

Facts and Suggestions on New Approaches to More Complete Fulfillment of Outer Planets Science Objectives from the 2003 Solar System Decadal Survey

The undersigned group commends the continuing dialog of the Outer Planets Assessment Group (OPAG) with NASA Headquarters management in order to provide science community input to the planning and prioritizing critical outer planets objectives and mission elements of the NASA solar system exploration program.. OPAG is responding to the 2003 Solar System Decadal Survey finding that *selection of New Frontiers missions needs to be a continuing process involving broad community input, as has been accomplished by this decadal survey report*. We are enthusiastic supporters of this process and frequent contributors to OPAG meetings and subgroups. Some of us directly participated in, or contributed to, the Decadal Survey providing the overall direction for OPAG .

Our group strongly supports new approaches to fulfill Decadal Survey science objectives in ways that might not be consistent with a more limited definition of the survey's exact recommended missions. New approaches are clearly needed in NASA's current political and financial environments. *Overall, we suggest that the science objectives should be given more weight than specific mission approaches suggested to date*. For the Jupiter and Saturn systems we see the highest priority (2003-2013) and deferred (post-2013) mission classes, respectively listed in our Tables 1 and 2 (extracted verbatim from Chapter 8 of the Decadal Survey report), to be more indicative of science priorities. The highest priority at the flagship level is assigned to Europa objectives, medium-class mission priority to Jupiter's atmosphere and polar magnetospheric environment, and small-class mission priority to expanded Saturn system measurements. The latter two objectives can partially be achieved with the approved Juno polar orbiter for Jupiter and fully achieved for Saturn with extension of the ongoing Cassini Orbiter mission. The Europa flagship objective was originally conceived to be met with the Jupiter Icy Moons Orbiter as defined by the JIMO Science Definition Team, but not with a launch in the 2003-2013 decade. Since no Europa mission concept fully meeting the primary flagship science objectives fits into the New Frontiers cost profile, and at present there appears to be no NASA budget support for flagship missions, then the main fact is that *the highest science priority of the Decadal Survey is not being addressed*.

The most direct resolution of this apparent disparity between Decadal Survey science priorities and mission implementations would of course be for NASA to implement the recommended series of flagship, medium-class, and small-class missions. We noted above that the valiant efforts of NASA to respond to these priorities with limited budgets have included mission selections with partial, *but not complete*, fulfillment of the objectives. In the current budget climate this may also be the way to fulfill some of the flagship science objectives for Europa at lower cost, while also covering some high priority science objectives for Jupiter's atmosphere (Table 1) and currently deferred science for Io and Ganymede (Table 2). Criteria for medium-class and small-class mission selections might include partial relevance to flagship-level objectives in addition to primary criteria for accomplishment of more focused objectives, all fitting within the solicited mission cost limits. Furthermore, one of the implicit assumptions in the Decadal Survey was that remote imaging technology was not sufficient to address multiple mission objectives within the Jupiter, Saturn, Uranus, or Neptune systems with single spacecraft missions. Advancements in distributed aperture systems, as now being studied at NASA Goddard Space Flight Center with corporate partners, have removed this limitation. Large moon

orbiters, e.g for Ganymede and Titan, can also function as planetary system observers. In general, high capability science instruments can now be developed for conventional spacecraft.

In view of these facts we offer the following three specific suggestions to OPAG and NASA:

- (1) Expand the New Frontiers list of desired mission implementations to the union of the Decadal Survey medium-class and large-class missions, including those originally deferred to the post-2013 era, to maximize fulfillment of high priority science objectives.*
- (2) Provide near-term funding opportunities for related mission studies and advanced science instrument development through NASA Research Opportunities in Space and Earth Science (ROSES) and other programs.*
- (3) Convene science implementation teams to determine optimal mission pathways to maximal achievement of the principal Decadal Survey objectives for outer planets science in the context of new mission concepts and science instrument technologies.*

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Table 1(From <http://books.nap.edu/html/newfrontiers/booklet.pdf>)

Prioritized List of New Solar System Missions for the Decade 2003-2013	
Priority in Cost Class	Mission Concept Name
Flight Missions	
Small (<\$325 million)	
1	Continuation of the existing series of Discovery missions
2	Extended operation of the ongoing Cassini mission to Saturn
Medium (<\$650 million)	
1	Kuiper Belt-Pluto Explorer
2	South Pole-Aitken Basin Sample Return
3	Jupiter Polar Orbiter with Probes
4	Venus In Situ Explorer
5	Comet Surface Sample Return
Large (>\$650 million)	
1	Europa Geophysical Explorer
2	Preparation for Mars Sample Return
Ground-based Facility	
Small (<\$325 million)	
1	Large Synoptic Survey Telescope

Table 2

Candidate Missions for Flight After 2013		
Medium Class	Large Class	
Geophysical Network Science	Mercury Sample Return	Titan Explorer
Asteroid Rover/Sample Return	Venus Sample Return	Uranus Orbiter with Probes
Io Observer	Mars Sample Return	Neptune Orbiter with Probes
Ganymede Observer	Europa Lander	Neptune Orbiter/Triton Explorer
Trojan/Centaur Reconnaissance Flyby	Saturn Ring Observer	Comet Cryogenic Sample Return