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24 year monitoring of extragalactic sources at 22 and 37 GHz⋆,⋆⋆

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Abstract. Long term monitoring results from 2001 to mid 2004 of quasar observations at 22 and 37 GHz done at the Metsähovi radio observatory are presented. Approximately 10 000 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 bands. 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 Northen location of the antenna (latitude = 60 N) limits the observed sources to those with declination higher than −5 degrees, with some exeptions. The sensitivity of the antenna, receivers and time spent in the observations limit the yearly observations to fewer than 5000. The source list was expanded after the year 2000, partly as a result of selecting new flat spectrum sources for monitoring prior to the next gamma-ray observatories AGILE and GLAST. The present sample will also be an important part of the foreground sources for the PLANCK mission. The stronger sources, which are also used for pointing the antenna, were observed daily, when possible, while the new candidate sources could be observed only a few times yearly to demonstrate their spectra and duty cycle. To succeed in a monthly monitoring of 200 sources one should have a larger antenna and more observing time. A better way to obtain well sampled flux curves would be to have more than one observing station, located preferably on a different continent. Bad weather lasting 1−2 weeks is not unusual at our location.

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, and thus the 87 GHz observations have been discontinued. The receivers at 22 and 37 GHz have HEMPT[1] front ends operating at room temperature. The total noise temperatures are in the range of 200−300 K DSB[2], 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 a dual beam mode.

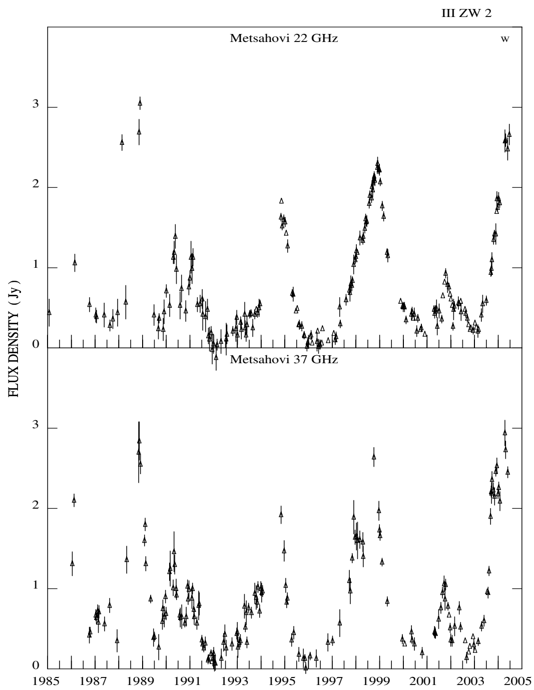

Fig. 1. Weekly mean flux density of observed sources at 22 and 37 GHz.

⋆ Table 1 and full Fig. 1 are only available in electronic form at http://www.edpsciences.org

⋆⋆ Catalog 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/440/409

[1] High electron mobility pseudomorphic transistor.

[2] Double side band.

The data reduction is described in more detail in Teräsranta et al. (1998).

3. Final remarks

The number of observations for each source is shown in Table 1. The data until the end of 2000 were published in Salonen et al. (1987), Teräsranta et al. (1987, 1992, 1998, 2003). The fluxes of BL Lac and AO 0235+164 have been published by Villata et al. (2004) and Raiteri et al. (2004), but will be shown here for completeness. The weekly mean fluxes of the 53 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 2001 to mid 2004 is published in Table 2 only at the CDS via anonymous ftp. The format Table 2 is: 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 data have been anylysed as in Valtaoja et al. (1988), Valtaoja et al. (1992) and numerous other publications.

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Online Material

Table 1. Number of observations at each frequency.

Source	n22	n37	total
III ZW 2	74	61	135
0007+171	8	6	14
0009+081	8	5	13
0017+200	8	4	12
0026+346	7	5	12
0035+413	5	4	9
0055+300	6	2	8
0059+581	116	87	203
OC 012	37	31	68
0109+224	34	26	60
0111+021	5	4	9
0119+115	6	5	11
0119+247	5	4	9
0119+041	6	4	10
DA 55	113	86	199
0146+056	5	6	11
0149+218	27	14	41
0201+113	5	4	9
0202+149	28	26	54
0212+735	16	9	25
0215+015	3	3	6
0218+35	8	1	9
0219+428	55	43	98
0221+067	7	7	14
0224+671	15	10	25
0229+13	6	5	11
0234+285	30	22	52
AO 0235+164	81	83	164
0237+040	5	4	9
0239+108	7	5	12
0256+075	5	3	8
0301+336	7	2	9
0306+102	10	6	16
3C 84	147	101	248
0319+121	8	5	13
0322+222	7	7	14
NRAO 140	28	20	48
0336-01	28	25	53
NRAO 150	82	50	132
3C 111	44	22	66
OA 129	106	79	185
0422+004	35	24	59
0429+415	10	5	15
3C 120	87	75	162
0430+289	4	0	4
0440-00	13	12	25
0446+11	33	25	58
0454+066	8	4	12
0458-020	1	0	1
0459+060	9	6	15
0500+019	7	2	9
0502+049	7	4	11
0528+134	111	70	181
0539-057	2	2	4
DA 193	54	28	82
0605-08	13	8	21
OH 471	56	27	83

Table 1. continued.

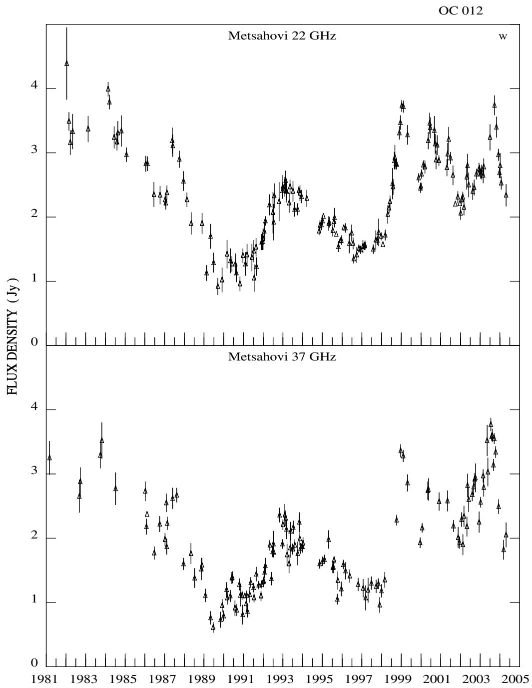
Source	n22	n37	total
0707+476	9	3	12
0710+439	9	4	13
0716+714	61	60	121
PKS 0735+17	58	45	103
0736+01	43	28	71
0738+313	9	5	14
0745+241	8	5	13
0746+483	6	2	8
0749+540	6	2	8
OI 090.4	40	30	70
0759+183	6	4	10
0804+499	53	13	66
0812+367	3	3	6
0814+425	52	18	70
0820+22	11	5	16
0820+560	3	2	5
0821+394	7	3	10
0823+033	7	4	11
0827+243	38	24	62
0829+046	20	10	30
0833+585	5	1	6
0834+250	5	3	8
0836+710	59	55	114
0839+187	6	3	9
0850+581	2	2	4
0850-1213	6	2	8
OJ 287	151	101	252
0859+470	8	3	11
0906+015	19	14	33
3C 216	23	11	34
0912+029	8	6	14
0917+449	20	7	27
0917+624	5	2	7
4C 39.25	167	91	258
0945+40	47	25	72
0952+179	9	6	15
0953+25	26	19	45
0954+55	27	8	35
0954+658	16	8	24
0955+326	5	2	7
0955+476	8	3	11
1005+141	6	4	10
1012+232	8	6	14
1020+400	7	2	9
1022+194	7	8	15
1030+415	6	1	7
1038+528	6	1	7
1038+064	8	8	16
1042+178	8	4	12
1049+21	12	9	21
1053+704	3	2	5
OL 093	63	44	107
1055+201	4	4	8
1058+726	4	3	7
Mark 421	118	52	170
1127-145	0	1	1

Table 1. continued.

Source	n22	n37	total
1128+385	4	2	6
1144+402	7	3	10
1147+24	13	10	23
1150+497	16	3	19
4C 29.45	83	66	149
1216+487	6	3	9
ON 231	47	38	85
1219+044	6	4	10
1222+216	53	27	80
1222+037	6	3	9
3C 273	148	102	250
1229-021	0	2	2
1237+049	1	1	2
1252+119	8	4	12
3C 279	135	104	239
1308+326	69	56	125
1324+224	27	21	48
1327+321	6	4	10
1330+022	7	3	10
1331+170	2	1	3
1334-127	17	19	36
1347+539	6	2	8
1402+044	6	7	13
1406-076	0	2	2
1413+135	48	30	78
1417+385	7	2	9
OQ 530	37	35	72
1427+543	8	3	11
1444+175	6	7	13
1456+044	7	7	14
1457+338	3	2	5
OR 103	35	29	64
1504+377	9	3	12
1510-089	82	75	157
1514+004	11	7	18
1532+016	10	7	17
4C 14.60	42	33	75
1546+027	13	7	20
1547+507	6	2	8
1548+05	8	4	12
1604+159	5	4	9
1606+106	62	49	111
1611+343	39	25	64
4C 38.41	117	103	220
OS 562	15	16	31
1636+473	6	6	12
1638+398	6	5	11
1640+254	6	5	11
3C 345	138	127	265
1642+69	4	2	6
1648+015	5	4	9
1652+398	57	48	105
1655+077	12	8	20
1656+482	4	2	6
1656+477	6	3	9
1717+178	5	5	10

Table 2. continued.

Source	n22	n37	total
1722+401	4	5	9
1725+044	11	6	17
1730-130	30	25	55
1732+389	4	6	10
1738+499	3	4	7
1739+522	24	12	36
1741-03	64	67	131
1743+173	8	4	12
1749+096	119	101	220
1749+701	4	2	6
1751+288	1	4	5
1758+388	2	5	7
1803+784	13	13	26
3C 371	12	12	24
1809+568	1	2	3
1811+430	2	3	5
1823+56	11	5	16
1849+670	5	6	11
1856+737	3	2	5
1928+738	15	13	28
1936+714	4	2	6
2005+40	35	29	64
2010+723	6	3	9
2022-077	11	5	16
2022+171	32	23	55
2032+107	9	6	15
2059+034	7	4	11
2121+053	16	9	25
OX 057	35	36	71
OX 161	9	6	15
OX 169	8	7	15
2145+067	115	94	209
2149+069	5	3	8
2150+173	7	5	12
BL Lac	208	170	378
2201+315	65	44	109
2201+171	7	8	15
2209+184	30	17	47
2209+236	6	5	11
2223+210	7	7	14
3C 446	41	39	80
CTA 102	22	21	43
2234+282	20	9	29
2245+029	3	3	6
2246+208	7	5	12
2250+194	3	3	6
2251+134	5	5	10
3C 454.3	101	95	196
2259+371	14	5	19
2318+049	5	4	9
2320+079	4	4	8
2320-035	8	9	17
2325+093	5	3	8
2331+073	4	3	7
2344+092	6	2	8
2346+385	13	4	17
2351+456	13	6	19
2356+196	1	1	2



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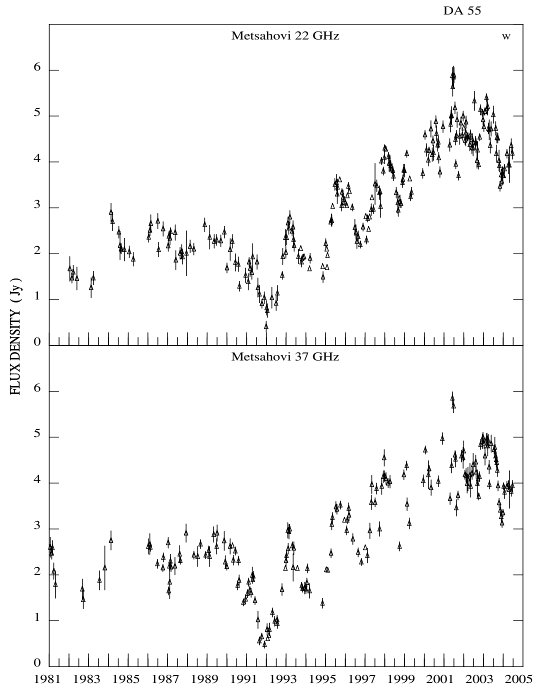

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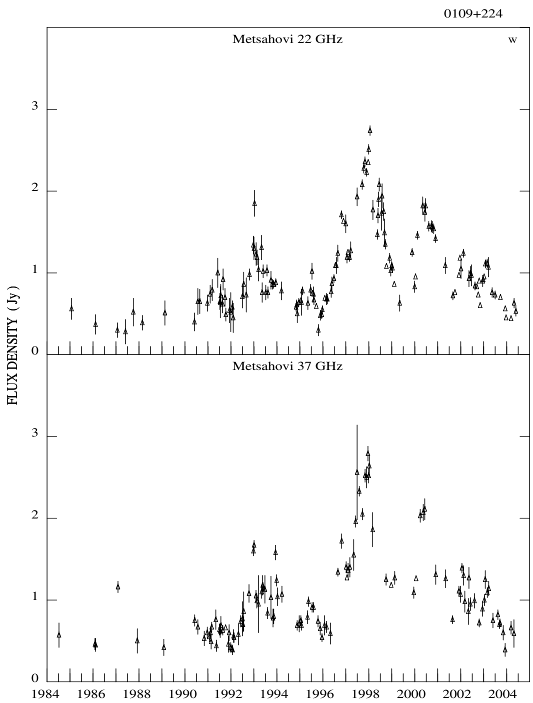

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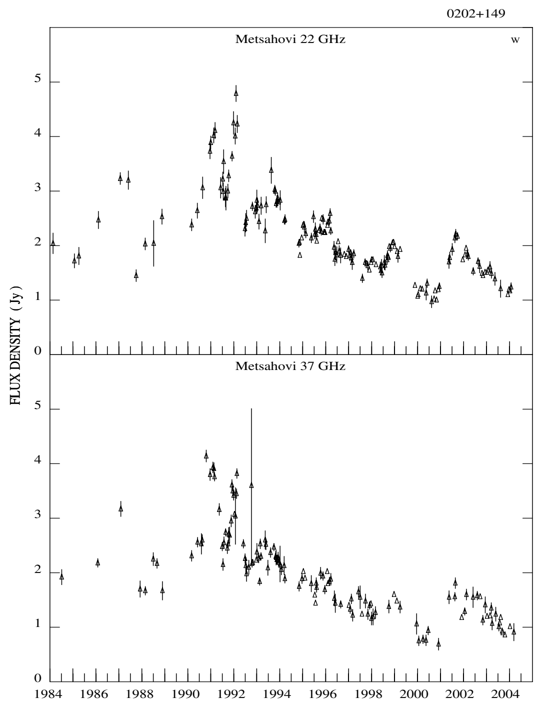

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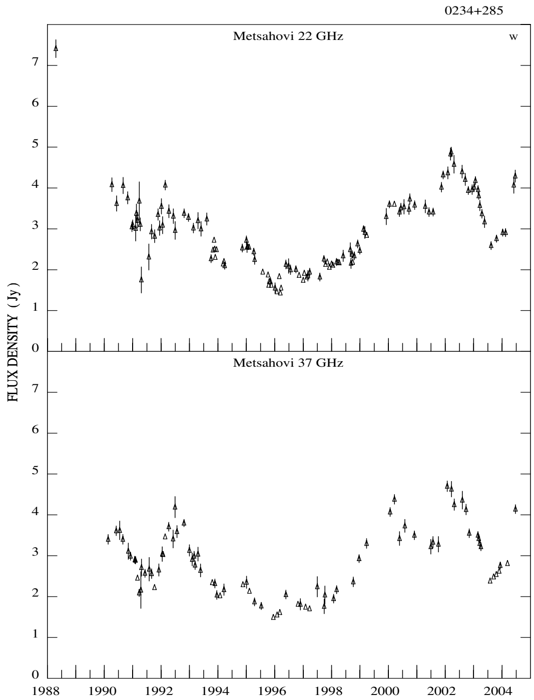

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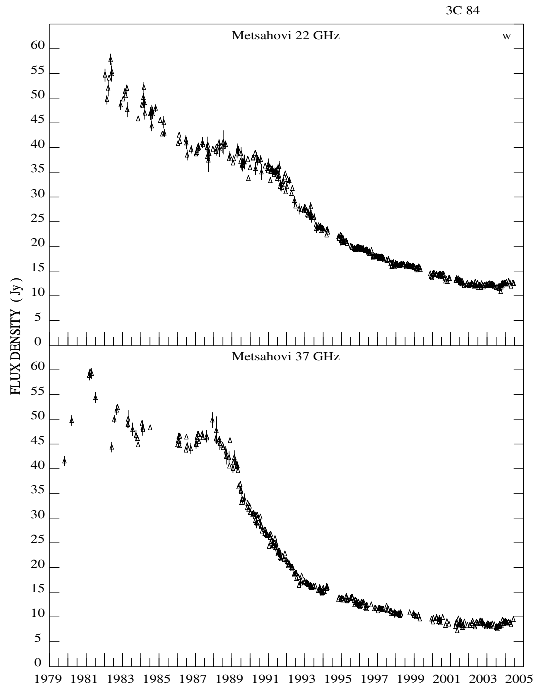

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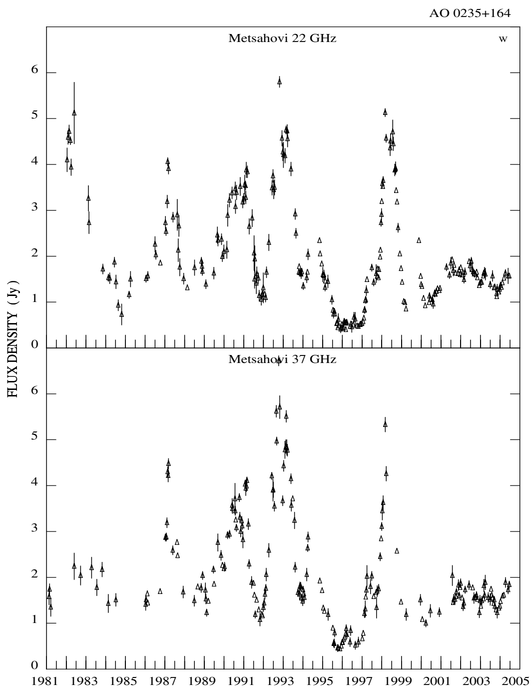

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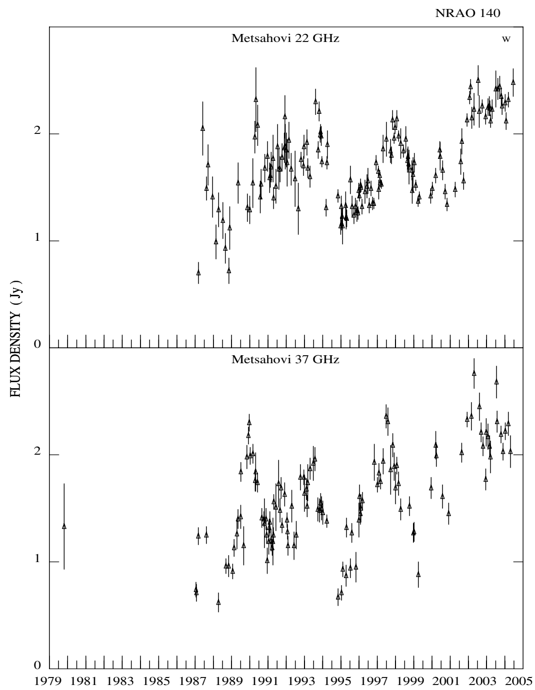

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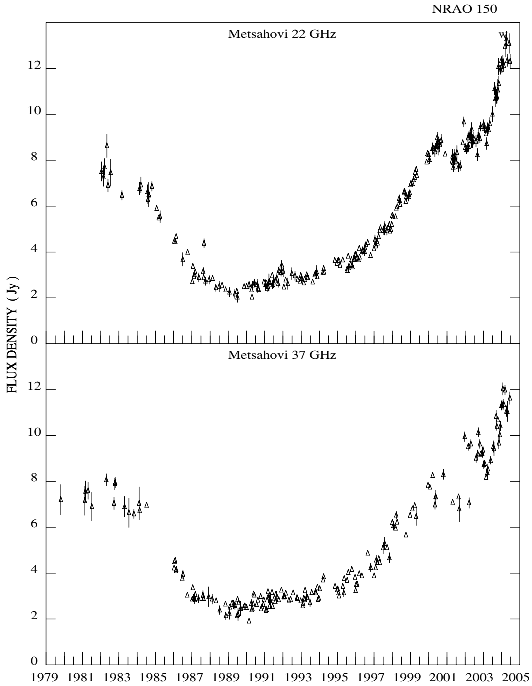

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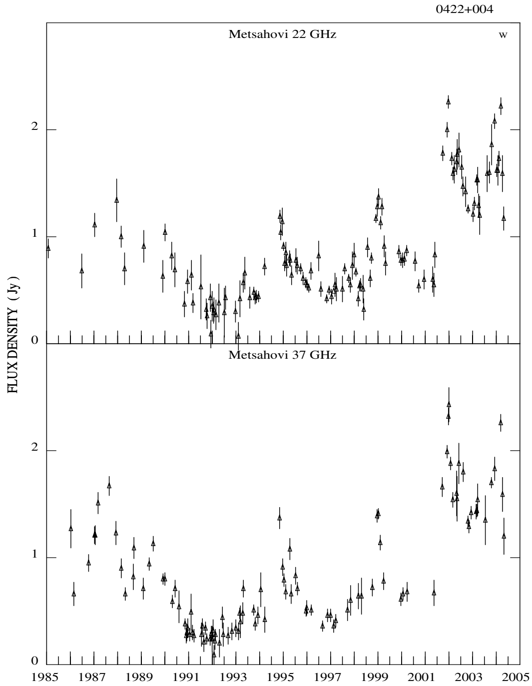

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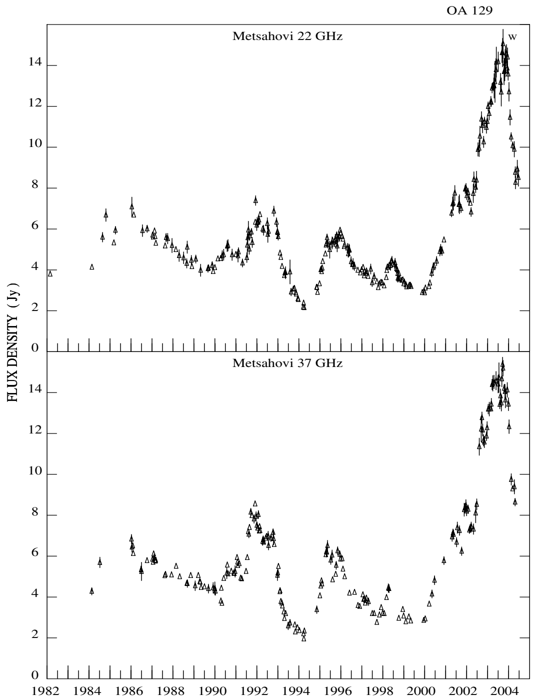

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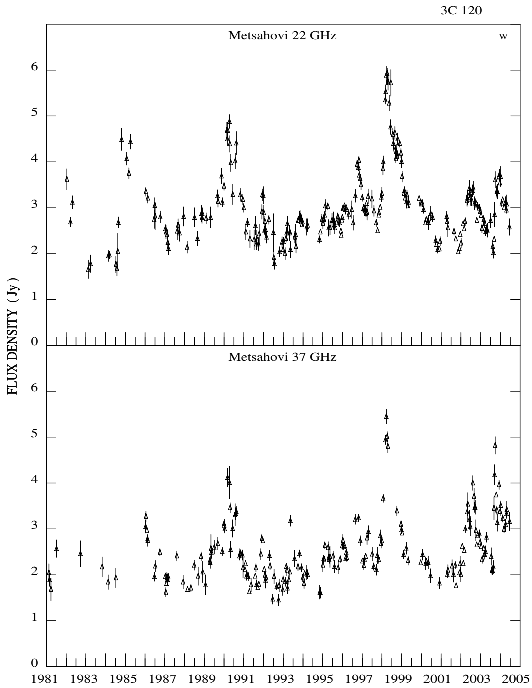

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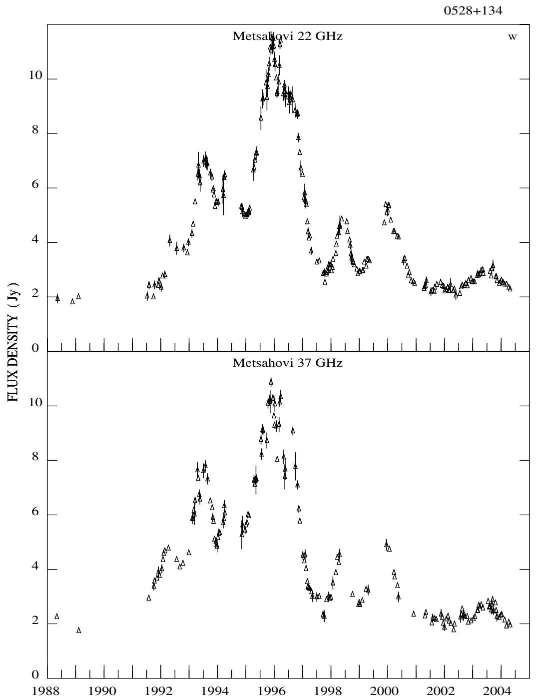

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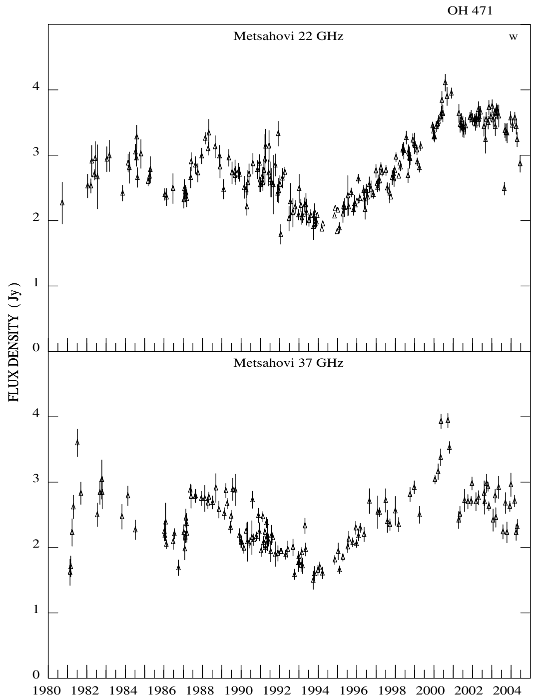

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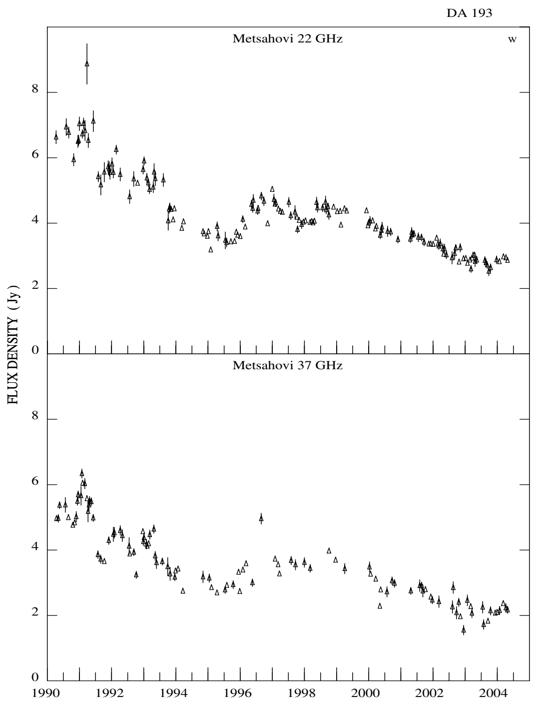

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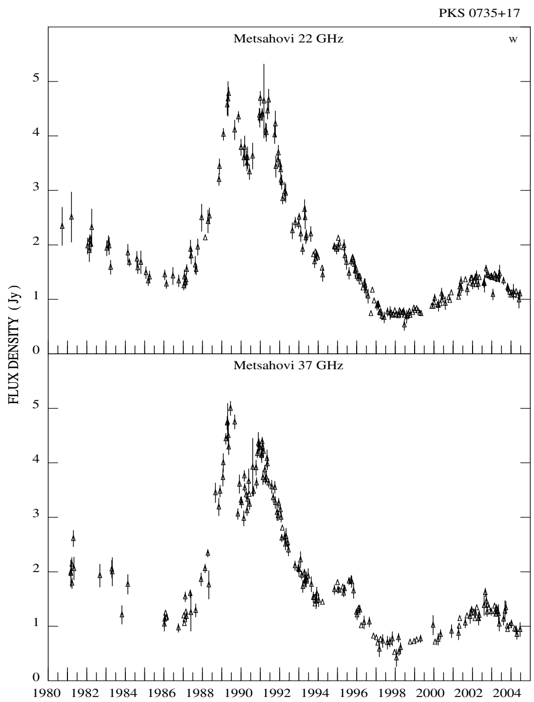

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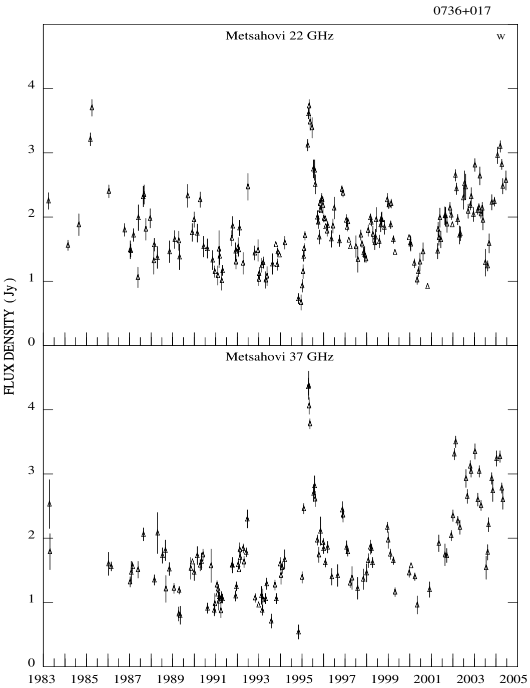

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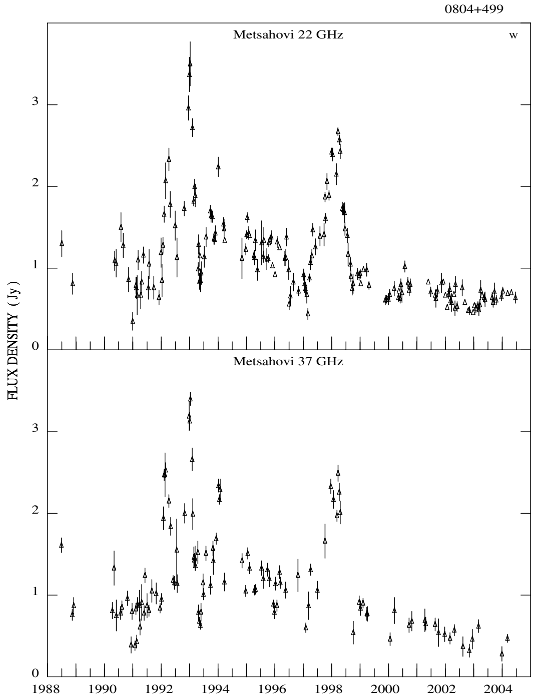

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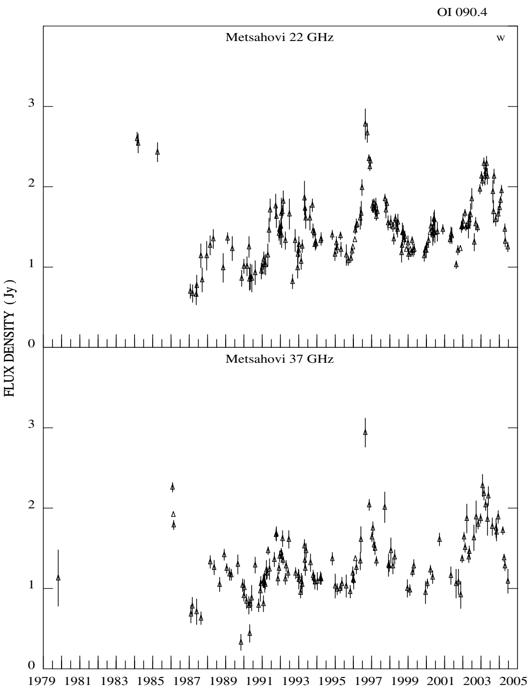

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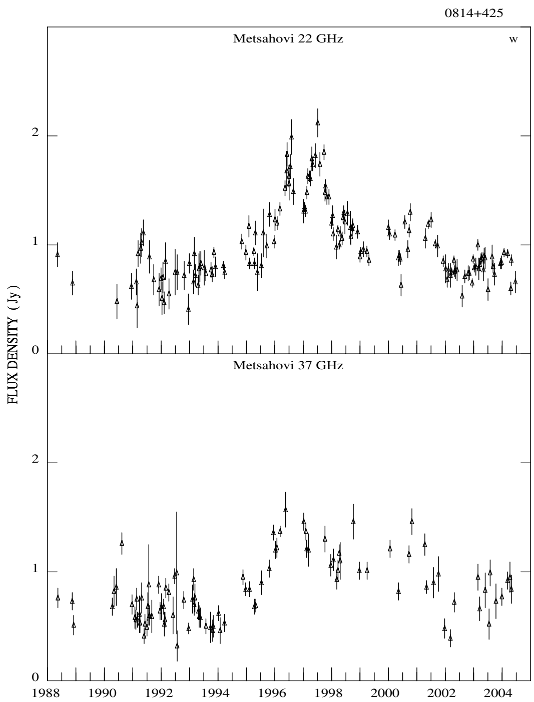

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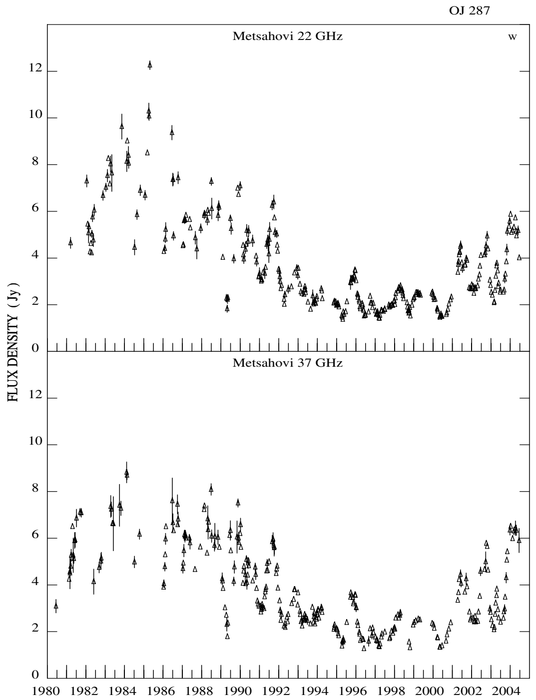

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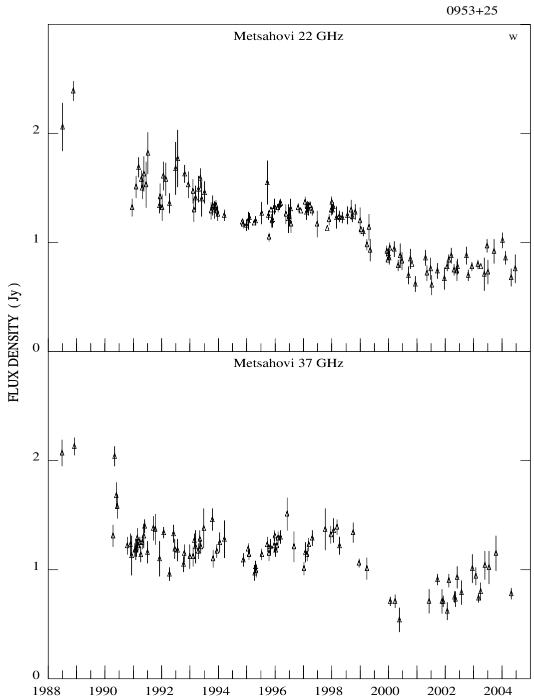

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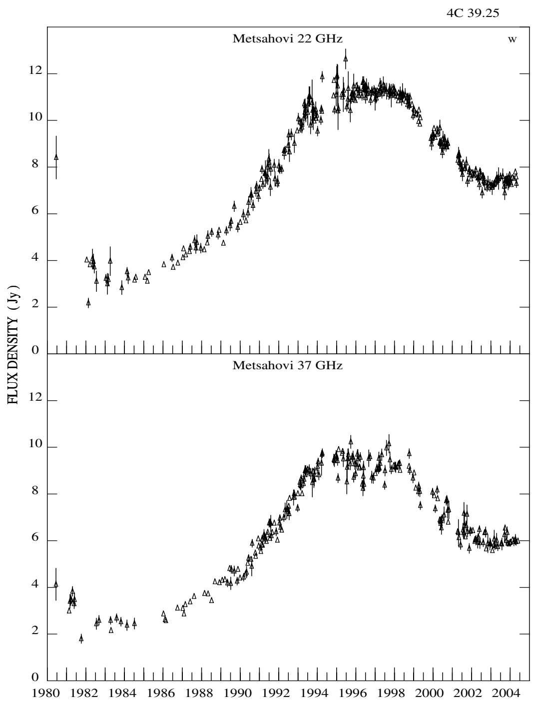

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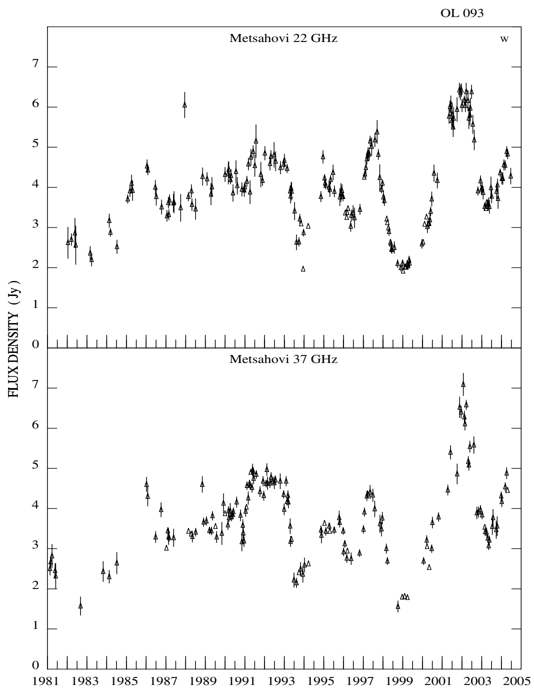

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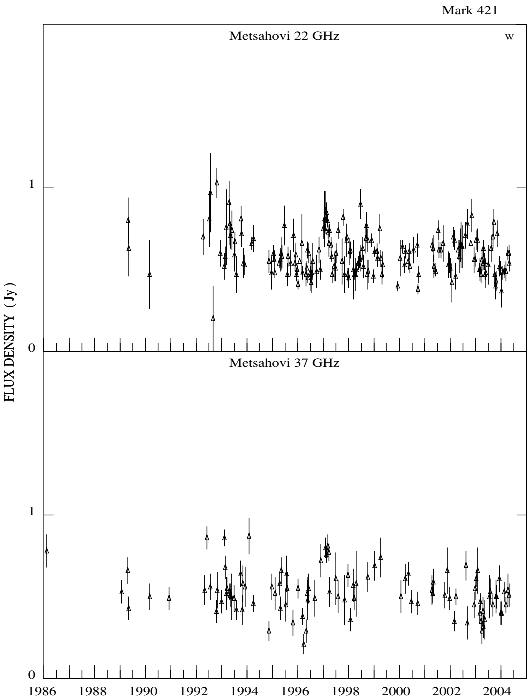

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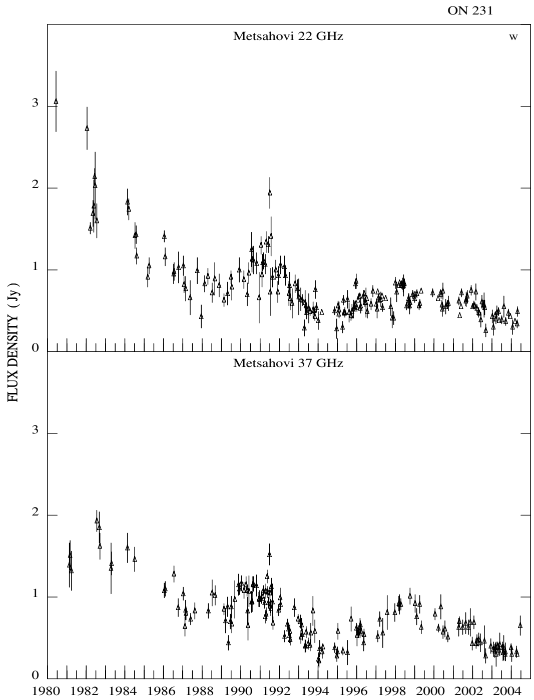

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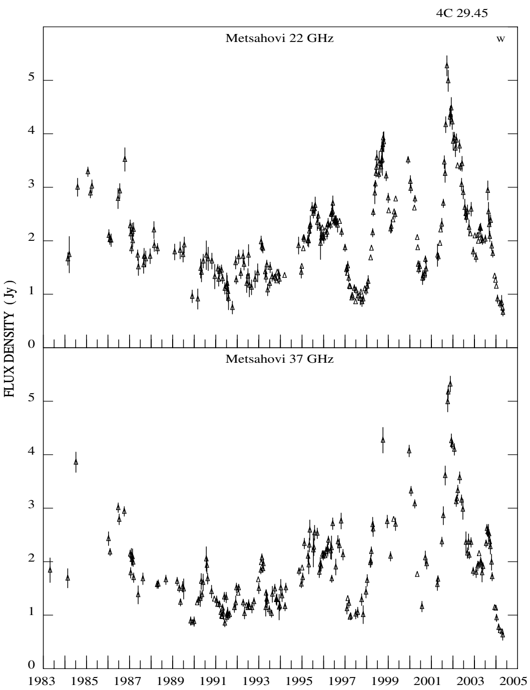

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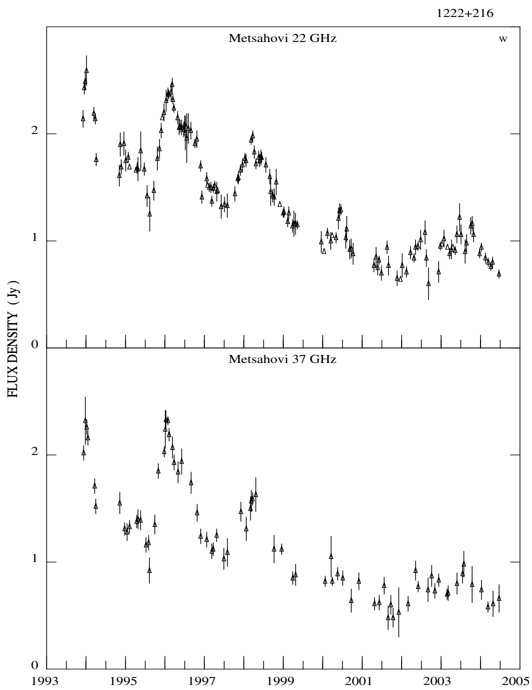

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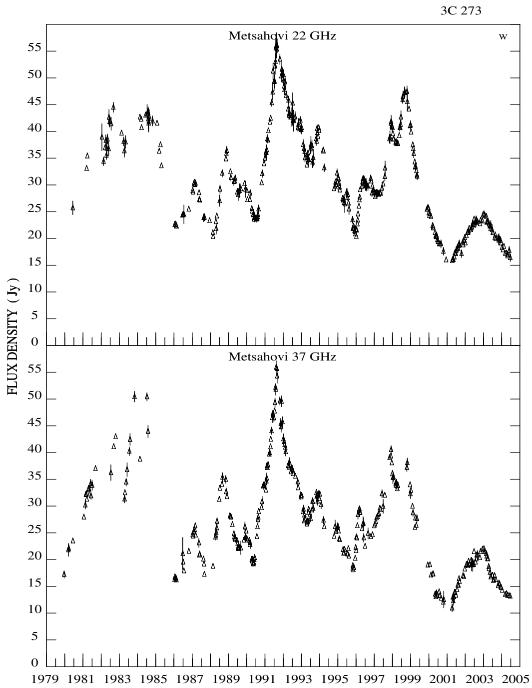

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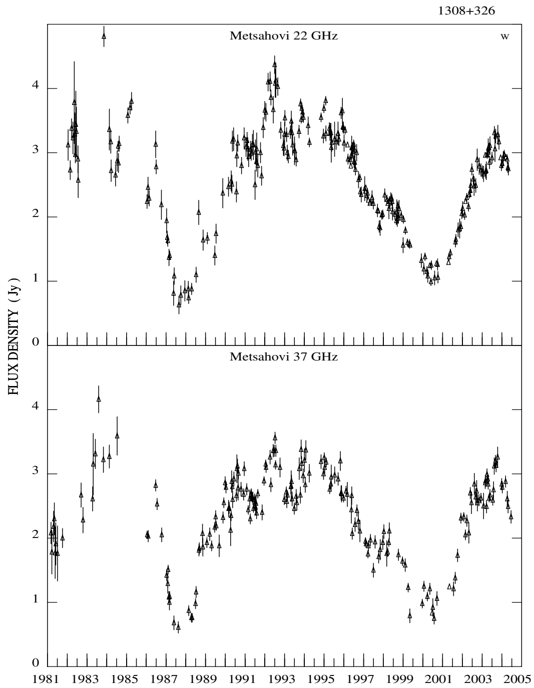

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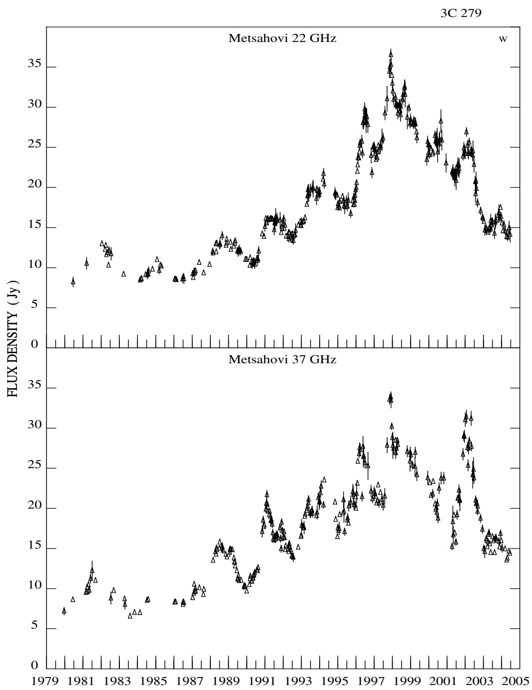

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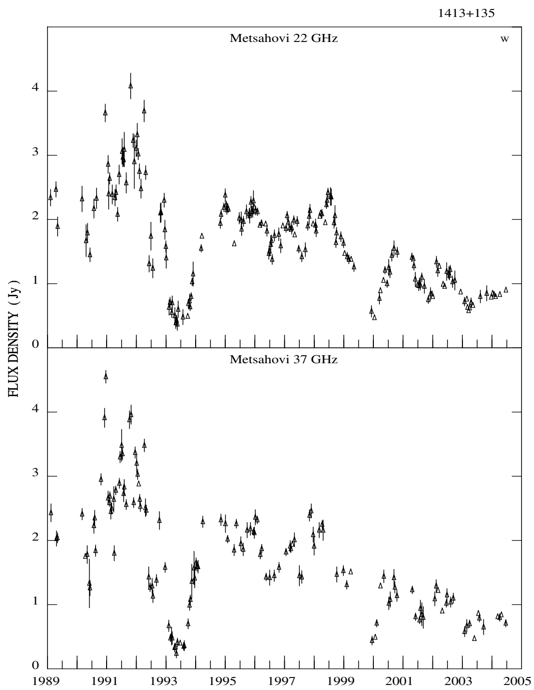

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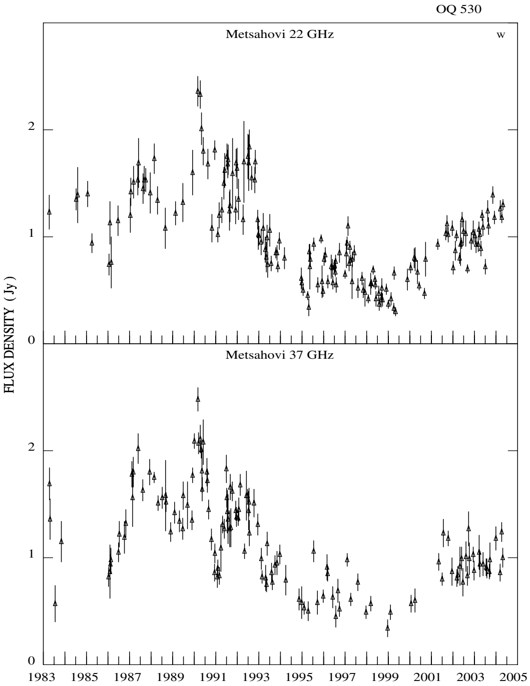

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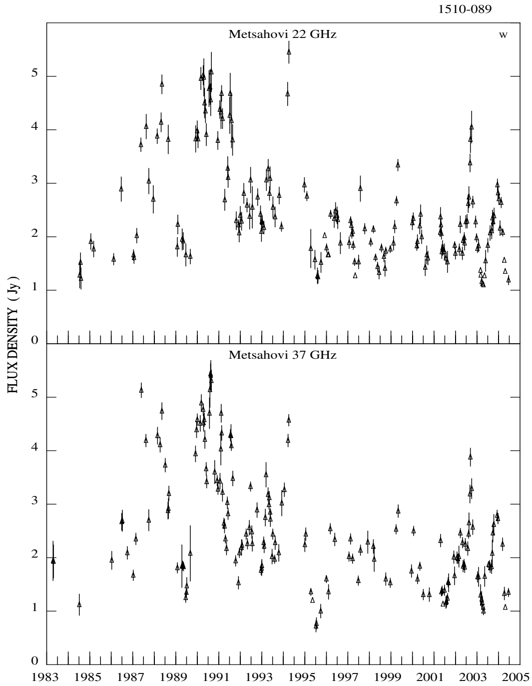

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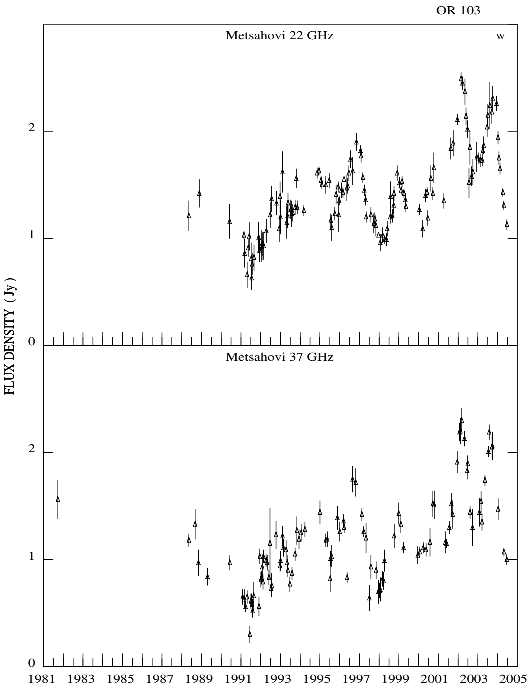

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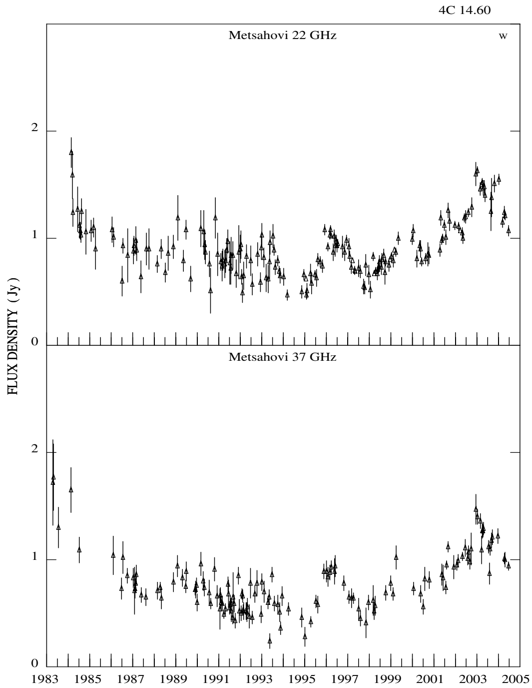

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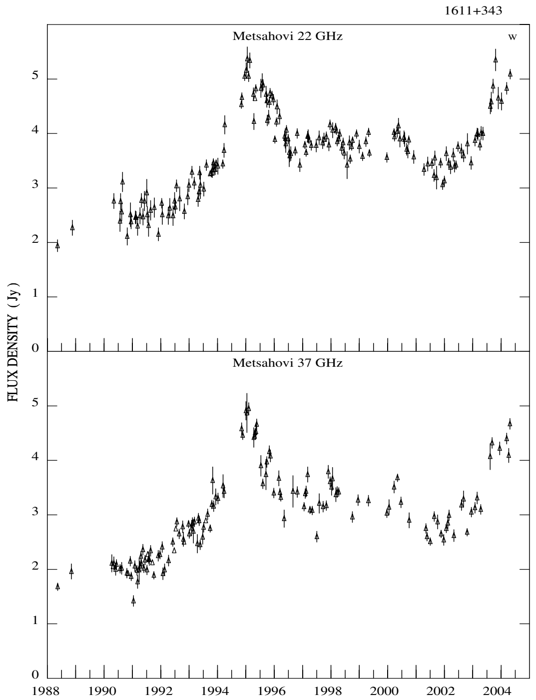

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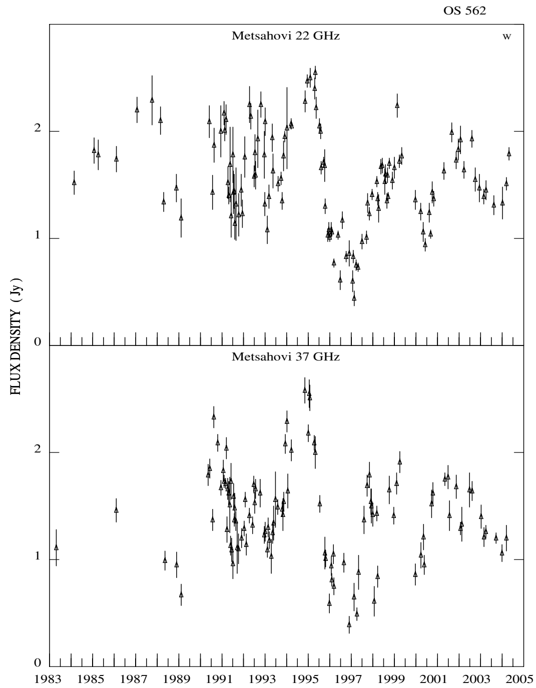

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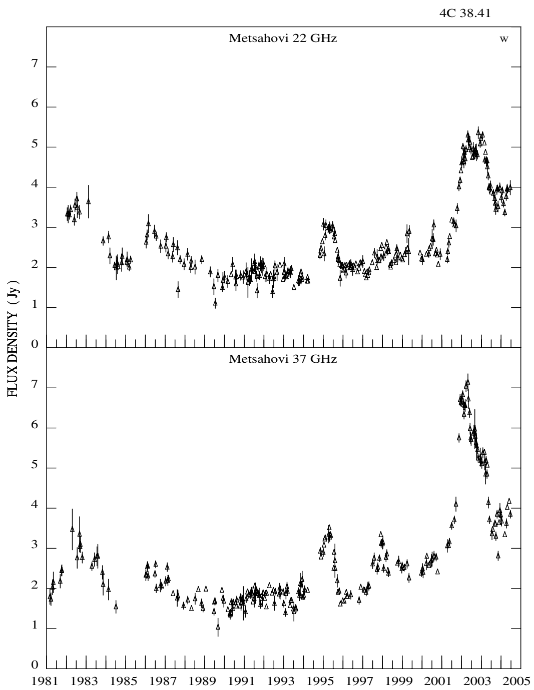

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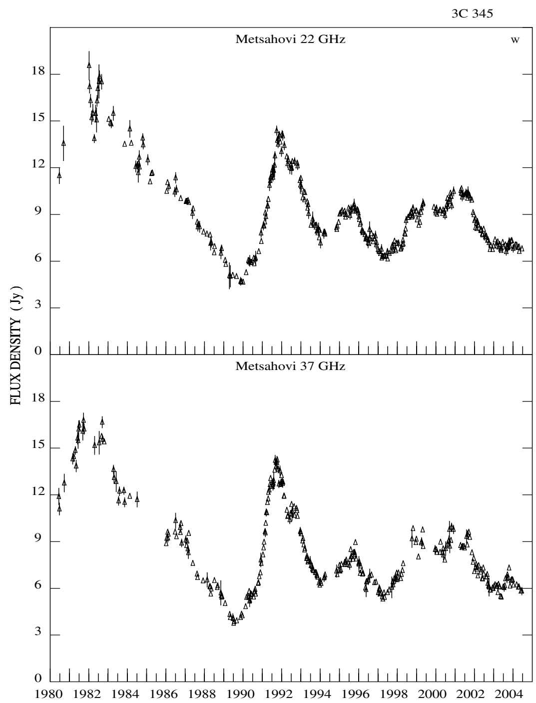

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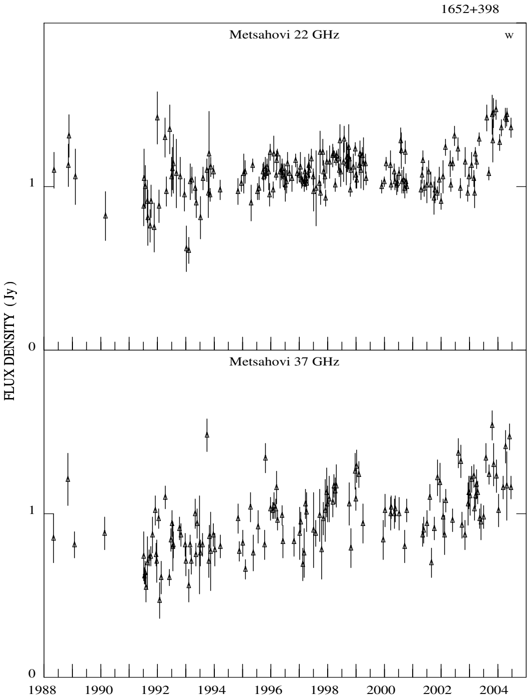

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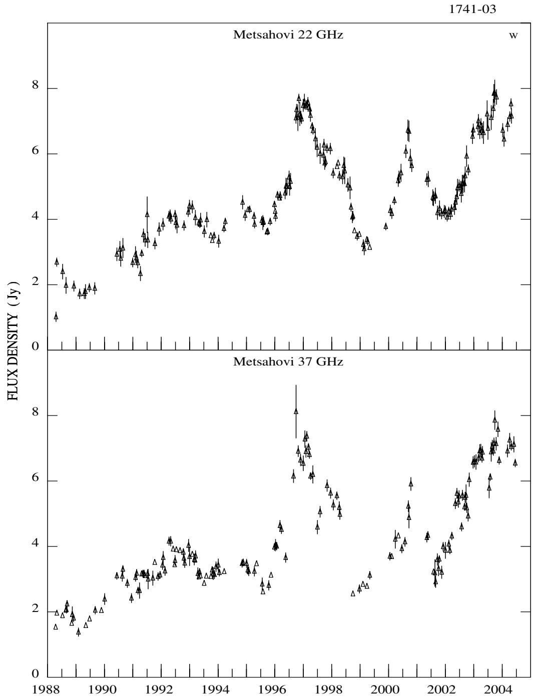

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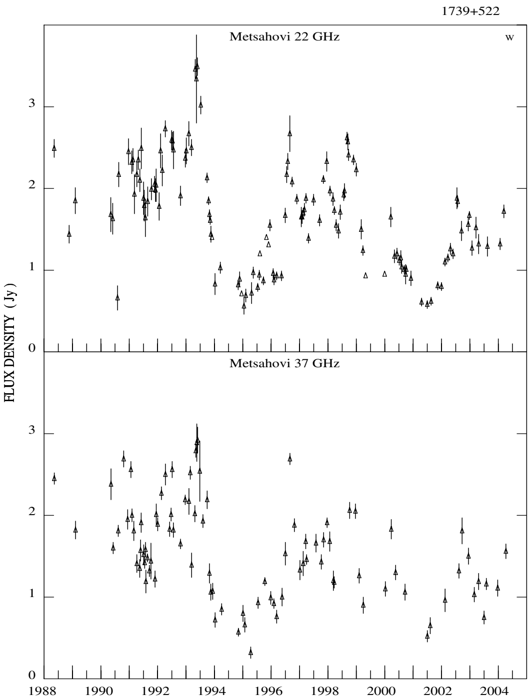

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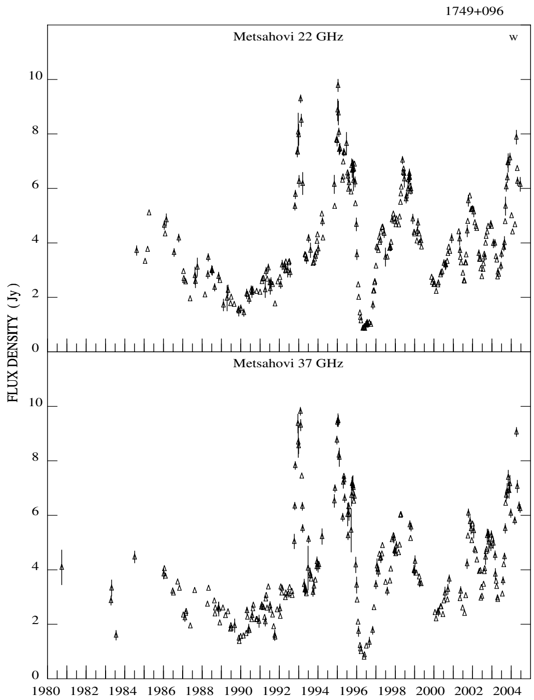

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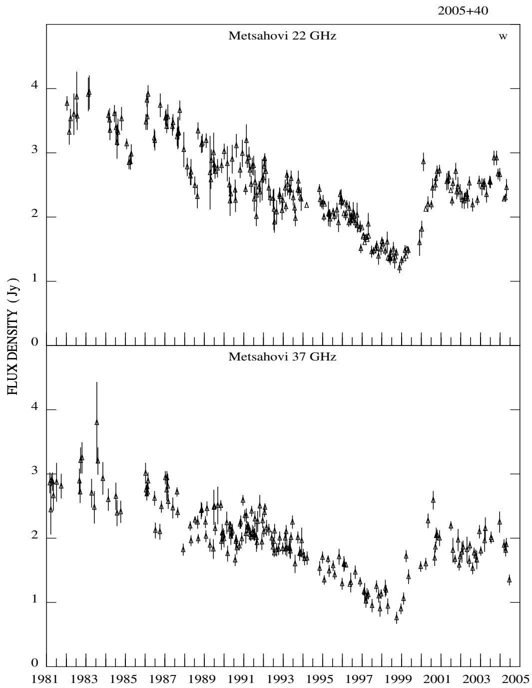

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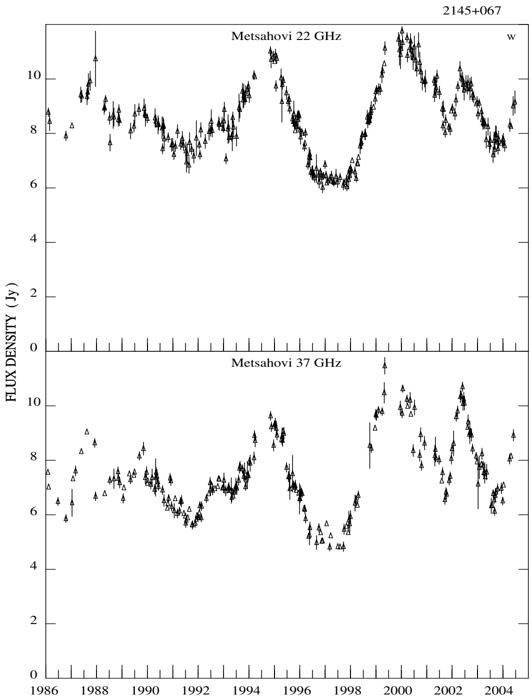

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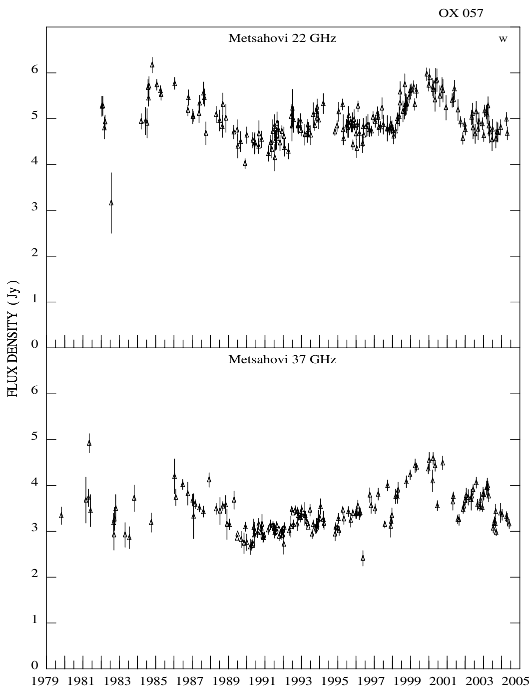

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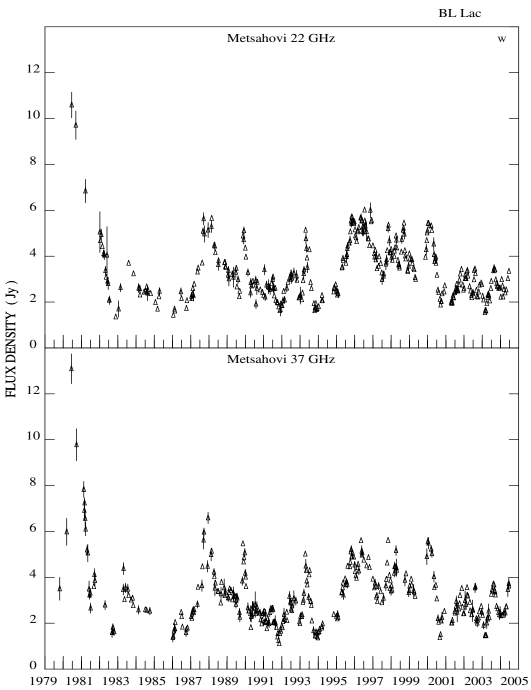

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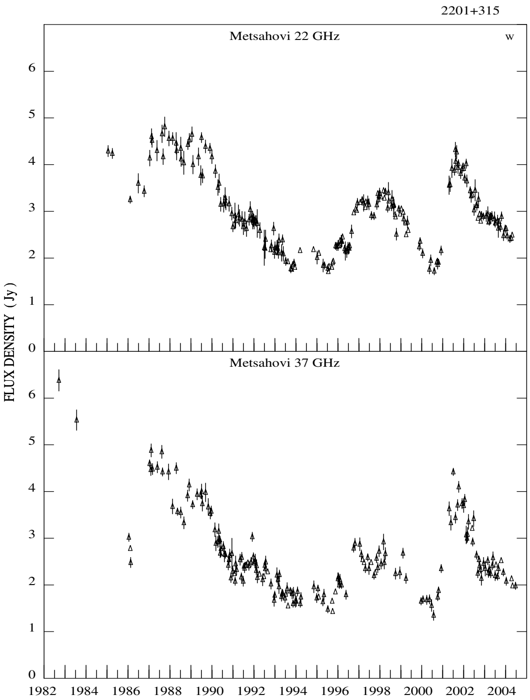

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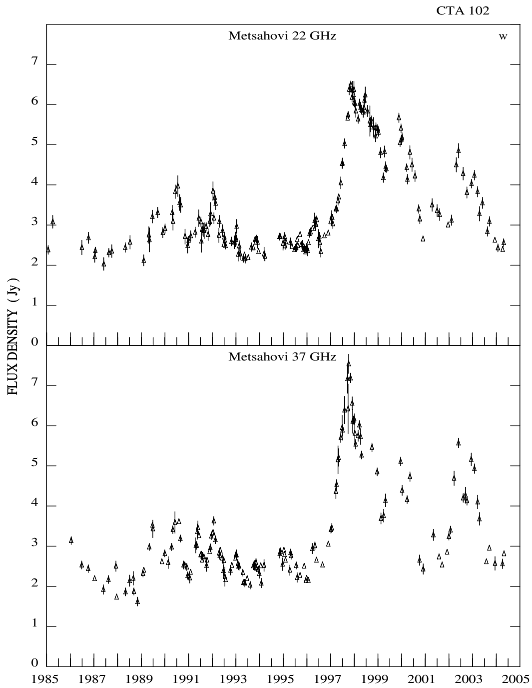

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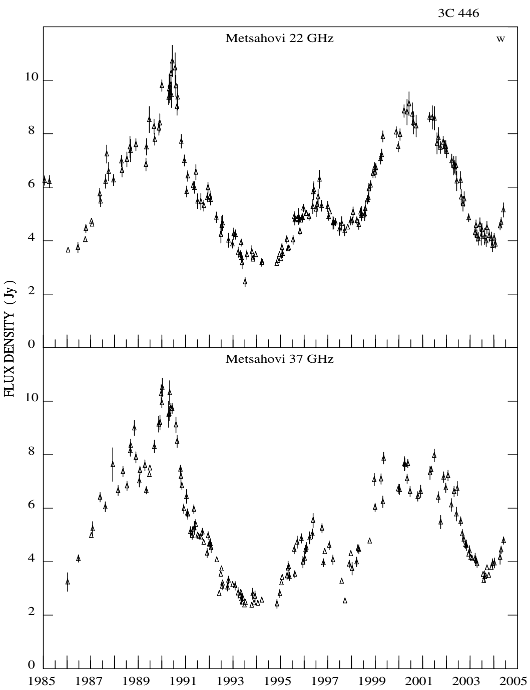

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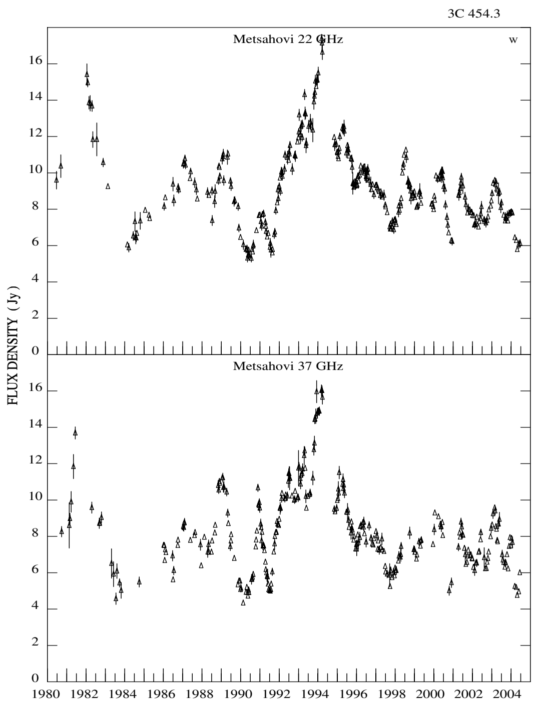

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