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INFRARED MIRA VARIABLES+

Infrared sky surveys at 2.2, 4 and 10 μm discovered many optically invisible objects which turned out to be late-type stars surrounded by optically thick circumstellar dust shells. Some of them, as well as some of the optically known Mira variables show intense OH maser emission at 1612 MHz. The emission shows a characteristic profile with two peaks separated by 10 to 60 km/s. Subsequent radio surveys of OH maser emission discovered several hundreds of such double-peaked sources. Many of them were found to be associated with extreme infrared objects (OH/IR stars). Often the infrared and radio emission vary with large amplitudes as in Mira variables. Periods were found between 500 and 1800 days. One example is given in Figure 1.

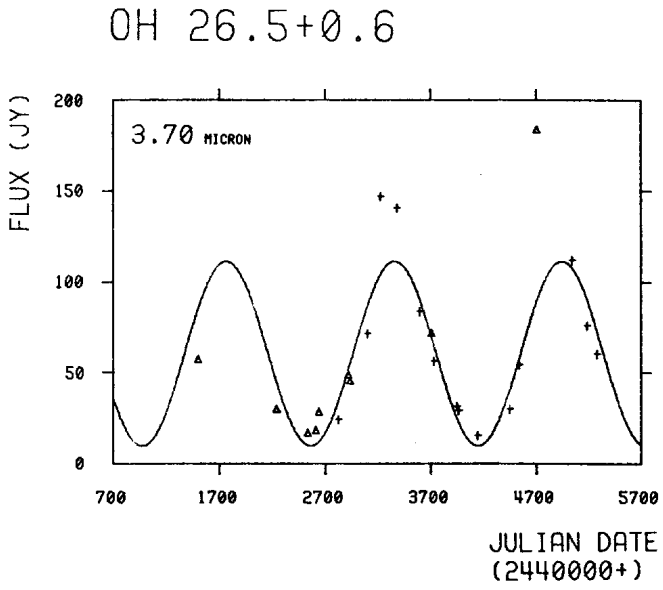

Figure 1

+Based on observations made at the European Southern Observatory (ESO)

Table I

Name	Coordinates (1950) α	δ	Period days	Epoch (2440000+)	L	J - L	H - L	K - L	L - M
19.2 - 1.0	$18^h26^m40^s.0$	- 12°39'43"	610 ± 10	3268	$6^m.00$	-	$>6^m$	$4^m.51$	$1^m.75$
20.3 - 0.1	18 25 27.3	- 11 18 18	680 ± 40	3781	4. 27	>8	5.51	3. 19	1. 21
23.7 + 1.2	18 27 24.1	- 7 39 6	700 ± 30	3438	4. 21	>8	6.09	3. 71	1. 31
26.2 - 0.6	18 38 32.9	- 6 17 55	1330 ± 50	3299	4. 24	-	> 8	5. 61	1. 66
26.4 - 1.9	18 43 45.4	- 6 43 46	540 ± 20	3125	3. 55	>9	7.14	3. 93	1. 29
26.5 + 0.6[a]	18 34 52.7	- 5 26 48	1630 ± 100	3357	1. 88	-	>10	6. 99	1. 91
28.7 - 0.6	18 43 9.4	- 4 4 5	640 ± 10	3445	2. 94	~8	5.35	2. 87	0. 93
30.1 - 0.2	18 44 32.8	- 2 39 3	970 ± 40	3605	3. 31	>8	7.02	3. 65	1. 13
30.1 - 0.7	18 46 3.7	- 2 53 48	1730 ± 200	3936	5. 91	-	-	>7	2. 61
30.7 + 0.4	18 43 17.2	- 1 50 2	1140 ± 30	3947	4. 83	-	>8	6. 60	1. 85
31.7 - 0.8	18 49 26.3	- 1 30 12	510 ± 20	3198	3. 82	5.73	3.43	1. 76	0. 55
32.0 - 0.5	18 48 51.9	- 1 7 27	1490 ± 50	5010	6. 20	-	-	> 7	2. 39
32.8 - 0.3	18 49 48.3	- 0 17 52	1750 ± 130	2895	5. 58	-	-	> 7	2. 68
39.7 + 1.5[b]	18 56 4.1	6 38 50	1340 ± 50	4827	0. 86	~10	6.87	3. 61	1. 00
39.9 + 0.0	19 1 42.8	6 8 58	770 ± 20	3617	4. 84	-	>8	5. 36	1. 67
42.3 - 0.1	19 6 44.0	8 11 55	1650 ± 150	3278	7. 35	-	-	>7	2. 76
45.5 + 0.1	19 11 58.7	11 5 21	720 ± 20	3544	4. 23	>8	6.01	3. 63	1. 03

a) AFGL 2205

b) AFGL 2290

Measurements made at ESO (+) and taken from different sources in the literature (Δ) are shown for a prototype object OH 26.5+0.6 together with a sine curve of ~4.5 years period. Such OH/IR stars are thus an extension of the phenomenon of Mira variability to longer periods and also higher luminosities (Engels et al. 1983), e.g. they are infrared Mira variables.

In the two tables a complete list of those OH/IR stars is given which are found to be variable from infrared observations. Since 1976, observations have been made at the ESO-1m-telescope equipped with an InSb-photometer. The photometer has filters with passbands centered at J=1.25 μm, H=1.65 μm, K=2.2 μm, L=3.7 μm and M=4.8 μm (e.g. Engels et al. 1981).

In Table I 17 infrared Mira variables are listed for which periods could be determined. The coordinates have an error of about 10". The mean L magnitude and mean colors are also given. The amplitudes in L are between 0.9 mag (31.7 - 0.8) and 3.3 mag (32.8 - 0.3), the color variations can be as high as 1.5 mag in K-L and 0.6 mag in L-M (Engels, 1982).

In Table II 39 newly discovered OH/IR stars are listed for which variations of more than 0.3 mag have been observed. They are candidate infrared Mira variables. The corresponding OH masers are listed in Caswell and Haynes 1975, Winnberg et al. 1981 and Caswell et al. 1981. Several objects were discovered independently by various groups as noted in the reference column. When possible, published coordinates are given. The L magnitude and the colors are those measured in March, 1982 (J.D. 2445040).

DIETER ENGELS

Sternwarte der Universität Bonn
Auf dem Hügel 71
53 Bonn 1, FRG

Table II

Name	Coordinates (1950) α	δ	L	J-L	H-L	K-L	L-M	Ref
285.05 + 0.07	$10^h28^m43^s.3$	- 57°33'27"	3.62	8.3	5.61	2.89	0.77	E, EN
286.50 + 0.06	10 38 0.5	- 58 17 38	2.28	5.71	3.93	2.27	0.76	EN
300.93 - 0.03	12 31 03.7	- 62 33 20	2.67	3.89	2.42	1.27	0.48	EN
305.91 - 1.91	13 15 42.6	- 64 21 51	5.45	-	-	3.43	1.10	EN
315.22 + 0.01	14 29 45.7	- 60 10 23	3.66	7.20	4.69	2.47	0.72	EN
327.1 - 0.3	15 46 54.8	- 54 20 28	7.09	-	-	-	2.90	E
327.4 - 0.6	15 50 17.3	- 54 24 34	0.98	6.57	4.22	2.25	0.69	G, J 1
328.4 - 0.2	15 53 32.0	- 53 28 54	3.99	-	5.66	3.24	1.12	G, J 1
328.7 - 0.2	15 55 16.2	- 53 16 34	4.35	-	6.22	3.12	0.82	G, J 1
331.6 - 0.3	16 09 41.0	- 51 22 23	4.74	-	4.64	2.54	0.72	G, J 1
338.5 - 0.2	16 38 19.1	- 46 26 38	4.43	-	-	4.98	1.48	J 1
338.5 + 0.1	16 37 27.0	- 46 13 26	5.18	-	-	3.49	0.79	J 1
339.93 + 0.37	16 41 32.5	- 44 57 50	5.31	-	6.09	3.23	0.95	EN
339.98 - 0.19	16 44 3.2	- 45 18 2	6.28	-	-	5.15	2.08	E
341.12 - 0.00	16 47 26.4	- 44 18 23	4.64	6.25	4.27	2.10	0.52	EN, J 1
342.01 + 0.25	16 49 31.1	- 43 27 44	2.15	6.46	3.71	1.84	0.55	EN
343.4 + 1.3	16 49 52.4	- 41 43 28	2.72	-	6.91	3.83	1.24	E
344.83 - 1.67	17 07 21.3	- 42 25 06	4.57	6.80	4.50	2.61	0.96	EN
346.86 - 0.18	17 07 24.9	- 39 55 3	2.81	6.13	3.63	1.86	0.46	EN
347.57 + 0.11	17 08 27.5	- 39 9 20	4.11	3.94	2.43	1.29	0.31	E
349.18 + 0.20	17 12 51.6	- 37 48 47	4.37	-	-	4.37	1.27	EN, J 1
349.39 - 0.01	17 14 28.5	- 37 45 57	3.93	5.83	3.50	1.78	0.51	EN
349.96 - 0.03	17 16 05.2	- 37 18 38	5.68	-	-	3.47	0.96	EN
352.61 - 0.19	17 24 14.3	- 35 13 1	3.70	-	7.25	3.57	0.94	E
353.23 - 0.24	17 26 9.5	- 34 44 42	7.31	-	-	2.63	1.15	EN
353.60 - 0.23	17 27 8.1	- 34 25 31	4.60	-	-	5.38	1.58	EN, J 1
354.53 + 0.03	17 28 29.9	- 33 30 21	5.27	-	-	4.20	1.36	J 1
354.88 - 0.54	17 31 44.8	- 33 31 38	3.00	-	-	7.46	2.18	J 1
357.71 - 0.27	17 37 53.4	- 31 00 11	3.47	5.87	3.38	1.63	0.43	EN
357.77 - 0.15	17 37 32.3	- 30 53 18	6.21	-	4.41	2.00	~0.6	EN

Table II (cont.)

358.16 + 0.50[a]	17 36 1.9	- 30 12 54	1.60	7.90	4.70	2.33	0.59	
2.6 - 0.4 [b]	17 50 10.9	- 26 56 00	1.02	5.80	3.38	1.78	0.71	
11.4 - 0.0	18 07 42.7	- 19 6 28	6.15	-	-	-	1.84	E
20.4 - 0.3	18 26 48.5	- 11 17 56	6.44	-	-	~5.4	2.34	J1
21.5 + 0.5	18 25 45.5	- 10 00 14	~8.1	-	-	-	~3.2	EB
42.6 + 0.1	19 06 34.5	08 32 54	6.25	-	-	-	1.47	E, J2
43.8 + 0.5	19 07 8.4	09 47 00	4.49	-	-	4.20	1.34	E
57.5 + 1.8	19 29 31.1	22 28 50	4.65	-	-	4.18	1.46	E, J2
65.4 + 1.3	19 49 20.6	29 05 15	3.79	~6.7	4.74	2.62	0.85	E, J2

a) AFGL 1992

b) AFGL 2019

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