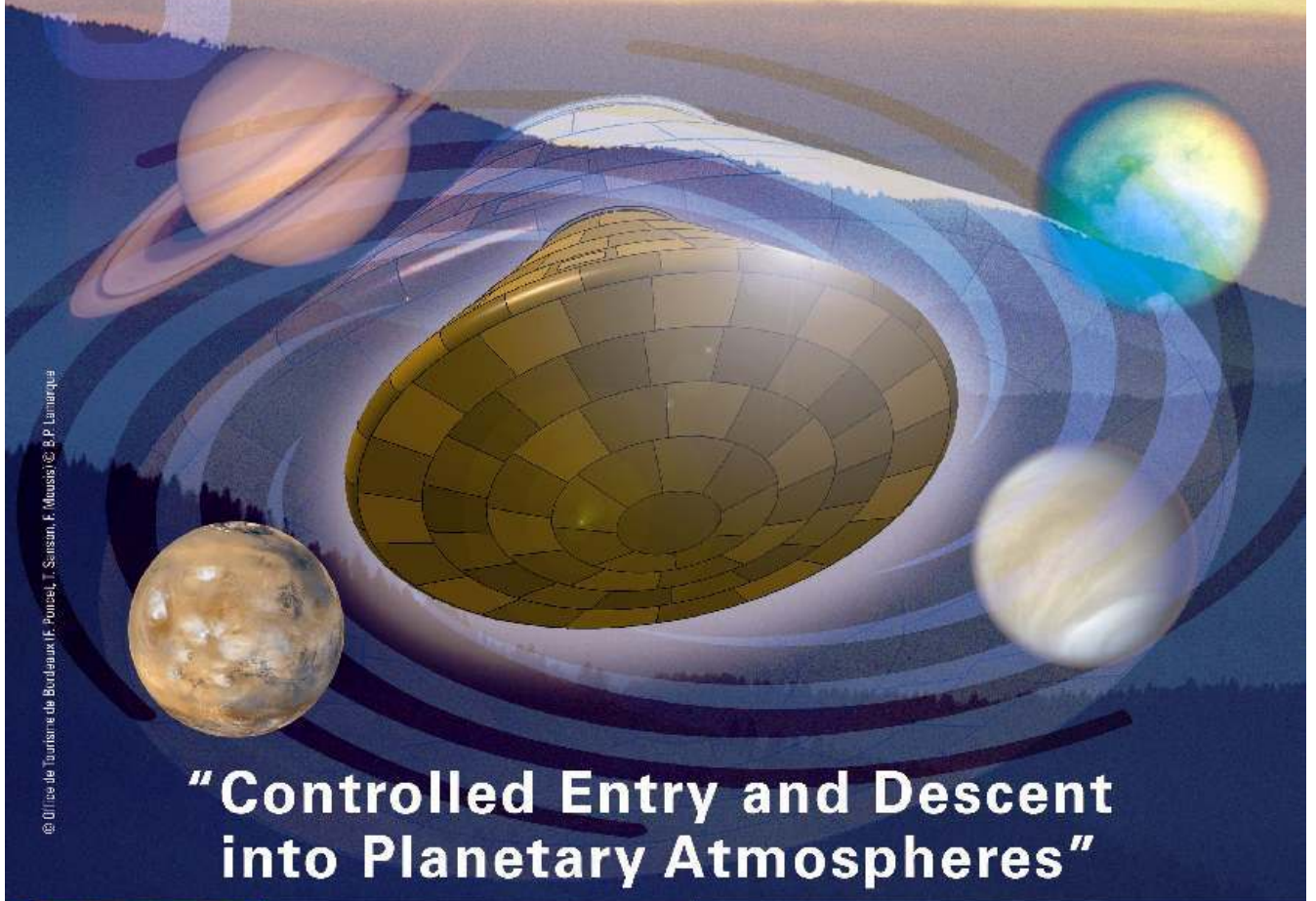




5TH INTERNATIONAL PLANETARY PROBE WORKSHOP JUNE 25-29, 2007 – BORDEAUX, FRANCE



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“Controlled Entry and Descent into Planetary Atmospheres”



SHORT COURSE • JUNE, 23-24, 2007



Short Course on Controlled Entry and Descent into Planetary Atmospheres

The Workshop will, as in previous years, be preceded by a two-day Short Course, aimed at graduate students and early-career professionals. The selected topic for 2007 is "Controlled Entry and Descent into Planetary Atmospheres". The course will be useful for engineers and scientists interested in the design and operation of probes for the in situ investigation of worlds with atmospheres. The first day will consist of a series of lectures given by experts in the field, covering topics such as: entry and descent architectures; entry trajectories; parachute descent; reference atmospheres; communications and tracking, and descent phase control systems. The second day will consist of four parallel 'case study' team projects, covering possible future missions to Venus, Mars, Saturn and Titan. Students will apply the knowledge gained on the first day and generate final presentations. It is also expected that the students will then participate fully in the main workshop. Below is an initial outline of the first day's lecture topics:

Day one 23rd June : Lectures

1 Introduction (15min, 09:00-09:15)

2 Separation and Arrival (65min, 09:15-10:20): Rodrigo Haya Ramos and Miguel Belló Mora (Deimos Space)

Introduction to EDLS. Propulsion, spin-up and eject. Delivery from orbit for hyperbolic entry; trade-off between ellipse size and carrier avoidance delta-v; constraints on entry location. Entry state determination. Science drivers for controlled entry and descent. Basics of entry and descent architectures, covering typical aeroshell / chute configurations and other examples. Where and why passive or active control is important. Consideration of pre-entry instrumentation.

-- Tea/Coffee Break (15min, 10:20-10:35) --

3 Reference Atmospheres and Their Use (45min, 10:35-11:20): Jere Justus (NASA Marshall)

Reference atmospheres; sources of uncertainty and propagation through to trajectory uncertainties. Basic differences between scientific measurements and models; scientific vs. engineering aspects.

4 The Entry Phase (70min, 11:20-12:30): Jacques Moulin (EADS Astrium)

Loads and heating. Stabilisation systems (TPS, thrusters, gyros, fins, ejected masses, ballistic vs. lifting bodies...). Entry instrumentation.

-- Lunch Break (75min, 12:30-13:45) --

5 Compositional Impact on Science and Engineering in Atmospheres (20min, 13:45-14:05): Tom Spilker (NASA JPL)

Examples include radio absorption due to condensibles in giant planet atmospheres such as Saturn, and the influence of methane abundance on probes to Titan.

6 Impact of Atmospheric Electricity on Probes (20min, 14:05-14:25): (Ralph Lorenz, JHU APL)

Effects of electrostatic charging and discharge on probe design and operations.

7 Descent (45min, 14:25-15:10): Steve Lingard (Vorticity)

Triggering the descent phase. Parachute system design. Descent duration. Probe spin. Deployment of balloons / aircraft, parafoils.

-- Tea/Coffee Break (15min, 15:10-15:25) --

8 Communications and Tracking (45min, 15:25-16:10): Sergei Pogrebenko and Leonid Gurvits (JIVE)

Communications and tracking architectures; capabilities and limitations (1-way, 2-way, relay or DTE, tones, data, VLBI,...); trajectory reconstruction.

9 Final approach (45min, 16:10-16:55): Roland Trautner (ESA ESTEC)

Sensing and Control for terminal descent (IMUs, accelerometers, gyros, localisation, altimetry by radar, laser, pressure,...); winds; thrusters.

10 Thoughts for Day 2 (5min, 16:55-17:00)

Agenda for Day two 24th June

1 Introduction and 'Thoughts for Day 2' - Guidelines for Student case study (30min, 09:00-09:30) : Short Course Co-Chairs

2 Case Study (60min, 09:30-10:30): 4 Groups

-- Tea/Coffee Break (15min, 10:30-10:45) --

2 Case Study (continued) (60min, 10:45-12:30): 4 Groups

-- Lunch Break (75min, 12:30-13:45) --

3 Presentation by Group A (30min, 13:45-14:15): Student Presenter

4 Presentation by Group B (30min, 14:15-14:45): Student Presenter

5 Presentation by Group C (30min, 14:45-15:15): Student Presenter

-- Tea/Coffee Break (15min, 15:15-15:30) --

6 Presentation by Group D (30min, 15:30-16:00): Student Presenter

7 Final Discussion (60min, 16:00-17:00): Moderator TBD

Day two 24th June : Four Parallel Case Studies

Venus

Chair: Tibor Balint (JPL) and Colin Wilson (Oxford)

Venus Exploration is prominently featured in the NASA roadmap and is being proposed for the ESA Cosmic Vision programme; JAXA-ISAS will soon launch a Venus orbiter and IKI plans a long-term Venus lander in the next decade. While orbiter missions - such as Venus Express and the proposed Venus Climate Orbiter - provide outstanding science data, in situ exploration of Venus will be required to address key science questions on habitability of terrestrial planets, and the history, evolution, processes and composition of Venus. The objective of this case study is to design a mission concept for long lived in situ exploration of Venus, with special focus on the various mission phases and the interdependencies between science goals, related instruments, and technology solutions to address possible pre-entry science, atmospheric entry, air mobility, mitigation of the extreme environment, power system trades and telecommunications. The impact of add-on elements (e.g., microprobes) on the mission architecture could also be discussed. Further details on the study concept and supporting backup material will be provided to the team during the first day of the short course.

Mars

Chair: Craig Peterson and Kim Reh (NASA JPL)

The Mars Exploration Programmes from both ESA and NASA have provided outstanding science results over the past decades. Orbiter missions mapped the surface in detail (e.g. Mars Express, MGS, Mars Odyssey, MRO), while the Mars Exploration Rovers, Spirit and Opportunity, are demonstrating the value of long-lived in situ missions, providing high science return. Future plans from both NASA and ESA include rovers, lander networks, and sample return concepts, but other mission architectures involving balloons and aerial vehicles have also been studied and proposed. The objective of this case study is to design a mission concept for in situ Mars exploration that could study the surface and the atmosphere over an extended period of time, with special focus on the various mission phases and the interdependencies between science goals, related instruments, and technology solutions to address possible pre-entry science, atmospheric entry, (air) mobility, power system trades and telecommunications. The concept should fit strategically into the broader international exploration programmes. Further details on the study concept and supporting backup material will be provided to the team during the first day of the short course.

Titan

Chair: Ralph Lorenz (JHU APL)

The Cassini-Huygens mission is considered as one of the most successful examples for international collaboration. While ongoing Cassini flybys continuously increase our knowledge about Titan, the Huygens probe gave us haunting images of a familiar yet alien world. Titan, with its cold and dense atmosphere lends itself to exploration with a Montgolfiere (hot air balloon), supported by an orbiter. Titan's pre-biotic chemistry may give us clues about the origin and development of life in the Universe, while its planetary processes may help to understand the formation and evolution of our Solar System. The objective of this case study is to design a mission concept for long-lived in situ exploration of Titan, with special focus on the various mission phases and the interdependencies between science goals, related instruments, and technology solutions to address possible pre-entry science, atmospheric entry, air mobility, mitigation of the cold environment, telecommunications, and power system trades including support to air mobility. Further details on the study concept and supporting backup material will be provided to the team during the first day of the short course.

Saturn

Chair: Tom Spilker (JPL)

Understanding solar system formation is one of the key science objectives in planetary exploration. Comparing isotopic abundances of certain key diagnostic elements among the Sun and the Giant Planets requires in situ measurements of atmospheric composition to appropriate depths, at times supported by remote sensing measurements. Other in situ measurements, such as atmospheric thermal structure, address other high-priority science objectives. NASA's 2006 Solar System Exploration Roadmap proposes a multi-probe mission to Saturn, and one response to ESA's 2006 Cosmic Vision AO will be a Saturn multi-probe mission proposal, closely linked to NASA's plans through international collaboration. Due to the deeper gravity wells, entry heat fluxes and loads experienced by probes to Giant Planets are significantly higher than those of probes to other planets or moons with atmospheres. Larger atmospheric scale heights at Saturn limit depths usefully accessible with probes, while deeper measurements, needed to complete the suite of elements observed, must rely on remote sensing techniques. The objective of this case study is to produce a high-level mission concept for in situ exploration of Saturn's upper troposphere using multiple probes, with special focus on the various mission phases and the interdependencies among science goals, related instruments, and technology solutions to address possible pre-entry science, atmospheric entry, probe descent options, and power system trades on the probe and the flyby element. Discussions should include trades between orbiter vs. flyby and direct-to-Earth vs. relay communications, and their impacts on remote sensing measurements. Further details on the study concept and supporting backup material will be provided to the team during the first day of the short course