UNVEILING THE EVOLUTION AND FORMATION OF ICY GIANTS. M. Laneuville[1], T. Bocanegra[2], C. Bracken[3], M. Costa[4], D. Dirkx[2], I. Gerth[2], K. Konstantinidis[5], C. Labrianidis[6], A. Luntzer[7], J. MacArthur[8], A. Maier[9], A. Morschhauser[10], T. Nordheim[8], R. Sallantin[11], R. Tlustos[7]. [1]IPG Paris, France (laneuville@ipgp.fr), [2]TU Delft, The Netherlands, [3]NUI Maynooth, Ireland, [4]ESAC Madrid, Spain, [5]UniBw Munich, Germany, [6]Tesat-Spacecom GmbH, [7]Uni Vienna, Austria, [8]UCL London, UK, [9]IWF Graz, Austria, [10]DLR Berlin, Germany, [11]CNES Toulouse, France.

Introduction: The Austrian Space Agency in colaboration with ESA holds a 2-week summer school every year for graduate students and young professionals to design a mission of their choice within that year's theme in Alpbach, Austria. This paper presents the outcome of the 2012 edition, with the theme 'Exploration of the giant planets and their systems'.

The planet Uranus is one of two ice giants in the solar system, both of which have only been visited only once by the Voyager 2 spacecraft. Therefore, a dedicated mission to an ice giant is crucial to deepen our knowledge of the formation, evolution and current characteristics of such a planet and its system. We present the science objectives, architecture rationale and system design for a mission to the Uranian system.

We conducted a detailed study on how to best fulfill the primary science goal, namely: to investigate Uranus and its system as an archetype for ice giants. To this end, we formulated specific science questions leading to measurement requirements and, finally, instrument requirements and suitable instruments.

The primary science questions relate to investigating Uranus' deep interior and outer layers as these are directly related to the primary science goal. Additionally, investigations of the moons, rings and the magnetosphere will provide complementary observations of the Uranian system specifically and icy giants in general.

Method: A trade-off between several mission architectures was performed, such as an orbiter with an atmospheric entry probe and a flyby mission. In this process, the relative importance of the science questions, the capabilities of each concept to carry a certain payload and its capability to answer the science questions in the given architecture were traded off. Similarly, the feasibility of each concept from an engineering point-of-view was assessed, taking into account matters such as complexity, cost and risk. The results are presented as a function of relative engineering and science score weights, providing an envelope of optimal mission selections over a range of mission scenarios. We conclude that a Uranus orbiter with a single entry probe and an extended moon tour fulfills the primary science goal in an optimal manner.

Outcome: The chosen mission scenario is based on a launch date in 2026 on an Ariane 5 ECA launcher and arrival at Uranus in 2044 using conventional high-thrust systems. The first two years of the mission are dedicated to observations of Uranus. In this phase, the periapsis is very close to Uranus and the apoapsis is outside the bow shock, specifically for performing magnetospheric studies. Subsequently, the periapsis is raised allowing for a nominal nine flybys for each of Uranus' largest moons. Dry mass in Uranus orbit is 2052 kg taking into account both system and subsystem margins. The probe's mass (350 kg), however, is not included. The spacecraft will be powered by four ASRGs which are currently under development. A set of batteries is included, capable of covering the loss of one ASRG through the peak power phase. It will have ~100 Gbit data storage capacity for optimizing the science return through careful selection of transmitted data. Data transmission is performed by a 3.5 m high gain antenna transmitting in X-band for communications and Ka-band for tracking. Possibilities exist for mission extension at the final orbit, which crosses the orbit of the moon Oberon, to extend even further the science return about this ice giant from this mission.

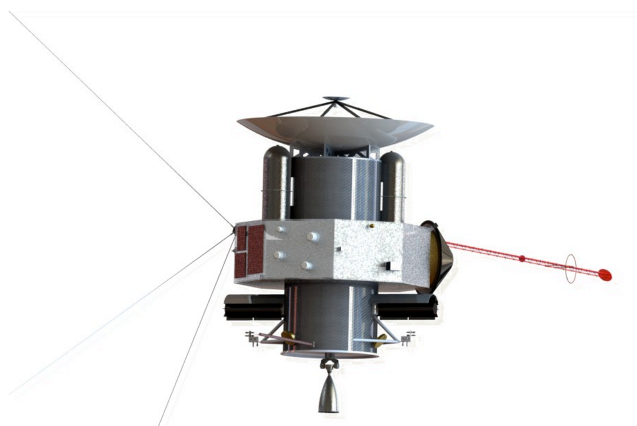

FIG. 4: Design of the main spacecraft, including the probe, 4 ASRGs, a 3.5 m high gain antenna, the main thruster.

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