SCIENCE AND RECONNAISSANCE FROM THE EUROPA CLIPPER MISSION CONCEPT. R. Pappalardo¹, L. Prockter², D. Senske¹, B. Paczkowski¹, S. Vance¹, G.W. Patterson², B. Goldstein¹, T. Magner², and B. Cooke¹.¹Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, ²Johns Hopkins Applied Physics Laboratory, Laurel, MD, 20723.

Introduction: A NASA-appointed Science Definition Team (SDT), working closely with a technical team from the Jet Propulsion Laboratory (JPL) and the Applied Physics Laboratory (APL), recently considered options for a future strategic mission to Europa [1], with the stated science goal: Explore Europa to investigate its habitability. The group considered several mission options, which were fully technically developed, then costed and reviewed by technical review boards and planetary science community groups. There was strong convergence on a favored architecture consisting of a spacecraft in Jupiter orbit making many close flybys of Europa, concentrating on remote sensing to explore the moon. Innovative mission design uses gravitational perturbations of the spacecraft trajectory to permit flybys at a wide variety of latitudes and longitudes, enabling globally distributed regional coverage of the moon’s surface, with nominally 45 close flybys at altitudes from 25 to 100 km. This concept has become known as the Europa Clipper.

Science Objectives: The Europa SDT recommended the following science objectives for the Europa Clipper:

Ice Shell and Ocean. Characterize the ice shell and any subsurface water, including their heterogeneity, ocean properties, and the nature of surface-ice-ocean exchange;

Composition. Understand the habitability of Europa's ocean through composition and chemistry;

Geology. Understand the formation of surface features, including sites of recent or current activity, and characterize high science interest localities.

The Europa SDT is currently considering implications of the recent HST detection of plumes at Europa [1], specifically what modifications may be warranted to the recommended science objectives and/or the investigations that flow from them.

Notional Payload for Science: The set of investigations derived from these science objectives traces to a notional payload for science, consisting of: Ice Penetrating Radar (for sounding of ice-water interfaces within and beneath the ice shell), Topographical Imager (for stereo imaging of the surface), ShortWave Infrared Spectrometer (for surface composition), Neutral Mass Spectrometer (for atmospheric composition), Magnetometer and Langmuir Probes (for inferring the satellite’s induction field to characterize an ocean), and Gravity Science (to confirm an ocean). This notional payload for science serves as a proof-of-concept for the Europa Clipper during its formulation stage. It is anticipated that the actual payload would be chosen through a NASA Announcement of Opportunity, if NASA were to proceed with the mission.

Reconnaissance Objectives: Following global-regional characterization of Europa, a possible subsequent exploration step would be to send a soft lander to its surface. In considering Europa strategic mission options, a lander was deemed premature at present because we do not yet understand whether or where Europa’s surface provides safe landing sites. Thus, the Europa Clipper concept should include the capability to perform reconnaissance for a future lander.

The Europa Clipper reconnaissance goal is: Characterize safe and scientifically compelling sites for a future lander mission to Europa. This leads to two reconnaissance objectives:

Site Safety. Assess the distribution of surface hazards, the load-bearing capacity of the surface, the structure of the subsurface, and the regolith thickness;

Science Value. Assess the composition of surface materials, the geologic context of the surface, the potential for geological activity, the proximity of near surface water, and the potential for active upwelling of ocean material.

To accomplish these reconnaissance objectives and the investigations that flow from them, principally to address issues of landing site safety, two additional instruments are included in the notional payload: a Reconnaissance Camera (for high-resolution imaging) and a Thermal Imager (to characterize the surface through its thermal properties). These instruments, in tandem with the notional payload for science, could assess the science value of potential landing sites.

Conclusions: The Europa Clipper concept provides a cost-efficient means to explore Europa and investigate its habitability, through understanding the satellite’s ice and ocean, composition, and geology. If NASA were to proceed with the mission, it could be possible to launch early in the coming decade, on an Atlas V or the Space Launch System.