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REFLECTOR, LARETS and METEOR-3M(1)

what did we learn from tracking campaign results

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REFLECTOR:

- The specialty satellite (Fig. 1), designed exclusively for calibration of large active optical observation systems, has been successfully tracked during a period from 21.12.2001 to 07.03.2003.
- The tracking campaign results demonstrated the operability of its passive attitude control system, while the oscillation damping (with help of magnetic hysteresis rods) was slower than anticipated prior to launch (Fig 2).
- The SLR observations also demonstrated that, using adequately arranged retroreflectors (or RR groups) on board of a spacecraft (SC), it is possible to determine the SC attitude from distance measurements at any moment with an accuracy sufficient for practical purposes (Fig 3,4).

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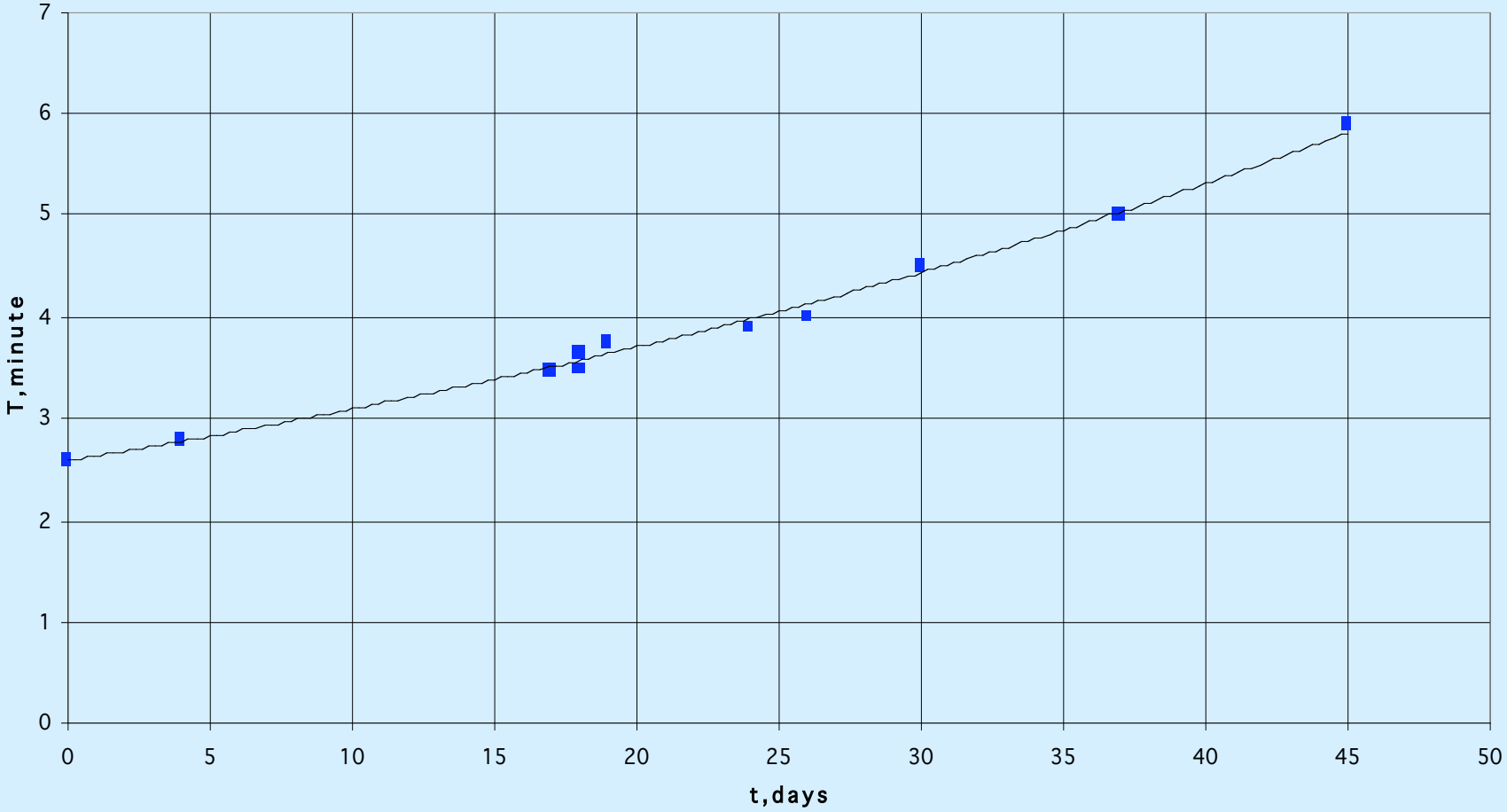
Fig.1 REFLECTOR microsatellite outlook

The REFLECTOR satellite has the following orbit parameters:

Major semiaxis of the orbit	7391 km
Inclination:	99.64 deg
Inclination:	0.0008
Orbit height:	1018.63±10.71 km
Orbiting period	105.34 min



Change of the period of fluctuations (rotation) REFLECTOR satellite from results of observation 23.12.2001 to 06.02.2002

Fig. 2

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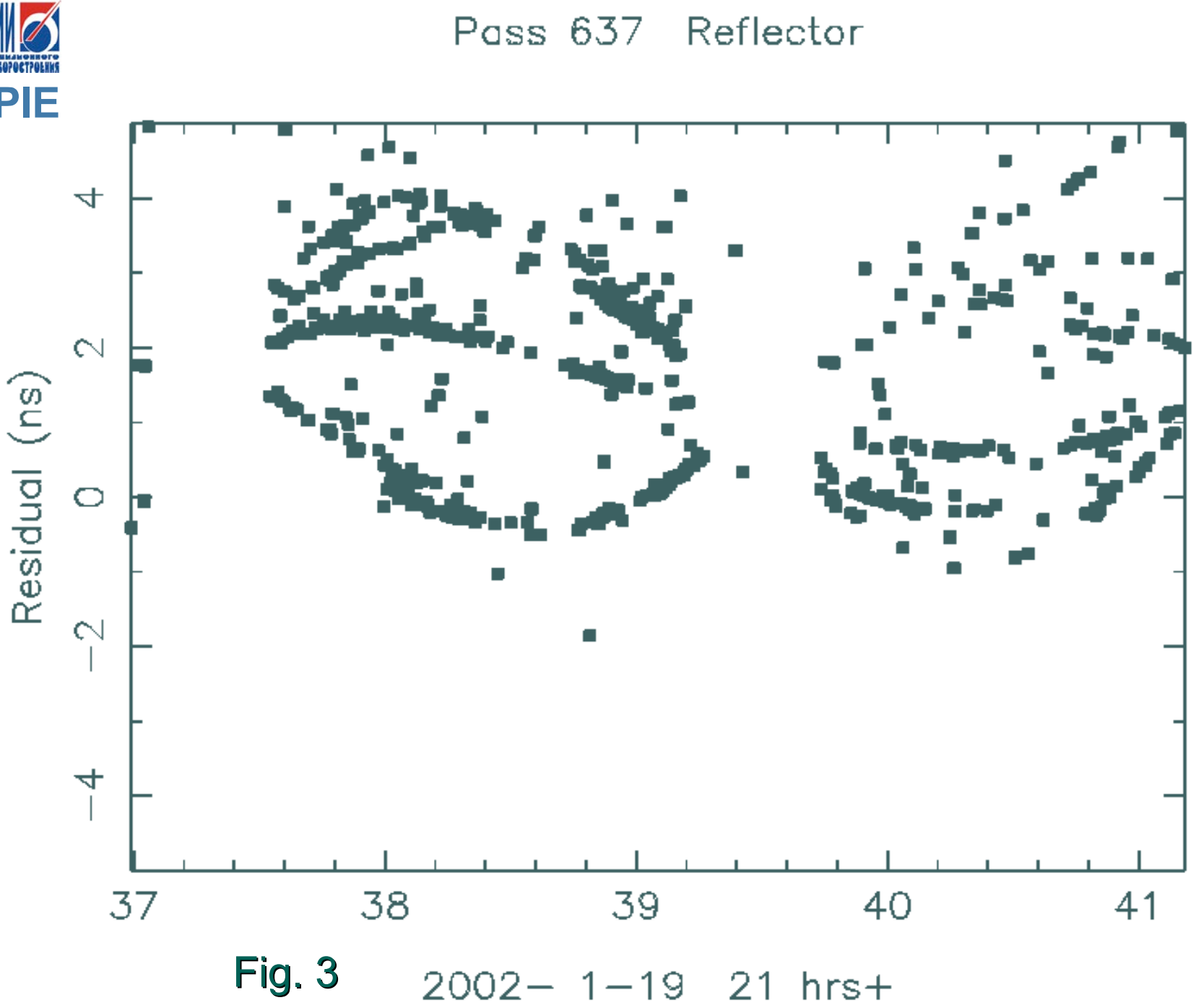
Pass 637 Reflector
Residual (ns)
4
2
0
−2
−4
37
38
39
40
41
2002− 1−19 21 hrs+

Fig. 3

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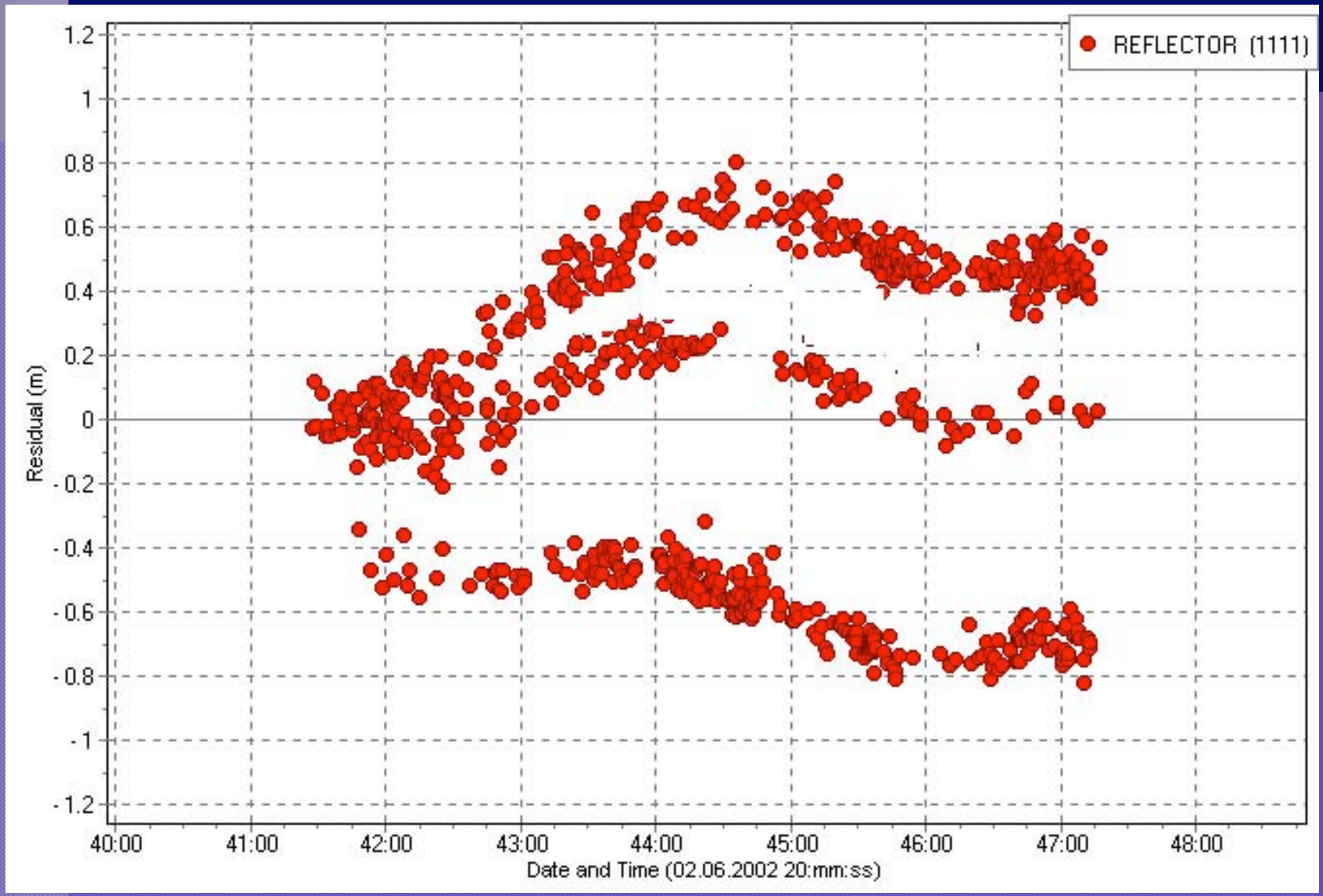
REFLECTOR (1111)
Residual (m)
1.2
1
0.8
0.6
0.4
0.2
0
- 0.2
- 0.4
- 0.6
- 0.8
- 1
- 1.2
40:00
41:00
42:00
43:00
44:00
45:00
46:00
47:00
48:00
Date and Time (02.06.2002 20:mm:ss)

Fig. 4

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LARETS:

- The satellite (Fig. 5) is a modified version of the formerly launched GFZ-1 and WESTPAC (a spherical brass body 24 cm in diameter, 23 kg mass, carrying 60 cube corner retroreflectors). The CCRs are recessed in the brass body to limit the single CCR field of view (instead of using external baffles, as on WESTPAC). Thus, we increased the target cross-section, and eliminated the dead spaces between the bursts of return signals, typical for WESTPAC. LARETS has also a much higher rotation rate than WESTPAC.
- The RMS target error of LARETS (about 1.5 mm) is only slightly more than with WESTPAC, while the cross-section, according to preliminary estimations, is approximately one fourth of that one of STELLA and STARLETTE, but much higher than that one of WESTPAC.

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LARETS:

- The LARETS satellite appears to be a reasonably successful design. We are very interested in the SLR community opinion on preferable orbit heights where the application of such a satellite will be most efficient.
- Currently, an investigation program is conducted to estimate the LARETS characteristics, as well as effort to use it for calibration of high-accuracy optical and microwave measurement systems. Therefore, we ask to extend the LARETS observation campaign for one year more.

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Passive low-orbit retroreflector satellite for laser ranging

Minister of Defense of Russia demonstrates the precise laser retroreflector satellite LARETS to the President of Russian Federation and the President of France

Fig. 5 LARETS

Orbit height 690 km
Used for scientific and applied tasks in geodesy and geodynamics

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METEOR-3M(1):

- The first experimental spherical retroreflector, 6 cm in diameter, mounted on board of this carrier SC, has been successfully tracked during 2.5 years. The initial part of tracking campaign demonstrated a good agreement with pre-launch predictions based on theoretical calculations and lab measurements (Fig. 6).
- A preliminary analysis of the campaign results shows that the initial cross-section value has gradually decreased; this is possibly due to the non-radiation-resistant glass used in the experimental retroreflector (the initially planned observation period was only 6 weeks — just to verify the design parameters).

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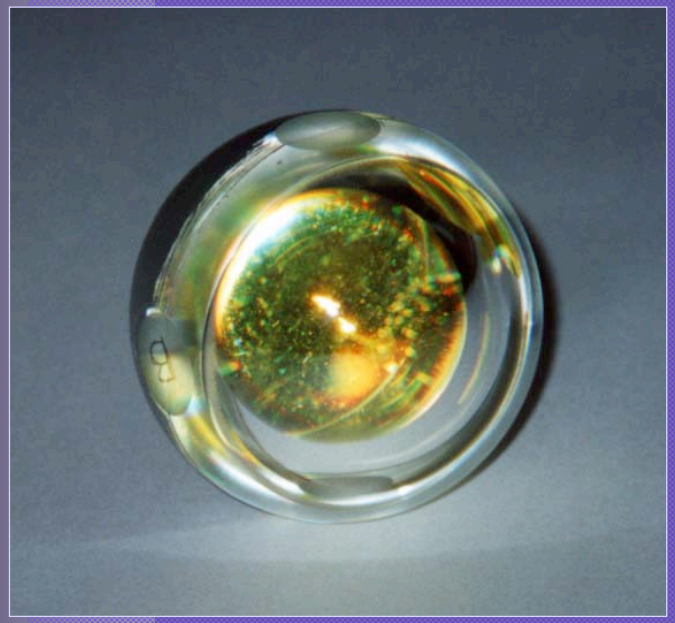
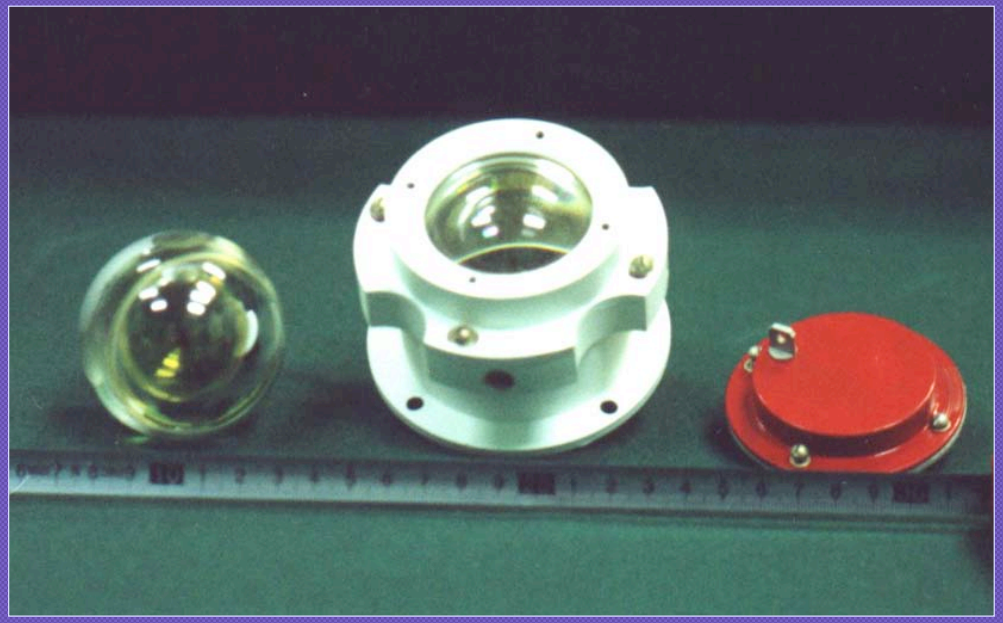
First spherical retroreflector



RR outlook



RR and holder

Fig. 6

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METEOR-3M(1):

- Currently we have completed the manufacturing of two larger spherical retroreflectors (17 cm in diameter, and about 7,5 kg mass) (Fig. 7); after a period of parameter investigation, we will be ready to launch at last one of them as an autonomous SLR satellite with a practically zero target error.
- Such a target satellite may be used for extreme accuracy measurements in geophysics, geodynamics, etc., and may stimulate further SLR hardware development to obtain better precision.
- If interested, the SLR community may address the Federal Space Agency of Russia to support an appropriate launching; IPIE may than take responsibility for organizing and preparation of a corresponding launching.

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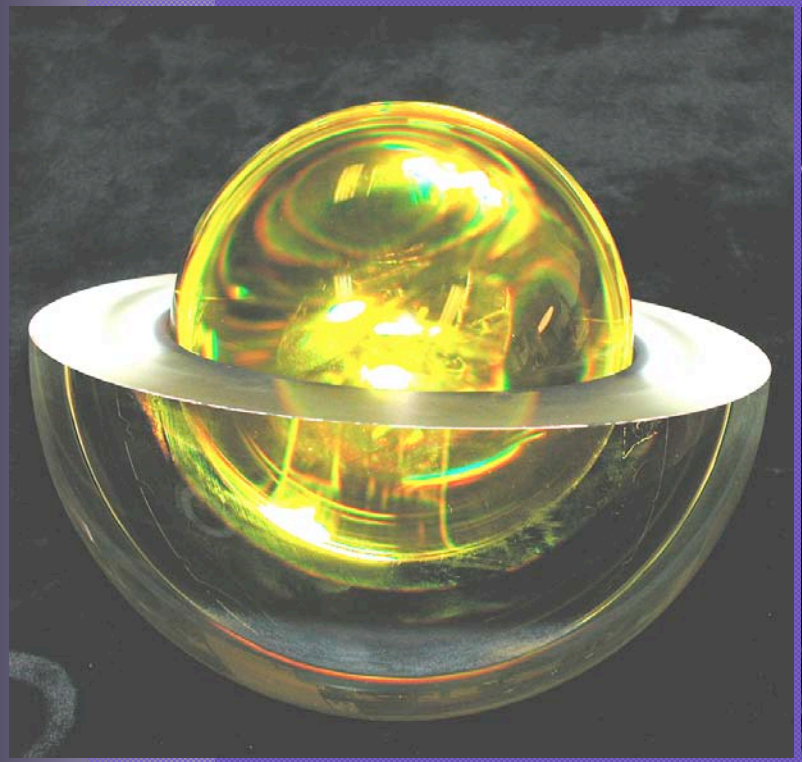
17 cm-diameter spherical retroreflector (dissembled)



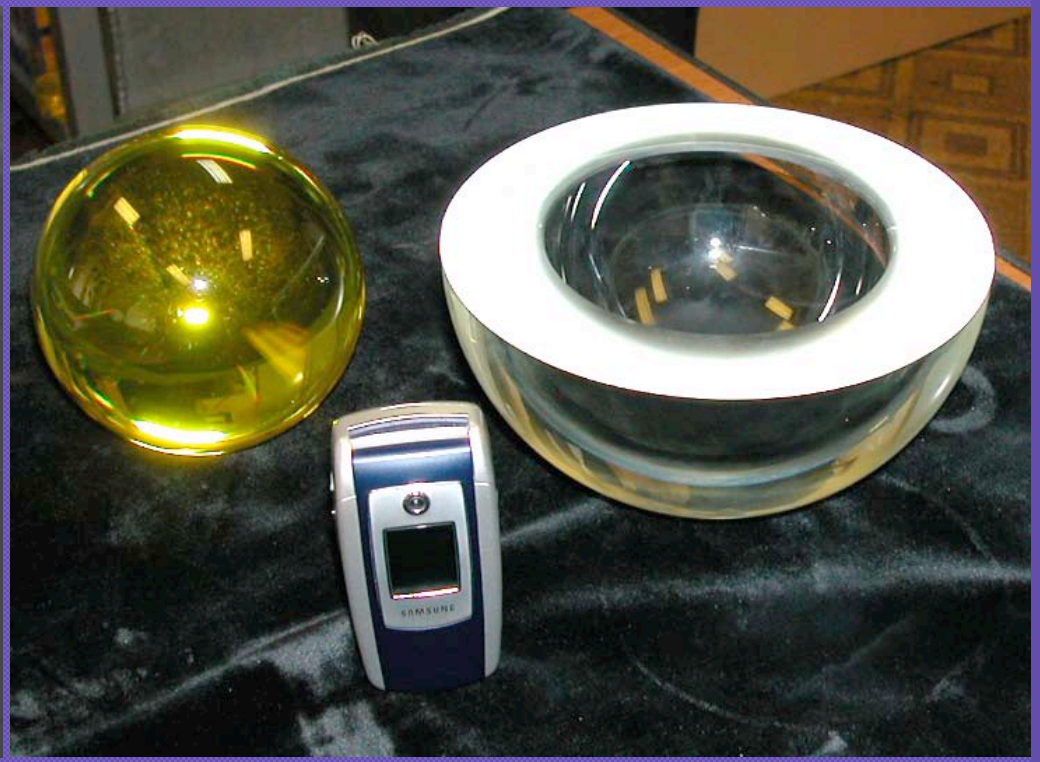


Fig. 7