# SMOG-1

*The new Hungarian pocket satellite*

Since the launch of Sputnik-1, Humanity has made enormous efforts on conquering space. In the past 60 years, space devices have represented the cutting edge of our technology, which have made it possible to extend the limits of our known universe and get to know our home planet better.

The advances in electronics have made it possible to create more and more intelligent and self-sustaining systems in ever-decreasing size. Since the beginning of the space age, Hungary has taken a significant role in the design and construction of satellite systems. In 2012 with the success of Masat-1 we have proven that we can create a satellite and operate in space on our own. Masat-1 was one of the first CubeSat class satellites with a 10 centimeter cubic shape which have successfully done their mission.

Following the success of Masat-1, a small team at the Budapest University of Technology and Economics consisting of students and experienced researchers has set the goal of creating the smallest scientific satellite of the world. This device, called SMOG-1 is a “pocket satellite”, known as PocketQube class, whose 5 centimeter size is less than a Rubik’s cube and total mass is below 250 grams.

## Mission of SMOG-1

Sustaining our civilization results in various forms of pollution, one of which is the “electro smog”, the useless part of the electromagnetic waves radiated by our electrical equipment. This electro smog is not observable by our senses, but is ever increasing with the spread of communications equipment and detectable with sensors.

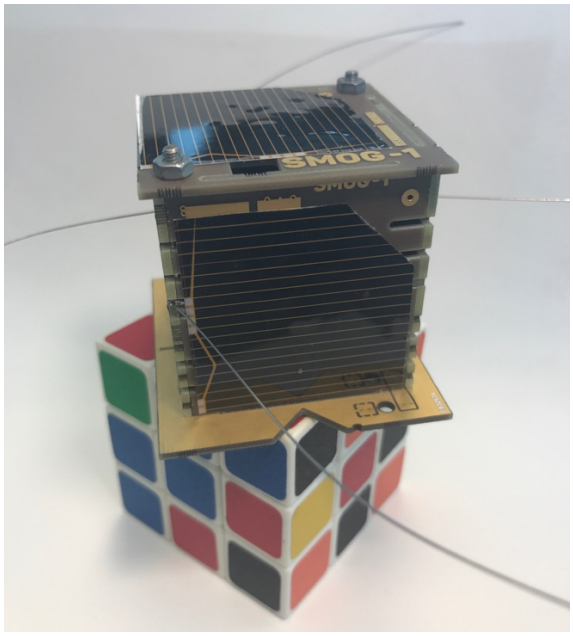
The primary mission of SMOG-1 is to examine this radiation with a tiny spectrum analyzer in the frequency band between 430 and 860 MHz, where this effect is best observable due to wave propagation. It continuously monitors the electrical field in orbit, so after processing the measurement data, we will be able to create a coverage map of the whole surface of our planet, which is unprecedented.

## Content

The advantage of the tiny size of SMOG-1 is that launching it in orbit is cheap; this is why creating small satellites has become popular among technical universities. However, the limitations of the form factor present unique challenges to the designers. The fabled Hungarian ingenuity was necessary.

Along with the spectrum analyzer, all other subsystems which were needed to survive in space were squeezed in the tiny satellite. The power supply systems provide the necessary energy from solar cells mounted on the sides of the satellite. These systems had to be constructed in the most efficient way with the most power saving possible, because the total surface of solar cells is so small that the

average power input is as low as only 0.3 W. This power is even less than what a TV consumes in standby mode.




*The model of SMOG-1 on Rubic's Cube for comparison*

Scheduling the measurements and control of all the subsystems is the job of the on-board computer, which also takes care of processing all the data and coding of the messages. Contrary to Masat-1, nor the size constraints, neither the energy limitations made it possible to put a camera on board. Instead, the satellite was equipped with a lot of auxiliary sensors which make it possible to perform scientific experiments, such as the magnetometer which is used for examining the magnetic field, the three-axis gyroscope and the light sensors mounted on the cube sides.

The secondary mission is to measure the total ionizing radiation dose that is exposed to the electrical components of the satellite, using two dosimeters. This instrument is custom developed, and is currently the smallest active dosimeter in the world. It only takes 13 by 13 millimeters on the electrical printed circuit boards.

Nearly a hundred different pieces of telemetry data are produced by the measurement systems. This data is transmitted using the radio circuits of the communication subsystem. SMOG-1 is also a radio amateur satellite, so anyone with the right equipment will be able to receive all the measurement data anywhere on Earth.

After the lengthy and thorough design phase, the satellite has been constructed from thousands of small parts. Currently the testing processes as in progress. The team intends to artificially create any possible state which can be expected in space during the mission. This is how the qualification tests are done to prepare the satellite for surviving even the worst possible conditions. Launch is expected in 2018, when hopefully another successful Hungarian mission will begin in space.