FIRST PLANETARY SCIENCE AND INSTRUMENTATION WORKSHOP

CBK PAN/ING PAN JOINT WORKSHOP, WARSAW, CBK PAN, JANUARY 15-16, 2013

SUMMARY OF DISCUSSION, JANUARY 16, 13:00-14:30

BACKGROUND TO THE DISCUSSION: THE WORKSHOP OBJECTIVES

The Polish Academy of Sciences has both a renowned expertise on space instrumentation design and a quantity of researchers in planetary science. As Poland is entering ESA, new opportunities of collaborations between CBK PAN and ING PAN are emerging.

During this workshop, the participants, engineers and researchers, have exchanged information and ideas in order to identify the areas where the technology skills meet the planetary science goals, in the objective of designing and building innovative instrumentation for space exploration. The engineers presented present their domains of competence, achievements, and ongoing developments, especially for the new planetary scientists at ING PAN. The researchers presented their own field of research, methods of investigations, and ongoing activities, as well as what are the instruments they dream of that would allow significant improvement of the knowledge in their field. One or two ideas of future instrument development will emerge during a discussion at the end of the workshop. Later, working groups will have refined the science objective and technological design of these instruments and present them for critical assessment and decision to continue the adventure of instrument development and seek the required funding.

MINUTE OF DISCUSSION

The discussion is moderated by Dr. Joanna Gurgurewicz, both at CBK PAN and ING PAN.

A summary of the solar system objects currently under investigation at CBK PAN and ING PAN was first given. At CBK PAN, works are concentrated on the Moon, Mercury, Mars and the small solar system bodies (comets and asteroids). At ING PAN, the planetology group (Wrocław Group for Planetology Advance, WROONA), studies are focused on Mars. D. Mège comments that until June 2015, the group is committed to work at full time on Mars research. The group activities are indeed funded at full time by a FNP/TEAM grant for a project devoted to the geologic study of Mars in comparison with the Earth until June 30th, 2015. In order to broaden the research topics of the WROONA group past this date, it is underlined that some time for investigating research topics on other planetary bodies can be

considered in the group, but no "hard work" can be expected during this period. It is therefore concluded that for the time being, developing activities common to CBK and ING should start from the Mars approach. M. Banaszkiewicz recalls that exploration missions are anyway projects to be considered on the long term, which leaves open the identification of solar system targets past 2015.

The instruments under development or potential development at CBK that would help in the present WROONA group's investigations are then listed, as well as ideas suggested by the WROONA group members in the workshop talks.

Of the currently developed instruments, the KRET penetrator is first discussed. This instrument has a huge potential for geologists due to its capabilities to transport sensors in the subsurface regions. Currently two type of sensors are ready to use thermal sensors and mechanical sensors, two other are currently investigated: active seismic sensors and spectrometers. The first two allow for determination thermal and geotechnical parameters of the regolith such as thermal conductivity, heat flow and dynamic penetration index. Two others (if developed) allow to measure molecular composition of the surrounding regolith and other physical properties of the regolith. H. Rickman mentioned about the huge expertise in sensors development in Uppsala university in Sweden.

There was a discussion about size of such networks would be to be useful for geophysical investigations. D. Mège and A. Żelaźniewicz answer that any size is interesting, from tens of meters to hundreds of kilometres, the spatial scale of observations being usually correlated with the scale of the imaged structures and processes. A classic way of proceeding by terrestrial geophysicists consists in making observations at broad scale first, then refine the interpretations and enter into more subtle structures and processes by decreasing transect length.

M. Banaszkiewicz mentions the usefulness of radar to probe the underground; application of radar sounding methods is started to be investigated at CBK with W. Kofman. Future collaborative effort on this matter can be coordinated on ING side by M. Massé, who has been working in the same laboratory as Kofman in Grenoble, France.

Later the discussion is focused on the potential development of a small and light (5-10 kg) hopper (or a network of them, to study rough terrains on Mars. J. Grygorczuk has carried out preliminary studies and submitted a project to ESA for further development two years ago (unfortunately unsuccesful). This idea has raised the enthusiasm of the ING geologists, for a reason explained by D. Mège by a quick drawing on the white board. In order to meet engineering constraints, rovers are committed to land on Mars in flat areas. As a consequence, a very limited number of geological formations (usually one) can be studied by one rover (probably more with Curiosity). hoppers that can land anywhere and jump between obstacles or onto cliffs could allow a survey of many geologic formations. Based on a simplified geologic cross-section of Valles Marineris, it is shown that if they land in areas such as Valles Marineris, in which several kilometers (up to 10 km) of the Martian crust is exposed, such hoppers could retrieve information on the history of Mars since probably more than 4 billion years.

In order to land safely, the hoppers could be placed within landing balls (such as those planned for Netlanders) released from orbit and breaked by a parachute, or at low altitude from a glider similar to the ARES glider proposed to recent NASA Scout mission calls. The balls would open once the surface of Mars is reached, and release the hoppers. Although a single rover would provide very useful science informations, their small size and weight makes possible consideration of a small swarm. The idea of a small mobile scientific squad for studying rough and geologically diverse areas on Mars had been presented in a talk by D. Mège earlier during the workshop (that idea was applied to a swarm of science balls mainly moved by winds and occasionally by spring).

Partly similar hopper ("Sand Flea") has been developed by Boston Dynamics and a video demonstration can be found at http://www.youtube.com/watch?v=6b4ZZQkcNEo. For a weight of 5 kg, it can jump 1-8 m on Earth, which on Mars would transform to 3-24 m.

The next part of the discussion is about the potential payload. It is clear for all that the basic instrumentation should include a camera. Several ideas are proposed for payload. Several times the question of having a fixed device (such as a small KRET?) attached to the hoppers are suggested, as well as a mass spectrometer whose design is anyway investigated at CBK within the framework of the PhD thesis of A. Nikolau-Kuklińska. J. Grygorczuk replies that the strength of a hopper lies in its robustness, lightness, and mobility, which is basically inconsistent with such an instrumentation.

This brainstorming is followed by the identification of tasks for working groups. The outcome of this workshop had been to end up with one or two ideas of space instrument development; from this discussion it appears that a single direction emerges, with the development of one or a swarm of hoppers.

Decision is made to identify several working groups in order to refine the science objectives, payload, and engineering aspects of the project, in view of submission of an instrument development project to the 1st Call for Outline Proposals under the European Space Agency's Polish Industry Incentive Scheme. Each group should include scientists of various horizons (geologists and engineers of various specialties), and is placed under the direction of a leader. We agreed to have next meeting before the end of February.

It is proposed that the working groups will meet as much as needed, whereas all the group members will participate to a general meeting every 6 months for sharing their achievements and discuss the next steps.

Minutes prepared by: Daniel Mège, Karol Seweryn, Joanna Gurgurewicz