A General Catalogue of Herbig-Haro Objects

2. Edition

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Abstract

A catalogue of all known Herbig-Haro objects is presented. For each object is given its HH number, previous designations if any, a position, the most probable energy source, and the region and distance. Additionally, extensive notes give a brief description of each object with detailed references to the literature. The catalogue will be updated as developments in the field require.

This catalogue will not be published in any journal. It is only available through the WWW at http://casa.colorado.edu/hhcat

Reference to this catalogue should be done as follows:

Reipurth, B.: 1999, *A general catalogue of Herbig-Haro objects*, 2. edition, http://casa.colorado.edu/hhcat

Introduction

Two catalogues of Herbig-Haro objects have previously been published. George Herbig's *A draft catalog of Herbig-Haro objects* from 1974 gave positions, finding charts and a brief description of all 43 objects known up to that time. This was followed by *A working catalogue of Herbig-Haro objects* by von Hippel, Burnell, Williams (1988), which gave positions, proper motions, radial velocities and spectral information for 89 HH objects or groups of HH knots, although more HH objects were known at the time. Since then the increasingly common use of large-field CCD detectors with interference filters have caused an almost explosive development in the discovery rate of HH objects, which now number more than 400 objects.

In the days when discoveries of HH objects were rare and only few people worked in the field it was possible to assign consecutive HH numbers to the objects as they became known. This has long since become impossible, and lacking some sort of coordinating facility, newly discovered HH objects have been given a great variety of names (e.g. S140/HH3, GGD 34, N2264 HH 14-4, RNO 40E, WSB 47, Re 4 head, GN20.18.3/HH, Th 28, HHG33.3+0.2).

Some years ago I was approached by Dr. M.-C. Lortet of the IAU Nomenclature Committee, who asked me if something could be done to bring order to this wild growing subject. After some hesitation I embarked upon a survey of the entire literature on Herbig-Haro flows with the aim to produce a complete catalogue of all known HH objects, and the result was the first edition of *A General Catalogue of Herbig-Haro Objects*, published electronically in 1994. The present second edition has been greatly expanded over the intervening 5 years. The philosophy of this catalogue is closer to that of Herbig's 1974 catalogue than to that of the von Hippel, Burnell, Williams 1988 catalogue. The present catalogue contains three parts. First, a table listing for each object an HH number, any previous designations, a position, identification of a suspected driving source, the name of the general region of the object, and a distance estimate. Second, a note section where each object is briefly described and extensive references, as complete as possible, are given to the literature. Third, a section with references, where also the title is listed, to help give a first idea about the content of a paper. The catalogue is thus less a source of information, and more a tool to find information.

All known HH objects accepted as such now have an HH number, in continuation of the already existing HH numbers assigned by Herbig and others. In most cases this is a great improvement over previous designations. In a few cases well known and beloved names have been sacrificed, with regret, for the sake of the larger vision of having once and for all a single nomenclature system that gives a complete description of an increasingly important class of astrophysical objects. When an object had to be renamed, a special effort was made to find a number that, whenever possible, was somehow related to the previous name. Thus RNO 40 and 43 are now HH 240 and 243, Th 28 is HH 228, M16-HH1 is HH 216, the M42 objects HH 1-10 are HH 201 - 210, GGD34 is HH 234, etc. Hopefully any transition difficulties will be shortlived.

What is an HH object (and what is not)?

In the course of this work, the question has inevitably arisen a number of times whether a certain object should or should not be included in the catalogue. While it is impossible to make very strict rules for what to include, at least a set of guidelines have been set up. HH objects are small-scale shock regions intimately associated with star forming regions. They generally have characteristic spectra which set them apart from photo-ionized regions. The best way to unequivocally identify a nebulous object in a star forming region as an HH object is to take a spectrum. Increasingly, however, a simpler technique is used, namely to take CCD images through a [SII] interference filter and through either a similar slightly blue- or red-shifted filter that avoids the [SII] lines or through a red broadband filter around 0.9 or 1.0 μm that transmits only few and weak HH lines. If the object observed appears strongly in the [SII] filter, but not in the other filter then it is virtually certain that the object is an HH object. However, this method becomes questionable if applied in regions away from molecular clouds and known star formation activity.

Another technique, pioneered by Solf, is to place a long slit on a young star at a variety of position angles. Very short HH flows, that would be difficult to see in a direct image where the brightness of the star could swamp it, will appear clearly after elimination of the stellar continuum. I have used the guideline that such flows that extend more than an arcsecond from a star, and which could thus in principle be studied morphologically using proper coronagraphic techniques, are included in the catalogue. Stars with HH emission lines but no appreciable extent have not been included.

With the advent of infrared imaging detectors, many HH objects have been found to emit significantly in H_2 and [FeII], with roughly similar morphologies at optical and infrared wavelengths. A number of molecular hydrogen objects have been detected in embedded molecular outflows with no optical counterparts. While it seems probable that these objects differ from ordinary HH objects only in the amount of extinction along the line-of-sight, much work on the infrared properties of HH flows remains to be done before it can be justified to expand the definition of HH objects to include all objects only detected in the infrared. However, for the first edition of this catalogue, this rule was relaxed for a few objects with additional strong morphological support for classification as an HH flow. Thus, HH 121 and HH 211, which are well collimated bipolar flows, located in regions of star formation and up to now only detected at infrared wavelengths, were included (two more objects, HH 212 and HH 288, which were first discovered as infrared objects, have subsequently been found to have some optical bona fide HH components). In hindsight, it must be recognized that it was not a good idea to make such exceptions, and consequently no further purely infrared emitting objects have been included in this HH catalogue.

In recent years an increasing number of shocked regions have been found in association with evolved stars. Kinematically and morphologically these objects do not appear to differ much from Herbig-Haro objects, but spectroscopically they are rather different because the shocks occur in highly processed material. From the point of view of hydrodynamics and shock physics these objects are undoubtedly as interesting as HH flows and supernova remnants and other supersonic flows. However, the most important aspect of the Herbig-Haro phenomenon is arguably the unique insights which it has provided into the processes that lead to the formation of stars. For this reason it was felt that HH flows should remain strictly as a star formation phenomenon, as it was originally defined by Herbig and Haro. Thus, this catalogue does not contain any objects which arise from evolved stars.

Electronic publishing

Electronic publishing has two major advantages. Firstly, it allows instantaneous and worldwide distribution without the long delays inherent in normal publishing. Secondly, it allows easy up-dating as often as required. It was originally foreseen that new versions of this catalogue would be made available of the order of once a year. However, in practice it has turned out to be so time consuming to keep track of the greatly expanding literature on HH objects, that five years have passed between the first and second version of the catalogue. I will continue to update the catalogue as the need arises and time permits. New versions will be announced in the *Star Formation Newsletter.*

The literature listed in this second edition is complete for papers published before 1 March 1999.

A limitation of the present catalogue is the absence of images of the various HH objects. However, work is rapidly progressing on a web-based version which includes images of each HH object. The next version of this catalogue will be an illustrated and fully linked web version.

A cooperative effort

New bona fide Herbig-Haro objects will, as they appear in the literature, continue to be included in the catalogue. But if you have found a new HH object, you may consider to contact me when you are in the final stages of writing your paper, to find out what is the next available HH number. Unless waived, all such information will be treated as confidential and will not appear in new versions of the catalogue until your paper is accepted. New HH objects are continuously having numbers reserved this way, so *please do not simply take the next apparently free HH number as this could cause grave confusion.* With a collaborative effort among the workers in the Herbig-Haro community it will be possible to establish this catalogue and its future expanded editions as a tool that will make our work easier. Your cooperation in this matter is highly appreciated.

While a major effort has been invested in making the references to work on individual objects as complete as possible, it is inevitable that some important references could be missing. Certainly not all papers mentioning a given object should be listed, and an estimate of relevance has been applied to all papers. For a little known object even a single poor observation can be helpful, but it could be irrelevant for very well studied regions like L1551. So no universal rule of inclusion can be made. If you feel that a useful reference is missing, please send an e-mail to me at *reipurth@casa.colorado.edu.*

Accuracy of positions

The positions listed in the catalogue are taken from the literature and are as such very heterogeneous. An effort has been made to take the best available positions, but in some cases the positions are rather approximate. The equinox is 1950 and proper motions have not been considered. The goal has been to give positions that will allow an observer to point a telescope and take a CCD image and be sure that the object or an important part of it is in the field. For more details on positions, the reader must consult the references listed.

Acknowledgements

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Boulder, Colorado 1 May 1999 Bo Reipurth

Catalogue of Herbig-Haro Objects

HH	Other designation	α_{1950}	δ_{1950}	Suspected source	Region	Dist [pc]
161	LkHα 198B/HH	0 08 48.9	+58 32 45	LkHα 198-B	Cassiopeia	950
164	LkHα 198 jet	0 08 47.5	+58 32 48	LkHα 198	Cassiopeia	950
162	V376 Cas/HH	0 08 49.8	+58 33 27	V376 Cas	Cassiopeia	950
461		0 08 52.0	+58 31 35	LkHα 198-B	Cassiopeia	950
288		0 34 18.6	+63 47 45	IRAS00342+6347	Cassiopeia	2000
163	AFGL4029 jet	2 57 36.0	+60 17 22	AFGL 4029	IC1848A	2200
280		3 20 40.5	+30 07 22		Perseus	300
267		3 20 58.3	+30 49 53		L1448	300
268		3 21 17.6	+30 37 36		L1448	300
193		3 21 48.1	+30 44 22		L1448	300
194		3 21 54.1	+30 37 09		L1448	300
196		3 22 08.9	+30 38 46		L1448	300
195		3 22 10.4	+30 36 28		L1448	300
197		3 22 32.3	+30 34 32		L1448	300
277		3 23 00.1	+30 28 51		L1448	300
278		3 23 55.1	+30 15 32		Perseus	300
317		3 24 07.3	+30 01 34		L1455	300
279		3 24 14.5	+30 06 51		Perseus	300
423		3 24 30.9	+30 05 30		L1455	300
318		3 24 40.5	+30 03 54		L1455	300
422		3 24 43.9	+30 01 15		L1455	300
338		3 25 07.3	+31 09 22		NGC 1333	220
351		3 25 13.0	+30 40 09		NGC 1333	220
339		3 25 25.5	+31 04 25		NGC 1333	220
340		3 25 39.7	+30 55 19		NGC 1333	220
13		3 25 42.1	+30 56 47		NGC 1333	220
14		3 25 44.4	+30 50 56		NGC 1333	220
341		3 25 44.8	+30 59 16		NGC 1333	220
334		3 25 46.0	+31 12 19		NGC 1333	220
342		3 25 46.5	+31 00 29		NGC 1333	220
343		3 25 49.1	+30 55 02		NGC 1333	220
426		3 25 49.3	+30 42 07		NGC 1333	220
350		3 25 49.6	+30 54 22		NGC 1333	220
12		3 25 52.1	+31 09 51	SVS 12	NGC 1333	220
15		3 25 53.5	+30 57 43		NGC 1333	220
344		3 25 56.2	+31 02 57		NGC 1333	220
11		3 25 59.0	+31 05 35	SVS 13	NGC 1333	220
10		3 25 59.8	+31 05 28	SVS 13	NGC 1333	220
8		3 26 00.7	+31 05 19	SVS 13	NGC 1333	220
9		3 26 00.9	+31 05 35	SVS 13	NGC 1333	220
7		3 26 02.5	+31 05 10	SVS 13	NGC 1333	220
16		3 26 02.8	+30 58 52		NGC 1333	220
333		3 26 06.1	+31 15 51		NGC 1333	220
345		3 26 09.6	+31 03 08		NGC 1333	220
6		3 26 07.0	+31 08 23		NGC 1333	220
347		3 26 10.2	+31 05 04		NGC 1333	220
335		3 26 12.0	+31 12 45		NGC 1333	220
352		3 26 13.1	+30 49 46		NGC 1333	220

HH	Other designation	α_{1950}	δ_{1950}	Suspected source	Region	Dist [pc]
17		3 26 14.7	+31 08 17		NGC 1333	220
5		3 26 14.8	+31 02 34		NGC 1333	220
346		3 26 16.0	+31 05 10		NGC 1333	220
4		3 26 18.6	+31 09 41		NGC 1333	220
348		3 26 19.9	+31 03 17		NGC 1333	220
18		3 26 21.0	+30 57 21		NGC 1333	220
336		3 26 30.1	+31 09 08		NGC 1333	220
349		3 26 30.7	+31 03 16		NGC 1333	220
353		3 26 32.2	+31 19 56		NGC 1333	220
368		3 27 19.2	+30 20 43		Barnard 1	220
369		3 27 22.3	+30 18 11		Barnard 1	220
370		3 27 28.3	+30 17 31		Barnard 1	220
427		3 27 33.1	+30 11 43		Barnard 1	220
371		3 27 41.2	+30 20 45		Barnard 1	220
372		3 27 41.2	+30 19 13		Barnard 1	220
428		3 27 42.4	+30 27 51		Barnard 1	220
429		3 28 42.4	+30 59 50		Barnard 1	220
430		3 29 21.7	+31 14 32		Barnard 1	220
356		3 29 59.8	+31 16 39		Barnard 1	220
431		3 30 09.2	+30 59 04	IRAS03301+3057	Barnard 1	220
432		3 30 27.5	+30 59 41		Barnard 1	220
433		3 30 43.7	+30 54 55	IRAS03304+3100	Barnard 1	220
211		3 40 48.2	+31 51 28		IC 348	300
366		3 43 49.7	+32 36 05	B5 IRS1	B5	350
367		3 43 57.9	+32 33 05	B5 IRS3	B5	350
462		3 50 46.8	+38 01 46	IRAS03507+3801	Perseus	350
362		4 01 20.5	+26 12 31		L1489	140
361		4 01 32.4	+26 13 35		L1489	140
360		4 01 40.5	+26 10 51		L1489	140
463	PP13S jet	4 07 20.9	+38 00 03	PP13S	L1473	350
464		4 07 22.4	+37 59 52	PP13N	L1473	350
465		4 07 22.4	+38 00 47	PP13N	L1473	350
220	CW Tau jet	4 11 11.3	+28 03 27	CW Tau	Taurus	140
156	CoKu Tau-1 jet	4 15 45.4	+28 13 14	CoKu Tau-1	Taurus	140
390		4 16 36.1	+27 08 42	IRAS04166+2706	Taurus	140
391		4 16 51.7	+27 02 16	IRAS04169+2702	Taurus	140
392		4 17 49.8	+26 52 46		Taurus	140
355		4 18 48.1	+19 43 40	T Tauri	Taurus	140
157	Haro 6-5B jet	4 18 56.4	+26 50 36	Haro 6-5B	Taurus	140
155	HH 1555	4 19 01.9	+19 25 05	T Tauri	Taurus	140
276		4 19 02.8	+26 50 25		Taurus	140
255	Burnham's Nebula	4 19 04.2	+19 24 55	T Tau-S	Taurus	140
300		4 22 21.7	+24 16 32	IRAS04329+2436	B18	140
159	DG Tau B jet	4 23 58.4	+25 59 00	DG Tau B	Taurus	140
158	DG Tau jet	4 24 01.0	+25 59 35	DG Tau	Taurus	140
410		4 25 11.6	+24 12 25	Haro 6-10	Taurus	140
31		4 25 14.4	+26 11 04	IRAS04248+2612	B218	140
184	Haro 6-10/HH	4 26 21.9	+24 26 29	Haro 6-10	Taurus	140
414		4 26 28.4	+24 33 22	IRAS04264+2433	Taurus	140
412		4 26 46.1	+24 30 40	Haro 6-10	Taurus	140
413		4 26 51.1	+24 31 42	IRAS04264+2433	Taurus	140

HH	Other designation	α_{1950}	δ_{1950}	Suspected source	Region	Dist [pc]
411		4 27 14.9	+24 36 14	Haro 6-10	Taurus	140
393		4 27 48.6	+24 34 59		Taurus	140
256	GH 1	4 27 59.5	+17 52 41	L1551 IRS 5	L1551	140
257	GNG 17	4 28 07.0	+17 54 17	L1551 IRS 5	L1551	140
258	GH 2-8	4 28 11.0	+17 57 07	L1551 IRS 5	L1551	140
28		4 28 13.2	+17 56 58	L1551 IRS 5	L1551	140
259	SH 229 group	4 28 20.3	+17 57 38	L1551 IRS 5	L1551	140
265	GNG 25	4 28 21.0	+18 05 35		L1551	140
264	GNG 4	4 28 24.6	+17 59 52		L1551	140
102	S239	4 28 25.3	+18 00 57		L1551	140
263	SH 214, GNG 3	4 28 29.5	+18 01 24		L1551	140
260	GNG 1	4 28 33.1	+18 00 31	L1551 IRS 5	L1551	140
29		4 28 33.2	+18 00 00	L1551 IRS 5	L1551	140
261	SH 219/220	4 28 36.1	+18 00 30	L1551 IRS 5	L1551	140
154	L1551 IRS5 jet	4 28 39.9	+18 01 39	L1551 IRS 5	L1551	140
30		4 28 43.6	+18 06 03	HH 30 IRS	L1551	140
150	HL Tau jet	4 28 44.5	+18 07 36	HL Tau	L1551	140
153	HL Tau Hα jet	4 28 45.4	+18 07 16		L1551	140
151	HL Tau VLA1 jet	4 28 45.6	+18 07 45	HL Tau VLA1	L1551	140
152	XZ Tau jet	4 28 46.1	+18 07 35	XZ Tau	L1551	140
454		4 28 48.8	+18 01 57	L1551-NE	L1551	140
266	GNG 24	4 28 58.2	+18 10 28		L1551	140
262	GH 9/10	4 29 07.1	+18 05 03	L1551 IRS 5	L1551	140
319	Haro 6-19	4 29 39.4	+24 15 27		Taurus	140
286		4 29 47.6	+18 10 18		L1551	140
394		4 30 12.5	+22 48 53	IRAS04302+2247	Taurus	140
467		4 30 31.2	+24 14 12		B18	140
466		4 30 33.7	+24 15 17	GK Tau	B18	140
468		4 30 35.9	+24 15 28		B18	140
123		4 32 31.7	−14 19 17	L1642-2A	L1642	125
378		4 32 39.6	+54 32 07	IRAS04327+5432	Camelopardalis	?
230	DO Tau jet	4 35 24.2	+26 04 55	DO Tau	Taurus	140
233		4 35 30.9	+26 04 45	HV Tau	Taurus	140
192		4 36 43.4	+25 57 37		L1527	140
395		4 37 04.8	+25 40 56	IRAS04369+2539	Taurus	140
408		4 38 34.7	+25 50 44	Haro 6-33	Taurus	140
231	DP Tau jet	4 39 34.3	+25 10 00	DP Tau	Taurus	140
386	UY Aur jet	4 48 35.7	+30 42 14	UY Aur	Auriga	140
229	RW Aur jet	5 04 37.7	+30 20 14	RW Aur	Auriga	140
114		5 15 00.7	+07 12 39	IRAS05155+0707	L1589	470
328		5 15 13.4	+07 12 47		L1589	470
329		5 15 58.6	+07 05 12		L1589	470
115		5 16 03.7	+07 02 21	IRAS05155+0707	L1589	470
240	RNO 40	5 17 13.8	−05 54 45	IRAS05173−0555	Orion	470
241	RNO 40-E	5 17 31.3	−05 55 23	IRAS05173−0555	Orion	470
190		5 27 27.5	+33 45 38		AFGL 5142	470
58		5 28 22.7	−04 11 44		Orion	470
176		5 28 38.3	+12 08 43	HK Ori	λ Ori	470
179		5 29 14.5	+12 33 16	IRAS05295+1247	λ Ori	470
244		5 29 24.0	+12 43 55	IRAS05295+1247	λ Ori	470

HH	Other designation	α_{1950}	δ_{1950}	Suspected source	Region	Dist [pc]
243	RNO 43	5 29 39.0	+12 51 12	IRAS05295+1247	λ Ori	470
245	RNO 43-N	5 29 44.3	+12 56 05	IRAS05295+1247	λ Ori	470
59		5 29 52.0	−06 31 09		Orion	470
60		5 30 11.4	−06 28 50		Orion	470
83	Re 17	5 31 05.4	−06 31 39	HH 83 IRS	L1641	470
84	Re 18	5 31 45.3	−06 35 58	HH 83 IRS	L1641	470
295		5 32 09.1	−05 06 13	IRAS05329−0505	OMC-3	470
131		5 32 18.9	−08 30 03		Orion	470
331		5 32 40.4	−05 02 42		OMC-3	470
269		5 32 41.7	−05 25 38		M42	470
201	M42-HH1	5 32 44.0	−05 23 48		M42	470
202	M42-HH2	5 32 44.0	−05 24 40		M42	470
205	M42-HH5	5 32 44.4	−05 22 18		M42	470
206	M42-HH6	5 32 45.0	−05 22 32		M42	470
207	M42-HH7	5 32 45.2	−05 22 43		M42	470
401	HH1/2-NW	5 32 45.8	−06 31 32	HH 1/2 VLA1	L1641	470
208	M42-HH8	5 32 46.3	−05 24 15		M42	470
209	M42-HH9	5 32 46.4	−05 23 40		M42	470
323	HH 33X	5 32 46.5	−06 19 35		L1641	470
322		5 32 46.8	−06 21 45		L1641	470
210	M42-HH10	5 32 48.0	−05 22 34		M42	470
357		5 32 48.3	−05 08 03		OMC 3	470
44		5 32 48.5	−05 12 19		NGC 1976	470
407		5 32 50.5	−06 01 32		L1641	470
33		5 32 51.5	−06 19 35	HH 34 IRS	L1641	470
293		5 32 53.6	−05 03 08		OMC-3	470
40	Haro 9a	5 32 54.5	−06 20 16	HH 34 IRS	L1641	470
203	M42-HH3	5 32 54.8	−05 26 51		M42	470
385		5 32 55.0	−05 09 13		OMC 2/3	470
204	M42-HH4	5 32 55.2	−05 27 06		M42	470
294		5 32 55.2	−05 05 55	IRAS05329−0505	OMC 2/3	470
384		5 32 57.7	−05 11 16		OMC 2/3	470
85	Re 20	5 32 58.2	−06 22 15	HH 34 IRS	L1641	470
383		5 32 58.7	−05 09 45		OMC 2/3	470
126	Re 21	5 33 00.5	−06 24 39	HH 34 IRS	L1641	470
287		5 33 01.9	−05 07 08		OMC 2/3	470
34		5 33 03.7	−06 28 53	HH 34 IRS	L1641	470
45		5 33 06.3	−04 52 43		NGC 1977	470
173		5 33 08.7	−06 34 53		L1641	470
134		5 33 10.1	−06 32 10		L1641	470
324		5 33 14.0	−06 20 25		L1641	470
330		5 33 14.2	−05 06 34		L1641	470
86	Re 25	5 33 14.3	−06 38 04	HH 34 IRS	L1641	470
222	Orion Streamers	5 33 15.6	−06 24 54	HH 222 VLA	L1641	470
87	Re 26	5 33 17.2	−06 39 21	HH 34 IRS	L1641	470
88	Re 27	5 33 18.0	−06 39 46	HH 34 IRS	L1641	470
310		5 33 22.2	−05 37 56		L1641	470
326		5 33 23.2	−06 33 55		L1641	470
127	Re 28	5 33 24.4	−07 02 08		L1641	470
325		5 33 24.5	−06 31 10		L1641	470

HH	Other designation	α_{1950}	δ_{1950}	Suspected source	Region	Dist [pc]
327		5 33 24.6	−06 37 20		L1641	470
316		5 33 28.1	−06 06 44		L1641	470
41	Haro 3a	5 33 34.1	−05 04 40	IRAS05329−0505	L1641	470
308		5 33 34.4	−06 02 15		L1641	470
309	Re 33	5 33 36.2	−05 51 37		L1641	470
42	Haro 4a	5 33 37.3	−05 06 31	IRAS05329−0505	L1641	470
128	Re 31	5 33 40.7	−05 06 28	IRAS05329−0505	L1641	470
307		5 33 41.0	−06 06 05		L1641	470
306	Re 34	5 33 41.5	−06 10 36		L1641	470
129	Re 32	5 33 43.3	−05 05 59	IRAS05329−0505	L1641	470
299		5 33 43.3	−06 21 49		L1641	470
296		5 33 45.2	−06 19 12		L1641	470
3	Haro 10a	5 33 45.8	−06 44 53		L1641	470
61		5 33 47.4	−07 08 51		L1641	470
62		5 33 47.5	−07 12 51		L1641	470
145		5 33 48.5	−06 48 11		L1641	470
297		5 33 49.3	−06 18 22		L1641	470
303	Re 35/36	5 33 52.7	−06 21 24	IRAS05338−0624	L1641	470
1	Haro 11a	5 33 54.5	−06 46 57	HH 1/2 VLA1	L1641	470
298		5 33 55.4	−06 23 40		L1641	470
144		5 33 55.4	−06 47 56	HH 1/2 VLA2	L1641	470
35		5 33 56.6	−06 43 40	V380 Ori	L1641	470
146		5 33 56.8	−06 50 10		L1641	470
305	Re 37/38/39	5 33 57.0	−06 17 32		L1641	470
148		5 33 57.4	−06 45 03		L1641	470
147		5 33 56.9	−06 46 46	IRAS05339−0646	L1641	470
2	Haro 12a	5 33 59.7	−06 49 04	HH1/2 VLA1	L1641	470
304	Re 41/42	5 34 10.6	−06 16 42		L1641	470
301	Re 43	5 34 12.7	−06 23 04		L1641	470
130	Re 45	5 34 20.1	−06 51 43	V380 Ori	L1641	470
36		5 34 20.7	−06 46 01		L1641	470
63		5 34 21.0	−04 27 45		Orion	470
302	Re 44	5 34 22.0	−06 22 25		L1641	470
285	AFGL5157/HH5	5 34 30.5	+31 57 17		AFGL 5157	1800
281	AFGL5157/HH1	5 34 32.8	+31 58 28		AFGL 5157	1800
282	AFGL5157/HH2	5 34 33.5	+31 58 19		AFGL 5157	1800
292		5 34 33.7	−06 35 12	BE Ori	L1641	470
283	AFGL5157/HH3	5 34 34.8	+31 58 11		AFGL 5157	1800
403		5 34 36.7	−05 54 40		L1641	470
284	AFGL5157/HH4	5 34 38.3	+31 57 51		AFGL 5157	1800
404		5 34 48.7	−05 45 49		L1641	470
402	HH1/2-SE	5 34 52.0	−07 02 24	HH 1/2 VLA1	L1641	470
405	Re 46	5 34 57.7	−05 45 20		L1641	470
406		5 35 11.7	−05 41 05		L1641	470
89	Re 47	5 35 21.9	−06 47 47		L1641	470
64		5 35 22.3	−07 07 12		L1641	470
289		5 35 38.5	−01 45 55	IRAS05355−0146	Ori-I-2	470
43	Haro 14a	5 35 45.4	−07 11 04	HH 43 IRS1	L1641	470
183		5 35 52.6	−07 04 06	V883 Ori	L1641	470
38		5 35 56.5	−07 13 18		L1641	470
449		5 36 17.5	−07 14 22	Haro 4-249	L1641	470

HH	Other designation	α_{1950}	δ_{1950}	Suspected source	Region	Dist [pc]
469		5 36 54.0	−07 28 03	Haro 4-255FIR	L1641	470
446		5 36 54.9	−02 35 05		σ Ori	470
470		5 37 03.8	−07 29 51	Haro 4-255	L1641	470
444		5 37 09.0	−02 32 56	V510 Ori	σ Ori	470
445		5 37 09.0	−02 34 50	A0976-357	σ Ori	470
447		5 37 38.1	−02 35 05	Haro 5-39	σ Ori	470
65		5 37 53.8	−07 26 36	Re 50 IRS	L1641	470
66		5 37 55.0	−02 04 04		L1630	470
67		5 38 32.6	−01 48 06		L1630	470
90	Re 51	5 38 52.8	−01 11 29	HH 91 IRS	L1630	470
248	N2023-HH2	5 38 55.6	−02 24 30		NGC 2023	470
247	N2023-HH1,4,5	5 39 00.9	−02 18 52	HH 247 star C	NGC 2023	470
249	N2023-HH3	5 39 01.9	−02 25 08		NGC 2023	470
68		5 39 08.7	−06 27 20		Orion	470
69		5 39 15.6	−06 31 18		Orion	470
91	Re 52/53	5 39 25.9	−01 15 01	HH 91 IRS	L1630	470
92	Re 54	5 39 48.9	−01 19 52		L1630	470
93	Re 55	5 40 23.8	−01 27 08		L1630	470
94	Re 56	5 40 56.3	−02 34 14		L1630	470
212		5 41 18.9	−01 04 09		L1630	470
95	Re 57	5 41 22.5	−02 39 03		L1630	470
175		5 42 03.0	+09 09 00	IRAS05417+0907	B35	470
19		5 43 16.0	−00 06 20		NGC 2068	470
20		5 43 21.5	−00 04 14		NGC 2068	470
21		5 43 22.0	−00 05 36		NGC 2068	470
37	SSWMW 18-37	5 43 22.2	−00 06 39		NGC 2068	470
70		5 43 28.7	−00 06 43		NGC 2068	470
26		5 43 31.1	−00 15 42	SSV 59	NGC 2068	470
25		5 43 33.2	−00 14 31	SSV 59	NGC 2068	470
24		5 43 36.1	−00 11 02	SSV 63	NGC 2068	470
22		5 43 40.3	−00 06 36		NGC 2068	470
23		5 43 40.9	−00 04 37	IRAS05436−0007	NGC 2068	470
27		5 43 49.4	−00 14 45		NGC 2068	470
291		5 44 02.9	+20 58 48		CB 34	1500
290		5 44 04.5	+20 59 08		CB 34	1500
71		5 44 46.1	+00 39 43		L1630	470
471		5 45 00.6	+00 37 47	LkHα 316	L1630	470
472		5 45 04.5	+00 37 35		L1630	470
473		5 45 06.2	+00 36 59		L1630	470
474		5 45 11.8	+00 38 05		L1630	470
311		5 47 13.6	+02 53 01	HH 111 VLA	L1617	470
110		5 48 47.8	+02 54 09		L1617	470
270		5 48 52.8	+02 55 22	HH 270 IRS	L1617	470
111		5 49 07.2	+02 47 52	HH 111 VLA	L1617	470
121		5 49 09.7	+02 47 58	HH 111 VLA	L1617	470
116		5 49 09.7	+08 24 40	IRAS05494+0820	L1598	470
112		5 49 14.4	+02 59 47		L1617	470
117		5 49 39.2	+08 15 31	IRAS05496+0812	L1598	470
118		5 49 40.0	+08 09 34	IRAS05496+0812	L1598	470
113		5 50 58.1	+02 42 49	HH 111 VLA	L1617	470
122		5 52 03.2	+01 43 26		L1622	470

HH	Other designation	α_{1950}	δ_{1950}	Suspected source	Region	Dist [pc]
396		5 55 03.4	+16 32 00	G192.16-3.82	Gemini	2000
397		5 55 30.7	+16 32 31	G192.16-3.82	Gemini	2000
273	GGD17/HH3	6 10 18.3	−06 10 56		L1646	830
272	GGD17/HH2	6 10 21.9	−06 10 30		L1646	830
271	GGD17/HH1	6 10 23.9	−06 12 10	Bretz 4	L1646	830
191		6 11 47.6	+13 50 36	IRS2w	S269	4000
39		6 36 21.8	+08 54 11	R Mon	Monoceros	800
124		6 38 17.0	+10 17 58	IRAS06382+1017	NGC 2264	800
226	N2264 HH11-6,7	6 38 17.2	+09 42 42		NGC 2264	800
225	N2264 HH14-4,5,6	6 38 17.7	+09 47 09		NGC 2264	800
125		6 38 20.3	+09 50 28		NGC 2264	800
227		6 57 07.9	−04 41 58		S287	2100
160	Z CMa jet	7 01 22.5	−11 28 36	Z CMa	S296	1150
72		7 18 04.5	−23 56 45	IRAS07180−2356	L1660	1500
120	Re 2	8 07 40.0	−35 56 02	CG30-IRS4	Gum Nebula	450
217	GN08.15.9/HH	8 15 59.0	−35 43 26	IRAS08159−3543	Puppis	3400
188	Re 4 head	8 19 28.9	−49 25 12	IRAS08194−4925	Gum Nebula	450
246		8 19 45.7	−49 29 59		Gum Nebula	450
219		8 21 09.4	−41 59 05	IRAS08211−4158	Gum Nebula	450
46		8 24 17.1	−50 50 34	HH 46/47 IRS	Gum Nebula	450
47		8 24 22.8	−50 50 00	HH 46/47 IRS	Gum Nebula	450
132		8 33 40.4	−40 28 28		Puppis	950
73		9 00 26.6	−44 39 25		Vela	700
74		9 00 28.6	−44 37 59		Vela	700
133		9 09 02.4	−45 18 18		Vela	700
75		9 09 50.7	−45 30 07		Vela	700
171		9 46 59.2	−54 43 05		Vela	?
48		11 03 01.9	−77 01 55	HH 48 IRS	Cha I	150
49		11 04 37.4	−77 17 21	Ced110-IRS4	Cha I	150
50		11 04 39.7	−77 16 44	Ced110-IRS4	Cha I	150
51		11 08 21.5	−76 08 01		Cha I	150
135		11 10 05.9	−58 30 14		Carina	2700
136		11 10 09.0	−58 29 44		Carina	2700
137		11 11 49.0	−60 36 17		Carina	2200
138		11 12 01.5	−60 36 35		Carina	2200
320		11 58 58.8	−64 51 29		Sa 136	200
321		11 59 02.4	−64 52 52	IRAS11590−6452	Sa 136	200
274		12 49 38.7	−76 50 51	IRAS12496−7650	Cha II	165
52		12 51 27.3	−76 41 40	IRAS12496−7650	Cha II	165
53		12 51 34.6	−76 41 17	IRAS12496−7650	Cha II	165
54		12 52 10.0	−76 40 08	IRAS12496−7650	Cha II	165
76		14 56 32.9	−62 52 20	IRAS14563−6250	Circinus	1000
77		14 56 42.9	−62 55 53		Circinus	1000
139		14 56 51.6	−63 04 59	vBH 65a	Circinus	1000
141		14 59 14.9	−63 12 09		Circinus	1000
140		14 59 15.3	−63 11 05	vBH 65b	Circinus	1000
142		14 59 17.6	−63 10 41		Circinus	1000
143		14 59 19.6	−63 11 51		Circinus	1000
185		15 39 50.6	−33 59 46	IRAS15398−3359	Lupus 1	170
186	Sz 68 jet	15 42 01.4	−34 08 08	Sz 68	Lupus 1	170
187	HG object 1	15 42 07.2	−34 08 11		Lupus 1	170

HH	Other designation	α_{1950}	δ_{1950}	Suspected source	Region	Dist [pc]
55		15 53 18.7	−37 42 12	HH 55 IRS	Lupus 2	150
228	Th 28 jet	16 05 08.3	−38 55 16	Th 28	Lupus 3	170
78		16 05 51.3	−38 57 10		Lupus 3	170
312		16 22 54.7	−24 14 01	SR 4	Ophiuchus	160
418		16 23 11.8	−24 34 15		Ophiuchus	160
313		16 23 17.5	−24 16 22	VLA 1623	Ophiuchus	160
419	C1	16 23 22.9	−24 24 06		Ophiuchus	160
314		16 23 37.2	−24 34 10		Ophiuchus	160
79		16 23 45.1	−24 13 42		Ophiuchus	160
224	WSB 47	16 24 15.0	−24 40 31		Ophiuchus	160
416	C4S	16 24 41.2	−24 42 39		Ophiuchus	160
417		16 25 24.4	−24 21 25		Ophiuchus	160
420	C5	16 25 36.5	−24 30 34		Ophiuchus	160
56		16 28 54.1	−44 48 37	Re 13	Norma 1	700
57		16 28 56.8	−44 49 17	V346 Nor	Norma 1	700
213	Re 15/16	17 59 26.6	−24 17 16		M8	1680
399		17 59 26.7	−23 04 04		M20	1680
180		18 14 25.2	−19 52 55		Sagittarius	1700
216	M16-HH1	18 16 05.1	−13 53 03		NGC 6611	2300
80		18 16 06.9	−20 53 06	IRAS18162−2048	L291	1700
81		18 16 07.5	−20 52 23	IRAS18162−2048	L291	1700
476		18 26 26.3	+00 27 12		Serpens	310
106		18 26 46.4	+01 12 15	ESO Hα 279	Serpens	310
477		18 27 06.2	+01 18 20		Serpens	310
460		18 27 06.4	+01 16 20		Serpens	310
107		18 27 15.9	+01 23 51	ESO Hα 279	Serpens	310
478		18 27 24.2	+01 13 35		Serpens	310
458		18 27 25.7	+01 11 38	SMM 3	Serpens	310
456		18 27 26.9	+01 09 10		Serpens	310
457		18 27 27.6	+01 08 41		Serpens	310
459		18 27 30.3	+01 12 39	SMM 3	Serpens	310
455		18 27 50.5	+01 14 12	PS 2	Serpens	310
108		18 33 01.7	−00 37 39	IRAS18331−0035	Serpens	310
109		18 33 04.5	−00 36 50	IRAS18331−0035	Serpens	310
172	HHG33.3+0.2	18 51 32.7	+00 28 52		Aquila	500
82		18 57 53.6	−37 01 36	S CrA	Cor.Austr.	130
101		18 58 12.3	−37 07 17	HH 100 IRS	Cor.Austr.	130
96		18 58 18.8	−37 05 11	HH 100 IRS	Cor.Austr.	130
97		18 58 23.3	−37 04 21	HH 100 IRS	Cor.Austr.	130
100		18 58 26.9	−37 02 59	HH 100 IRS	Cor.Austr.	130
98		18 58 30.4	−37 01 57	HH 100 IRS	Cor.Austr.	130
104		18 58 36.7	−37 01 37	R CrA	Cor.Austr.	130
99		18 58 43.1	−36 59 01	HH 100 IRS	Cor.Austr.	130
223		19 15 45.6	+19 06 23	IRAS19156+1906	L723	300
332		19 18 05.3	+10 54 58		Aquila	300
32		19 18 07.9	+10 56 21	AS353A	Aquila	300
250		19 18 51.9	+10 46 48	IRAS19190+1048	Aquila	300
221		19 26 37.5	+09 32 24	Parsamyan 21	Aquila	300
119		19 34 25.8	+07 27 24	B335 IRS	B335	250
387	V536Aql jet	19 36 34.8	+10 23 22	V536 Aql	Aquila	300
165	1548C27 jet	19 40 48.0	+23 17 09	1548C27	Vulpecula	2400

HH	Other designation	α_{1950}	δ_{1950}	Suspected source	Region	Dist [pc]
365		19 41 12.0	+23 22 46	1548C27	Vulpecula	2400
214	GN20.18.3/HH	20 18 21.3	+37 00 43	IRAS20183+3700	Cygnus	1000
425		20 18 46.0	+41 12 06	V1318 Cyg	Cygnus	1000
475		20 22 53.9	+42 05 40		Cygnus	2000
166	AFGL 2591 jet	20 27 36.0	+40 01 16		IC 1318	2000
376		20 35 36.0	+67 43 58	IRAS20359+6745	L1152	500
375		20 38 43.2	+67 50 39	IRAS20386+6751	L1157	440
315		20 45 04.2	+67 52 23	PV Cep	Cepheus	500
215		20 45 23.3	+67 46 36	PV Cep	L1158	500
415		20 45 34.2	+67 49 25		Cepheus	500
199		20 55 52.8	+77 20 44	IRAS20582+7724	L1228	300
200		20 56 11.3	+77 19 45	HH 200 IRS	L1228	300
381		20 56 42.8	+52 17 18	IRAS20568+5217	Cygnus	?
382		20 56 52.3	+52 05 39		Cygnus	?
380		20 57 39.7	+52 22 31		Cygnus	?
389		20 59 32.2	+50 09 56	V1331 Cyg	Cygnus	550
424		20 59 59.3	+49 40 00	LkHα321B	Cygnus	550
421		21 00 16.9	+49 39 45	LkHα321	Cygnus	550
198	RNO 129	21 00 24.0	+78 11 00		Cepheus	300
218	V645Cyg/HH	21 38 10.6	+50 00 43	V645 Cyg	Cygnus	3500
103		21 41 15.8	+65 49 55		NGC 7129	1000
232	GGD 32, GM2-32	21 41 18.0	+65 50 42		NGC 7129	1000
242	HL14 jet	21 41 29.9	+65 52 50		NGC 7129	1000
238	N7129/HH3	21 41 31.4	+65 51 55		NGC 7129	1000
237	N7129/HH2	21 41 33.3	+65 51 37		NGC 7129	1000
239	N7129/HH4	21 41 35.2	+65 52 51		NGC 7129	1000
236	N7129/HH1	21 41 50.2	+65 53 52		NGC 7129	1000
167	LkHα234 jet	21 41 57.6	+65 53 07	LkHα 234	NGC 7129	1000
105		21 42 12.9	+65 54 00		NGC 7129	1000
234	GGD 34, GM2-34	21 42 20.6	+65 54 50		NGC 7129	1000
235	GGD 35, GM2-35	21 42 33.5	+65 54 38		NGC 7129	1000
379		21 42 59.1	+47 18 55	IRAS21432+4719	Cygnus	?
354		22 06 01.6	+58 57 11	IRAS22051+5848	L1165	750
251	S140/HH1	22 17 57.4	+63 17 50		S140	900
252	S140/HH2	22 18 01.1	+63 17 32		S140	900
253	S140/HH3	22 18 08.4	+63 16 38		S140	900
254	S140/HH4	22 18 12.7	+63 16 09		S140	900
363		22 26 35.0	+68 45 39	IRAS22266+6845	L1221	200
398	LkHα233 jet	22 32 28.3	+40 24 32	LkHα 233	Lacerta	880
149		22 34 22.0	+75 01 32	IRAS22343+7501	L1251	300
373		22 35 55.9	+74 59 40		L1251	300
374		22 36 33.6	+74 51 54		L1251	300
364		22 37 13.5	+74 57 29		L1251	300
189	L1251 HH1-2-3	22 37 33.7	+74 55 02	IRAS22376+7455	L1251	300
168	GGD 37	22 54 04.8	+61 45 59	HW 2	Ceph A	700
169	GGD 37-NE	22 54 35.8	+61 46 33	HW 2	Ceph A	700
174		22 54 59.3	+61 45 39	HW 2	Ceph A	700
377		23 01 08.4	+61 25 53	IRAS23011+6126	Ceph E	700
170	MWC 1080/HH	23 15 14.8	+60 34 19	MWC 1080	Cassiopeia	2200
358		23 22 42.2	+73 56 06		L1262	180
359		23 24 30.7	+74 05 57		L1262	180