

## Twenty years monitoring of extragalactic sources at 22, 37 and 87 GHz<sup>★,★★,★★★</sup>

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**Abstract.** Long term monitoring results from mid 1995 to the end of 2000 of quasar observations at 22, 37 and 87 GHz done at the Metsähovi radio observatory are presented. Approximately 15 700 observations are published here.

**Key words.** galaxies: active – radio continuum: galaxies – quasars: general – astronomical data bases: miscellaneous

### 1. Introduction

To better understand the behaviour of quasars, it is important to monitor them over a large range of frequencies. The sources selected in this study are radio loud, have a flat radio spectrum and have shown blazar flaring type behaviour at least in some frequency band. Due to the small size of our antenna (13.7 m), the sample is limited to stronger sources with flux density  $S > 0.5$  Jy. The Northern location of the antenna (latitude = 60N) limits the observed sources to those with declination higher than  $-5$  degrees, with some exceptions. The variability time scale of these sources at 22 and 37 GHz is typically from months to years. Monthly monitoring would in most cases be enough in to produce representative flux curve. The sensitivity of the antenna, receivers and time given for the observations limit the yearly observations to under 5000, which would allow a sample of 200 sources to be observed monthly. Currently in the list there are over 200 sources, partly as a result of selecting new flat spectrum sources for monitoring prior to the next gamma-ray observatories AGILE and GLAST. The stronger sources, which are also used for pointing the antenna, are observed daily, while for the new candidate sources must be limited to 2–4 yearly to demonstrate their spectra and duty cycle.

\* Table 1 is also available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via <http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/427/769>

\*\* Table 2 is only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via <http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/427/769>

\*\*\* The complete Fig. 1 is only available in electronic form at <http://edpsciences.org>

### 2. Observing system

The Metsähovi radio telescope is a 13.7 m diameter radome enclosed antenna. The surface accuracy of the antenna, 0.1 mm rms, allows observations at over 100 GHz, but the sea level location is not suitable for submillimeter observations, at least during the warm season. The receivers at 22 and 37 GHz have HEMPT<sup>1</sup> front ends operating at room temperature. The total noise temperatures are in the range of 200–300 K DSB<sup>2</sup>, depending on the season. The 1 sigma rms values for a 30 min integration, with good observing conditions are about 0.03–0.06 Jy. Both receivers operate with dual beam mode. The Metsähovi antenna was upgraded by changing the antenna panels and back structure in 1994. The effects of the better panels on the data reduction were described in Teräsranta et al. (1998).

### 3. Final remarks

The number of observations for each source is shown in Table 1. The data before mid 1995 were published in Salonen et al. (1987), Teräsranta et al. (1987), Teräsranta et al. (1992) and Teräsranta et al. (1998). The weekly mean fluxes of the 56 best sampled sources since the start of monitoring are shown in Fig. 1 at 22 and 37 GHz. The numerical data of flux densities from mid 1995 to the end of 2000 is published in Table 2 only at the CDS via anonymous ftp. The data format in Table 2 is the following: object designation, other name, observing frequency (GHz), observation date, time in UT hours, time in minutes, flux density (Jy), 1 sigma error estimate (Jy). The earlier

<sup>1</sup> High electron mobility pseudomorphic transistor.

<sup>2</sup> Double side band.

**Table 1.** Number of observations at each frequency.

Source	n22	n37	n87	Total
0003-066	26	11	0	37
III ZW 2	145	47	2	194
0016+731	28	12	0	40
0048-097	24	10	0	34
0059+581	32	14	2	48
OC 012	69	28	1	98
0109+224	81	36	2	119
DA 55	102	41	2	145
0149+218	70	28	0	98
0153+744	15	5	0	20
0202+149	106	42	0	148
0212+735	60	19	0	79
0218+357	27	9	0	36
0219+428	91	31	2	124
0224+671	53	18	0	71
0229+131	19	4	0	23
0234+285	61	23	1	85
AO 0235+164	154	73	2	229
0238-084	19	7	0	26
0248+430	32	11	0	43
0300+470	35	11	0	46
0306+102	34	8	0	42
3C 84	407	173	5	585
0323+022	2	1	0	3
NRAO 140	70	35	0	105
0336-019	55	22	0	78
NRAO 150	115	48	2	165
3C 111	88	43	1	132
OA 129	130	59	1	190
0422+004	52	24	2	78
3C 120	176	65	4	245
0440-003	45	20	0	65
0446+112	66	24	2	92
0454+844	2	0	0	2
0454+039	19	9	0	28
0458-020	46	16	2	64
0528+134	313	134	5	452
DA 193	90	31	1	122
0605-085	26	12	0	38
OH 471	86	29	1	116
0716+714	93	24	0	117
0723-008	15	5	0	20
0723+679	22	8	0	30
PKS 0735+17	109	41	1	151
0736+017	84	37	0	121
0742+103	33	9	0	42
0743-006	11	6	0	17
OI 090.4	87	34	1	122
0804+499	108	36	1	145
0814+425	88	28	1	117
0820+225	23	7	0	30
0827+243	82	29	1	112
0828+493	4	1	0	5
0829+046	18	7	1	26
0836+710	131	33	0	164
0846+513	19	8	0	27

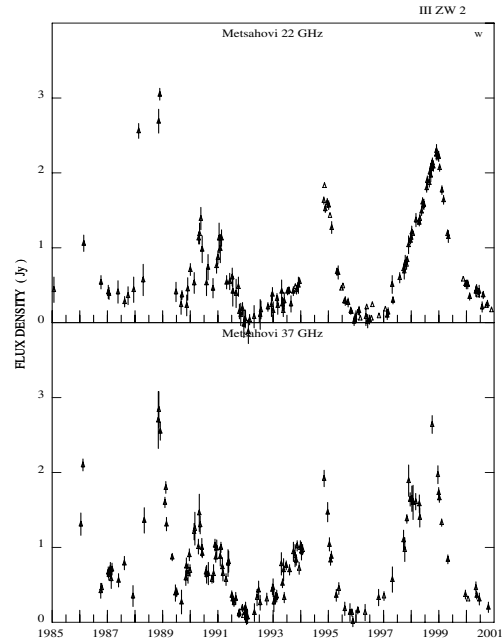
**Table 1.** continued.

Source	n22	n37	n87	Total
0850-1213	26	6	0	32
OJ 287	325	129	4	458
0859+470	8	1	0	9
3C 216	30	15	0	45
4C 39.25	387	148	4	539
0927+352	18	7	0	25
0945+408	58	18	1	77
0953+253	79	34	0	113
0954+556	52	18	0	70
0954+658	45	13	0	58
0957+227	2	0	0	2
1038+528	11	2	0	13
1039+811	2	0	0	2
1040+123	24	4	0	28
1049+215	31	9	0	40
OL 093	87	39	0	126
1057+100	2	1	0	3
Mark 421	191	46	1	238
1133+704	2	0	0	2
1146-037	14	7	0	21
1147+245	35	14	0	49
1150+497	33	9	0	42
4C 29.45	193	76	0	269
1215+303	24	4	0	28
1218+304	1	0	0	1
ON 231	107	38	0	145
1222+216	161	59	0	220
3C 273	356	160	3	519
3C 279	310	142	3	455
1302-102	2	2	0	4
1308+326	142	49	0	191
1308+328	21	5	0	26
1324+224	44	14	0	58
1406-076	19	10	0	29
1413+135	100	46	0	146
OQ 530	72	18	0	90
OR 103	67	35	0	102
1510-089	61	26	0	87
1522+155	11	2	0	13
4C 14.60	73	29	0	102
1548+056	48	20	0	68
1553+113	15	1	0	16
1606+106	72	32	0	104
1611+343	102	45	1	148
4C 38.41	152	76	1	229
OS 562	58	35	0	93
1638+398	24	5	0	29
3C 345	332	140	2	474
1642+690	11	3	0	14
1652+398	205	64	0	269
1725+044	42	12	0	54
1730-130	46	16	0	62
1739+522	60	31	1	92
1741-038	134	58	1	193
1749+096	287	126	1	414
1749+701	12	3	0	15

**Table 1.** continued.

Source	n22	n37	n87	total
1803+784	48	15	0	63
3C 371	59	22	0	81
1823+568	39	14	0	53
3C 380	43	19	0	62
1845+797	39	12	0	51
1901+319	33	15	0	48
1928+738	58	21	0	79
1954+513	27	12	0	39
2005+403	106	41	2	149
2007+776	42	13	0	55
OW 637	39	10	0	49
2022+171	87	24	1	112
CYG X-3	9	0	0	9
2037+511	41	18	2	61
2121+053	41	14	0	55
2131-021	26	10	0	36
OX 057	81	35	0	116
OX 161	45	16	0	61
2144+092	35	12	0	47
2145+067	265	120	1	386
BL Lac	383	157	13	553
2201+315	106	47	1	154
2216-038	30	17	0	47
3C 446	81	43	2	126
2225-055	3	0	0	3
2227-088	18	6	0	24
CTA 102	163	76	10	249
2234+282	36	13	0	49
3C 454.3	353	160	16	529
2254+074	35	12	0	47
2344+092	28	11	0	39

data has been analysed as in in Valtaoja et al. (1988), Valtaoja et al. (1992) and numerous other publications.



**Fig. 1.** Weekly mean flux density of observed sources at 22 and 37 GHz.

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# Online Material

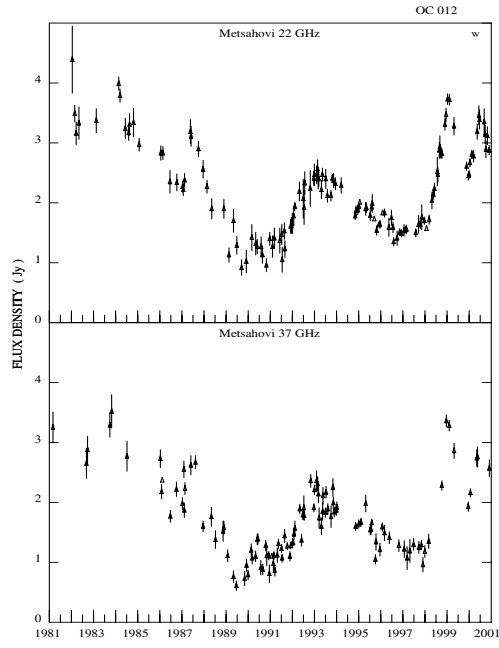


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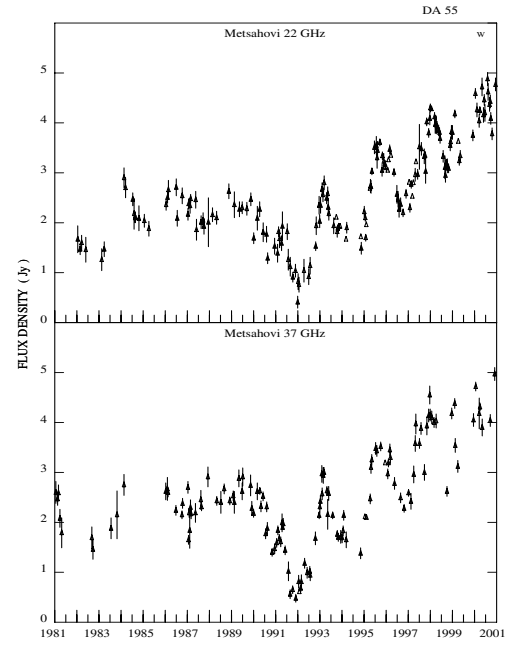


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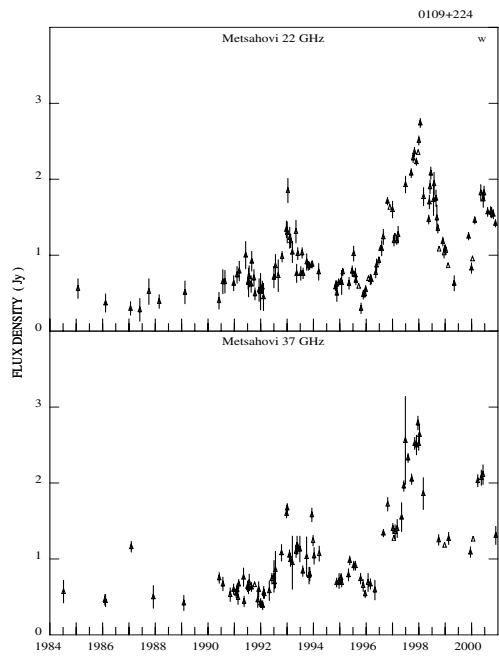


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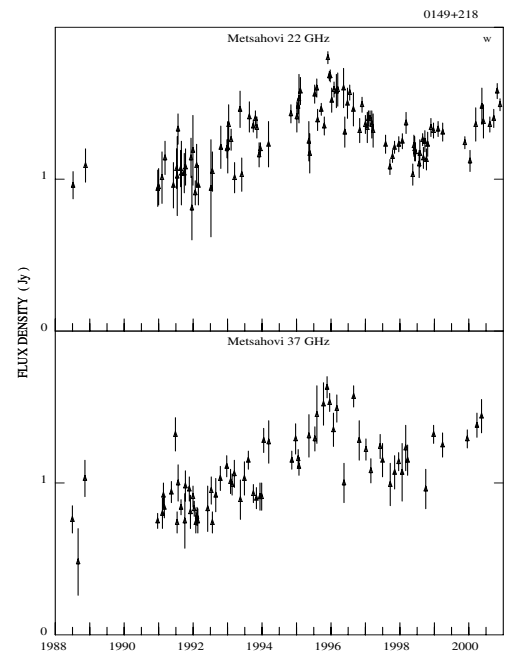


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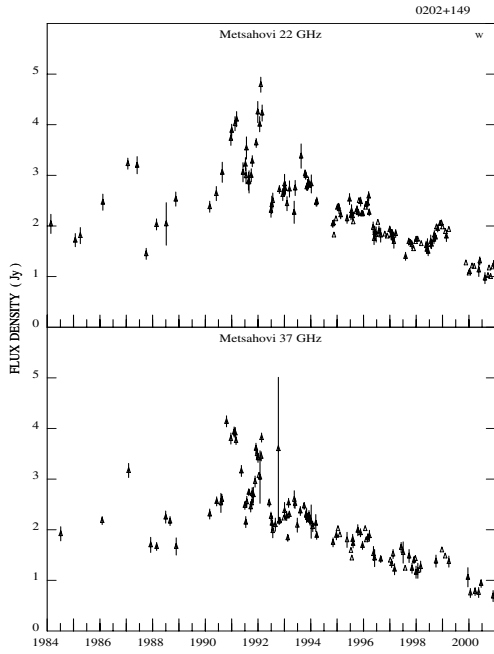


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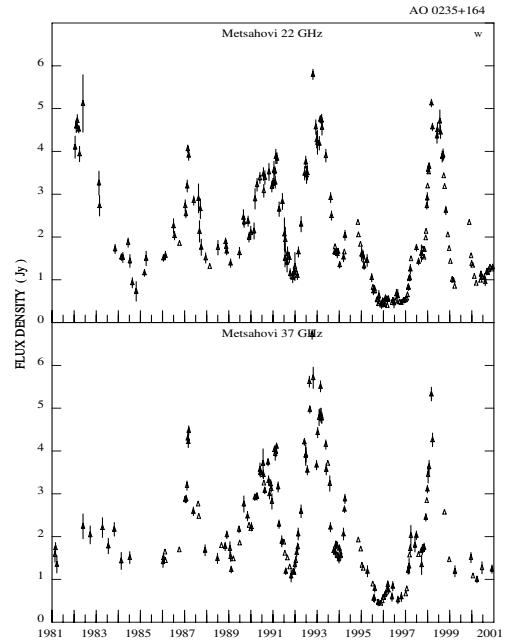


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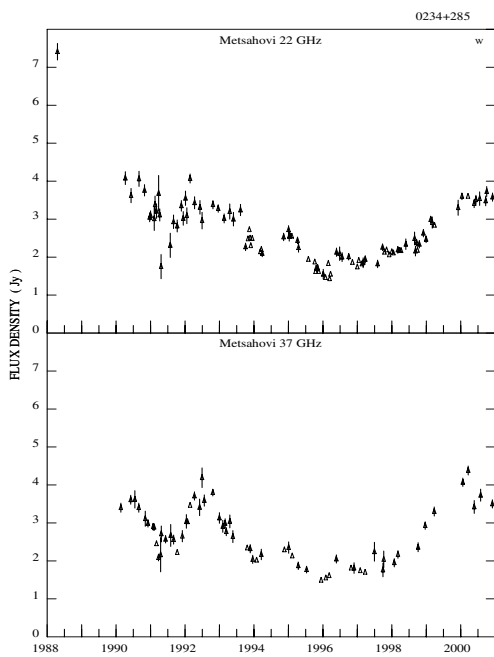


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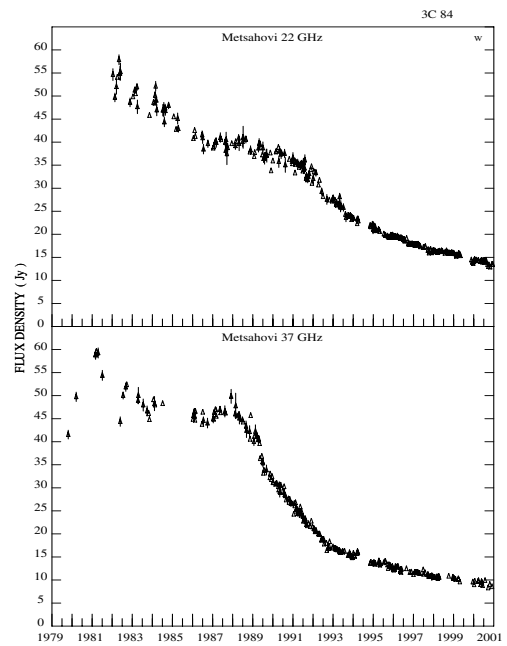


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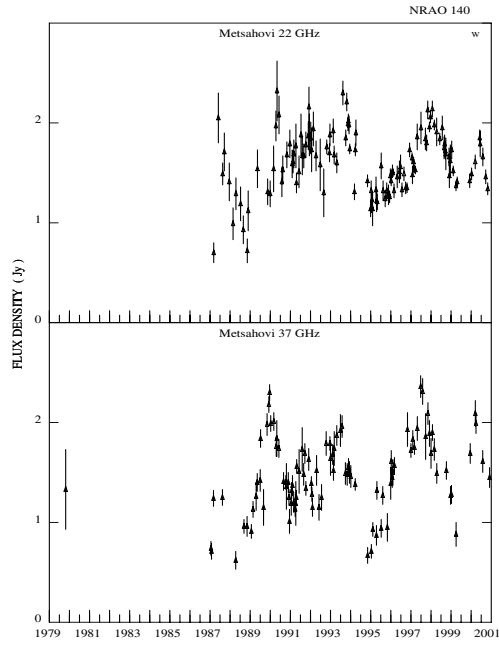


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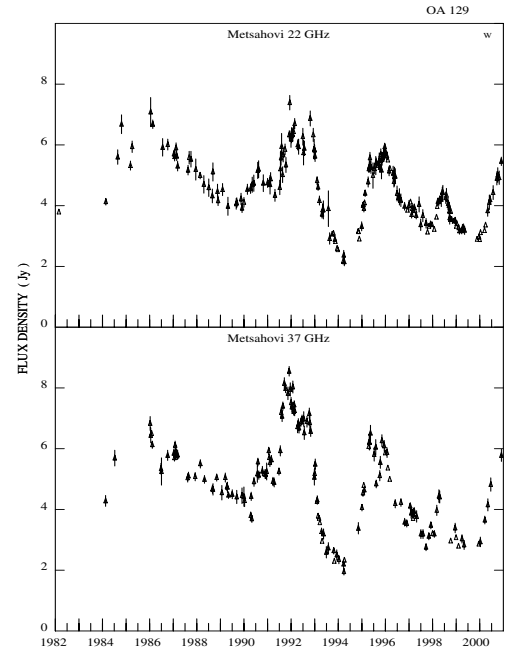


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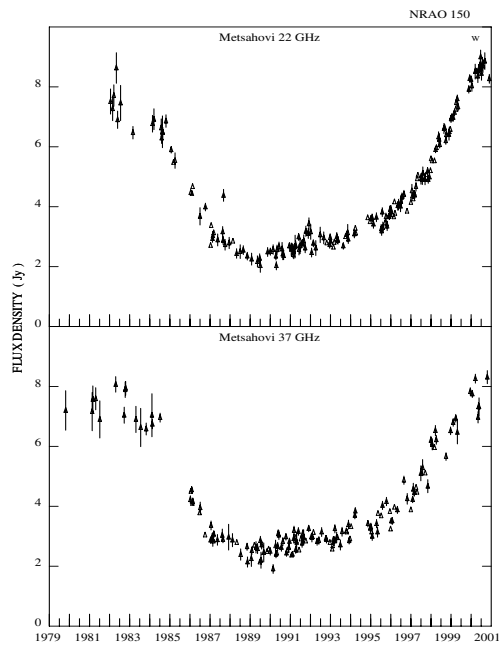


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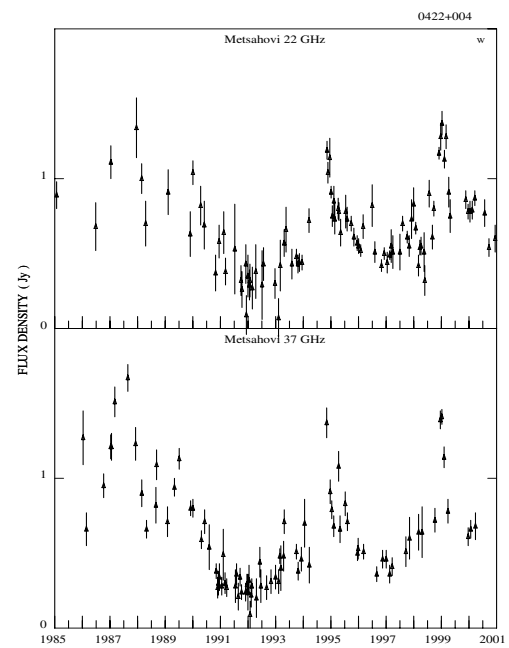


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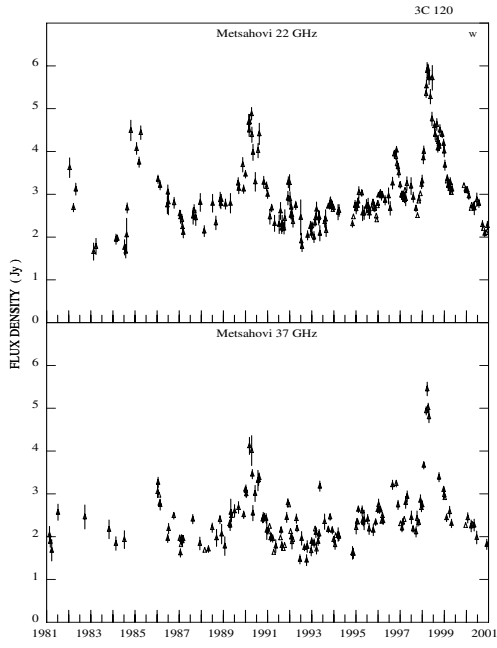


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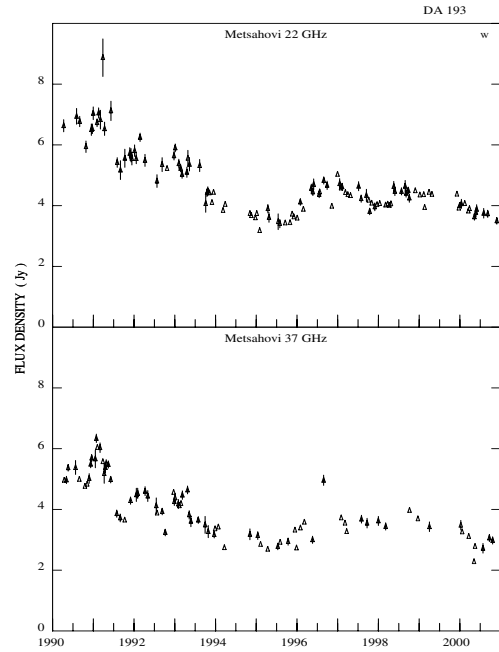


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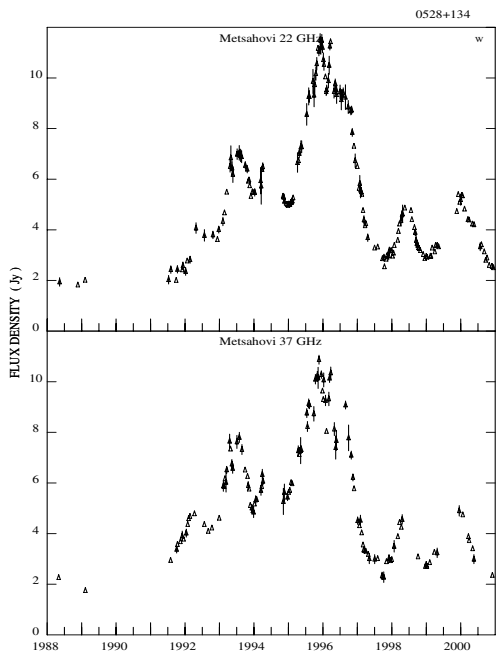


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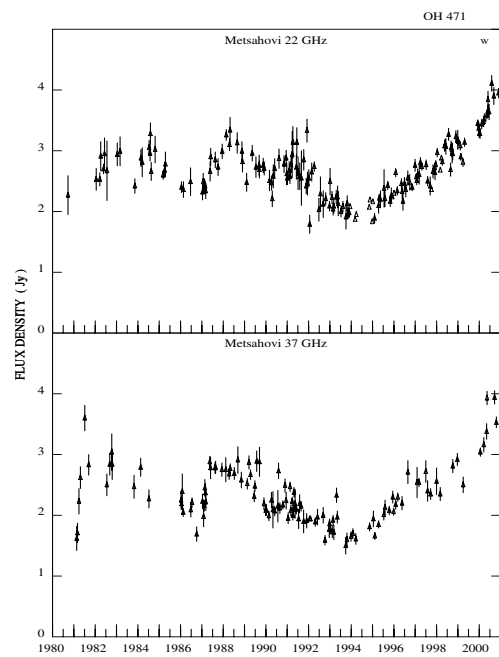


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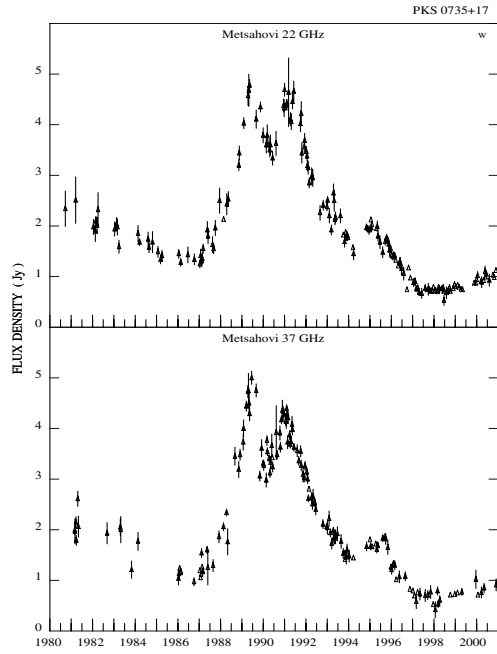


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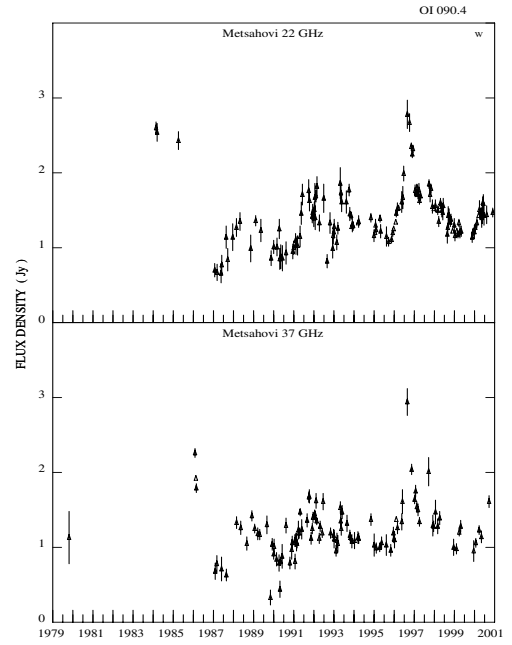


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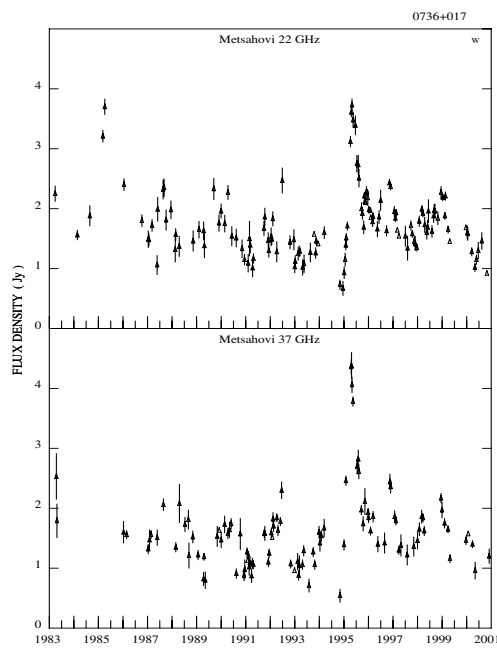


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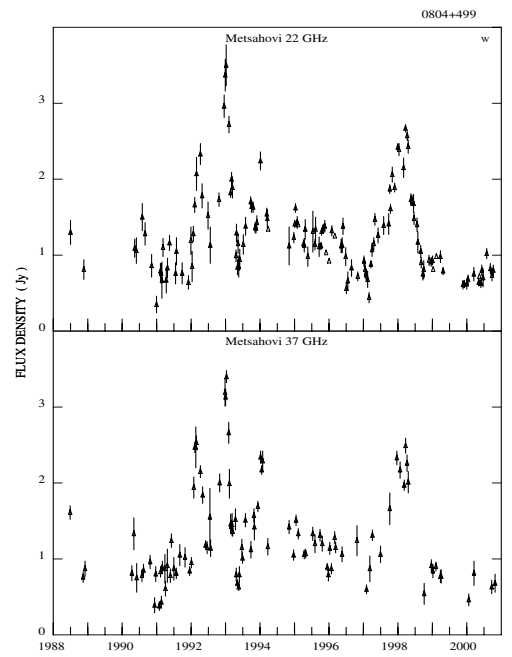


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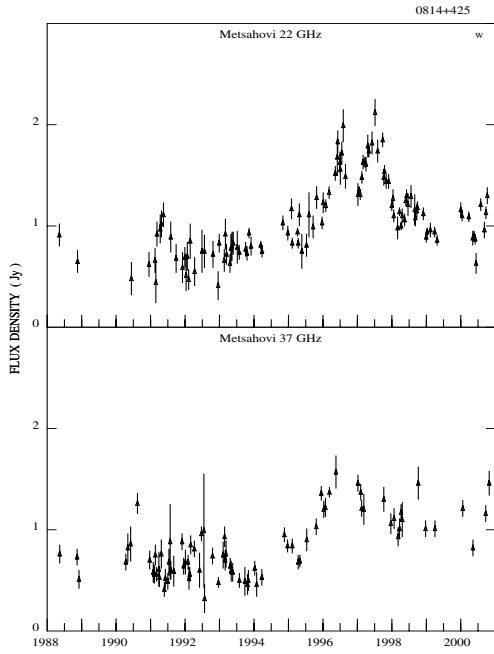


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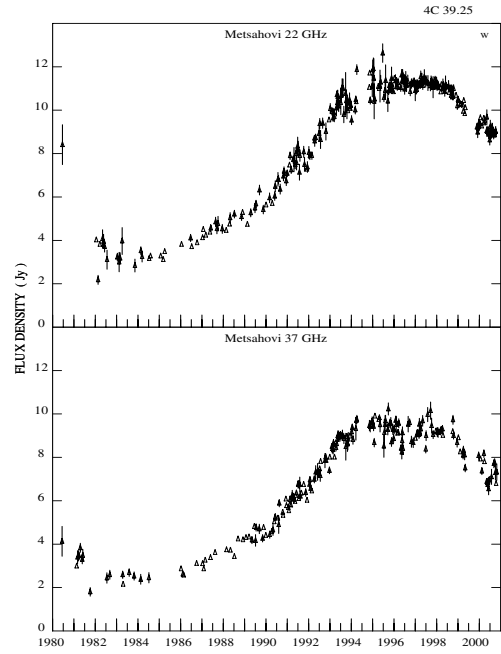


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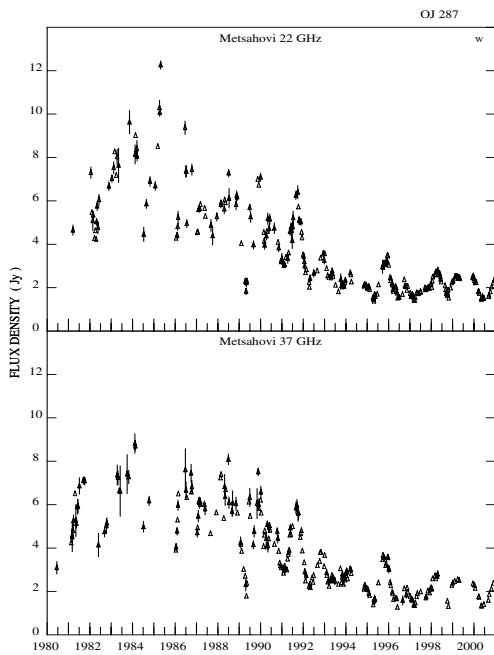


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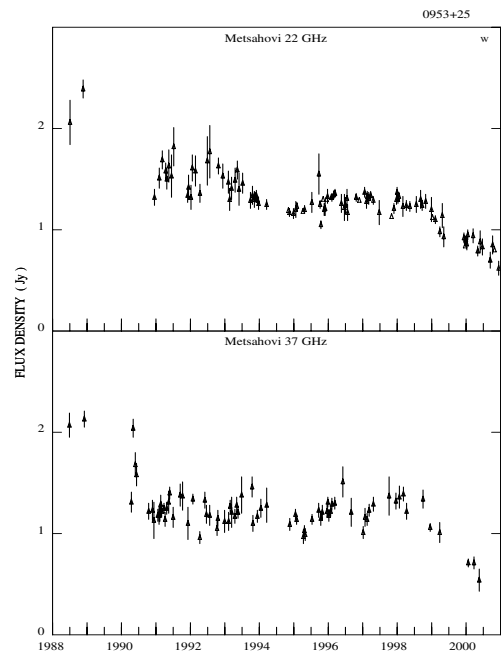


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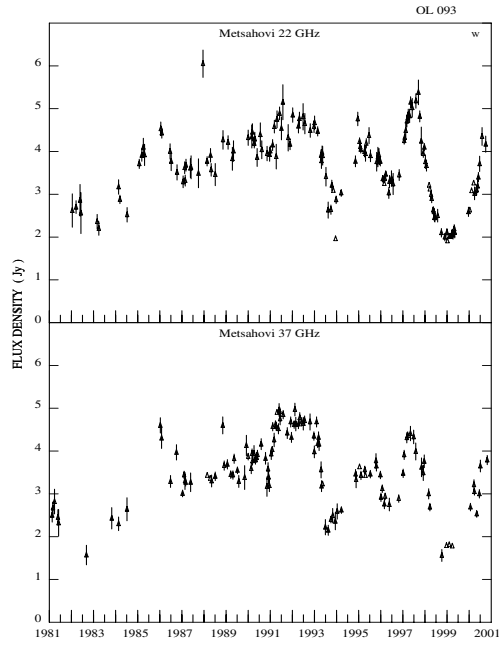


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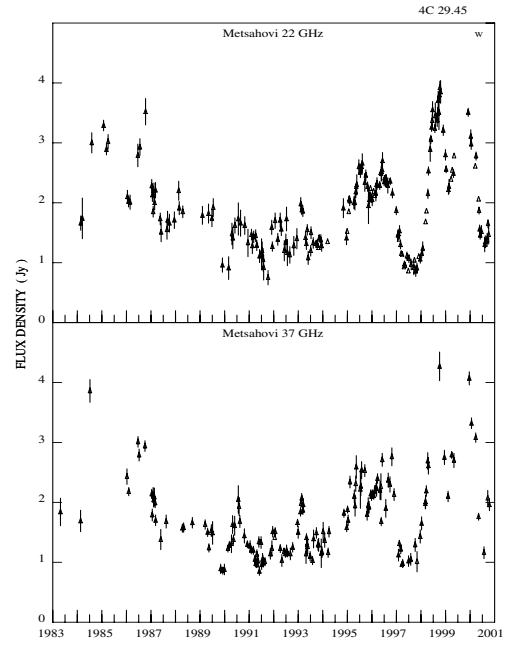


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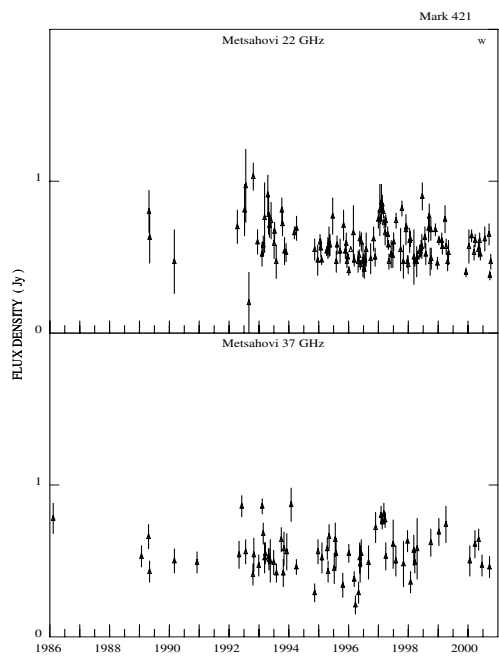


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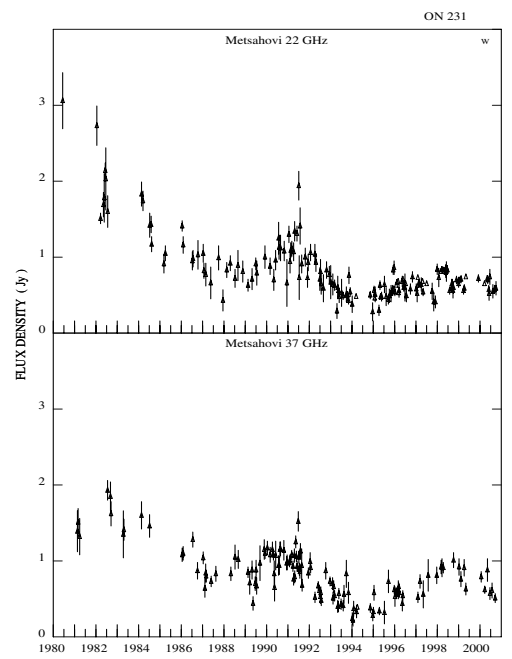


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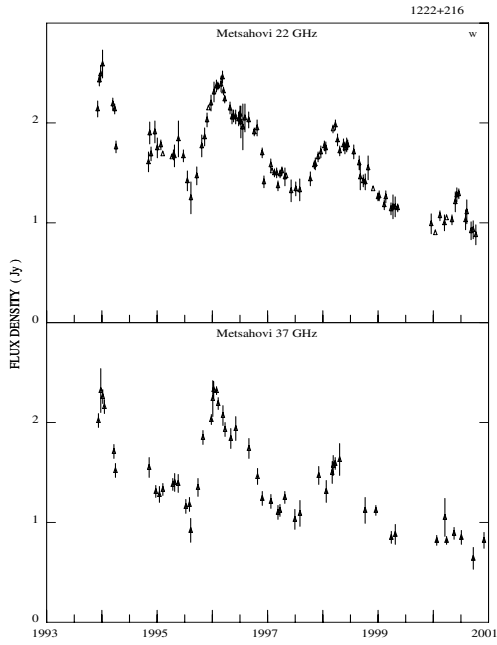


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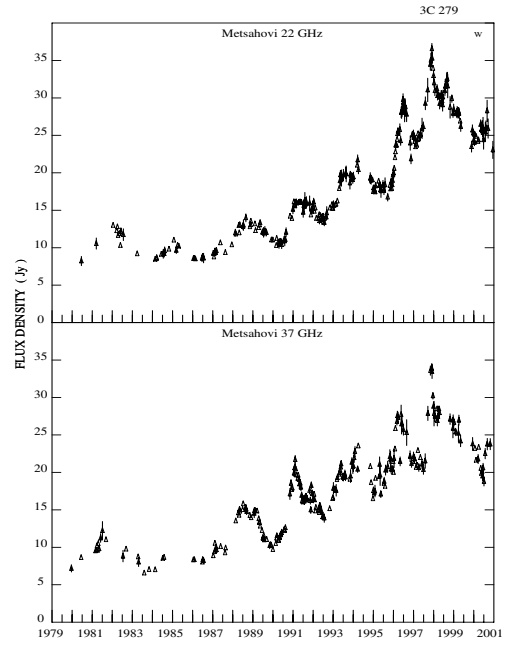


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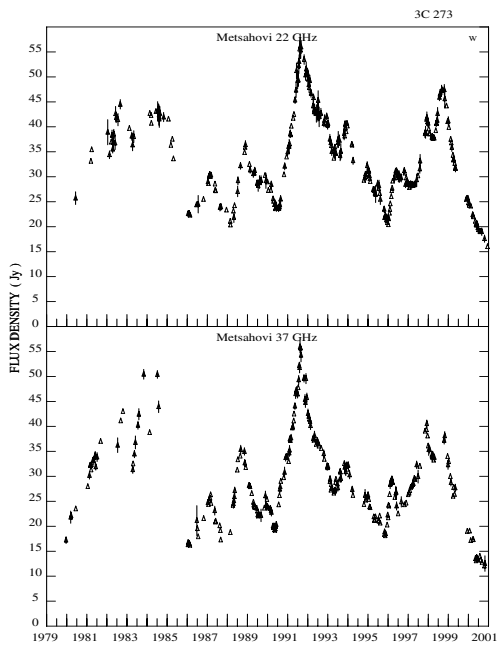


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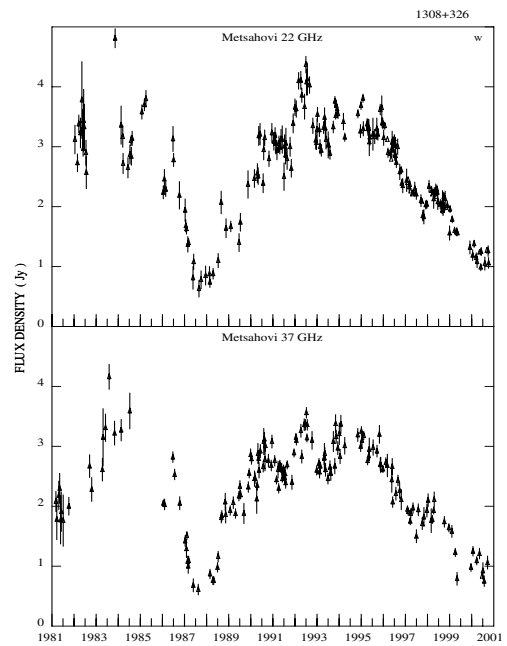


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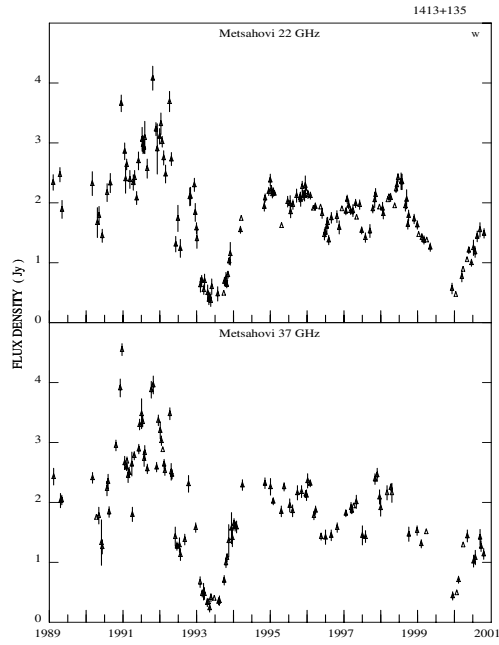


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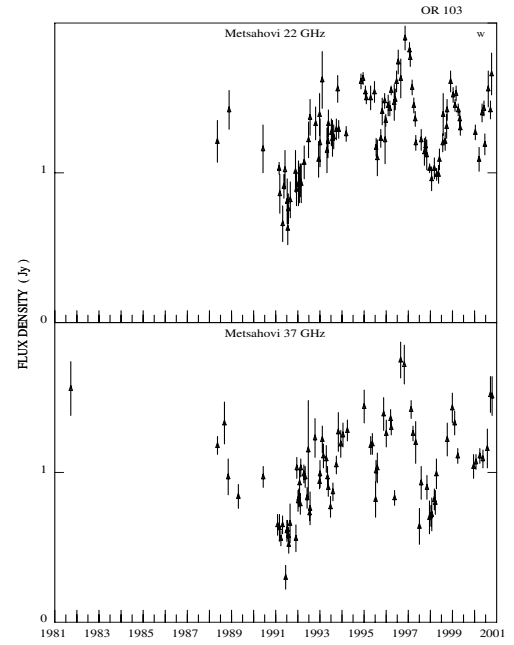


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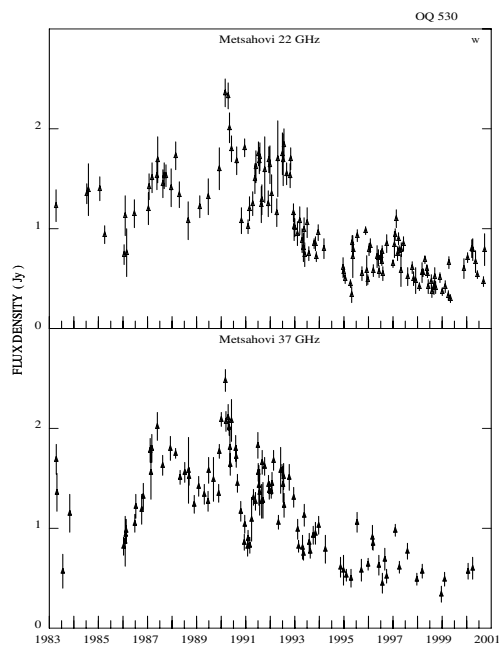


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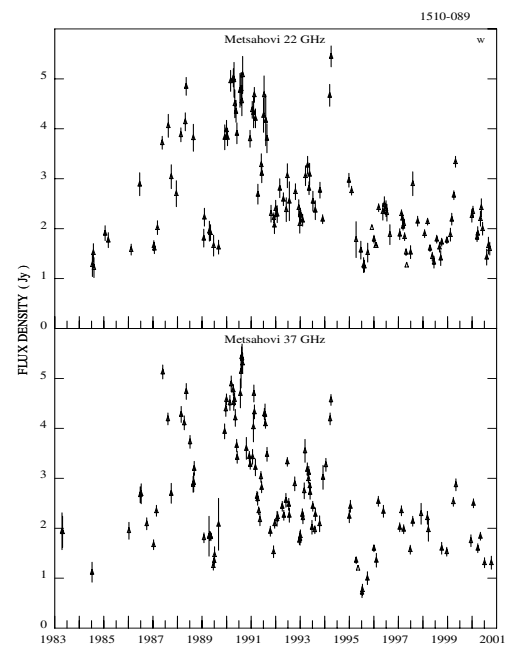


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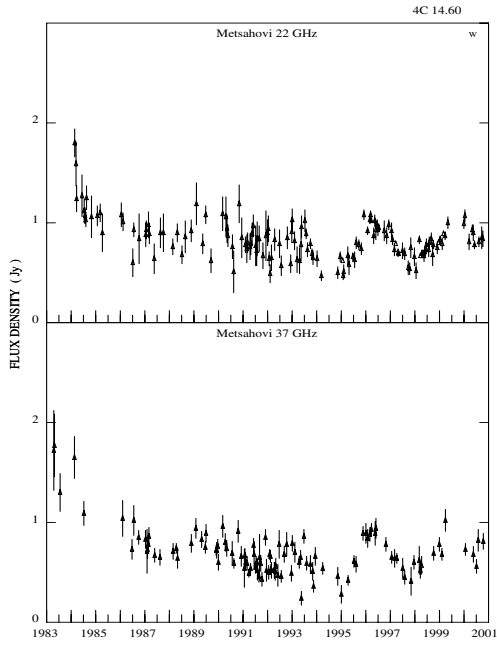


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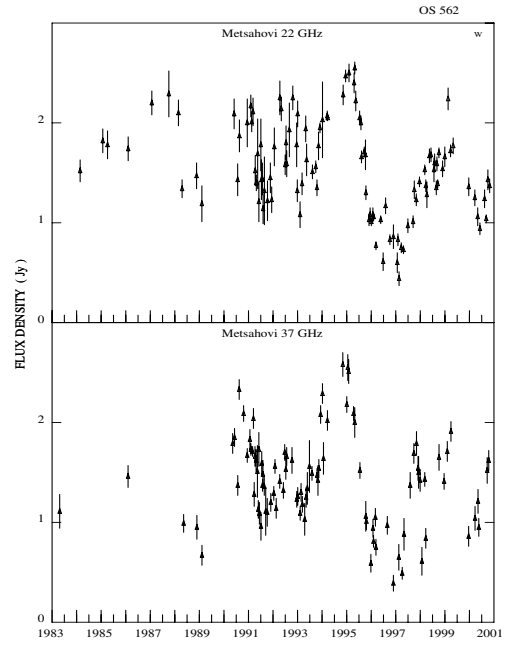


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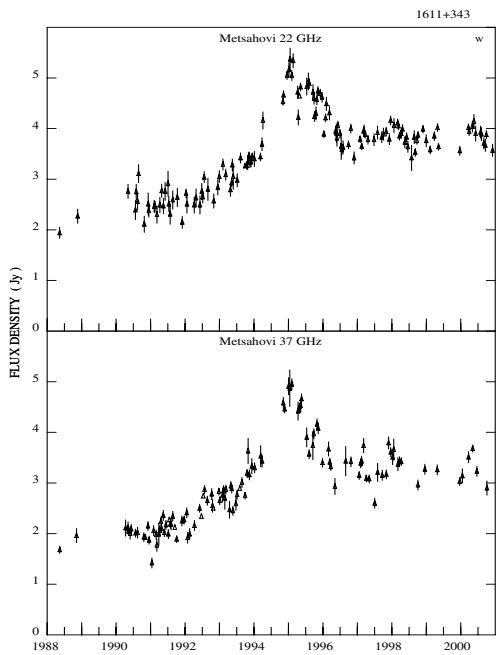


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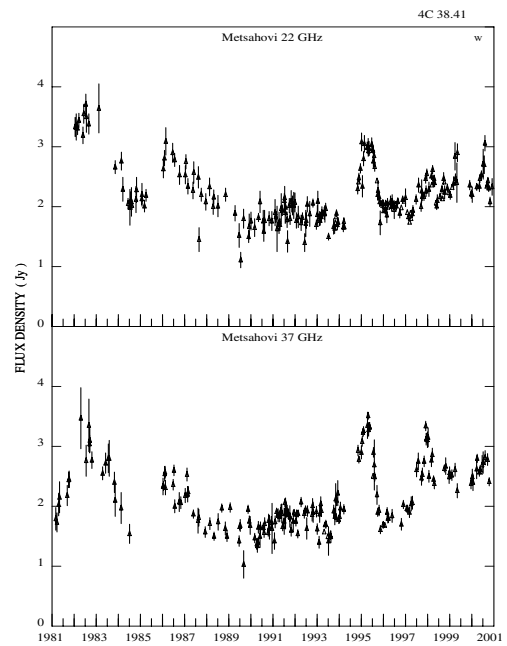


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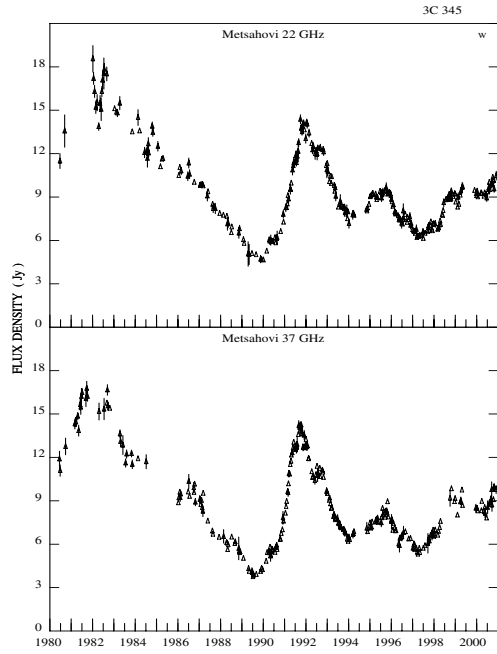


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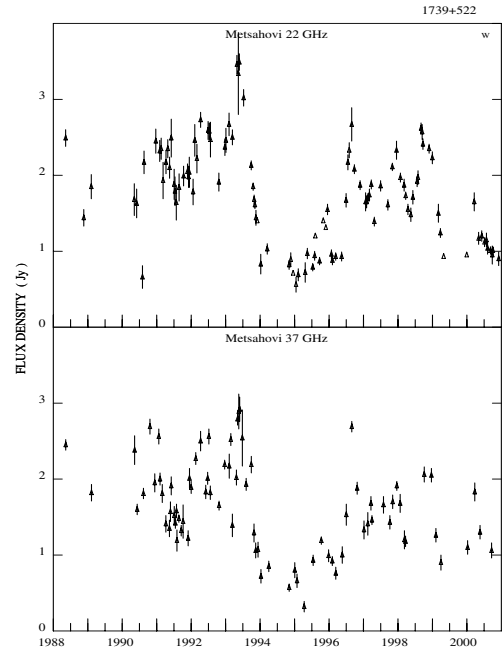


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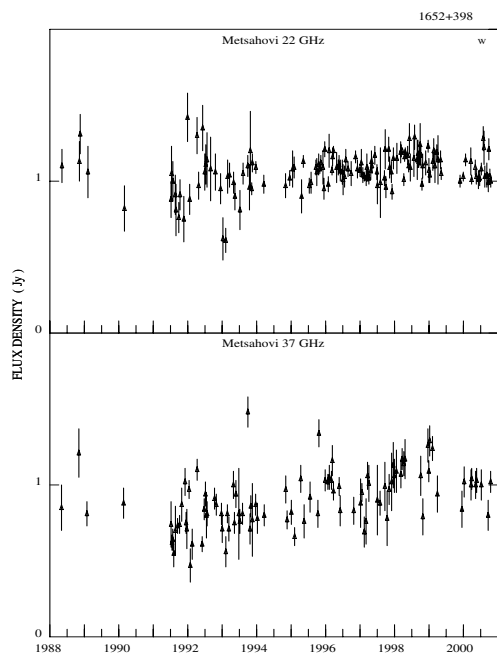


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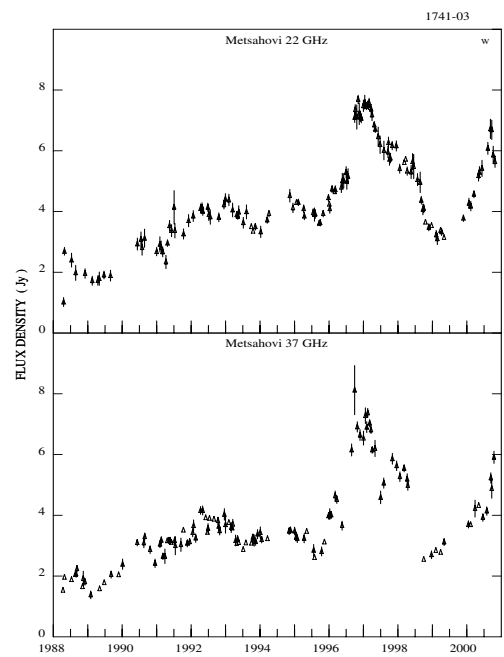


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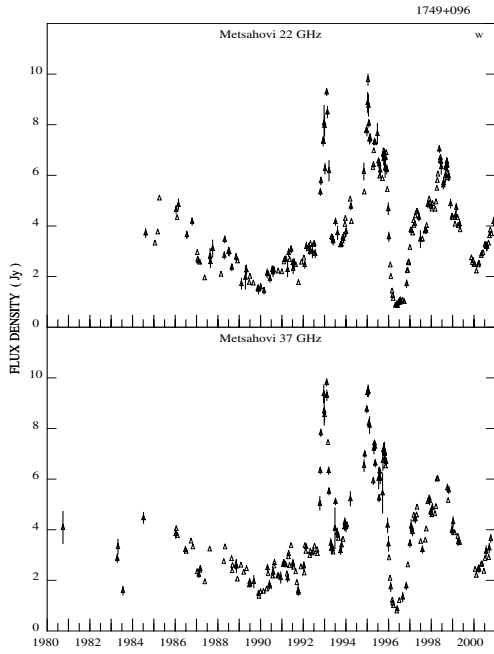


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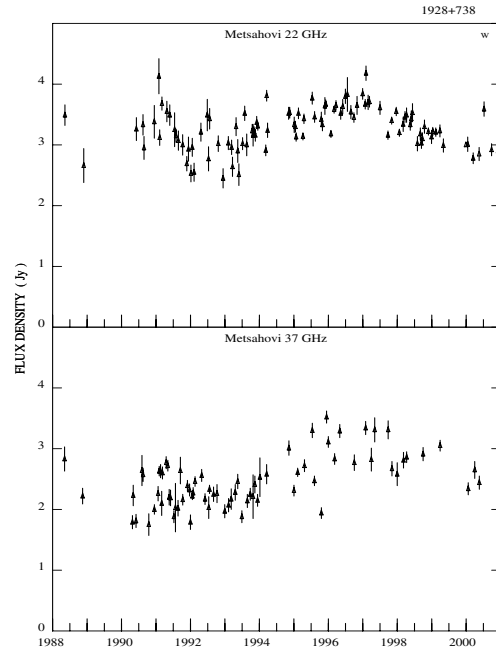


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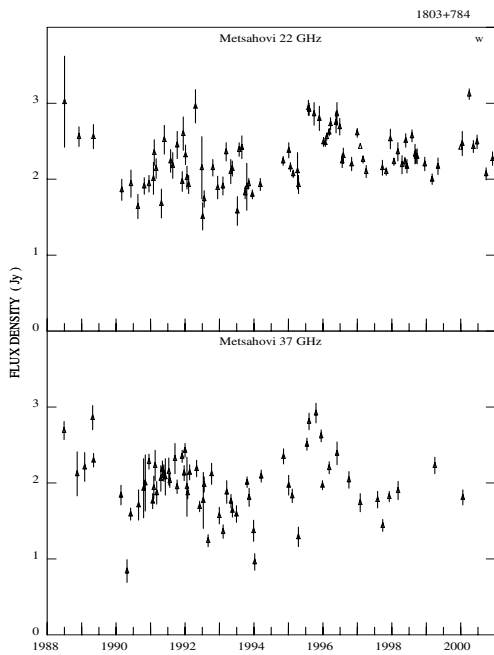


Fig. 1. continued.

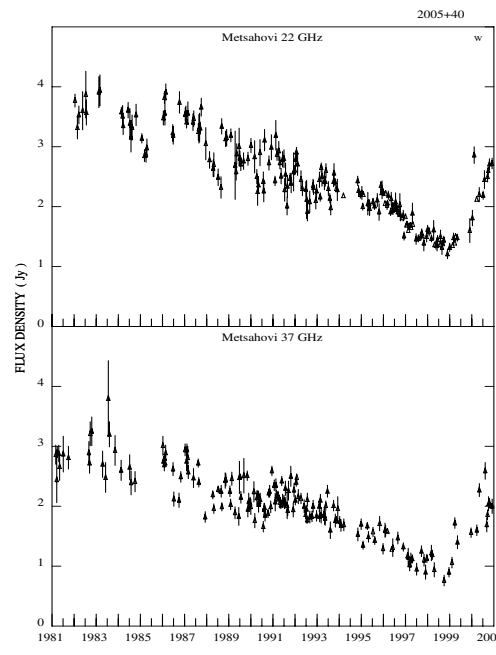


Fig. 1. continued.



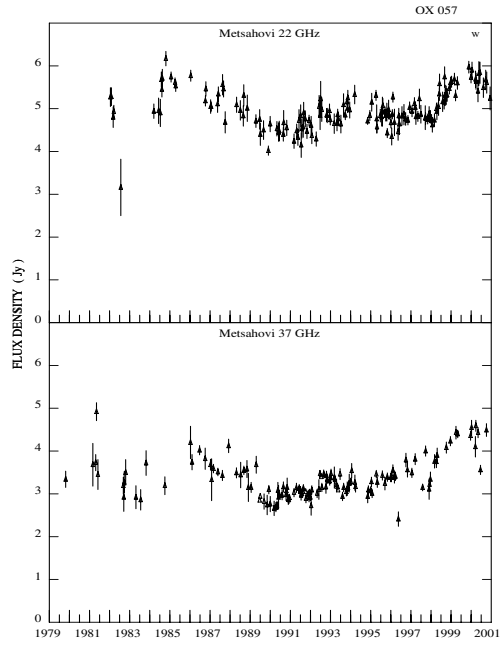


Fig. 1. continued.

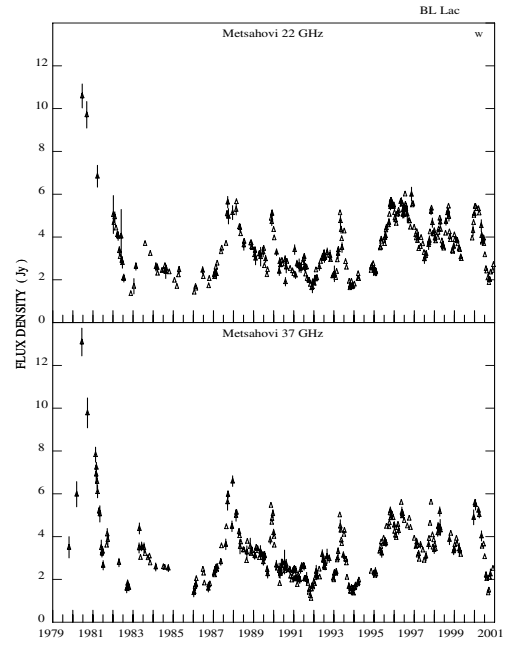


Fig. 1. continued.

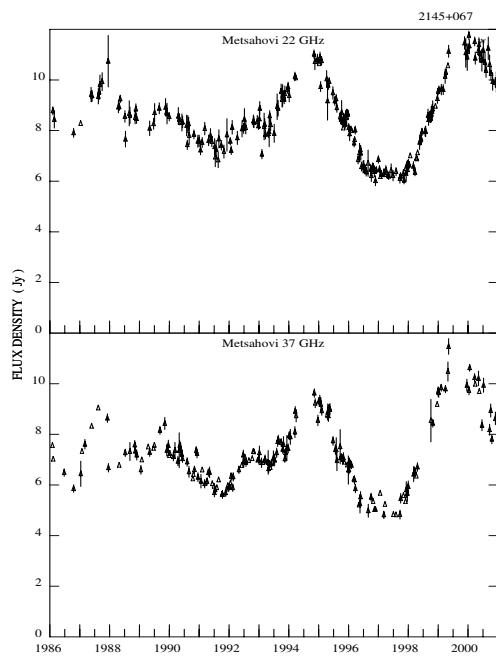


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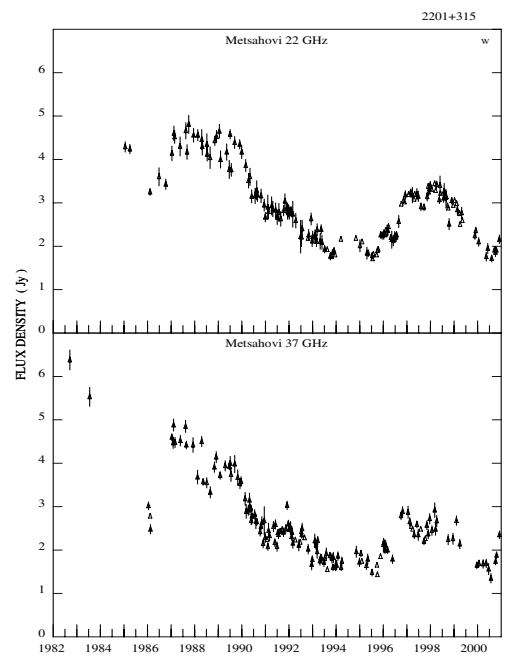


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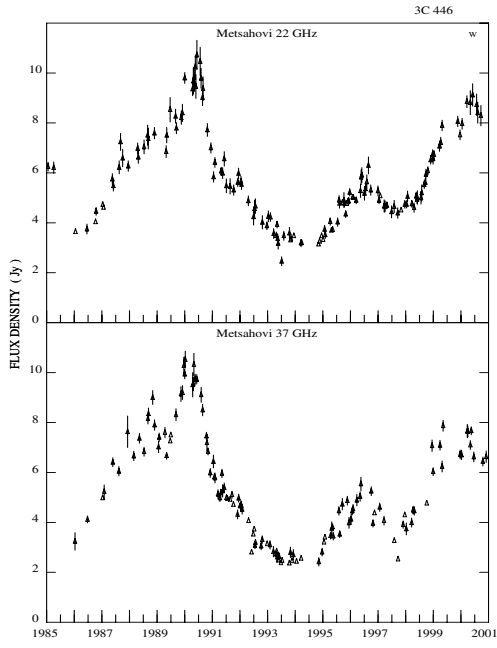


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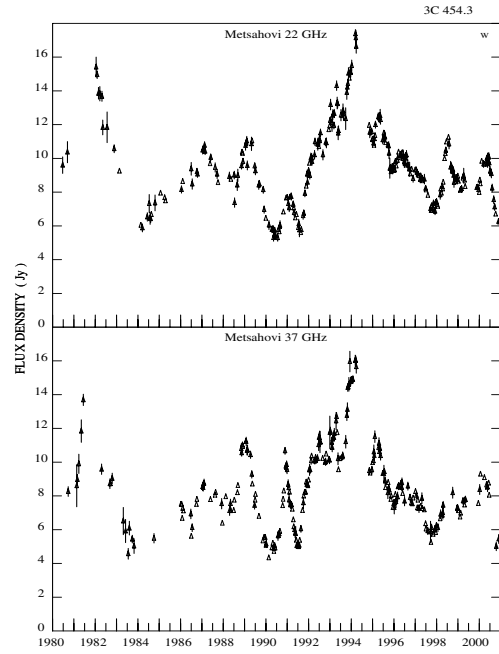


Fig. 1. continued.

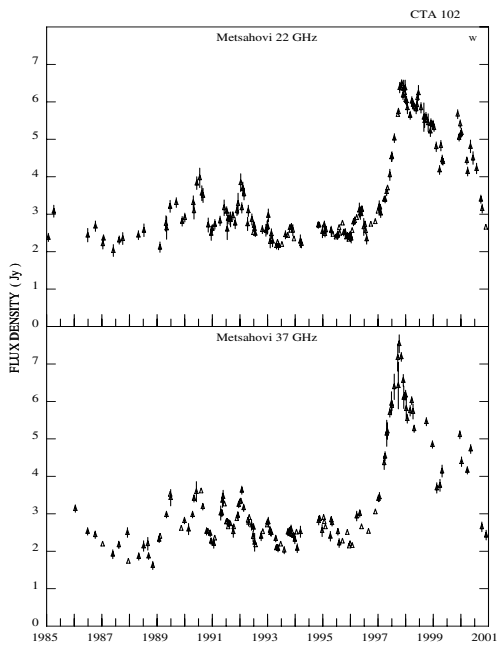


Fig. 1. continued.