

# Space Control and Analysis System Application for Debris Observation

Evpatoria 2007

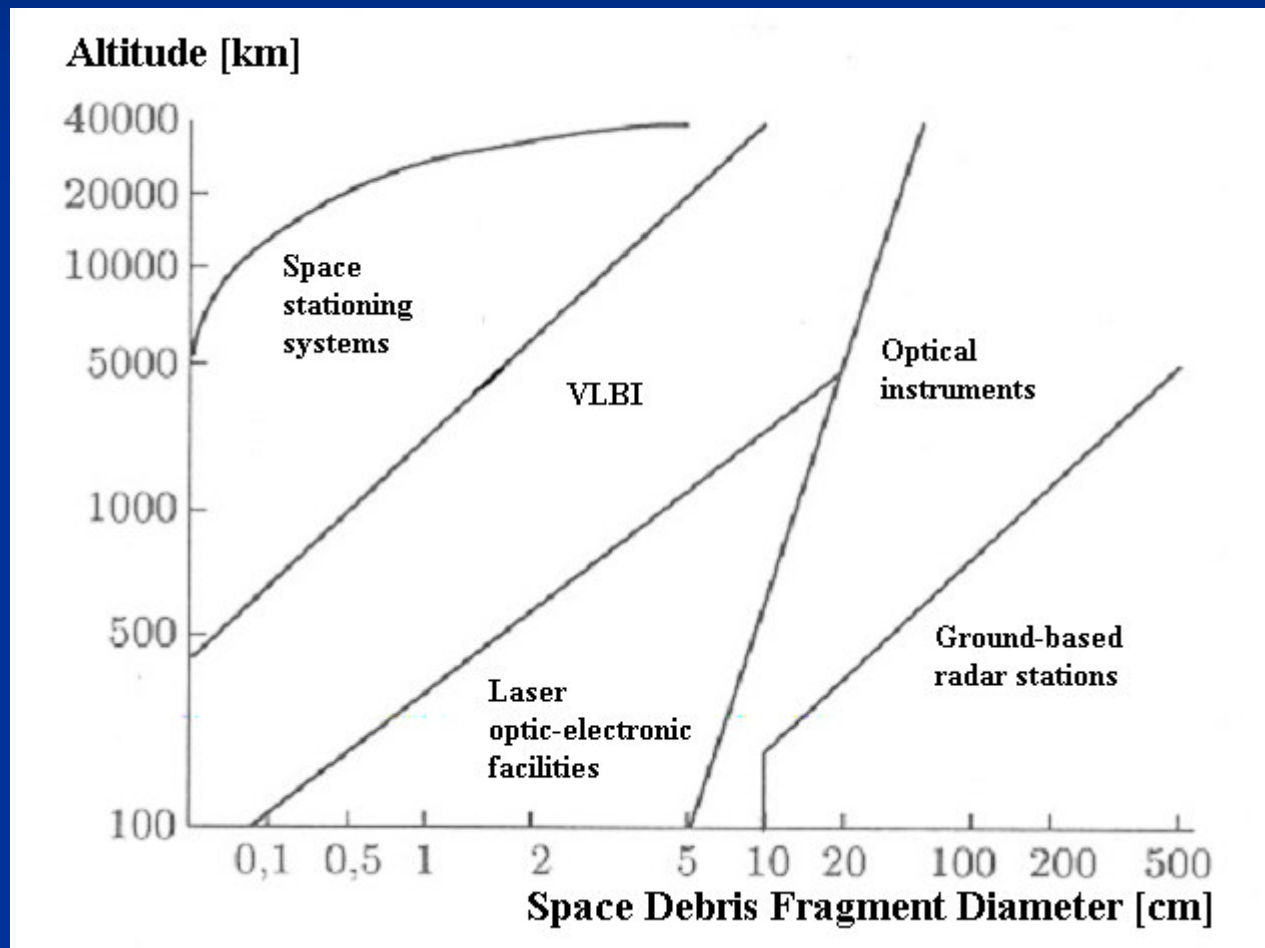
# Debris problem importance is caused with:

- Manned space flight safety necessity;
- Continuous increasing of the probability of the space object collision with each other or with man-made debris resulting in new debris accumulation;
- Probability of the unpredicted space object and man-made debris fall on the Earth causing chemical, biological and radioactive contamination of its surface and atmosphere;
- Space object destruction as a result of in-orbit explosions and of launch vehicle explosions in the upper atmosphere at launch;
- Contamination of the upper atmosphere, ionosphere and biosphere with combustion materials of rocket propellant at space object launch;
- Hindrances for astronomical observations and various near-Earth space experiments;
- Changes of the features of the near-Earth space, upper atmosphere and ionosphere of the Earth that can cause irreversible changes in the biosphere.

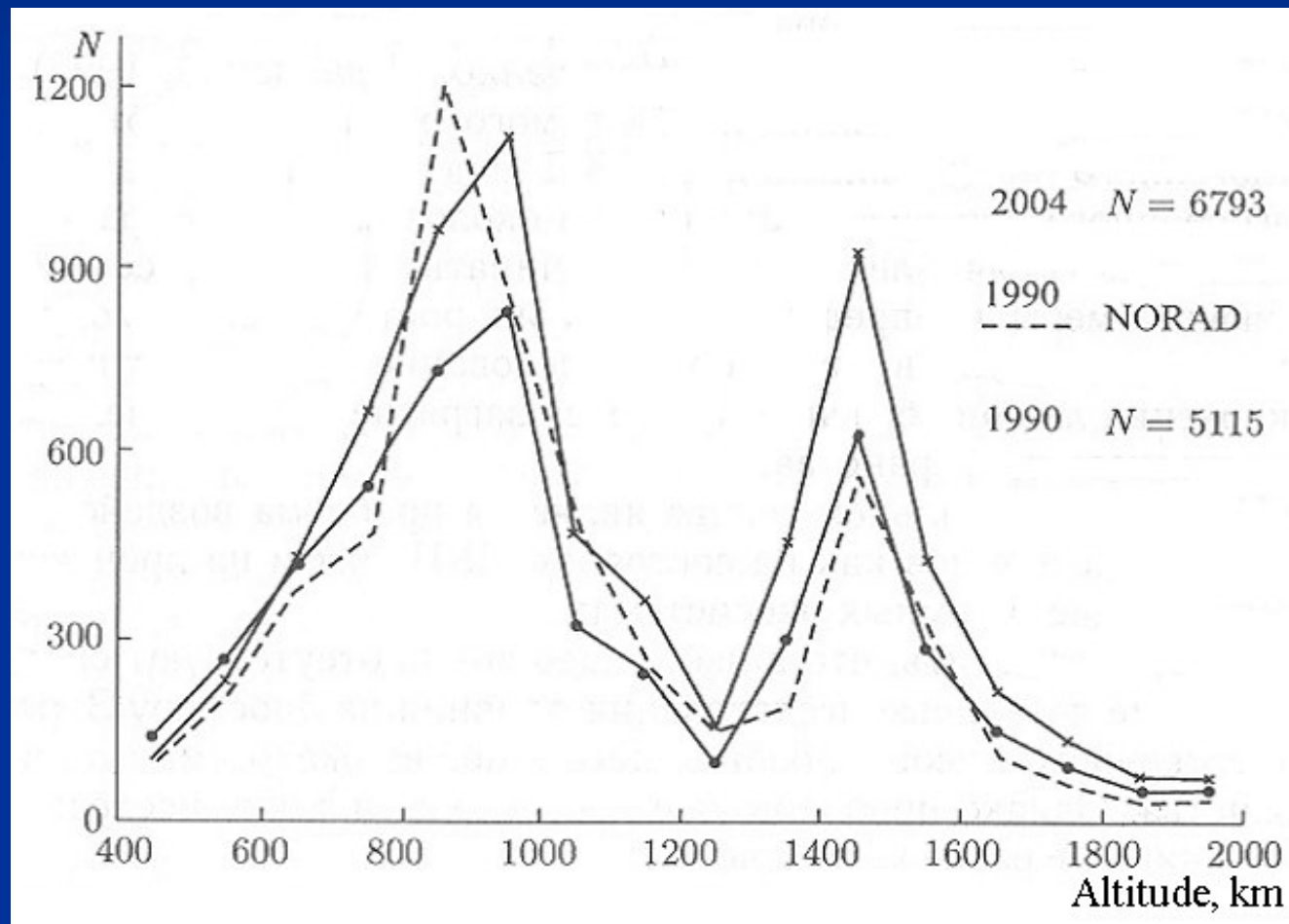
# Space Control and Analysis System Facilities for Near-Earth Space Object Observations



# Capabilities of Technical Facilities for Near-Earth Debris Observations



# Distribution of Man-made Debris Particles Number in Low Orbits



# LFVN Experiments on VLBI Location Using RT-70

Name	Realization date	Objects under investigation	Used radio telescopes
VLBR99.1	02-08th June, 1999	Venus, Mars	Evpatoria, Svetloe, Shanghai, Uroomchi, Toroon, Kashima
VLBR00.2	03-09th August, 2000	Venus, Mercury, asteroids Mitra and 2000CE59	Evpatoria, Svetloe, Shanghai, Uroomchi, Toroon, Medvezhii Ozera
VLBR01.1	23-29th May, 2001	Venus, Mercury, asteroid 1999KW4, 7 geostationary objects	Evpatoria, Svetloe, Shanghai, Kashima, Noto, Uroomchi, Toroon, Medvezhii Ozera, Merlin
VLBR01.2	14-19th December, 2001	Asteroid 1998WT24, 5 geostationary, 4 high elliptical objects, tests in geostationary orbits	Evpatoria, Svetloe, Shanghai, Uroomchi, Toroon, Kalyazin, Zelenchuk, Algonquin
VLBR02.1	23-29th July, 2002	Asteroid 2000PH5, Venus, 7 geostationary, high elliptical, semi-diurnal objects	Evpatoria, Medvezhii Ozera, Kalyazin, Shanghai, Noto, Uroomchi
VLBR03.1	23-29th July, 2003	Asteroid 2000PH5, Mars, 10 geostationary, high elliptical, semi-diurnal objects, test beam-park in low orbits	Evpatoria, Medvezhii Ozera, Noto, Uroomchi, Simeheez
VLBR04.1	21-25th June, 2004	Asteroid Itokawa, 15 objects in geostationary, high elliptical and semi-diurnal orbits, beam-park, test beam track	Evpatoria, Medvezhii Ozera, Noto, Simeheez
VLBR04.2	23-29th July, 2004	Asteroid 2000PH5, Venus, 18 geostationary, high elliptical and semi-diurnal objects, beam-park, beam track	Evpatoria, Medvezhii Ozera, Noto, Simeheez
VLBR04.3	29th September- 5th October, 2004	Asteroid Tautatis, Venus, Moon, 12 geostationary, high elliptical and semi-diurnal objects, beam-park, beam track	Evpatoria, Medvezhii Ozera, Noto, Simeheez
VLBR05.1	10-16th September, 2005	Asteroid 1999 RQ36, Mars, Moon, 18 geostationary, high elliptical objects (including small-sized), beam-park, beam track	Evpatoria, Medvezhii Ozera, Simeheez, Puschino, Uroomchi
VLBR06.1	3-9th July, 2006	Asteroid 2004XP14, Mercury, Moon, 20 geostationary, high elliptical objects (including small-sized), beam-park, beam track	Evpatoria, Goldstone, Noto, Simeheez, Kalyazin, Uroomchi, Zelenchukskaya

# Space Object Observations by means of AMT-28



AMT-28

Telescope AMT-28 is a main data source of Space Control and Analysis System among the optical facilities.

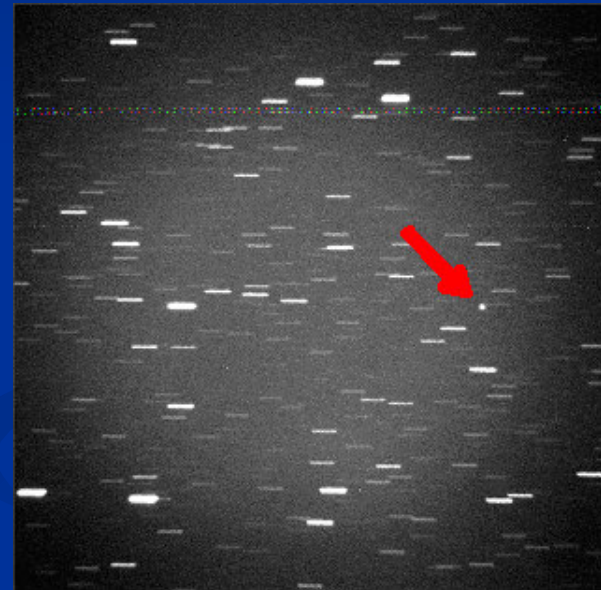
Space Control and Analysis System performs the object classification and the accurate definition of their orbits based on AMT-28 measurements.

By means of this telescope about 1000 tracking sessions are conducted yearly.

# Geosynchronous orbit fragment observations using AMT-8



AMT-8 with mounted camera  
IMG1001E



Geosynchronous orbit debris images  
received by means of AMT-8  
equipped with CCD-camera  
FLI1001E..



# Result of AMT-8 Observations of Near-Earth Objects within the Project “Interferometer” (from the 26<sup>th</sup> of June till the 8<sup>th</sup> of July, 2006)

Measurement date	Object number	Object name	Measurement number	Interval h : min
2006-06-29	23880/96034A	GORIZONT 32	5	00:01
2006-06-29	10987/78073A	RADUGA 4	6	00:01
2006-07-01	095099	-	40	00:19
2006-07-01	17874/84016F	SL-12 R/B(2)	23	00:17
2006-07-01	11890/80060A	EKRAN 5	5	00:05
2006-07-02	90008	Debris of EKTRAN 4	34	00:17
2006-09-14	26470/00046B	NILESAT 102	6	00:01
2006-09-14	25311/98024A	NILESAT	6	00:01
2006-09-14	26695/01005B	SKYNET 4F	3	00:01
2006-09-14	096008	-	8	00:03
2006-09-14	00001	New fragment	7	00:03
2006-09-16	90008	Debris of EKTRAN 4	33	00:18
2006-09-16	90031	Debris of EKTRAN 9	39	00:23
2006-09-16	90032	Debris of EKTRAN 4	120	00:22
2006-09-16	11728/80016D	SL-12 R/B(2)	90	00:21
2006-09-16	14595/83127F	SL-12 R/B(2)	4	00:01
2006-09-17	90008	Debris of EKTRAN 4	46	00:14
2006-09-17	28905/05046D	ARIANE 5 DEB	27	00:04
2006-09-17	13554/82093A	EKRAN 9	33	00:08
2006-09-17	27704/03010A	NAVSTAR 52	5	00:01

# Conclusion

- Study of the small fragment population is one of the technically difficult but high-priority tasks for countries that explore space.
- The technical facilities of Space Control and Analysis System track orbits and debris formed as a result of the payload delivery with the Ukrainian launch vehicles as well as the national spacecraft decay.
- The radar stations located near Sevastopol and Mukachevo provide continuously renewed data concerning the near-Earth space occupation in low orbits.
- Putting into service the telescope AMT-8 equipped with a new CCD-camera allows Space Control and Analysis System to take an active part in the international observations, for example, organized by IADC, of small objects and their clusters to develop a cooperation in this sphere and to provide a measurement data exchange.
- International VLBI locations devoted to space debris study using RT-70 enabled to receive the unique results, in particular on the high orbit objects with the high “Area-to-Mass” ratio. It is planned to perform geostationary orbit fragment VLBI location from the 28<sup>th</sup> of July till the 5<sup>th</sup> of August, 2007 including the objects tracked within the international IADC campaign.

# Used Scientific Sources

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- Molotov I.E. Project “Low frequency VLBI network LFVN: history and first results”. "News of the Pulkovo astronomic observatory" № 216, 2002 .
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