

Sub-spacecraft capabilities for planetary exploration

Background:

We have been involved in several project developments (AIM, Hera APEX, Mars multi-craft, Heavy Metal, upstream monitors of objects, ...) within ESA regarding Sub-crafts for planetary exploration (asteroids, Ceres, Icy moons), as well as multiple spacecrafts in flying in formation mostly for space physics use (e.g., space weather, solar wind turbulence, Earth's and Mars' space environments). For planetary exploration it is of use for gravity measurements to find the internal structure of bodies, for electric- and magnetic fields as well as particles to look for sub-surface oceans (and probe the interiors) and to determine the space environment (e.g., plume characteristics or other outgassing) close to bodies. However, the developments up to date have mostly made use of Cube-sat (1-3U) technology (developed for LEO), and when real science payload requirements are applied, they often tend to become larger, like 6U or 8U or even 12U) and the technology is most often not adapted to work at a long distance from the Earth. The reason is that these Sub-craft need many abilities that need be developed, e.g., sizable solar panels, autonomous navigation, stability with booms, communication and ranging to a Main-craft carrier, etc, etc. Also, these smaller Sub-craft can be more tailored/integrated together with the payload, where the payload can be a large part of the total mass. It is often the same kind of payload that is suggested for these Sub-craft. Electric and magnetic fields, INMS, solar wind (upstream) monitor, a video imager, an Inter Satellite Link, Accelerometers, then, depending on target a special instrument. In Europe the development of sub-crafts has totally been misjudged, and often small Cube-sat:s with instruments giving limited information is adopted.

Proposal:

Sweden can take a lead in this development of Sub-crafts for planetary exploration use. Sweden has a heritage in making small spacecraft with an integrated limited number of relevant payloads. There also exist considerable knowledge in formation flying and GNC and the Swedish groups have good international contacts with groups that know autonomous navigation. Making Sub-craft as robust space systems for European sustainable planetary exploration can become a Swedish lead activity with strong know-how. This can involve on the Swedish side: IRF at Uppsala and Kiruna, OHB Sweden, Vinterstellar AB, SSC, and many others.

Different Sub-craft studies have been made up to phase-A level with different international participation. We need a coordinative study over 2 years. The cost is estimated to ca 8 FTE. The product should be a Swedish lead useful Sub-craft design that can be immediately suggested to various planetary exploration missions.

Project Owners:

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