
LBWG memo 31

LBA calibrator observations

Neal Jackson, 22.06.22

The LBCS survey provides calibrator information for the international baselines only in the high-band. It is uncertain how many sources can be used as LBA calibrators. Hence, 128 sources were observed within a 35 degree radius of the bright calibrator 3C196, to determine whether fringes could be detected between the phased core ST001 and each of the international baselines. All of the sources were good LBCS calibrators; that is, code 'P' on all, or nearly all, antennas, and $>1.5\text{Jy}$ LoTSS flux in the high band. All such sources were observed. We had previously tried and failed to detect a 1.5-Jy LBCS calibrator with the LBA during a busy week, which provided the motivation for these observations.

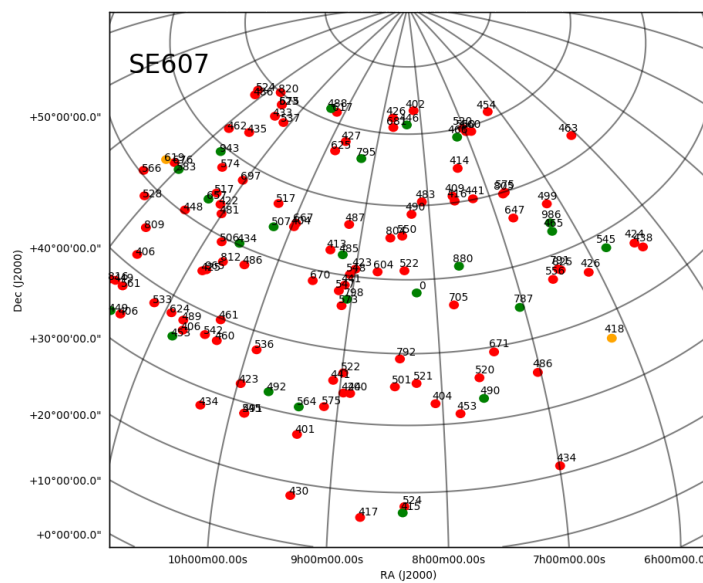
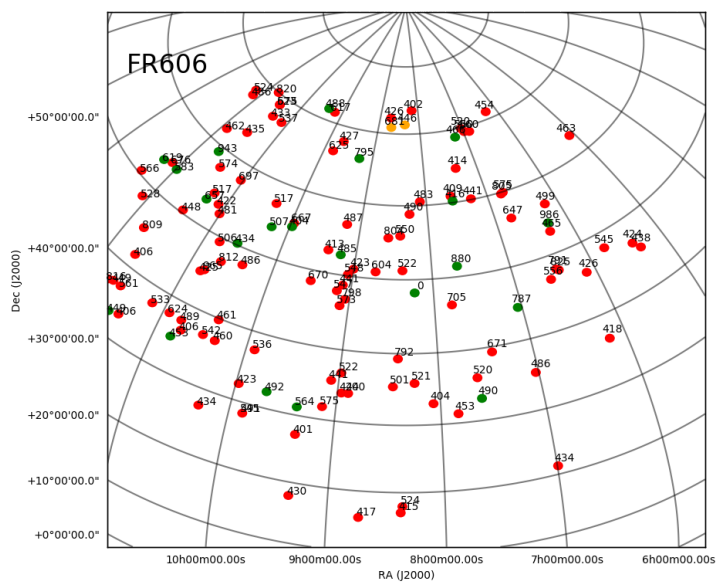
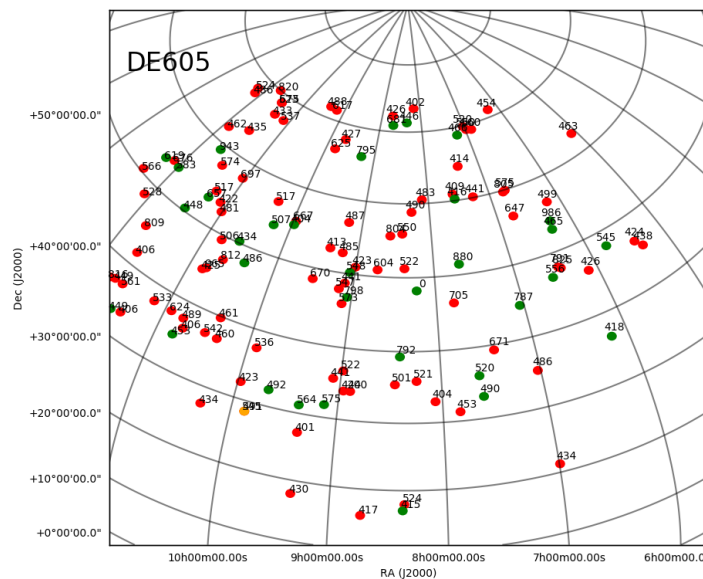
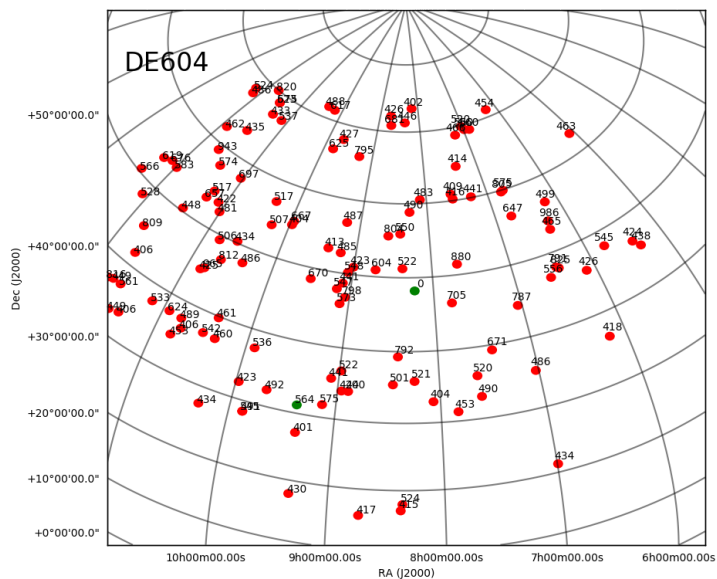
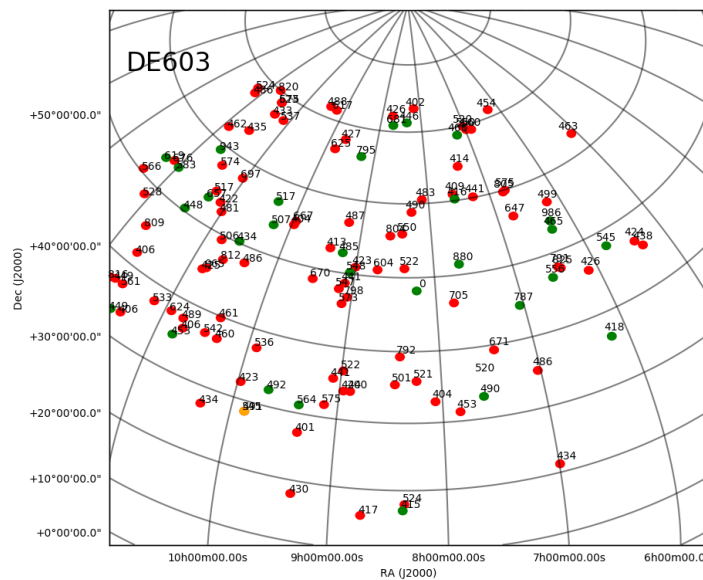
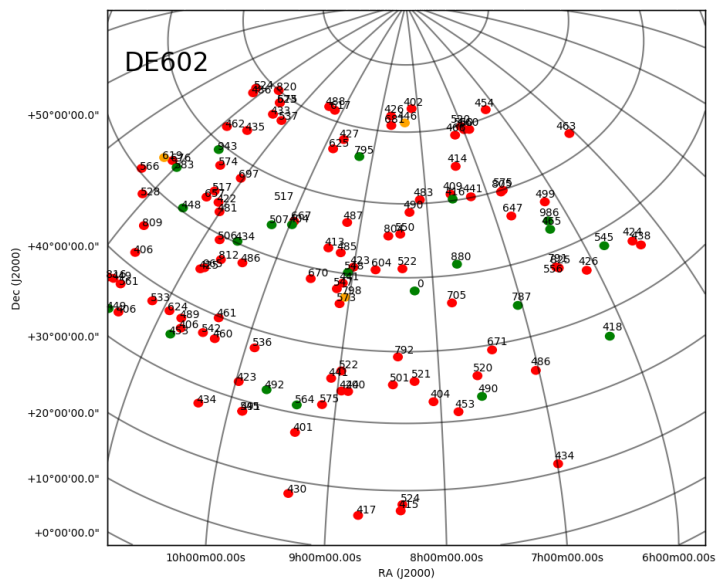
Observations were done on 2022 April 8-9, with half an hour on each source and 10 MHz of bandwidth. The data were corrected to circular polarization, read into AIPS and chunks of 5 minutes, with 64 48 kHz channels, from each observation were analysed using the standard LBCS processing with the following exceptions:

- solution interval of 18 seconds, to account for the generally lower S:N
- no delay search window, because of the generally larger delays
- required SNR per solution of 4 instead of 2.

The results are shown in figure 1 per antenna. Sources are coloured green, orange and red for P, S and X codes, here in the low-band at approximately 50 MHz. The numbers by the sources represent implied compact source flux on 250-km baselines with the HBA. It appears that there are about 30 usable calibrators in this area of about 3500 square degrees, reducing to 10 for the more distant stations, i.e. of order 0.01 per square degree. DE604 appeared not to work well, and DE601 did not participate in the observations.

Standard LBCS data products (the fringe-rate/delay maps and png files of the phase vs frequency/time and solution plots) are available on the Hertfordshire cluster under `/data/lofar/lbcs/lbacal`.

Table 2 shows the results of the analysis by source. The format is the same as for the high-band LBCS table (Jackson et al. 2016, 2022).



L336640	05:05:46.21	62:42:33.1	2022-04-08	15:14:09	-XXXXXXXXXXXX	0	-350800080000	0	76.442542	62.709194
L336648	05:20:47.51	45:28:35.0	2022-04-09	15:14:09	-XXXXXXXXXXXX	0	-120924090011	14	80.197958	45.476389
L336674	05:24:42.88	46:31:39.7	2022-04-08	20:19:09	-XXXXXXXXXXXX	0	-020200030000	12	81.178667	46.527694
L336980	05:46:04.16	47:55:29.6	2022-04-09	17:16:09	-PPXPXPXPXXXX	0	-480936091010	12	86.517333	47.924889
L336058	06:07:10.99	46:01:59.9	2022-04-08	15:14:09	-XXXXXXXXXXXX	0	-020301020000	0	91.795792	46.033306
L448456	06:10:57.07	36:34:31.6	2022-04-09	18:17:09	-PPXPXSXPXXXX	0	-990968291000	62	92.737792	36.575444
L337200	06:11:58.20	56:33:11.0	2022-04-08	16:15:09	-XXXXXXXXXXXX	0	-140411040000	12	92.9925	56.553056
L448572	06:15:36.01	71:02:15.1	2022-04-09	19:18:09	-XXXXXXXXXXXX	0	-000100020000	0	93.900042	71.037528
L337084	06:17:33.26	54:04:26.3	2022-04-08	16:15:09	-PPXP PPPPPPPP	0	-793999999799	12	94.388583	54.073972
L337098	06:19:07.60	52:55:51.8	2022-04-09	16:15:09	-PPXPXPXPXXXX	0	-991949496332	44	94.781667	52.931056
L336318	06:25:46.82	47:44:04.6	2022-04-08	18:17:09	-XXXXXXXXXXXX	0	-010901060000	37	96.445083	47.734611
L336334	06:27:22.67	47:58:46.2	2022-04-09	20:19:09	-XXXXXXXXXXXX	0	-010401060000	0	96.844458	47.979500
L336336	06:33:52.12	46:53:39.8	2022-04-08	21:20:09	-DPXPXPXPXXXX	0	-786911292100	37	98.467167	46.894389
L336146	06:44:04.67	59:55:21.1	2022-04-09	21:20:09	-XXXXXXXXXXXX	0	-000602060000	12	101.019458	59.922528
L336188	06:45:46.77	56:17:50.8	2022-04-08	21:20:09	-XXXXXXXXXXXX	0	-120421040000	37	101.444875	56.297444
L336152	06:46:20.69	59:46:26.4	2022-04-09	17:16:09	-XXXXXXXXXXXX	0	-230832040110	12	101.586208	59.774000
L759125	06:51:54.94	69:11:12.8	2022-04-08	17:16:09	-XXXXXXXXXXXX	0	-020421030000	37	102.978917	69.186889
L758389	06:58:46.52	69:20:50.0	2022-04-09	15:14:09	-XXXXXXXXXXXX	0	-140214061211	14	104.693833	69.347222
L589127	06:59:37.81	21:17:42.2	2022-04-08	19:18:09	-XXXXXXXXXXXX	0	-000100010000	25	104.907542	21.295056
L758393	07:01:27.15	69:51:50.4	2022-04-09	20:19:09	-XXXXXXXXXXXX	0	-000200000000	0	105.363125	69.864000
L448258	07:01:45.66	35:18:16.3	2022-04-08	15:14:09	-XXXXXXXXXXXX	0	-240901090010	0	105.44025	35.304528
L685398	07:02:53.63	44:31:11.9	2022-04-09	15:14:09	-PPXP PPPPPPPD	0	-993989796776	14	105.723458	44.519972
L758363	07:13:14.15	68:52:08.3	2022-04-08	18:17:09	-XPXP PPPPPPPX	0	-192999997090	37	108.308958	68.868972
L336608	07:16:15.43	60:06:38.9	2022-04-09	16:15:09	-XXXXXXXXXXXX	0	-000000000000	44	109.064292	60.110806
L335952	07:23:30.89	64:34:47.0	2022-04-08	15:14:09	-XXXXXXXXXXXX	0	-470803272001	0	110.878708	64.579722
L758925	07:25:50.06	39:17:24.4	2022-04-09	19:18:09	-XXXXXXXXXXXX	0	-000200010000	0	111.458583	39.290111
L335966	07:34:18.53	60:12:34.9	2022-04-08	19:18:09	-PPXPXPDP PPPD	0	-990952496663	25	113.577208	60.209694
L335982	07:35:24.16	60:54:58.1	2022-04-09	21:20:09	-XXXXXXXXXXXX	0	-000000000000	12	113.850667	60.916139
L715804	07:35:55.57	33:07:08.7	2022-04-08	19:18:09	-PPXP PPD PDDP	0	-990999797251	25	113.981542	33.119083
L712532	07:37:04.16	36:03:20.1	2022-04-09	16:15:09	-XDXPXPXPXXXX	0	-550923191100	44	114.267333	36.055583
L335484	07:40:17.39	51:25:03.6	2022-04-08	17:16:09	-PPXP PPPPPPPP	0	-990999595543	37	115.072458	51.417667
L335896	07:47:43.63	46:18:58.1	2022-04-09	21:20:09	-XXXXXXXXXPXXXX	0	-220995190304	12	116.931792	46.316139
L715898	07:50:12.33	31:19:47.6	2022-04-08	21:20:09	-XXXXXXXXXXXX	0	-010301040000	37	117.551375	31.329889
L716114	08:04:05.38	32:59:11.7	2022-04-09	22:21:09	-XXXXXXXXXXXX	0	-000000000000	25	121.022417	32.986583
L335042	08:06:15.55	60:30:47.5	2022-04-08	20:19:09	-XXXXXXXXXXXX	0	-000111020000	12	121.564792	60.513194
L712392	08:10:23.00	73:23:15.3	2022-04-09	19:18:09	-XXXXXXXXXXXX	0	-250622040100	0	122.595833	73.387583
L3C196	08:13:36.03	48:13:02.6	2022-04-09	16:15:09	-PPPPPPPPPPPD	0	-999999999997	44	123.400125	48.217378
L759947	08:14:49.01	35:53:48.2	2022-04-08	15:14:09	-XXXXXXXXXXXX	0	-000000000000	0	123.704208	35.896722
L334928	08:16:34.58	58:50:04.8	2022-04-09	22:21:09	-XXXXXXXXXXXX	0	-040401030000	25	124.144083	58.834667
L712388	08:21:30.97	71:19:42.2	2022-04-08	21:20:09	-SPXPSPXPXXXX	0	-492968392020	37	125.379042	71.328389
L618244	08:21:44.02	17:48:20.5	2022-04-09	21:20:09	-XXXXXXXXXPXXXX	0	-250931290010	12	125.433417	17.805694
L618248	08:22:35.16	16:48:18.9	2022-04-08	22:21:09	-XPXPXPXPXXXX	0	-390957492031	28	125.6465	16.805250
L334836	08:22:36.88	51:12:29.3	2022-04-09	20:19:09	-XXXXXXXXXXXX	0	-000000000000	0	125.653667	51.208139
L334894	08:24:47.15	55:52:43.3	2022-04-08	19:18:09	-XXXXXXXXXXXX	0	-020101020000	25	126.196458	55.878694
L759211	08:24:55.42	39:16:40.3	2022-04-09	17:16:09	-XXXPXXXXXXXX	0	-460922080000	12	126.230917	39.277861
L758653	08:27:38.90	35:24:58.0	2022-04-08	22:21:09	-XXXXXXXXXXXX	0	-120422051121	28	126.912083	35.416111
L334980	08:34:54.91	55:34:21.0	2022-04-09	22:21:09	-XXXXXXXXXXXX	0	-010000000000	25	128.728792	55.572500
L712362	08:41:24.37	70:53:42.0	2022-04-08	19:18:09	-XPXP SX XXXXXX	0	-491988091322	25	130.351542	70.895000
L335124	08:43:09.86	50:55:30.7	2022-04-09	18:17:09	-XXXXXXXXXXXX	0	-130522060000	62	130.791083	50.925194
L712386	08:43:19.38	72:15:10.4	2022-04-08	22:21:09	-XXXXXXXXXXXX	A	-000984442224	28	130.83075	72.252889
L618262	08:43:56.41	15:47:43.2	2022-04-09	15:14:09	-XXXXXXXXXXXX	0	-000000052000	14	130.985042	15.795333
L712782	08:53:42.04	34:06:22.3	2022-04-08	22:21:09	-XXXXXXXXXXXX	0	-240577090020	28	133.425167	34.106194
L712480	08:57:40.20	34:04:05.0	2022-04-09	16:15:09	-XXXXXXXXXXXX	0	-490811080000	44	134.4175	34.068056
L759741	08:59:02.10	36:50:39.7	2022-04-08	17:16:09	-XXXXXXXXXXXX	0	-010201010000	37	134.75875	36.844361
L712800	09:00:16.54	51:00:13.2	2022-04-09	21:20:09	-XXXXXXXXXXXX	0	-000000000000	12	135.068917	51.003667
L334296	09:03:03.97	46:51:04.5	2022-04-08	18:17:09	-SXXPXPXPXPXS	A	-550999491525	37	135.766542	46.851250
L712974	09:03:50.04	50:12:37.4	2022-04-09	16:15:09	-PPXPXPXPXXXX	0	-990956392211	44	135.9585	50.210389
L759543	09:04:32.33	35:39:03.4	2022-04-08	22:21:09	-XXXXXXXXXXXX	0	-350535293233	28	136.134708	35.650944
L334264	09:06:12.37	45:53:44.8	2022-04-09	19:18:09	-XXXXXXXXXXXX	0	-020413040000	0	136.551542	45.895778
L334272	09:06:19.13	48:41:48.8	2022-04-08	22:21:09	-XXXXXXXXXXXX	0	-010100020001	28	136.579708	48.696889
L712468	09:07:51.43	31:49:04.6	2022-04-09	22:21:09	-XXXP XXXXXXXX	0	-890999191007	25	136.964292	31.817944
L334282	09:09:53.82	47:49:43.6	2022-04-08	19:18:09	-XXXXXXXXXXXX	0	-000001000000	25	137.47425	47.828778
L335282	09:12:08.01	56:50:36.4	2022-04-09	20:19:09	-XXXXXXXXXXXX	0	-140934060001	0	138.033375	56.843444
L335396	09:12:10.27	52:40:59.7	2022-04-08	20:19:09	-PPXP PPPXPDPD	0	-090339991399	12	138.042792	52.683250
L760021	09:15:34.99	65:59:38.2	2022-04-09	21:20:09	-PPXP PPPPPDPP	0	-990999997799	12	138.895792	65.993944
L618106	09:20:11.16	17:53:25.0	2022-04-08	16:15:09	-XXXXXXXXXXXX	0	-220100010000	12	140.0465	17.890278
L618176	09:20:45.13	27:14:05.6	2022-04-09	18:17:09	-XXXXXXXXXXXX	0	-240900060000	62	140.188042	27.234889
L716270	09:22:10.44	31:11:09.2	2022-04-08	21:20:09	-PPPPPPXPDP PP	0	-999999469899	37	140.5435	31.185889
L335412	09:22:49.41	53:02:23.2	2022-04-09	21:20:09	-XXXXXXXXXXXX	0	-160232142010	12	140.705875	53.039778
L334382	09:30:16.78	48:31:45.7	2022-04-08	15:14:09	-XXXXXXXXXXXX	0	-150601190110	0	142.569917	48.529361
L760013	09:41:02.55	67:51:33.9	2022-04-09	17:16:09	-XXXXXXXXXXXX	0	-000000010000	12	145.260625	67.859417
L716356	09:41:05.94	32:21:47.2	2022-04-08	20:19:09	-PPXP PPXPXPXX	0	-790997296534	12	145.27475	32.363111
L759235	09:49:12.18	66:15:00.4	2022-04-09	19:18:09	-XXXXXXXXXXXX	0	-191753070311	0	147.30075	66.250111

L618182	09:52:06.14	28:28:33.2	2022-04-08	19:18:09	-XSXSDXXXXXXXX	0	-490777253443	25	148.025583	28.475889
L716530	09:52:06.14	28:28:33.2	2022-04-09	15:14:09	-XXXXXXXXXXXXX	0	-000100010000	14	148.025583	28.475889
L759727	09:54:34.04	37:33:38.2	2022-04-08	18:17:09	-XXXXXXXXXXXXX	0	-250534051111	37	148.641833	37.560611
L334648	09:57:38.33	55:22:54.9	2022-04-09	22:21:09	-XXXXXXXXXXXXX	0	-000011010000	25	149.409708	55.381917
L334616	09:58:14.80	54:51:57.8	2022-04-08	21:20:09	-PXXPPXPXXXX	0	-940985196574	37	149.561667	54.866056
L619308	09:58:20.98	32:24:03.9	2022-04-09	16:15:09	-XXXXXXXXXXXXX	0	-350711161100	44	149.587417	32.401083
L711952	10:11:33.06	71:24:40.7	2022-04-08	16:15:09	-XXXXXXXXXXXXX	0	-000000000000	12	152.88775	71.411306
L334774	10:14:37.64	53:58:34.1	2022-04-09	18:17:09	-PPXPPXPXXXX	0	-991978090101	62	153.656833	53.976139
L716602	10:17:49.77	27:32:07.7	2022-04-09	15:14:09	-XXXXXXXXXXXXX	0	-000000000000	14	154.457375	27.535472
L333682	10:20:03.29	57:05:06.7	2022-04-08	20:19:09	-DPXXXXXPXXXX	0	-580756295343	12	155.013708	57.085194
L440216	10:20:39.94	36:57:02.0	2022-04-09	17:16:09	-XXXXXXXXXXXXX	0	-130200030000	12	155.166417	36.950556
L711972	10:22:47.51	71:36:27.8	2022-04-08	18:17:09	-XXXXPPXXXXXX	0	-750878154131	37	155.697958	71.607722
L333732	10:23:10.58	47:51:46.5	2022-04-09	18:17:09	-XXXPXXXXXXXX	0	-370855192101	62	155.794083	47.862917
L440334	10:23:11.54	39:48:15.7	2022-04-08	17:16:09	-XXXXXXXXXXXXX	0	-150726050010	37	155.798083	39.804361
L440270	10:29:16.98	37:05:43.1	2022-04-09	19:18:09	-XXXXXXXXXXXXX	0	-020110031100	0	157.32075	37.095306
L333774	10:34:17.81	50:13:29.8	2022-04-08	17:16:09	-PPXPPXPXXXX	0	-991999395021	37	158.574208	50.224944
L333766	10:39:15.45	47:05:42.2	2022-04-09	19:18:09	-XXXXXXXXXXXXX	0	-370746191110	0	159.814375	47.095056
L440316	10:43:53.90	36:21:01.6	2022-04-08	21:20:09	-XXXXXXXXXXXXX	0	-460955193131	37	160.974583	36.350444
L440328	10:46:18.65	37:38:03.1	2022-04-09	20:19:09	-XXXXXXXXXXXXX	0	-130221190000	0	161.577708	37.634194
L334116	10:47:33.61	45:08:53.3	2022-04-08	21:20:09	-XXXXXXXXXXXXX	0	-000000020000	37	161.890042	45.148139
L334132	10:47:47.75	49:22:37.5	2022-04-09	20:19:09	-XXXXXXXXXXXXX	0	-010222030000	0	161.948958	49.377083
L618722	10:48:34.51	34:57:26.1	2022-04-08	22:21:09	-PPXPPXPXXXX	0	-990999695678	28	162.143792	34.957250
L759499	10:49:53.24	44:46:20.0	2022-04-09	22:21:09	-XXXXXXXXXXXXX	0	-010100010000	25	162.471833	44.772222
L440298	10:55:44.59	37:46:00.7	2022-04-08	18:17:09	-XXXXXXXXXXXXX	0	-120211020100	37	163.935792	37.766861
L392699	11:00:37.61	52:36:13.6	2022-04-09	17:16:09	-XXXXXXXXXXXXX	0	-140210030000	12	165.156708	52.603778
L334050	11:02:24.06	57:47:24.9	2022-04-08	20:19:09	-XXXXXXXXXXXXX	0	-230233151121	12	165.60025	57.790250
L334084	11:06:14.94	53:36:00.2	2022-04-09	20:19:09	-XXXXXXXXXXXXX	0	-320922072000	0	166.56225	53.600056
L759421	11:08:00.71	67:00:26.4	2022-04-08	20:19:09	-XXXXXXXXXXXXX	0	-250532262121	12	167.002958	67.007333
L440400	11:09:28.90	37:44:30.9	2022-04-09	17:16:09	-XXXXXXXXXXXXX	0	-000000020000	12	167.370417	37.741917
L334058	11:15:34.90	54:34:19.4	2022-04-08	17:16:09	-XXXXXXXXXXXXX	0	-310924031000	37	168.895417	54.572056
L333056	11:18:12.58	53:19:45.8	2022-04-09	22:21:09	-XPXPPXPXXXX	0	-460998372130	25	169.552417	53.329389
L440528	11:23:18.05	67:04:33.0	2022-04-08	16:15:09	-XXXXXXXXXXXXX	0	-000000000000	12	170.825208	67.075833
L619132	11:26:23.58	33:45:27.3	2022-04-09	21:20:09	-XXXXXXXXXXXXX	0	-230310011001	12	171.59825	33.757583
L333142	11:27:43.70	57:43:15.8	2022-04-08	18:17:09	-XXXXXXXXXXXXX	0	-020202030000	37	171.932083	57.721056
L466274	11:28:32.93	68:49:27.3	2022-04-08	19:18:09	-XXXXXXXXXXXXX	0	-120110010110	25	172.137208	68.824250
L440540	11:28:32.93	68:49:27.3	2022-04-09	19:18:09	-XXXXXXXXXXXXX	0	-120221020001	0	172.137208	68.824250
L333044	11:29:10.83	50:23:46.7	2022-04-09	18:17:09	-PPXPXPXPDX	0	-991910090000	62	172.295125	50.396306
L393075	11:32:35.07	63:24:07.3	2022-04-08	20:19:09	-XXXXXXXXXXXXX	0	-130333041111	12	173.146125	63.402028
L716672	11:33:31.94	33:18:05.3	2022-04-09	18:17:09	-PPXPPXPXXXX	0	-692999094100	62	173.383083	33.301472
L439710	11:35:05.89	37:08:40.1	2022-04-08	16:15:09	-XXXXXXXXXXXXX	0	-000000000000	12	173.774542	37.144472
L393025	11:38:59.17	41:48:40.2	2022-04-09	17:16:09	-XXXXXXXXXXXXX	0	-000000000000	12	174.746542	41.811167
L333332	11:40:49.49	59:12:26.1	2022-04-08	18:17:09	-PPXPPSPXPX	0	-691999494040	37	175.206208	59.207250
L439802	11:41:40.98	37:07:01.5	2022-04-09	20:19:09	-XXXXXXXXXXXXX	0	-000100010000	0	175.42075	37.117083
L466310	11:45:07.60	69:58:17.1	2022-04-08	15:14:09	-XXXXXXXXXXXXX	0	-100000000000	0	176.281667	69.971417
L439830	11:45:38.41	36:46:27.6	2022-04-09	16:15:09	-XXXXXXXXXXXXX	0	-000000000000	44	176.410042	36.774333
L333464	11:46:15.19	45:20:38.4	2022-04-08	17:16:09	-XXXXXXXXXXXXX	0	-030314141030	37	176.563292	45.344000
L393079	11:54:06.70	62:07:06.3	2022-04-09	15:14:09	-XXXXXXXXXXXXX	0	-010001010000	14	178.527917	62.118417
L392703	11:59:13.55	53:53:07.8	2022-04-08	17:16:09	-PPXPPXPXPX	0	-991969298151	37	179.806458	53.885500
L332518	12:05:12.55	48:17:52.7	2022-04-09	18:17:09	-XXXXXXXXXXXXX	0	-000000010000	62	181.302292	48.297972
L333400	12:07:14.14	54:07:54.0	2022-04-08	16:15:09	-XXXXXXXXXXXXX	0	-051801396080	12	181.808917	54.131667
L439904	12:08:10.51	67:30:06.4	2022-04-09	16:15:09	-XXXXXXXXXXXXX	0	-000203050202	44	182.043792	67.501778
L439912	12:11:28.45	68:11:01.9	2022-04-08	16:15:09	-XXXXXXXXXXXXX	0	-020402030000	12	182.868542	68.183861
L332446	12:15:29.88	53:35:50.2	2022-04-09	22:21:09	-SPXPPSPXPX	0	-991999494183	25	183.8745	53.597278
L333620	12:22:51.88	50:26:55.0	2022-04-08	15:14:09	-XXXXXXXXXXXXX	0	-380504151331	0	185.716167	50.448611