Space-related activites at

University of Szeged

Natural Sciences and Informatics Dept.

* Scientific experiments in zero gravity (μgrav.)
* nanosatellite parts
* cubesat development (with students)
* Space telescope usage (approved telescope time on JWST; Kepler & TESS data analysis…)

Engineering Department

* Rocketry (started in 2023) „SZTE Spacewalkers” team (student activity)

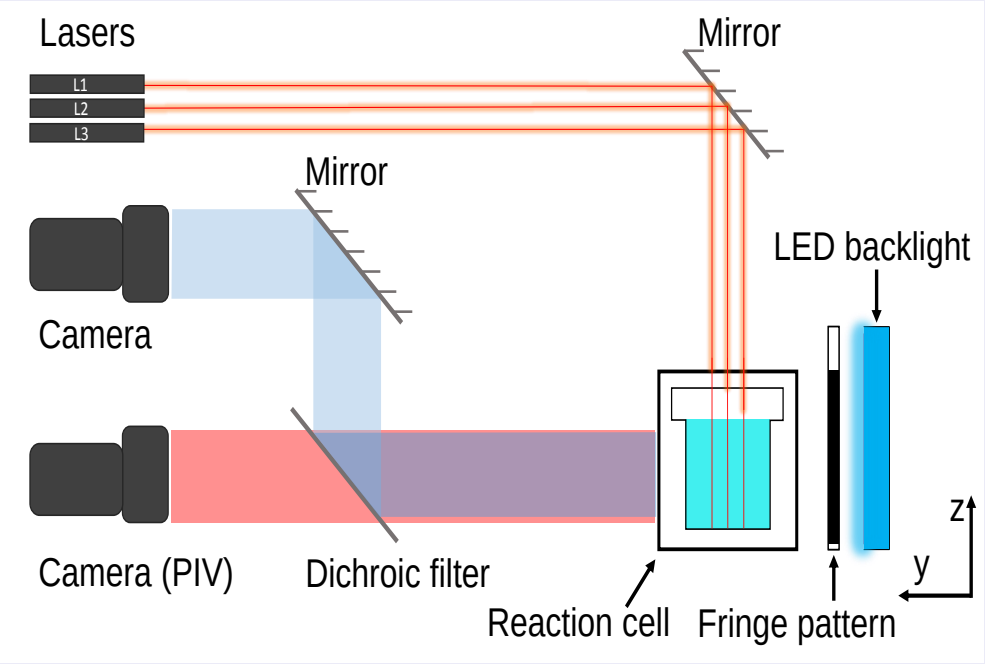
Baja Observatory

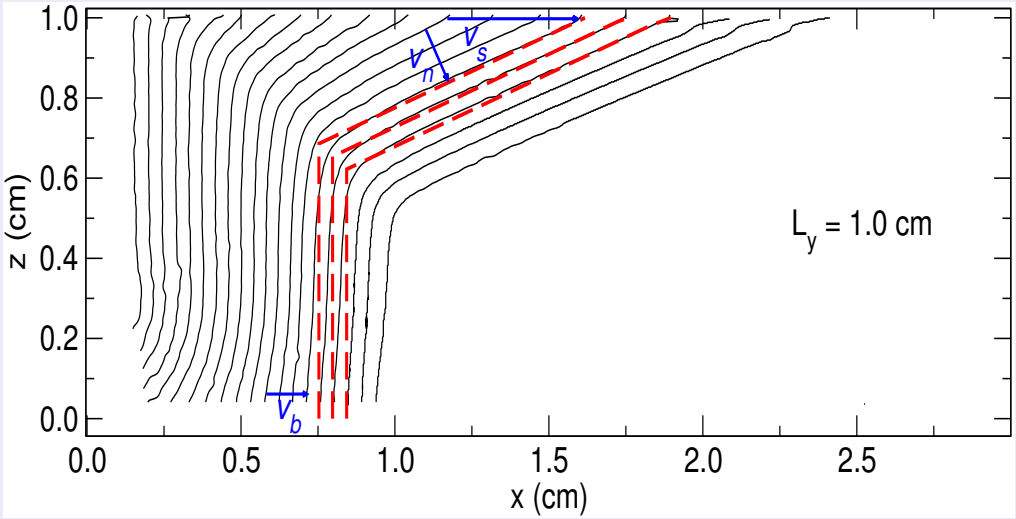
* Satellite and space debris optical tracking (SST)
* Space weather studies (meteor & fireball observations and orbit determination, fall
* high-altitude balloon experiments (measurements, tests)
* Space telescope usage (Kepler & TESS data analysis+ ground-based follow-up obs.)

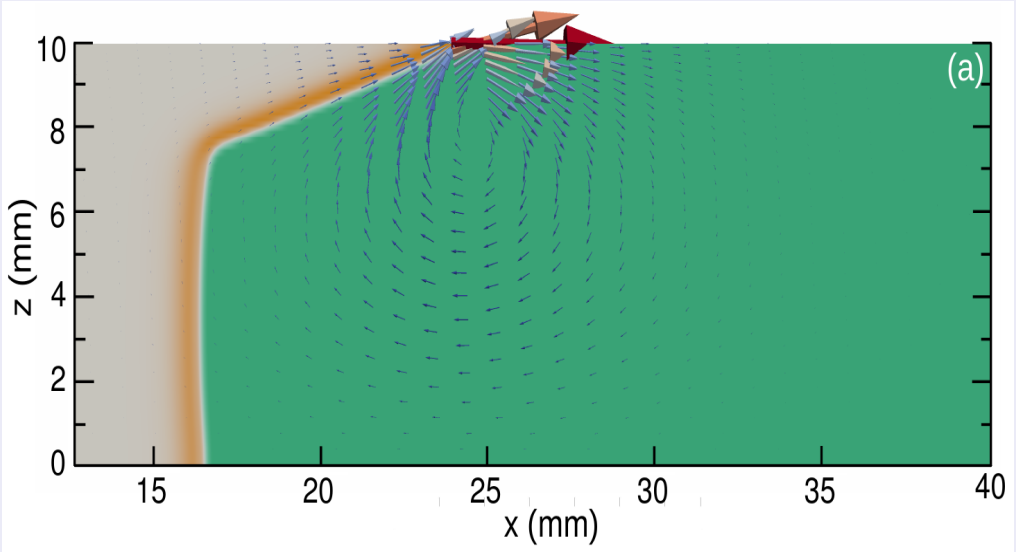
SZTE Nonlinear Dynamics and Kinetics Group

Marangoni effect on reactive interfaces (ESA PF56, ESA MASER-13)

- penetration depth: 1-2 mm
- dynamic contact line on surface
- reaction-diffusion front in bulk
- front shape: geometric spreading



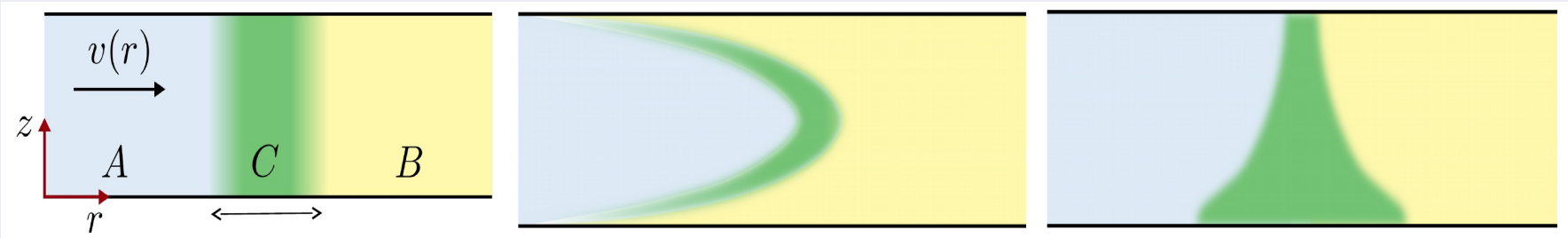




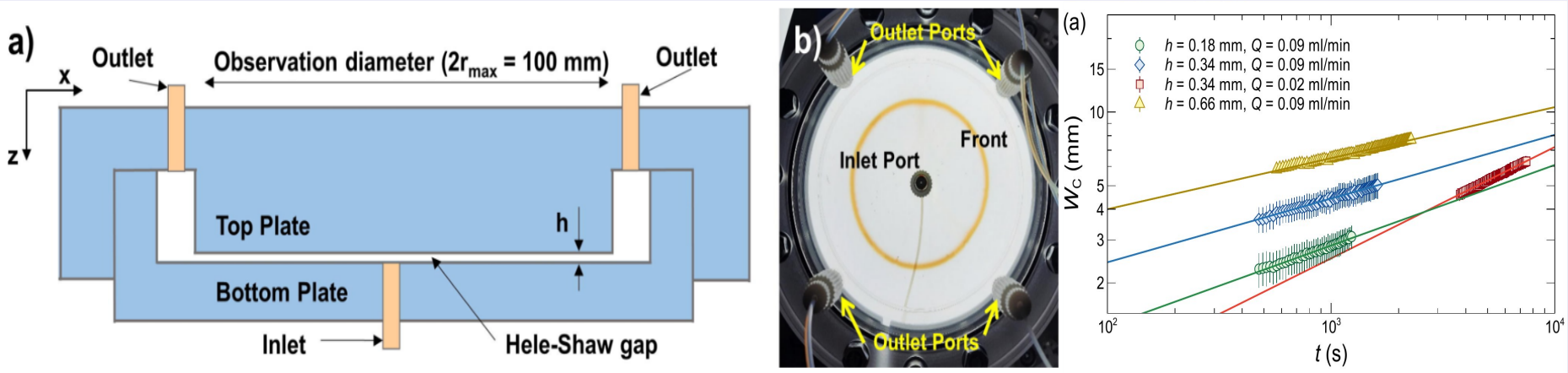
PRL 121, 024501 (2018), Langmuir 35, 406 (2019)

Scaling laws of reaction zones (ESA PF73, DLR TEXUS-57)

- scaling laws around point sources: $x_f = \alpha\sqrt{Qt}$ $\quad w = \delta(Q)t^{1/6}$ $\quad R = \beta(Q)t^{-2/3}$
- distinction of dispersive and convective effects



- significant Taylor-dispersion in thin layer (porous media)



ULB UNIVERSITÉ LIBRE DE BRUXELLES

20 OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

TECHNISCHE UNIVERSITÄT DRESDEN

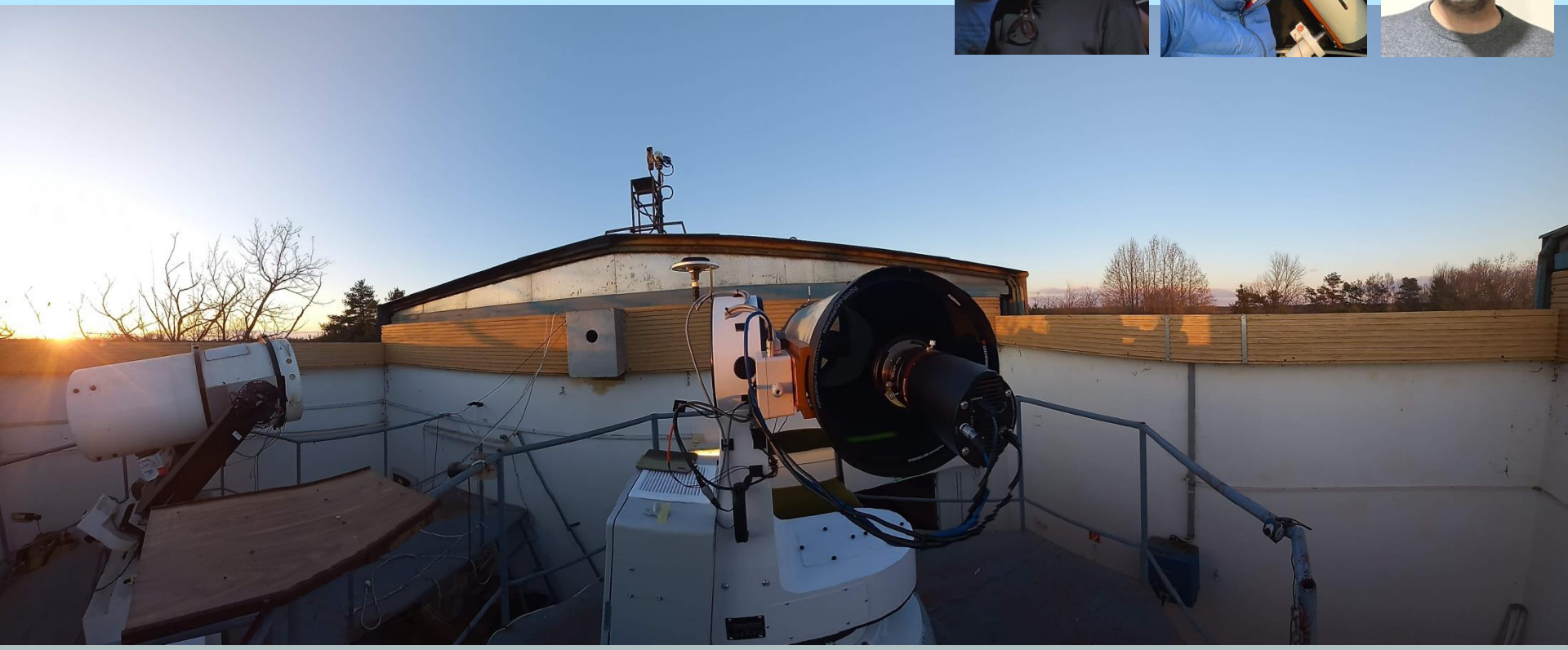
UNIVERSITÉ TOULOUSE III PAUL SABATIER

Chem. Eng. Sci. 257, 117703 (2022), Phys. Rev. Fluids 7, 110503 (2022), NPJ Microgravity *accepted* (2024)

Planetary defense-related activity program at Baja Observatory of SZTE

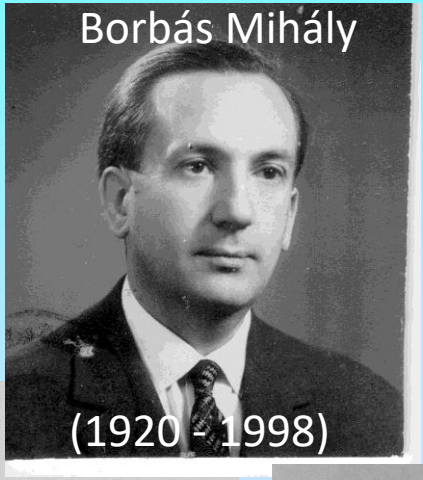
Hegedüs Tibor [1,2,3], Jäger Zoltán [1], Kereszty Zsolt [2,3], Ledneczki István [1]

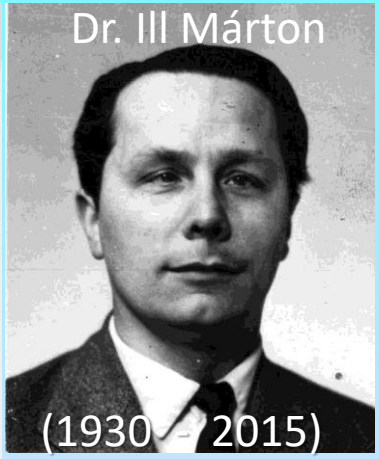
(1) Baja Observatory of the University of Szeged
(2) AstroTech KFT, Baja
(3) Hungarian Meteoritics Society

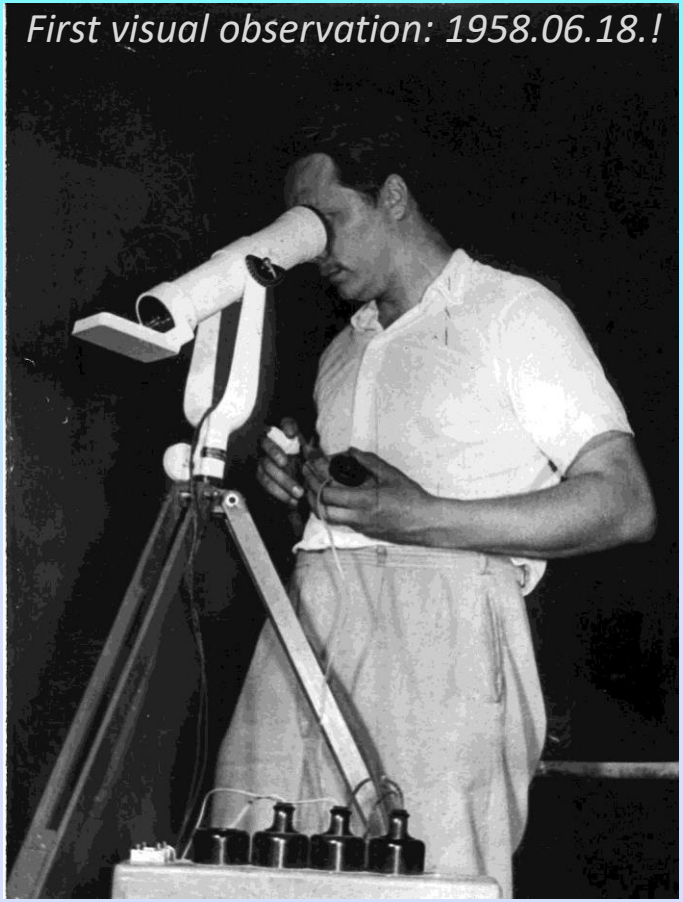


Space Forum (28 March, 2024, Eötvös Lóránd Tudományegyetem, Budapest)

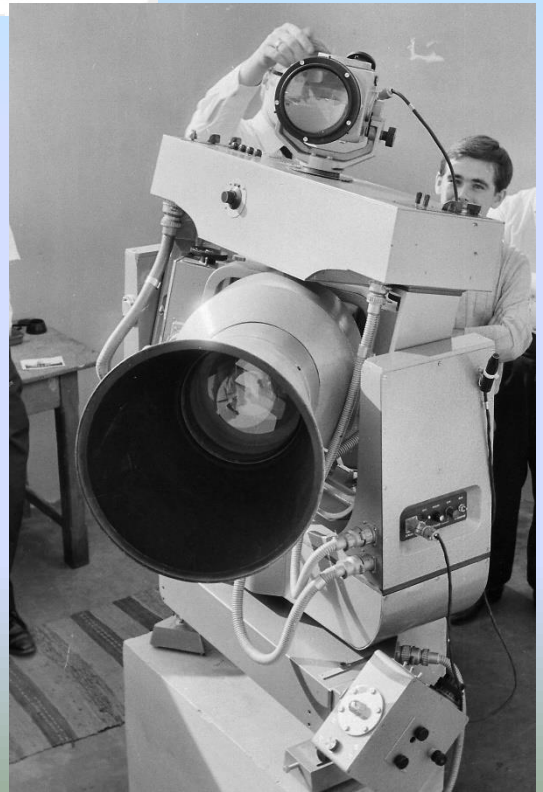
Satellite observations at Baja 1958-1988







Márton Ill is observing with AT-1 (in June 18, 1958), the very first…

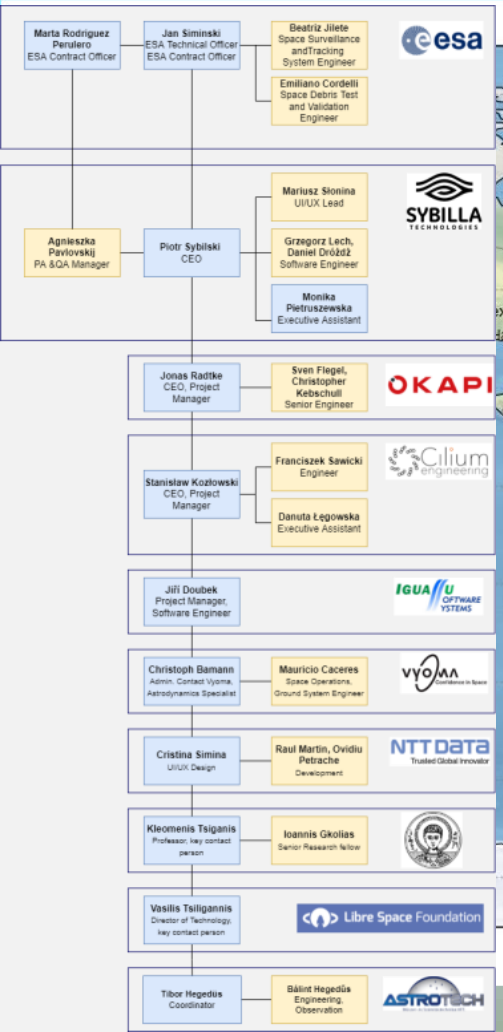


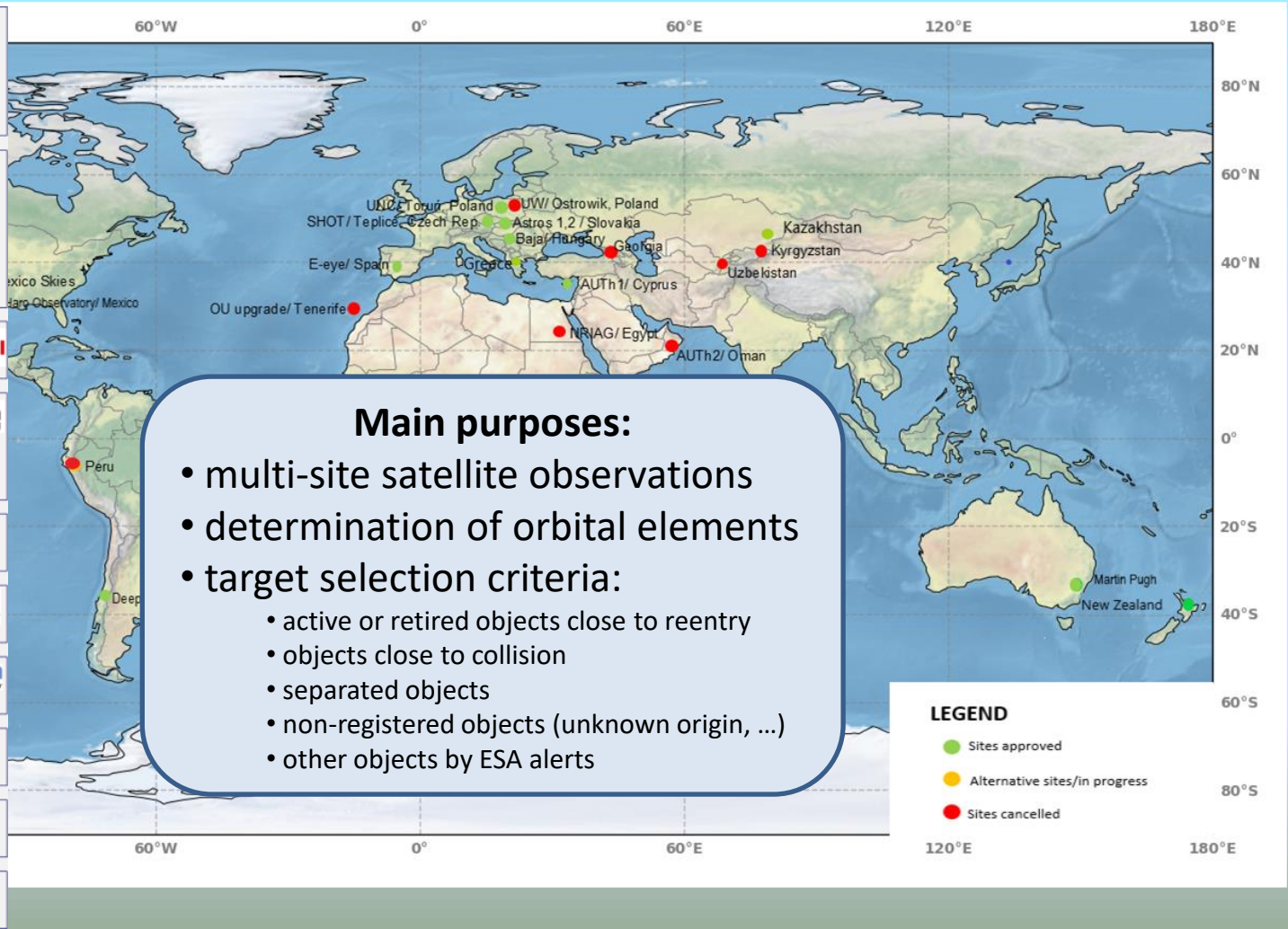
Satellite tracking restarted at Baja 2022-

EON – European Optical Network (ESA contract No. 4000136665/21/D/MRP)

Project leader: Sybilla Technologies (Bydgoszcz, Poland) Hungarian subcontractor: AstroTech (Baja)

Hungarian observing site: Baja Observatory





Main purposes:

- multi-site satellite observations
- determination of orbital elements
- target selection criteria:
  - active or retired objects close to reentry
  - objects close to collision
  - separated objects
  - non-registered objects (unknown origin, …)
  - other objects by ESA alerts

Satellite tracking restarted at Baja 2022-

EON – European Optical Network (ESA contract No. 4000136665/21/D/MRP)

Camera:

QHY268M (APS-C format SONY IMX571 M CMOS sensor, no color filter) ~0,9 kg
number of pixels: 6280x4210 (w/ overscan rows)
pixel size: 3,76x3,76 μm (full-well-cap.: 51 k e^-)
imaging area: APS-C (24x16mm)
exposure times: 30 μsec – 3600 sec (FFR: 6 sec^{-1})
full frame download time: max. 0,17 sec (6 fps)

GPS sensor

Optics:

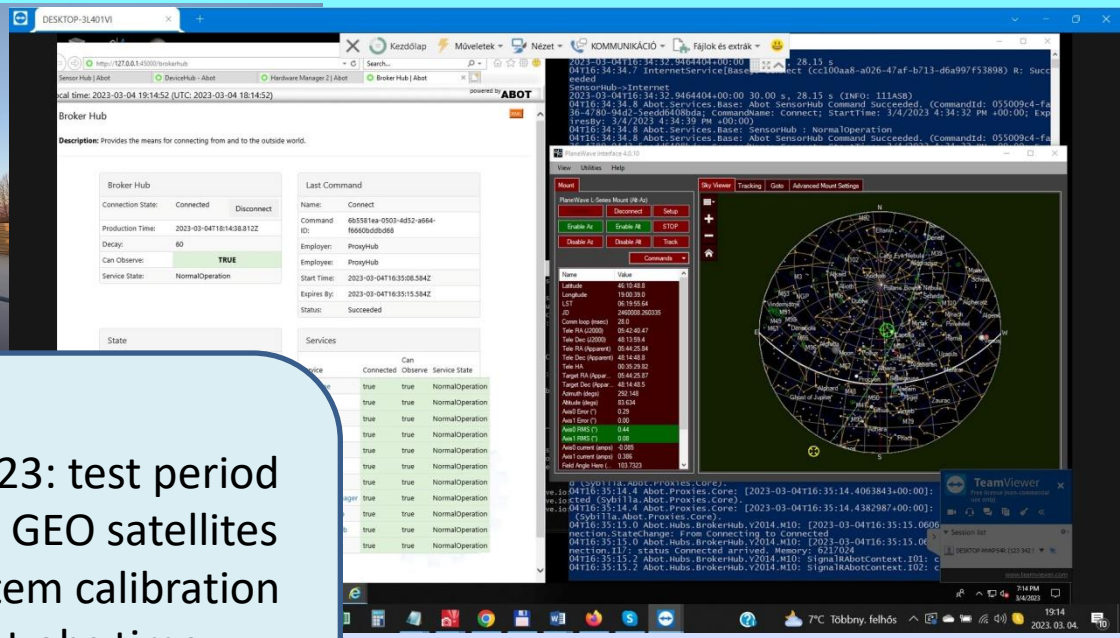
Celestron 11” Rowe-Ackermann Schmidt Astro-graph f/2,2 OTA) mass is ~16 kg
Diameter of the main mirror: 280 mm
Focal length: 620 mm
Diameter of central obscuration: 114 mm
Optimalized image diameter: 43 mm *(400-700 nm)*

Mount:

PlaneWave L-350 altazimuthal direct drive mount
Self mass: 50 kg, load capacity: ~45 kg
Pointing accuracy: 2 arcsec at sidereal velocity
Slew speed: 20 deg/sec standard (50 maximum)

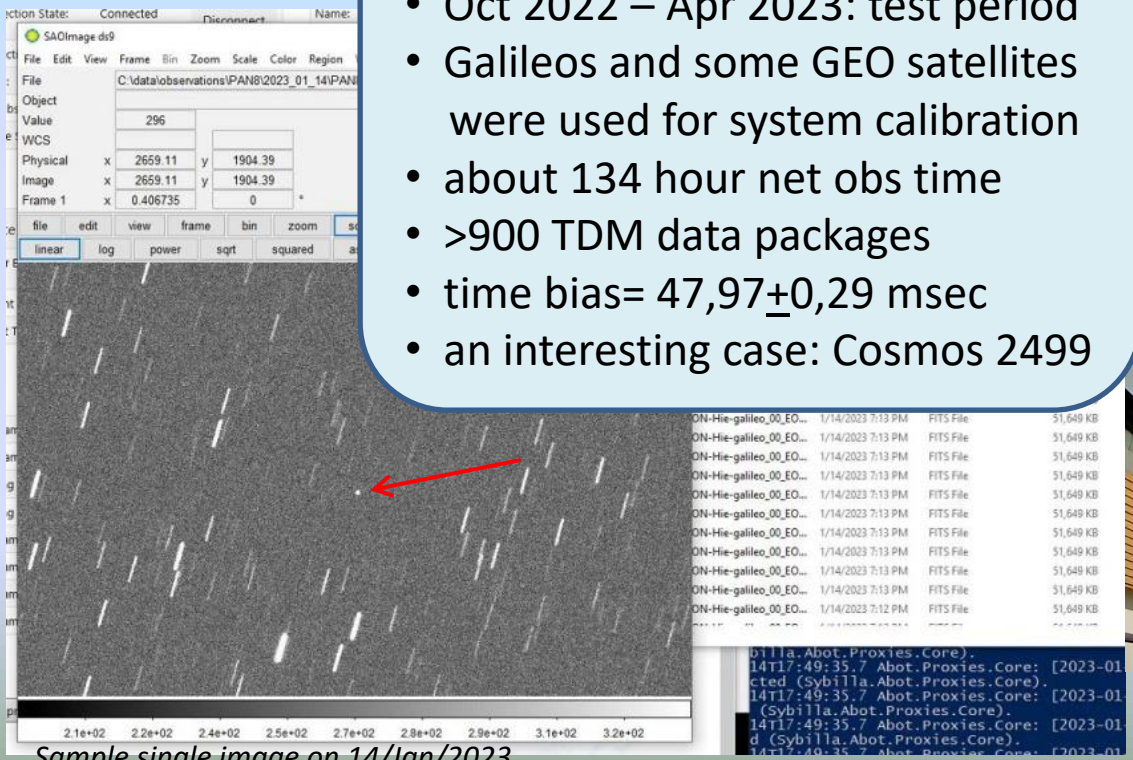
Satellite tracking restarted at Baja 2022-

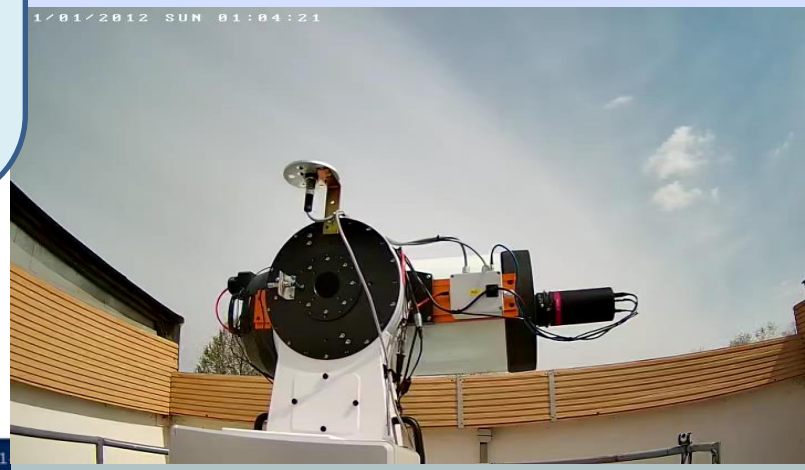
EON – European Optical Network (ESA contract No. 4000136665/21/D/MRP)



First results:

- Oct 2022 – Apr 2023: test period
- Galileos and some GEO satellites were used for system calibration
- about 134 hour net obs time
- >900 TDM data packages
- time bias= 47,97±0,29 msec
- an interesting case: Cosmos 2499



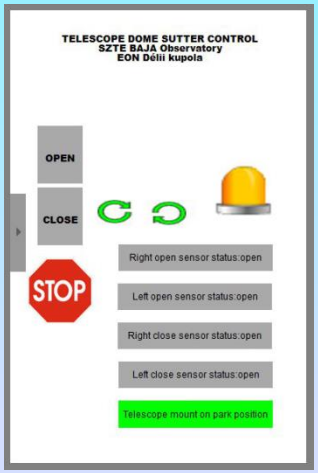


Sample single image on 14/Jan/2023

Satellite tracking restarted at Baja 2022-

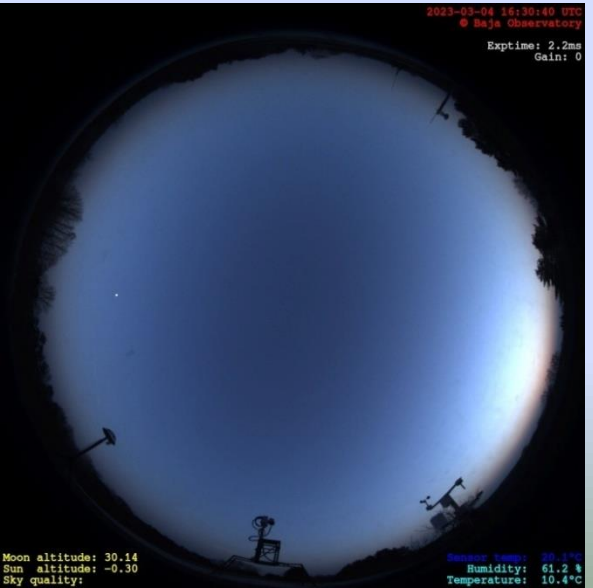
EON – European Optical Network (ESA contract No. 4000136665/21/D/MRP)

Assisting subsystems:



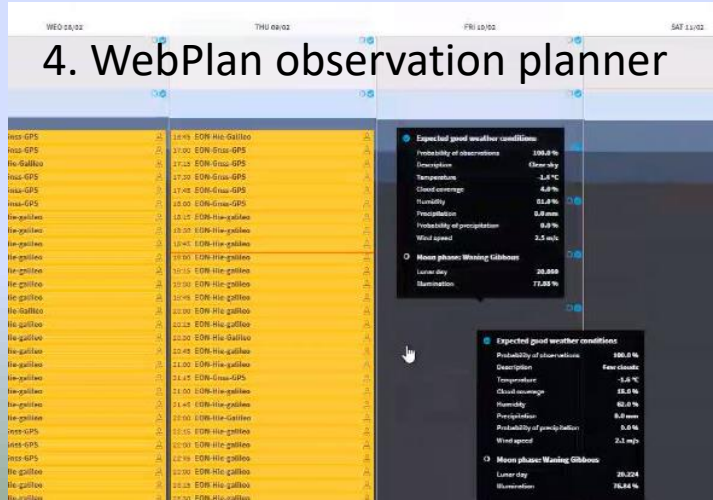
1. Roof Remote Control

2. Allsky image



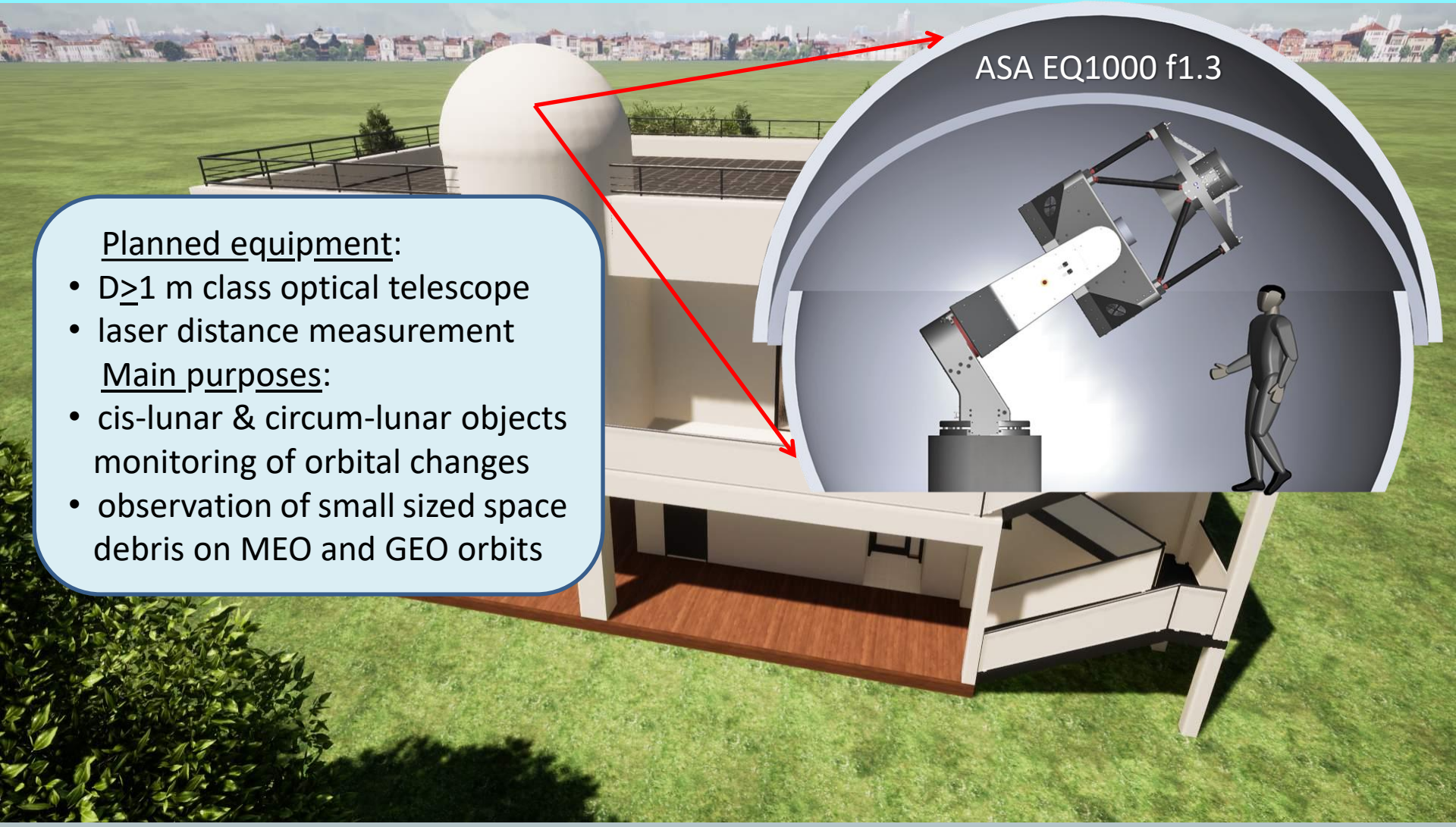
3. Meteorological station

4. WebPlan observation planner



Near future of SST activity @ Baja 2025-

(we are opened for partnership in some of the forthcoming ESA call rounds)



Planned equipment:

- D≥1 m class optical telescope
- laser distance measurement

Main purposes:

- cis-lunar & circum-lunar objects monitoring of orbital changes
- observation of small sized space debris on MEO and GEO orbits

Plan: expansion of existing small building – into a larger research building w/a new SST telescope

Other space (&near-space)-related programs at SZTE Baja Observatory

Cooperating partners: Hungarian Meteoritics Society, Bajai TIE, …

Educational program (since 2022)

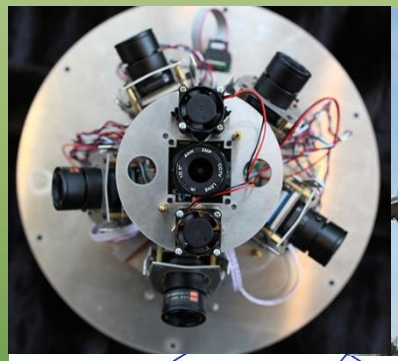
* CANSAT (for high schools)
* Space courses (ELTE, SZTE, …)
  (e.g. „UniSpace” theory+practice)

Baja Airfield, April 29, 2023 - UniSpace

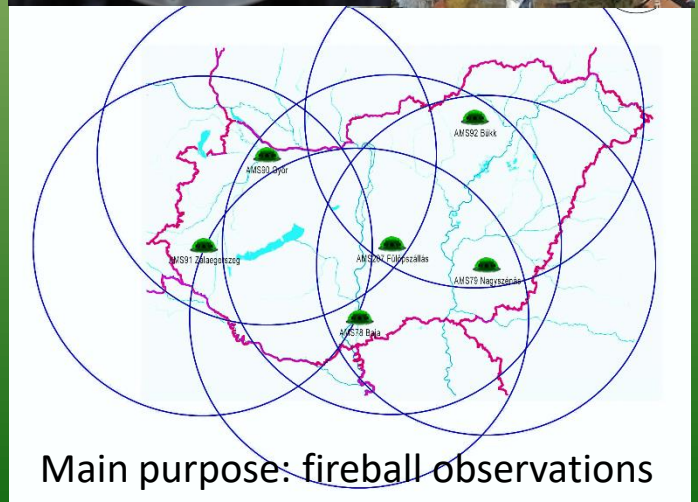
Baja Airfield, May 13, 2023 - UniSpace

Space weather services (since 2021)

* nonstop day+night allsky monitoring
* 6 stations covering whole Hungary



7 (8) cameras/each



Main purpose: fireball observations

Near-space activities

* high-altitude ballooning
* measurement & testing
* model/sport rocketry

University Rocket group (goal till 2026: achieving 10 km)

Baja Airfield, May 13, 2023

THANK YOU FOR YOUR ATTENTION!