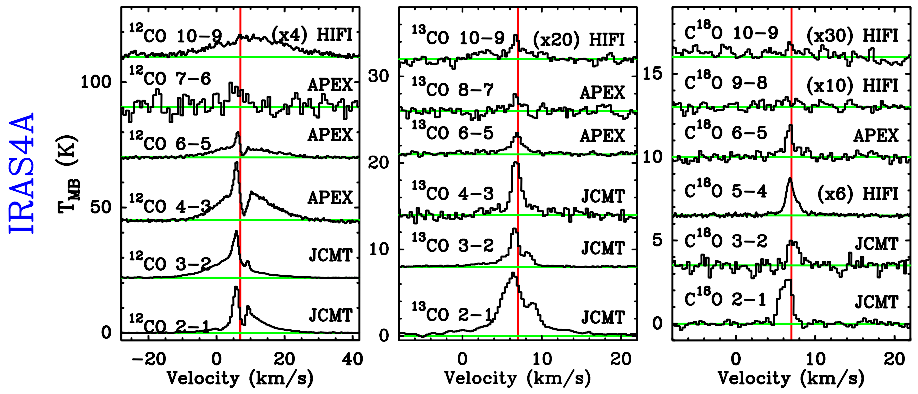

Figure A.3 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for IRAS 4A

Table A.3 – Observed line intensities for IRAS4A in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{\rm MB} dV$ [K km s^{-1}]	$T_{\rm peak}$ [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	116.5	18.4	0.11
	3–2	JCMT-HARPB	0.63	132.6	18.9	0.07
	4–3	JCMT[a]	0.38	220.0	23.4	0.92
	6–5	APEX-CHAMP$^+$	0.48	84.2	10.0	0.27
	7–6	APEX-CHAMP$^+$	0.45	55.0	17.0	4.39
	10–9	*Herschel*-HIFI[b]	0.64	52.2	2.3	0.18
^{13}CO	2–1	JCMT-RxA	0.74	39.3	7.6	0.15
	3–2	JCMT-HARPB	0.63	11.4	4.5	0.08
	4–3	JCMT[a]	0.38	15.2	7.4	0.78
	6–5	APEX-CHAMP$^+$	0.52	7.0	2.6	0.20
	8–7	APEX-CHAMP$^+$	0.49	1.9	1.0	0.42
	10–9	*Herschel*-HIFI[c]	0.74	0.7	0.2	0.02
C^{18}O	2–1	JCMT-RxA	0.69	4.9	2.7	0.23
	3–2	JCMT-HARPB	0.63	4.2	2.3	0.22
	5–4	*Herschel*-HIFI[d]	0.76	0.6	0.4	0.01
	6–5	APEX-CHAMP$^+$	0.48	3.3	2.0	0.26
	9–8	*Herschel*-HIFI	0.74	0.16	0.05	0.02
	10–9	*Herschel*-HIFI[e]	0.74	0.05	0.02	0.008

The values given here are calculated for 20" beam, therefore values are slightly different than Yıldız et al. (2012). [a]Taken in 11" beam. [b]Herschel observation corrected for the chopped emission and only H polarization observation is used. [c]H- and V-polarization observations averaged. [d]Only H-polarization observation is used. [e]Observed by open time program OT2_rvisser_2. H- and V-polarization observations averaged.

A.4 IRAS4B

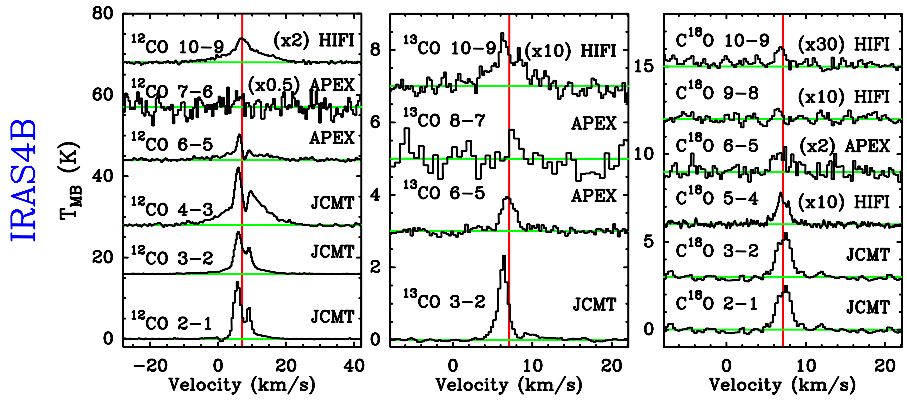

Figure A.4 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for IRAS 4B

Table A.4 – Observed line intensities for IRAS4B in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{\rm MB} dV$ [K km s^{-1}]	$T_{\rm peak}$ [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	54.7	13.9	0.07
	3–2	JCMT-HARPB	0.63	53.9	10.4	0.03
	4–3	JCMT[a]	0.38	115.2	14.4	0.26
	6–5	APEX-CHAMP$^+$	0.48	35.3	6.3	0.29
	7–6	APEX-CHAMP$^+$	0.45	<35.0	...	4.51
	10–9	*Herschel*-HIFI[b]	0.64	29.2	2.9	0.10
^{13}CO	3–2	JCMT-HARPB	0.63	5.9	2.3	0.02
	6–5	APEX-CHAMP$^+$	0.52	2.2	1.0	0.10
	8–7	APEX-CHAMP$^+$	0.42	0.8	...	0.28
	10–9	*Herschel*-HIFI[c]	0.74	0.5	0.15	0.02
C^{18}O	2–1	JCMT-RxA	0.69	5.3	2.5	0.16
	3–2	JCMT-HARPB	0.63	2.4	1.7	0.30
	5–4	*Herschel*-HIFI[d]	0.76	0.3	0.2	0.01
	6–5	APEX-CHAMP$^+$	0.48	1.3	0.8	0.22
	9–8	*Herschel*-HIFI	0.74	<0.06	...	0.02
	10–9	*Herschel*-HIFI[e]	0.74	0.06	0.04	0.009

The values given here are calculated for 20" beam, therefore values are slightly different than Yıldız et al. (2012). [a]Taken in 11" beam. [b]*Herschel* observation corrected for the chopped emission and only H polarization observation is used. [c]H- and V-polarization observations averaged. [d]Only H-polarization observation is used. [e]Observed by open time program OT2_rvisser_2. H- and V-polarization observations averaged.

A.5 L1527

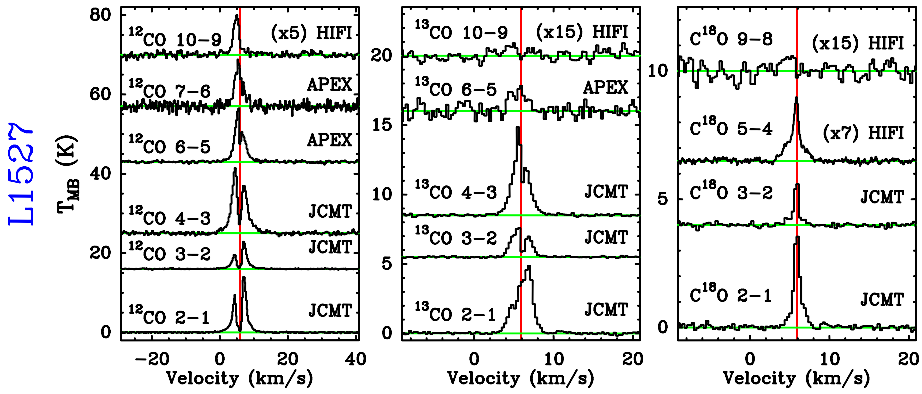

Figure A.5 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for L1527

Table A.5 – Observed line intensities for L1527 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{\rm MB} dV$ [K km s^{-1}]	$T_{\rm peak}$ [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	38.1	14.0	0.09
	3–2	JCMT-HARPB	0.63	19.4	6.9	0.12
	4–3	JCMT[a]	0.38	63.6	16.4	0.46
	6–5	APEX-CHAMP$^+$	0.52	38.0	14.9	0.33
	7–6	APEX-CHAMP$^+$	0.49	31.9	11.8	0.85
	10–9	*Herschel*-HIFI[b]	0.64	5.2	2.0	0.12
^{13}CO	2–1	JCMT-RxA	0.69	12.1	4.9	0.09
	3–2	JCMT-HARPB	0.63	4.7	2.7	0.07
	4–3	JCMT[a]	0.38	12.0	6.4	0.09
	6–5	APEX-CHAMP$^+$	0.48	4.2	2.4	0.51
	10–9	*Herschel*-HIFI[b]	0.76	0.1	0.1	0.02
C^{18}O	2–1	JCMT-RxA	0.69	4.6	3.9	0.11
	3–2	JCMT-HARPB	0.63	1.5	1.9	0.10
	5–4	*Herschel*-HIFI[b]	0.76	0.5	0.3	0.01
	9–8	*Herschel*-HIFI	0.74	<0.05	…	0.02

[a]Taken in 11” beam. [b]Only H-polarization observation is used.

A.6 Ced110IRS4

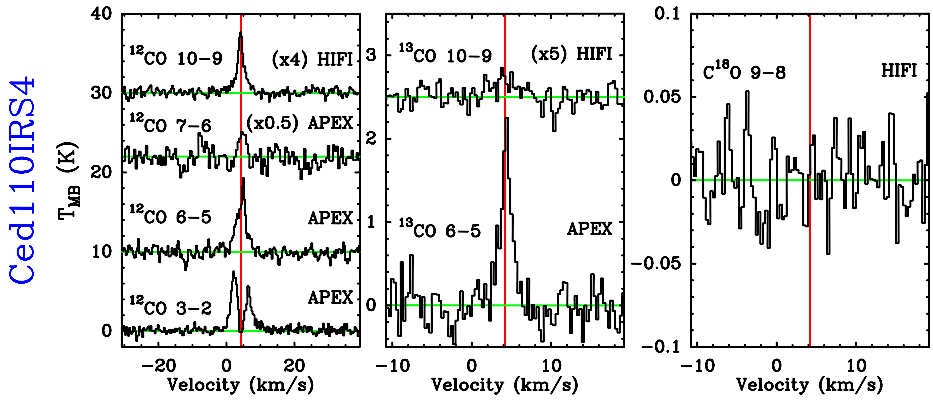

Figure A.6 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for Ced110IRS4

Table A.6 – Observed line intensities for Ced110IRS4 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	3–2	APEX	0.73	31.1	7.7	0.35
	6–5	APEX-CHAMP$^+$	0.45	24.4	10.4	0.71
	7–6	APEX-CHAMP$^+$	0.42	18.2	6.8	1.49
	10–9	*Herschel*-HIFI[a]	0.66	5.1	1.9	0.12
^{13}CO	6–5	APEX-CHAMP$^+$	0.45	3.0	2.7	0.30
	10–9	*Herschel*-HIFI[a]	0.74	0.1	0.1	0.03
C^{18}O	9–8	*Herschel*-HIFI	0.74	<0.06	...	0.03

[a]H- and V-polarization observations averaged.

A.7 BHR71

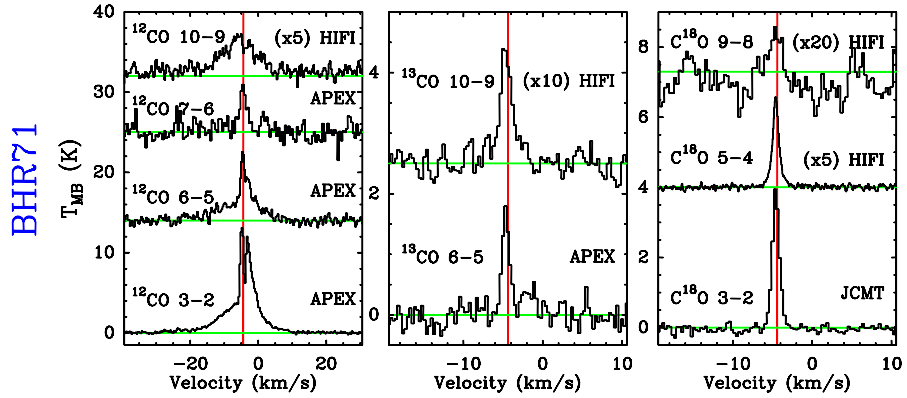

Figure A.7 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for BHR71

Table A.7 – Observed line intensities for BHR71 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	3–2	APEX	0.73	96.5	14.5	0.20
	6–5	APEX-CHAMP$^+$	0.46	49.1	8.7	0.52
	7–6	APEX-CHAMP$^+$	0.49	27.3	6.8	1.31
	10–9	*Herschel*-HIFI[a]	0.64	15.1	1.0	0.15
^{13}CO	6–5	APEX-CHAMP$^+$	0.45	2.7	1.9	0.23
	10–9	*Herschel*-HIFI[b]	0.74	0.4	0.2	0.02
C^{18}O	3–2	APEX	0.73	4.1	4.1	0.11
	5–4	*Herschel*-HIFI[a]	0.76	0.6	0.5	0.01
	9–8	*Herschel*-HIFI	0.74	0.1	0.1	0.02

[a]Only H-polarization observation is used. [b]H- and V-polarization observations averaged.

A.8 IRAS153981

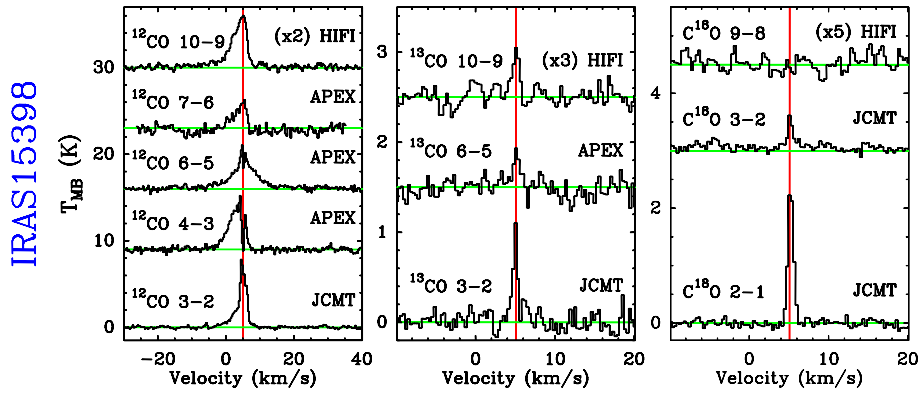

Figure A.8 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for IRAS15398

Table A.8 – Observed line intensities for IRAS15398 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	3–2	APEX	0.73	22.0	8.5	0.15
	4–3	APEX	0.60	26.3	6.8	0.32
	6–5	APEX-CHAMP$^+$	0.48	33.9	5.3	0.25
	7–6	APEX-CHAMP$^+$	0.49	16.9	3.9	0.64
	10–9	*Herschel*-HIFI[a]	0.64	17.7	3.0	0.10
^{13}CO	3–2	JCMT-HARPB	0.63	1.2	1.3	0.12
	6–5	APEX-CHAMP$^+$	0.48	0.5	0.5	0.12
	10–9	*Herschel*-HIFI[a]	0.74	0.2	0.2	0.03
C^{18}O	2–1	JCMT-RxA	0.69	2.0	2.5	0.09
	3–2	JCMT-HARPB	0.63	0.8	0.7	0.08
	9–8	*Herschel*-HIFI	0.74	<0.06	...	0.02

[a]H- and V-polarization observations averaged.

A.9 L483mm

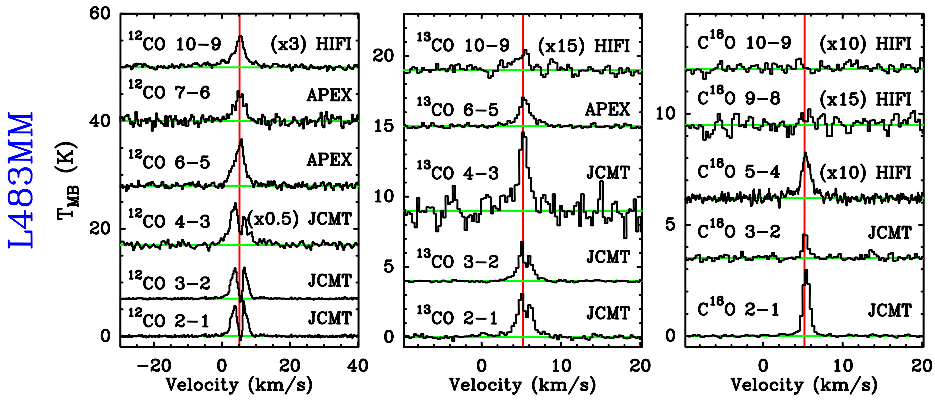

Figure A.9 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for L483mm

Table A.9 – Observed line intensities for L483mm in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	22.4	6.5	0.13
	3–2	JCMT-HARPB	0.63	21.0	4.8	0.06
	4–3	JCMT	0.38	76.1	18.6	0.94
	6–5	APEX-CHAMP$^+$	0.45	32.4	8.9	0.49
	7–6	APEX-CHAMP$^+$	0.49	22.1	6.3	1.11
	10–9	*Herschel*-HIFI[a]	0.64	11.4	2.0	0.10
^{13}CO	2–1	JCMT-RxA	0.74	7.0	3.2	0.17
	3–2	JCMT-HARPB	0.63	4.3	2.9	0.07
	4–3	JCMT[b]	0.38	10.9	6.6	0.93
	6–5	APEX-CHAMP$^+$	0.46	4.2	2.2	0.13
	10–9	*Herschel*-HIFI[a]	0.74	0.2	0.1	0.02
C^{18}O	2–1	JCMT-RxA	0.69	3.5	3.1	0.04
	3–2	JCMT-HARPB	0.63	1.2	1.4	0.15
	5–4	*Herschel*-HIFI[c]	0.76	0.3	0.2	0.01
	9–8	*Herschel*-HIFI	0.74	<0.05	...	0.02
	10–9	*Herschel*-HIFI	0.74	<0.05	...	0.02

[a]H- and V-polarization observations averaged. [b]Taken in 11" beam. [c]Only H-polarization observation is used.

A.10 SMM1

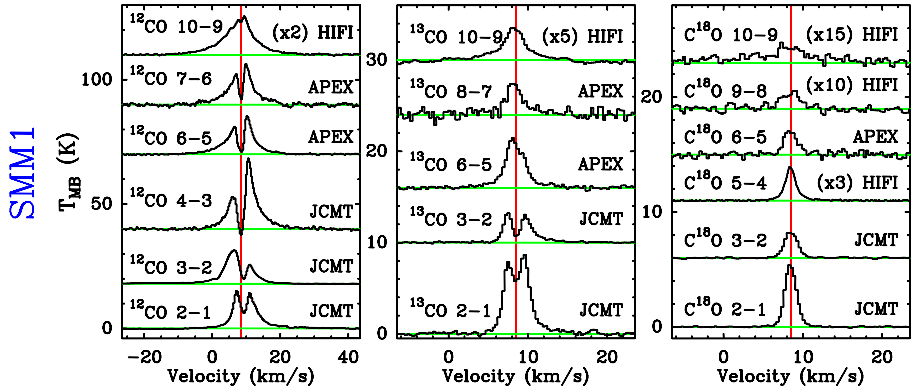

Figure A.10 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for SMM1

Table A.10 – Observed line intensities for SMM1 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{\rm MB} dV$ [K km s^{-1}]	$T_{\rm peak}$ [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	112.5	15.1	0.19
	3–2	JCMT-HARPB	0.63	101.8	13.4	0.02
	4–3	JCMT	0.38	160.0	29.0	0.39
	6–5	APEX-CHAMP$^+$	0.52	108.4	15.5	0.17
	7–6	APEX-CHAMP$^+$	0.40	105.6	16.4	0.59
	10–9	*Herschel*-HIFI[a]	0.64	82.3	7.7	0.09
^{13}CO	2–1	JCMT-RxA	0.74	31.8	8.9	0.17
	3–2	JCMT-HARPB	0.63	11.2	3.4	0.07
	6–5	APEX-CHAMP$^+$	0.46	17.5	5.6	0.18
	8–7	APEX-CHAMP$^+$	0.49	5.0	1.6	0.39
	10–9	*Herschel*-HIFI[b]	0.74	3.4	0.7	0.03
C^{18}O	2–1	JCMT-RxA	0.69	10.3	5.5	0.06
	3–2	JCMT-HARPB	0.63	4.8	2.2	0.05
	5–4	*Herschel*-HIFI[b]	0.76	1.8	1.0	0.01
	6–5	APEX-CHAMP$^+$	0.56	4.7	2.1	0.26
	9–8	*Herschel*-HIFI	0.74	0.4	0.02	0.02
	10–9	*Herschel*-HIFI	0.74	0.6	0.1	0.02

[a]H- and V-polarization observations averaged. [b]Only H-polarization observation is used.

A.11 SMM4

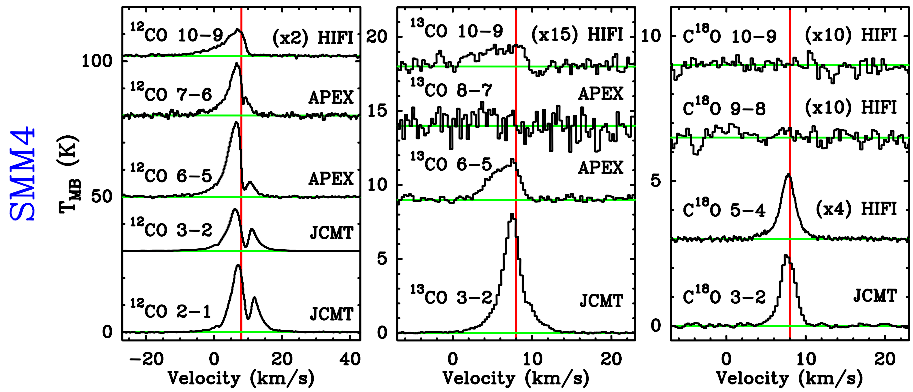

Figure A.11 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for SMM4

Table A.11 – Observed line intensities for SMM4 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{\rm MB} dV$ [K km s^{-1}]	$T_{\rm peak}$ [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	168.4	24.8	0.10
	3–2	JCMT-HARPB	0.63	108.4	15.5	0.02
	6–5	APEX-CHAMP$^+$	0.52	159.6	27.6	0.23
	7–6	APEX-CHAMP$^+$	0.40	110.1	19.4	0.63
	10–9	*Herschel*-HIFI[a]	0.64	40.2	5.0	0.13
^{13}CO	3–2	JCMT-HARPB	0.63	26.1	8.1	0.05
	6–5	APEX-CHAMP$^+$	0.52	10.6	2.6	0.15
	8–7	APEX-CHAMP$^+$	0.49	1.6	2.6	1.00
	10–9	*Herschel*-HIFI[b]	0.74	0.5	0.1	0.02
C^{18}O	3–2	JCMT-HARPB	0.63	6.0	2.5	0.06
	5–4	*Herschel*-HIFI[b]	0.76	1.4	0.5	0.01
	9–8	*Herschel*-HIFI	0.74	<0.06	...	0.02
	10–9	*Herschel*-HIFI	0.74	<0.05	...	0.02

[a]Only H-polarization observation is used. [b]H- and V-polarization observations averaged.

A.12 SMM3

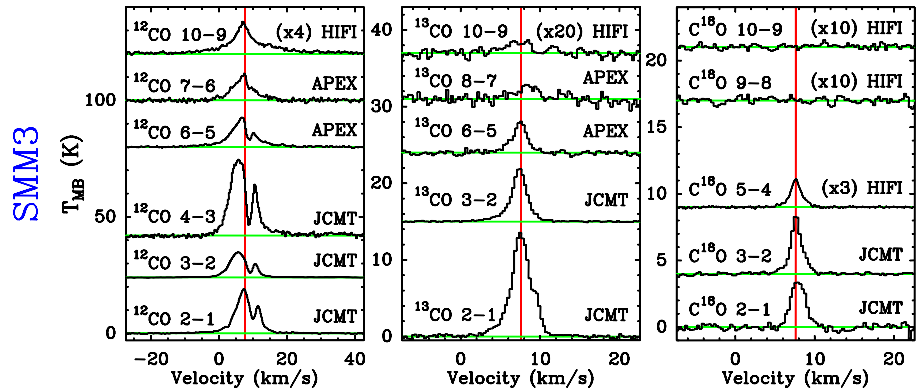

Figure A.12 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for SMM3

Table A.12 – Observed line intensities for SMM3 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	133.0	19.1	0.11
	3–2	JCMT-HARPB	0.63	78.1	10.8	0.03
	4–3	JCMT	0.38	243.0	32.9	0.79
	6–5	APEX-CHAMP$^+$	0.52	97.6	12.7	0.22
	7–6	APEX-CHAMP$^+$	0.40	74.3	11.5	0.55
	10–9	*Herschel*-HIFI[a]	0.64	35.7	3.5	0.09
^{13}CO	2–1	JCMT-RxA	0.74	44.5	13.7	0.18
	3–2	JCMT-HARPB	0.63	18.3	7.1	0.07
	6–5	APEX-CHAMP$^+$	0.52	9.6	4.1	0.26
	8–7	APEX-CHAMP$^+$	0.49	5.6	2.3	0.61
	10–9	*Herschel*-HIFI[a]	0.74	0.3	0.09	0.02
C^{18}O	2–1	JCMT-RxA	0.69	8.0	3.4	0.32
	3–2	JCMT-HARPB	0.63	5.0	2.6	0.06
	5–4	*Herschel*-HIFI[b]	0.76	1.3	0.7	0.01
	9–8	*Herschel*-HIFI	0.74	<0.04	...	0.02
	10–9	*Herschel*-HIFI	0.74	<0.03	...	0.01

[a]H- and V-polarization observations averaged. [b]Only H-polarization observation is used.

A.13 L723mm

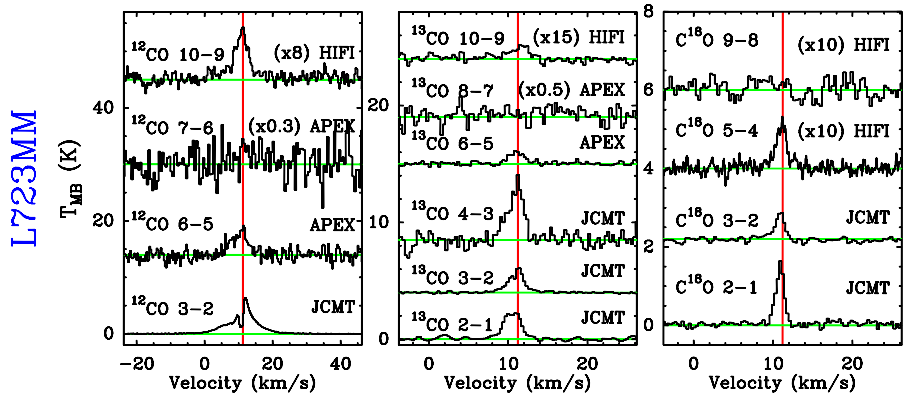

Figure A.13 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for L723mm

Table A.13 – Observed line intensities for L723mm in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	3–2	JCMT-HARPB	0.63	39.5	6.4	0.05
	6–5	APEX-CHAMP$^+$	0.52	22.0	5.4	1.11
	7–6	APEX-CHAMP$^+$	0.49	11.0	6.0	3.81
	10–9	*Herschel*-HIFI[a]	0.64	6.6	1.2	0.09
^{13}CO	2–1	JCMT-RxA	0.74	7.1	2.2	0.10
	3–2	JCMT-HARPB	0.63	4.8	2.2	0.08
	4–3	JCMT[b]	0.38	10.8	5.9	0.76
	6–5	APEX-CHAMP$^+$	0.45	3.3	1.3	0.18
	8–7	APEX-CHAMP$^+$	0.49	1.9	4.7	1.55
	10–9	*Herschel*-HIFI[a]	0.74	0.2	0.1	0.03
C^{18}O	2–1	JCMT-RxA	0.69	2.2	1.7	0.08
	3–2	JCMT-HARPB	0.63	1.0	0.7	0.09
	5–4	*Herschel*-HIFI[c]	0.76	0.2	0.1	0.02
	9–8	*Herschel*-HIFI	0.74	<0.04	...	0.02

[a]H- and V-polarization observations averaged. [b]Taken in 11" beam. [c]Only H-polarization observation is used.

A.14 B335

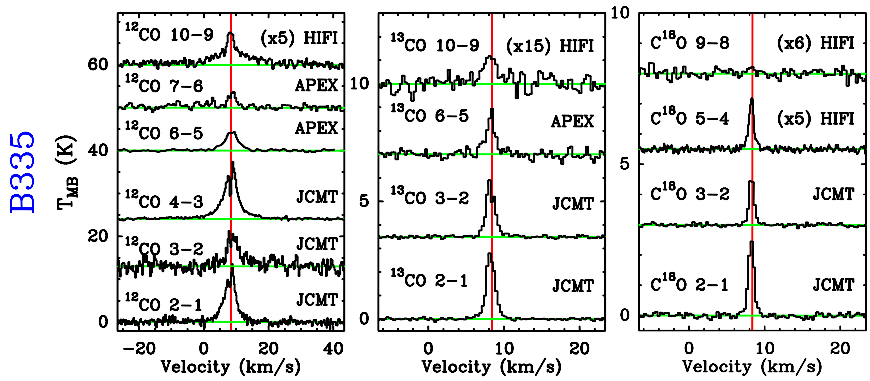

Figure A.14 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for B335

Table A.14 – Observed line intensities for B335 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{\rm MB} dV$ [K km s^{-1}]	$T_{\rm peak}$ [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	56.1	13.6	0.51
	3–2	JCMT-HARPB	0.63	38.3	8.7	1.49
	4–3	JCMT	0.38	68.7	13.4	0.15
	6–5	APEX-CHAMP$^+$	0.52	25.9	4.4	0.23
	7–6	APEX-CHAMP$^+$	0.49	21.9	3.6	0.58
	10–9	*Herschel*-HIFI[a]	0.64	12.5	1.5	0.13
^{13}CO	2–1	JCMT-RxA	0.74	4.3	3.2	0.05
	3–2	JCMT-HARPB	0.63	3.4	3.0	0.07
	6–5	APEX-CHAMP$^+$	0.48	2.6	2.1	0.21
	10–9	*Herschel*-HIFI[b]	0.74	0.2	0.08	0.02
C^{18}O	2–1	JCMT-RxA	0.69	2.4	2.5	0.10
	3–2	JCMT-HARPB	0.63	1.4	1.9	0.06
	5–4	*Herschel*-HIFI[a]	0.76	0.3	0.3	0.01
	9–8	*Herschel*-HIFI	0.74	<0.05	...	0.03

[a]Only H-polarization observation is used. [b]H- and V-polarization observations averaged.

A.15 L1157

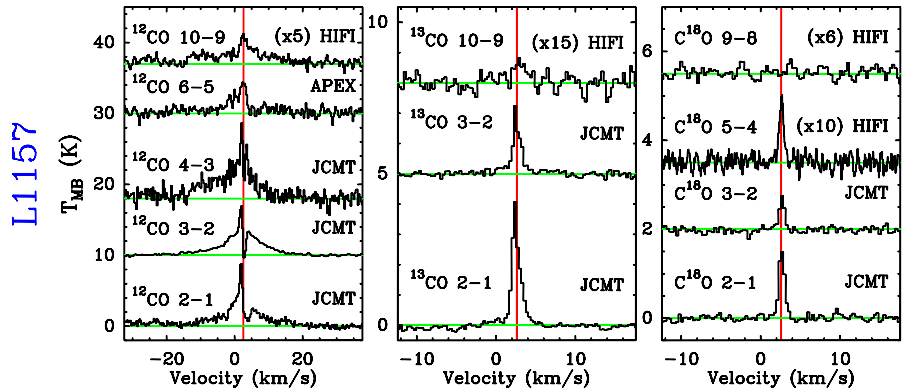

Figure A.15 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for L1157

Table A.15 – Observed line intensities for L1157 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	47.9	8.8	0.28
	3–2	JCMT-HARPB	0.63	48.2	7.4	0.10
	4–3	JCMT	0.38	78.1	10.7	0.88
	10–9	*Herschel*-HIFI[a]	0.64	8.9	0.9	0.15
^{13}CO	2–1	JCMT-RxA	0.74	5.1	4.3	0.10
	3–2	JCMT-HARPB	0.63	3.1	2.6	0.11
	10–9	*Herschel*-HIFI[b]	0.74	0.3	0.1	0.03
C^{18}O	2–1	JCMT-RxA	0.69	1.5	1.5	0.09
	3–2	JCMT-HARPB	0.63	0.5	0.8	0.09
	5–4	*Herschel*-HIFI[b]	0.76	0.1	0.1	0.01
	9–8	*Herschel*-HIFI	0.74	<0.05	...	0.02

[a]H- and V-polarization observations averaged. [b]Only H-polarization observation is used.

A.16 L1489

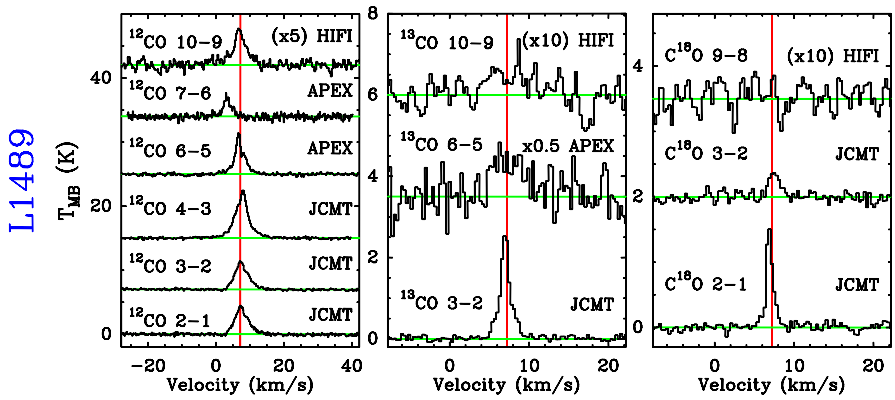

Figure A.16 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for L1489

Table A.16 – Observed line intensities for L1489 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{\rm MB} dV$ [K km s^{-1}]	$T_{\rm peak}$ [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	19.9	4.5	0.15
	3–2	JCMT-HARPB	0.63	13.0	4.0	0.49
	4–3	JCMT	0.38	33.8	7.1	0.15
	6–5	APEX-CHAMP$^+$	0.45	20.9	6.5	0.16
	7–6	APEX-CHAMP$^+$	0.49	9.1	3.6	0.37
	10–9	*Herschel*-HIFI[a]	0.64	6.2	1.2	0.11
^{13}CO	3–2	JCMT-HARPB	0.63	4.4	2.7	0.08
	6–5	APEX-CHAMP$^+$	0.45	8.2	3.8	1.29
	10–9	*Herschel*-HIFI[a]	0.74	0.2	0.1	0.03
C^{18}O	2–1	JCMT-RxA	0.69	1.7	1.6	0.07
	3–2	JCMT-HARPB	0.63	0.7	0.4	0.10
	9–8	*Herschel*-HIFI	0.74	<0.05	...	0.02

[a]H- and V-polarization observations averaged.

A.17 L1551IRS5

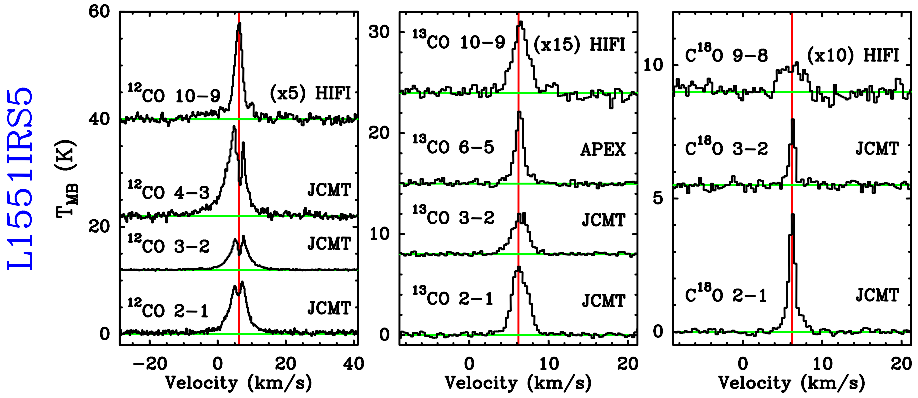

Figure A.17 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for L1551IRS5

Table A.17 – Observed line intensities for L1551IRS5 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{\rm MB} dV$ [K km s^{-1}]	$T_{\rm peak}$ [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	71.5	9.8	0.27
	3–2	JCMT-HARPB	0.63	37.5	6.7	0.11
	4–3	JCMT[a]	0.38	108.1	16.7	0.45
	10–9	*Herschel*-HIFI[b]	0.64	14.7	3.6	0.13
^{13}CO	2–1	JCMT-RxA	0.74	17.8	7.0	0.25
	3–2	JCMT-HARPB	0.63	10.2	4.8	0.18
	6–5	APEX-CHAMP$^+$	0.48	10.5	7.5	0.24
	10–9	*Herschel*-HIFI[b]	0.74	1.4	0.5	0.03
C^{18}O	2–1	JCMT-RxA	0.69	5.3	4.6	0.08
	3–2	JCMT-HARPB	0.63	2.3	2.6	0.18
	9–8	*Herschel*-HIFI	0.74	0.2	0.2	0.03

[a]Taken in 11” beam. [b]H- and V-polarization observations averaged.

A.18 TMR1

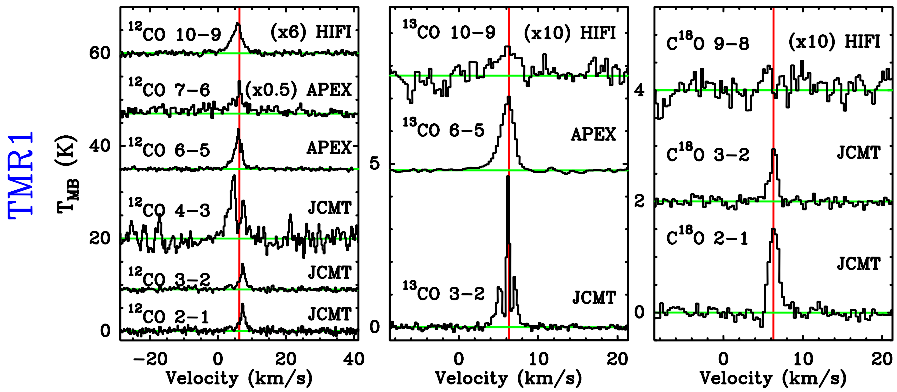

Figure A.18 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for TMR1

Table A.18 – Observed line intensities for TMR1 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	11.9	5.9	0.41
	3–2	JCMT-HARPB	0.63	8.5	4.6	0.09
	4–3	JCMT[a]	0.38	40.8	15.2	3.26
	6–5	APEX-CHAMP$^+$	0.45	22.7	9.2	0.32
	7–6	APEX-CHAMP$^+$	0.42	21.9	8.9	0.81
	10–9	*Herschel*-HIFI[b]	0.64	9.2	2.2	0.13
^{13}CO	3–2	JCMT-HARPB	0.63	4.3	4.6	0.06
	6–5	APEX-CHAMP$^+$	0.45	4.8	2.0	0.03
	10–9	*Herschel*-HIFI[b]	0.74	0.5	0.1	0.03
C^{18}O	2–1	JCMTRxA	0.69	2.2	1.6	0.11
	3–2	JCMT-HARPB	0.63	1.1	1.2	0.09
	9–8	*Herschel*-HIFI	0.74	<0.05	...	0.02

[a]Taken in 11" beam. [b]H- and V-polarization observations averaged.

A.19 TMC1A

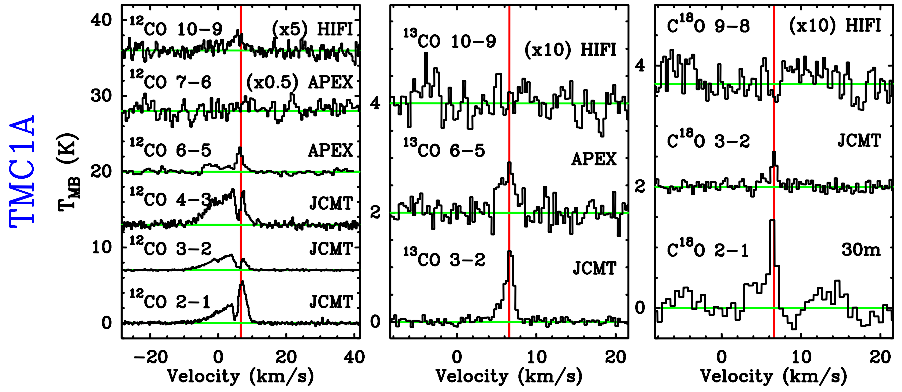

Figure A.19 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for TMC1A

Table A.19 – Observed line intensities for TMC1A in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	30.3	5.5	0.19
	3–2	JCMT-HARPB	0.63	19.1	2.1	0.09
	4–3	JCMT[a]	0.38	42.5	4.8	0.46
	6–5	APEX-CHAMP$^+$	0.52	11.7	3.2	0.24
	7–6	APEX-CHAMP$^+$	0.49	4.1	2.1	0.81
	10–9	*Herschel*-HIFI[b]	0.64	1.4	0.5	0.13
^{13}CO	3–2	JCMT-HARPB	0.63	2.2	1.4	0.07
	6–5	APEX-CHAMP$^+$	0.48	1.8	1.1	0.25
	10–9	*Herschel*-HIFI[b]	0.74	<0.1	...	0.03
C^{18}O	2–1	IRAM 30m	0.59	2.0	2.4	0.33
	3–2	JCMT-HARPB	0.63	0.6	0.6	0.11
	9–8	*Herschel*-HIFI	0.74	<0.05	...	0.02

[a]Taken in 11" beam. [b]Only H-polarization observation is used.

A.20 TMC1

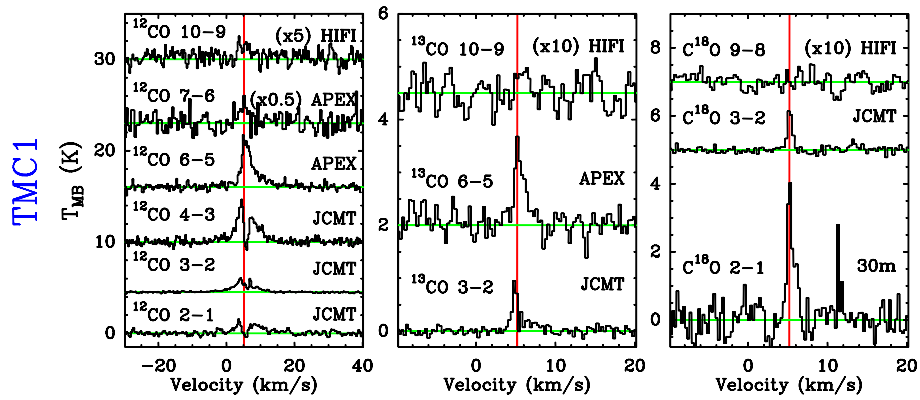

Figure A.20 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for TMC1

Table A.20 – Observed line intensities for TMC1 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{\rm MB} dV$ [K km s^{-1}]	$T_{\rm peak}$ [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	9.1	1.6	0.21
	3–2	JCMT-HARPB	0.63	9.8	2.0	0.10
	4–3	JCMT[a]	0.38	22.6	4.7	0.44
	6–5	APEX-CHAMP$^+$	0.52	26.6	6.0	0.36
	7–6	APEX-CHAMP$^+$	0.49	11.1	4.5	0.92
	10–9	*Herschel*-HIFI[b]	0.64	2.9	0.5	0.15
^{13}CO	3–2	JCMT-HARPB	0.63	1.2	1.1	0.09
	6–5	APEX-CHAMP$^+$	0.48	2.4	1.8	0.24
	10–9	*Herschel*-HIFI[c]	0.74	<0.1	...	0.03
C^{18}O	2–1	IRAM 30m	0.59	4.2	4.1	0.41
	3–2	JCMT-HARPB	0.63	0.9	1.3	0.12
	9–8	*Herschel*-HIFI	0.74	<0.05	...	0.02

[a]Taken in 11" beam. [b]Only H-polarization observation is used. [c]H- and V-polarization observations averaged.

A.21 HH46

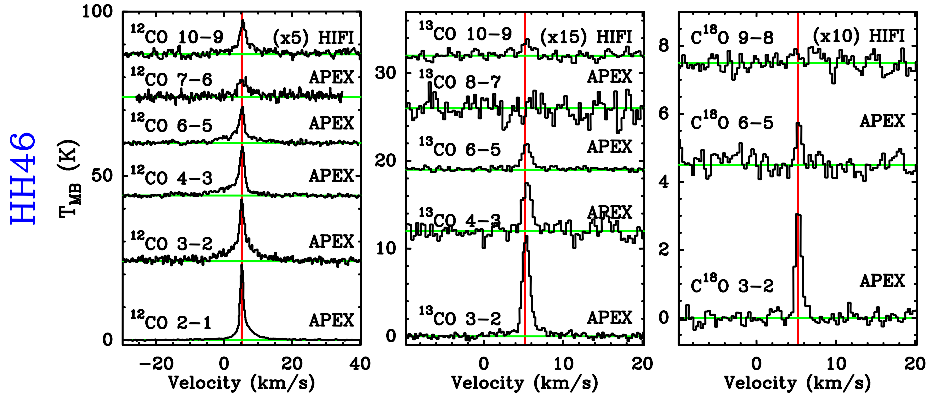

Figure A.21 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for HH46

Table A.21 – Observed line intensities for HH46 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	2–1	APEX	0.73	53.6	23.0	0.08
	3–2	APEX	0.73	81.9	18.8	0.72
	4–3	APEX	0.70	42.8	14.6	0.49
	6–5	APEX-CHAMP$^+$	0.45	45.2	11.8	0.47
	7–6	APEX-CHAMP$^+$	0.49	22.9	6.0	0.89
	10–9	*Herschel*-HIFI[a]	0.64	8.2	2.1	0.14
^{13}CO	3–2	APEX	0.73	17.5	11.9	0.32
	4–3	APEX[b]	0.70	8.0	6.0	1.08
	6–5	APEX-CHAMP$^+$	0.45	5.9	3.1	0.23
	8–7	APEX-CHAMP$^+$	0.42	<1.1	...	0.39
	10–9	*Herschel*-HIFI[a]	0.74	0.2	0.2	0.04
C^{18}O	3–2	APEX–2a	0.70	3.2	...	0.10
	6–5	APEX-CHAMP$^+$	0.56	1.3	1.5	0.50
	9–8	*Herschel*-HIFI	0.74	<0.05	...	0.03

[a]Only H-polarization observation is used. [b]Taken in 11" beam.

A.22 DK Cha

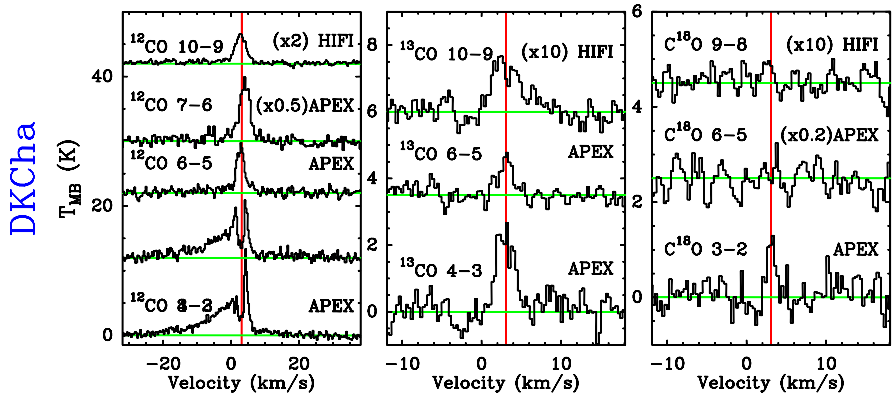

Figure A.22 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for DK Cha

Table A.22 – Observed line intensities for DK Cha in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	3–2	APEX	0.73	80.0	13.3	0.38
	4–3	APEX	0.65	71.8	10.2	0.49
	6–5	APEX-CHAMP$^+$	0.45	28.0	8.2	0.57
	7–6	APEX-CHAMP$^+$	0.42	84.9	20.2	1.89
	10–9	*Herschel*-HIFI[a]	0.64	11.4	2.3	0.12
^{13}CO	3–2	APEX[b]	...	6.7	...	...
	4–3	APEX	0.65	6.5	3.0	0.44
	6–5	APEX-CHAMP$^+$	0.45	2.1	1.3	0.25
	8–7	APEX-CHAMP$^+$	0.49	0.8	...	0.90
	10–9	*Herschel*-HIFI[c]	0.74	0.8	0.2	0.03
C^{18}O	3–2	APEX	0.70	1.4	1.5	0.40
	9–8	*Herschel*-HIFI	0.74	<0.05	...	0.03

[a]H- and V-polarization observations averaged. [b]Only H-polarization observation is used. [c]van Kempen et al. (2006)

A.23 GSS30IRS1

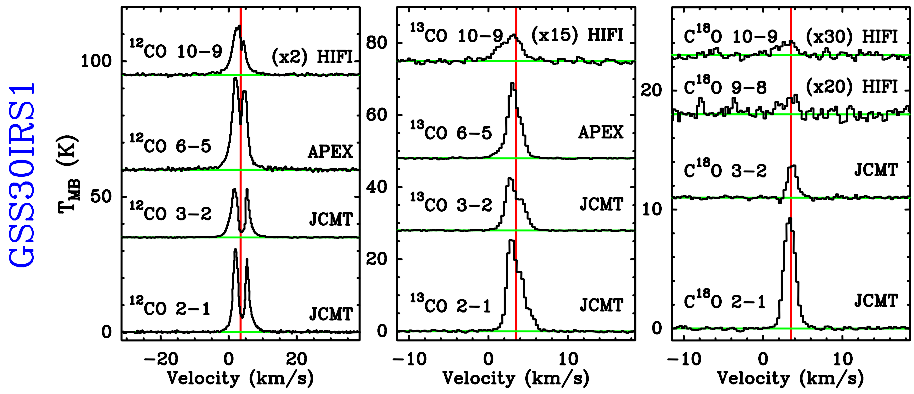

Figure A.23 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for GSS30IRS1

Table A.23 – Observed line intensities for GSS30IRS1 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{MB} dV$ [K km s^{-1}]	T_{peak} [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	114.8	30.8	0.23
	3–2	JCMT-HARPB	0.63	78.0	18.9	0.08
	6–5	APEX-CHAMP$^+$	0.45	172.4	34.4	0.41
	10–9	*Herschel*-HIFI[a]	0.64	41.8	9.3	0.15
^{13}CO	2–1	JCMT-RxA	0.74	58.9	26.3	0.25
	3–2	JCMT-HARPB	0.63	34.3	14.9	0.12
	6–5	APEX-CHAMP$^+$	0.48	41.6	21.4	0.13
	10–9	*Herschel*-HIFI[a]	0.74	2.1	0.5	0.03
C^{18}O	2–1	JCMT-RxA	0.69	17.1	9.4	0.12
	3–2	JCMT-HARPB	0.63	3.7	2.8	0.12
	9–8	*Herschel*-HIFI	0.74	0.2	0.09	0.02
	10–9	*Herschel*-HIFI[b]	0.74	0.09	0.04	0.009

[a]Only H-polarization observation is used. [b]H- and V-polarization observations averaged.

A.24 Elias29

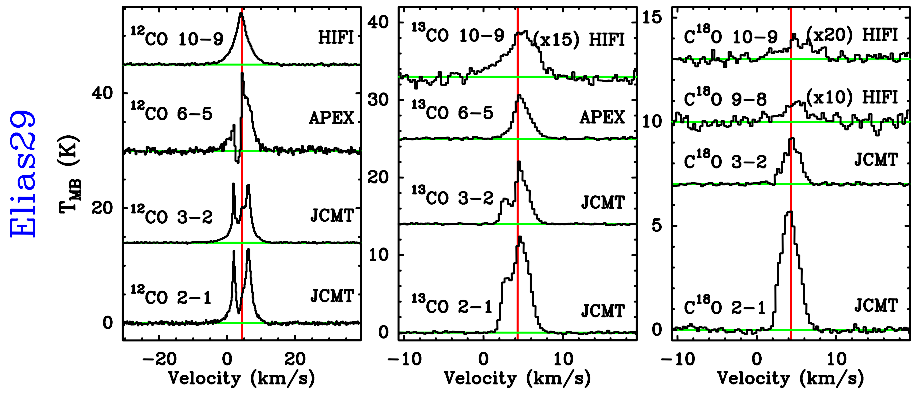

Figure A.24 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for Elias29

Table A.24 – Observed line intensities for Elias29 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{\rm MB} dV$ [K km s^{-1}]	$T_{\rm peak}$ [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	53.7	12.9	0.18
	3–2	JCMT-HARPB	0.63	48.3	11.1	0.07
	6–5	APEX-CHAMP$^+$	0.48	45.0	14.6	0.48
	10–9	*Herschel*-HIFI[a]	0.64	45.9	9.1	0.11
^{13}CO	2–1	JCMT-RxA	0.74	37.4	12.6	0.17
	3–2	JCMT-HARPB	0.63	18.7	8.3	0.10
	6–5	APEX-CHAMP$^+$	0.48	14.6	5.7	0.13
	10–9	*Herschel*-HIFI[a]	0.74	1.7	0.4	0.03
C^{18}O	2–1	JCMT-RxA	0.69	15.7	5.9	0.15
	3–2	JCMT-HARPB	0.63	5.3	2.5	0.07
	9–8	*Herschel*-HIFI	0.74	0.4	0.1	0.03
	10–9	*Herschel*-HIFI[b]	0.74	0.23	0.07	0.01

[a]H- and V-polarization observations averaged. [b]Only H-polarization observation is used.

A.25 Oph IRS63

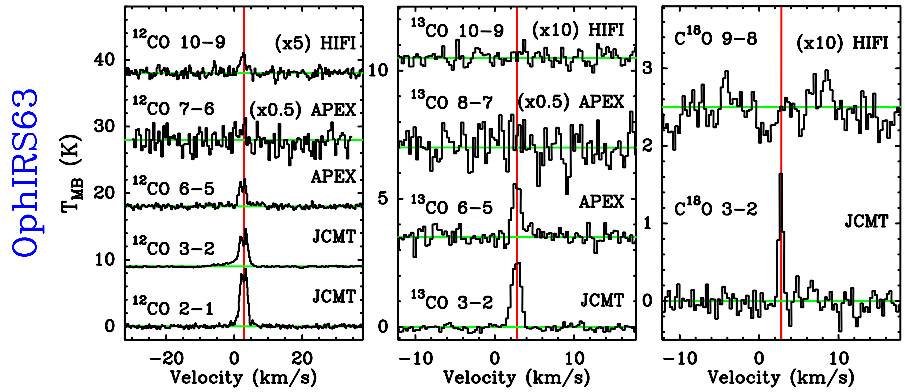

Figure A.25 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for Oph IRS63

Table A.25 – Observed line intensities for OphIRS63 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{\rm MB} {\rm d}V$ [K km s^{-1}]	$T_{\rm peak}$ [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	23.3	8.6	0.19
	3–2	JCMT-HARPB	0.63	16.5	6.1	0.09
	6–5	APEX-CHAMP$^+$	0.48	11.1	4.4	0.32
	7–6	APEX-CHAMP$^+$	0.48	8.6	4.8	1.09
	10–9	*Herschel*-HIFI[a]	0.64	1.1	0.6	0.13
^{13}CO	3–2	JCMT-HARPB	0.63	3.6	2.7	0.13
	6–5	APEX-CHAMP$^+$	0.45	3.0	2.5	0.35
	8–7	APEX-CHAMP$^+$	0.49	<4.3	...	1.68
	10–9	*Herschel*-HIFI[a]	0.74	<0.06	...	0.03
C^{18}O	3–2	JCMT-HARPB	0.63	0.9	1.7	0.17
	9–8	*Herschel*-HIFI	0.74	<0.05	...	0.02

[a]H- and V-polarization observations averaged.

A.26 RNO91

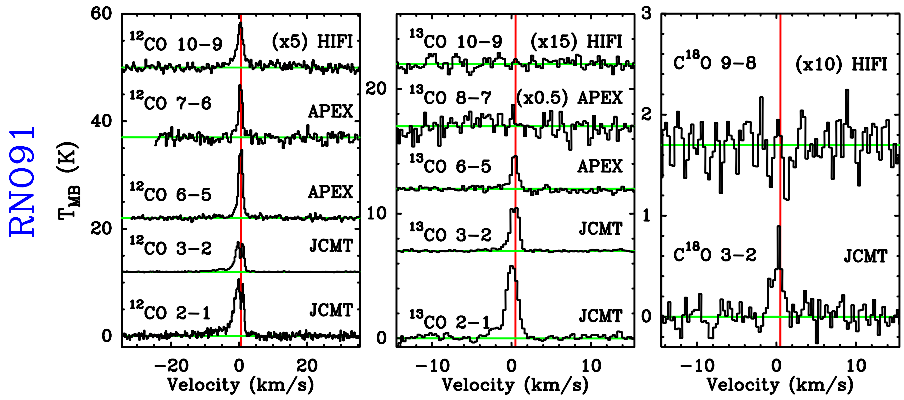

Figure A.26 – Observed ^{12}CO, ^{13}CO, and C^{18}O transitions for RNO91

Table A.26 – Observed line intensities for RNO91 in all observed transitions.

Mol.	Transition	Telescope	Efficiency η	$\int T_{\rm MB} dV$ [K km s^{-1}]	$T_{\rm peak}$ [K]	rms [K]
CO	2–1	JCMT-RxA	0.69	40.5	10.6	0.42
	3–2	JCMT-HARPB	0.63	16.7	6.2	0.06
	6–5	APEX-CHAMP$^+$	0.48	26.0	13.5	0.33
	7–6	APEX-CHAMP$^+$	0.49	14.9	11.1	1.15
	10–9	*Herschel*-HIFI[a]	0.64	5.2	1.7	0.10
^{13}CO	2–1	JCMT-RxA	0.74	11.8	5.9	0.39
	3–2	JCMT-HARPB	0.63	5.4	3.9	0.08
	6–5	APEX-CHAMP$^+$	0.45	2.4	3.0	0.28
	8–7	APEX-CHAMP$^+$	0.49	1.6	4.6	1.77
	10–9	*Herschel*-HIFI[a]	0.74	<0.07	...	0.03
C^{18}O	3–2	JCMT-HARPB	0.63	1.1	1.1	0.14
	9–8	*Herschel*-HIFI	0.74	<0.05	...	0.02

[a]H- and V-polarization observations averaged.