

## Meteorite Like Nano and Pico Space Devices and Robots and the Polar Region of Mars

Vizi, P.<sup>1</sup>, Horváth A.<sup>2,3</sup>, Hudoba Gy.<sup>4</sup>, Bérczi Sz.<sup>3,5</sup>, Sík A.<sup>3,5</sup>.

<sup>1</sup>Wigner Research Centre for Physics, H-1121 Budapest, Konkoly-Thege M. út 35. Hungary, <sup>2</sup>Konkoly Observatory, H-1121 Budapest, Konkoly-Thege M. út 13-17. Hungary, <sup>3</sup>NEST Foundation, Budapest, <sup>4</sup>Óbuda University, Alba Regia University Center, H-8000, Székesfehérvár, Budai út 45., Hungary. <sup>5</sup>Eötvös University, Institute of Physics, H-1117 Budapest, Pázmány Péter sétány 1/a., Hungary. ([vizi.pal.gabor@wigner.mta.hu](mailto:vizi.pal.gabor@wigner.mta.hu))

**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 planetary object 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 is to put into Mars programs containers and during orbits of landing drop them onto Polar Regions.

### Nano Pico Space Devices/Robots (NPSDR):

*Name, idea, purpose and structure:* To minimize the cost of researching with small devices it is necessary to study falling of meteorites and they structures. Some remaining fragments can keep inner texture after breaking through in atmospheres and surviving the perpendicular falling. It is necessary to use container landing devices, rockets or in case of atmosphere aero breaking shields and additional destination reaching mechanism but the goal is to minimize the size, mass and cost with simplicity. The name of Nano Pico Space Devices and Robots (NPSDR) gives the image-word for similarities of everyday tools: The meteorite like ‘Lump Sugar and Salt Shaker style 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 nowadays.

Significant 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 a large amount of these lump sugar sized meteorite like devices as the salt caster scatters the salt. The salt caster like space probe approaching the planetary surface and 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. (Over the lump-sugar or pencil 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 contains 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.

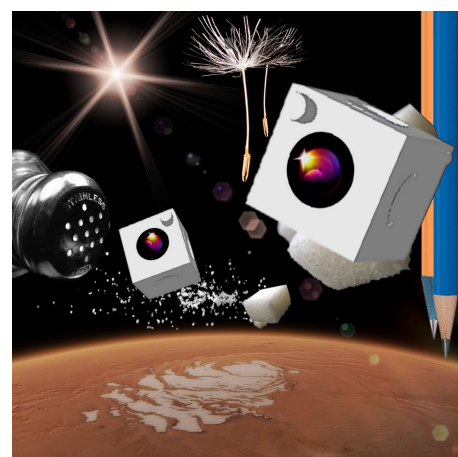


Figure 1. Similarity of NPSDR probes

**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 milliinch 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 travelling 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 shared. 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 MSO-s, which begins 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.

Figure 2 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.

**Summary:** Above we have shown some new ideas coming from micro and nano technology available nowadays. We presented possible types 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. Proposal is to put into Mars programs containers and during orbits of landing drop them onto Polar Regions.

**References:** [1] Horváth, A., Gánti, T., Gesztesi, A., Bérczi, Sz., Szathmáry, E. (2001) Probable evidences of recent biological activity on Mars: appearance and growing of dark dune spots in the South Polar Region. *Lunar Planet. Sci. XXXII*, #1543, LPI, Houston. [2] Gánti et al. (2003) *Origins of Life and Evolution of the Biosphere*. 33(4-5) pp. 515-557. [3] Horvath et al. (2009) *Astrobiology*, 9, Iss. 1, 90-103. [4] Kereszturi et al. (2010) *Icarus*, 207, Issue 1, 149-164. [5] Sik A. (2011): Távérzékelés és felszínalaktan ( Remote Sensing and Planetary Surface Morphology). PhD Thesis, Eötvös L. University, Budapest

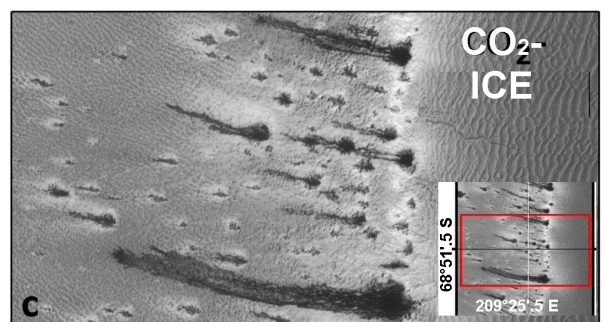


Figure 2. Seepages DDS on the slopes of Konkoly crater