THE THIRD *EXTREME ULTRAVIOLET EXPLORER* RIGHT ANGLE PROGRAM CATALOG: THE LAST YEARS

DAMIAN J. CHRISTIAN

Eureka Scientific, Inc., Suite 100, 2452 Delmer Street, Oakland, CA 94602; damian@pha.jhu.edu

Received 2002 August 9; accepted 2002 September 11

ABSTRACT

We present 63 new extreme-ultraviolet sources from observations taken during the Right Angle Program (RAP) of the *Extreme Ultraviolet Explorer* (*EUVE*). This paper concentrates on data taken in the last years of the RAP, 1999 and 2000, with a sky coverage of 7%. We present sample light curves for several sources, including flare detections from the previously uncataloged source *EUVE* J0613–23.9B, the active late-type star *EUVE* J0728–20.9 (V372 Pup), and the cataclysmic variable *EUVE* J0332–25.9 (VY For). This final RAP catalog, combined with the *EUVE* all-sky survey, Lampton et al. faint list, and previous RAP catalogs, brings the total number of *EUVE* sources to nearly 1200.

Key words: catalogs — stars: late-type — ultraviolet emission

1. INTRODUCTION

The *Extreme Ultraviolet Explorer* (*EUVE*) conducted an all-sky survey between 1992 July and 1993 January (Bowyer et al. 1996; Malina et al. 1994). In the subsequent 8 years of pointed spectroscopic observations, the all-sky survey telescopes were used to collect data serendipitously. These all-sky survey telescopes are mounted 90° from the main spectrometers, and these serendipitous observations became known as the Right Angle Program (McDonald et al. 1994; Christian et al. 1999).

The *EUVE* all-sky survey (2EU, Bowyer et al. 1996) detected 737 objects. The *EUVE* source list was expanded by correlating *EUVE* all-sky survey detections from the Lexan bandpass, centered at 100 Å, with *ROSAT* Position Sensitive Proportional Counter (PSPC) detections (Lampton et al. 1997), thus raising the number of *EUVE* sources to over 900. The *EUVE* and *ROSAT* Wide Field Camera (Pye et al. 1995) surveys showed the brightest extreme-ultraviolet (EUV) sources to be hot white dwarfs, active and nearby late-type stars, cataclysmic variables, and various types of active galactic nuclei. The long exposure times of RAP observations have provided valuable photometric and timing studies of cataclysmic variables (Howell et al. 1995; Warren, Sirk, & Vallergera 1995; Craig et al. 1996), active galactic nuclei (Fruscione 1998), and late-type stars (Christian, Drake, & Mathioudakis 1998), and detections of stellar flares (Christian 2001; Christian & Vennes 1999). The first RAP catalog (McDonald et al. 1994) presented 99 new EUV detections, and Christian et al. (1999) presented 169 new EUV detections from RAP observations between 1994 January and 1998 November.

In this paper, we present analysis of RAP data taken in the final 2 years of the RAP program and since the second RAP catalog (RAP2, Christian et al. 1999). This present catalog also includes serendipitous Deep Survey sources. In § 2, we briefly review the Right Angle Program observations. We present details of the RAP analysis in § 3. In § 4, we present details of the catalog with new RAP identifications and sample light curves for two active late-type stars and one cataclysmic variable. We compare the RAP results with the *EUVE* all-sky survey source distribution in § 5 and present a summary of the current catalog in § 6.

2. RAP OBSERVATIONS

EUVE (described in detail by Bowyer & Malina 1991 and Malina et al. 1994) provided wavelength coverage in the 58–740 Å range. The three *EUVE* telescopes used during the all-sky survey are mounted perpendicular to the main Deep Survey/Spectrometer (DS/S) instruments. Two of the three scanning telescopes each had a Lexan/boron (“Lexan”; 100 Å) filter with a bandpass covering 58–174 Å and an Al/Ti/C (“Al/C”; 200 Å) filter covering 156–234 Å. The third scanning telescope had a Ti/Sb/Al (“Dagwood”; 400 Å) filter, which covered the 345–605 Å bandpass, and an Sn/SiO (“Tin”; 600 Å) filter covered 500–740 Å. The Deep Survey Lexan/B band covers 67–178 Å.

After the initial phase of the all-sky survey was completed, *EUVE* was dedicated to Guest Observer pointed observations, primarily using the DS/S telescope. However, pseudo-serendipitous observations of the EUV sky continued through this phase with the Right Angle Program by using the survey telescopes (“scanners”). The pointing of the scanners depended on the pointing of the main DS/S instrument and the allowable spacecraft roll angle. Average RAP exposure times in this catalog are 53 ks, almost 20 times that of the all-sky survey. As the *EUVE* mission matured, DS/S exposure times lengthened considerably, and the number of RAP pointings per year decreased by 50% compared with the first RAP catalog (McDonald et al. 1994). In addition, the all-sky survey detectors were often turned off in the year 2000 to save telemetry slots for the spectrometers. This catalog concentrates on RAP data taken in 1999 and 2000 and includes 145 unique scanner and Deep Survey pointings with a combined sky coverage of $\geq 7\%$. This catalog also includes a small number of scanner and DS pointings that were not included in the first two RAP catalogs.

3. RAP ANALYSIS

EUVE scanner data were not included in the *EUVE* permanent archive, because of limited resources. We obtained the scanner data directly from the on-line telemetry database at the Center for EUV Astrophysics. We used the *EUVE* IRAF analysis packages to convert the *EUVE* tele-

metry into QPOE (quick position-oriented event) files. These files are essentially a photon list remapped to the position of the source on the sky and therefore contain all the necessary timing information for deriving count rates and light curves. Count rates were determined using appropriate source and background apertures applied to the scanner QPOE files. Exposure times for “good” data (spacecraft nighttime data with no Earth blockage and periods spent passing through the South Atlantic Anomaly removed) were corrected for telescope vignetting, instrument dead times, and dead times in the telemetry (called Primbsching) using the IRAF EFFEXP routine in the EUV package. RAP analysis is limited to the Lexan and Al/C bands from scanners A and B. The longer wavelength scanner, scanner C, which only had five detections in RAP2, was off for most of the later part of the *EUVE* mission to save telemetry slots. As in RAP2, sources with marginal signal-to-noise ratio were required to have an acceptable point-spread function (PSF). Fainter sources in the Deep Survey are more easily discernible because of its “tri-lobed” PSF. The imaging performance of the *EUVE* telescope has been reviewed by Sirk et al. (1997). Additional RAP analysis details are given in Christian et al. (1999).

4. RESULTS

4.1. New Sources

We present new sources and identifications in Table 1, including scanner A and B Lexan and Al/C bands, as well as the Deep Survey Lexan band. Source identifications were performed using the SIMBAD, HEASARC, and NED (Helou et al. 1995) databases and references therein. Specific EUV and soft X-ray catalogs are discussed below. For the table we give the *EUVE* name based on the J2000 *EUVE* position in column (1), measured *EUVE* J2000 right ascension and declination in columns (2) and (3), and the effective exposure time in column (4). Columns (5) and (6) give the count rates per kilosecond in the Lexan and Al/C bands, respectively. We indicate 90% confidence upper limits with less-than signs. Column (7) gives a quality flag to indicate the confidence of the identification. We have adapted the same quality flags as used in the 2EU, namely, a “1” indicates a likely identification with supporting evidence as a previously identified EUV source, a “2” indicates that although the detection is statistically significant there was no other supporting evidence, and an “H” indicates that no identification was found. Sources with strong ultraviolet continuum and possible “UV leak” are designated in with a “U” as done in the 2EU and RAP2. Columns (8) and (9) give source identifications where plausible, and columns (10) and (11) give spectral type and magnitude, respectively, from SIMBAD or the literature if indicated. Column (12) gives the angular separation between the measured *EUVE* position and the identified source’s position. Lastly, column (13) notes if the source was detected in the Deep Survey (DS) and provides comments, which include references to the literature, an indication whether the source was off-axis (OA) or obstructed by a filter bar (FB), and an indication whether the source was detected in previous EUV or soft X-ray catalogs. We have indicated these catalogs with a three- or four-letter abbreviation, with 2EU for the Second *EUVE* Source Catalog (Bowyer et al. 1996), L97 for the Lampton et al. (1997) catalog of fainter *EUVE* detections, BSL for the

first *EUVE* Bright Source List (Malina et al. 1994), 1RXS for the *ROSAT* All-Sky Bright Source Catalogue (Voges et al. 1999), 2RE for the second *ROSAT* all-sky survey catalog (Pye et al. 1995), 1WGA for the White, Giommi, & Angelini (1994, 2000) *ROSAT* PSPC catalog,¹ 1ES for the first *Einstein* Slew Survey (Elvis et al. 1992), and 2E for the second *Einstein* soft X-ray catalog (McDowell 1994). Table 1 includes 76 source detections, of which 63 are new *EUVE* detections.

4.2. Sample Light Curves

We used the XRAY/XTIMING package in IRAF to create light curves from the QPOE photon event lists. Although we created FITS images of all individual RAP pointings, we did not create QPOE files for all duplicate pointings. Generally, for sources with repeat pointings we chose the RAP observation with the longest exposure time. For light curves, we found that binning the data per *EUVE* orbit provided sufficient counts for useful signal-to-noise ratio while maintaining as much time resolution as possible. We used the canonical value of 2000 s for the nighttime portion of the 96 minute *EUVE* orbit.

We searched the RAP light curves for variability and for stellar flares from the late-type stars. Stellar flares were detected from *EUVE* J0728–30.2 (V372 Pup) and *EUVE* J0613–23.9B. V372 Pup is a dM1e star, and the nearly 14 day RAP light curve (Fig. 1) shows several flares. *EUVE* J0613–23.9B is a previously uncataloged source ≈ 2.5 away from the Guest Observer source *EUVE* J0613–23.9 (HD 43162), a G5 star. A flare rising over 30 times above the quiescent level was detected from this source, along with a

¹ See <http://heasarc.gsfc.nasa.gov/wgacat/wgacat.html>.

FIG. 1.—The ≈ 14 day *EUVE* RAP scanner Lexan (100 Å) light curve of V372 Pup (*EUVE* 0728–30.2). The light curve continues from the top to the bottom panel. Bin size is 2000 s.

TABLE 1
RAPDS AND SCANNER RESULTS

Name (1)	R.A. (J2000) (2)	Decl. (J2000) (3)	Exp. (ks) (4)	Lexan ^a (counts ks ⁻¹) (5)	Al/Ti/C ^b (counts ks ⁻¹) (6)	$\bar{Q}$ (7)	ID Name 1 (8)	ID Name 2 (9)	Type ^c (10)	Mag. (11)	Ang. Sep. ^d (arcsec) (12)	Comments ^e (13)
EUVE J0007+33.2.....	00 07 30.3	+33 17 50.4	1.4	280 ± 15	...	1	GD 2	EGGR 203	DAw	13.8	31	2EU, 2RE, IRXS
EUVE J0030-63.3.....	00 30 02.2	-63 23 48.7	3	1110 ± 20	65 ± 7	1	WD 0027-636	MCT 0027-6341	DA	15.0	61	2EU, 2RE, IRXS, IWGA
EUVE J0053-32.9.....	00 53 14.8	-32 58 02.4	1.1	2100 ± 45	951 ± 33	1	CSI - 33°00509	WD 0050-332	sdO	13.36	118	2EU, 2RE, IRXS, IWGA
EUVE J0143-63.8.....	01 43 37.9	+63 48 50.9	45	<5	...	1	HD 10436	BD +63°229	K5 V	8.41	38	IRXS
EUVE J0147+63.8.....	01 47 41.8	+63 50 39.6	45	6 ± 4	...	1	HD 10780	BD +63°238	K0 V	5.63	36	IRXS
EUVE J0213+37.6.....	02 12 23.2	+37 39 59.4	444	<6	...	1	IRXS J021217.8+373827	...	X-ray	...	112	IRXS
EUVE J0229+34.4.....	02 29 38.2	+34 29 11.8	56	<5	...	1	BD +33°442	AG +34°239	K2	10.2	158	...
EUVE J0251+13.4.....	02 51 01.8	+13 25 28.4	26	7 ± 5	...	H	No ID	...	...	...	...	...
EUVE J0327-37.9.....	03 27 06.0	-37 54 19.3	76	4 ± 0.5	...	1	HD 21534	HIP 16080	F3 V	8.1	53	IRXS
EUVE J0332-25.9.....	03 32 08.6	-25 56 50.7	92	15 ± 1	...	1	VY For	EXO 0329.9-2606	CV	17.5	54	DS, B89
EUVE J0332-08.9.....	03 32 46.9	-08 55 30.6	49	8 ± 1	...	1	IRXS J033243.5-085531	...	X-ray	...	48	DS, IRXS
EUVE J0354+05.1.....	03 54 42.4	+05 08 49.0	17	7 ± 3	...	1	KUV 03520+0500	RX J0354.6+0508	WD	16	34	IRXS
EUVE J0356-41.6.....	03 56 56.5	-41 40 56.0	7.5	74 ± 16	...	2	HD 25086	SAO 216576	F3 V	9.48	279	FB
EUVE J0417+30.6.....	04 17 52.4	+30 38 21.3	78	...	<3	H	No ID	...	...	...	...	...
EUVE J0436+54.9.....	04 36 41.4	+54 57 58.7	26	5 ± 1	...	H	No ID	...	...	...	...	...
EUVE J0501+53.1.....	05 01 39.8	+53 07 44.0	39	14 ± 2	...	1	IRXS J050138.7+530728	...	X-ray	...	19	DS, IRXS
EUVE J0505+59.0.....	05 05 57.4	+59 00 42.9	110	2 ± 0.6	...	1	BM Cam	HD 32357	K0 III	6.1	118	IES, IRXS, OA
EUVE J0519-13.1.....	05 19 44.7	-13 07 44.8	10	63 ± 6	224 ± 9	U	λ Lep	HD 34816	B0.5 IV	4.3	227	TDI, 2RE, OA
EUVE J0521-10.5.....	05 21 26.4	-10 32 04.2	10	140 ± 7	95 ± 10	1	WD 0518-105	2RE J0521-102	DA	15.6	171	2EU, 2RE, IRXS
EUVE J0526-11.8.....	05 26 55.5	-11 52 53.5	10	115 ± 14	13 ± 2	1	HD 35850	BD -12°1169	F7 V	6.3	151	2EU, 2RE, IRXS, EXO, IWGA
EUVE J0613-23.9B ^f	06 13 48.4	-23 54 00.4	195	51 ± 4	...	1	IRXS J061349.6-235522	...	X-ray	...	83	DS, IRXS
EUVE J0616+12.2.....	06 16 35.4	+12 14 05.1	59	12 ± 7	...	2	HD 254377	BD +12°1086	A3	8.98	140	...
EUVE J0616+12.3.....	06 16 35.4	+12 14 47.9	39	7 ± 1	...	1	k Ori	HD 43386	F5 IV-V	5.0	158	TDI, IRXS
EUVE J0620+13.3.....	06 20 55.5	+13 23 52.8	65	27 ± 8	...	1	WD 0618+134	2RE J062049+132424	DA	14.5	88	L97, IRXS
EUVE J0645-16.7.....	06 45 04.6	-16 46 12.4	7	7571 ± 72	...	1	α CMa B	GJ 244B	DA	8.44	198	FB, 2EU, 2RE, 2E
EUVE J0709+18.4.....	07 09 59.7	+18 26 48.4	26	10 ± 5	...	1	RE J071010+182742	...	K3	8.7	156	IRXS
EUVE J0728-30.2.....	07 28 57.9	-30 15 29.3	297	47 ± 9	...	1	V372 Pup	GJ 2060	M1e	10.4	94	2EU, L97, 2RE, IRXS
EUVE J0731+46.0.....	07 31 06.5	+46 00 20.1	31	2 ± 0.6	...	1	IRXS J073101.9+460030	...	M2 V	...	50	IRXS
EUVE J0731+45.9.....	07 31 40.0	+45 57 23.5	31	1 ± 0.2	...	1	IRXS J073138.4+455718	...	M2 V	...	16	IRXS
EUVE J0738+47.7.....	07 38 19.5	+47 43 09.9	31	6 ± 1	...	1	HD 60737	BD +48°1555	G0	7.7	110	...
EUVE J0815-49.3.....	08 15 24.6	-49 18 05.6	63	<2	...	1	IRXS J073816.1+474459	...	X-ray	...	115	IRXS
EUVE J0832+15.8.....	08 32 37.9	+15 50 17.9	8	13 ± 2	4 ± 1	1	IRXS J081521.3-491829	...	X-ray	...	40	DS, IRXS
EUVE J0902+14.4.....	09 02 00.1	+14 24 25.4	81	6 ± 3	...	1	FR Cnc	BD +16°1753	Star	10.4	119	IES
EUVE J0945+23.7.....	09 45 50.9	+23 46 13.6	96	<4	...	1	BPM 86540	...	K5	10.9	202	FB, IRXS
EUVE J1009+15.3.....	10 09 34.9	+15 22 21.6	9	4 ± 1	...	1	ε Leo	HD 84441	G1 II	2.97	14	IRXS
EUVE J1013-70.0.....	10 13 44.6	-70 02 42.6	92	56 ± 17	...	U	ω Car	...	G0	8.5	94	IRXS
EUVE J1014+17.8.....	10 14 42.8	+17 48 07.7	84	<5	...	H	No ID	TD1 14707	B8 IIIe	3.3	61	DS, TDI
EUVE J1014+17.6.....	10 14 48.6	+17 39 54.1	84	<5	...	1	BD +18°2336	...	...	...	...	...
EUVE J1015+49.4.....	10 15 05.0	+49 26 06.4	35	27 ± 2	...	1	QSO B1011+496	SAO 99021	K2	9.3	145	DS, 2E, IES, IRXS, IWGA
EUVE J1018-56.1.....	10 18 45.4	-56 07 31.2	52	<3	...	1	HD 89569	TD1 14754	F6 V	5.8	82	TDI, IRXS
EUVE J1019+19.4.....	10 19 43.1	+19 28 42.1	154	13 ± 1	...	1	40 Leo	HD 89449	F6 IV	4.8	31	DS, IRXS, TDI
EUVE J1020-57.1.....	10 20 36.8	-57 09 43.7	52	<4	...	U	HD 89844	TD1 14785	B2 II: n	7.74	28	TDI
EUVE J1021-57.3.....	10 21 04.4	-57 19 48.6	52	2 ± 0.4	...	H	No ID	...	...	...	...	...
EUVE J1021-56.0.....	10 21 04.5	-56 02 57.6	52	<3	...	U	HD 89890	TD1 14791	B3 IIIe	4.5	83	TDI
EUVE J1021-56.0.....	10 21 04.5	-56 02 57.6	52	<3	...	2	CPD -55°3286B	SAO 237960	...	8.4	79	...

TABLE 1—Continued

Name (1)	R.A. (J2000) (2)	Decl. (J2000) (3)	Exp. (ks) (4)	Lexan ^a (counts ks ⁻¹) (5)	Al/Ti/C ^b (counts ks ⁻¹) (6)	Q (7)	ID Name 1 (8)	ID Name 2 (9)	Type ^c (10)	Mag. (11)	Ang. Sep. ^d (arcsec) (12)	Comments ^e (13)
EUVE J1032+53.4.....	10 32 07.6	+53 26 30.7	16	2215 ± 81	...	1	WD 1029+537	...	DA	14.5	173	2EU, 2RE, 1WGA
EUVE J1050-05.0.....	10 50 39.8	-05 04 40.8	21	<7	...	1	BD -04°29'58	...	Star	10.5	156	
EUVE J1100-35.1.....	11 00 07.4	-35 08 07.6	11	<13	...	1	[HHP98] TW Hya X40	...	X-ray	...	100	
							CD -34°71'35	LTT 4042	Star	11.2	107	
EUVE J1119+48.3.....	11 19 15.3	+48 23 32.1	46	<2	...	1	IRXS J111915.0+482403	...	X-ray	...	31	DS, IRXS
EUVE J1147+66.7.....	11 47 32.1	+66 43 29.3	39	9 ± 1	...	1	IRXS J114728.8+664405	...	X-ray	...	40	DS, OA
							HD 102479	BD +67°721	G5	8.55	212	
EUVE J1200-46.4.....	12 00 54.3	-46 26 00.9	8	<5	...	1	IRXS J120053.0-462845	...	X-ray	...	165	IRXS
							IRXS J120100.8-462329	...	X-ray	...	167	IRXS
EUVE J1234+48.2.....	12 34 16.0	+48 13 22.4	121	4 ± 1	...	1	IRXS J123415.2+481306	...	X-ray	...	18	DS, IRXS, 1WGA
EUVE J1258-04.7.....	12 58 50.2	-04 47 59.0	140	3 ± 0.4	...	1	RBS 1194	IRXS J125847.7-044746	BL Lac	...	38	DS, IRXS, 1WGA, RBS
EUVE J1259-04.4.....	12 59 45.9	-04 26 00.8	140	3 ± 0.3	...	1	HD 112863	BD -03°33'85	K0	8.7	13	DS
							IRXS J125945.2-042549	...	X-ray	...	15	DS, IRXS, 1WGA
EUVE J1331+29.2.....	13 31 45.0	+29 14 00.5	22	2 ± 0.5	...	1	DG CVn	GJ 3789	M4	11.9	155	IRXS
EUVE J1334+57.8.....	13 34 35.1	+57 50 16.6	43	2 ± 0.5	...	1	IRXS J133434.3+575019	...	X-ray	...	7	DS, IRXS, 1WGA
EUVE J1434-60.4.....	14 34 14.0	-60 24 54.9	76	33 ± 3	...	1	V841 Cen	HD 127535	K1 IV/V e	8.58	30	DS, BSL, 2RE, 1RXS, 1WGA
EUVE J1557-41.5.....	15 57 15.2	-41 30 28.1	125	3 ± 0.5	...	1	RX J1557.2-4130	...	K7-M0	...	25	IRXS
							CD -41°10'454	...	G0	10.3	10	
EUVE J1623-39.2.....	16 23 30.5	-39 14 33.8	2	438 ± 16	...	1	WR 1620-391	EGGR 274	DA	11.0	62	2EU, 2RE, IRXS, 1WGA
EUVE J1623-39.1.....	16 23 59.0	-39 12 32.7	2	22 ± 5	...	1	HR 6094	HD 147513	G5 V	5.4	64	2EU, 2RE, IRXS
EUVE J1628+39.5.....	16 28 38.2	+39 33 23.3	44	18 ± 3	...	1	NGC 6166	3C 338	Galaxy	12.9	19	DS, IRXS, 1WGA
EUVE J1629+40.1.....	16 29 02.1	+40 08 16.3	44	21 ± 4	...	1	[BFE95] 216	IES 1627+40.2	Seyfert 1	19.0	19	DS, IRXS, 1ES, EXO, 1WGA
EUVE J1732-37.1.....	17 32 54.7	-37 11 55.7	124	2 ± 0.4	...	1	IRXS J173253.6-371200	...	X-ray	...	13	DS, IRXS, 1WGA
EUVE J1735-37.4.....	17 35 41.5	-37 26 25.0	63	9 ± 1	...	1	IRXS J173543.3-372620	...	X-ray	...	22	DS, IRXS, 1WGA
							HD 159312	TD1 20627	A0 V	6.48	18	DS, TDI
EUVE J1856-37.9.....	18 56 38.0	-37 54 35.3	4	31 ± 4	...	1	IES 1853-37.9	...	X-ray	...	16	1ES, IRXS, 1WGA
							EUVE J1856-37.9	...	X-ray	...	49	L97
EUVE J1936-22.6.....	19 36 42.0	-22 36 12.4	4	28 ± 3	...	H	No ID	...	...	...	...	
EUVE J1943-22.3.....	19 43 43.2	-22 19 06.9	4	381 ± 10	...	2	PPM 735524	...	Star	9.9	112	
EUVE J1948-21.6.....	19 48 04.2	-21 37 55.8	4	33 ± 4	...	H	No ID	...	...	...	...	
EUVE J2044-31.3.....	20 44 57.1	-31 18 25.6	121	3 ± 0.2	...	1	EXO 204152-3129.3	...	...	...	...	DS
EUVE J2141+19.6.....	21 41 09.7	+19 37 32.0	8	6 ± 1	...	1	IRXS J214105.0+193530	...	X-ray	...	138	IRXS
EUVE J2147-16.1.....	21 47 07.8	-16 07 59.0	8	30 ± 3	...	1	δ Cap	BD -16°59'43	A7 IIIIm	2.9	79	2EU, 2RE, TDI, 1RXS
EUVE J2303+20.9.....	23 03 04.7	+20 55 03.3	19	22 ± 2	...	1	MT Peg	HD 217813	G5 V	6.66	5	DS, IRXS
EUVE J2313+11.1.....	23 13 05.7	+11 11 31.4	17	9 ± 1	...	1	IRXS J231304.5+111148	...	X-ray	...	25	DS, IRXS, 1WGA
EUVE J2316+78.7.....	23 16 16.7	+78 42 20.2	71	<2	...	1	IRXS J231616.5+784156	...	X-ray	...	24	DS, IRXS, 1WGA
EUVE J2333-47.2.....	23 33 23.7	-47 17 22.4	53	2 ± 0.4	...	2	HD 221550	SAO 231662	G0	9.4	56	DS, 1WGA
EUVE J2342-14.5.....	23 42 47.7	-14 31 48.5	12	57 ± 5	...	1	IRXS J234249.1-143216	...	X-ray	...	34	DS, IRXS
EUVE J2350+22.6.....	23 50 06.3	+22 39 57.1	1.5	78 ± 16	...	2	DIR 105-38	...	IR	...	150	FB

NOTE.—Units of right ascension are hours, minutes, and seconds, and units of declination are degrees, arcminutes, and arcseconds.

^a EUVE count rate in the Lexan/B band: 58–174 Å (0.075–0.21 keV) for the scanners and 67–178 Å (0.07–0.18 keV) for the DS.^b EUVE count rate in the Al/Ti/C band (156–234 Å, or 0.053–0.079 keV).^c Spectral types from SIMBAD, NED, and the literature where available.^d Angular separation between the EUVE position and the identified source's position.^e Comments and selected references: (DS) detection from Deep Survey; (FB) filter bar; (OA) off axis; (B89) Beuermann et al. 1989; (2EU) Bowyer et al. 1996; (1ES) Elvis et al. 1992; (BSL) Malina et al. 1994; (L97) Lampton et al. 1997; (2E) McDowell 1994; (2RE) Pye et al. 1995; (RBS) Schwöpe et al. 2000; (TD1) Thompson et al. 1978; (IRXS) Voges et al. 1999; (1WGA) White et al. 1994, 2000.^f Source is ≈2/5 from Guest Observer target EUVE J0613-23.9 (HD 43162).

FIG. 2.—*EUVE* RAP Deep Survey Lexan light curve of *EUVE* J0613–23.9B. Bin size is 2000 s.

smaller flare. The light curve for *EUVE* J0613–23.9B is shown in Figure 2. We also show the Deep Survey Lexan light curve of the cataclysmic variable *EUVE* J0332–25.9 (VY For) in Figure 3*a* and the light curve folded on the best-fit period of 228.38 minutes in Figure 3*b*. This period is within 0.2% of the period derived by Beuermann et al. (1989).

5. *EUVE* SOURCE DISTRIBUTION

The results from this catalog, when combined with the *EUVE* all-sky survey catalogs of Bowyer et al. (1996) and

TABLE 2
COMPARISON WITH PREVIOUS RESULTS

Type	2EU ^a	Faint List ^b	RAP 1994–1998 ^c	RAP 1999–2000 ^d
Early stars (O, B, A)	24 (15)	8	44	5
Later stars (F, G, K, M)	275 (45)	81	72	23
White dwarfs.....	105 (7)	5	4	1
Extragalactic.....	37 (3)	...	7	4
Other	37 (17)	10	49	22
Cataclysmic variables.....	14 (3)	1	1	1
No ID	245 (34)	61	34	7
Total	737 (124)	166	211	63

^a Bowyer et al. 1996 (McDonald et al. 1994 results are shown in parentheses).

^b Lampton et al. 1997.

^c Christian et al. 1999.

^d This work.

Lampton et al. (1997) and the previous RAP catalogs (McDonald et al. 1994; Christian et al. 1999), bring the total number of sources detected with *EUVE* in the Lexan (100 Å) band to 1177. A comparison of the *EUVE* second all-sky survey catalog and Lampton faint list with our RAP results is given in Table 2. We note that the McDonald et al. RAP catalog results were incorporated in Table 3 of Bowyer et al. (1996). We show these results in parentheses in Table 2, and we also note that Table 3 of McDonald et al. (1994) sums to 124 sources, not the claimed 114. The RAP source distribution has a similar percentage of late-type stars ($\approx 35\%$) as that of the all-sky survey, but the RAP found significantly fewer white dwarfs (only 2% vs. 14%) and fewer extragalactic sources (3% vs. 5%). In these cases, the lesser sky coverage of the RAP and the interstellar medium probably contribute to diminish source detections. The category of “other” sources was proportionally higher for the RAP (22% vs. 5% for the all-sky survey), and this is the result of including a large number of sources classified as “X-ray” in

FIG. 3*a*

FIG. 3*b*

FIG. 3.—(a) *EUVE* Deep Survey Lexan light curve of *EUVE* J0332–25.9 (VY For); (b) light curve folded on the best-fit 228.38 minute period (see text)

FIG. 4.—Aitoff projection of *EUVE* sources in Galactic coordinates. Shown are sources from both the *EUVE* all-sky survey second catalog (Bowyer et al. 1996) and Lampton et al. (1997) faint list as open symbols, and sources from this work and the RAP2 catalog as filled symbols. Sources are classified as late-type stars (*five-pointed stars*), early-type stars (*squares*), white dwarfs (*diamonds*), other (*circles*), extragalactic (*triangles*), or no ID (“N,” or “n” for 2EU + L97).

this category. Many of these sources are probably nearby active late-type stars, such as those detected with *ROSAT* (see, e.g., Fleming 1998), but have yet to be optically identified.

We present the total *EUVE* source distribution in Figure 4, including sources from the all-sky survey catalogs of Bowyer et al. (1996) and Lampton et al. (1997) and all 274 unique RAP detections from this work and RAP2. A color version of the total *EUVE* source distribution and an ASCII file of source positions can be found at the Multimission Archive at the Space Telescope Science Institute.² Figure 4 shows that the RAP sky coverage was uniform but lacking at higher Galactic latitudes when compared with the *EUVE* all-sky surveys. The excess of sources in Galactic quadrant 3 ($180^\circ < l < 270^\circ$) shown in the *EUVE* and *ROSAT* (Pye et al. 1995) all-sky surveys is also seen in the RAP all-sky distribution. There are an especially large number of sources (over 40) in quadrant 3 with $b < 0^\circ$ in the well-known low-column direction near Galactic position ($210^\circ, -20^\circ$) (Welsh et al. 1994). There are also very few RAP sources near Galactic positions ($90^\circ, +30^\circ$) and ($300^\circ, -30^\circ$), where the *EUVE* all-sky surveys found an excess of sources. The lack of RAP sources must be a selection effect due to the lack of sky coverage. Bowyer et al. (1996) and Lampton et al. (1997) note that the distribution of EUV sources is non-isotropic as a result of the nonuniformity of the local interstellar medium, and again the combined RAP sources mirror the *EUVE* all-sky survey distribution.

In Figure 5a, we compare the $\log N$ – $\log S$ distribution of the RAP with the *EUVE* all-sky survey. As expected, the

RAP, with its longer exposure times, is biased toward fainter sources in the EUV sky. Figure 5b combines all current *EUVE* source detections and compares the total distribution with that of the late-type stars and white dwarfs. The late-type stars dominate the distribution below 0.1 counts s^{-1} and indicate a nearby population of fainter objects. The white dwarf distribution is strongly diminished below 1 count s^{-1} and indicates a uniform distribution attenuated by the interstellar medium.

6. SUMMARY

We have presented the detection of 76 extreme-ultraviolet sources, of which 63 are new detections using the *Extreme Ultraviolet Explorer*’s Right Angle Program. These observations concentrate on the final 2 years of the RAP (1999 and 2000), with a small number of “gap filling” observations from previous years. The 8 years of the Right Angle Program covered approximately 25% of the sky. This catalog, combined with the previous RAP results and the all-sky survey catalogs (Bowyer et al. 1996; Lampton et al. 1997), brings the total number of *EUVE* sources to nearly 1200. We presented sample light curves for several active late-type stars, including flare detections from the previously uncataloged source EUVE J0613–23.9B and from EUVE J0728–20.9 (V372 Pup), and the folded light curve of the cataclysmic variable VY For.

This research was made possible by NASA Astrophysical Data Products grants NAG 5-3470 and S-54536-G. The author thanks Jean Dupuis for useful discussions about the EUV sources, and Bryce Roberts for his always superb pro-

² See <http://archive.stsci.edu/euve/survey.html>.

FIG. 5a

FIG. 5b

FIG. 5.—The log N –log S distributions for the *EUVE* all-sky survey and RAP sources. (a) Comparison of the all-sky survey sources with the total detected in all RAP catalogs. The RAP distribution is biased toward fainter sources not detected in the all-sky survey. (b) Comparison of all of the *EUVE* detections (all-sky surveys plus RAP) with the distributions of late-type stars and white dwarfs (see text).

gramming skills. This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France; the NASA/IPAC Extragalactic Database (NED), which is operated by the Jet Propulsion Laboratory, California Institute of Technology, under contract with NASA; and the High Energy Astrophysics Science Archive Research Center (HEASARC), provided by NASA's Goddard Space Flight

Center. Several of the Deep Survey data sets were obtained from the Multimission Archive at the Space Telescope Science Institute (MAST). STScI is operated by the Association of Universities for Research in Astronomy, Inc., under NASA contract NAS 5-26555. Support for MAST for non-*HST* data is provided by the NASA Office of Space Science via grant NAG 5-7584 and by other grants and contracts.

REFERENCES

- Beuermann, K., Thomas, H.-C., Giommi, P., Tagliaferri, G., & Schwöpe, A. D. 1989, *A&A*, 219, L7
- Bowyer, S., Lampton, M., Lewis, J., Wu, X., Jelinsky, P., & Malina, R. F. 1996, *ApJS*, 102, 129
- Bowyer, S., & Malina, R. F. 1991, in *Extreme Ultraviolet Astronomy*, ed. R. F. Malina & S. Bowyer (New York: Pergamon), 397
- Christian, D. J. 2001, in *ASP Conf. Ser. 223, Cool Stars, Stellar Systems, and the Sun: 11th Cambridge Workshop*, ed. R. J. García López, R. Rebolo, & M. R. Zapatero Osorio (San Francisco: ASP), CD-1127
- Christian, D. J., Craig, N., Cahill, W., Roberts, B., & Malina, R. F. 1999, *AJ*, 117, 2466
- Christian, D. J., Drake, J. J., & Mathioudakis, M. 1998, *AJ*, 115, 316
- Christian, D. J., & Vennes, S. 1999, *AJ*, 117, 1852
- Craig, N., Howell, S. B., Sirk, M. M., & Malina, R. F. 1996, *ApJ*, 457, L91
- Elvis, M., Plummer, D., Schachter, J., & Fabbiano, G. 1992, *ApJS*, 80, 257
- Fleming, T. A. 1998, *ApJ*, 504, 461
- Fruscione, A. 1998, *Adv. Space Res.*, 21, 83
- Helou, G., Madore, B. F., Schmitz, M., Wu, X., Corwin, H. G., Jr., Lague, C., Bennett, J., & Sun, H. 1995, in *Information and On-Line Data in Astronomy*, ed. D. Egret & M. A. Albrecht (Dordrecht: Kluwer), 95
- Howell, S. B., Sirk, M. M., Malina, R. F., Mittaz, J. P. D., & Mason, K. O. 1995, *ApJ*, 439, 991
- Lampton, M., Lieu, R., Schmitt, J. H. M. M., Bowyer, S., Voges, W., Lewis, J., & Wu, X. 1997, *ApJS*, 108, 545
- Malina, R. F., et al. 1994, *AJ*, 107, 751
- McDonald, K., Craig, N., Sirk, M. M., Drake, J. J., Fruscione, A., Vallerger, J. V., & Malina, R. F. 1994, *AJ*, 108, 1843
- McDowell, J. 1994, *The Einstein Observatory Soft X-Ray Source List (SAO High-Energy Astrophys. Div. CD-ROM Ser. 1, Nos. 18–36)* (Cambridge: Smithsonian Astrophys. Obs.)
- Pye, J. P., et al. 1995, *MNRAS*, 274, 1165
- Schwöpe, A. D., et al. 2000, *Astron. Nachr.*, 321, 1
- Sirk, M. M., Vallerger, J. V., Finley, D. S., Jelinsky, P., & Malina, R. F. 1997, *ApJS*, 110, 347
- Thompson, G. I., Nandy, K., Jamar, C., Monfils, A., Houziaux, L., Carnochan, D. J., & Wilson, R. 1978, *Catalogue of Stellar Ultraviolet Fluxes* (London: Sci. Res. Council)
- Voges, W., et al. 1999, *A&A*, 349, 389
- Warren, J. K., Sirk, M. M., & Vallerger, J. V. 1995, *ApJ*, 445, 909
- Welsh, B. Y., Craig, N., Vedder, P. W., & Vallerger, J. V. 1994, *ApJ*, 437, 638
- White, N. E., Giommi, P., & Angelini, L. 1994, *IAU Circ.* 6100
- , 2000, *The WGA Catalogue of ROSAT Point Sources* (Greenbelt, MD: GSFC)

Note added in proof.—In 2002 September, S. Vennes & A. Kawka obtained an optical spectrum of EUVE J0613–23.9B from Mount Stromlo and found this source to be an active M star.