

System of **O**bservation of **D**aytime **A**steroids (SODA)

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The SODA project scientific goals:

- To detect almost all potentially dangerous bodies of >10 m size approaching from the Sun (inside Earth's orbit, day-time asteroids)
- To ensure warning time of ~10 hours
- To determine Earth's atmosphere entry point with accuracy up to 100 km

Telescopes:

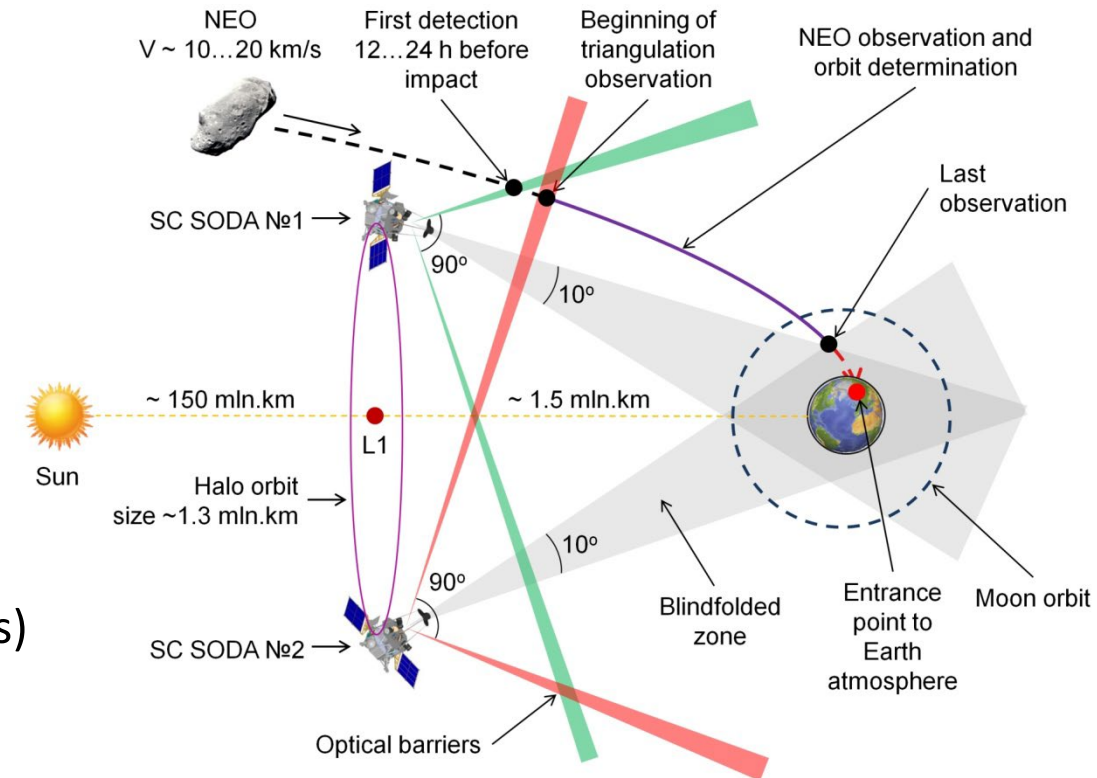
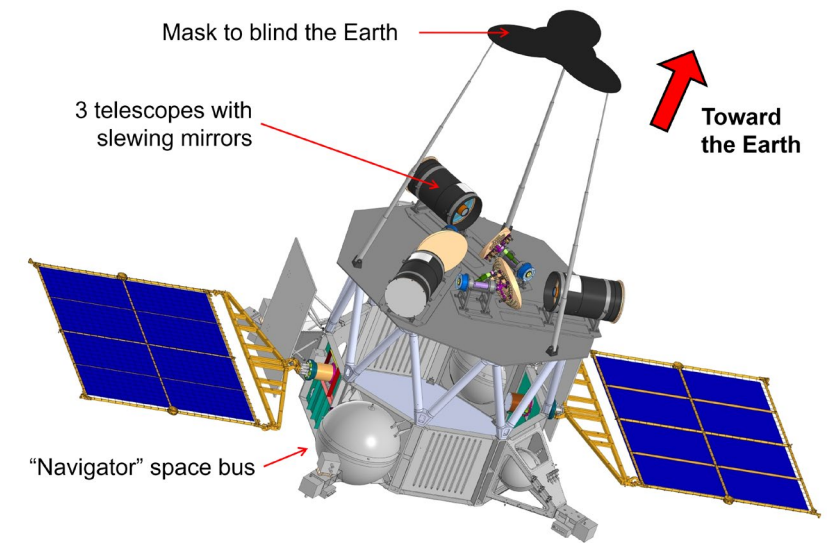
- Baseline option: three 30 cm aperture telescopes
- 3.75° field of view, 0.5" single observation accuracy
- 17^m limiting sensitivity (4 s exposure)
- CMOS detector 30×30 mm, 6×6 k
- Pre-aperture slewing mirror, area of observation 50°×120°

Modes of operation:

- Searching for new asteroids (detection on the optical barrier)
- Tracking of potentially hazardous objects to calculate their orbits

SODA Spacecraft

- Location: L1 Sun-Earth system, baseline option: one SC
- Scientific payload mass: 200 kg
- SC mass: up to 2000 kg (Navigator spacebus and other instruments)
- 0.25 Mbps data channel
- 3-4 ground stations for uninterrupted data transfer



The SODA technological demonstrator

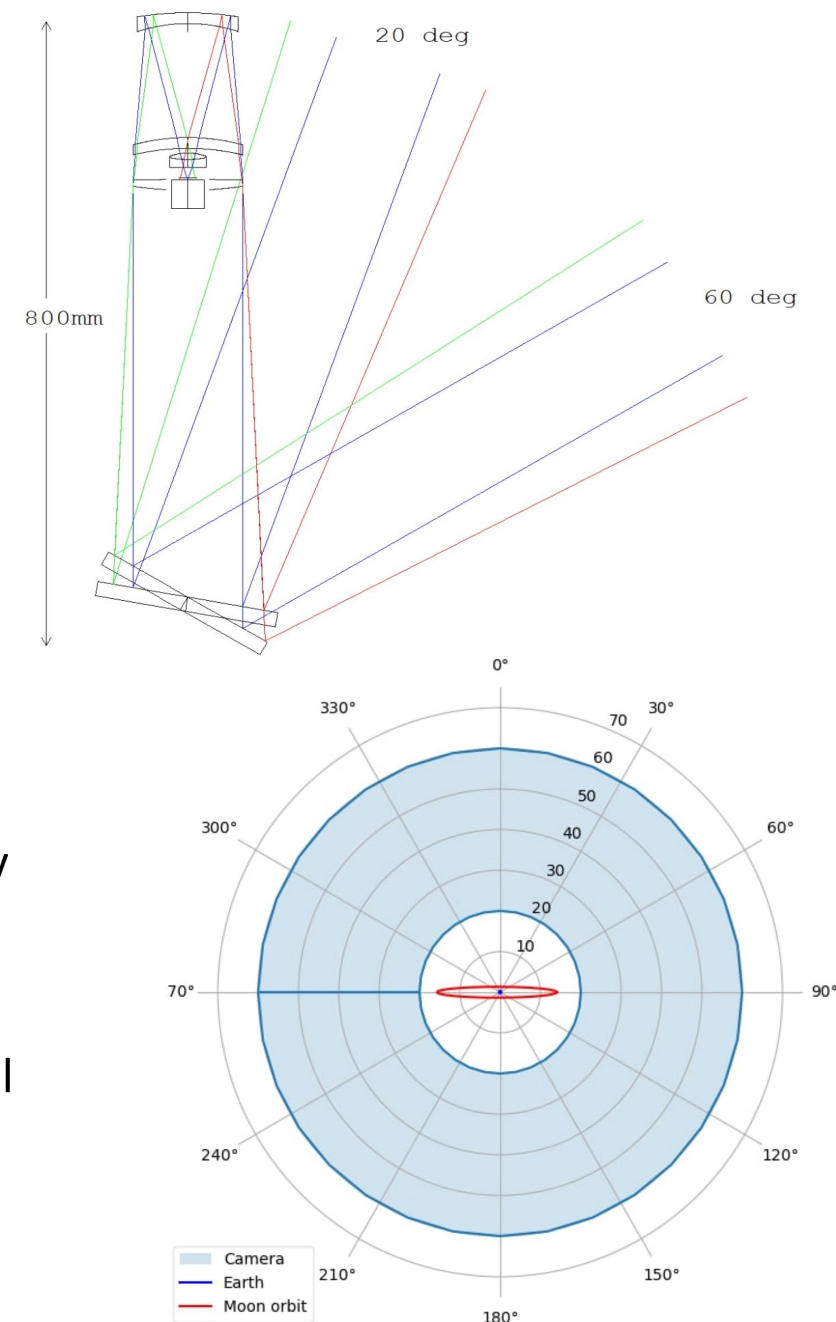
- 30 kg mass budget, 80 cm length, 30 cm wide

In parallel to studying the full-scale SODA project, the concept of a small and cheap SODA technological demonstrator is being studied.

Main differences between full-scale SODA and technological demonstrator:

- Only one telescope instead of 3-4 telescopes
- Smaller telescope aperture: 10-15 cm instead of 25-30 cm
- Larger FoV to compensate survey rate: 6 deg instead of 3 deg
- Area of observation: 360° full-turn, 20°...60° around the Earth
- Barrier observation cycle time: 8 min
- CMOS detectors with small pixels (3-5 μm) to improve angular resolution
- Single observation angular accuracy: up to 1 arcsec
- Lower completeness of discovery of 10 m class bodies due to lack of sensitivity (smaller aperture)
- Slewing mirror size: 220×250 mm

SODA technological demonstrator can be very efficient to verify almost all critical features of the SODA mission and enable beginning of scientific operation – discovery of small asteroids, coming to the Earth from the sunward direction.



Conclusions

- The only realistic way to detect daytime asteroids is to use a space born telescope located relatively far from the Earth (e.g. SODA).
- Some years ago, we presented the SODA pre-Phase A study (feasibility and definition). Substantial improvements of optical features of the SODA project were made since then. These include a new optical telescope design, pre-aperture slewing mirror and new detector.
- SODA uses existing technologies, it is a relatively low-cost project.
- Now the SODA concept is considered as a part of the conceptual national project “Mlechny Put” (The Milky way) which covers the asteroid hazard problem, Sun observation and Space weather. In addition to the SODA payload, the spacecraft at L1 will be equipped with many other important instruments.
- The SODA technological demonstrator is being studied, it can be suggested as an additional payload to any other spacecraft at L1.
- We are open for international cooperation on SODA and SODA technological demonstrator.