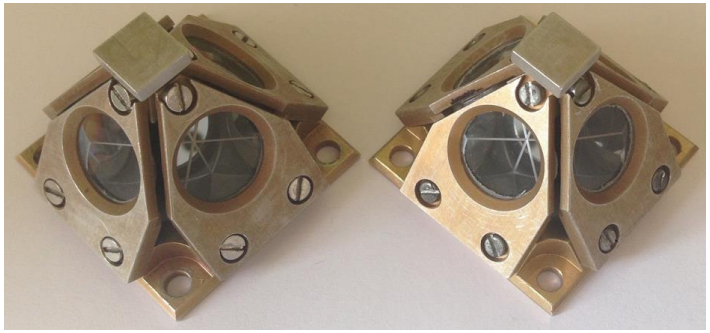
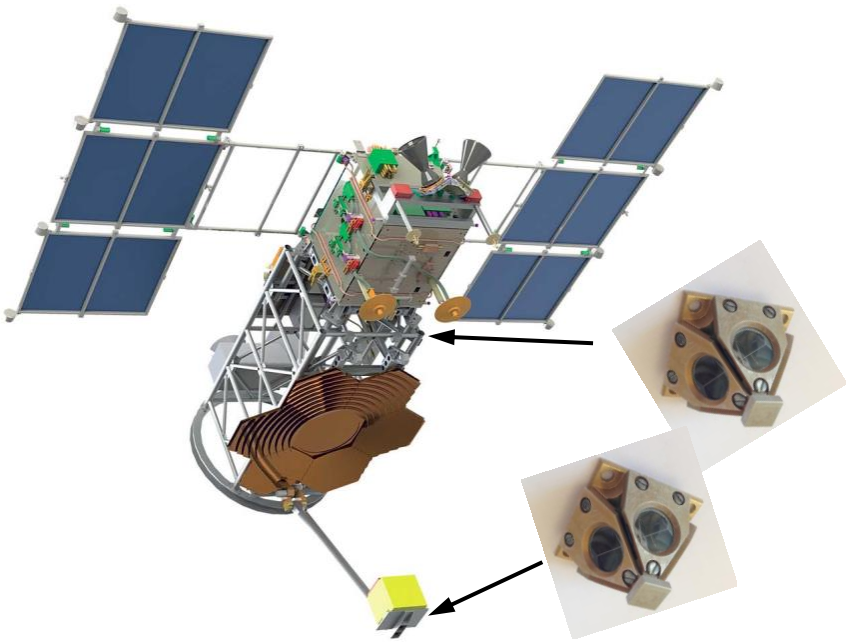
JOINT-STOCK COMPANY «RESEARCH-AND-PRODUCTION CORPORATION “PRECISION SYSTEMS AND INSTRUMENTS»



Retroreflector arrays for «Lomonosov» SC

Akentyev A.S., Vasiliev V.P, Sokolov A.L.

SC «Lomonosov»

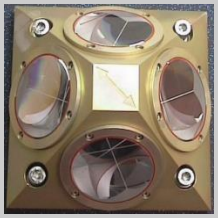


Orbit type	sun-synchronous
Orbit altitude	500 km
Inclination	97,6°
Spacecraft mass	620 kg
Exploitation period	3 years

The project includes the following scientific equipment installation on-board the satellite intended for the following problems studies:

- The studies of the cosmic rays of the extremely high energy (10^{19} – 10^{20} eV);
- The studies of the space gamma-bursts;
- The studies of the transient luminous phenomena in the upper atmosphere;

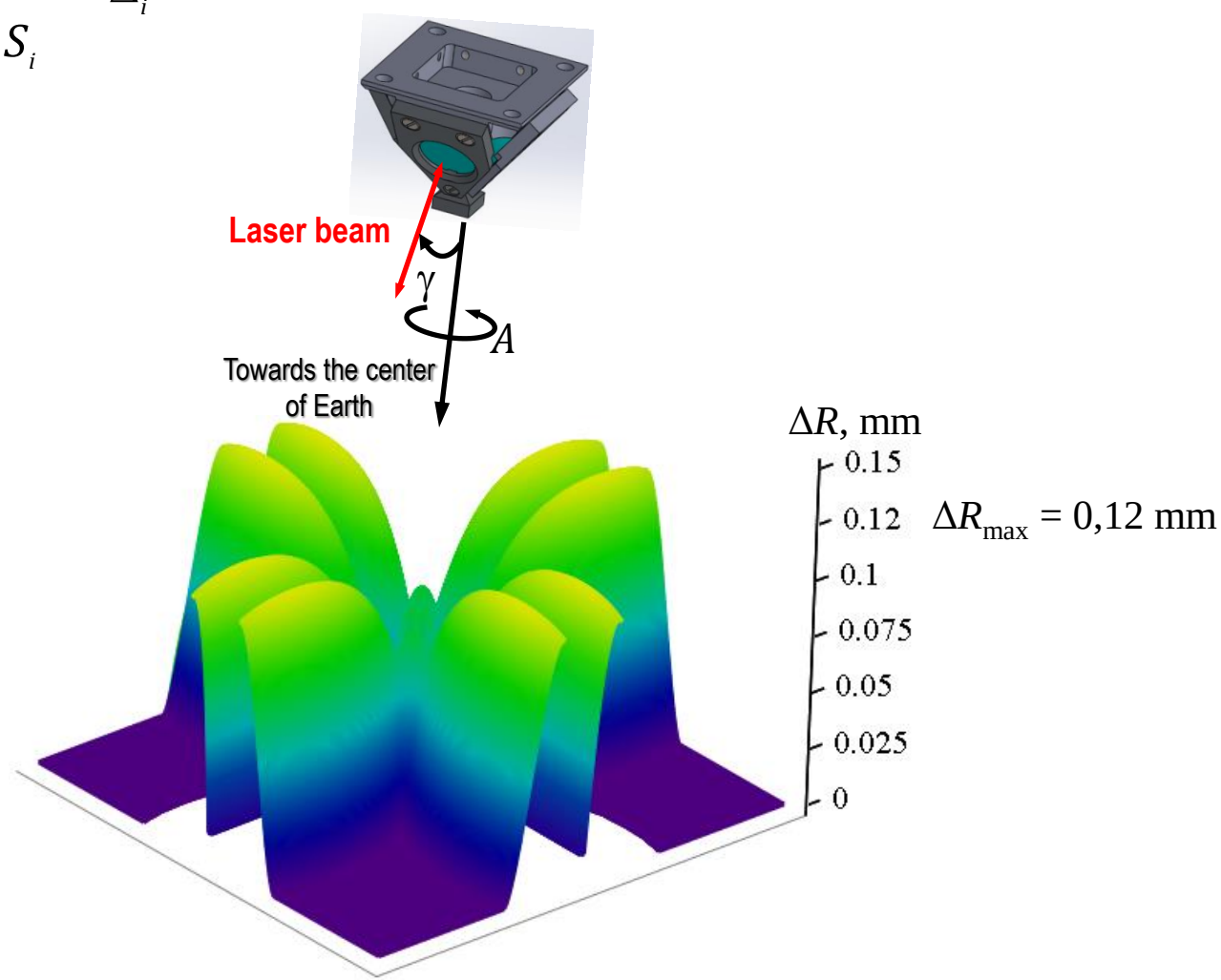
Retroreflector arrays comparison

Retroreflector array	Number of CCR	Mass	Size	Target error
Champ and al. 	4	210 g	110x110x48 mm	≈5 mm
CryoSat-2 and al.	7	375 g	∅114x50 mm	≈6 mm
Lomonosov	4	30 g	40x40x30 mm	< 0.5 mm

Target error

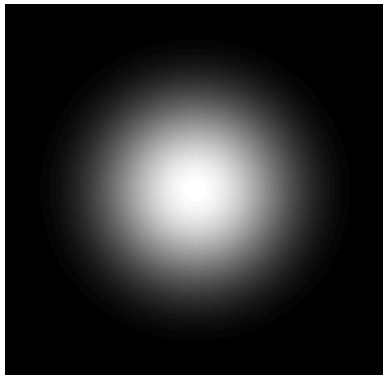
$$\Delta R = \frac{\sum_{i=1}^{4} S_i \Delta_i}{\sum_{i=1}^{4} S_i} - \Delta_i$$

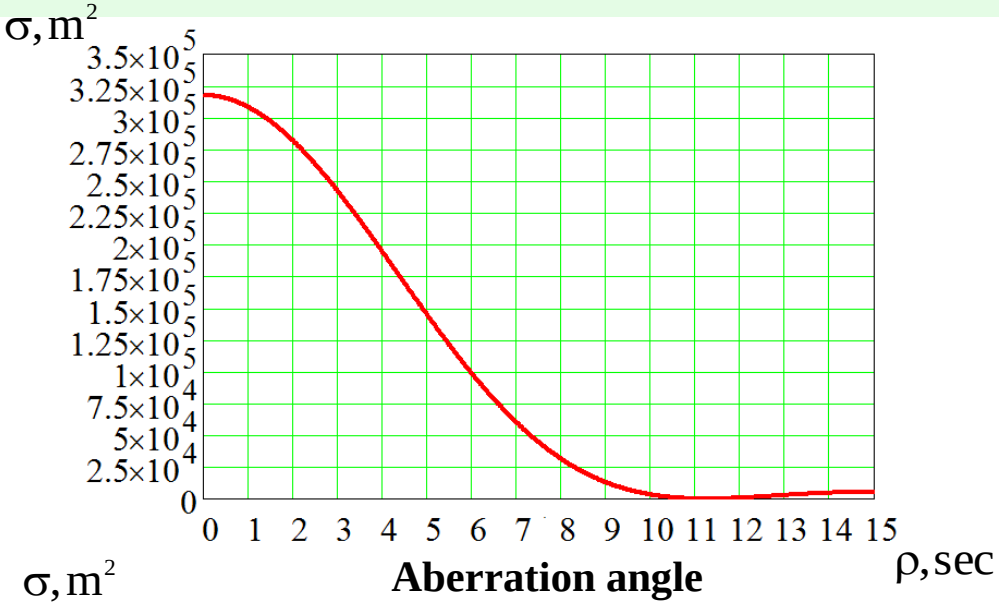
Δ_i – systematic range correction of a single i-cube corner
S_i – active reflecting area of i-cube corner



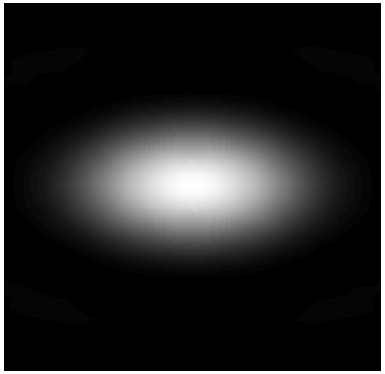
FFDP and cross-section of CCR

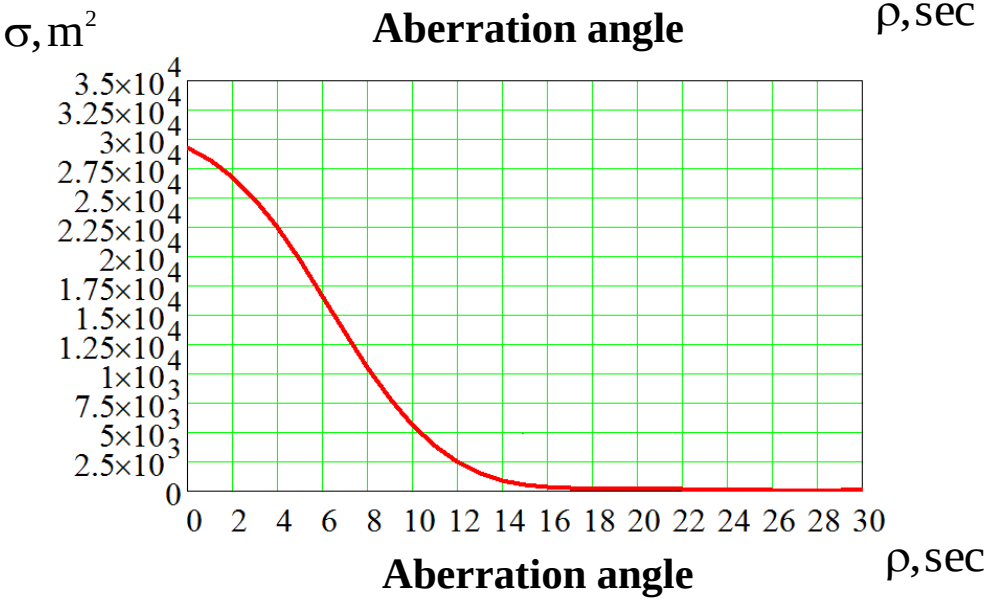
Incident angle 0°





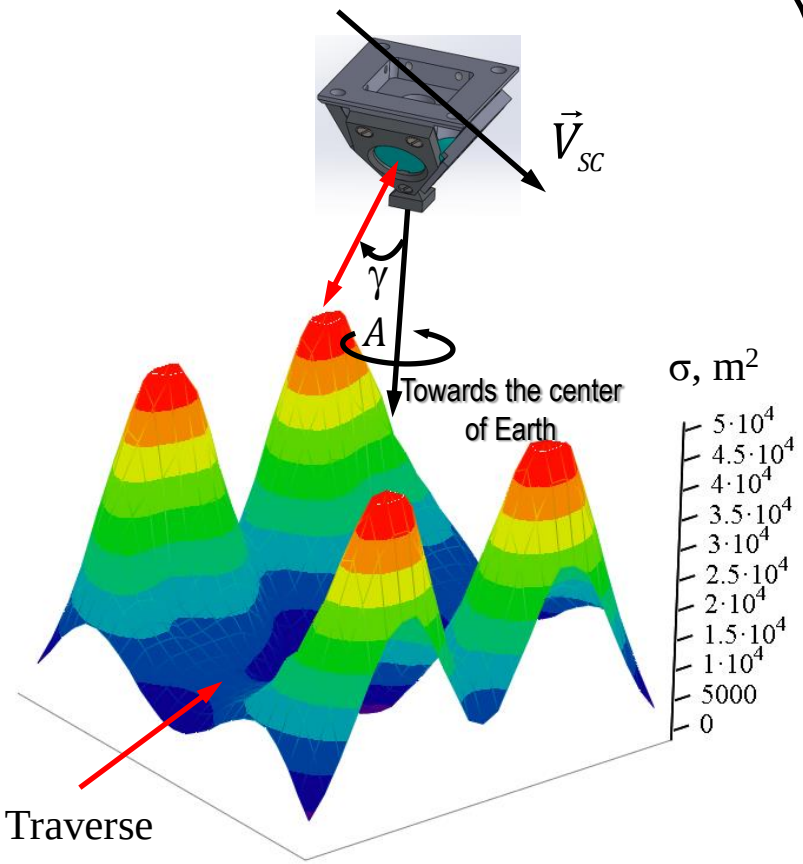
Incident angle 30°





Cross-section of “Pyramid”

Cross-section



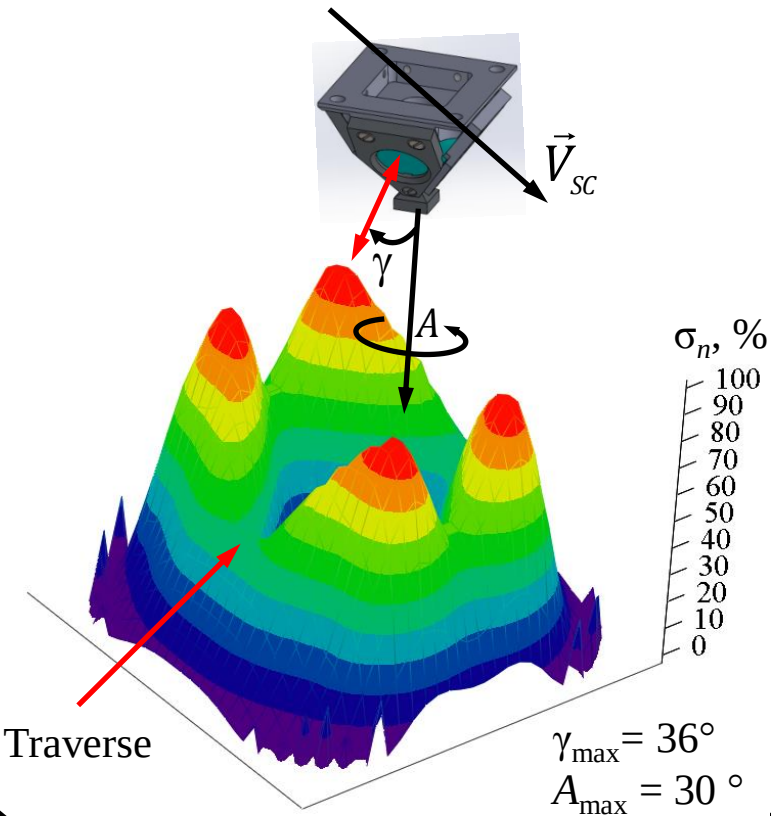
$\gamma_{max} = 62°$
$A_{max} = 29°$
$\sigma_{max} = 5.0 \cdot 10^4\ m^2$

$\gamma_{traverse} = 54°$
$A_{traverse} = 90°$
$\sigma_{traverse} = 1 \cdot 10^4\ m^2$

Normalized cross-section

$$\sigma_n = \frac{\sigma\, k^2 H^2}{\sigma_{max} R^2}$$

R – distance to the SC,
k – atmospheric attenuation;
H – SC altitude



$\gamma_{max} = 36°$
$A_{max} = 30°$