Rethinking Innovation in the Explorer Class of Missions
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Explorers and LEO
The Small Explorers (SMEX) mission class was implemented in 1989 specifically to fund space exploration missions that cost no more than (currently) $120M. There have been ten SMEX missions successfully launched, nine of which into Low-Earth Orbit (LEO) and one into a Medium Earth Orbit (MEO). The SMEX formulation and cost cap effectively limits the orbits available and hence the scientific reach of the SMEX class of missions to topics related to interactions of the ionosphere-thermosphere-mesosphere (ITM), magnetosphere-ionosphere (MI) coupling, or solar research.

However, the world of Heliophysics is much broader than these topics. The full study of the solar wind, particle acceleration, magnetospheric processes, and so much more simply cannot be pursued within SMEX due to this limited reach. Traditionally this is where the Medium-Class Explorers (MIDEX) class comes into play. These have tended to be significantly larger missions with much broader scopes of investigation. As evidenced by the recent selection of a broad range of MIDEX missions with a large diversity of targets: STORM for the whole magnetosphere, HelioSwarm for turbulence, MUSE for the solar atmosphere, ARCS for the aurora, and Solaris for the solar poles. From these diverse missions it is clear that most of Heliophysics is accessible via a MIDEX-sized mission.

The Planetary Approach
At the same time, Planetary Science missions have been expanding into low-cost exploration using ride-shares on their larger missions via the Small Innovative Missions for Planetary Exploration (SIMPLEX) program. These missions are to be carried to far off destinations such as Mars by their host spacecraft, e.g. the Psyche Discovery mission or the Interstellar Mapping and Acceleration Probe (IMAP) Solar Terrestrial Probes (STP) mission. These missions are truly innovative and are delivering exciting science on a small budget.

On Planetary Discovery missions the removal of launch and operations costs from the proposed Principal Investigator (PI)-managed cost cap of the mission opened this mission class to the outer planets, places we once believed could only be reached with multi-billion dollar flagship missions. The most recent Discovery down-selections include one mission to Jupiter’s moon Io and a mission to fly by Neptune’s moon Triton. By removing launch and operations costs from the cost cap NASA’s Planetary Science Division (PSD) was able to open the door to a whole new realm of planetary missions.

SMEX Innovation
The Heliophysics community is yearning to produce innovative mission concepts within a SMEX class budget, but is hampered by launch costs and access to orbits above LEO. We suggest that SMEX requirements follow the Planetary Science Division’s approach and remove the launch and operations costs from the proposal cost caps. This action will open the door for innovative SMEX missions that can reach far beyond LEO. In addition this would provide NASA the flexibility to co-manifest these missions and potentially gain more “bang for the buck” from a single launch. With this change we believe the SMEX mission class would then become as broad in scope as the MIDEX missions that were selected in the last round. An alternative possibility would be for NASA to allow missions to launch on a refurbished Falcon-9 (or similar) launch vehicle (LV), which would open up a wide and far-reaching range of exotic orbits and science targets, enabling new discoveries with SMEX for a reasonable LV cost (~$55M).

Rethinking the Explorer Class of Missions
If we then take this thinking one step further we can imagine how in 2050 the portfolio of NASA Heliophysics missions would look if we remove the “Small,” “Medium,” and “Flagship” terminology from the mission classes. Without these monikers the missions then take on a strategic place in the continuum of innovation that occurs in science. The SMEX missions embody the forward-looking
innovation in the field. These are the high-risk, high-reward missions, which can include experimental technology that may fail, but may also yield breakthroughs in our thinking. The MIDEX missions are then an open class that produce closure on broad science topics, but are not constrained by a strategic mission list (these would be akin to the planetary Discovery missions). The STP missions would then subscribe to a target list similar to that of the New Frontiers category in planetary and Living with a Star (LWS) missions are then the flagship missions, both of which comprise the strategic mission class meant to tackle the large overarching science questions and so require comprehensive instrumentation and experimentation.