A CO, ^{13}CO and C^{18}O survey of cold IRAS sources

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Selection criteria for PMO observations:

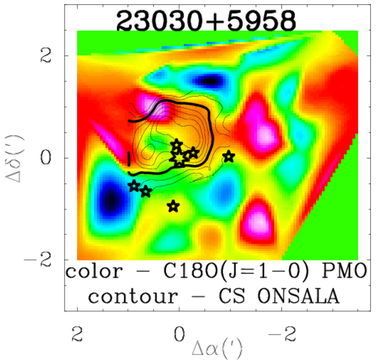
Coordinates have to be in: $16^h \le \alpha(1950) \le 8^h$, $\delta(1950) \ge -35°$, $|b| \le 25°$, $|b| \ge 1°$ with $l \le 60°$ or $l \ge 300°$

Sources should be detected at least in three IRAS diapasons.

Flux at 12 μm 25 μm и 60 μm have to comply $\log(F_{12}/F_{25}) \le -0.4$ and $\log(F_{25}/F_{60}) \le -0.4$ or $\log(F_{12}/F_{60}) \le -0.4$ assuming radiant flux on 25 μm is equal 1.

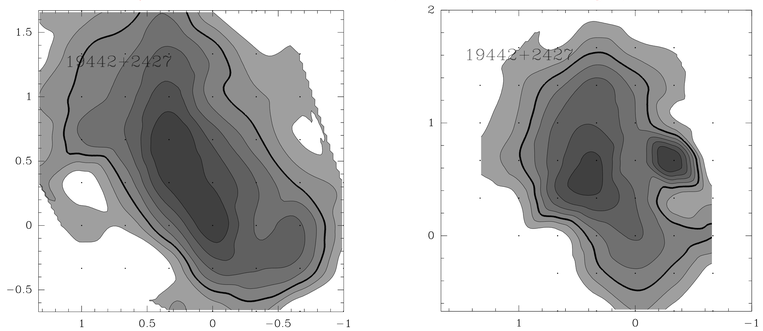
Sources are not associated with stars and with other sources not related to galactic star formation.

Antenna temperature in CO line less than 10K according to survey [Ji Yang ApJS, 2002, v. 141, p. 157]



Map of IRAS 23030+5958 with IRAS source (big star) and MSX sources (small stars).
Colour – PMO observations in C^{18}O(1-0), contour – Onsala CS(2-1)
About 20% of sources from the survey do not have MSX associations.

Maps of IRAS 19442+2427 (Onsala) in HCN (Left) and CS (right) lines



IRAS name	Angle size (')	Size (pc)	Distance (kpc)	M_{LTE} (M_{SUN})	M_{VIR} (M_{SUN})	n(H_2) (10^3*cm^{-3})	L	B
01202+6133	4.92	0.65	0.91	525	394	6	126.7	-0.8
03236+5836	5.29	0.53	0.69	479	442	11	139.9	0.2
05044-0325	3.74	0.36	0.67	184	163	13	142	-1.8
05327-0457	1.95	0.24	0.85	306	144	75	203.5	-24.7
05338-0624	16.96	1.66	0.67	3310	2905	2.51	208.6	-19.2
05375+3536	5.97	21.22	24.44	262753	29273	<0.1	206.5	-16.3
05391-0152	6.58	0.7	0.73	1294	676	13	206.9	-16.5
05391-0217	8.21	0.87	0.73	1699	546	9	189.9	0.3
06055+2034	5.64	1.26	1.54	4832	2690	8	189.8	0.3
06055+2039	5.64	2.87	3.5	21384	5925	3	224.4	-2
07028-1100	1.95	0.33	1.15	266	324	26	26.4	1.7
18136-1347	7.74	2.28	2.03	3919	5514	1.14	29.1	2.2
18162-2048	6.28	1.64	1.8	3447	2647	2.69	37.4	1.5
18258-0737	7.65	3.1	2.78	11164	7293	1.29	38.9	-1
19446+2505	4.22	1.23	2	1308	1133	3	60.9	-0.1
20255+3712	3.91	2.28	4.01	10087	2649	3	76.4	-0.6
21078+5211	3.57	0.76	1.46	787	1628	6	92.7	3.1
21418+6552	4.65	0.69	1.02	486	458	5	105.4	9.9
22176+6303	7.31	0.96	0.9	1578	1360	6	106.8	5.3
22198+6336	3.39	0.48	0.97	184	170	6	107.3	5.6
22543+6145	3.19	0.45	0.98	377	696	14	109.9	2.1
22566+5830	3.57	1.87	3.6	6831	2777	4	108.8	-1
23020+5948	11.83	8.73	5.08	74376	44316	0.38	110.1	0
23030+5958	3.19	2.97	6.4	15179	7800	2	111.9	0.8
23140+6121	4.07	2.79	4.71	11984	5643	2	113	1.0

Spectra reduction

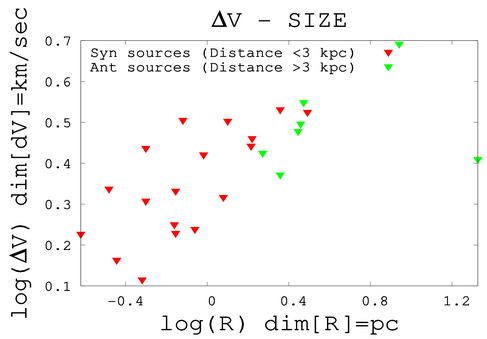
Spectra reduction was held with GILDAS package [http://www.iram.fr/IRMFR/GILDAS/] taking into account baseline (polynomial with power not higher than 3) and standing wave. For integrated criteria moment method was used.

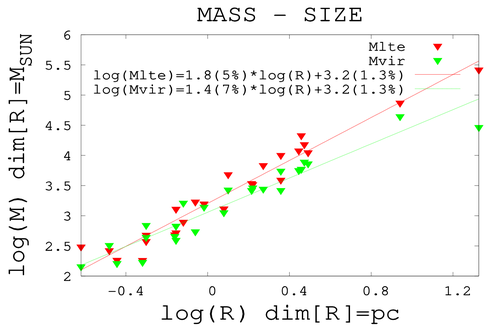
Observation

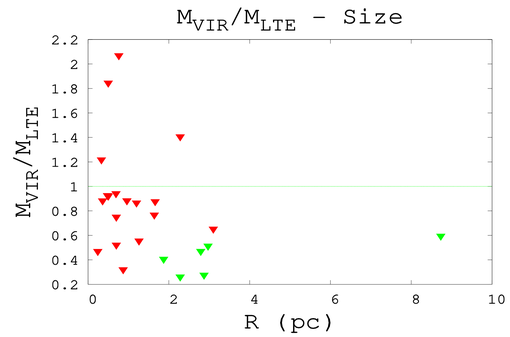
Most sources were observed on 13.7-m Purple Mountain Observatory telescope (China) in emission lines of CO, C^{18}O, ^{13}CO (J=1-0) using position switching with noise temperature from 250K to 500K.

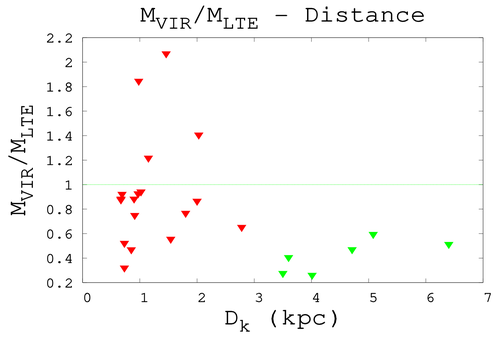
About 10 sources were observed in Onsala space observatory in emission lines of N_2H^+, HCN, C^{18}O, HCO+, CS and ^{13}CO with average noise temperature about 550K.

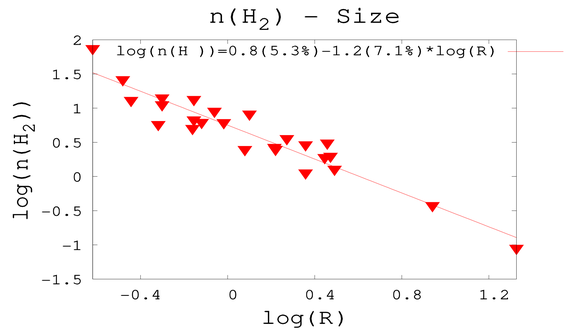
Physical parameters











Selection criteria for Onsala observations:

All the sources was observed using PMO telescope

Abnormal C^{18}O/^{13}CO ratio

Correlation with MSX sources

Interesting (non spherical) physical structure

Modeling

In order to verify physical parameters, emission transfer modeling in lines of CO and C^{18}O was performed using Monte-Carlo method for simplest sources showing spherical symmetry (including 19442+2427).

In general, three sources for which modeling was performed showing good correlation of physical parameters derived from model and using observations. Significant error in distance determination can explain some lack of correlation between modeling and observations.

Summary

$\log(M_{LTE})=1.8(0.1)*\log(R)+3.2(0.03)$, p=0.94

$\log(n(H_2))=-1.2(0.1)*\log(R)+0.8(0.05)$, p=0.87

Conclusions

In total 62 objects were observed using PMO telescope physical parameters of 24 objects were determined, 10 objects from the initial list were observed using Onsala telescope

Variation of physical parameters are. Masses vary: from 140 to $210*10^3$ Sun masses, hydrogen density from $<1\cdot10^3$ to $7.5\cdot10^4$ (cm^{-3}), sizes from 0.3 to 8 (pc),

M_{VIR}/M_{LTE} from 0.1 to 2 with average 0.7(0.1)

Dependences : masses and sizes $M \sim R^2$, averaged density and sizes : $n \sim R^{-1}$, line width and sizes $dV \sim R^{0.3}$

Good correlation with simple models

Kinematic distance has up to 35% errors for our objects, so distances has significant errors – this can explain some lack of correlation between modeling and observations

ИПФ РАН