

SMOG-1, the 4 th. Hungarian PocketQube Class Student Satellite "Radio Frequency SMOG Measurement System on Low-Earth-Orbit"

Tibor Herman, Levente Dudás PhD, András Gschwindt PhD

Budapest University of Technology and Economics
Faculty of Electrical Engineering and Informatics
Department of Broadband Infocommunications and Electromagnetic Theory
Microwave Remote Sensing Laboratory
Radio Club of BME

dudas.levente@vik.bme.hu

<https://gnd.bme.hu>

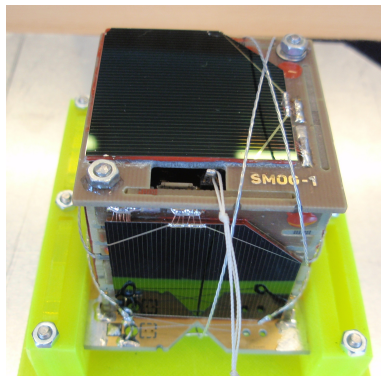
26-04-2021

In Education: SMOG-1 & SMOG-P

1. DVB-T band Spectrum Monitor.
2. Measurement of Total Ionising Dose.
3. Application of hysteresis material to decrease orbit lifetime.

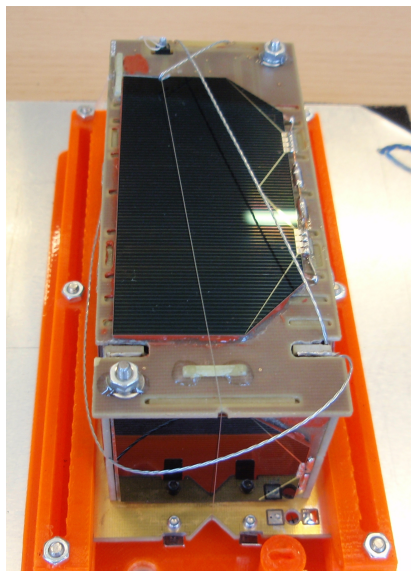
Single-point failure tolerant, cold-redundant on-board satellite sub-systems with local intelligence.

- ▶ 50 x 50 x 50 mm
- ▶ 183 g mass
- ▶ $-40... + 80^{\circ}\text{C}$ temp. range
- ▶ 20g acc. load
- ▶ 06-12-2019, Electron - SMOG-P
- ▶ 22-03-2021, Soyuz - SMOG-1



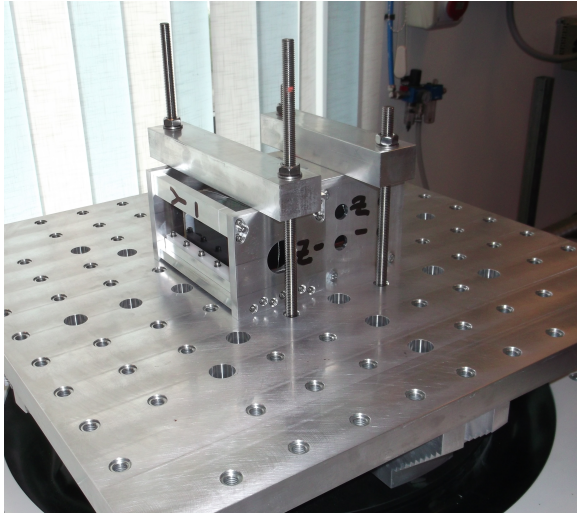
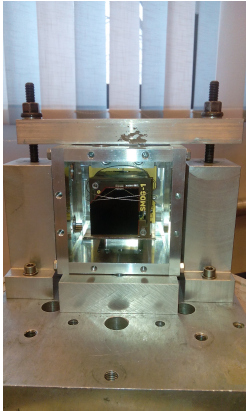
ATL-1 2-PocketQube Class Satellite

- ▶ 5 x 5 x 10 cm size
- ▶ 336 g mass
- ▶ avg. 500 mW DC, 1 W peak
- ▶ 4 batteries
- ▶ 3 special thermal insulator materials
- ▶ 06.12.2019, New-Zealand, Electron



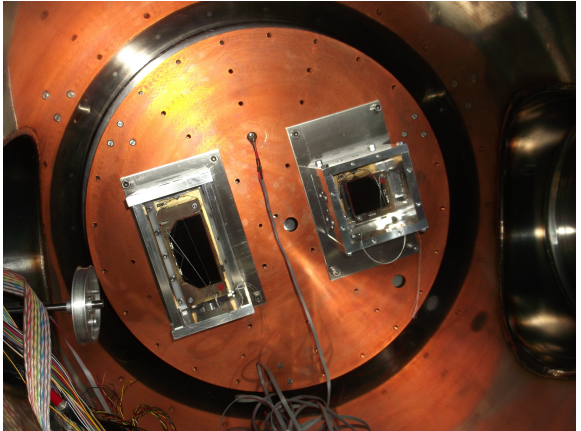
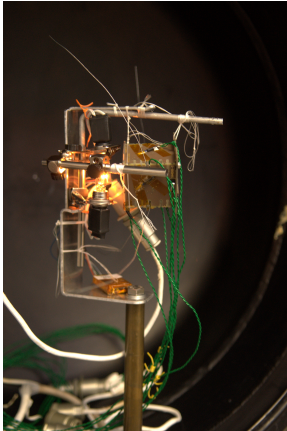
Shaking Test - BHE Ltd.

Qualification 20 g sine, 65 g random peak.
Acceptance 12 g sine (20 Hz -20 kHz), 10 g random.



Thermal Vacuum Test - Centre for Energy Research

+70 deg, 3h baking, -40..+80 deg 4 cycles



Frequency Coordination: Radio Amateur Satellites



SMOG-1 HA5BME

- ▶ 437.345 MHz
- ▶ 20 kHz downlink
- ▶ 12.5 kHz uplink
- ▶ 100 mW

SMOG-P HA4C

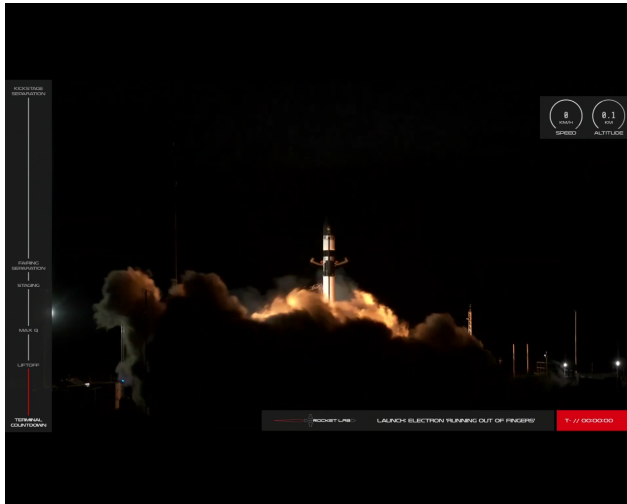
- ▶ 437.150 MHz
- ▶ 20 kHz downlink
- ▶ 12.5 kHz uplink
- ▶ 100 mW

ATL-1 HA1ATL

- ▶ 437.175 MHz
- ▶ 20 kHz downlink
- ▶ 12.5 kHz uplink
- ▶ 100 mW

"Running Out of Fingers" RocketLab Electron START

06-12-2019, Mahia Island, New-Zealand



- ▶ ATL-1 2P
- ▶ FossaSat 1P
- ▶ SMOG-P 1P
- ▶ TRSI 1P

- ▶ Noor1-A 3P
- ▶ Noor1-B 3P

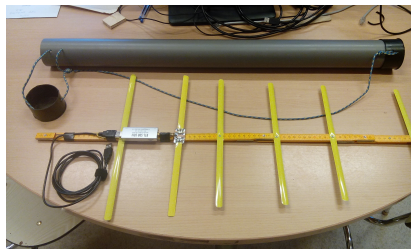
Primary Ground Station of SMOG-1, SMOG-P, ATL-1

- ▶ 4,5 m par. refl. type aperture ant
- ▶ 21 dBlin / 24 dBcir gain
- ▶ 1 kW RF transmit power
- ▶ HW and SDR



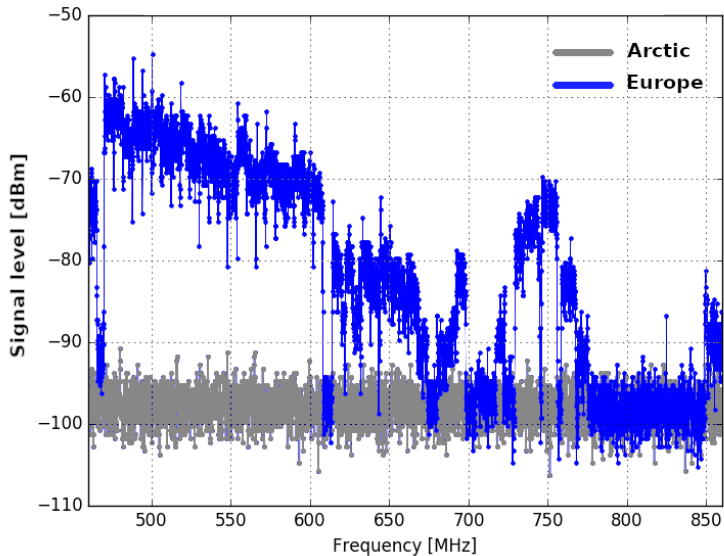
Automated satellite tracking and remote-control.

SMOG-P & ATL-1 Reception Minimal Configuration

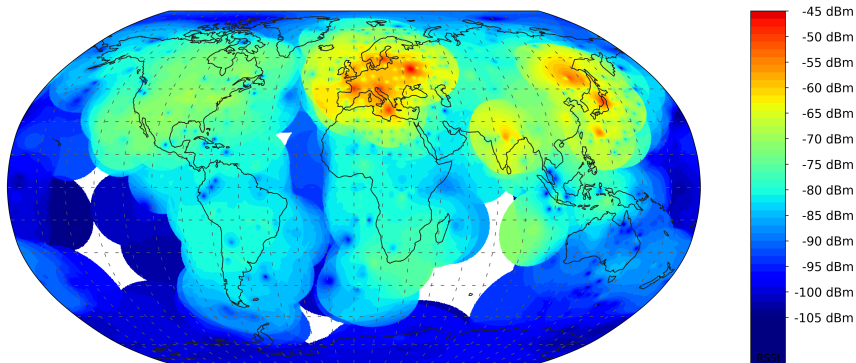


- ▶ RTL-SDR
- ▶ 6-el hand-held Yagi
- ▶ OpenWebRX
- ▶ <https://gnd.bme.hu>
- ▶ <https://gitlab.com/phorvath/smogcli2>

Measured DVB-T Spectrum



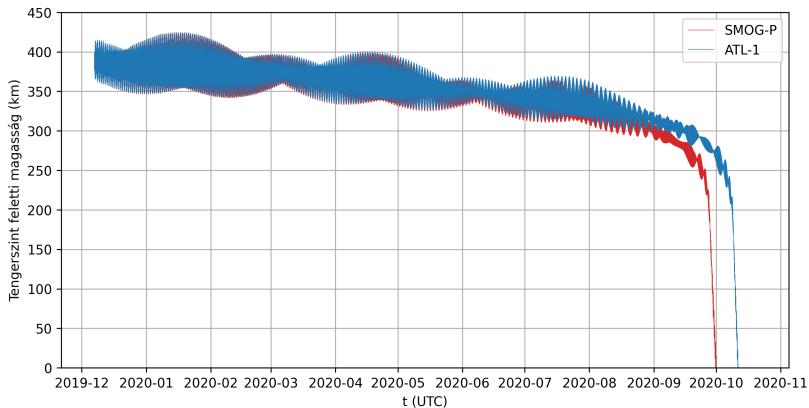
Global DVB-T Band Electromagnetic Pollution Map



Donát Takács, Boldizsár Markotics - BME VIK TDK 2020

Hungarian PocketQubes' Orbital Decay

SMOG-P: 28-09-2020, ATL-1: 09-10-2020

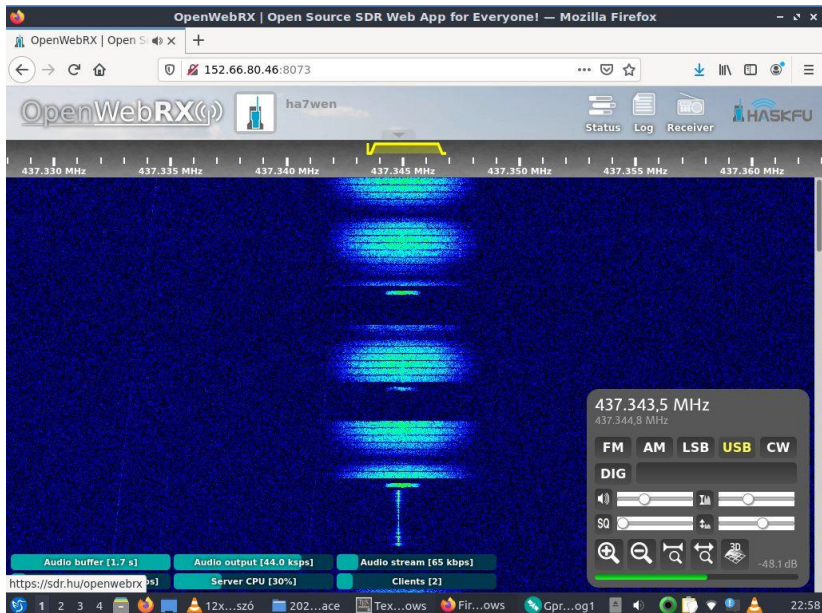


Donát Takács, Boldizsár Markotics - BME VIK TDK 2020

SMOG-1 - Soyuz Start 22-03-2021



SMOG-1 - first signals 25-03-2021 0:46



Plan: SMOG-2 - 5 x 5 x 15 cm

▶ Electrical Power System

- ▶ MPPT
- ▶ SDC
- ▶ LimSW

▶ On-Board Computer

- ▶ Motion Sensor
- ▶ Flash Memory
- ▶ Real-Time-Clock and Calendar

▶ Communication System

- ▶ 437.150 MHz UHF
- ▶ 12.5 kHz up-link
- ▶ 20 kHz down-link

Payloads:

1. Spectrum Analyzer

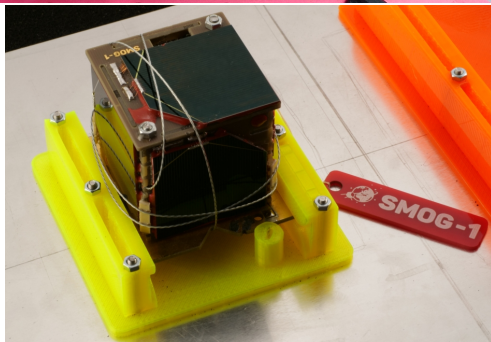
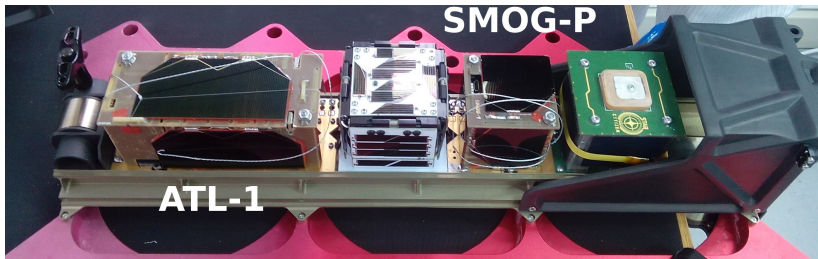
- ▶ 30-120 MHz
- ▶ 120-960 MHz
- ▶ 960-1800 MHz
- ▶ 1800-2600 MHz

2. Active Magnetic Attitude Control - 3 axis

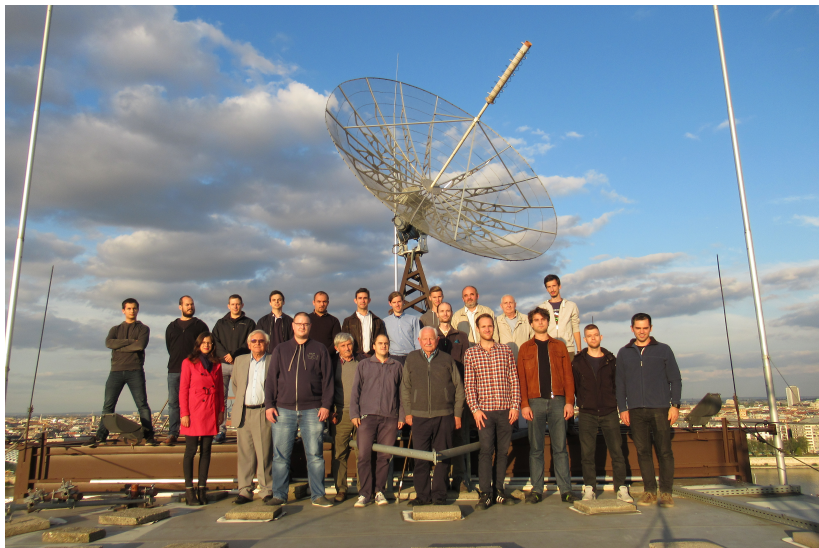
3. ESA-RILDOS - DSSS BPSK + GPS

4. S-band QPSK down-link

5. Total Ionizing Dose Measurement - 27G



Decayed: Masat-1, SMOG-P, ATL-1; Operational: SMOG-1



dudas.levente@vik.bme.hu

<https://gnd.bme.hu/>

<http://152.66.80.46/smog1>