
Center for Space Debris Data Collection, Processing and Analysis
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High Geocentric Orbit Space Debris Circular No.2

Coverage period ends on Feb 28, 2007

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Introduction

This circular opens new series of publications devoted to periodical summarizing of worldwide scientific activity in observations of space debris objects on high geocentric orbits (GEO, HEO and high near-circular non-GEO). Objects considered to be included into this publication are fragments (operational by nature, created in fragmentation events or in result of larger objects surface and construction deterioration due to environment conditions) having brightness fainter than 15th visual magnitude during most part of their observation time. This limit corresponds to equivalent approximately 1 m size object on geostationary orbit. It is possible that sometimes these objects can be brighter than 15th magnitude due to combination of their specific properties (surface reflectivity and attitude) and favorable observation conditions (good phase angle, high elevation etc.).

The goal of this publication is to give world scientific community imagination about the status of high geocentric orbit space debris researches and to provide most recent data for each discovered object including orbital parameters, estimated standard magnitude and estimated area-to-mass ratio value. Those data can be included into existed space debris models as well as can be used for study of long-term orbital evolution and possible origin of the objects. The Circular will also serve as some reference document for scientists and amateurs involved into those objects observations and data analysis. Operators of spacecrafts on high geocentric orbits (mainly in GEO) can use this publication in order to obtain more real description of situation around their orbital assets.

Observation planning, ephemeris support, processing and analysis of obtained data are made by researchers from Keldysh Institute of Applied Mathematics (KIAM) (Vladimir Agapov, Igor Molotov, Viktor Stepanyants, Vladimir Titenko) with invaluable help of Zakhariy Khutorovskiy (Vympel Corporation) and Vasiliy Yurasov (Scientific and Research Institute of Precise Instrument Engineering, IPIE).

All questions regarding cooperation in the joint research program for high geocentric orbit space debris studies should be sent to Prof. E. L. Akim, KIAM Deputy Director. All questions regarding observation schedule, required formats, ephemeris support, observations and orbital data processing, analysis and usage should be sent to Dr. V. M. Agapov. All questions regarding requirements for observation instruments, CCD-frames processing software, possible help in the instrument's upgrade in order to make possible participation in the research program should be sent to Dr. I. Ye. Molotov.

List of sensors

This list includes all sensors participating to the date in a joint program of observation and analysis of space debris objects on high geocentric orbits. Each sensor has own identification

number assigned to it in the KIAM space objects database. Most of sensors are involved into minor planet observations as well thus having the MPC assigned identification code. But for purposes of this research program it was decided to maintain separate ID system permitting to describe all participating sensors regardless of their other research programs involvement. Coordinates of sensors are given for reference purposes only and shouldn't be used in real observation processing. In the column "Instrument" common name, aperture (d, mm) and focal length (f, mm) of each instrument are given.

The list will be updated each time new sensor will send observations for studied objects.

Table 1. List of participating sensors

Ref. ID	Longitude, °	Latitude, °	Height, km	Observatory/ Facility	Instrument
10003	100.919 E	51.622 N	1.998	Mondy	AZT-14
10010	41.432 E	43.657 N	2.070	Arhyz	Zeiss-600 d600/f7500
10012	42.499 E	43.276 N	3.127	Terskol	Zeiss-2000 d2000/f16000
10016	30.273 E	46.397 N	0.010	Mayaki	RC-600 d600/f4800
10018	33.163 E	45.219 N	0.010	Yevpatoriya	AZT-8 d700/f2800
10019	33.997 E	44.403 N	0.340	CrAO/Simeiz	Zeiss-1000
10031	34.016 E	44.726 N	0.585	CrAO/Nauchnyi	AT-64 d640/f900
10041	66.896 E	38.673 N	2.593	Maidanak	Zeiss-600 d600/f7500
10042	41.443 E	43.649 N	2.059	SAO/Arhyz	Zeiss-1000 d1000
10071	64.624 W	21.596 S	1.865	Tarija	Zeiss-600 d600/f7500
10102	100.920 E	51.622 N	2.000	Mondy	Zeiss-600 d600/f7500
10103	100.919 E	51.617 N	2.025	Mondy	AZT-33IK d1500/f30000
10191	7.465 E	46.877 N	0.951	Zimmerwald	ZIMLAT-1000 d1000/f10500
10198	16.512 W	28.301 N	2.445	Teide/OGS	Zeiss-1000 d1000/f13300
10531	34.016 E	44.728 N	0.595	CrAO/Nauchnyi	ZTSh d2600/f10000
10532	34.017 E	44.730 N	0.595	GAISh/Nauchnyi	Zeiss-600 d600/f4680
10533	34.016 E	44.726 N	0.585	CrAO/Nauchnyi	PH-1 d220/f507

New objects

This section contains information on objects newly detected during period Feb 1 – Feb 28, 2007.

There are two lists. The first one contains information on objects which had been successfully recovered in follow-up observations after initial detection and one-night tracking and for which orbital data and area-to-mass ratio value had been determined with high level of confidence. The second one contains information on objects having only one night track of observations. Complete set of orbital data can't be determined for these objects. Only some orbital parameters (mainly inclination and RAAN) are determined relatively accurate. The AMR values can't be determined for these objects at all.

It should be noted that all one-night tracks had been probed to identify with all other one-night tracks and with all known objects in the KIAM database having well determined orbits (both bright and faint). It is possible that identification had negative results not only due to absence of other tracks of the same object but also due to uncertainty caused by unknown AMR value which can result in very significant orbital evolution that prevents proper correlation of one-night tracks.

Each object listed in this section has two identifiers. The first one is assigned by the observer discovered the object and the second one is assigned in the KIAM space objects database. Since widely agreed space debris identification system doesn't exist still then all

provided identifiers can be assumed as temporary ones. As soon as such the agreed system will appear, all objects will be assigned with the new identifiers.

Orbital elements are referring to True Equinox Mean Equator (TEME) coordinate system. Area-to-mass ratios are calculated assuming reflectivity coefficient equal to 1.3. Orbital elements for short tracks (Table 3) have obtained in two steps. At the first one attempt to construct orbit with fixed zero value eccentricity was made. In case of great (more than 3 expected sigma) residuals of measurements the second step was applied. At this step it was allowed eccentricity to vary as well.

Table 2. List of newly discovered and confirmed objects

ID1	ID2	Date/time, UTC	a , km	e	i , °	Ω , °	ω , °	u , °	AMR, m ² /kg
43116	E07042 A	23.02.2007 01:19:47.3 7	41902.1 7	0.400327 8	9.636	336.58 3	337.89 5	151.674	15.7
43117	E07042C	25.02.2007 00:09:05.7 6	41957.6 0	0.120433 7	7.197	72.543	287.73 5	95.084	5.36
43118	E07043C	22.02.2007 23:52:32.0 6	39190.1 6	0.182079 9	8.666	307.99 2	47.078	217.440	3.76
43119	E07045 A	24.02.2007 22:28:17.6 8	21208.7 8	0.662079 0	3.980	83.897	262.79 0	88.013	0.51
4312 0	E07045B	21.02.2007 00:52:38.4 4	42959.4 3	0.029370 7	15.78 3	3.059	21.100	136.847	0.51
4312 1	E07045 D	22.02.2007 22:04:55.3 7	42039.9 7	0.025124 9	13.19 8	6.125	303.33 3	112.361	1.26
4312 2	E07046 A	23.02.2007 05:29:28.4 6	42776.3 1	0.122807 7	20.42 3	17.492	341.119	193.000	6.11
4312 3	E07046B	20.02.2007 22:13:07.2 2	42436.6 1	0.044520 7	14.72 7	358.69 8	21.332	82.072	0.57
4312 4	E07047 A	18.02.2007 23:41:08.1 7	39977.9 6	0.1931110	12.93 5	341.45 8	333.87 3	201.732	2.73
4312 5	E07048 A	20.02.2007 03:13:30.2 2	44506.4 6	0.071629 6	18.58 1	31.800	334.05 8	106.729	0.075
4312 6	E07049 A	23.02.2007 03:20:52.3 6	42359.7 2	0.033315 2	15.17 2	3.744	33.545	199.869	1.89
4312 7	E07052 D	24.02.2007 22:13:17.1 8	41895.8 3	0.1146483	15.02 2	354.42 9	322.76 6	172.840	4.42

Table 3. List of newly discovered objects having only single one-night track of observations

ID1	ID2	Date/time, UTC	Track duration, hh:mm	T , min	a , km	e	i , °	Ω , °	ω , °
4616 3	g070209a	09.02.200 7	00:22	1289.77	39249.6	0.0687	09.357	350.2 5	281.36
4616 4	g070209 b	09.02.200 7	00:18	1439.68	42234.9	0.0170	08.673	320.0 8	191.79
4616 5	g070221a	21.02.200 7	00:32	1386.69	41192.0	0.0193	09.573	326.9 9	228.81
4620 2	M070210	10.02.200 7	00:01	1403.39	41522.0	0	14.565	352.4 2	239.42

New identifications

This section contains information on successful identification of newly and previously obtained single one-night tracks with each other as well as with objects having well determined orbits.

Table 4. New identifications

ID_new	ID_old	Observation date	Observer
No new identifications in Feb 2007			

Updated orbits

This section contains information on latest orbital updates for objects discovered prior to Feb 1, 2007 and observed at least once in Feb 2007 or for which the latest orbital update was not published in previous issues.

Table 5. Updated orbital parameters for objects observed in Feb 2007.

ID1	ID2	Date/time, UTC	a , km	e	i , °	Ω , °	ω , °	u , °	AMR, m ² /kg
43007	EGEO07	21.02.2007 01:24:19.91	43516.9 9	0.081053 6	16.27 5	1.855	339.093	138.596	1.47
43026	EGEO26	24.02.2007 17:37:23.93	41442.3 0	0.133947 9	9.448	335.824	334.713	162.469	4.22
43031	EGEO31	21.02.2007 01:52:31.02	40190.4 5	0.122664 0	12.02 9	337.393	325.644	213.119	1.34
43032	EGEO32	25.02.2007 19:23:27.12	39456.6 5	0.098323 8	10.77 5	339.235	323.215	174.442	1.24
43033	EGEO33	20.02.2007 05:02:26.98	33183.9 6	0.347071 4	8.203	71.712	250.548	110.379	3.35
43045	EGEO45	24.02.2007 20:56:15.05	42153.7 7	0.120644 5	9.605	330.618	61.829	160.124	1.35

ID1	ID2	Date/time, UTC	a , km	e	i , °	Ω , °	ω , °	u , °	AMR, m ² /kg
43081	E06204 D	21.02.2007 22:40:53.90	46829.9 5	0.3196119	9.442	130.462	308.640	57.290	8.56
43082	E06205C	30.01.2007 18:34:44.00	41418.5 6	0.042054 4	13.85 8	345.092	254.884	91.087	2.17
43084	E06207B	20.02.2007 02:36:38.87	38318.2 7	0.238765 0	10.33 5	335.252	324.710	239.060	21.9
43091	E06293 A	26.02.2007 21:27:25.30	40254.0 2	0.287178 8	5.265	126.215	204.494	62.079	11.3
43093	E06326 A	17.02.2007 20:43:15.26	43579.3 6	0.077224 7	9.175	333.297	320.910	74.172	3.02
43094	E06326C	13.02.2007 04:46:27.16	40819.9 2	0.231471 4	7.693	300.501	18.286	228.853	11.3
43095	E06327B	22.02.2007 23:31:06.06	42517.3 3	0.017759 5	11.573	347.047	168.909	141.087	7.58
43096	E06321 D	05.02.2007 02:45:06.13	41425.5 7	0.044882 8	8.896	321.432	288.187	226.002	1.78
43098	E06327F	11.02.2007 21:59:30.26	43310.4 8	0.058421 8	9.667	333.875	288.675	95.913	2.61
43099	E06348B	12.02.2007 22:38:40.27	41637.11	0.023392 2	10.94 6	336.683	333.181	179.450	0.043
43100	E06327E	17.02.2007 01:31:51.08	39990.3 8	0.062573 0	12.51 5	344.745	254.418	221.265	0.40
43105	E07014 A	22.02.2007 21:49:00.36	42144.5 4	0.292236 0	17.01 8	329.290	340.355	184.723	12.4
43107	E07015 D	23.02.2007 01:11:34.35	41430.1 3	0.096176 0	10.30 2	337.452	331.511	150.898	3.78
43110	E07020C	26.02.2007 20:42:32.10	20502.0 3	0.666262 8	7.861	0.099	3.923	143.352	0.10
43111	E07020 D	21.02.2007 19:53:39.90	41847.8 8	0.056919 7	15.96 7	333.569	331.507	189.958	7.51
43112	E07021 A	21.02.2007 20:47:40.26	42225.0 6	0.062125 7	10.75 0	337.529	287.692	91.751	1.49
43113	E07021B	22.02.2007 20:45:52.26	25032.9 8	0.717826 4	7.734	84.319	243.209	51.607	2.19
43114	E07021 D	24.02.2007 20:12:22.05	24759.1 6	0.717632 0	4.980	73.725	276.262	73.503	7.06
43115	E07022 A	24.02.2007 22:42:43.87	43703.9 4	0.235084 5	1.863	165.040	132.958	13.576	11.51
90006	90006	19.02.2007 14:53:48.50	42192.1 6	0.0011531	14.44 6	352.366	14.391	122.134	0.0067
90008	90008	24.02.2007 17:54:20.93	42149.0 2	0.004137 4	14.34 9	358.146	103.139	143.515	0.0079
90009	90009	15.02.2007 14:53:23.50	42279.1 9	0.0030117	14.67 8	359.315	352.868	126.017	0.11
90014	90014	09.02.2007 19:26:06.97	42616.2 4	0.008080 6	14.98 2	353.923	110.113	31.650	0.086
90016	90016	03.02.2007 21:31:27.51	42241.4 1	0.007789 0	13.99 4	332.441	185.504	69.801	2.02

ID1	ID2	Date/time, UTC	a , km	e	i , °	Ω , °	ω , °	u , °	AMR, m ² /kg
90019	90019	18.02.2007 17:08:49.01	42225.3 4	0.006316 9	14.81 0	359.697	24.161	81.971	0.14
90021	90021	04.02.2007 18:23:53.28	42697.3 8	0.021426 7	14.91 7	359.994	346.308	23.119	0.39
90022	90022	15.02.2007 15:18:49.50	42158.7 5	0.004756 8	14.55 6	358.901	226.059	111.826	0.13
90023	90023	25.02.2007 19:48:04.90	40109.9 2	0.034928 5	12.36 0	355.445	34.439	153.237	1.66
90025	90025	25.02.2007 20:14:59.12	41178.79	0.033307 7	10.63 5	333.608	6.473	174.022	0.15
90028	90028	21.02.2007 19:05:42.31	42493.3 7	0.012978 8	14.60 3	359.013	61.745	72.287	0.0053
90031	90031	25.02.2007 20:01:37.11	42154.3 9	0.002047 4	13.81 4	7.629	206.775	140.397	0.0075
90032	90032	25.02.2007 21:59:33.27	42153.9 6	0.018848 9	14.28 1	359.027	236.221	177.884	0.0049
90034	90034	18.02.2007 19:03:50.73	24642.5 8	0.715420 1	7.005	171.254	43.528	285.019	-
90041	90041	26.02.2007 21:05:35.43	41986.8 2	0.003682 8	11.439	29.488	3.926	164.562	0.12
90042	90042	22.02.2007 00:20:14.52	38704.4 7	0.029004 3	11.405	335.840	290.193	204.397	0.88
90047	90047	04.02.2007 18:43:25.42	43043.3 4	0.094589 9	13.78 0	9.647	337.202	64.827	0.90
90048	90048	25.02.2007 21:11:25.17	41583.4 1	0.062125 3	13.90 9	346.742	286.381	156.123	1.60
90049	90049	25.02.2007 20:32:35.14	38796.5 5	0.047366 8	17.72 2	349.054	214.893	157.888	1.33
90050	90050	21.02.2007 22:05:50.06	42222.7 5	0.067326 5	11.214	343.728	338.056	120.683	4.29
90051	90051	31.01.2007 04:40:38.99	42721.8 4	0.025576 7	14.68 0	10.293	270.028	138.925	0.21
90052	90052	14.02.2007 16:56:47.09	41053.5 5	0.007898 0	9.507	324.874	180.880	127.131	0.034
90053	90053	13.02.2007 20:31:26.77	41166.89	0.184623 2	7.635	317.771	134.821	178.869	1.53

Master list of objects

The master list of objects includes all high altitude orbit faint objects discovered to the date with description of obstacles of discovery and last update of orbital information. Due to large volume of the master list it will be distributing in electronic form only.

Observation statistics

This section contains general statistics on obtained measurements.

Table 6. Distribution of measurements obtained by each facility by year of observation (as of Feb 28, 2007)

	2004	2005	2006	2007	TOTAL

Nauchnyi	1240	6478	12925	3461	24104
Zimmerwald	0	597	3389	620	4606
Teide	0	624	2284	1465	4368
Maidanak	0	150	2166	931	3247
Mayaki	0	0	981	0	981
SAO	0	258	524	0	782
Terskol	0	0	475	0	475
Mondy	0	229	65	163	457
Yevpatoriya	0	0	272	0	272
Simeiz	0	0	213	0	213
Arhyz	0	0	115	11	126
Tarija	0	0	21	0	21
TOTAL	1240	8336	23410	6651	39652

**Distribution of measurements obtained for faint high altitude objects during 2004-2007
by participated facilities as of Feb 28, 2007
(total number of single measurements and percentage)**

