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THE *HUBBLE SPACE TELESCOPE*/ADVANCED CAMERA FOR SURVEYS ATLAS OF PROTOPLANETARY DISKS IN THE GREAT ORION NEBULA*

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ABSTRACT

We present the atlas of protoplanetary disks in the Orion Nebula based on the Wide Field Channel of the Advanced Camera for Surveys (ACS/WFC) images obtained for the *Hubble Space Telescope (HST)* Treasury Program on the Orion Nebula Cluster. The observations have been carried out in five photometric filters nearly equivalent to the standard B, V, $H\alpha$, I, and z passbands. Our master catalog lists 178 externally ionized protoplanetary disks (*proplyds*), 28 disks seen only in absorption against the bright nebular background (*silhouette disks*), eight disks seen only as dark lanes at the midplane of extended polar emission (*bipolar nebulae* or *reflection nebulae*), and five sources showing jet emission with no evidence of either external ionized gas emission or dark silhouette disks. Many of these disks are associated with jets seen in $H\alpha$ and circumstellar material detected through reflection emission in our broadband filters; approximately two-thirds have identified counterparts in X-rays. A total of 47 objects (29 proplyds, seven silhouette disks, six bipolar nebulae, five jets with no evidence of proplyd emission or silhouette disk) are new detections with *HST*. We include in our list four objects previously reported as circumstellar disks, which have not been detected in our *HST*/ACS images either because they are hidden by the bleeding trails of a nearby saturated bright star or because of their location out of the *HST*/ACS Treasury Program field. The other 31 sources previously reported as extended objects do not harbor a stellar source in our *HST*/ACS images. We also report on the detection of 16 red, elongated sources. Their location at the edges of the field, far from the Trapezium cluster core ($\gtrsim 10'$), suggests that these are probably background galaxies observed through low-extinction regions of the Orion Molecular Cloud (OMC-1).

Key words: ISM: individual (Orion Nebula) – ISM: jets and outflows – planetary systems: protoplanetary disks – reflection nebulae – stars: formation – stars: pre-main sequence

Online-only material: color figure, machine-readable and VO table, extended figures, supplemental data (FITS) file (tar.gz)

1. INTRODUCTION

The Orion Nebula (M42, NGC 1976) is a unique laboratory for studying the physical processes related to star and planet, formation. It harbors one of the richest and youngest clusters (Orion Nebula Cluster, ONC) in the solar neighborhood, spanning the full spectrum of stellar and substellar masses down to a few Jupiter masses (Lucas & Roche 2000). In 1979 several compact photoionized knots were first detected in the central region of the Orion Nebula as emission-line sources (Laques & Vidal 1979), and then important follow-up studies were made in radio (Garay et al. 1987; Churchwell et al. 1987) and via emission-line spectroscopy (Meaburn 1988; Meaburn et al. 1993; Massey & Meaburn 1993). Since the early 1990s, *Hubble Space Telescope* (*HST*) observations of the ONC have been fundamental for clarifying the main characteristics of these young stellar objects (YSO) and their accretion disks. After the pioneering surveys of O'Dell et al. (1993) and Prosser et al. (1994), performed with the spherically aberrated WF/PC, O'Dell & Wen (1994) used Wide Field Planetary Camera 2 to discover several externally ionized protoplanetary disks (*proplyds*), as well as a number of disks seen only in absorption against the bright nebular background (*silhouette disks*), both rendered visible by their location in or near the core of the H II region. Following this discovery, other *HST* programs have increased the number of known objects (O'Dell & Wong 1996; McCaughrean et al. 1996; Bally et al. 1998, 2000). O'Dell (2001) and Smith et al. (2005), targeting areas out of the core, showed that these systems are ubiquitous across the Great Orion Nebula.

So far a total of ∼200 silhouette disks and bright proplyds have been revealed by the *HST* observations of the Orion Nebula, the large majority through narrowband filters centered on the $H\alpha$ λ6563 emission lines, and occasionally through filters centered on the [N II] λ6583, [O I] λ6300, [O III] λ5007, and [S II] λ6717 + 6731 lines.

In this paper we present an atlas of multicolor observations of circumstellar disks and resolved circumstellar emission obtained with the Wide Field Channel of the Advanced Camera for Surveys (ACS/WFC). These images are part of the *HST* Treasury Program on the ONC (Cycle 13, GO Program 10246, P. I.: M. Robberto), aimed at measuring with high precision the main stellar parameters of the cluster members. For this reason, the Treasury Program used broadband filters to obtain the most accurate photometry of each source, together with $H\alpha$-narrowband images to address the presence of circumstellar emission that may contaminate the photometry and the point-spread function of the broadband data. The combination of broadband and narrowband images opens a new window on the study of disks in the ONC. It also makes it possible to detect disks where the nebular background is too faint, thanks to the light of the central stars reflected by the circumstellar material at the disk's polar regions (reflection nebulae).

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Table 1
ACS/WFC Photometric Filters

Filter	Ground Equivalent	Integration Time (s)
F435W	Johnson *B*	420
F555W	Johnson *V*	385
F658N	$H\alpha$+[N II] λ6583	340
F775W	Cousin I_C	385
F850LP	*z*-Band	385

After a brief description of the observations (Section 2), we present the new ACS/WFC images of all circumstellar disks (Section 3). We then provide a complete catalog of circumstellar disks in the Orion Nebula, including also the few disks that were not detected in our programs for a variety of reasons (Section 4). Finally, after a brief description of the new proplyds, silhouette disks, and bipolar nebulae[2] (Sections 5 and 6) we present the images of 16 red, elongated, and diffuse objects which most probably represent galaxies seen through the background curtain provided by the Orion Molecular Cloud (OMC-1, Section 7). A few remarkable objects are being investigated and will be discussed in separate papers (see, e.g., Robberto et al. 2008a).

2. OBSERVATIONS

The images have been extracted from the large dataset (520 images) of ACS/WFC observations executed between 2004 November and 2005 April. The ACS/WFC survey has covered an area of about 450 arcmin^2, centered about 4′ southwest of the Trapezium cluster. The filters and exposure times are listed in Table 1. The narrowband F658N filter transmits both $H\alpha$ λ6583 and [N II] λ6583, but it is conventionally referred to as the ACS $H\alpha$ filter. Due to the dithering strategy adopted for the survey, most of the field has been exposed two times (or more, occasionally), so the total integration time is typically twice that reported in Table 1. Only at the edges of the ACS survey field was a single image obtained. Images have been combined using the Py-Drizzle algorithm, allowing for the removal of cosmic rays when two or more exposures were available. Sources lying at the outer edges of the nebula are therefore clearly recognizable by the presence of uncorrected cosmic rays in our images. The mosaics of ACS images have been registered against the Two Micron All Sky Survey (2MASS) catalog (Cutri et al. 2003) to derive absolute astrometry of the sources accurate to approximately 1/2 pixel (25 mas).

Each individual ACS image, both raw and drizzled, has been visually inspected for source identification, resulting in a master catalog of ∼3200 stellar or compact sources. Each source has been classified as either a single star, binary, photoevaporated disk, dark silhouette, or candidate galaxy. The last three classes constitute the sample presented in this paper. Note that since the ACS catalog targets stellar sources, it does not include Herbig-Haro objects, bow-shocks, and jets unless they are closely associated (within ≈1″) with a point source. Further details on the *HST* Treasury Program observing strategy and on data-reduction procedures are given in Robberto et al. (2008b), whereas the complete photometric catalog is given in Soderblom et al. (2008).

[2] Note that in this paper we do not follow the nomenclature convention described in O'Dell & Wen (1994) that would use the designation "proplyd" to include all of the protostellar objects with surrounding material that are in or near H II regions.

Table 2
ACS/WFC Photometric Zero Points

Filter	VEGAMAG	ABMAG	STMAG
F435W	25.779	25.673	25.157
F555W	25.724	25.718	25.672
F658N	22.365	22.747	23.148
F775W	25.256	25.654	26.393
F850LP	24.326	24.862	25.954

3. NEW *HST*/ACS IMAGES OF CIRCUMSTELLAR DISKS

We found 219 sources that show distinct evidence of circumstellar matter. Of them, 178 are externally ionized protoplanetary disks seen in emission, five show jet emission in $H\alpha$ with no evidence of either external ionized gas emission or dark silhouette disks, and 36 can be classified as dark silhouette disks. They are directly visible either in absorption against the nebular background, or revealed through the blocking of light coming from their central star, or by the presence of detached bipolar lobes.

Figures 2–5 show the ACS/WFC images of our sources in the five photometric bands used for our ACS observations. In particular, the ionized protoplanetary disks seen in emission are reported in Figure 2, while Figure 3 shows the dark silhouette disks, Figure 4 shows the reflection nebulae, and Figure 5 shows the jets with no external ionized gas emission or silhouette disk. Each frame is 100 × 100 ACS/WFC pixels, corresponding to ∼5″ × 5″, or ∼2000 × 2000 AU at the distance of the Orion Nebula, here assumed to be ∼420 pc (Menten et al. 2007).

In each row, we report the images in the five photometric bands, in order of increasing wavelength: F435W, F555W, F658N, F775W, and F850LP. The gray scale goes from 2σ below the average sky level through 3σ above it, where both the average and σ have been estimated using an iterative algorithm to reject outliers. The color images at the end of each row were created in this way: the intensity of blue is the average of the fluxes measured in the F435W and F555W bands, the intensity of red is the average of F775W and F850LP, and the intensity of green is the flux measured only in the F658N filter.

All the FITS files from which these images have been taken are in the electronic version of the *Astronomical Journal*. In these drizzled images the pixel values are in counts per seconds, and an estimate in magnitudes of the photometry of a source can be directly extracted by

$$m_X = -2.5 \cdot \log F_X + ZP_X, \quad (1)$$

where X is the passband of interest, F_X is the observed flux of the source in counts per seconds in the passband X, and ZP_X is the zero-point magnitude in the passband X for a certain photometric system. In Table 2 we list the zero-point magnitudes derived by the photometric calibration of the *HST*/ACS camera (Sirianni et al. 2005) in the VEGAMAG, ABMAG, and STMAG standard photometric systems for the filters used by our survey.

4. THE CATALOG OF CIRCUMSTELLAR DISKS IN ORION

We have searched the original literature and the SIMBAD[3] database to cross-identify each object that we found. For 170

[3] http://simbad.u-strasbg.fr/simbad

Table 3
Circumstellar Disks From the *HST*/ACS Treasury Program

Object	R.A.[a]	Decl.[a]	OW[b]	BOM[b]	JW[b]	P[b]	AD[b]	2MASS[b]	COUP[b]	Type[c]	Note[d]
4364-146	5:34:36.44	−5:21:45.95	...	...	...	...	...	J05343646-0521458	...	j	J
4466-324	5:34:46.59	−5:23:24.19	...	...	83	...	987	J05344656-0523256	29	j	J, B
4468-605	5:34:46.76	−5:26:04.79	...	...	86	...	95	...	...	i	J
4538-311	5:34:53.79	−5:23:10.73	...	...	...	...	...	...	...	rn	
4596-400	5:43:59.56	−5:24:00.19	4596-400	000-400	191	...	1026	J05345955-0524002	137	i	
4582-635	5:34:58.16	−5:26:35.13	...	...	...	...	...	J05345816-0526350	...	i	
005-514	5:35:00.47	−5:25:14.34	005-514	005-514	198	...	875	J05350046-0525143	147	i	
006-439	5:35:00.58	−5:24:38.79	...	...	...	...	...	...	...	j	J
016-149	5:35:01.60	−5:21:49.35	...	...	...	...	1063	J05350162-0521489	165	rn	
038-627	5:35:04.19	−5:26:27.89	038-627	...	245	...	859	J05350419-0526278	212	i	
044-527	5:35:04.42	−5:25:27.40	044-527	044-527	...	...	...	J05350445-0525264	...	i	
046-3838	5:35:04.61	−5:38:38.00	...	...	...	...	92	J05350461-0538379	...	rn	
046-245	5:35:04.63	−5:22:44.85	...	...	...	...	...	...	...	i	
049-143	5:35:04.94	−5:21:42.99	...	...	...	...	...	...	...	i	
051-3541	5:35:05.05	−5:35:40.84	...	...	...	...	...	J05350505-0535407	...	rn	EO
053-717	5:35:05.40	−5:27:16.99	...	053-717	268	...	845	J05350540-0527170	241	d	
057-419	5:35:05.73	−5:24:18.55	057-419	...	278	...	...	J05350572-0524184	250	i	
061-401	5:35:06.09	−5:24:00.60	061-401	...	...	...	...	...	...	i	
064-3335	5:35:06.44	−5:33:35.25	...	...	295	...	2221	J05350644-0533351	267	i	
066-3251	5:35:06.57	−5:32:51.49	...	...	...	...	371	J05350656-0532515	273	i	
066-652	5:35:06.59	−5:26:51.99	066-652	...	296	...	851	J05350660-0526509	275	i	B
069-601	5:35:06.91	−5:26:00.60	069-601	069-601	299	...	867	...	279	i	
072-135	5:35:07.21	−5:21:34.43	072-135	072-135	...	...	1069	...	...	i	EO
073-227	5:35:07.27	−5:22:26.56	073-227	073-227	300	...	3012	...	283	i	
078-3658	5:35:07.84	−5:36:58.15	...	...	...	...	...	...	...	j	J, B
090-326	5:35:09.02	−5:23:26.20	...	...	...	...	...	...	...	d	
093-822	5:35:09.59	−5:28:22.92	093-822	...	334	...	2257	J05350959-0528228	341	i	
099-339	5:35:09.89	−5:23:38.50	...	...	...	2	2654	...	350	i	J
102-233	5:35:10.13	−5:22:32.74	102-233	...	340	...	3354	...	358	i	
102-021	5:35:10.19	−5:20:20.99	102-021	...	339	...	3357	J05351019-0520210	362	i	
102-322	5:35:10.20	−5:23:21.56	102-322	...	341	...	3148	J05351021-0523215	365	i	
106-417	5:35:10.54	−5:24:16.70	106-417	...	349	4	3291	...	385	i	
106-156	5:35:10.58	−5:21:56.24	106-156	...	347	...	3181	J05351058-0521562	382	i	
109-246	5:35:10.90	−5:22:46.36	109-246	109-247	355	...	3476	...	403	i	
109-327	5:35:10.95	−5:23:26.45	109-327	109-327	...	...	3401	...	...	i	J
110-3035	5:35:10.98	−5:30:35.23	...	110-3035	...	...	...	...	...	rn	J
114-426	5:35:11.30	−5:24:26.50	114-426	114-426	...	...	2578	...	419	d	EO, RN
117-421	5:35:11.65	−5:24:21.50	117-421	...	366	6	2588	...	434	i	
117-352	5:35:11.73	−5:23:51.70	...	117-352	368	7	2641	...	443	i	
119-340	5:35:11.90	−5:23:39.70	119-340	...	...	...	...	...	...	i	
121-1925	5:35:12.09	−5:19:24.80	121-1925	121-1925	374	...	...	...	460	d	
121-434	5:35:12.12	−5:24:33.80	121-434	...	376	...	2569	...	465	i	
124-132	5:35:12.38	−5:21:31.39	124-132	124-132	...	17	2840	...	476	i	J, EO, B
131-046	5:35:13.05	−5:20:45.79	131-046	...	...	...	...	...	...	i	
131-247	5:35:13.11	−5:22:47.11	131-247	131-247	...	31	...	...	524	i	J
132-1832	5:35:13.24	−5:18:32.95	...	132-1832	...	...	...	...	...	d	EO
132-042	5:35:13.24	−5:20:41.94	132-042	132-042	...	36	...	...	...	i	J, EO
133-353	5:35:13.30	−5:23:53.05	133-353	...	...	37	...	...	540	i	B
135-220	5:35:13.51	−5:22:19.49	135-220	135-220	411	46	...	...	551	i	
138-207	5:35:13.78	−5:22:07.39	138-207	...	423	51	...	...	579	i	
139-320	5:35:13.92	−5:23:20.16	...	...	...	...	3430	...	593	i	
141-520	5:35:14.05	−5:25:20.50	141-520	141-520	...	...	2504	...	604	i	FO
140-1952	5:35:14.05	−5:19:51.90	140-1952	141-1952	429	...	2364	J05351405-0519520	597	d	FO
142-301	5:35:14.15	−5:23:00.91	142-301	141-301	...	...	2713	...	...	i	
143-425	5:35:14.27	−5:24:24.55	143-425	...	437	...	3100	J05351427-0524246	616	i	
144-522	5:35:14.34	−5:25:22.30	144-522	143-522	...	...	...	...	...	i	
146-201	5:35:14.61	−5:22:00.94	...	...	...	66	...	...	...	i	
147-323	5:35:14.72	−5:23:23.01	...	147-323	451	...	3527	...	658	i	
148-305	5:35:14.80	−5:23:04.76	148-305	...	...	73	...	...	664	i	B
149-329	5:35:14.92	−5:23:29.05	149-329	...	455	...	...	...	671	i	
150-147	5:35:15.00	−5:21:47.34	...	...	...	83	...	...	...	i	
150-231	5:35:15.02	−5:22:31.11	150-231	...	...	86	...	...	678	i	B
152-319	5:35:15.20	−5:23:18.81	152-319	...	...	...	3512	...	690	i	
152-738	5:35:15.21	−5:27:37.85	152-738	...	...	...	816	J05351521-0527378	693	i	
154-324	5:35:15.35	−5:23:24.11	154-324	...	...	...	...	...	...	i	B
154-225	5:35:15.37	−5:22:25.35	154-225	...	472	96	...	...	699	i	B

Table 3
(Continued)

Object	R.A.[a]	Decl.[a]	OW[b]	BOM[b]	JW[b]	P[b]	AD[b]	2MASS[b]	COUP[b]	Type[c]	Note[d]
154-240	5:35:15.38	−5:22:39.85	. . .	154-240	. . .	. . .	. . .	. . .	. . .	i	
155-338	5:35:15.51	−5:23:37.45	155-338	155-338	. . .	. . .	3143	. . .	717	i	
157-323	5:35:15.72	−5:23:22.59	157-323	. . .	488	. . .	3253	. . .	733	i	B
158-323	5:35:15.83	−5:23:22.59	158-323	. . .	. . .	. . .	3254	. . .	746	i	B
158-327	5:35:15.79	−5:23:26.51	158-327	158-327	489	. . .	. . .	. . .	. . .	i	B
158-326	5:35:15.81	−5:23:25.51	158-326	158-326	. . .	. . .	3254	. . .	747	i	B
159-338	5:35:15.90	−5:23:38.00	159-338	. . .	. . .	. . .	. . .	. . .	757	i	B
159-418	5:35:15.90	−5:24:17.85	159-418	159-418	. . .	118	3438	. . .	748	i	
159-221	5:35:15.93	−5:22:21.05	159-221	. . .	496	120	3456	. . .	756	d	
159-350	5:35:15.96	−5:23:50.30	159-350	. . .	499	. . .	3138	. . .	758	i	B
160-353	5:35:16.01	−5:23:53.00	160-353	. . .	503	. . .	. . .	. . .	768	i	J
161-324	5:35:16.05	−5:23:24.35	161-324	. . .	. . .	. . .	. . .	. . .	. . .	i	
161-328	5:35:16.07	−5:23:27.81	161-328	161-328	. . .	. . .	. . .	. . .	. . .	i	
161-314	5:35:16.10	−5:23:14.05	161-314	. . .	. . .	. . .	. . .	. . .	779	i	
162-133	5:35:16.19	−5:21:32.39	162-133	. . .	507	131	3352	. . .	783	i	
163-026	5:35:16.31	−5:20:25.24	. . .	163-026	510	137	2926	. . .	796	d	B
163-210	5:35:16.27	−5:22:10.45	163-210	. . .	511	134	3177	. . .	784	i	B
163-317	5:35:16.27	−5:23:16.51	163-317	. . .	512	. . .	. . .	. . .	787	i	
163-222	5:35:16.30	−5:22:21.50	163-222	163-222	. . .	140	. . .	. . .	799	i	B, FO
163-249	5:35:16.33	−5:22:49.01	163-249	. . .	513	139	3167	. . .	800	i	B
164-511	5:35:16.35	−5:25:09.60	164-511	. . .	516	141	2519	. . .	803	i	
165-235	5:35:16.48	−5:22:35.16	165-235	. . .	519	143	3518	. . .	807	i	
165-254	5:35:16.54	−5:22:53.70	. . .	165-254	. . .	. . .	. . .	. . .	. . .	d	RN
166-316	5:35:16.61	−5:23:16.19	166-315	. . .	. . .	. . .	3528	. . .	820	i	
166-519	5:35:16.57	−5:25:17.74	166-519	. . .	. . .	147	3411	. . .	814	d	
166-406	5:35:16.57	−5:24:06.00	166-406	. . .	521	146	. . .	J05351675-0524041	813	i	
166-250	5:35:16.59	−5:22:50.36	166-250	. . .	. . .	. . .	. . .	. . .	. . .	i	
167-231	5:35:16.73	−5:22:31.30	167-231	167-231	. . .	151	3519	. . .	825	d	FO
167-317	5:35:16.74	−5:23:16.51	167-317	. . .	524	. . .	. . .	. . .	826	i	
168-235	5:35:16.81	−5:22:34.71	168-235	. . .	. . .	. . .	. . .	. . .	. . .	i	
168-328	5:35:16.77	−5:23:28.06	168-328	. . .	. . .	. . .	. . .	. . .	827	i	B
168-326	5:35:16.83	−5:23:25.91	168-326	. . .	. . .	. . .	. . .	. . .	. . .	i	B
169-338	5:35:16.88	−5:23:38.10	169-338	. . .	. . .	. . .	. . .	. . .	. . .	i	B
170-301	5:35:16.95	−5:23:00.91	170-301	. . .	533	161	3163	. . .	845	i	
170-249	5:35:16.96	−5:22:48.51	170-249	170-249	532	160	3260	. . .	844	i	B
170-337	5:35:16.97	−5:23:37.15	170-337	170-337	534	. . .	. . .	. . .	847	i	B
171-340	5:35:17.04	−5:23:39.75	171-340	171-340	537	. . .	3144	. . .	856	i	B
171-434	5:35:17.11	−5:24:34.40	171-434	. . .	. . .	. . .	. . .	. . .	. . .	i	B
172-028	5:35:17.22	−5:20:27.84	172-028	172-028	542	. . .	2921	. . .	865	d	
173-341	5:35:17.32	−5:23:41.40	173-341	. . .	. . .	178	. . .	. . .	886	i	B
173-236	5:35:17.34	−5:22:35.81	173-236	174-236	548	174	. . .	. . .	876	i	
174-305	5:35:17.37	−5:23:04.86	174-305	. . .	. . .	175	3451	. . .	879	i	
174-414	5:35:17.38	−5:24:13.90	174-414	. . .	. . .	176	3419	. . .	887	i	
175-251	5:35:17.47	−5:22:51.26	175-251	. . .	. . .	181	. . .	. . .	884	i	B
175-355	5:35:17.54	−5:23:55.05	175-355	175-355	. . .	. . .	. . .	. . .	. . .	i	
175-543	5:35:17.54	−5:25:42.89	175-543	176-543	557	182	. . .	. . .	901	i	J, EO, B
176-325	5:35:17.55	−5:23:24.96	176-325	. . .	554	. . .	3529	. . .	900	i	
176-252	5:35:17.64	−5:22:51.66	176-252	. . .	. . .	188	. . .	. . .	906	i	
177-341W	5:35:17.66	−5:23:41.00	177-341	177-341	558	190	. . .	. . .	. . .	i	B
177-454	5:35:17.69	−5:24:54.10	177-454	. . .	559	193	2544	. . .	914	i	
177-541	5:35:17.71	−5:25:40.76	. . .	177-541	. . .	. . .	. . .	. . .	. . .	i	EO, B
177-444	5:35:17.73	−5:24:43.75	177-444	. . .	. . .	192	3407	. . .	. . .	i	
177-341E	5:35:17.73	−5:23:41.10	177-341	177-341	558	190	. . .	. . .	. . .	i	B
178-441	5:35:17.81	−5:24:41.05	. . .	. . .	. . .	198	. . .	. . .	925	i	
178-258	5:35:17.84	−5:22:58.15	. . .	. . .	. . .	. . .	. . .	. . .	. . .	i	
179-056	5:35:17.92	−5:20:55.44	179-056	. . .	. . .	. . .	. . .	. . .	940	i	B
179-354	5:35:17.96	−5:23:53.50	179-354	179-353	. . .	. . .	. . .	. . .	. . .	i	
180-331	5:35:18.03	−5:23:30.80	180-331	. . .	. . .	211	. . .	. . .	. . .	i	B
181-247	5:35:18.08	−5:22:47.10	181-247	181-247	. . .	. . .	. . .	. . .	. . .	i	B
181-825	5:35:18.10	−5:28:25.04	. . .	181-825	580	. . .	607	J05351810-0528249	948	i	RN
182-316	5:35:18.19	−5:23:31.55	182-316	182-332	. . .	214	. . .	. . .	. . .	d	B
182-413	5:35:18.22	−5:24:13.45	182-413	182-413	. . .	. . .	. . .	. . .	. . .	i	
183-439	5:35:18.28	−5:24:38.85	183-439	. . .	. . .	221	3298	. . .	. . .	i	B
183-419	5:35:18.31	−5:24:18.85	183-419	183-419	. . .	. . .	. . .	. . .	. . .	i	
183-405	5:35:18.33	−5:24:04.85	183-405	183-405	588	233	. . .	. . .	966	d	FO, B
184-427	5:35:18.35	−5:24:26.85	184-427	. . .	. . .	224	. . .	. . .	967	i	B

Table 3
(Continued)

Object	R.A.[a]	Decl.[a]	OW[b]	BOM[b]	JW[b]	P[b]	AD[b]	2MASS[b]	COUP[b]	Type[c]	Note[d]
184-520	5:35:18.44	−5:25:19.29	184-520	...	...	227	3410	...	...	i	
187-314	5:35:18.68	−5:23:14.01	187-314	...	596	233	...	...	986	i	B
189-329	5:35:18.87	−5:23:28.85	189-329	...	604	240	3150	...	1000	i	
190-251	5:35:19.03	−5:22:50.65	...	...	...	...	...	...	...	i	B
191-232	5:35:19.13	−5:22:31.20	...	191-232	...	...	...	...	...	d	
191-350	5:35:19.06	−5:23:49.50	191-350	191-350	607	244	3139	J05351906-0523495	1011	i	J
193-1659	5:35:19.25	−5:16:58.69	...	...	...	...	...	...	...	rn	
197-427	5:35:19.65	−5:24:26.70	197-427	197-427	622	254	2594	...	1045	i	RN
198-222	5:35:19.82	−5:22:21.55	198-222	...	624	255	...	...	1056	i	
198-448	5:35:19.83	−5:24:47.95	198-448	...	625	...	3305	...	1058	i	
199-1508	5:35:19.89	−5:15:08.25	...	...	...	...	2402	J05351983-0515089	1053	i	B
200-106	5:35:20.04	−5:21:05.99	200-106	...	631	...	3194	J05352004-0521059	1071	i	
201-534	5:35:20.14	−5:25:33.84	201-534	...	...	260	...	...	...	i	
202-228	5:35:20.15	−5:22:28.30	202-228	...	...	261	...	...	1084	i	B
203-504	5:35:20.26	−5:25:04.05	203-504	203-504	644	...	2530	...	1091	i	B
203-506	5:35:20.32	−5:25:05.55	...	203-506	...	...	2530	...	...	d	RN
205-330	5:35:20.45	−5:23:29.96	205-330	...	648	263	...	...	1101	i	B
205-052	5:35:20.52	−5:20:52.05	205-052	...	650	...	2901	...	1104	i	
205-421	5:35:20.53	−5:24:21.00	205-421	205-421	652	265	3306	...	1107	i	FO
206-446	5:35:20.62	−5:24:46.45	206-446	206-446	658	...	3097	...	1112	i	
208-122	5:35:20.83	−5:21:21.45	208-122	...	662	...	3351	...	1120	rn	
209-151	5:35:21.00	−5:21:52.30	209-151	...	665	...	...	...	1122	i	B
210-225	5:35:21.03	−5:22:25.20	...	...	...	275	3491	...	...	i	
212-557	5:35:21.15	−5:25:57.04	212-557	...	674	...	3110	J05352115-0525569	1139	i	
212-400	5:35:21.19	−5:24:00.20	...	...	...	276	3443	...	...	i	
212-260	5:35:21.24	−5:22:59.51	212-260	...	...	280	3334	J05352124-0522594	1141	i	
213-533	5:35:21.28	−5:25:33.11	...	...	...	...	...	...	...	i	B
213-346	5:35:21.30	−5:23:46.10	...	...	...	...	...	...	1149	i	B
215-652	5:35:21.45	−5:26:52.40	...	...	...	...	...	...	...	i	
215-317	5:35:21.49	−5:23:16.71	215-317	...	685	284	3541	...	1155	i	
215-106	5:35:21.55	−5:21:05.60	215-106	...	684	...	2883	...	1154	i	J
216-541	5:35:21.60	−5:25:40.70	...	...	...	...	2491	...	...	i	
216-715	5:35:21.62	−5:27:14.65	216-715	...	689	...	825	J05352162-0527145	1163	i	
218-339	5:35:21.77	−5:23:39.30	218-339	...	694	289	3146	J05352177-0523392	1167	i	
218-354	5:35:21.79	−5:23:53.90	218-354	218-354	698	290	3332	J05352181-0523539	1174	d	EO, B
218-529	5:35:21.82	−5:25:28.46	...	218-529	...	...	...	...	...	i	B
218-306	5:35:21.84	−5:23:06.46	...	...	...	294	3542	...	1173	i	B
221-433	5:35:22.08	−5:24:32.95	221-433	...	...	...	3099	...	1184	i	
223-414	5:35:22.31	−5:24:14.25	223-414	...	710	...	3124	J05352232-0524141	1205	i	B
224-728	5:35:22.37	−5:27:28.40	224-728	...	716	...	824	J05352237-0527283	1206	i	
228-548	5:35:22.83	−5:25:47.69	228-548	...	724	...	2487	...	...	i	
230-536	5:35:23.02	−5:25:36.29	...	...	...	...	3507	...	...	d	
231-460	5:35:23.05	−5:24:59.86	231-460	...	...	...	...	...	1237	i	
231-502	5:35:23.16	−5:25:02.19	231-502	...	...	...	...	...	...	i	B
231-838	5:35:23.10	−5:28:37.34	231-838	...	...	...	...	...	1238	i	J
232-453	5:35:23.22	−5:24:52.79	232-453	...	...	...	...	...	...	i	
234-853	5:35:23.40	−5:28:53.19	...	...	...	...	...	...	...	i	
236-527	5:35:23.59	−5:25:26.54	236-527	...	737	...	3207	...	1262	i	
237-627	5:35:23.66	−5:26:27.15	237-627	...	743	...	3073	...	1263	i	
238-334	5:35:23.80	−5:23:34.30	238-334	...	744	...	3152	...	1268	i	B
239-334	5:35:23.86	−5:23:34.05	...	239-334	...	...	...	...	...	d	EO, B
239-510	5:35:23.98	−5:25:09.94	239-510	...	...	...	3319	...	1275	i	
240-314	5:35:24.02	−5:23:13.85	240-314	...	...	...	3502	J05352402-0523138	1276	i	B
242-519	5:35:24.22	−5:25:18.79	242-519	242-519	750	...	2516	J05352425-0525186	1281	i	
244-440	5:35:24.38	−5:24:39.74	244-440	244-440	756	...	3098	J05352443-0524398	1290	i	
245-632	5:35:24.45	−5:26:31.55	245-632	...	758	...	3060	J05352445-0526314	1291	i	B
245-1910	5:35:24.48	−5:19:09.84	...	...	...	...	2350	...	...	i	RN, B
245-502	5:35:24.51	−5:25:01.59	245-502	...	759	...	2541	...	1293	i	
247-436	5:35:24.69	−5:24:35.74	247-436	...	762	...	3087	...	1302	i	J
250-439	5:35:25.02	−5:24:38.49	250-439	...	...	...	...	...	1313	i	
252-457	5:35:25.21	−5:24:57.34	252-457	252-457	773	...	2553	...	1317	i	
253-1536	5:35:25.30	−5:15:35.54	...	253-1536	...	...	...	...	...	d	J, RN, B
254-412	5:35:25.37	−5:24:11.50	254-412	...	775	...	3128	...	1323	i	
255-512	5:35:25.52	−5:25:11.84	...	...	...	...	...	...	...	i	
262-521	5:35:26.18	−5:25:20.49	262-521	...	...	...	3321	...	1345	i	
264-532	5:35:26.42	−5:25:31.69	264-532	...	...	...	3505	...	...	i	

Table 3
(Continued)

Object	R.A.[a]	Decl.[a]	OW[b]	BOM[b]	JW[b]	P[b]	AD[b]	2MASS[b]	COUP[b]	Type[c]	Note[d]
266-558	5:35:26.62	−5:25:57.84	...	266-558	...	...	...	...	...	i	
280-931	5:35:27.96	−5:29:31.15	...	...	824	...	2276	J05352797-0529311	1403	i	
280-1720	5:35:28.05	−5:17:20.33	...	...	821	...	1314	J05352804-0517202	1404	d	FO
281-306	5:35:28.13	−5:23:06.45	...	...	825	...	3164	J05352813-0523064	1407	d	FO
282-458	5:35:28.20	−5:24:58.19	282-458	282-458	826	...	3080	...	1409	i	J
282-614	5:35:28.20	−5:26:14.20	...	...	...	...	...	...	...	i	
284-439	5:35:28.40	−5:24:38.69	...	...	...	...	...	J05352840-0524386	1414	i	
294-757	5:35:29.43	−5:37:56.60	...	...	...	...	...	J05352943-0537563	...	rn	
294-606	5:35:29.48	−5:26:06.63	...	294-606	...	...	...	...	...	d	RN
297-025	5:35:29.67	−5:30:24.75	...	...	...	...	622	J05352967-0530247	1431	i	
304-539	5:35:30.41	−5:25:38.63	304-539	...	850	...	2333	J05353042-0525385	1444	i	
307-1807	5:35:30.70	−5:18:07.24	307-1807	...	854	...	...	J05353070-0518071	1449	i	
314-816	5:35:31.40	−5:28:16.48	...	...	872	...	755	J05353141-0528163	1474	i	
321-602	5:35:32.10	−5:26:01.94	321-602	...	...	...	...	...	...	d	EO
332-405	5:35:33.19	−5:24:04.74	...	...	...	...	...	J05353316-0524050	...	d	
332-1605	5:35:33.20	−5:16:05.38	332-1605	...	...	...	2411	J05353319-0516053	...	i	
346-1553	5:35:34.62	−5:15:52.92	...	...	903	...	1701	...	...	d	FO
347-1535	5:35:34.67	−5:15:34.88	347-1535	...	...	...	...	...	...	d	J
351-3349	5:35:35.13	−5:33:49.18	...	...	913	...	306	...	...	i	J
353-130	5:35:35.32	−5:21:29.59	...	...	...	...	...	...	...	j	J, B
473-245	5:35:47.34	−5:22:44.82	...	...	...	...	...	...	...	d	EO

Notes.
[a] Units of right ascension are hours, minutes, seconds and units of declination are degrees, arcminutes, and arcseconds (J2000.0).
[b] The abbreviations of the catalogs are: OW—O'Dell & Wen 1994; O'Dell & Wong 1996; O'Dell 2001; BOM—Bally et al. 2000; Smith et al. 2005; P—Prosser et al. 1994; JW—Jones & Walker 1988; AD—Ali & DePoy 1995; 2MASS—Two Micron All Sky Survey (Cutri et al. 2003); COUP—*Chandra* Orion Ultradeep Project (Getman et al. 2005).
[c] In this column, i: ionized disk seen in emission; d: dark disk seen only in silhouette; rn: reflection nebulae with no external ionized gas emission; j: jet emission with no evidence of either ionized disk or silhouette disk.
[d] In this column, J: jet; RN: reflection nebula; EO: disk seen nearly edge-on; FO: disk seen nearly face-on; B: binary system.

(This table is available in its entirety in machine-readable and Virtual Observatory (VO) forms in the online journal. A portion is shown here for guidance regarding its form and content.)

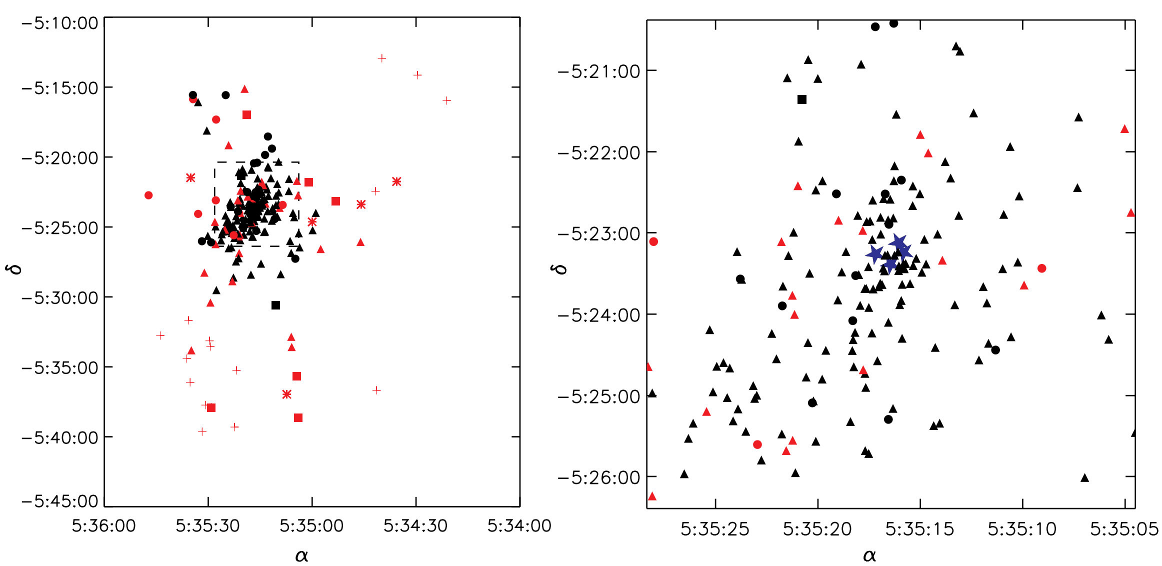


Figure 1. Left: map of the circumstellar disks and other extended objects detected in the *HST*/ACS Treasury Program images. Right ascension and declination are J2000. The triangles represent the externally ionized protoplanetary disks, the circles represent the disks seen only in silhouette, the squares represent the reflection nebulae with no external ionized gas emission, the asterisks are the sources showing jet emission with neither external ionized gas emission nor silhouette disk, while the crosses are the elongated objects described in Section 7. The black objects are the disks already detected before the observations described in this paper, while the red color is associated with the new discovered objects. The dashed lines delimit a 6 × 6 arcmin region centered around θ^1Ori-C, the brightest star of the Trapezium cluster. Right: expansion of the inner region delimited by the dashed lines in the upper panel. The four blue stars are the brightest Trapezium cluster stars.

(A color version of this figure is available in the online journal.)

of them there is a previous *HST* classification as proplyd, silhouette disk, or compact non-stellar object. In particular, our catalog includes all the sources identified by O'Dell & Wen (1994), O'Dell & Wong (1996), Bally et al. (2000), O'Dell (2001), and Smith et al. (2005). For 34 of these objects we could not confirm their nature as proplyds or silhouette disks.

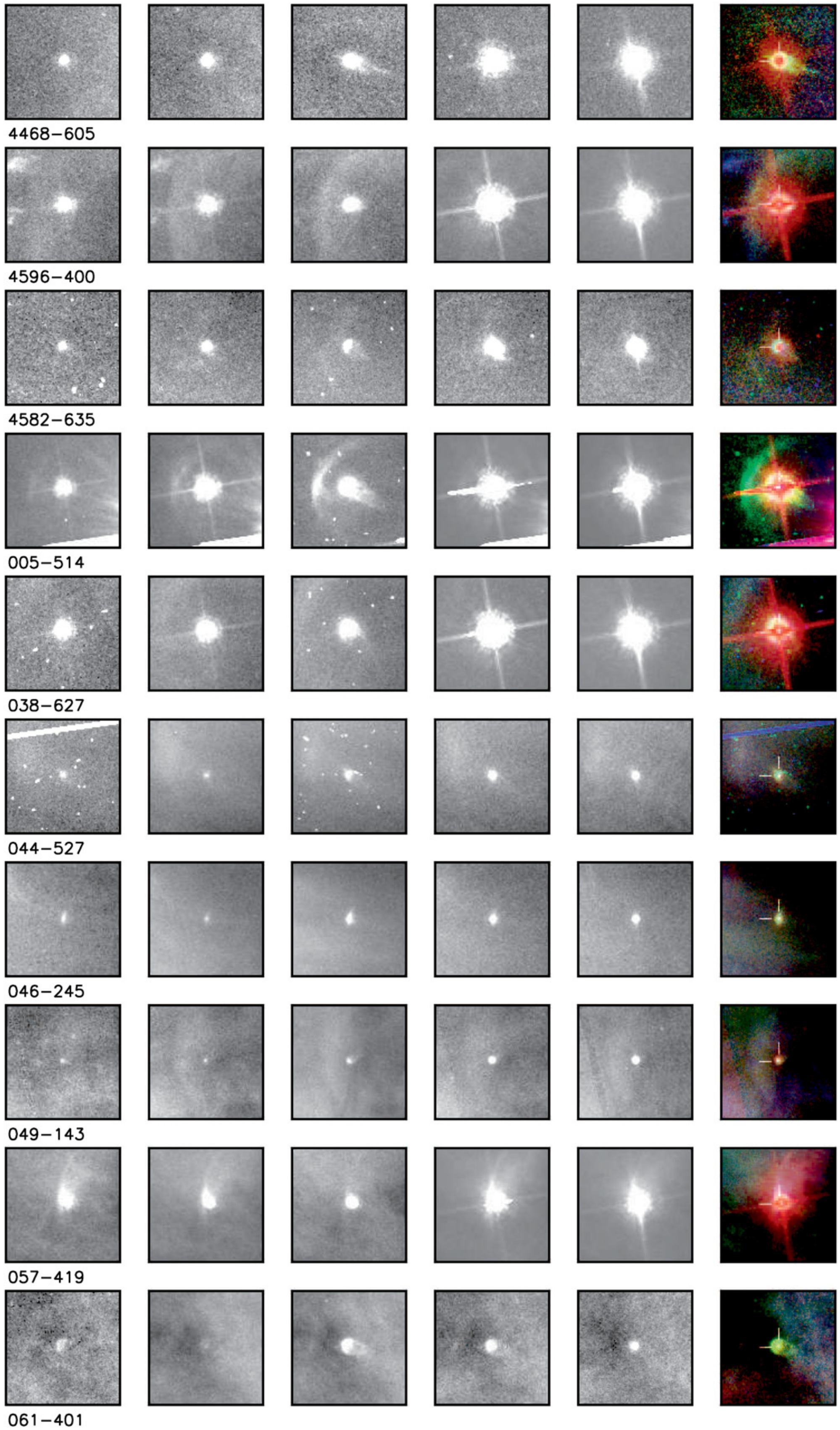


Figure 2. *HST*/ACS images of Orion proplyds.
(An extended version of this figure is available in the online journal.)

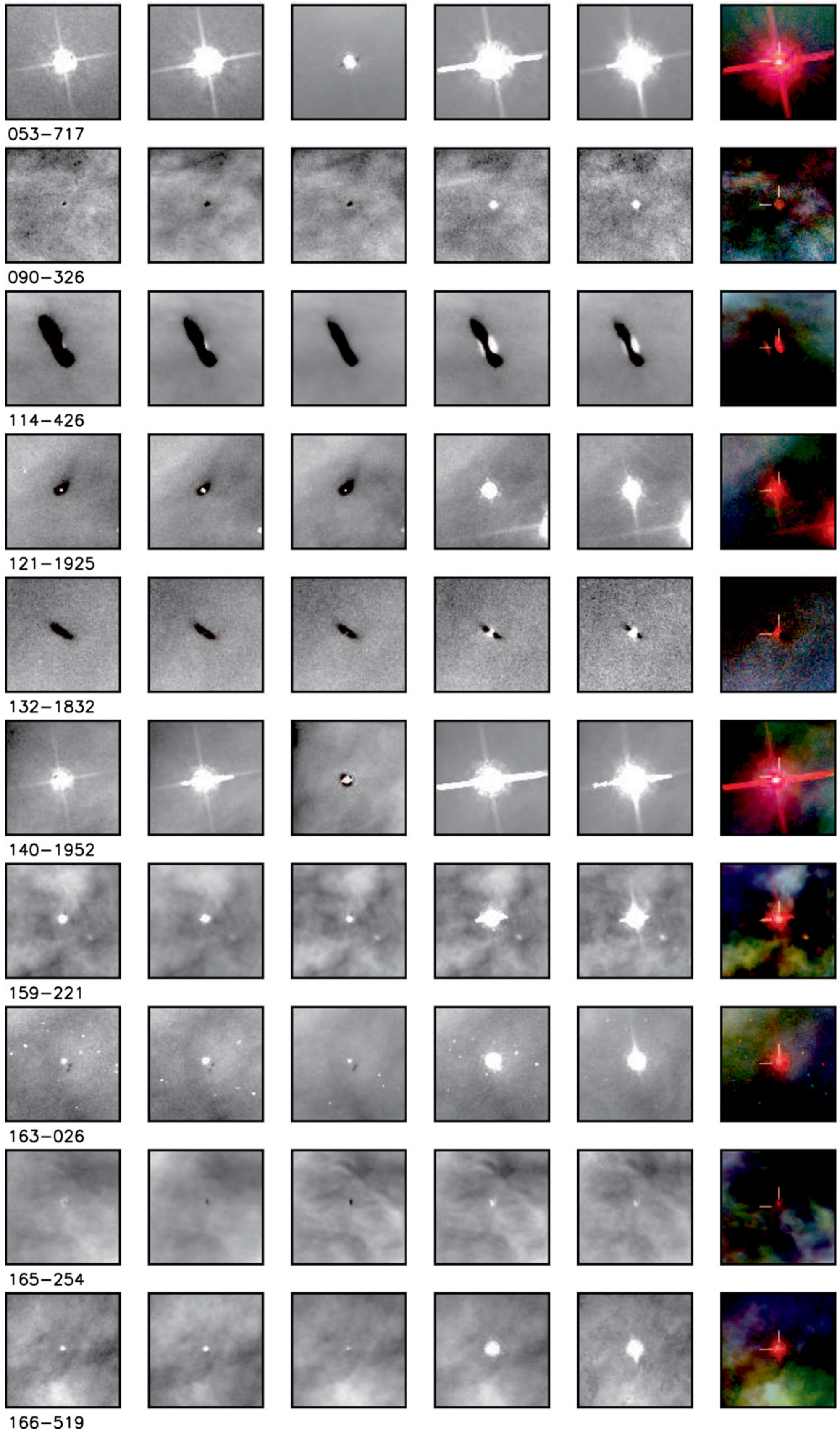


Figure 3. *HST*/ACS images of Orion disks seen only in silhouette.
(An extended version of this figure is available in the online journal.)

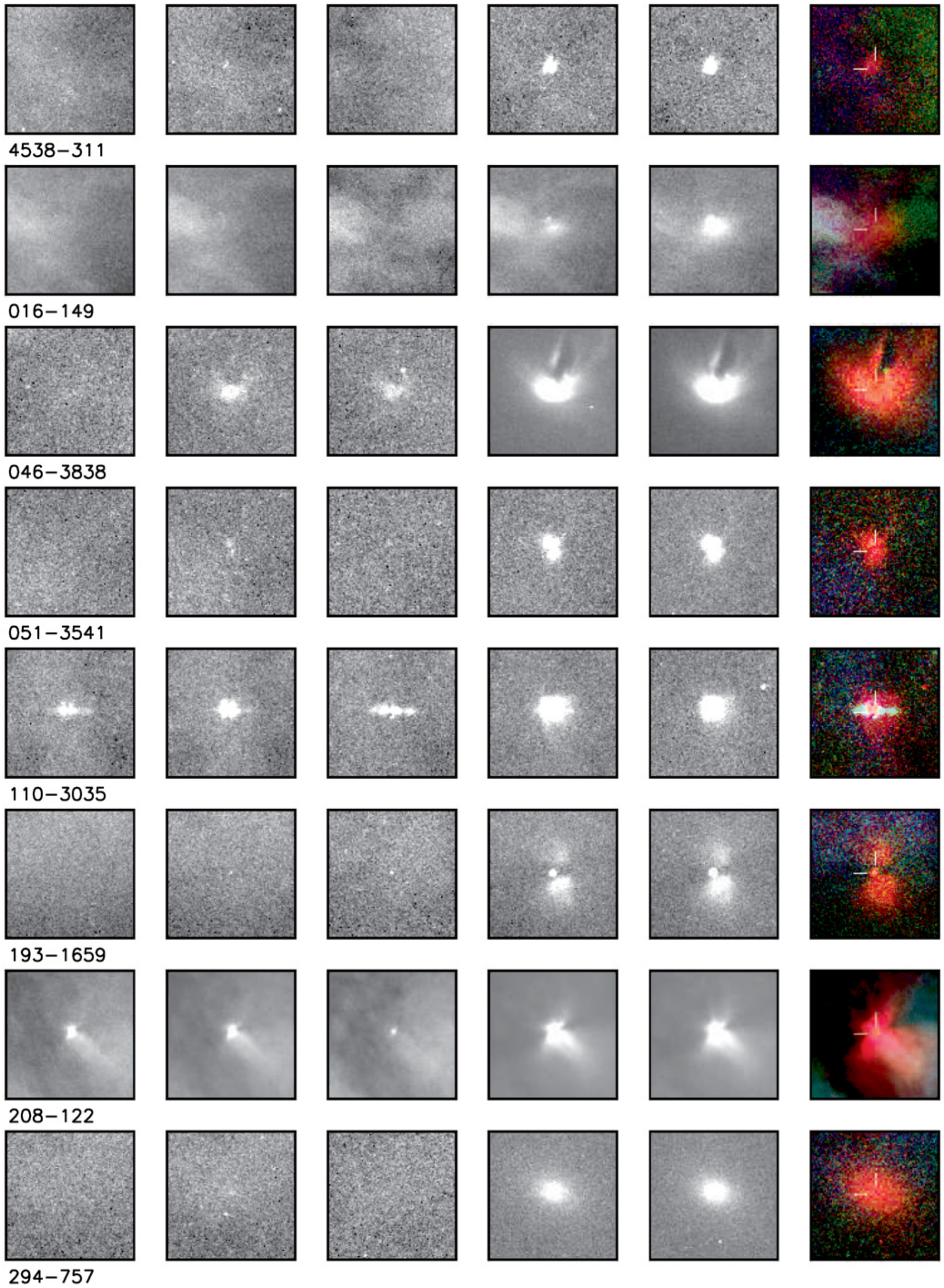


Figure 4. *HST*/ACS images of Orion reflection nebulae with no external ionized gas.

Our observations missed three sources (158-314, 163-322, and 163-323), hidden by the bleeding trail of saturated bright stars, and the silhouette disk 216-0939 (Smith et al. 2005), which is located outside the field covered by the *HST* Treasury Program. We have excluded these sources from our main catalog of disks, listing them separately in Table 4. Regarding the other 30 sources, the *HST*/ACS images (Figure 7) show that some are close binary systems with no visible circumstellar emission, while some are Herbig-Haro objects. We have listed these objects in Table 5, in which Column 11 points out the object's type as it appears from our images. However, it is important to note that some of these objects may still have low-ionization circumstellar emission (e.g. from [O III] emission line), since the ACS filters would not pick this up. On the other hand, our images provide the first identification for 63 objects, of which 29 are proplyds, seven are silhouette disks, six are bipolar nebulae, five are jets with no external ionized gas emission or silhouette disk, and other 16 are probably galaxies.

In Figure 1 we show a map with all the circumstellar disks and the extended objects found in the *HST*/ACS images. The 63 newly discovered objects are shown in red. It is remarkable that new circumstellar disks have also been discovered in the well-explored inner part of M42. Namely, 18 new proplyds and three disks seen only in silhouette have been found in a 6 × 6 arcmin region around θ^1Ori-C. This demonstrates how important it is to search for these objects with a multi-wavelength strategy. In several cases, only the presence of a star in our reddest filter images (F850LP) allows us to unambiguously recognize the

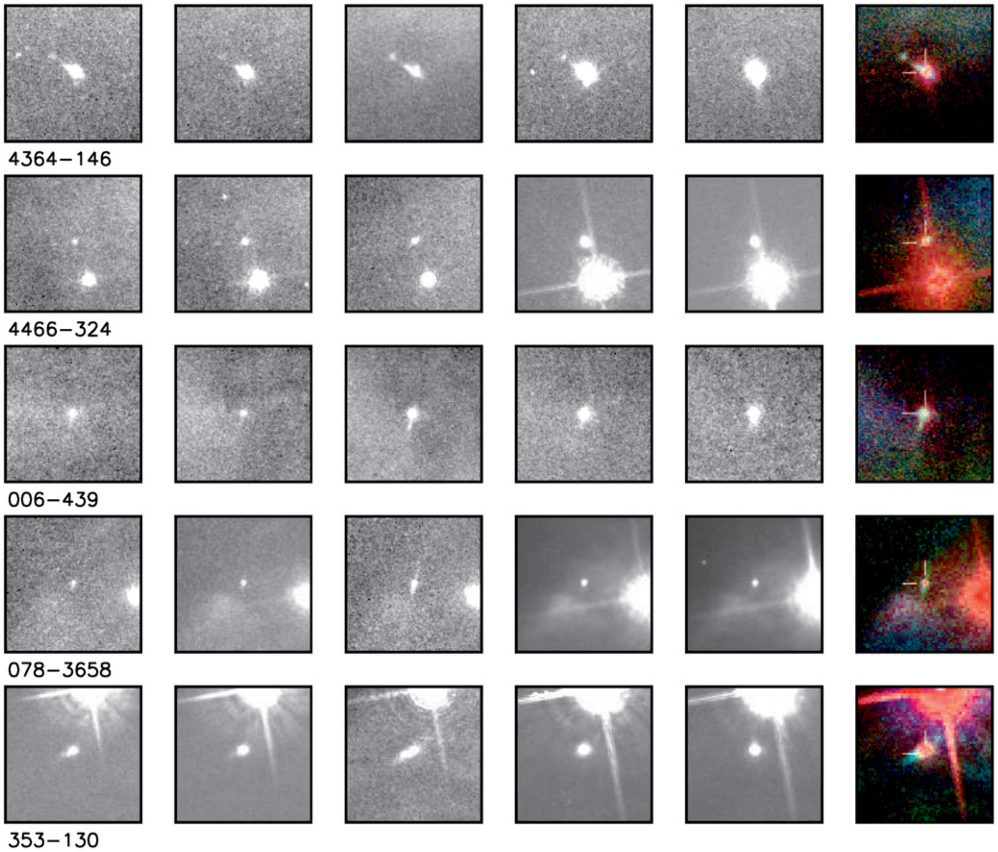


Figure 5. *HST*/ACS images of Orion sources with jet emission with no evidence of either external ionized gas emission or silhouette disk.

Table 4
Previously Observed Protoplanetary Disks not Detected From the *HST*/ACS Images

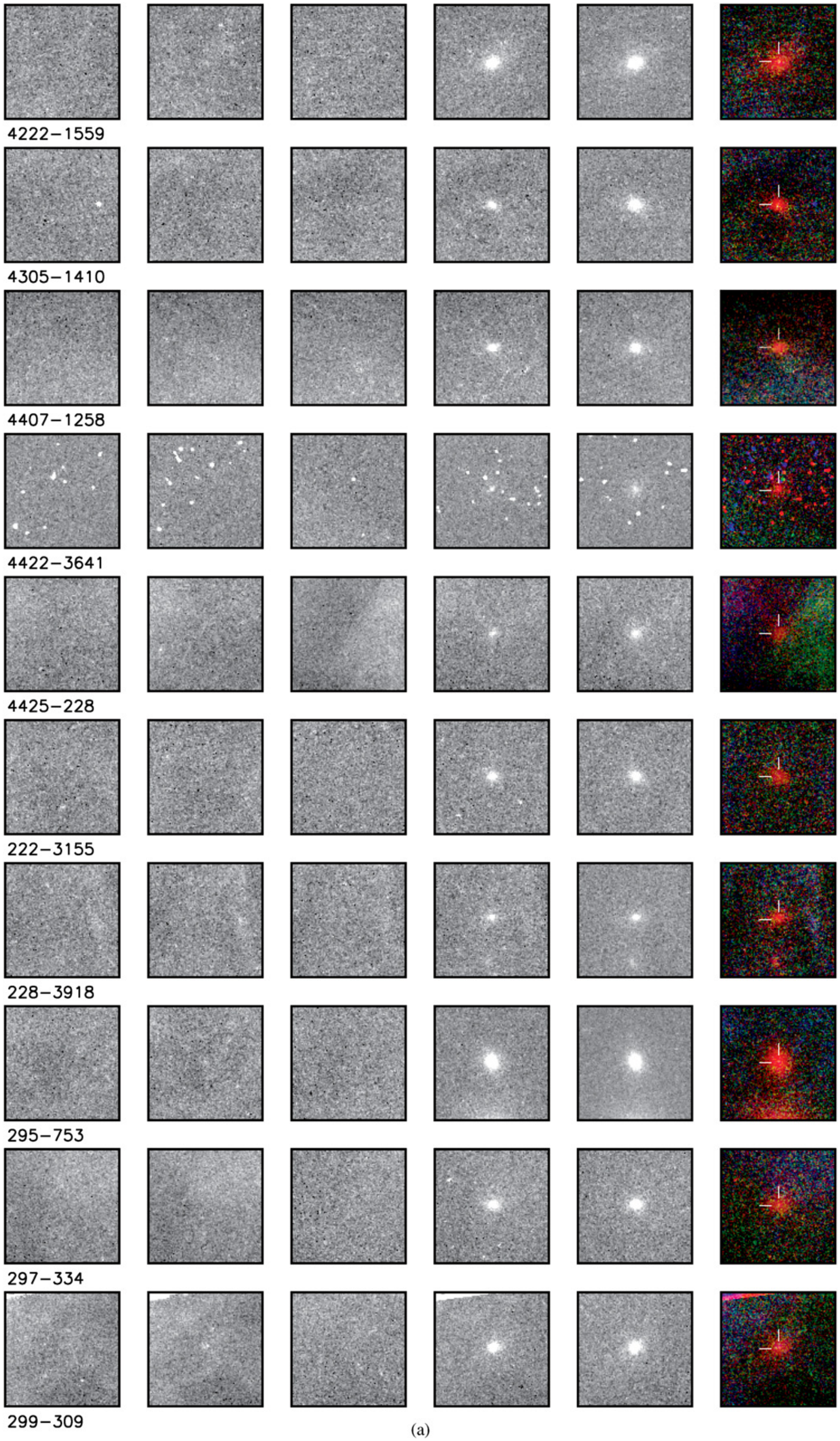
Object	R.A.[a]	Decl.[a]	OW[b]	BOM[b]	JW[b]	P[b]	AD[b]	2MASS[b]	COUP[b]	Note[c]
158-314	5:35:15.82	−5:23:14.56	158-314	...	...	...	...	...	745	Close to bright star
163-322	5:35:16.29	−5:23:21.76	163-322	...	...	...	...	...	...	Close to bright star
163-323	5:35:16.32	−5:23:22.67	163-323	...	...	...	...	...	...	Close to bright star
216-0939	5:35:21.57	−5:09:38.9	...	216-0939	676	...	1914	...	...	Out of ACS FOV

Notes.
[a] Units of right ascension are hours, minutes, seconds and units of declination are degrees, arcminutes, and arcseconds (J2000.0). Since the objects in this table could not be found in our images we kept their previously reported coordinates.
[b] The abbreviations of the catalogs are: OW—O'Dell & Wen 1994; O'Dell & Wong 1996; O'Dell 2001; BOM—Bally et al. 2000; Smith et al. 2005; P—Prosser et al. 1994; JW—Jones & Walker 1988; AD—Ali & DePoy 1995; 2MASS—Two Micron All Sky Survey (Cutri et al. 2003); COUP—*Chandra* Orion Ultradeep Project (Getman et al. 2005).
[c] This column explains the reason why we could not detect the objects listed in this table: close to bright star—under the saturation bleeding trail of a close bright star; out of ACS FOV—out of *HST*/ACS Treasury Program field of view.

presence of circumstellar disks or a reflection nebula too faint to be detected in the $H\alpha$ filter.

It is evident from Figure 1 that almost all the disks seen only in silhouette (the circles in the figure) and reflection nebulae (the squares) have been observed in the outskirts of the Orion Nebula. This is for the following two reasons: (1) in the outer regions the ultraviolet photon flux is low because of the larger distance from the O- and B-type stars of the Trapezium cluster (the few silhouette disks seen in the inner part of the nebula most probably lie in the foreground); (2) in regions of low nebular background, it is easier to spot the presence of a disk through the scattering from the polar regions than by direct imaging of the dark silhouette against the background. This is how circumstellar disks are commonly imaged in Tau associations (e.g., Koresko 2002). Conversely, most of the circumstellar disks associated with the emission of externally ionized gas are observed close to the Trapezium stars. Some of them are also detected in the outer regions, indicating that stars other than θ^1Ori (the Trapezium) are affecting the structure and evolution of protoplanetary disks in the ONC.

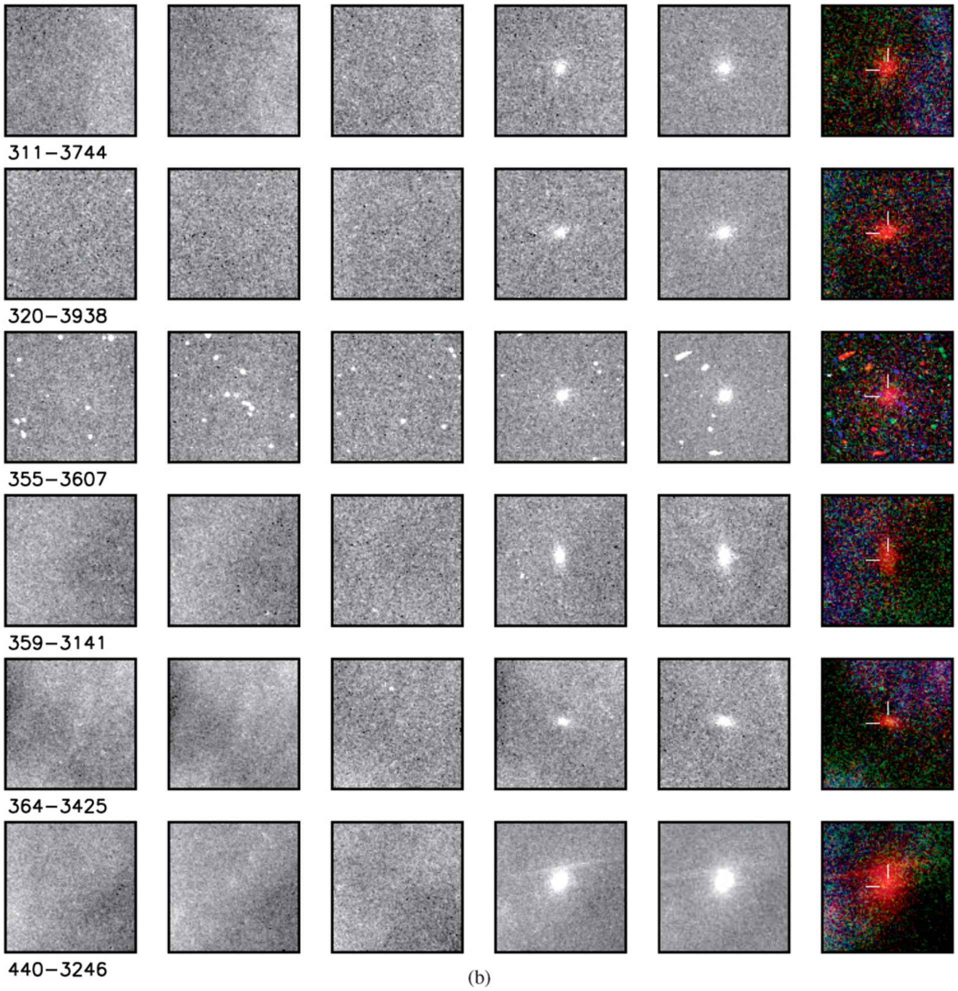
In Table 3, we list all the sources sorted according to their right ascension and declination, derived from the absolute astrometric solution of our survey. Cross-references to previous *HST* surveys follow the SIMBAD convention, where the O'Dell & Wen (1994) and O'Dell & Wong (1996) lists are merged together and labeled under the "OW" prefix (in this catalog we also included the four circumstellar disks observed by O'Dell 2001), whereas the Bally et al. (2000) and Smith et al. (2005) lists are merged with the "BOM" prefix. We also list the corresponding entry in the Prosser et al. (1994)



(a)

Figure 6. *HST*/ACS images of galaxy candidates.

catalog, in the optical survey of Jones & Walker (1988), in two near-infrared sources catalogs (Ali & DePoy 1995; 2MASS, Cutri et al. 2003), and in the X-ray source catalog of the *Chandra* Orion Ultradeep Project (COUP; Getman et al. 2005). The last two columns of Table 3 report the main characteristics of the objects derivable from the images. In particular,



(b)

Figure 6. (Continued)

Column 11 defines the type of each object (either an ionized disk seen in emission or a dark disk seen only in silhouette or a reflection nebulae with no external ionized gas emission), while Column 12 points out the presence of jets, reflection nebulae, binary stellar systems, nearly edge-on, or face-on circumstellar disks.

For the object name, we used the coordinate-based nomenclature of O'Dell & Wen (1994): objects with coordinates $\alpha = 5{:}35{:}AB.C$, $\delta = -5{:}2X{:}YZ$ are labeled ABC-XYZ. If the right ascension is 5:34:AB.C, then a 4 is added, i.e. 4ABC at the beginning of the R.A. group. Similarly, if the declination is $-5{:}1X{:}YZ$, it becomes 1XYZ. This coordinate-based method is affected by astrometric errors, as better measures, or just measures at different wavelengths, may require a change of name. This is the approach followed by Bally et al. (2000), who renamed a few sources originally labeled by the O'Dell team on the basis of their improved astrometry. Unfortunately, this generates ambiguity and is a potential source of error when data are retrieved from archives. For this reason, we decided to maintain the nomenclature of the objects given in their discovery papers, i.e., in the case of different names in the OW and BOM catalogs, we used the OW name. Our coordinates thus take the lowest priority, and were used only for the new objects discovered by the *HST* Treasury Program to give them a name.

Among the 235 circumstellar disks and other extended objects presented in this paper, 118 have been observed by Ali & DePoy (1995) in the near-infrared; only 49 are listed in the 2MASS catalog (Cutri et al. 2003). The COUP survey shows 137 objects, i.e., 58% of all the objects. The COUP fraction rises to 63% if we do not consider the extended objects described in Section 7. The high fraction of circumstellar disks revealed in X-rays is particularly interesting since, even if the X-ray luminosities are in general relatively small, this high-energy radiation effectively penetrates deeper through the disks, ionizing otherwise neutral molecular gases and even melting solid particles. Together with the ionizing flux from the brightest cluster members, X-rays from low-mass stars may thus have profound effects on their associated circumstellar disks and therefore on planet formation (Feigelson et al. 2007).

5. NEW PROPLYDS

We detected 29 previously unknown proplyds, whose images have been reported together with all the other Orion proplyds in Figure 2. In Table 3 they can be recognized as those ionized disks seen in emission (flag "i" in Column 11) that have not been observed in the OW and BOM catalogs (i.e., with no designations in Columns 4 and 5, except for the proplyd 280-931, observed by Bally et al. 2001 not included in the BOM catalog in SIMBAD).

Among these 29 new proplyds, three show evidence of emission from jets mainly in the $H\alpha$ filter, and all of them are located in the outskirts of the Orion Nebula (4468-605, 099-339, and 351-349). Also, five other objects in the M42 outer regions

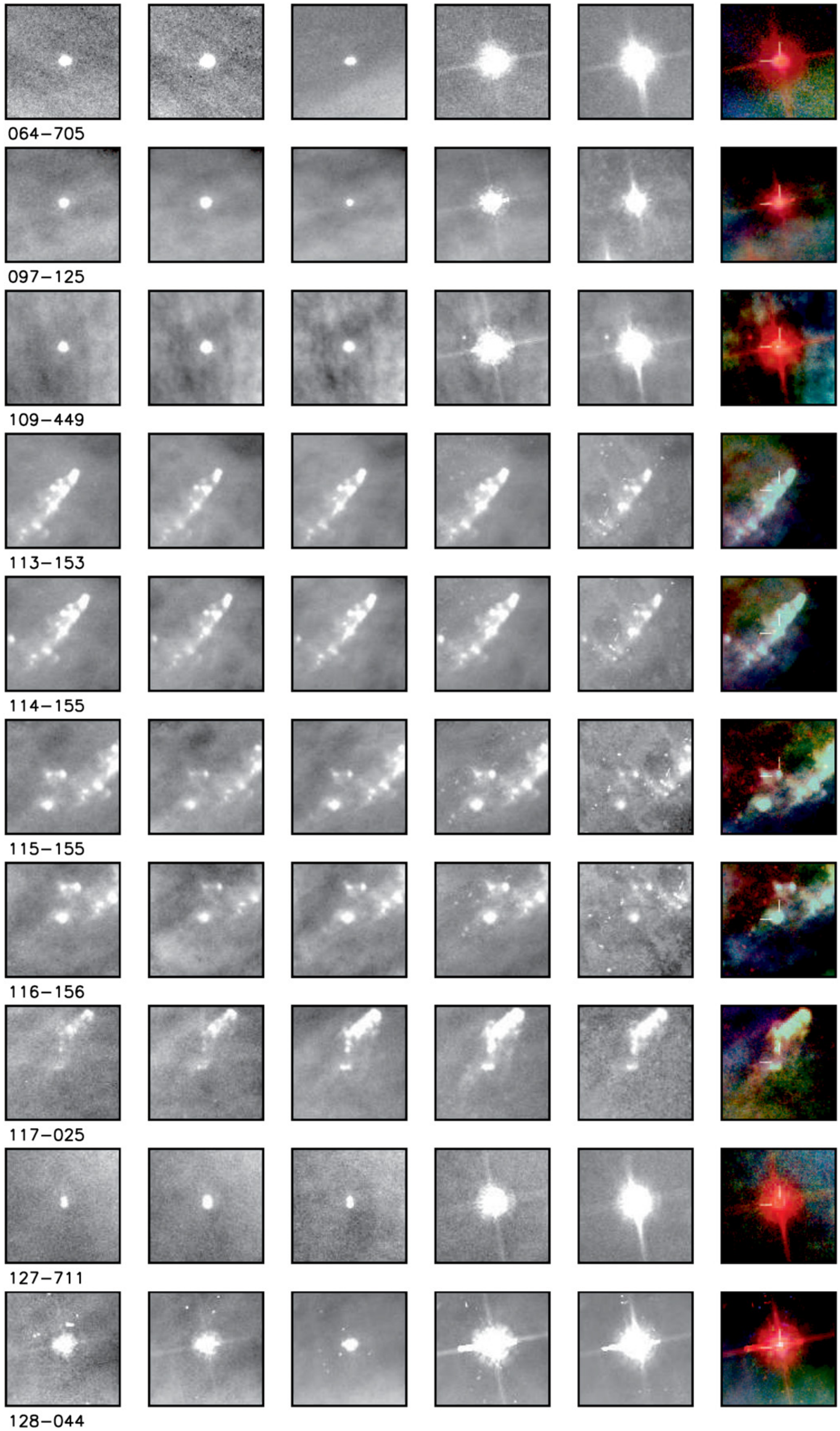


Figure 7. *HST*/ACS images of the objects previously identified as non-stellar are excluded from our catalog of circumstellar disks.
(An extended version of this figure is available in the online journal.)

Table 5

Previously Observed Extended Objects not Identified as Circumstellar Disks From the *HST*/ACS Images

Object	R.A.[a]	Decl.[a]	OW[b]	BOM[b]	JW[b]	P[b]	AD[b]	2MASS[b]	COUP[b]	ACS Type[c]
064-705	5:35:06.43	−5:27:04.74	064-705	...	290	...	...	J05350642-0527048	266	B
097-125	5:35:09.69	−5:21:24.89	097-125	...	332	...	3187	...	336	*
109-449	5:35:10.93	−5:24:48.65	109-449	...	356	...	3103	J05351094-0524486	404	*
113-153	5:35:11.31	−5:21:53.14	113-153	...	...	...	2801	...	...	HH
114-155	5:35:11.34	−5:21:53.94	114-155	...	...	...	2801	...	...	HH
115-155	5:35:11.50	−5:21:54.29	115-155	...	...	...	...	...	...	HH
116-156	5:35:11.54	−5:21:55.64	116-156	...	...	...	...	...	...	HH
117-025	5:35:11.70	−5:20:25.19	117-025	...	...	...	2920	...	...	HH
127-711	5:35:12.70	−5:27:10.75	127-711	...	392	...	3008	J05351270-0527106	498	B
128-044	5:35:12.81	−5:20:43.68	128-044	...	391	23	3239	J05351281-0520436	501	*
132-221	5:35:13.17	−5:22:20.89	132-221	...	399	33	3522	...	523	B
132-222	5:35:13.17	−5:22:21.09	132-222	...	...	...	...	...	...	B
135-227	5:35:13.35	−5:22:26.11	135-227	...	404	41	3523		538	*
137-222	5:35:13.72	−5:22:22.19	137-222	...	420	50	...	...	573	*
144-334	5:35:14.39	−5:23:33.50	144-334	...	441	...	...	...	631	*
153-321	5:35:15.35	−5:23:21.25	153-321	...	...	...	...	...	...	*
153-1902	5:35:15.35	−5:19:02.15	153-1902	...	469	...	1374	J05351534-0519021	695	*
154-042	5:35:15.48	−5:20:42.14	154-042	...	...	...	2903	...	...	HH
155-040	5:35:15.47	−5:20:40.25	155-040	...	...	...	2907	...	703	HH
156-403	5:35:15.61	−5:24:03.15	156-403	...	480	105	3125	...	726	*
158-425	5:35:15.77	−5:24:24.75	158-425	...	...	112	3403	...	736	B
168-309	5:35:16.81	−5:23:09.93	168-309	...	...	...	...	...	...	
171-315	5:35:17.88	−5:23:15.48	171-315	...	...	...	...	...	...	B
171-334	5:35:17.06	−5:23:33.95	171-334	...	538	...	...	J05351705-0523341	855	*
172-327	5:35:17.20	−5:23:26.66	172-327	...	...	...	...	...	...	ISM
174-400	5:35:17.38	−5:24:00.25	174-400	...	...	...	...	...	...	*
179-534	5:35:17.94	−5:25:33.79	174-534	...	570	203	3303	...	937	B
179-536	5:35:17.88	−5:25:36.03	174-536	...	...	...	2495	...	...	
201-534	5:35:20.14	−5:25:33.84	201-534	...	...	260	...	...	...	*
222-637	5:35:22.18	−5:26:37.40	222-637	...	709	...	3074	J05352219-0526373	1202	B

Notes.

[a] Units of right ascension are hours, minutes, seconds and units of declination are degrees, arcminutes, and arcseconds (J2000.0). When no objects could be found in our images around a 2″-radius circle from their previously reported coordinates, we kept these latter ones.

[b] The abbreviations of the catalogs are: OW—O'Dell & Wen 1994; O'Dell & Wong 1996; O'Dell 2001; BOM—Bally et al. 2000; Smith et al. 2005; P—Prosser et al. 1994; JW—Jones & Walker 1988; AD—Ali & DePoy 1995; 2MASS—Two Micron All Sky Survey (Cutri et al. 2003); COUP—*Chandra* Orion Ultradeep Project (Getman et al. 2005).

[c] Object type as it appears from *HST*/ACS images: B—close binary system; HH—Herbig-Haro object; *—star; ISM—interstellar material.

show evidence of jet emission in $H\alpha$ (4364-146, 4466-324, 006-439, 078-3658, and 353-130, see Figure 5). This is probably due to the low level of background nebular emission in those regions that makes the faint jets easier to detect than in the inner region of M42.

Compared with many of the previously known proplyds with bright cusps observed in the M42 core, these new objects are fainter. For the proplyds located in the outer regions of the Orion Nebula, this lack of ionized gas is due to the distance from the ionizing sources located in the M42 core. The lack of bright cusps in proplyds located in the inner region can be explained by several factors: their physical distance from the M42 core may be larger than the projected one due to the position of these objects with respect to the line of sight, these disks may have a smaller amount of mass compared with the brighter proplyds, the ongoing photoevaporation processes in the disk's surface may be in an early or late phase, so that the ionization front is not much developed.

In the following, we briefly describe two of the new proplyds with bright ionization fronts, located ∼10′ away from the ONC core.

064-3335 (Figure 2(b), row 1): this proplyd is located ∼10′ south of the ONC core. Its ionization cusp has a diameter of roughly 3.″5 with a P.A. of ∼300°. Other than the bright cusp, observed in all the five ACS filters, two filaments extending for ∼800 AU from the center of the proplyd are visible mainly in the $H\alpha$ filter, almost along the cusp axis direction.

066-3251 (Figure 2(b), row 2): this proplyd is located ∼10′ south of the ONC core and is very close to 064-3335 (the distance between the two proplyds is 43″). The ionization cusp, oriented with a P.A. ∼ 320°, has a diameter of roughly 3″. With respect to 066-3251 this bright star is located 225″ in a direction P.A. ∼ 315°. In the southern side of the object a long outflow extends for about 30″, corresponding to ∼600 AU.

6. NEW SILHOUETTE DISKS AND REFLECTION NEBULAE

In this section, we provide a short description of the seven dark silhouette disks and the six reflection nebulae discovered by the new *HST*/ACS images.

090-326 (Figure 3(a), row 2): this silhouette disk is located ∼10′ southeast of the ONC core. It has a P.A. of roughly 50°, major and minor axes of ∼0.″3 and 0.″15 in the $H\alpha$ filter (approximately 120 × 60 AU), respectively, from which an inclination angle of ∼60° can be derived assuming

Table 6
Extended Objects Detected From the *HST*/ACS Treasury Program Described in Section 7

Object	R.A.[a]	Decl.[a]	OW[b]	BOM[b]	JW[b]	P[b]	AD[b]	2MASS[b]	COUP[b]
4222-1559	5:34:22.15	−5:15:58.94	...	...	...	...	...	...	...
4305-1410	5:34:30.48	−5:14:09.79	...	...	...	...	...	...	...
4407-1258	5:34:40.67	−5:12:57.71	...	...	...	...	...	...	...
4422-3641	5:34:42.19	−5:36:41.02	...	...	...	...	...	...	...
4425-228	5:34:42.48	−5:22:27.75	...	...	...	...	999	...	...
222-3155	5:35:22.23	−5:35:15.45	...	...	...	...	...	...	...
228-3918	5:35:22.79	−5:39:18.45	...	...	...	...	...	...	...
295-753	5:35:29.45	−5:37:53.25	...	...	...	...	...	...	...
297-334	5:35:29.69	−5:33:33.74	...	...	...	...	...	...	...
299-309	5:35:29.92	−5:33:08.69	...	...	...	...	...	...	...
311-3744	5:35:31.11	−5:37:44.39	...	...	...	...	...	...	...
320-3938	5:35:32.03	−5:39:38.45	...	...	...	...	...	...	...
355-3607	5:35:35.47	−5:36:06.77	...	...	...	...	...	...	...
359-3141	5:35:35.94	−5:31:41.10	...	...	...	...	...	...	...
364-3425	5:35:36.43	−5:34:25.10	...	...	...	...	...	...	...
440-3246	5:35:44.01	−5:32:46.34	...	...	...	...	...	...	...

Notes.
[a] Units of right ascension are hours, minutes, seconds and units of declination are degrees, arcminutes, and arcseconds (J2000.0).
[b] The abbreviations of the catalogs are: OW—O'Dell & Wen 1994; O'Dell & Wong 1996; O'Dell 2001; BOM—Bally et al. 2000; Smith et al. 2005; P—Prosser et al. 1994; JW—Jones & Walker 1988; AD—Ali & DePoy 1995; 2MASS—Two Micron All Sky Survey (Cutri et al. 2003); COUP—*Chandra* Orion Ultradeep Project (Getman et al. 2005).

a circular thin disk. However, since the central star is obscured in the F435W, F555W, and $H\alpha$ filters, the disk may have larger inclination angle and thickness. In the bluer filters a faint emission is detected in the southeast side all around the disk. The emission from the disk edges can be either due to reflection nebular light, or due to a very mild level of ionization of the disk surface in a region of the Orion Nebula where the UV flux from the O- and B-spectral type stars is unable to support a fully developed proplyd.

230-536 (Figure 3(b), row 8): this small silhouette disk (approximately $0''.5 \times 0''.25$ in the F435W filter, corresponding to about 200×100 AU), located $\sim 5'$ southeast of the ONC core has an inclination angle of roughly $\sim 60°$ as derived from the apparent axes ratio. This justifies the detection of the red pre-sequence star in the $H\alpha$ filter. Its P.A. is $\sim 160°$.

280-1720 (Figure 3(c), row 1): this silhouette disk, located $\sim 8'$ northwest of the ONC core is seen nearly face-on in the F435W and $H\alpha$ filters. The size is approximately $0''.75 \times 0''.75$ in the $H\alpha$ filter, corresponding to about 300×300 AU.

281-306 (Figure 3(c), row 2): this small silhouette disk, located $\sim 12'$ southeast of the Trapezium cluster is visible face-on only in the $H\alpha$ filter. The diameter of the disk is $\sim 0''.4$ or about 160 AU.

332-405 (Figure 3(c), row 5): this silhouette disk, located $\sim 5'$ east of the ONC core is seen in absorption in the F435W, F555W, and $H\alpha$ filters. The major and minor axes are approximately $0''.75 \times 0''.25$, corresponding to about 300×100 AU in the F555W filter, and implying an inclination angle of about 70°. The disk P.A. is $\sim 120°$.

346-1553 (Figure 3(c), row 6): this silhouette disk, located in the M43 region, $\sim 12'$ northeast of the ONC core, is seen in absorption only in the broadband filters F435W and F555W. The disk appears to be face-on with a diameter of $\sim 0''.5$ in the F435W, or ~ 200 AU at the distance of Orion Nebula.

473-245 (Figure 3(c), row 8): this spectacular silhouette disk with reflection nebula is located $\sim 10'$ east of the ONC core. The disk is seen nearly edge-on (the two sides of the bipolar emission appear to be very symmetric), flared, with a P.A. of $\sim 60°$, and a major axis in the $H\alpha$ of roughly $0''.75$, corresponding to a physical diameter of 300 AU.

4538-311 (Figure 4, row 1): the disk, located $\sim 6'$ east of the ONC core, appears as an equatorial dark lane at the midplane of bipolar nebula. The emission is nearly symmetric, with the northeast side slightly wider and brighter than the southwest one, suggesting that it originates from the surface of a disk seen almost edge-on with the northeast face tilted toward us. The nebula is detected only in the F775W and F850LP filters, with some emission from the northwest side also visible in the F555W, close to the noise floor of our image. This indicates that the pre-main-sequence star hidden by the disk is very red. The P.A. of the disk is approximately 150°.

016-149 (Figure 4, row 2): this object, located $\sim 3'$ northeast of the ONC core, appears only in the F775W and F850LP filters as a bipolar nebula. In this case the morphology is highly asymmetric, with the southwest side much brighter and more extended than the northeastern one. The asymmetry, together with the low contrast of the equatorial dust lane, suggests that the disk is seen with low inclination angle, i.e., far from being face-on. However, the fact that the northeastern lobe appears as a point-like source brighter than the more-extended southwestern one suggests that the former source may rather be a red star, whose radiation scattered by circumstellar matter is seen as the southwestern lobe.

046-3838 (Figure 4, row 3): this source, $\sim 15'$ south of the ONC core, shows an extended region (diameter $\sim 5''$) with bright emission especially in the F775W and F850LP filters, and a dark tail in the direction P.A. $\sim 350°$. Since 046-3838 is rather weak in $H\alpha$ compared to the fluxes observed in F555W, F775W, and F850LP, this source is most probably a reflection nebula with a red central star.

051-3541 (Figure 4, row 4): located $\sim 15'$ south of the ONC core, this bipolar source appears highly symmetric and relatively bright. It is detected mainly in the F775W and F850LP filters with a conspicuous equatorial dust lane at P.A. of about 100°, suggesting the presence of an almost edge-on disk around a red pre-main-sequence star. The lobes appear nearly round and more extended than those of 4538-311, for instance, suggesting either a very strong disk flaring or the presence of circumstellar material at the disk's polar regions.

193-1659 (Figure 4, row 6): this well-developed bipolar nebula is located $\sim 7'$ north of the ONC core. The asymmetrical brightness of the two lobes (seen only in the F775W and F850LP filters) and the detection of a red pre-main-sequence star away from the center of the bipolar nebula suggest that either the circumstellar disk that blocks the star light or the circumstellar matter that reflect it is non-symmetric. The P.A. of the disk is approximately 100°.

294-757 (Figure 4, row 8): this red source, observed only in the F775W and F850LP $\sim 7'$ southeast of the ONC core, is a bipolar nebula with equatorial dark lane clearly detected in the F775W image. This suggests the presence of a nearly edge-on disk with P.A. $\sim 70°$ (southeastern side facing toward us).

7. CANDIDATE BACKGROUND GALAXIES

In Figure 6, 16 red and elongated objects are shown. These sources are listed in Table 6. They are all visible only in the F775W and F850LP filters and in the outer regions of the Orion Nebula (see Figure 1). These two facts suggest that these objects might be background galaxies seen through sparse regions of the reddening Orion Molecular Cloud OMC-1. An alternative plausible interpretation is that of reflection nebulae turned on by red pre-main-sequence stars (two similar objects in which nearly edge-on reflecting disks are visible are 294-757 and 016-149). In this hypothesis, their location in the Orion Nebula outskirts, far from the ionizing O- and B-type stars in the Trapezium cluster, is consistent with the non-detection of light from ionized plasma, which would have been observed in the $H\alpha$ filter as well. To understand the nature of these objects spectra are needed.

8. SUMMARY

In this paper, we have shown the *HST*/ACS images of the 178 proplyds, 28 disks seen only in silhouette, eight reflection nebulae without external ionized plasma, five jets without either external ionized plasma or silhouette disks, and 16 other extended objects observed by the *HST* Treasury Program on the ONC. For every object we have reported all the images taken through the five photometric filters used by the *HST* Treasury Program (F435W, F555W, F658N, F775W, and F850LP).

The fact that most of these objects are associated with X-ray sources observed by the COUP is particularly interesting, since high-energy photons could play an important role in the star- and planet-formation processes.

Among all the objects reported, 63 have been discovered by these images: 29 proplyds, seven silhouette disks, six reflection nebulae with no external ionized plasma, five jets with no external ionized plasma or silhouette disk, and 16 other elongated objects.

Searching in the literature we found that four objects previously reported as circumstellar disks have not been detected by *HST*/ACS images either because they are hidden by the saturation bleeding trails of a close bright star or because they are located out of the *HST*/ACS Treasury Program field of view. For the 30 other sources previously reported as extended objects *HST*/ACS images reveal no circumstellar emission around them.

A brief description of all the newly discovered proplyds, disks seen only in silhouette, and reflection nebulae with no external ionized plasma has been carried out in Sections 5 and 6.

Finally, we have discussed possible interpretations for the nature of the 16 extended objects. Because of their location far away from the Trapezium cluster ($\gtrsim 10'$) and because of their red color, they are probably background galaxies reddened by the Orion Molecular Cloud OMC-1, but the alternative hypothesis of reflection nebulae turned on by red pre-main-sequence stars cannot be ruled out only by our observations.

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