Meeting Date(s)	:	March 12 <sup>th</sup> 2012 (AN)	Page 1/11
Venue	:	IAA HQ OFFICE, PARIS	

## **Participants:**

1.	GIUSEPPE REIBALDI	ESA	Chairman
2.	JOHN C MANKINS	ARTEMIS	Past-Chair
3.	S. RAMAKRISHNAN	ISRO	Secretary
4.	KOREPANOV V	UKRAINE	Member
5.	CHRISTOPHE BONNAL	CNES	Member
6.	KAWAGUCHI JUNICHIRO	JAXA	Invitee
7.	ARAKI SHUJI	JAXA	Invitee
8.	MORIMOTO KOUICHI	JAXA	Invitee
9.	DUPAS ALAIN		Invitee
1 <b>0.</b>	JUKOLA PAIVI		Invitee
11.	RUSSO GENNARO		Invitee
12.	UESUGI KUNINORI		Invitee
13.	PAVEL TRIVAILO		Invitee
1 <b>4</b> .	BELLO MORA MIGUEL		Invitee
15.	RAUCK HORST		Invitee
1 <b>6</b> .	DEL VECCHIO ANTONIO		Invitee
17.	RITTWEJV ANDREUS		Invitee

Meeting Date(s)	:	March 12 <sup>th</sup> 2012 (AN)	Page 2/11
Venue	:	IAA HQ OFFICE, PARIS	

#### <u>AGENDA</u>

- 1. IAA Commission III Introduction
- 2. Completed Studies & Follow-up Actions (SG3.11) Space Solar Power
- 3. On-going Studies. Status Presentation:
  - # SG 3.9 Private Human Access to Space
  - # SG 3.10 Interstellar Precursor Missions Technologies
  - # SG 3.12 Global Human Space Exploration.
  - # SG 3.13 Space Elevators
- 4. New Study initiatives (Team Leads/Specialists Welcome)
- 5. Briefing on Study Process improvements proposed
- 6. Symposia Status IAC 2012/IAC 2013
- 7. Report to SAC from Commission III
- 8. Presentation on Database creation for ionospheric exploration by Valery Korepanov
- 9. AoB

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### Minutes :

Subject/Description	Action	Due	Date
Mr. Giuseppe Reibaldi, Chairman Com-			
mission III welcomed the members and			
other invitees/participants to the			
Commission III meeting.			
The Agenda for the meeting was introduced.			
1. Commission III Introduction			
The current IAA Commission III			
membership was displayed			
(Annexure-1)			
It was pointed out that as per IAA			
Groups as well as the Chairs of			
Symposia sessions are also to be			
included in the extended list of			
members of respective sponsoring	Chairman,		
Commission, and should be displayed	Comm.III		
at IAA wedsite.			

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2. Completed Studies & Follow-up		
Actions:		
It was recalled that a number of significant studies have been successfully completed under Commission III, the latest one being the Study on Solar Power from Space which was carried out under the leadership of John C. Mankins, the Past-Chair of Commission III. The study spanning three years with the participation of representatives from ten countries has resulted in a comprehensive report which was published by IAA in October 2012. As a follow-up, Global Space Solar Power Working Group, an international forum is mooted and the first kick-off meeting is scheduled on 13 <sup>th</sup> March at ESA Ha Office.		
Paris.		
The objective is to initiate pilot projects through international effort and it is proposed to be put up in the agenda for forthcoming Heads of Space Agencies Summit planned in November 2013.		

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In 2013 IAC symposia, one session is devoted to SSP to be coordinated by John C Mankins and will address technologies and infrastructure for Solar Power from Space.	
3. Ongoing Studies - Status:	
#SG 3.9 Private Human Access to Space:	
Mr. Christophe Bonnal, the Study Lead briefed the members about the scope, objectives and progress made so far (Annexure-2).	
It was noted that the scope of first phase of the study report is limited to sub-orbital flights.	
The first draft of the report titled 'IAA Situation Review on Private Human Access to Space – Vol.1 : Sub-Orbital' is expected to be ready by September 2012.	
A special issue of Acta Astronautica on the subject with a selection of	

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about 20 papers from two IAA Symposia is under processing for release.		
It was suggested that inputs on Private Space ports in Japan may be sought from Prof. Kaya.		
It was noted that two plenary events on this topic are proposed at IAC, Naples.		
The Study report is targeted for submission to IAA for approval by March 2013.	C.Bonnal	
There is a proposal to pursue part-2 of this study (Annexure-3).		
#SG 3.10 Technologies for Inter- stellar Precursor Missions:		
Mr. Giuseppe Reibaldi presented the status of this Study on behalf of Prof. Claudio Bruno (Annexure-4)		
He briefed the contents of the final (3 <sup>rd</sup> draft) peer reviewed version of		

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the Study Report sent by Prof. Bruno, to Commission III.		
It was noted that the study is not on any specific mission towards a destination but generally addresses the technological issues of interstellar space travel.		
It was also pointed out that the study focuses more on propulsion options, specifically the Solar soil and Nuclear propulsion systems on which detailed calculations are presented. Critical and limiting technologies in these areas are highlighted.		
The members were requested to go through the report and give their comments / feedback to Chairman, Commission III on the maturity of the Report to be submitted for IAA approval.	Members, Comm.III	31 <sup>st</sup> March 2012
#SG3.12 Global Human Space Exploration: The members were informed that due to lack of progress, the		

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Commission has decided to close this study, as the Human Space Flight study Group is pursuing this topic as follow-up action from Heads of Space Agencies summit held in November 2011.		
A new Study proposal on Global Human Mars Reference Mission and Technologies is being processed (Annexure-5).		
#SG3.13 Space Elevators Techno- logies Feasibility:		
The progress made on this study was briefed to the participants (Annexure-6).		
The Study Report will identify all essential technologies, their current feasibility status, risks involved and possible resolution methodology.		
The Study report is making good progress under the leadership of Dr. P. Swan and the first draft report will be submitted to the Commission III by Dec 2012.	Dr.P Swan	December 2012

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4.	New Study Initiatives :	
	The members and participants were informed about the new study subjects identified by Commission III in earlier meeting held at Cape Town, SA (Annexure-7).	
#	A Study proposal on 'On-orbit propellant depot' has been put up by the new member and vice-chair of Commission III Prof. Lu Yu of China. (Annexure-8).	
	It was suggested that the study should have broader scope and participation and can address all aspects of orbiting propellant storage systems, to qualify as a cosmic study.	
#	A study proposal on Global Human Mars Reference Mission is under process by Commission III (Annexure-5).	
	The study should essentially address the Mission requirements, critical technologies and global strategy to accomplish such mission.	

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<ul> <li># Another new study proposal is as a follow on and part-2 of SG 3.9 and will address the orbital flight through Private Human Access to Space (Annexure-3).</li> <li>The members and participants who are interested in the above new studies and can contribute were requested to come forward and communicate their comments / suggestions to the Commission III Chairman.</li> </ul>	Members / participants.	
5. Study Process Improvement proposed:		
The participants were briefed about the IAA initiative to reform and streamline the Study Group activities, which are expected to be implemented shortly.		
6. IAC 2012 – Symposia Status:		
The members reviewed the Commission III sponsored symposia status for IAC- 2012 (Annexure-9).		

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### IAA SPRING MEETINGS AT PARIS

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7. Report to SAC :	
Given in Annexure-10.	
8. Presentation by Mr. Valery Korepanov:	
Mr. Valery Korepanov of Ukraine made a brief technical presentation on data base creation for ionospheric exploration. (Annexure-11)	

# **Commission III Composition (2011-2013)**

Giuseppe Reibaldi (It), Chairman Lu Y (Ch), Vice Chairman John C. Mankins (USA), Past Chair S. Ramakrishnan (In), Secretary Claudio Bruno (It), Member Junjiro Onoda (J), Member Lenard R (USA), Member Christophe Bonnal (F), Member Valeriy Korepanov (Ukr), Member Rablu B (Nig), Member





### Progress report on

### IAA Study Group 3.9 "Private Human Access to Space"

Proposer(s): H. Rauck – G. Brachet Chair: Ch. Bonnal Primary IAA Commission Preference: Commission 3 Secondary IAA Commission Interests: Commission 5

### **Overall Goal:**

Identify and quantify the key topics associated to Manned Private Access to Space for both Orbital and Sub-orbital missions.

### Key words:

- Technical aspects
- Legal and regulatory aspects, safety aspects
- Financial aspects, market analyses, associated business plans
- Motivations of potential customers
- Physiological and Psychological requirements, ergonomic constraints

### Expected outcome of the study:

IAA Position Paper giving the keys to the topic and potentially including recommendations. Subdivision of the study into key chapters, with one "book captain" per chapter ; 7 or 8 members per chapter covering a wide range of origins (countries, agencies, industrials, searchers, operators...)

### Time line:

Initially: 3 years following the initial proposal (March 2007)

Revised timeline:

1 <sup>st</sup> IAA symposium on Private Human Access to Space (Arcachon)	
⇒ 28-30 May 2008	
Publication of the full CD with all the papers, most of the presentation pictures Distribution to all participants	۱S,
⇒ End of September 2008	

Report during IAC Glasgow ⇒ October 2008

 Publication in Acta Astronautica of the 15-20 best papers out of the 68 presented in Arcachon

Process undergoing: 15 papers pre-selected

- 4 rejected
- 2 withdrawn after review

SG: Formal invitation of members of the SG

Additional members are welcome, but may lead to problems of coherence and homogeneity (lack of efficiency; depends on the definition of a Working Group !)

	,	Budjeen, eeteber 2000
Extended table of contents	⇒	IPC. Paris March 2010

IAC 2010: presentation of the status of the action

Decision taken during the meeting to hold the 2<sup>nd</sup> IAA Symposuim on Private Human Access to Space in 2011

2<sup>nd</sup> IAA symposium on Private Human Access to Space (Arcachon)

⇒ 30, 31 May, 1<sup>st</sup> June 2011

Nice little conference (100 participants from 12 countries)

56 presentations + 2 round tables

Good press support thanks to presence of Astronauts, candidates, Virgin Galactic, X-COR, Astrium...

Proceedings distributed to all participants, available upon request

 Preparation of a dedicated issue of Acta Astronautica with a selection of 15-20 most interesting papers out

Process undergoing: Formalism towards Acta, notification to authors See following page

Associated proposal to delay the preparation of the Position Paper. Already discussed with IAA SG

- ⇒ Report of the conference expected in CapeTown, September 2011
- ⇒ No progress since March on the content due to conference
- ⇒ Fist complete draft expected for Paris meeting March 2012
   ৬ Late, as only half of the contributions are available
- ⇒ Final draft expected for IAC 2012 in Naples

### Special Issue of Acta Astronautica on Private Human Access to Space

### Co-editors: Tannja Masson-Zwaan, Christophe Bonnal

### Selected Structure:

Editorial (4 pages), Tanja + Christophe

1<sup>st</sup> Keynote: Jean-Perre Haigneré (ACE)  $\rightarrow$  Under consolidation 2<sup>nd</sup> Keynote: Bernhard Hufenbach (ESA) $\rightarrow$  Available, under approval 3<sup>rd</sup> keynote: Derek Webber (Spaceport Associates)  $\rightarrow$  Under review 4<sup>th</sup> keynote: Jean-Luc Wibaux (Virgin Galactic accredited agent)  $\rightarrow$  Available, under submission

1<sup>st</sup> part, Christophe editor

Editorial (2 pages), Christophe

- LeGoff (Astrium), market  $\rightarrow$  under submission
- DeLuca (Poli Milano), hybrid propulsion  $\rightarrow$  under review
- Maggi (PoliMilano), hybrid propulsion  $\rightarrow$  under review
- Chavagnac Clervoy (Astrium)  $\rightarrow$  under submission
- Onuki (Japan), Commercial Human space flight in Japan  $\rightarrow$  under consolidation
- Trujillo (ESA), Safety  $\rightarrow$  under submission
- Eymar (N4E), business  $\rightarrow$  under review
- Salt (Vega), business  $\rightarrow$  under review
- Götz (DLR), medical aspects  $\rightarrow$  under submission
- Webber (Spaceport Associates), Point to Point  $\rightarrow$  under review
- Sippel (DLR), Point to Point  $\rightarrow$  under submission
- Peeters (ISU), Point to Point  $\rightarrow$  under submission
- ♦ strong potential still to loose 2 or 3

2<sup>nd</sup> part, Tanja editor

Editorail (2 pages), Tanja

- VanDer Dunk (Uni Nebraska)  $\rightarrow$  under review
- Lazare (CNES)  $\rightarrow$  under review
- Ametova (Leiden Uni)  $\rightarrow$  under review
- Johnson (IISL)  $\rightarrow$  under review
- Galhego-Rosa (Leiden Uni)  $\rightarrow$  under review
- Masson-Zwaan (IIASL)  $\rightarrow$  under review
- Beamer-Downie (General Counsel Airclaims)  $\rightarrow$  under review
- Mahmoudi (Aerospace Research Institute, Iran)  $\rightarrow$  under submission
- Carminati (Weil, Gotshal & Manges) → under review

-1-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

## Proposal for Forming an IAA Study Group

Title of Study: Private Human Access to Space – Vol.2: Orbital

### Proposer(s):

J.Mankins

Primary IAA Commission Preference: Commission 3

Secondary IAA Commission Interests: Commission 4, 5, 6

Members of Study Team

Chair(s): TBD

Secretary: Alain Dupas

**Other Members:** 

Philippe Berthe, Paul Eckert, Paul Spudis, Alan Bond, Horst Rauck, All TBCs TO BE COMPLETED

### Short Description of Scope of Study

Overall Goal:

Identify possibilities and conditions for the creation and sustainability of commercial orbital flight market.

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

#### Intermediate Goals:

Characterize, assess the potential and establish scenarios for the development of commercial orbital spaceflight in the 2012-2050 period. The addressed topics include current ISS commercial cargo services, forthcoming LEO commercial crew transport, commercial space stations, private services for BEO (Beyond Earth Orbit) exploration activities (fuel depots in LEO and/or Lagrange points, commercial electric, chemical, nuclear space tugs, lunar resources exploitation and trading, etc.). Technical and economic aspects will be considered. Different scenarios will be established and discussed.

-3-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

### Methodology:

*E-mail mainly.* Progress meetings will be organized during IAF/IAA events. A dedicated workshop will be organized 6 months before the end of the Study

#### Time Line: 2 to 3 Years

### **Final Product :**

REPORT

#### **Target Community:**

Industry, Space Agencies

### Support Needed:

### **Potential Sponsors:**

Astrium, TAS, OHB, Arianespace, Boeing, Lockeed, Martin, SpaceX, Orbital, ATK

To be returned to the IAA Secretary General Paris

by fax: 33 1 47 23 82 16 or by email: sgeneral@iaamail.org

#### Date:

(No Signature required if document authenticated).

#### IAA, Paris, 2012 Form

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Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

#### Follow-up Section for IAA use only

Initial Phase
Application received:
Commission Approved:
SAC Approved:
Web Site Section opened:
Members Formally Appointed by IAA

Final Phase

Peer Review by Commission Completed:

Recommended by the Commission:

Final Report Received:

SAC Approved:

BOT Accepted:

Publisher Selected:

Study Published:

## ANNEXURE-4

## **SG 3.10**

## "Technologies for Interstellar Precursor Missions (IPM)"

by

C. Bruno, B.Dachwald,G.Genta,P.Gilster,G.Grappone,L.Johnson,R.Kezerashvili,W.Loeb,K.Long,C.Maccone,G.Matloff,A.Oh ndorf,S.Santoli,K-H.Schartner,W.Seboldt,D.Simone,G.Vulpetti



IAA Commissions Plenary Meeting Paris, 12 March 2012

## Contents

- Definition, Concept and Justifications
- Interstellar Distances and Destinations
- Propulsion alternative
- Solar Sails propulsion technologies
- Nuclear Electric propulsion (NEP) technologies
- The Long Term View
- Recommendations

## **Definition, Concepts, Justification**

- Interstellar Precursor Mission = Deep space mission outside the solar system, but not aimed at reaching another star.
- Mission Lapsed time: 20-25 years to reach destinations
- Mission Distance Goal: 50 to 500- 550 A.U;
- Closest star is at 270.000 A.U.
- Justification:
  - Scientific: Explore limit of Heliopause, Kuiper belt objects, Sun Gravitational Lens, Radio Astronomy
  - Technology: Demonstrate technologies (e.i. mainly propulsion, but also telecommunication and autonomous systems) required to reach a star, when it will become feasible

## **Interstellar Distances and Destinations (1/2)**

Kuiper belt: 30-50 ; Heliopause: 90-100 ; Focal point of Sun's Gravitational lens:550; Oorts'Cloud: 700-1000 AU;



## **Interstellar Distances and Destinations (2/2)**

Gravitational lensing at work: 550 AU. Exploit effects to make detailed studies of other solar systems



## **Focus on: Propulsion Alternatives** Propulsion is THE enabling technology



## **SOLAR SAIL Propulsion**



## Solar Sail Unfurled before Vacum Testing (Courtesy NASA)



## **NUCLEAR ELECTRIC (NEP) Propulsion**



## **The Long Term View**

## **Propulsion:**

- ► Interstellar Ramjets (scooping up interstellar hydrogen and fusing it);
- ► Fusion as a power source, replacing fission rockets/ET
- Antimatter-matter annihilation (a form of fusion) as power source;
- ► Beamed energy (to power a spacecraft rocket or fusion engine)

▼Our physics (Tsiolkovski's Law/Newton, special relativity) limits what is actually feasible

▼Short of breakthroughs in Physics, our progress is impeded.

## **TLC and Autonomous Exploration Systems:**

- TLC capable of covering IPM distances with low N/S probably.
   Time Delay is the PROBLEM
- Autonomous exploration of distant targets by sensors and specialized, Artificial Intelligent robots is mandatory. Novel ideas are based on hyperincursive systems (e.i. Predictive capability). Theory still embryonic.

# **Conclusions and Recommendations (1/2)**

- 1. Key technologies needed to perform interstellar precursor missions are propulsion, TLC, and means for autonomous robotic exploration. That include sensors and guidance (GNC) in the broad sense. AI requirements will be extremely high.
- Targets of great interest to science are the Heliopause and the galactic space beyond, including Kuiper belt objects, the nearer Oort cloud, and the Sun gravitational inner focus. All offer tremendous opportunities for new discoveries.
- 3. Among innovative propulsion this study has singled out NEP and Solar Sails as the most promising in terms of timeliness, feasibility and performance potential.
- 4. Near-term NEP using nuclear reactors in the 1-2 MW<sub>e</sub> range can enable one-way IPM to the heliosphere, Kuiper belt objects and perhaps some Oort cloud objects, with reasonable scientific payload fractions and high exploration potential.
- 5. Solar Sails enable similar IPM with much smaller payloads, but with much less initial investment in financial and technology resources.

# **Conclusions and Recommendations (2/2)**

- 6. Key technologies for Solar Sails and NEP are, respectively, advanced sail materials and long-life ET and light nuclear reactors.
- 7. In the long term (30 to 50 years from now), clear alternative candidate propulsion systems are hard to envisage. Fusion ET propulsion is perhaps the most feasible, but complexity, size and cost are challenges even in that timeframe.
- 8. Among other key technologies needed are reliable and robust TLC systems, as well as autonomous AI and GNC, both in space and on the target, once reached. Conceptual solutions proposed have not been explored sufficiently to conclude about their feasibility and reliability.
- 9. IAA should foster detailed investigations to identify out one or two IPM that may be, or become, feasible in the near term. These will become *innovation drivers* similarly to the DARPA's funded "100-year Spaceship". Investment in NEP, Solar Sails and their enabling technologies is also recommended.
- 10. IPM, a driver of innovative and unconventional thought and ideas, should be supported by new IAA initiatives across all Commissions

-1-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

## **Proposal for Forming an IAA Study Group**

### Title of Study:

**Global Human Mars Reference Mission and Technologies** 

### Proposer(s):

G.Reibaldi/C.Bonnal

Primary IAA Commission Preference:

Commission III

**Secondary IAA Commission Interests:** 

All other Commissions

Members of Study Team

Chair(s): TBD

Secretary: TBD

**Other Members:** 

Members from the HoA Summit Follow-on working groups

Former Members of SG 3.12:

Maria Antonietta Perino, Christian Sallaberger, John Logsdon, B.Foing, .....TBC Heidman, Salotti, etc.

### Short Description of Scope of Study

Human Missions to Mars have been studied individually by several Space Agencies, however a shared Mission Reference scenario and Technologies definition road map is missing.

-2-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

ISECG is not dealing with the above subject since it is limiting the coordination of the activities to the Mars Sample Return Mission

#### **Overall Goal:**

Define a global Human Mars mission reference scenario and technologies roadmap with their related needed timelines.

### Intermediate Goals:

The Study will consider the following aspects:

- 1) Rationale definition Political, Scientifical, Economical, Cultural
- 2) Questions to be answered with the relevant timelining
- 3) Enabling Technologies required
- 4) Mission Architetture Options
- 5) Definition of selected Refence Mission
- 6) Sustainability of the project
- 7) Outreach aspects
- 8) Cooperative Framework
- 9) Decision Roadmap
- 10) Raccomandation
- 11) Conclusions

-3-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

#### Methodology:

The Study can become a Pilot Project of the HoA Summit follow-on as such a fast track will be required.

E-mail, teleconferences, face-to-face meetings, specific workshop will be organised

### Time Line:

November 2013

### Final Product (Report, Publication, etc.):

Report

### **Target Community:**

Head of Space Agencies, UN, High Level Space Policy Forum, G-20

### **Support Needed:**

National Space Agencies, Private Companies

### **Potential Sponsors:**

European Union, UN, Private Companies, National Space Agencies

To be returned to the IAA Secretary General Paris

by fax: 33 1 47 23 82 16 or by email: sgeneral@iaamail.org

#### Date:

(No Signature required if document authenticated).

#### IAA, Paris, 2012 Form

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Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

#### Follow-up Section for IAA use only

Initial Phase		
Application received:		
Commission Approved:		
SAC Approved:		
Web Site Section opened:		
Members Formally Appointed by IAA		

Final Phase

Peer Review by Commission Completed:

Recommended by the Commission:

Final Report Received:

SAC Approved:

BOT Accepted:

Publisher Selected:

Study Published:

### Assessment of the Technological Feasibility and Challenges of the Space Elevator Concept

A Cosmic Study for the International Academy of Astronautics Editors: Cathy Swan, David Raitt, Skip Penny, Ted Semon, Peter Swan [contact through Dr-swan@cox.net]

**Major Topics:** Overview, Outline, Schedule, Meetings Achieved, Near-term Meetings, General Summary, Individual Chapter Abstracts & Questions

**Overview:** The Space Elevator Community has made great progress in the last six months which is significantly assisting the IAA Cosmic Study. The big events that did contribute to individual chapters are:

- International Space Elevator Conference (Aug 2011, Redmond Washington, USA) Focus day on carbon nano-tubes for tension strength. [yearly event with Cosmic study meetings held]
- International Space Elevator Consortium Study Report Published entitled; *"Space Elevator Survivability, Space Debris Mitigation,"* Lulu.com, Apr 2011.
- National Geographic Magazine [with over 100 million readers] featured two pages on Space Elevator in the July 2011 issue.
- International Space Elevator Consortium published first Journal entitled "CLIMB." [Jan 2012]

#### Outline:

Chapter	Preface	
1	Introduction	
Part I – Major Elements		
2	Tether Material	
3	Tether Riders	
4	Power for the System	
5	End Station Infrastructure (Base & Counter Weight)	
Part II – Systems Approach		
6	Systems of Systems Design	
7	Dynamics of Operation Tether	
8	Tether Deployment Approaches	
9	Systems Design for Environment	
10	Systems Design for Space Debris	
11	Space Elevator Developmental Roadmaps	
12	Operations Concept	
Part III – Future Considerations		
13	Legal Perspective	
14	Financial Perspective	
15	Study Conclusions	
16	Study Recommendations	
Ap	pendix (History, acronyms)	
**Schedule:** The study is on track for a Spring 2013 publishing date. The study schedule is as follows:

Date	Action	Туре	Location	Host
Oct 10	Study Approved by IAA	Written	Paris	IAA
Oct 10	Kick off study	Mtg	Prague	IAA
Mar 11	Outline Due	Mtg	Paris	IAA
Aug 11	Annotated outline/major questions	Mtg	Seattle	ISEC
9 Sept 11	Draft Chapters Due [half submitted]	Written	To Website	team
Oct 11	Discuss Chapter inputs [need more]	Mtg	Cape Town	IAA
9 Jan 12	Feedback Chapters + final of some	Written	On website	team
9 Mar 12	Draft Chapters resubmitted	Written	On website	team
12Mar 12	Chapters discussed in detail	Mtg	Paris	IAA
9 July 12	Final Chapters submitted	Written	On website	Team
Aug 12	Chapter overlap review	Mtg	Seattle	ISEC
Oct 12	Final review chapters/feedback	Mtg	Naples	IAA/ISEC
1 Dec 12	Final Chapters submitted	Written	On website	Team
Mar 13	Peer Review 1 Dec – 15 March	Written	From website	Team
9 Apr 13	Corrections accomplished – final	Written	From website	Team
9 Jun 13	Final Approval from ISEC & IAA	Written	From website	Team

**General Summary:** the status of the study group is fine. We are progressing and hopefully making significant discoveries. The real indicator is the excellent set of chapter abstracts and basic questions for the study. The study is on schedule and should make the April 2013 date.

**Naples Abstracts:** The key is that each chapter should submit a paper covering their chapter. The March meeting will ensure that the chapters are progressing.

**ISEC Annual Meeting, Aug 2012:** This meeting will be a general discussion approach to ensuring that the chapters are compatible between themselves. Each chapter will be presented and discussed. The major points will be shown with alternatives presented also. This half day event will quickly go through the chapters and ensure that each chapter has its opportunity to speak and present their plans and major thrust.



# IAA Commission III Meeting 12<sup>th</sup> March 2012

### **New Study Proposals**

- # Public/Private Innovative Initiatives in Human Space Flight
- # Building Blocks for Future Space Exploration
- # Transformational Space Access
- # Future Space Activities benefits in Solving Global Challenges
- # space Capabilities and disaster Management Lessons learned
- # Future propulsion systems Technologies
- # Orbital Propellant Storage Depot
- # Innovative Spacecraft Architecture

### **Proposal for Forming an IAA Study Group**

### Annex-8

Title of Study:

### LONG TERM SPACE PROPELLANT DEPOT

### Proposer(s): Lu Yu

Primary IAA Commission Preference: COMMISSION 3 Space Technology & Systems Development Secondary IAA Commission Interests: COMMISSION 4 Space Systems Operations

& Utilization

### Members of Study Team

Lu Yu, Shen Lin, Liu Wei, Gao Zhaohui, Wang Xiaowei, Li Yufei **Chair(s):TBD** 

Secretary: Wang Xiaowei, TBC

Other Members: Open to members and non- members of the Academy

### Short Description of Scope of Study

Long term on-orbit storage of propellant is a key technology for future deep space exploration, this involves numerous technology requirements such as cryogenic propellant management, boil-off control, propellant supply and transfer on-orbit, etc. The study will promote and advance the future application of high energy propulsion in various space transportation systems, so that the objectives of future missions may be enhanced with a cost reduction.

### **Overall Goal:**

*Identify requirements, concepts and opportunities for future high energy propellant space depots, identify* required key technologies and define the road map for this new capability.

#### Intermediate Goals:

Offer opportunities for cooperation among nations on international deep space exploration and utilization, motivate innovation, and foster deep space exploration activities.

Identify, evaluate and characterize requirements and concepts for future long term space propellant depots in the 2020-2050 time frame. Both technical and economic aspects will be

considered, and alternate scenarios established and discussed.

High level findings and recommendations for the consideration of the global space community will be formulated.

#### Methodology:

Setup an international study group, draft a detailed schedule of the study;

Agreement on a study report outline.

Assigning individual responsibility for parts or the study report.

Assigning editor to coordinate individual parts and compile a coherent study report.

Work to be conducted through on-line collaboration and study group meetings held in the course of annual International Astronautical Congresses and the IAA Spring meetings.

#### Time Line:

Draft outline of report: November 2013 Review outline of report and make assignments: October 2014 First draft of report: December 2014 Final report: December 2015

### Final Product (Report, Publication, etc.):

Publishable report to be distributed to the space international community

#### **Target Community:**

International space community, universities, small businesses in the aerospace and education communities.

#### **Support Needed:**

Communication of meeting opportunities at conferences

### Potential Sponsors:

CASA

To be returned to the IAA Secretary General Paris by fax: 33 1 47 23 82 16 or by email: sgeneral@iaamail.org

#### Date:

(No Signature required if document authenticated).

Follow-up Section for IAA use only

Initial Phase
Application received:
Commission Approved:
SAC Approved:
Web Site Section energy
web Site Section opened:
Members Formally Appointed by IAA:

Final Phase

Peer Review by Commission Completed:

Recommended by the Commission:

Final Report Received:

SAC Approved:

BOT Accepted:

Publisher Selected:

Study Published:

## IAC 2012 IAA Commission-III Symposia Status [5/3/2012]

Symposium Title/ Session Title	Co-ordinator (Symp)/ Chairman (Session)	No. of Abstract s
A 5. Human Exploration of the Moon & Mars Symposium	W. Mendell, C. Sallaberger	
<b>A 5.1</b> Near-term Strategies for Lunar Surface Infrastructure	MA Perino, W. Mendell, N Ghafoor (R)	9
<b>A 5.2</b> Long-term scenarios for Human Moon/Mars presence	U. Apel, W.H. Siegfried, N. Ghafoor (R)	8
A 5.3/B 3.6 Joint session on Human and Robotic partnerships to realize space Exploration goals	C Sallenberger, A.r. Gross, M. Hempsell, A Kindrat (Rs)	9
<b>A5.4</b> Going beyond the Earth-Moon System: Human missions to Mars, Liberation points, and NEO's	G. Gargir, E. Messerschmid, G Schwehm (R)	20

## IAC 2012 IAA Commission-III Symposia Status (Contd...)

Symposium Title/ Session Title	Co-ordinator (Symp)/ Chairman (Session)	No. of Abstracts
C 3 .1 Space Power Symposium	L Summerer	
<b>C 3.1</b> Space-based Solar Power architectures – New Governmental and Commercial concepts and ventures	L. Summerer , J. Mankins, N. Kaya(R)	15
D 3. Symposium on Building Blocks for Future Space Exploration & Development	J.C. Mankins, A. Pradier	4
<b>D 3.1</b> Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration & Development	J.C. Mankins, MA Perino, W.H. Siegfried, H Rauck (Rs)	16
<b>D 3.2</b> Systems & Infrastructures to Implement Future Building Blocks in Space Exploration & Development	W.H. Siegfried , S. Hovland, H Rauck, P Jukola (Rs)	11

### IAC 2012 IAA Commission-III Symposia Status (Contd..)

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Symposium Title/ Session Title	Co-ordinator (Symp)/ Chairman (Session)	No. of Abstracts
<b>D. 3.3</b> Novel Concepts & Technologies for Enable Future Building Blocks in Space Exploration & Development	A Pradier, A Dupas, C Moore, J Onoda (Rs)	10
<b>D. 3.4</b> Space Technology and System Management Practices and Tools	J Mankins, P. Jukola, MA Perino, H Hoffmann (Rs)	19

### IAC 2012 IAA Commission-III Symposia Status (Contd..)

Symposium Title/ Session Title	Co-ordinator (Symp)/ Chairman (Session)	No. of Abstracts
D 4. Symposium on Visions and Strategies for the Far future	Hans E.W. Hoffmann, G. Reibaldi	
<b>D 4.1</b> Novel Concepts & Technologies	C Bruno, A Dupas, P Jukola, H Hoffmann (Rs)	13
<b>D. 4.2</b> Joint Session on Global Public/Private Innovative Initiatives in Spaceflight	H. Rauck, R Villain, S. Ramakrishnan (R)	3
<b>D.4.3</b> Space Elevator Feasibility & Technology	PA Swan, RE Penny, D Raitt (R)	12
<b>D 4.4</b> Contribution of Space Activities to Solving Global Societal Challenges	J Mankins G Reibaldi P Jukola (R)	8

### **ANNEXURE 10**



## IAA COMMISSION III

Report to SAC

12 March 2012, Paris

## **Commission Proceedings**

2 Commission meetings held:

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-> one with Invitation to Members only, 5 attended

-> one open, 20 attended

The Commission Leadership (Chair, Co-Chair, Secretary, Past

Chair) held teleconferences every 2 months to monitor

progress and take required actions.

Commission has recently published the following Studies:

-> Nuclear Space Power and Propulsion Systems, 2008

-> Dealing with Threats to Earth from Asteroids/Comets, 2009

-> Space Solar Power, The First International Assesment..,2011

Initiation of the SSP Working Group, kick-off 13 March 2012

## **Studies Progress Report**

SG 3.9 "Private Human Access, Vol I: Sub-Orbital"

-> Two IAA Symposia organized 2008,2011

-> Draft to be completed in Sept. 2012, Peer Review Dec.

### 2012

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SG 3.10 "Technologies for Interstellar Precursor Missions"

-> Peer Review , October 2011

-> Final Draft to Commission, March 2012; to SAC VC, April 2012

SG 3.12 "Global Human Exploration: The next Steps"

-> Study cancelled in view of problem with leadership availability

SG 3.13 "Space Elevator concept, Technological Feasibility.."

-> Peer Review March 2013, SAC approval June 2013

## New Study Proposals (1/2)

### "Long term space propellant depot"

- -> Draft Study Form submitted by CALT, China
- -> Team Leadership/Participants to be completed
- -> Perticipants from other Commissions sollicited
- -> Proposal to SAC VC in April 2012

"Global Human Exploration Mars System Missions:

#### **Requirements and Technologies":**

- -> Draft Study Form completed
- -> Team Leadership/Participants can flow from SG 3.12
- -> Proposal to SAC VC in April 2012
- -> Participants from other Commissions/Young Professionals

#### sollicited

-> To be proposed as part of the Summit Follow-on Activities

## New Study Proposals (2/2)

- "Public/Private Human Access to Space Vol. 2:
  - **Commercial Space Transportation to LEO and Beyond**"
  - -> Draft Study Form completed

•

- -> Team Leadership/Participants to be completed
- > Proposal to SAC VC in May 2012
- > Participants from Other Commissions sollicited

## IAC 2012 Symposia

• Commission III responsible for the following Symposia:

-> A5 "Human Exploration of the Moon and Mars" (4 Sessions)
 -> C3.1 "Space Based Solar Power Architecture.." (1 Session)
 -> D3 "Building Blocks for Future Space Exploration.." (4 Sessions)
 -> D4 "Vision and Strategies for the Far Future" (4 Sessions)
 Average is 10 papers for 13 sessions submitted for review

## IAC 2013 Symposia

- New Criteria and rule for Commission Membership applied
- Change of Coordinators/Session Chairs implemented, if required
- Symposia consolidated to be complementary to past/future

Studies carried out by the Commission

- Main Changes to be confirmed after IPC meeting:
- A5 focused on Human Mars Mission and Cislunar Space
- D4 focused on SSP WG activities + Advanced missions

(ei.interstellar)

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- D3 not changed with emphasis on Nuclear Propulsion

- C3.1 not changed

## **BACK-UP CHARTS**

IAC 2013 Symposia:

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A5 "Human Exploration of the Moon and Mars"

IPCoordinator: C.Sallaberger, W.Mendell (To be replaced) A5.1 "Near Term Strategies for Cislunar (Lunar Surface)

Infrastructures" (Change)

A5.2 "Human Mission to Mars, Reference mission/technologies" (NEW)

A5.3 Joint session on Human and Robotic Partnership (No Change)

A5.4 "Going Beyond the Cislunar System: Libtation Point, NEOs

(Change)

## IAC 2013 (2/2)

- C3.1 "Space Based Solar Power Architecture..." (No change)
- D3"Building Blocks for Future Space Exploration and development" (No change)
- D4"Visions and Strategies for the far future"
  - D4.1 "Novel Concept and Technologies" (No change)
  - D4.2" Solar Power Satellite working Group status"
    - (new)
  - D4.3 "Space Elevator Feasibility and Technologies" (No change)
  - D4.4 "Contribution of Space Activities to Solving Global

Societal Challenges (No change)



### **ANNEXURE -11**

### **Project of the FP7 SPACE Programme**



Problem-oriented Processing and Database Creation for Ionosphere Exploration



EUROPEAN COMMISSION European Research Area



### **General information**

**Project title:** *Problem-Oriented Processing and Database Creation for Ionosphere Exploration* 

Short title: POPDAT

FP-7 Direction: Activity 9.2 – Strengthening Space Foundations Area 9.2.1: Research to support space science and exploration
Sub-area – 9.2.1.3: Exploitation of space science and exploration data

Terms of execution: 01.06.2011 - 30.04.2013

Requested EU contribution: 1 374 209.00 €



## **Project Consortium**



## Abstract

The Project purpose is <u>the problem-oriented processing of data</u> <u>collected and stored by former ionospheric satellite missions</u>.

At a first stage of the Project implementation, the <u>different types</u> of wave data will be selected, processed and <u>arranged in</u> <u>topical catalogues</u>: AGW, TID, and ELF-VLF plasma emissions. Then the lonosphere Wave Service will be created including the composition of catalogues metadata to provide useful tool to access the database <u>through a web portal</u>.

<u>Ionosphere Wave Service</u> will be promoted to a great number of specialists working in the numerous theoretical and applied space oriented branches.



## The particular goals of the POPDAT Project are:

- Collection of datasets from different sources which concern the wave-like phenomena in ionosphere;
- Appropriate design of the flexible software tools for the search of wavelike behaviors detected in the satellite datasets;
- Creation of thematic catalogues of ionosphere perturbations;
- Implementation of a Ionosphere Wave Service accessible to scientific communities and public users;
- Liaison with ULISSE information system;
- Creation of Ionosphere Virtual Dynamic Observatory to assist educational activities;
- Dissemination and promotion of the Ionosphere Wave Service at topical conferences and in scientific and public press.



## **POPDAT Concept**



### WP1. Problem-oriented data processing of selected space experiments

O density % err.

UT

Task 1.1: Ionosphere satellite experiments review and clustering according to the observed wave processes

Task 1.2: Theoretical substantiation and development of the methodology of wave disturbances selection from satellite data

Task 1.3: Data mining



N2 density % err.

He density

Orbit

Alt.

Lat.

Lo

# WP2. Creation of topical catalogues



Task 2.1: Inventory of users needs

Task 2.2: Optimization of the list of physical parameters and their structuring in catalogues

Task 2.3: Creation of catalogues which concern the wave-like phenomena in ionosphere

www.popdat.org



# WP3. Ionosphere Waves Service creation

- **Task 3.1: Service requirements**
- Task 3.2: Service architecture design
- Task 3.3: Development of the service

Task 3.4: Validation



#### of the service Ionosphere Waves service Data mining services Task 3.5: Database Service 1 Management services **Deployment of** Service Service the service Software FTP server Web interface interface Service 3 Service : Ionosphere Waves Database server Users Service Manager Service 4 Task 3.6: To describe and determine data etc Web server policy and data preservation for each experiment incorporated in demonstrator www.popdat.org Database storage

### **WP4.** Study results dissemination and education



### Task 4.1: Project website creation

- Task 4.2: Exhibition of the efficiency of lonosphere Wave Service application in solving certain scientific problems design
- Task 4.3: Information events
- Task 4.4: Traditional dissemination activities

POPDAT



## **POPDAT Team**



## Contact



**Coordinator:** Prof. Klaus Brieß

Project Manager: Dr. Arnold Sterenharz <u>arnold.sterenharz@ecm-office.de</u>

The research leading to these results has received funding from the European Community's Seventh Framework Programme ([FP7/2007-2013]), under Grant Agreement No. 263240.



### I.A.A. Commission III (Restricted)

### IAA SPRING MEETINGS AT PARIS

Meeting Date(s)	:	March 12 <sup>th</sup> 2012 (FN)	Page 1/11
Venue	:	IAA HQ OFFICE, PARIS	

### **Participants:**

1.	GIUSEPPE REIBALDI	ESA	Chairman
2.	JOHN C MANKINS	ARTEMIS	Past-Chair
3.	S. RAMAKRISHNAN	ISRO	Secretary
4.	KOREPANOV V	UKRAINE	Member
5.	JUNJIRO ONADA	JAXA	Member
6.	PETER SWAN	USA	Invitee

### I.A.A. Commission III (Restricted)

### IAA SPRING MEETINGS AT PARIS

Meeting Date(s)	:	March 12 <sup>th</sup> 2012 (FN)	Page 2/11
Venue	:	IAA HQ OFFICE, PARIS	

#### <u>AGENDA</u>

- 1. Introduction Commission III Composition
- 2. Commission Membership
- 3. Review of Study Status:
  - # SG 3.9 Private Human Access to Space
  - # SG 3.10 Technologies for Interstellar Precursor Missions
  - # SG 3.12 Global Human Exploration of Space
  - # SG 3.13 Technological Feasibility of Space Elevators
- 4. Follow up on completed Study (SG 3.11 Space Solar Power)
- 5. Recommendations for Improvement of Scientific Activities of IAA
- 6. Study Process Improvement Initiative Outcome
- 7. New Study Proposals / Subjects
- 8. Symposia Status IAC 12/IAC 13
- 9. Commission III Report to SAC
- 10. AoB

### IAA SPRING MEETINGS AT PARIS

Meeting Date(s)	:	March 12 <sup>th</sup> 2012 (FN)	Page 3/11
Venue	:	IAA HQ OFFICE, PARIS	

### Minutes :

Subject/Description	Action	Due	Date
Mr. Giuseppe Reibaldi, Chairman Commission III welcomed the participants and briefed them about the new process of conducting IAA Commission meetings in two sessions, one restricted to members and the second meeting open to all.			
The Agenda for the restricted Commission III meeting was displayed.			
1. Commission III composition			
It was noted that the new Commission III (2011-13) with effect from October 2011, consists of ten members. Three new members have joined from China, Ukraine and Nigeria respectively. Prof. Lu Yu of China is nominated as Vice-Chair of Commission III.			
2. Commission III Membership			
The current Commission III members list was displayed (Annexure-1)			

### IAA SPRING MEETINGS AT PARIS

Meeting Date(s)	:	March 12 <sup>th</sup> 2012 (FN)	Page 4/11
Venue	:	IAA HQ OFFICE, PARIS	

It was informed that Prof. Lu Yu	
could not be present for this meeting	
at Paris. However, he has been	
actively participating in tele-	
conferences and has also put up a	
new Study Group proposal under	
Commission III.	
Mr. Karananay Valary of Ukraina	
who attended the meeting was	
who attended the meeting was	
Warmiy welcomed to Commission III.	
The was noted that he has more than EQ was a for averaging a fire frage	
Deservely activities mostifically in the	
Research activities, specifically in the	
area of Space Physics and on the	
application of space precursors to	
predict natural disasters such as	
eartnquake etc.	
Mr. Rabiu.B of Nigeria has not	
attended any of the meetings and has	
also not communicated with the	
Commission leads, so far.	
It was noted that another member	
Mr. Roger Lenard of USA has not	
been active in the last couple of	

### IAA SPRING MEETINGS AT PARIS

Meeting Date(s)	:	March 12 <sup>th</sup> 2012 (FN)	Page 5/11
Venue	:	IAA HQ OFFICE, PARIS	

Chairman, Commission III stressed the importance of active participation from the members through e-mails and teleconference to keep the Commission alive and effective in fulfilling its responsibilities. He will take it up with IAA Secretary on further action with respect to above two members.	Giuseppe Reibaldi <i>,</i> Chairman		
It was noted that Prof. Onoda of JAXA would like to be relieved from the Commission III membership and will nominate an alternate member from JAXA. However, he agreed to continue for the current term upto October 2013.			
3. Review of Study Status: #SG 3.9 Private Human Access to			
Space: This was postponed to the afternoon Commission III open session, as the Study lead was preoccupied with another meeting.			
The Commission noted that the work on the Study report Vol.1 addressing			
Meeting Date(s)	:	March 12 <sup>th</sup> 2012 (FN)	Page 6/11
-----------------	---	----------------------------------	-----------
Venue	:	IAA HQ OFFICE, PARIS	

sub-orbital flights has made good progress, under the leadership of Mr. Christophe Bonnal (Annexure-2).	
There is a proposal to form a new study group with Mr. Alain Dupas as secretary to bring out the Vol.2 of the report focusing on Orbital flights (Annexure-3).	
#SG 3.10 Technologies for Inter- stellar Precursor Missions:	
The Commission noted that the final report after incorporating Peer Review inputs has been submitted (3 <sup>rd</sup> draft) by Prof. Claudio Bruno to Commission III.	
As Prof. Bruno, the study lead is unable to attend the meeting, the status (Annexure-4) will be presented by Mr. Giuseppe on his behalf.	
It was decided to discuss this report during the afternoon Commission III open session.	

Meeting Date(s)	:	March 12 <sup>th</sup> 2012 (FN)	Page 7/11
Venue	:	IAA HQ OFFICE, PARIS	

#SG3.12 Global Human Exploration	
of Space:	
The Commission noted that this	
study has not yet taken off and is	
getting delayed mainly due to	
personal and health related problems	
of the Study Lead Mr. W.Mendell.	
It is decided to close this study and a	
new Study Group is proposed	
(Annexure-5) on more specific and	
currently relevant topic 'Global	
Human Mars Reference Mission and	
Technologies'.	
This Study Crown is under definition	
This Study Group is under definition	
and will essentially have members	
from the SG3.12 as well as Head of	
Agencies Summit follow-on working	
groups.	
#SG3.13 Technological Feasibility of	
Space Elevators:	
Dr. Swan briefed the Commission on	
the status of this Study.	
He gave an overview of progress	
made on the Study Report including	

Meeting Date(s)	:	March 12 <sup>th</sup> 2012 (FN)	Page 8/11
Venue	:	IAA HQ OFFICE, PARIS	

the chapters and their contents as well as the milestones and schedule for completion of Study (Annexure- 6). It was noted that the study is on track for release by Spring 2013.	
Dr. Swan highlighted that the key element is material technology enabling realization of long tethers of appropriate dimensions to construct the Elevator.	
Members pointed out following specific issues to be addressed in this feasibility study:	
<ul> <li>Impact of micro-meteors and orbital debris on the tether integrity.</li> <li>Carriage velocity and its</li> </ul>	
relationship with the velocity of elastic wave propagation in tether.	
The Commission made the following recommendations w.r.t. the proposed Study Report organization/contents:	

Meeting Date(s)	:	March 12 <sup>th</sup> 2012 (FN)	Page 9/11
Venue	:	IAA HQ OFFICE, PARIS	

<ul> <li>Under Part-I on Major Elements, include technology maturity assessment for each element of SE.</li> <li>Under Part-II on Systems Approach, include a Chapter on summary of technology status assessment addressing the total system including all interfaces.</li> <li>The chapters on SE development roadmap and operations to be shifted to Part-III.</li> </ul>		
The first draft report incorporating above suggestions will be ready for review by Commision-III members.	Dr. P.Swan	Dec 2012
4. Follow up on Completed Study (Space Solar Power) : John C Mankins briefed the Commission on the follow-up actions subsequent to the successful completion and publication of the Study Report (SG3.11) on Solar Power from Space.		
With the approval of IAA, Commission III has taken the initiative to sponsor a		

Meeting Date(s)	:	March 12 <sup>th</sup> 2012 (FN)	Page 10/11
Venue	:	IAA HQ OFFICE, PARIS	

Global Space Solar Power Working Group (Global SSP-WG). This international WG created on the same lines as the Lunar Exploration Working Group is having its first meeting on 13 <sup>th</sup> March 2012 at ESA Hq Office under the Chairmanship of Mr. Giuseppe, the Commission III Chair.	
Commission III members were welcomed to attend this first kick-off meeting.	
<ul> <li>5. Recommendations for Improvements of Scientific Activities :</li> <li>&amp;</li> <li>6. Study Process Improvement Initiative:</li> </ul>	
The Commission members were briefed about the action taken by IAA on the above two issues through opinion survey and review Committee. The outcome and recommendations will be implemented after formal approval by Board of Trustees, IAA.	

Meeting Date(s)	:	March 12 <sup>th</sup> 2012 (FN)	Page 11/11
Venue	:	IAA HQ OFFICE, PARIS	

7. New Study Proposals:		
The Commission noted that in the last Commission meeting, seven topics were identified to which one more is added as possible subjects for new Study Groups under Commission III (Annexure-7).		
As of now, three new Study proposals have been defined and proposed in the required format (Annexures-3,5&8)		
The Commission members agreed for putting up of the above three study proposals for IAA approval to enable constitution of respective Study Groups under Commission III	Chairman <i>,</i> Comm. III	
8. Symposia Status :		
It was noted that the response to the Commission III sponsored symposia in IAC-12 is good with 10 to 15 papers in each session (Annexure-9)		
Session 4.2, where only three submissions are there may not be viable.		
<b>9. Report to SAC:</b> Given in Annexure-10.		

## **Commission III Composition (2011-2013)**

Giuseppe Reibaldi (It), Chairman Lu Y (Ch), Vice Chairman John C. Mankins (USA), Past Chair S. Ramakrishnan (In), Secretary Claudio Bruno (It), Member Junjiro Onoda (J), Member Lenard R (USA), Member Christophe Bonnal (F), Member Valeriy Korepanov (Ukr), Member Rablu B (Nig), Member





### Progress report on

### IAA Study Group 3.9 "Private Human Access to Space"

Proposer(s): H. Rauck – G. Brachet Chair: Ch. Bonnal Primary IAA Commission Preference: Commission 3 Secondary IAA Commission Interests: Commission 5

### **Overall Goal:**

Identify and quantify the key topics associated to Manned Private Access to Space for both Orbital and Sub-orbital missions.

### Key words:

- Technical aspects
- Legal and regulatory aspects, safety aspects
- Financial aspects, market analyses, associated business plans
- Motivations of potential customers
- Physiological and Psychological requirements, ergonomic constraints

### Expected outcome of the study:

IAA Position Paper giving the keys to the topic and potentially including recommendations. Subdivision of the study into key chapters, with one "book captain" per chapter ; 7 or 8 members per chapter covering a wide range of origins (countries, agencies, industrials, searchers, operators...)

### Time line:

Initially: 3 years following the initial proposal (March 2007)

Revised timeline:

1 <sup>st</sup> IAA symposium on Private Human Access to Space (Arcachon)						
⇒ 28-30 May 2008						
Publication of the full CD with all the papers, most of the presentatio pictures Distribution to all participants						
⇒ End of September 2008						

Report during IAC Glasgow ⇒ October 2008

 Publication in Acta Astronautica of the 15-20 best papers out of the 68 presented in Arcachon

Process undergoing: 15 papers pre-selected

- 4 rejected
- 2 withdrawn after review

SG: Formal invitation of members of the SG

Additional members are welcome, but may lead to problems of coherence and homogeneity (lack of efficiency; depends on the definition of a Working Group !)

		Buojoon, Oolobol 2000	
Extended table of contents	⇒	IPC. Paris March 2010	

IAC 2010: presentation of the status of the action

Decision taken during the meeting to hold the 2<sup>nd</sup> IAA Symposuim on Private Human Access to Space in 2011

2<sup>nd</sup> IAA symposium on Private Human Access to Space (Arcachon)

⇒ 30, 31 May, 1<sup>st</sup> June 2011

Nice little conference (100 participants from 12 countries)

56 presentations + 2 round tables

Good press support thanks to presence of Astronauts, candidates, Virgin Galactic, X-COR, Astrium...

Proceedings distributed to all participants, available upon request

 Preparation of a dedicated issue of Acta Astronautica with a selection of 15-20 most interesting papers out

Process undergoing: Formalism towards Acta, notification to authors See following page

Associated proposal to delay the preparation of the Position Paper. Already discussed with IAA SG

- ⇒ Report of the conference expected in CapeTown, September 2011
- ⇒ No progress since March on the content due to conference
- ⇒ Fist complete draft expected for Paris meeting March 2012
   ৬ Late, as only half of the contributions are available
- ⇒ Final draft expected for IAC 2012 in Naples

### Special Issue of Acta Astronautica on Private Human Access to Space

### Co-editors: Tannja Masson-Zwaan, Christophe Bonnal

### Selected Structure:

Editorial (4 pages), Tanja + Christophe

1<sup>st</sup> Keynote: Jean-Perre Haigneré (ACE)  $\rightarrow$  Under consolidation 2<sup>nd</sup> Keynote: Bernhard Hufenbach (ESA) $\rightarrow$  Available, under approval 3<sup>rd</sup> keynote: Derek Webber (Spaceport Associates)  $\rightarrow$  Under review 4<sup>th</sup> keynote: Jean-Luc Wibaux (Virgin Galactic accredited agent)  $\rightarrow$  Available, under submission

1<sup>st</sup> part, Christophe editor

Editorial (2 pages), Christophe

- LeGoff (Astrium), market  $\rightarrow$  under submission
- DeLuca (Poli Milano), hybrid propulsion  $\rightarrow$  under review
- Maggi (PoliMilano), hybrid propulsion  $\rightarrow$  under review
- Chavagnac Clervoy (Astrium)  $\rightarrow$  under submission
- Onuki (Japan), Commercial Human space flight in Japan  $\rightarrow$  under consolidation
- Trujillo (ESA), Safety  $\rightarrow$  under submission
- Eymar (N4E), business  $\rightarrow$  under review
- Salt (Vega), business  $\rightarrow$  under review
- Götz (DLR), medical aspects  $\rightarrow$  under submission
- Webber (Spaceport Associates), Point to Point  $\rightarrow$  under review
- Sippel (DLR), Point to Point  $\rightarrow$  under submission
- Peeters (ISU), Point to Point  $\rightarrow$  under submission
- ♦ strong potential still to loose 2 or 3

2<sup>nd</sup> part, Tanja editor

Editorail (2 pages), Tanja

- VanDer Dunk (Uni Nebraska)  $\rightarrow$  under review
- Lazare (CNES)  $\rightarrow$  under review
- Ametova (Leiden Uni)  $\rightarrow$  under review
- Johnson (IISL)  $\rightarrow$  under review
- Galhego-Rosa (Leiden Uni)  $\rightarrow$  under review
- Masson-Zwaan (IIASL)  $\rightarrow$  under review
- Beamer-Downie (General Counsel Airclaims)  $\rightarrow$  under review
- Mahmoudi (Aerospace Research Institute, Iran)  $\rightarrow$  under submission
- Carminati (Weil, Gotshal & Manges) → under review

-1-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

### Proposal for Forming an IAA Study Group

Title of Study: Private Human Access to Space – Vol.2: Orbital

### Proposer(s):

J.Mankins

Primary IAA Commission Preference: Commission 3

Secondary IAA Commission Interests: Commission 4, 5, 6

Members of Study Team

Chair(s): TBD

Secretary: Alain Dupas

**Other Members:** 

Philippe Berthe, Paul Eckert, Paul Spudis, Alan Bond, Horst Rauck, All TBCs TO BE COMPLETED

### Short Description of Scope of Study

Overall Goal:

Identify possibilities and conditions for the creation and sustainability of commercial orbital flight market.

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

### Intermediate Goals:

Characterize, assess the potential and establish scenarios for the development of commercial orbital spaceflight in the 2012-2050 period. The addressed topics include current ISS commercial cargo services, forthcoming LEO commercial crew transport, commercial space stations, private services for BEO (Beyond Earth Orbit) exploration activities (fuel depots in LEO and/or Lagrange points, commercial electric, chemical, nuclear space tugs, lunar resources exploitation and trading, etc.). Technical and economic aspects will be considered. Different scenarios will be established and discussed.

-3-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

### Methodology:

*E-mail mainly.* Progress meetings will be organized during IAF/IAA events. A dedicated workshop will be organized 6 months before the end of the Study

#### Time Line: 2 to 3 Years

### **Final Product :**

REPORT

### **Target Community:**

Industry, Space Agencies

### Support Needed:

### **Potential Sponsors:**

Astrium, TAS, OHB, Arianespace, Boeing, Lockeed, Martin, SpaceX, Orbital, ATK

To be returned to the IAA Secretary General Paris

by fax: 33 1 47 23 82 16 or by email: sgeneral@iaamail.org

#### Date:

(No Signature required if document authenticated).

#### IAA, Paris, 2012 Form

-4-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

#### Follow-up Section for IAA use only

Initial Phase					
Application received:					
Commission Approved:					
SAC Approved:					
Web Site Section opened:					
Members Formally Appointed by IAA:					

Final Phase

Peer Review by Commission Completed:

Recommended by the Commission:

Final Report Received:

SAC Approved:

BOT Accepted:

Publisher Selected:

Study Published:

## ANNEXURE-4

## **SG 3.10**

## "Technologies for Interstellar Precursor Missions (IPM)"

by

C. Bruno, B.Dachwald,G.Genta,P.Gilster,G.Grappone,L.Johnson,R.Kezerashvili,W.Loeb,K.Long,C.Maccone,G.Matloff,A.Oh ndorf,S.Santoli,K-H.Schartner,W.Seboldt,D.Simone,G.Vulpetti



IAA Commissions Plenary Meeting Paris, 12 March 2012

## Contents

- Definition, Concept and Justifications
- Interstellar Distances and Destinations
- Propulsion alternative
- Solar Sails propulsion technologies
- Nuclear Electric propulsion (NEP) technologies
- The Long Term View
- Recommendations

## **Definition, Concepts, Justification**

- Interstellar Precursor Mission = Deep space mission outside the solar system, but not aimed at reaching another star.
- Mission Lapsed time: 20-25 years to reach destinations
- Mission Distance Goal: 50 to 500- 550 A.U;
- Closest star is at 270.000 A.U.
- Justification:
  - Scientific: Explore limit of Heliopause, Kuiper belt objects, Sun Gravitational Lens, Radio Astronomy
  - Technology: Demonstrate technologies (e.i. mainly propulsion, but also telecommunication and autonomous systems) required to reach a star, when it will become feasible

## **Interstellar Distances and Destinations (1/2)**

Kuiper belt: 30-50 ; Heliopause: 90-100 ; Focal point of Sun's Gravitational lens:550; Oorts'Cloud: 700-1000 AU;



## **Interstellar Distances and Destinations (2/2)**

Gravitational lensing at work: 550 AU. Exploit effects to make detailed studies of other solar systems



## **Focus on: Propulsion Alternatives** Propulsion is THE enabling technology



## **SOLAR SAIL Propulsion**



## Solar Sail Unfurled before Vacum Testing (Courtesy NASA)



## **NUCLEAR ELECTRIC (NEP) Propulsion**



## **The Long Term View**

### **Propulsion:**

- ► Interstellar Ramjets (scooping up interstellar hydrogen and fusing it);
- ► Fusion as a power source, replacing fission rockets/ET
- Antimatter-matter annihilation (a form of fusion) as power source;
- ► Beamed energy (to power a spacecraft rocket or fusion engine)

▼Our physics (Tsiolkovski's Law/Newton, special relativity) limits what is actually feasible

▼Short of breakthroughs in Physics, our progress is impeded.

### **TLC and Autonomous Exploration Systems:**

- TLC capable of covering IPM distances with low N/S probably.
   Time Delay is the PROBLEM
- Autonomous exploration of distant targets by sensors and specialized, Artificial Intelligent robots is mandatory. Novel ideas are based on hyperincursive systems (e.i. Predictive capability). Theory still embryonic.

## **Conclusions and Recommendations (1/2)**

- 1. Key technologies needed to perform interstellar precursor missions are propulsion, TLC, and means for autonomous robotic exploration. That include sensors and guidance (GNC) in the broad sense. AI requirements will be extremely high.
- Targets of great interest to science are the Heliopause and the galactic space beyond, including Kuiper belt objects, the nearer Oort cloud, and the Sun gravitational inner focus. All offer tremendous opportunities for new discoveries.
- 3. Among innovative propulsion this study has singled out NEP and Solar Sails as the most promising in terms of timeliness, feasibility and performance potential.
- 4. Near-term NEP using nuclear reactors in the 1-2 MW<sub>e</sub> range can enable one-way IPM to the heliosphere, Kuiper belt objects and perhaps some Oort cloud objects, with reasonable scientific payload fractions and high exploration potential.
- 5. Solar Sails enable similar IPM with much smaller payloads, but with much less initial investment in financial and technology resources.

## **Conclusions and Recommendations (2/2)**

- 6. Key technologies for Solar Sails and NEP are, respectively, advanced sail materials and long-life ET and light nuclear reactors.
- 7. In the long term (30 to 50 years from now), clear alternative candidate propulsion systems are hard to envisage. Fusion ET propulsion is perhaps the most feasible, but complexity, size and cost are challenges even in that timeframe.
- 8. Among other key technologies needed are reliable and robust TLC systems, as well as autonomous AI and GNC, both in space and on the target, once reached. Conceptual solutions proposed have not been explored sufficiently to conclude about their feasibility and reliability.
- 9. IAA should foster detailed investigations to identify out one or two IPM that may be, or become, feasible in the near term. These will become *innovation drivers* similarly to the DARPA's funded "100-year Spaceship". Investment in NEP, Solar Sails and their enabling technologies is also recommended.
- 10. IPM, a driver of innovative and unconventional thought and ideas, should be supported by new IAA initiatives across all Commissions

-1-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

### **Proposal for Forming an IAA Study Group**

### Title of Study:

**Global Human Mars Reference Mission and Technologies** 

### Proposer(s):

G.Reibaldi/C.Bonnal

Primary IAA Commission Preference:

Commission III

**Secondary IAA Commission Interests:** 

All other Commissions

Members of Study Team

Chair(s): TBD

Secretary: TBD

**Other Members:** 

Members from the HoA Summit Follow-on working groups

Former Members of SG 3.12:

Maria Antonietta Perino, Christian Sallaberger, John Logsdon, B.Foing, .....TBC Heidman, Salotti, etc.

### Short Description of Scope of Study

Human Missions to Mars have been studied individually by several Space Agencies, however a shared Mission Reference scenario and Technologies definition road map is missing.

-2-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

ISECG is not dealing with the above subject since it is limiting the coordination of the activities to the Mars Sample Return Mission

### **Overall Goal:**

Define a global Human Mars mission reference scenario and technologies roadmap with their related needed timelines.

### Intermediate Goals:

The Study will consider the following aspects:

- 1) Rationale definition Political, Scientifical, Economical, Cultural
- 2) Questions to be answered with the relevant timelining
- 3) Enabling Technologies required
- 4) Mission Architetture Options
- 5) Definition of selected Refence Mission
- 6) Sustainability of the project
- 7) Outreach aspects
- 8) Cooperative Framework
- 9) Decision Roadmap
- 10) Raccomandation
- 11) Conclusions

-3-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

#### Methodology:

The Study can become a Pilot Project of the HoA Summit follow-on as such a fast track will be required.

E-mail, teleconferences, face-to-face meetings, specific workshop will be organised

### Time Line:

November 2013

### Final Product (Report, Publication, etc.):

Report

### **Target Community:**

Head of Space Agencies, UN, High Level Space Policy Forum, G-20

### **Support Needed:**

National Space Agencies, Private Companies

### **Potential Sponsors:**

European Union, UN, Private Companies, National Space Agencies

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#### IAA, Paris, 2012 Form

-4-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

#### Follow-up Section for IAA use only

Initial Phase					
Application received:					
Commission Approved:					
SAC Approved:					
Web Site Section opened:					
Members Formally Appointed by IAA:					

Final Phase

Peer Review by Commission Completed:

Recommended by the Commission:

Final Report Received:

SAC Approved:

BOT Accepted:

Publisher Selected:

Study Published:

### Assessment of the Technological Feasibility and Challenges of the Space Elevator Concept

A Cosmic Study for the International Academy of Astronautics Editors: Cathy Swan, David Raitt, Skip Penny, Ted Semon, Peter Swan [contact through Dr-swan@cox.net]

**Major Topics:** Overview, Outline, Schedule, Meetings Achieved, Near-term Meetings, General Summary, Individual Chapter Abstracts & Questions

**Overview:** The Space Elevator Community has made great progress in the last six months which is significantly assisting the IAA Cosmic Study. The big events that did contribute to individual chapters are:

- International Space Elevator Conference (Aug 2011, Redmond Washington, USA) Focus day on carbon nano-tubes for tension strength. [yearly event with Cosmic study meetings held]
- International Space Elevator Consortium Study Report Published entitled; *"Space Elevator Survivability, Space Debris Mitigation,"* Lulu.com, Apr 2011.
- National Geographic Magazine [with over 100 million readers] featured two pages on Space Elevator in the July 2011 issue.
- International Space Elevator Consortium published first Journal entitled "CLIMB." [Jan 2012]

#### Outline:

Chapter	Preface
1	Introduction
Part I –	Major Elements
2	Tether Material
3	Tether Riders
4	Power for the System
5	End Station Infrastructure (Base & Counter Weight)
Part II -	- Systems Approach
6	Systems of Systems Design
7	Dynamics of Operation Tether
8	Tether Deployment Approaches
9	Systems Design for Environment
10	Systems Design for Space Debris
11	Space Elevator Developmental Roadmaps
12	Operations Concept
Part III	<ul> <li>Future Considerations</li> </ul>
13	Legal Perspective
14	Financial Perspective
15	Study Conclusions
16	Study Recommendations
Ap	pendix (History, acronyms)

**Schedule:** The study is on track for a Spring 2013 publishing date. The study schedule is as follows:

Date	Action	Туре	Location	Host
Oct 10	Study Approved by IAA	Written	Paris	IAA
Oct 10	Kick off study		Prague	IAA
Mar 11	1 Outline Due		Paris	IAA
Aug 11	Annotated outline/major questions	Mtg	Seattle	ISEC
9 Sept 11	Draft Chapters Due [half submitted]	Written	To Website	team
Oct 11	Discuss Chapter inputs [need more]	Mtg	Cape Town	IAA
9 Jan 12	Feedback Chapters + final of some	Written	On website	team
9 Mar 12	Draft Chapters resubmitted	Written	On website	team
12Mar 12	Chapters discussed in detail	Mtg	Paris	IAA
9 July 12	Final Chapters submitted	Written	On website	Team
Aug 12	Chapter overlap review	Mtg	Seattle	ISEC
Oct 12	Final review chapters/feedback	Mtg	Naples	IAA/ISEC
1 Dec 12	Final Chapters submitted	Written	On website	Team
Mar 13	Peer Review 1 Dec – 15 March	Written	From website	Team
9 Apr 13	Corrections accomplished – final	Written	From website	Team
9 Jun 13	Final Approval from ISEC & IAA	Written	From website	Team

**General Summary:** the status of the study group is fine. We are progressing and hopefully making significant discoveries. The real indicator is the excellent set of chapter abstracts and basic questions for the study. The study is on schedule and should make the April 2013 date.

**Naples Abstracts:** The key is that each chapter should submit a paper covering their chapter. The March meeting will ensure that the chapters are progressing.

**ISEC Annual Meeting, Aug 2012:** This meeting will be a general discussion approach to ensuring that the chapters are compatible between themselves. Each chapter will be presented and discussed. The major points will be shown with alternatives presented also. This half day event will quickly go through the chapters and ensure that each chapter has its opportunity to speak and present their plans and major thrust.



# IAA Commission III Meeting 12<sup>th</sup> March 2012

## **New Study Proposals**

- # Public/Private Innovative Initiatives in Human Space Flight
- # Building Blocks for Future Space Exploration
- # Transformational Space Access
- # Future Space Activities benefits in Solving Global Challenges
- # space Capabilities and disaster Management Lessons learned
- # Future propulsion systems Technologies
- # Orbital Propellant Storage Depot
- # Innovative Spacecraft Architecture

-1-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

### Proposal for Forming an IAA Study Group

### Title of Study:

Global Human Mars Reference Mission and Technologies

### Proposer(s):

G.Reibaldi/C.Bonnal

Primary IAA Commission Preference:

Commission III

**Secondary IAA Commission Interests:** 

All other Commissions

Members of Study Team

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Secretary: TBD

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Former Members of SG 3.12:

Maria Antonietta Perino, Christian Sallaberger, John Logsdon, B.Foing, .....TBC Heidman, Salotti, etc.

### Short Description of Scope of Study

Human Missions to Mars have been studied individually by several Space Agencies, however a shared Mission Reference scenario and Technologies definition road map is missing.

-2-

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### **Overall Goal:**

Define a global Human Mars mission reference scenario and technologies roadmap with their related needed timelines.

### Intermediate Goals:

The Study will consider the following aspects:

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-3-

Instructions and application form: see: "Scientific Activity" section at http://iaaweb.org/content/view/256/393/

#### Methodology:

The Study can become a Pilot Project of the HoA Summit follow-on as such a fast track will be required.

E-mail, teleconferences, face-to-face meetings, specific workshop will be organised

### Time Line:

November 2013

### Final Product (Report, Publication, etc.):

Report

### **Target Community:**

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-4-

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SAC Approved:		
Web Site Section opened:		
Members Formally Appointed by IAA		

Final Phase

Peer Review by Commission Completed:

Recommended by the Commission:

Final Report Received:

SAC Approved:

BOT Accepted:

Publisher Selected:

Study Published:

### IAC 2012 IAA Commission-III Symposia Status [5/3/2012]

Symposium Title/ Session Title	Co-ordinator (Symp)/ Chairman (Session)	No. of Abstract s
A 5. Human Exploration of the Moon & Mars Symposium	W. Mendell, C. Sallaberger	
<b>A 5.1</b> Near-term Strategies for Lunar Surface Infrastructure	MA Perino, W. Mendell, N Ghafoor (R)	9
<b>A 5.2</b> Long-term scenarios for Human Moon/Mars presence	U. Apel, W.H. Siegfried, N. Ghafoor (R)	8
A 5.3/B 3.6 Joint session on Human and Robotic partnerships to realize space Exploration goals	C Sallenberger, A.r. Gross, M. Hempsell, A Kindrat (Rs)	9
<b>A5.4</b> Going beyond the Earth-Moon System: Human missions to Mars, Liberation points, and NEO's	G. Gargir, E. Messerschmid, G Schwehm (R)	20

### IAC 2012 IAA Commission-III Symposia Status (Contd...)

Symposium Title/ Session Title	Co-ordinator (Symp)/ Chairman (Session)	No. of Abstracts
C 3 .1 Space Power Symposium	L Summerer	
<b>C 3.1</b> Space-based Solar Power architectures – New Governmental and Commercial concepts and ventures	L. Summerer , J. Mankins, N. Kaya(R)	15
D 3. Symposium on Building Blocks for Future Space Exploration & Development	J.C. Mankins, A. Pradier	4
<b>D 3.1</b> Strategies & Architectures as the Framework for Future Building Blocks in Space Exploration & Development	J.C. Mankins, MA Perino, W.H. Siegfried, H Rauck (Rs)	16
<b>D 3.2</b> Systems & Infrastructures to Implement Future Building Blocks in Space Exploration & Development	W.H. Siegfried , S. Hovland, H Rauck, P Jukola (Rs)	11

### IAC 2012 IAA Commission-III Symposia Status (Contd..)

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Symposium Title/ Session Title	Co-ordinator (Symp)/ Chairman (Session)	No. of Abstracts
<b>D. 3.3</b> Novel Concepts & Technologies for Enable Future Building Blocks in Space Exploration & Development	A Pradier, A Dupas, C Moore, J Onoda (Rs)	10
<b>D. 3.4</b> Space Technology and System Management Practices and Tools	J Mankins, P. Jukola, MA Perino, H Hoffmann (Rs)	19

### IAC 2012 IAA Commission-III Symposia Status (Contd..)

Symposium Title/ Session Title	Co-ordinator (Symp)/ Chairman (Session)	No. of Abstracts
D 4. Symposium on Visions and Strategies for the Far future	Hans E.W. Hoffmann, G. Reibaldi	
<b>D 4.1</b> Novel Concepts & Technologies	C Bruno, A Dupas, P Jukola, H Hoffmann (Rs)	13
<b>D. 4.2</b> Joint Session on Global Public/Private Innovative Initiatives in Spaceflight	H. Rauck, R Villain, S. Ramakrishnan (R)	3
<b>D.4.3</b> Space Elevator Feasibility & Technology	PA Swan, RE Penny, D Raitt (R)	12
<b>D 4.4</b> Contribution of Space Activities to Solving Global Societal Challenges	J Mankins G Reibaldi P Jukola (R)	8

### **ANNEXURE 10**



# IAA COMMISSION III

Report to SAC

12 March 2012, Paris

## **Commission Proceedings**

2 Commission meetings held:

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-> one with Invitation to Members only, 5 attended

-> one open, 20 attended

The Commission Leadership (Chair, Co-Chair, Secretary, Past

Chair) held teleconferences every 2 months to monitor

progress and take required actions.

Commission has recently published the following Studies:

-> Nuclear Space Power and Propulsion Systems, 2008

-> Dealing with Threats to Earth from Asteroids/Comets, 2009

-> Space Solar Power, The First International Assesment..,2011

Initiation of the SSP Working Group, kick-off 13 March 2012

### **Studies Progress Report**

SG 3.9 "Private Human Access, Vol I: Sub-Orbital"

-> Two IAA Symposia organized 2008,2011

-> Draft to be completed in Sept. 2012, Peer Review Dec.

#### 2012

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SG 3.10 "Technologies for Interstellar Precursor Missions"

-> Peer Review , October 2011

-> Final Draft to Commission, March 2012; to SAC VC, April 2012

SG 3.12 "Global Human Exploration: The next Steps"

-> Study cancelled in view of problem with leadership availability

SG 3.13 "Space Elevator concept, Technological Feasibility.."

-> Peer Review March 2013, SAC approval June 2013

## New Study Proposals (1/2)

#### "Long term space propellant depot"

- -> Draft Study Form submitted by CALT, China
- -> Team Leadership/Participants to be completed
- -> Perticipants from other Commissions sollicited
- -> Proposal to SAC VC in April 2012

"Global Human Exploration Mars System Missions:

#### **Requirements and Technologies":**

- -> Draft Study Form completed
- -> Team Leadership/Participants can flow from SG 3.12
- -> Proposal to SAC VC in April 2012
- -> Participants from other Commissions/Young Professionals

#### sollicited

-> To be proposed as part of the Summit Follow-on Activities

## New Study Proposals (2/2)

- "Public/Private Human Access to Space Vol. 2:
  - **Commercial Space Transportation to LEO and Beyond**"
  - -> Draft Study Form completed

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- -> Team Leadership/Participants to be completed
- > Proposal to SAC VC in May 2012
- > Participants from Other Commissions sollicited

## IAC 2012 Symposia

• Commission III responsible for the following Symposia:

-> A5 "Human Exploration of the Moon and Mars" (4 Sessions)
 -> C3.1 "Space Based Solar Power Architecture.." (1 Session)
 -> D3 "Building Blocks for Future Space Exploration.." (4 Sessions)
 -> D4 "Vision and Strategies for the Far Future" (4 Sessions)
 Average is 10 papers for 13 sessions submitted for review

## IAC 2013 Symposia

- New Criteria and rule for Commission Membership applied
- Change of Coordinators/Session Chairs implemented, if required
- Symposia consolidated to be complementary to past/future

Studies carried out by the Commission

- Main Changes to be confirmed after IPC meeting:
- A5 focused on Human Mars Mission and Cislunar Space
- D4 focused on SSP WG activities + Advanced missions

(ei.interstellar)

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- D3 not changed with emphasis on Nuclear Propulsion

- C3.1 not changed

### **BACK-UP CHARTS**

IAC 2013 Symposia:

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A5 "Human Exploration of the Moon and Mars"

IPCoordinator: C.Sallaberger, W.Mendell (To be replaced) A5.1 "Near Term Strategies for Cislunar (Lunar Surface)

Infrastructures" (Change)

A5.2 "Human Mission to Mars, Reference mission/technologies" (NEW)

A5.3 Joint session on Human and Robotic Partnership (No Change)

A5.4 "Going Beyond the Cislunar System: Libtation Point, NEOs

(Change)

## IAC 2013 (2/2)

- C3.1 "Space Based Solar Power Architecture..." (No change)
- D3"Building Blocks for Future Space Exploration and development" (No change)
- D4"Visions and Strategies for the far future"
  - D4.1 "Novel Concept and Technologies" (No change)
  - D4.2" Solar Power Satellite working Group status"
    - (new)
  - D4.3 "Space Elevator Feasibility and Technologies" (No change)
  - D4.4 "Contribution of Space Activities to Solving Global

Societal Challenges (No change)