

'LUMP SUGAR AND SALT SHAKER'-LIKE NANO AND PICO SPACE DEVICES AND ROBOTS

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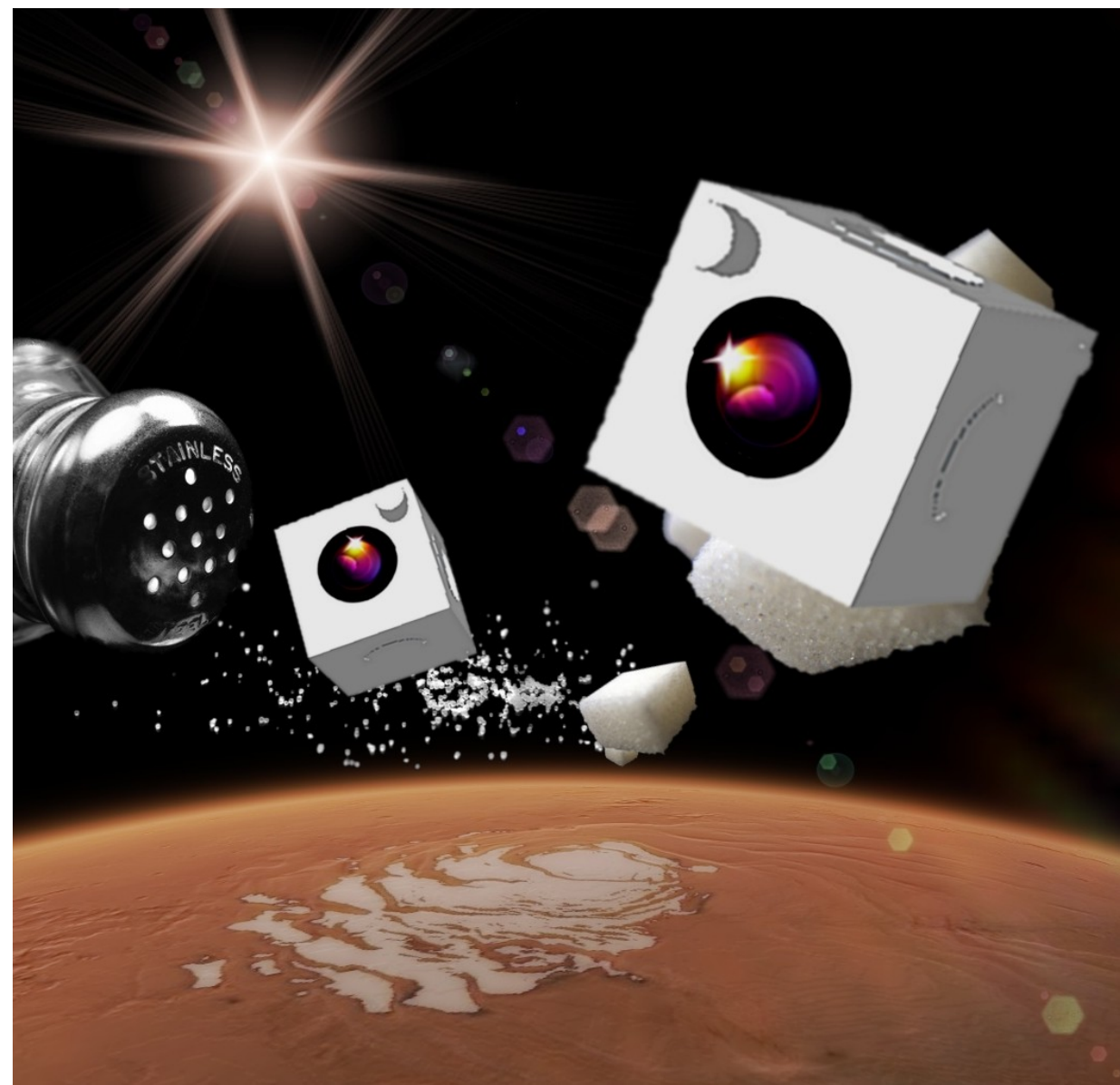
Introduction:

In the present article we give a brief summary of some new ideas coming from the micro and nano technology which have become available for space technologies, too. The application of the Nano-, Pico- Space Devices and Robots (NPSDR) focuses on detections and measurements which can be carried out on planetary surfaces with a new strategy, i.e. a multiple and parallel use of these instruments. The great number of NPSDR devices allows covering larger surfaces on the planet measuring several focused parameters. Using NPSDR devices we also focus on environmentally friendly instruments in Space. We selected a promising application field: studies on defrosting phenomena of DDS at the South Polar Regions of Mars. Proposal to put into ExoMars Program two containers of NPSDR and during orbits of landing drop them onto North and South Polar Region.

Nano Pico Space Devices/Robots (NPSDR):

Name, idea, purpose and structure. The name of Nano Pico Space Devices and Robots (NPSDR) gives the image-word for similarities of everyday tools: 'The Lump Sugar and Salt Shaker Space Technology'. The volume of nano and pico sized space probes are between one cubic decimeter and one cubic centimeter. To reach this economical size we must use the micro and nano technology available in recent technology.

The main purpose of this strategy is to make measurable a larger area on the surface of a planet at one time. The container space probe holds and scatters these Lump-sugar sized objects (devices) as the Salt Caster scatters the salt. The salt caster space probe, approaching the planetary surface, spreads the measuring devices evenly and randomly on the targeted field. To reach deeper region of surfaces can be used lengthwise pencil and bullet shaped rotated objects. To keep the device moving by atmosphere it can be similar to a flying flower seed. (Over the lump-sugar sized devices even additional inner parts can be salt grain or hair sized and shaped ones, too. Hair elements can serve as electrical wire or optical fiber cable units measuring core systems of extended salt grain sized detectors.)



Design and Structure:

Structure of the NPSDR consists of outer and inner parts. The outer one is the frame with cover, the inner one is hardware and software. The outer frame with cover is a container for the whole device which also contains sensors, and cameras. The inside structures are for the hardware and software which are a reduced set of a combined symbiotic chemical and mechanical structures.

Size. The size of the device is similar to a Lump Sugar in the inch or centimeter range and when necessary can contain smaller parts, see below.

Parts (different subsystem distinction): The three main parts include 1) container, 2) measuring system or detectors, and 3) information transmitter. The container can hold, deliver e.g. put things of wide spectrum of variability into the target.

Deploying design: To fly and arrive at the target ellipsoid shaped scatter field is the job of the main spacecraft of the experiment, which is cheaper because it is not necessary to land only to deliver smaller NPSDR probes.

Moving design: Some situations require NPSDR to move. Because of size in inch or centimeter range the moving solutions are similar to the world of insects or small things e.g. screws or small balls. From simple to complex there are possibilities from the simple random jumping to the oriented moving.

Mechanical design: The mechanical design is to substitute and reduce the software and hardware requirements, e.g. shapes and origami like one way springs with chemical based reagent detectors.

Functional content: Each device contains a developed process hardware and software with a reduced set of a combined symbiotic chemical and mechanical structure to perform measurement at the selected target. Each device may contain other smaller parts in the millinch or millimeter range to deliver them locally.

Information transmitter: The information transmitter (analog or digital data, in the simplest case yes or no) signs are possible from simple time delay or single/double signs or some special frequencies or combinations of listed types.

The power system: The power for the information system comes from two or more components which are separated during traveling and activated only at the necessary part of the mission. The starting trigger may come from successful targeting, e.g. the landing event in case of a planet surface. It may come from another starting trigger indicated at the end of the measurement when the measured data are ready for transmission. In the less difficult case the measurement solves simple one bit information, zero or one or, in other words, yes or no. If the question is "Is there any predefined, measurable thing?", the answer could be yes or no. According to a measuring method the yes/no answer could be a delay or a different sign, e.g. different frequency according to simplicity.

Detection: Because of small size of NPSDR the simplicity is important from simple to complex and from individual to common. An NPSDR must be individually simple, but the data receiver needs to be more complex, and post processing must be excellent. NPSDR is deployed for analyzing in situ and remote radar sensors are collecting the emitted data at distant orbiting space probes. The orbit can be elongated to remain above the scatter-field for long enough and to keep the orbiting price at a low cost, according to price of fuel to reach a round shape orbit.

Purpose:

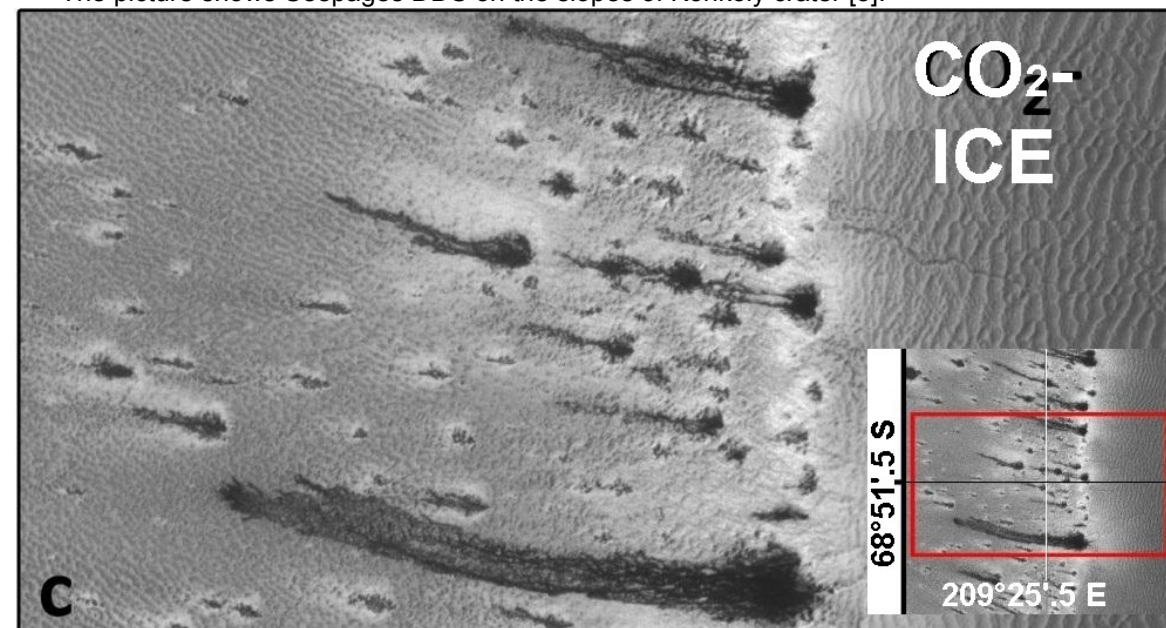
Main purposes of the NPSDR is to detect and to measure several planetary surface characteristics, presence of chemical components or complex units, or to detect subsystems characteristic to clues of life: all these on an extended surface area and in the outer space the plasma which coming from Sun or magnetic fields and cosmic rays.

Possible target:

To detect parameters and conditions of living organisms on Mars South Subpolar Region during seasonal defrosting: One of our important focuses by NPSDR to detect characteristic features of supposed MSO-units (Mars Surface Organisms) at DDS (Dark Dune Spots). As proposed by Horváth et al. (2001) [1][3], Gánti et al. [2], Kereszturi et al. [4]

Dark Dune Spots are seasonal defrosting features at Polar Regions of Mars. The ground material is dark basaltic sand with areal extension of some hundreds of meters. DDS begin to develop at late winter – early summer. Spots on the slopes emit slowly flowing streaks which were shown to contain water. Their most probable component is brine. At the original explanation the seasonal activity was supposed to be triggered by the MSOs, which begin their seasonal activity when springtime insulation awakes them. Using NPSDR units special examination reagent matter would be recommended to deploy on a DDS scatter field. Detecting parameters include salty components of the brine, conductivity changes in the soil during the gradually increasing temperature of spring, gas emission during seasonal activity.

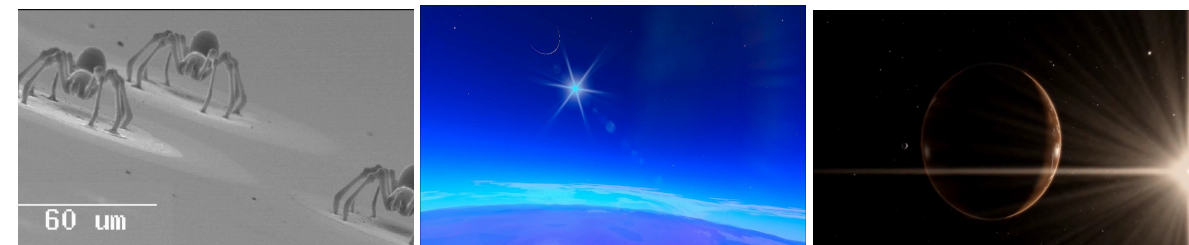
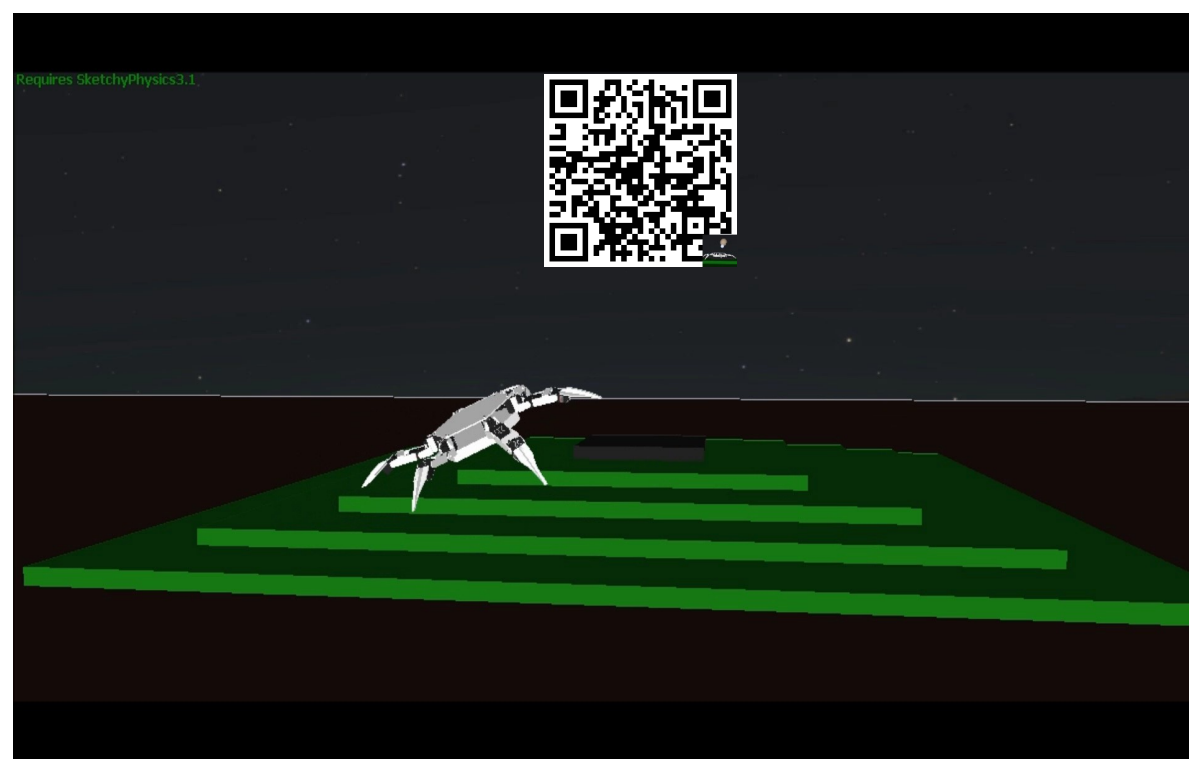
The picture shows Seepages DDS on the slopes of Konkoly crater [5].



Environmentally friendly: NPSDR can be environmentally friendly because of their structure. It can contain only environmentally friendly resources as far as structure and content are concerned. Natural materials as e.g. in the cosmic and terrestrial abundances of elements and isotopes which naturally and frequently fall from the space e.g. meteorites and cometary dust.

Who can make these micro or nano space probes?

We are organizing a competition by lead Attila Sipos which is the Simulated Mars Rover Model Competition www.magyarokamaron.hu (Hungarians on Mars) [6].



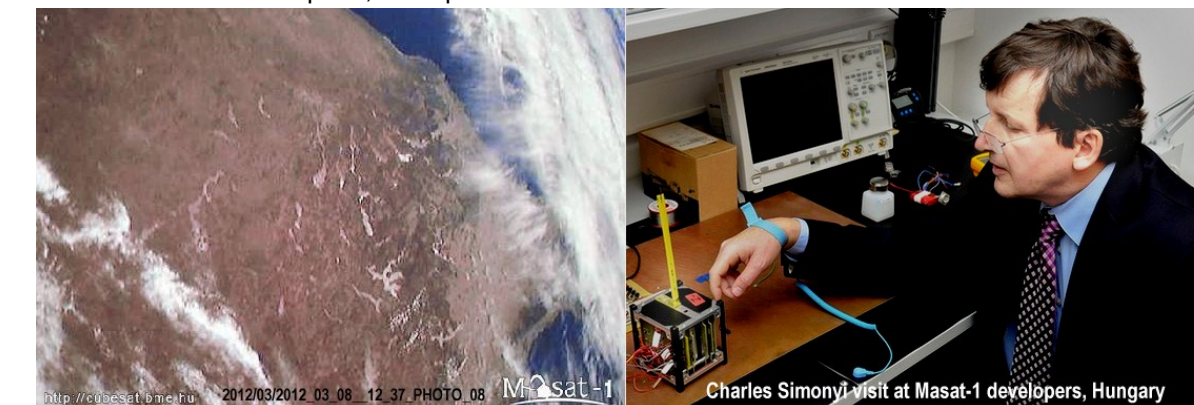
This is a Competition of Applied Engineering Sciences. For the past six years there were several teams, high school and University departments have been trying to complete missions. Some of them were effective and students were successfully started or have finished PhD. studies. One of them became a successful CubeSat developer group.

Success in micro sized satellites: the Masat-1 CubeSat:

Developers of Masat-1 defined the mission criteria in degrees of success. In case of full mission success the satellite must be operated reliably for 3 weeks after launch and must be received all of scientific data and telemetry of the satellite.

My job was to help the Masat-1 group during tests. We have started the preparations for the thermo-vacuum test on 14th July 2010 at KFKI RMK1 (former Research Institute for Particle and Nuclear Physics nowadays the Wigner RCP). We examined the temperature behavior of the satellite at several degrees and in high vacuum during the measurement. We tested it about proper work in the extreme environmental condition. The measurements lasted for two weeks with permanent 24 hours supervision. Results were accepted to have furthermore investigations. [7][8]

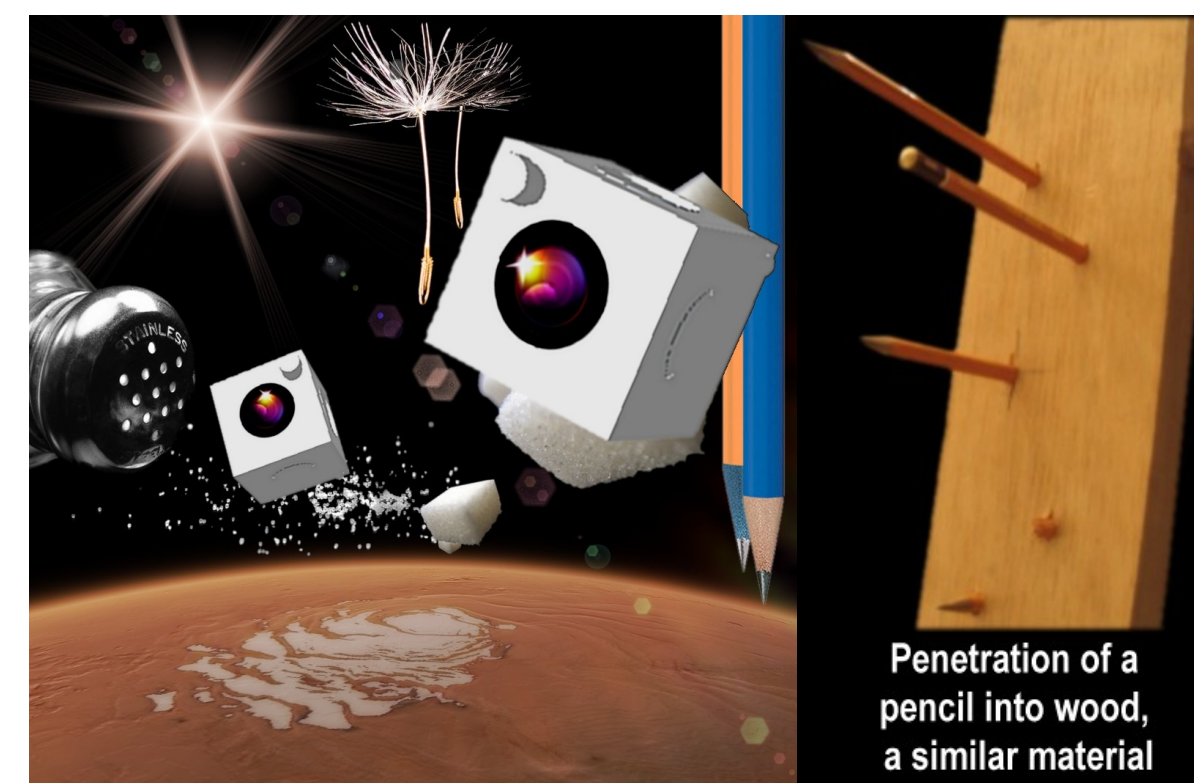
Masat-1 is a "more than full mission success" satellite because of error-less working since launch and several data from space, clear pictures are included.



Summary:

Above we have shown some new ideas coming from micro and nano technology available nowadays. We presented one possible type of Nano, Pico Space Devices and Robots (NPSDR) which are in cm range in size. We summarized briefly some ideas to detect and measure on planetary surfaces and, in addition, we demonstrated one specific instrumental use for detection of clues of living organisms at the dark dune spots during seasonal defrosting changes. At the same time we emphasized the use of environmentally friendly devices in Space. At last we publicized the success of a small space device connected to our researches: the Hungarian Masat-1.

Proposal to put into ExoMars Program two containers of NPSDR and during orbits of landing drop them onto North and South Polar Region.



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