International Academy of Astronautics

IAA Committee on Space Debris

Beijing, Sep. 21st, 2013

Agenda

1. IAA Committee on Space Debris
2. Lessons learned from Naples 2012
3. Status of Space Debris Symposium for Beijing 2013
4. Preparation of Space Debris Symposium for Toronto 2014
5. Actions
6. Information

1. IAA Committee on Space Debris

General frame:

- **Officially created within IAA in 2012 ***
  - **Independent Committee**
  - **Permanent Committee**
  - **Attachment to Commission V questionable**

- **Actions of the Committee:**
  - **Position Paper on Orbital Debris in 1993, revised in 2000**
  - **Position Paper SG 5.1 on Space Debris Mitigation in 2006**
  - **Position Paper SG 5.5 on Space Debris Remediation under finalization**
  - **Participation to SG 5.10 on Orbital Debris Removal: Policy, Legal, Political and Economic considerations**
  - **New Situation Report Paper to be discussed today**

(*) NDLR: a working group on space debris was officially created at the IAA in 1991 and terminated in 2003 when the commissions were created.

1. IAA Committee on Space Debris

Terms of Reference (recall):

Scope

The IAA Permanent Committee on Space Debris is in charge of the coordination of all activities related to Space Debris within the Academy, covering the complete span of related topics including but not limited to: measurements, modeling, risk assessment in space and on the ground, reentry, hypervelocity impacts and protection, mitigation and standards, legal and policy, Active Debris Removal and Space Surveillance..

As such, its main tasks are:

- Organization of the IAA Symposium on Space Debris A6 for the International Astronautical Congress, mainly identification of the proposed sessions including scope, chairs and rapporteurs, proposals for joint sessions with other symposia, proposals for Keynote Lectures within the A6 Symposium, or Highlight Lectures in the more general IAC frame,

- Organization of any stand-alone conference on Space Debris on behalf the Academy, including nomination of the Program Committee,

1. IAA Committee on Space Debris

Terms of Reference (recall):

its main tasks are (ctd):

- Coordination of the Academy sponsoring, participation and contribution to selected conferences dedicated to Space Debris, such as for instance the ESA Darmstadt Conference,

- Coordination of the Space Debris contribution in conferences not dedicated to Space Debris, but where some sessions may be devoted to the topic, sponsored by the Academy, Identification of potential studies on Space Debris within Commission V or coordinated with any other Academy Commission, proposal of associated Cosmic Study and proposal for the corresponding Study Group,

- Dissemination of information among the members of the Technical Committee, mainly during regular TC meetings taking place twice a year, before the IAC and during the IAA March meetings in Paris. During these meetings, general information concerning past activities at international level on Space Debris shall be shared among the members, including debriefings from past conferences and major related actions (for instance IADC, COSPAR…). Practical aspects of the preparation of the upcoming Conferences, Symposia, Sessions are also dealt with during these meetings.

1. IAA Committee on Space Debris

Membership:

No need to be member of IAA !

- **Members of the IAA A6 Symposium Program Committee (chairs & rapporteurs)**
- **Members of the Program Committee of other IAA sponsored conferences with Space Debris concerns**
- **Members of Space Debris related working groups (IADC, UNCOPUOS, COSPAR, ISO …)**
- **Academics, Labs, Universities, Industrials… working on the topic**

However, it is requested to be somehow “active”:

- **Participation to the meetings**
- **Debriefing of activities during the meetings**
- **Cross information with other members**

Two meetings per year:

- **One just before each year’s IAC (Saturday is confirmed during the meeting)**
  - ↳ **Includes the status of the sessions, workshops, round tables… of the week**
- **One just before or during the IAC March Meeting in Paris**
  - ↳ **Includes the pre-selection of the abstracts for the following IAC**

1. IAA Committee on Space Debris

Official membership:

Co-Chairs:
Christophe Bonnal
Heiner Klinkrad
Nicholas L. Johnson

Committee Membership:
Patrick Seitzer,
Vladimir Agapov,
Thomas Schildknecht,
Luciano Anselmo,
Carsten Wiedemann,
Toshiya Hanada,
James Hyde,
Alessandro Francesconi,
Frank Schaefer,
Fernand Alby,
John Hussey,
Fabrizio Piergentili,
Darren McKnight,
Seishiro Kibe,
Michael Yakovlev,
Martin Rudolph,
Walter Flury,
Lubos Perek,
Eddy Van Breukelen,
T.S. Kelso,
Holger Krag,
Carmen Pardini,
Sergey Meshcheryakov,
Richard Crowther,
V. Adimurthy,
Phillip Anz-Meador,
Vladimir Kouprianov,
Mark Mulrooney,
Gene Stansbery,
Paula Krisko,
Mark Matney,
Eric Christiansen,
Jer-Chyi Liou,
A.S. Ganeshan,
Hedley Stokes,
Yasuhiro Akahoshi,
Gérard Brachet,
Bill Ailor

Anyone missing?

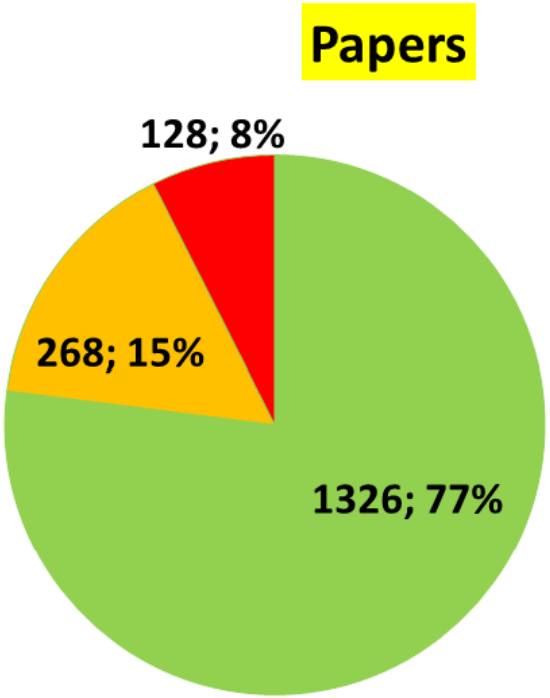
2. Feedback from Naples 2012

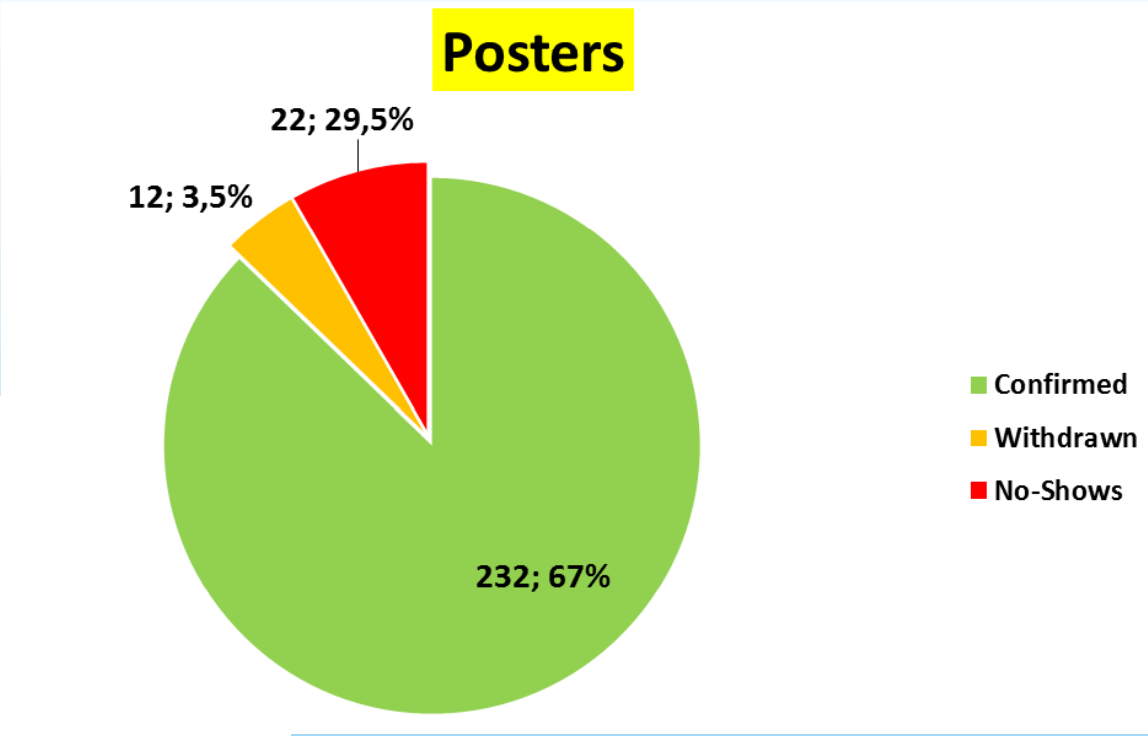
Statistics from Naples 2012

SESSION ID	TECHNICAL SESSIONS	AUTHOR ATTENDANCE PER SYMPOSIUM	Min Att	Max Att	Papers Sched	Papers Pres	Notified Withdraw	No Show	% Papers Present	% No Show	% Notified Withdrawn
	A6. Space Debris										
A6.1.	Measurements		60	90	11	9	1	1	82%	9%	9%
A6.2.	Modeling and Risk Analysis		63	78	10	9	0	1	90%	10%	0%
A6.3.	Hypervelocity Impacts and Protection		35	43	11	6	4	1	55%	9%	36%
A6.4.	Mitigation and Standards		45	60	11	10	0	1	91%	9%	0%
A6.5.	Space Debris Removal Issues		95	105	10	7	3	0	70%	0%	30%
A6.6.	Political, Economic and Institutional Aspects of Space Debris Mitigation and Removal (Joint with Space Security Committ		35	50	12	9	2	1	75%	8%	17%
A6.7	Space Debris Removal Concepts		40	100	10	10	0	0	100%	0%	0%
	TOTAL		373	526	75	60	10	5	80%	6%	13%

2. Feedback from Naples 2012

Statistics from Naples 2012





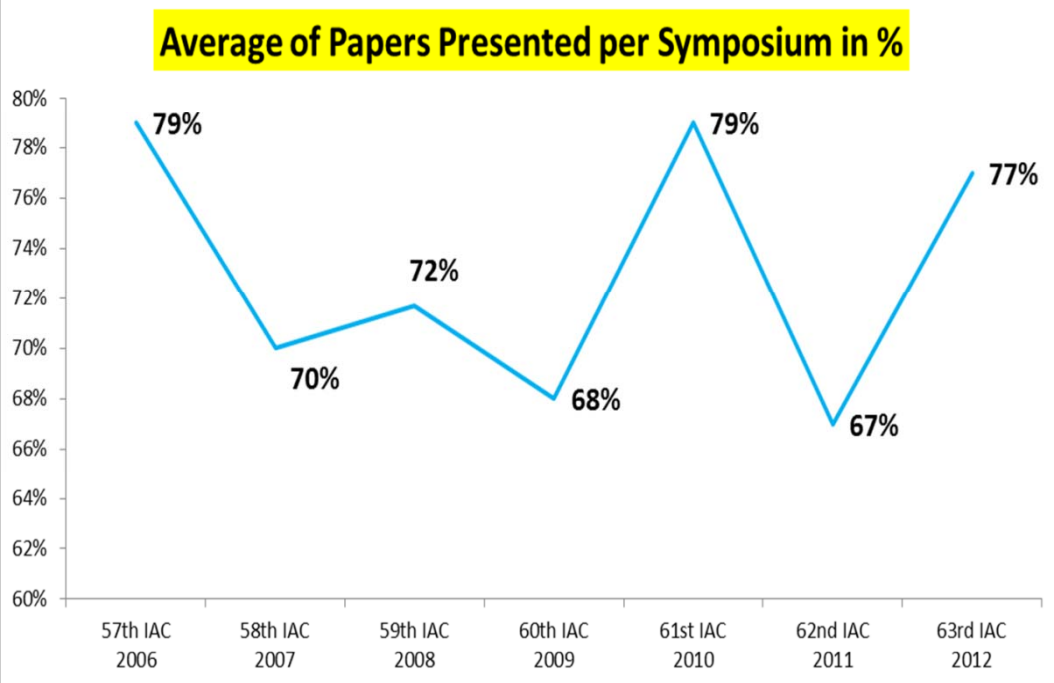
2. Feedback from Naples 2012

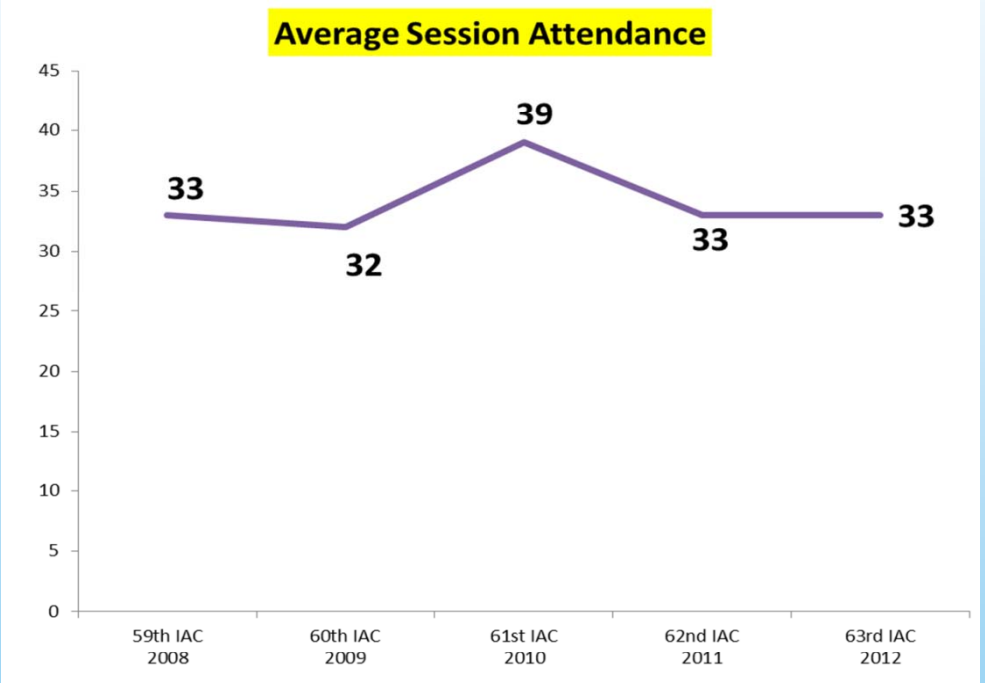
Statistics from Naples 2012

TECHNICAL SESSIONS	AUTHOR ATTENDANCE	Min Att	Max Att	Papers Sched	Papers Pres	Notified Withdraw	No Show	% Papers	% No	% Notified
A1. SPACE LIFE SCIENCES		237	353	98	73	15	10	0,752	0,113	0,1495
A2. MICROGRAVITY SCIENCES AND PROCESSES		176	272	81	69	3	9	85%	12%	4%
A3. SPACE EXPLORATION		329	571	52	44	5	3	84%	7%	9%
A4. 41st SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) – The Next Steps		93	114	21	12	9	0	59%	0%	42%
A5. HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM		67	95	27	17	6	4	0,62	0,127	0,2533
A6. Space Debris		373	526	75	60	10	5	0,804	0,064	0,132
B1. EARTH OBSERVATION		130	243	63	51	8	4	81%	6%	13%
B2. SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM		123	204	85	49	19	17	0,582	0,198	0,2272
B3. HUMAN SPACE ENDEAVOURS		226	406	84	67	12	5	81%	5%	13%
B4. 19th SYMPOSIUM ON SMALL SATELLITE MISSIONS		368	570	99	77	16	6	79%	5%	16%
B5. SYMPOSIUM ON INTEGRATED APPLICATIONS		**30**	**49**	**21**	**17**	**3**	**1**	**82%**	**5%**	**14%**
B6. SPACE OPERATIONS SYMPOSIUM		144	190	47	43	4	0	0,917	0	0,082
C1. ASTRODYNAMICS		457	610	116	99	15	2	85%	3%	13%
C2. MATERIALS AND STRUCTURES		201	328	104	72	19	13	69%	12%	18%
C3. SPACE POWER		121	204	50	38	9	3	76%	6%	20%
C4. SPACE PROPULSION		217	346	86	66	11	9	77%	11%	13%
D1. SPACE SYSTEMS		165	277	60	51	6	3	83%	4%	13%
D2. SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM		362	679	95	75	15	5	79%	6%	15%
D3. SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT		76	135	42	34	5	3	80%	8%	12%
D4. SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FAR FUTURE		71	115	28	21	6	1	75%	3%	22%
D5. 45th SYMPOSIUM ON SAFETY AND QUALITY IN SPACE ACTIVITIES		68	81	37	29	3	5	80%	12%	8%
D6. SYMPOSIUM ON COMMERCIAL SPACEFLIGHT SAFETY ISSUES		60	100	18	14	3	1	77%	7%	16%
E1. SPACE EDUCATION AND OUTREACH		175	309	88	66	16	6	74%	5%	20%
E2. 42nd STUDENT CONFERENCE		55	87	26	23	3	0	89%	0%	11%
E3. 25th SYMPOSIUM ON SPACE POLICY, REGULATIONS AND ECONOMICS		115	176	36	29	4	3	0,818	11%	8%
E4. 46th IAA HISTORY OF ASTRONAUTICS		124	170	30	24	5	1	83%	3%	14%
E5. 23rd SYMPOSIUM ON SPACE ACTIVITY AND SOCIETY		132	175	53	40	6	7	80%	11%	10%
E6. BUSINESS INNOVATION SYMPOSIUM		86	126	39	29	8	2	**0,748**	5%	20%
E7. 55th IISL COLLOQUIUM ON THE LAW OF OUTER SPACE		143	278	76	55	14	7	**0,738**	9%	17%
E8. MULTILINGUAL ASTRONAUTICAL TERMINOLOGY SYMPOSIUM		6	14	7	4	2	1	**0,57**	14%	29%

2. Feedback from Naples 2012

Statistics from Naples 2012

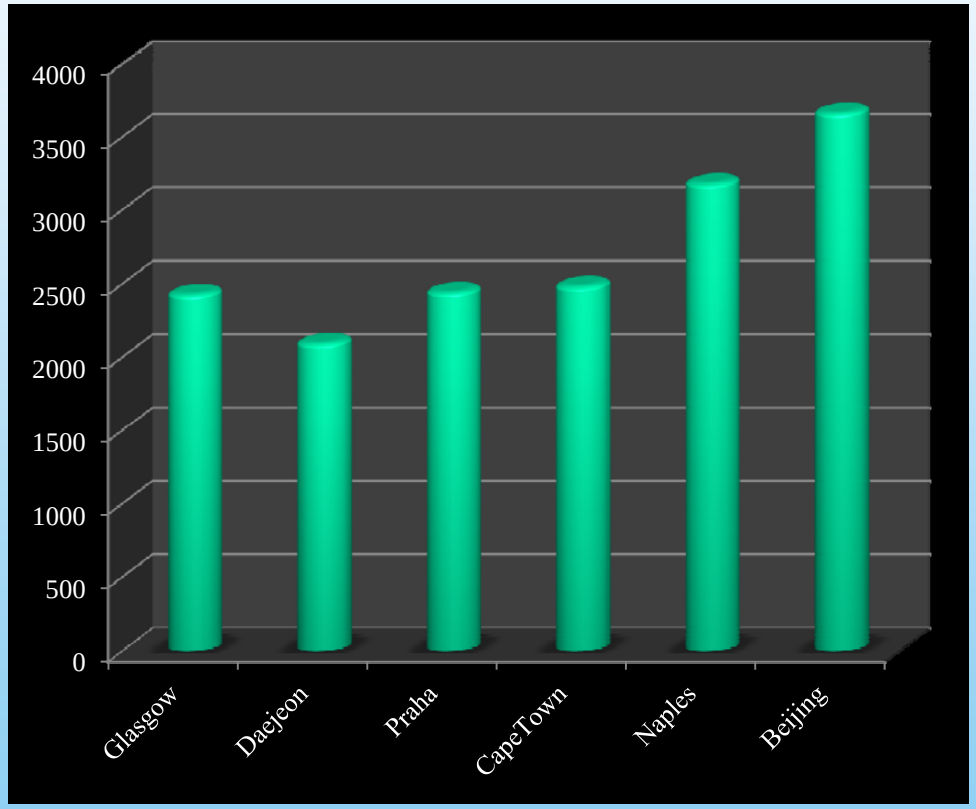




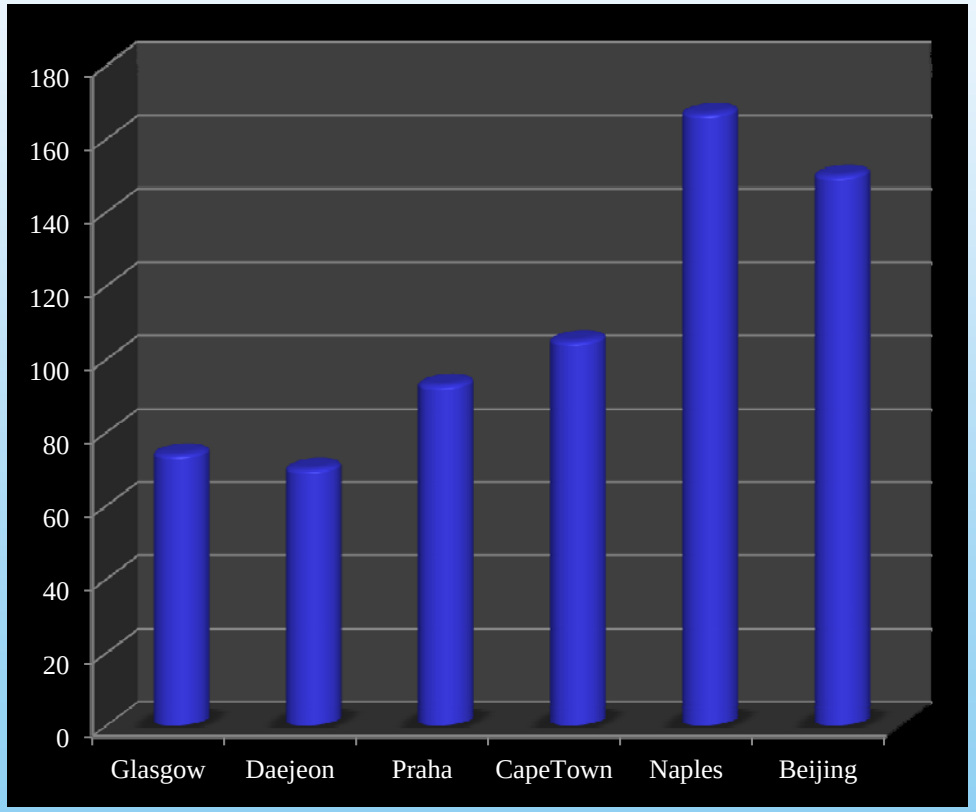
3. Beijing 2013

Number of abstracts since 2008

Total IAC



Space Debris Symposium



3. Beijing 2013

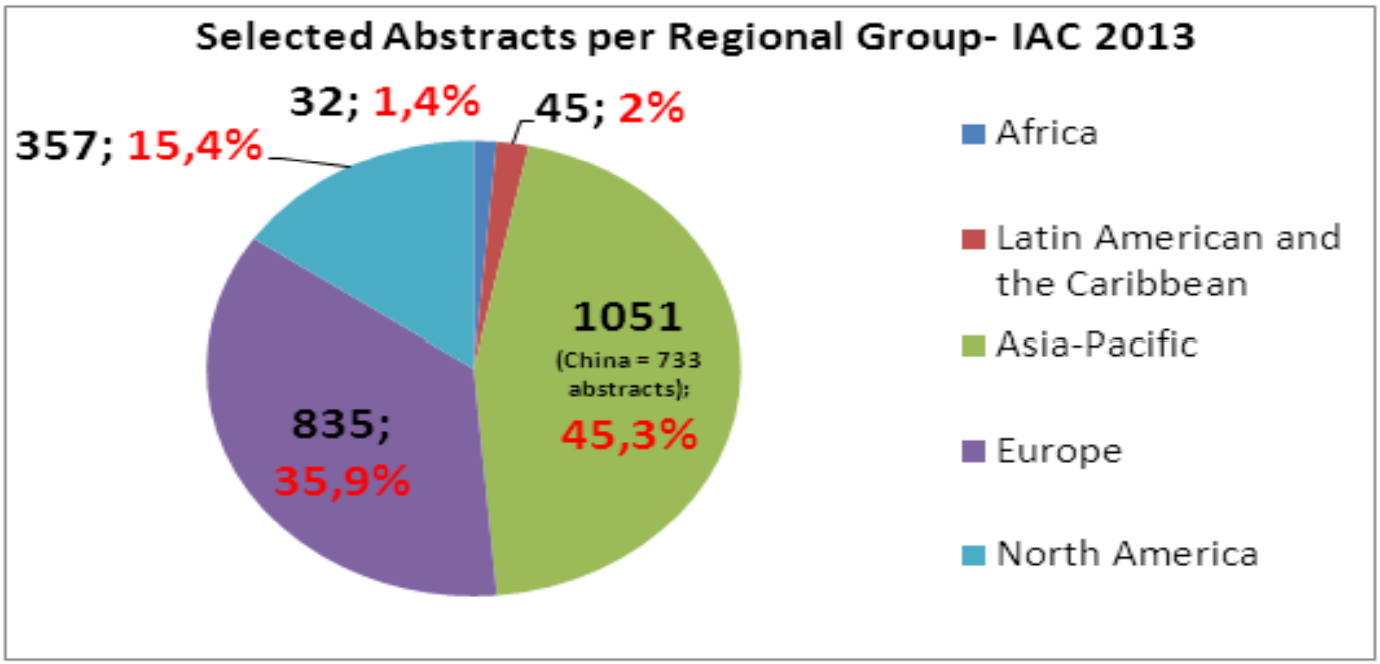
Number of abstracts for Beijing 2013

Spring Meetings 2013 – Abstract Selection RESULTS

Papers, in total 3657
Papers, rejected 1285 (35 %)
Papers, accepted 2320 (65 %)

Posters: 545
Oral Presentations: 1775

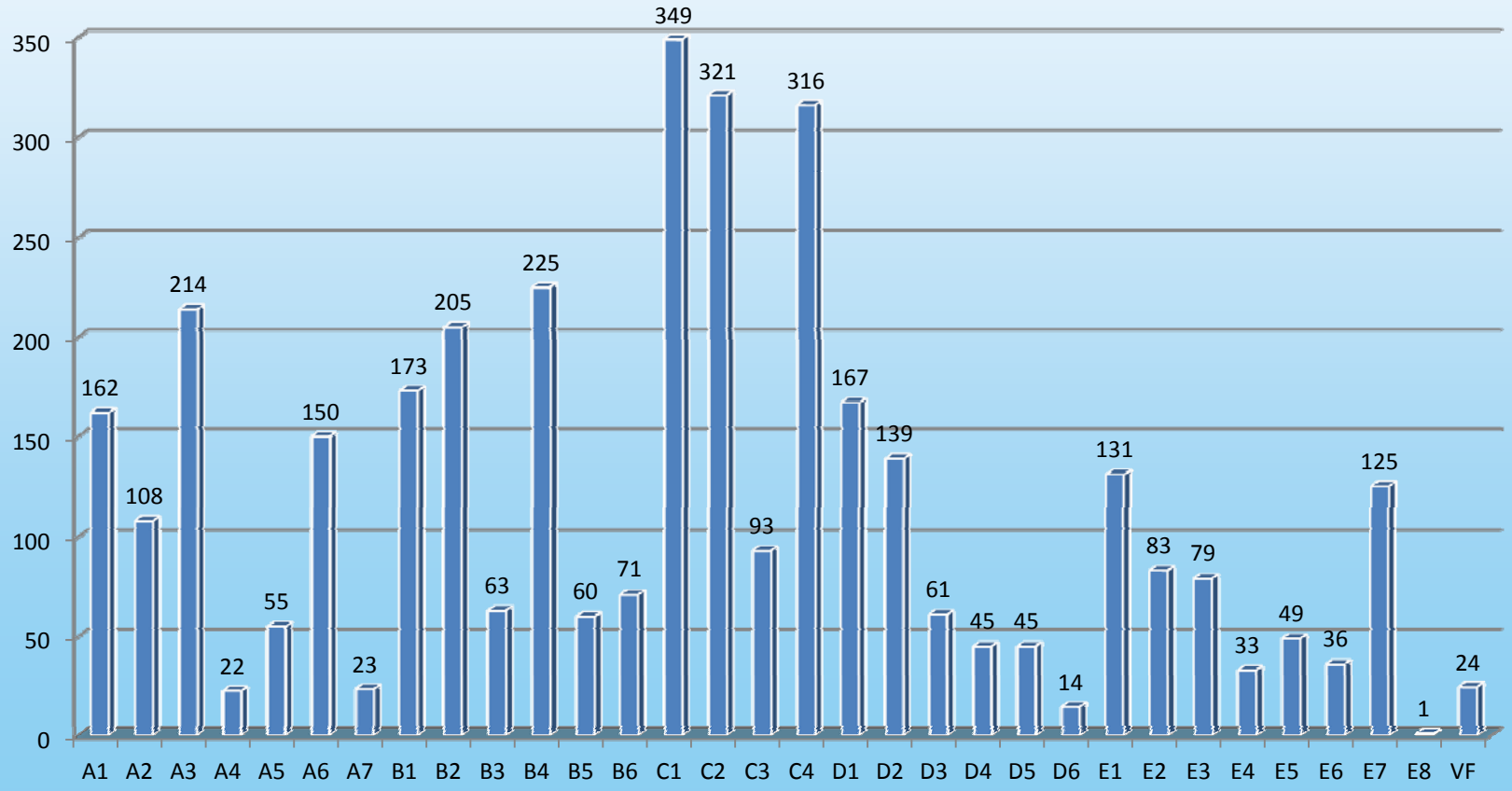
Zone de graphique



3. Beijing 2013

Total Number of abstracts		Oral Presentation	Oral or Poster	Poster
3665		1460	1843	362

Abstracts Submitted by Symposium



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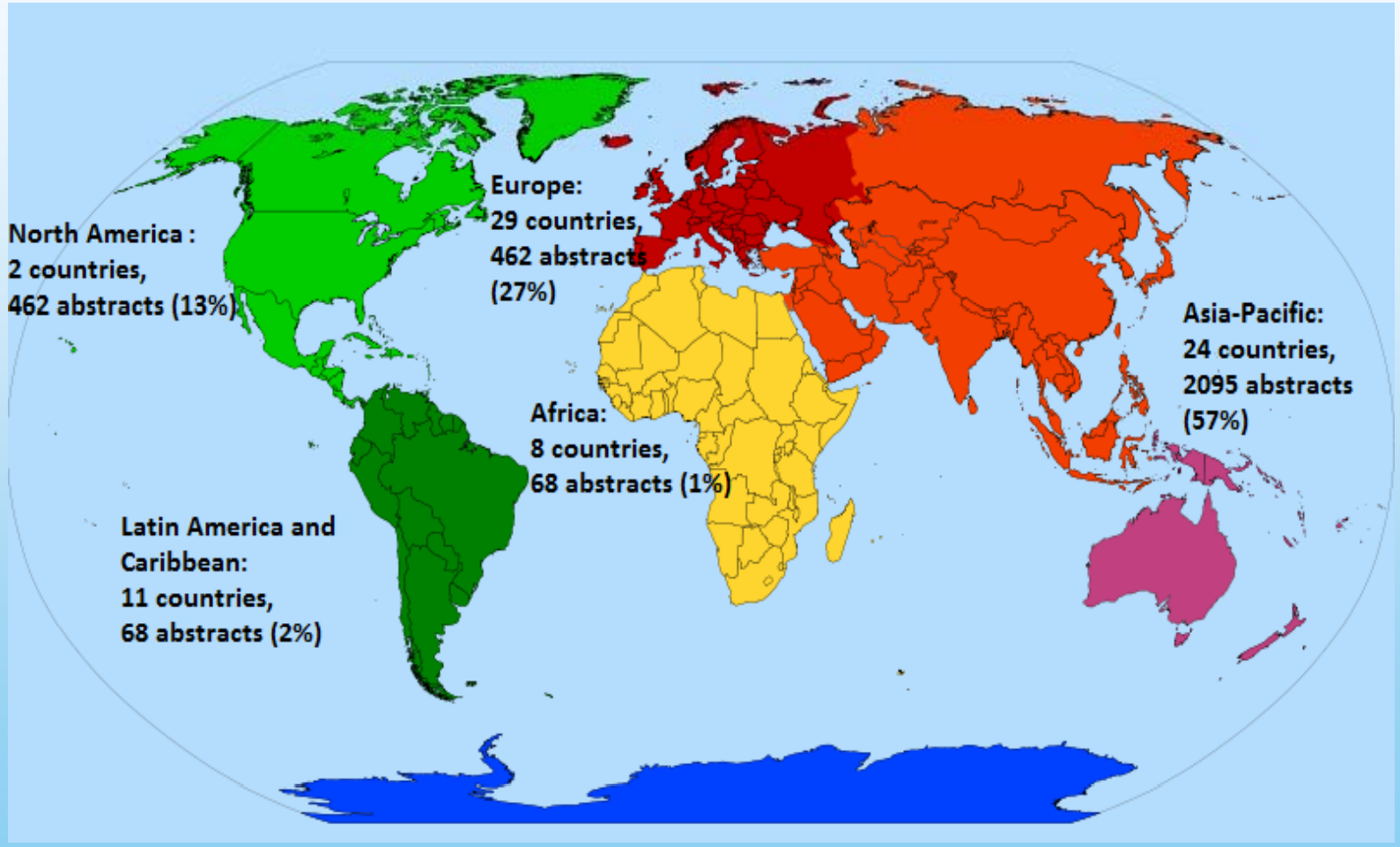
Number of abstracts for Beijing 2013



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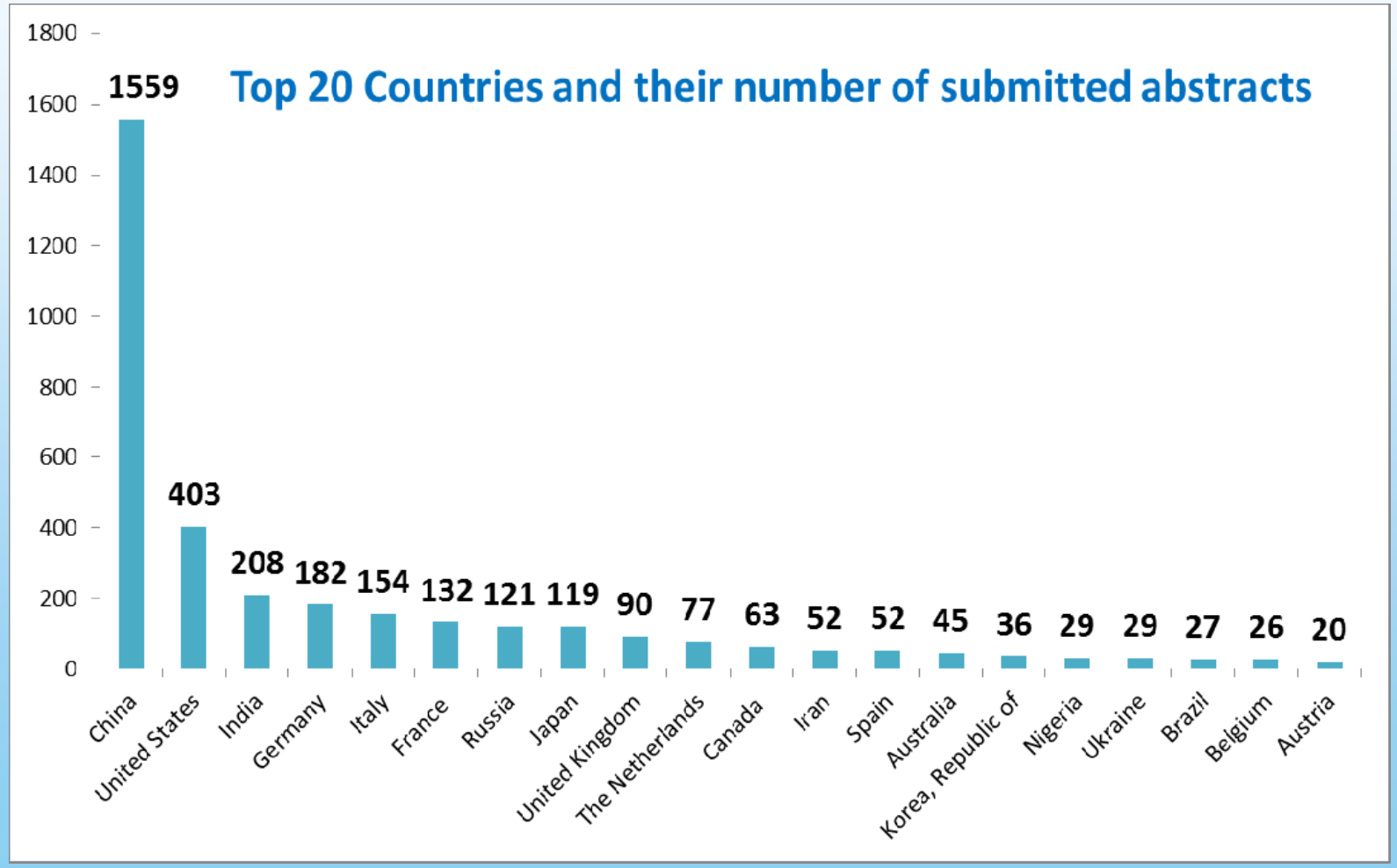


3. Beijing 2013 A6 Symposium

As of Sep.18th

A6.1: Measurements:
Agapov – Schildknecht – Seitzer

A6.2: Modeling and Risk Analysis:
Pardini – Krisko – Wiedemann

A6.3: Hyper Velocity Impacts and Protection:
McKnight – Rudolph – Francesconi

A6.4: Mitigation and Standards:
Alby – Klinkrad – Yakovlev

A6.5: Space Debris Removal Issues:
Adimurthy – Hussey – Santoni

A6.6: Space Removal Concepts
Anz Meador – Kibe – Rudolph

A6.7: Operations in Space Debris environment, Space Situational Awareness:
Finkleman – McKnight – Krag

A6.8: Political, Legal, Institutional and Economic Aspects of Space Debris Mitigation and Removal:
Suzuki – Krisko - Mathieu

A6.P: Space Debris: Posters
McKnight – Bonnal

NNN – OK, NNN – No News, NNN – No Show

3. Beijing 2013 A6 Symposium

As of Sep.18th

A6.1: Measurements:

10 papers – 2 withdrawn – 4 loaded – 6 confirmed – 1 presentation – 2 to 4 ?

A6.2: Modeling and Risk Analysis:

10 papers – 0 withdrawn – 10 loaded – 10 confirmed – 7 presentations

A6.3: Hyper Velocity Impacts and Protection:

11 papers – 3 withdrawn – 7 loaded – 8 confirmed – 6 presentations – 1 to 2 ?

A6.4: Mitigation and Standards:

10 papers – 0 withdrawn – 10 loaded – 10 confirmed – 7 presentations

A6.5: Space Debris Removal Issues:

9 papers – 2 withdrawn – 7 loaded – 7 confirmed – 4 presentations – 2 ?

A6.6: Space Removal Concepts

11 papers – 3 withdrawn – 8 loaded – 5 confirmed – 3 presentations – 3 ?

A6.7: Operations in Space Debris environment, Space Situational Awareness:

8 papers – 2 withdrawn – 7 loaded – 6 confirmed – 1 presentation – 1 ?

A6.8: Political, Legal, Institutional and Economic Aspects of Space Debris Mitigation and Removal:

9 papers – 0 withdrawn – 7 loaded – 7 confirmed – 1 presentation – 1 ?

A6.P: Space Debris: Posters

43 papers – 2 withdrawn – 24 loaded – 34 confirmed – 19 ?

3. Beijing 2013 A6 Symposium

Recall of a few basic rules

- Nice large room 210A for all the sessions: 100+ seats
- Poster in North Foyer
  - Nice Poster competition this year ! (chaired by D. McKnight for our symposium)

- No paper, no show :
  - check that the paper is effectively loaded before the session

- Status of the presenters:
  - Are we sure the authors will show up ?
  - Do we have their short bios ?
  - Try to ask them to come 15' in advance to check that everything is OK, Powerpoint, Videos…

- Timing may be critical !
  - Please, do not overpass the standard 3 hours, except if there is nothing after
  - Have clear rules explained to speakers in advance
  - We may have an extra oral presentation in A6.5: IAC-13,A6,P,24.p1,x18983
  - Keep time for Q&A

- Publications: no dedicated IAC issue of Acta Astronautica any more
  - Selection of 2 or 3 best papers, if any !
  - Chairs and Rapporteurs may be asked to act as Peer Reviewers

4. Toronto 2014 A6 Symposium

A6: Space Debris Symposium *(see Appendix 1)*

Johnson – Matney – Bonnal

The Symposium will address the complete spectrum of technical issues of space debris: measurements, modelling, risk assessment in space and on the ground, reentry, hypervelocity impacts and protection, mitigation and standards, and Space Surveillance.

A6.1: Measurements: Schildknecht – Agapov - Stansbery

This session will address advanced ground and space-based measurement techniques, relating processing methods, and results of space debris characterization.

A6.2: Modelling and Risk Analysis: Anselmo – Matney – Hanada

This session will address the characterization of the current and future debris population and methods for in-orbit and on-ground risk assessments. The in-orbit analysis will cover collision risk estimates based on statistical population models and deterministic catalogues, and active avoidance.

A6.3: Hypervelocity Impacts and Protection: Francesconi – Sen Liu – Schäfer

The session will address passive protection, shielding and damage predictions. Shielding aspects will be supported by experimental and computational results of HVI tests. Use of HVI techniques for debris mitigation.

A6.4: Mitigation and Standards: Alby – Klinkrad – Yakovlev

This session will focus on the definition and implementation of debris prevention and reduction measures and vehicle passive protection. The session will also address space debris mitigation guidelines and standards that exist already or are in preparation at the national or international level.

4. Toronto 2014 A6 Symposium

A6.5: Space Debris Removal Issues: Piergentili – Adimurthy – Bérend

This session will address active removal techniques "ground and space based", review potential solutions and identify implementation difficulties.

A6.6: Space Debris Removal Concepts: Anz-Meador – Kawamoto – Bonnal

This session will address active removal techniques "ground and space based", review potential solutions and identify implementation difficulties.

A6.7: Operations in Space Debris Environment, Situational Awareness:

Kelso – Krag – Krisko

This session will address the multiple aspects associated to safe operations in Space dealing with Space Debris, including operational observations, orbit determination, catalogue build-up and maintenance, data aggregation from different sources, relevant data exchanges standards and conjunction analyses.

A6.8 (joint with Space Security Committee): Political, Legal, Institutional and Economic Aspects of Space Debris Mitigation and Removal

Suzuki – McKnight – Mathieu – Finkleman

This session will deal with the non-technical aspect of space debris mitigation and removal. Political, legal and institutional aspects includes role of IADC and UNCOPUOS and other multilateral bodies. Economic issues including insurance, financial incentives and funding for space debris mitigation and removal. The role of international cooperation in addressing these issues will be considered

A6.P: Posters, **depending on experience from Beijing 2013** – XXX

⇨ **Modifications if any to be given to IAF secretary before the end of the week to implement on the web site**

5. Actions

5.1. IAA Space Debris Reference Paper 2014

Proposal to have an IAA Study Group devoted to a Reference Report on Space Debris
To mark the 20th anniversary of the first IAA Position Paper on Space Debris

Table of content:
- could be the same as PP revision 2001 (not selected following discussions):

Preface
1. Introduction
2. Present Status
3. The Future Environment
4. Debris Control Options
5. Implementation of Debris Control Options
6. Summary
References
Glossary

Appendices
A Review of Past Activities
B Space Surveillance
C Reentering Spacecraft
D Technology Issues
E International Policy Issues

- ***could be slightly modernized (preferred, see following page):***

(present status, space surveillance, reentering space objects, future environment, mitigation, remediation, protectio
legal…, international aspects…)

5. Actions

5.1. IAA Space Debris Reference Paper 2014

Proposal to have an IAA Study Group devoted to a Reference Report on Space Debris
To mark the 20th anniversary of the first IAA Position Paper on Space Debris

Table of content and chapter captains:

Introduction, scope, past studies: Christophe
Present status: Heiner,
Measurements: Thomas & Vladimir
Space surveillance & collision: Fernand & Dave
Reentering space objects: Paula & Mark
Future environment: Paula
Debris mitigation: Mark
Remediation: Darren & Seishiro
Protection: Franck & Martin
Legal: Tanja Masson-Zwaan
References & Standards: Christophe
International aspects: Charlotte

Finalization of the IAA SG request please ***(see Appendix 2)***

5. Actions

5.2. IAC in Toronto 2014:

Highlight Lecture, Keynote Event or similar during

To mark the 20th anniversary of the first IAA Position Paper on Space Debris

Table of content could be:

- **Position Paper 1993 (D. McKnight, W. Flury)**
- **Position Paper on Space Traffic Management**
- **Position Paper update 2005 (W. Flury, N. Johnson)**
- **Position Paper on Space Debris Mitigation (Ch. Bonnal, W. Flury)**
- **Space Debris Remediation 2012 (H. Klinkrad, N. Johnson)**
- **The Inter-Agency Space Debris Coordination Committee (IADC)**

Possibilities:

- **Official proposal to have 30 minutes as IAC Highlight Lecture (preferred)**
- **Back-up: 1st paper, invited, (authors: D. Mc Knight, W. Flury) in one of the A6 sessions**

5. Actions

5.3. Report for UNOOSA:

Request from UNOOSA (United Nations Office for Outer Space Affairs):

- **To provide a report and information for the Scientific and Technical Subcommittee**
- **Will be translated into all the official languages of the UN**
- **Will be presented at its 51st session**

The report should focus on:

- **Research on space debris**
- **Safety of space objects with nuclear power sources on-board**
- **Problems relating to the collision of “such objects” with space debris**
- **Ways in which debris mitigation guidelines are being implemented**

Report shall be sent 14 octobre 2013…

Typically 5 pages

↳ *Any volunteer ? Not really… :o)*

5. Actions

5.4. On going IAA Studies

SG 5.5 Space Debris Remediation

Study completed 2.5 years ago

Review, internal to Com V, then outside

Updated version with comments from Com V included

Sent for Peer Review

6 Reviews received, basically agreeing with the content, with suggestions for improvement

No major points; some formal things

Formal reply sent to IAA shortly after Naples

Approved by IAA Scientific Activities Committee and the Board of Trustees

IAA Request to CNES for printing on Sept.12th, 2013 – 500 copies

Agreement by CNES; could be available by end of October 2013

SG 5.10 Orbital Debris Removal: Policy, Legal, Political and Economic considerations

Nice progress in the Draft Outline *(see Appendix 3)*

Current members of the SG from the Debris Committee: Klinkrad, McKnight, Bonnal

6. General information

6.1. Working Groups, Congresses, Workshops held since Beijing 2012

*** Already seen during March meeting in Paris**

- **UN – IAF Workshop → 11 February 2013 in Vienna**
- **JAXA Workshop → 24 & 25 January 2013 in Tokyo**

*** Held since March meeting in Paris**

- **31st IADC → 17 to 19 April 2013 in Darmstadt**
- **6th European Conference on Space Debris → 22 to 25 April 2013 in Darmstadt *(see Appendix 4)***
- **6th IAASS → 21 to 23 May 2013 in Montreal**
- **CNES Space Debris Synthesis Group → 27 June 2013 *(see appendix 5)***
- **5th EUCASS → 1 to 5 July 2013 in Munich**
- **EU FP7 P²ROTECT Workshop → 10 & 11 September 2013 in Torino**

*** Ongoing activity**

- **ISO ODWG meetings (from R. DeStefanis)**

6. General information

IAF Symposium at COPUOS/STSC
UN, Vienna, 11 February 2013

PROGRAMME

11 February 2013
(15h-18h)

Moderator: Gerard Brachet, former Vice President, IAF and former chairman of IAF/CLIODN (2009-2012)

- 15:00 to 15:10: Welcome Statement - Kiyoshi Higuchi, IAF President

Introduction of the symposium by the moderator

- 15:10 to 17:20: Presentations

US Active debris removal efforts
Darren McKNight, Technical Director for Integrity Applications, Inc. (IAI), Chantilly, Virginia, USA

Active Debris Removal activities in CNES
Christophe Bonnal, Senior engineer, Launcher Directorate, CNES, Paris, France

Space Debris Related Activities- Japanese Case
Tetsuo Yasaka, Professor Emeritus, Kyushu University, QPS Institute

ISTC activities on Space Debris Problem
Tatiana Ryshova, ISTC, Moscow, Russian Federation,

The German on Orbit Servicing Mission DEOS
Alin Albu-Schaeffer, Institute of Robotics and Mechatronics, German Aerospace Center (DLR), Germany

Status of ADR developments at the Swiss Space Center
Muriel Richard, Swiss Space Center, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

The ESA Clean Space Initiative
Luisa Innocenti, European Space Agency (ESA),

The Non-Technical Challenges of Active Debris Removal
Brian Weeden, Technical Advisor, Secure World Foundation, Broomfield, Colorado, USA

- 17:20 to 17:55: Questions to the speakers, debate on the way forward on Active Debris Removal

- 17:55 to 18:00: Concluding Remarks

Coordinator of the Symposium:
Gerard Brachet (IAF)

5th Space Debris Workshop

January 22-23, 2013

Administration Bldg. No1 2F Lecture-hall, JAXA Chofu Aerospace Center

Tuesday 22 January 09:55 ～ 17:55

09:55 **Opening remarks** *Keiichi Hirako(JAXA)*

International Session(English)

10:00 **Long Term Sustainability of Outer Space and Role of UNCOPUOS**
○ *Yasushi Horikawa(Chair of UNCOPUOS)*

10:30 **Overview of JAXA's Space Debris related Activities**
○ *Yasuyuki ITO(JAXA)*

11:00 **The Long-Term Stability of the LEO Debris Population and the Challenges for Environment Remediat**
○ *J.-C. Liou(NASA)*

11:30 **Active Debris Removal activities in CNES**
○ *Christophe Bonnal(CNES)*

12:00～13:20 **Luncheon**

13:20 **Global Debris Mitigation Control and Corresponding Activities in JAXA**
○ *Akira Kato(JAXA)*

13:40 **Current status of studies on active debris removal at JAXA**
○ *S. Kawamoto, Y. Ohkawa, Y. Katayama, H. Kamimura, H. Nakanishi, N. Imura, S. Kitamura, S. Kibe, K. Hirako (JAXA)*

14:00 **Some constraints of international space law on the conduct of active debris removal and preliminary studies to searching for a solution**
○ *Hiroyuki Kishindo(JAXA)*

14:20 **Promoting the Active Debris Removal Project on Business**
○ *Masaya Mine(SJAC)*

14:40 **Prediction of Orbital Debris Population with an Orbital Debris Evolutionary Model**
○ *Yuya Ariyoshi, Toshiya Hanada(Kyushu University), Satomi Kawamoto(JAXA)*

15:00 **Approach Strategy to a Non-Cooperative Target**
○ *Toru Yamamoto, Naomi Murakami, Koji Yamanaka(JAXA)*

15:20～15:35 **Break**

6. General information

15:20 - 15:35 Break

15:35 **Vision-based Measurement and Motion Estimation for Space Debris Removal**
○Yasuhiro Katayama, Heihachiro Kamimura, Shinichiro Nishida, Satomi Kawamoto(JAXA)

15:55 **The Strategy and Technology for Non-cooperative Target Capture**
○H. Nakanishi and S. Kawamoto(JAXA)

16:15 **R&D of Electrodynamic Tether for On-orbit Demonstration**
○Yasushi Ohkawa, Satomi Kawamoto, Koji Matsumoto, Hiroshi Shiomi, and Shoji Kitamura(JAXA)

16:35 **The Plan of Electrodynamic Tether Experiments on HTV for Debris Removal**
○Daisuke Tsujita, Masayuki Harada, Satomi Kawamoto, Yasushi Okawa(JAXA)

16:55 **GEO Debris Removal using Ion Beam Irradiation**
○Shoji Kitamura, Yukio Hayakawa, Yasushi Ohkawa, Satomi Kawamoto(JAXA)

17:15 **Orbital change of space debris using the charged satellite**
○Masaki Nakamiya, Yosuke Akashi, Hiroshi Yamakawa(Kyoto Univ.)

17:35 **Study of Active Debris Removal Project**
○Akiko Otsuka, Fumihiro Kuwao(NEC), Satomi Kawamoto(JAXA), Masayuki Ikeuchi(NTS), Kenji Hirota, Jun-ichiro Watanabe(TECS)

Wednesday 23 January 10:00 ～ 18:20

10:00 **Ballistic Limit Weight and Thickness of Kevlar and Beta Cloth for Sub-millimeter Debris Impact**
○Masumi Higashide, Naomi Onose, Sunao Hasegawa(JAXA)

10:20 **Impact experiments on aluminum foam targets: as a favored candidate material for a light-weight space debris bumper shield**
○Naomi Onose, Masumi Higashide, Sunao Hasegawa(JAXA)

10:40 **Damage evaluation of silicon nitride ceramics subjected to hypervelocity impact**
○N. Kawai, S. Hawegawa, E. Sato(JAXA)

11:00 **An Estimation of the Ballistic Limit Curves by Performing Numerical Analyses of the Small-Size Space Debris Impacts on the Components of Satellites for the Purpose of their Designs**
○Atsushi Takeba, Masahide Katayama(ITOCHU-Techno Solutions, CTC), Kumi Nitta(JAXA)

11:20 **Plasma Generation caused by Hypervelocity Impact against Thin Sheet Materials**
○Koji Tanaka(JAXA), Yoichi Nagaoka(Sokendai), Susumu Sasaki(JAXA)

11:40 **Size distribution of ejecta resulting from hypervelocity impacts of projectiles**
○Masahiro Nishida, Koichi Hayashi(NITech), Sunao Hasegawa(JAXA)

13:20 **Space Debris Conjunction Assessment -- Collision Risk Mitigation Experience --**
○Kaneaki Narita, Shinichi Nakamura, Toru Tajima, Kazunori Someya, Junya Abe(JAXA)

13:40 **Non-life insurance related to Space debris**
○Shigeo Suzuki(Aioi Nissay Dowa Insurance)

14:00 **R&D on in-situ measurement MMOD sensors at JAXA**
○Y. Kitazawa(IHI, JAXA), H. Matsumoto(JAXA), O. Okudaira,(JAXA), P. Faure(Kyutech), Y. Akahoshi (Kyutech), M. Hattori(The University of Tokyo), T. Hanada(Kyushu University), A. Karaki(IHI), A. Sakurai, K. Funakoshi, T. Yasaka(iQPS)

14:20 **Expansion of Tactical Utilities for Rapid ANalysis of Debris on Orbit Terrestrial**
Jeongho Kim, ○Shinji Hatta(MUSCAT Space Engineering), Masumi Higashide, Satomi Kawamoto(JAXA)

14:40 **KIBO/MPAC Experiment Summary**
Yugo Kimoto(JAXA), ○Miyuki Waki(AES)

15:00 **Measurement and modeling of breakup events in the geostationary region**
○Masahiko Uetsuhara, Toshiya Hanada(Kyushu Univ.), Toshifumi Yanagisawa(JAXA), Yukihito Kitazawa(IHI)

5. General information

http://iaassconference2013.spacesafetyfoundation.org/

6. General information

6th IAASS → 21 to 23 May 2013 in Montreal

- Very good conference although the effect of travel embargo due to US budget sequestration could be felt

Gen. Woodward, head of USAF Safety, and Ed Mango, head of NASA Commercial Crew Program, sent video recorded speeches

- During the conference 110 papers were presented, about 200 people attended the 39 conference sessions

- In the course of the Conference Gala Dinner, the newly established IAASS "J. Loftus Space Sustainability Award" was presented to Dr. Heiner Klinkrad and to the ESA Space Debris Office

Congratulations !

- The other award "Jerome Lederer Space Pioneer Award" was presented to Art Thompson and the Red Bull Stratos Team.

6. General information

5th EUCASS → 1 to 5 July 2013 in Munich

http://eucass.eu/ and http://www.eucass2013.de/

- **Science and R&T conference held every 2 years**

- **Very successful conference**
  - **84 sessions + 8 Plenaries**
  - **600 papers presented + Posters + Exhibition**
  - **600+ participants**

- **3 Space Debris sessions coordinated by L. Anselmo with a nice assistance**

- SI.08-Space Debris-I -"Orbital Debris Mitigation Tools and Technologies"
- SI.09-Space Debris-II - "Orbital Debris Remediation Concepts and Approaches"
- SI.10/FD.10-Space Debris 3-GNC&RDV for ADR

6. General information

EU FP7 P²ROTECT Workshop → 10 & 11 September 2013 in Torino

Recall: Space Debris Activities within the EU FP7 Program

Space Debris FP7 Projects

ACCORD	Alignment of Capability and Capacity for the Objective of Reducing Debris	425
BETs	Propellantless deorbiting of space debris by bare electrodynamic tethers	1.773
CLEANSPACE	Small debris removal by laser illumination and complementary technologie	1.976
DEORBIT SAIL	De-Orbiting of Satellites using Solar Sails	1.997
P²-ROTECT	Prediction, Protection & Reduction of OrbiTal Exposure to Collision Threats	1.996
ReVuS	Reducing the Vulnerability of Space Systems	1.971
SPA	Support to Precursor SSA Services	500
		10.64 M€

- P²ROTECT devoted to Protection
- Total study amount 3 M€
- Prime: ONERA
- Large Industrial team led by TAS-I
  + Labs + Academics
- Proceedings not yet available

General status of the ISO items

- **Standards published: 7 (3 HP)**
  - ISO 24113 - Space Debris Mitigation (HP, adopted by ECSS)
  - ISO 27875 - Re-entry risk management for Unmanned S/C and launch vehicle orbital stages
  - ISO 26872 - Disposal of satellites operating at geosynchronous altitude (HP)
  - ISO 23339 - Estimating the mass of remaining usable propellant
  - ISO 27852 - Estimation of orbit lifetime (HP)
  - ISO 11227 - Test procedures to evaluate S/C material ejecta upon hypervelocity impact
  - ISO 14200 - Guide to process-based implementation of meteoroid and debris environmental models
- **Documents reaching FDIS (Final Draft International Standard): 3 (1 HP)**
  - ISO 14222 - Earth Atmosphere density above 120 km (DIS passed 2012-02-14)
  - ISO 16126 - Survivability of Unmanned Spacecraft against Space Debris and Meteoroid Impacts
  - ISO 16127 - Prevention of Break-up of Unmanned Spacecraft (HP)

General status of the ISO items

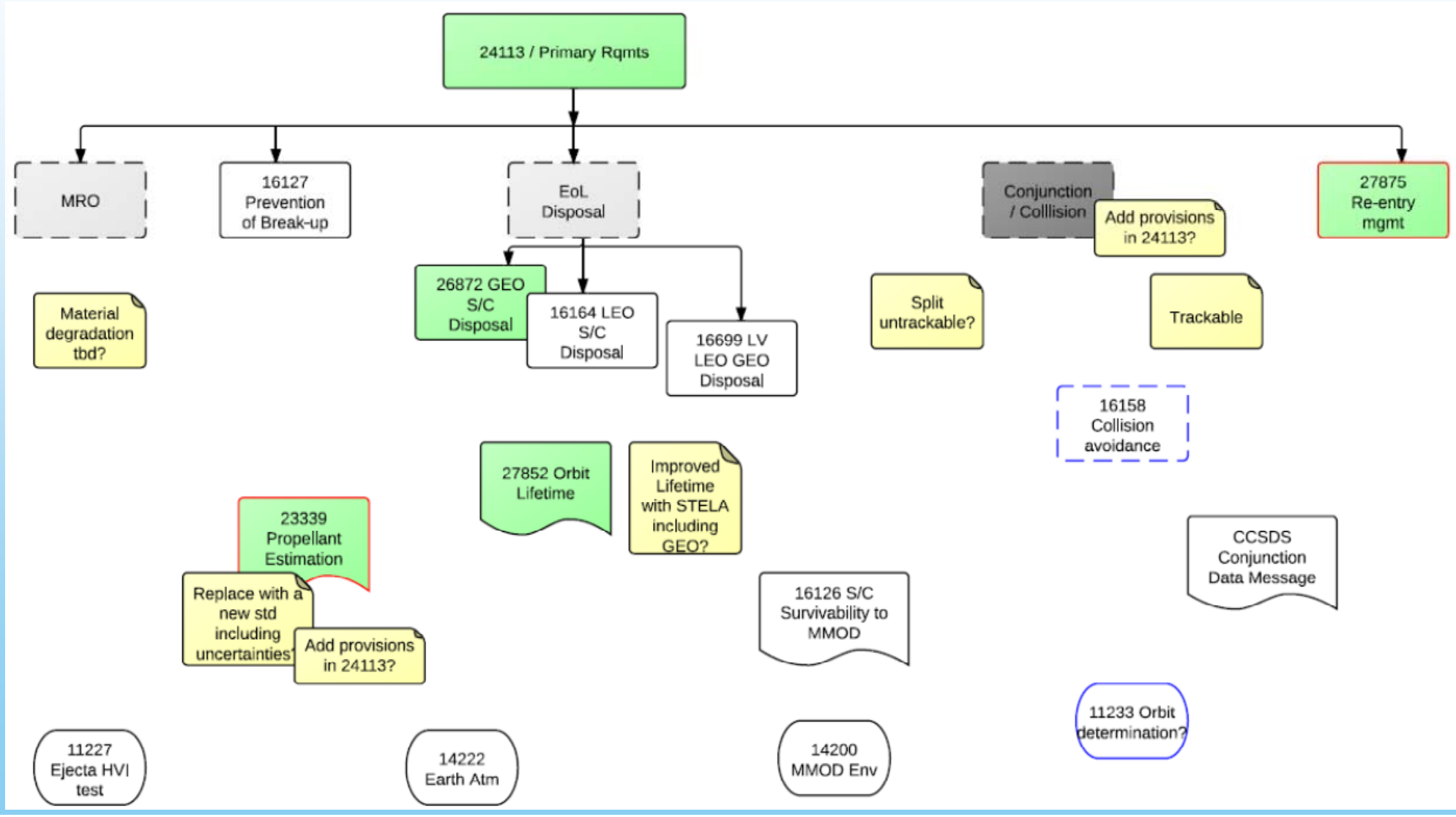
- **Documents in DIS (Draft International Standard): 2 (1 HP)**
  - ISO 11233 - Orbit determination and estimation - Process for describing techniques (TS, DIS review ends 2012-07-27)
  - ISO 16699 - Disposal of orbital launch stages (HP, CD/C ends 2012-06-02)

- **Documents in CD (Committee Draft): 2 (1 HP)**
  - ISO 16158 - Avoiding collisions with orbiting objects (TR, to be reinstated for CD/V)
  - ISO 16164 - Disposal of satellites operating in or crossing LEO (HP, waiting for CD/V)

- **Projects moving to WD: 2**
  - ISO N817 - Design and operation manual for spacecraft operated in the debris environment (Technical Report) (NWIP vote passed 2012-05-09, HP)
  - ISO 16679 (N788) - Relative motion analysis elements after LV/SC Separation

6. General information

General status of the ISO items



ISO TC20/SC14 ORBITAL DEBRIS MITIGATION STANDARDS

WG1 DESIGN

- Prevention of Break-up of of un-manned S/C (16127)
- Survivability of unmanned S/C against SD and MM impacts (16126)

WG2 INTG & TEST

WG3 OPERATIONS

- Disposal at GEO (26872)
- Disposal in LEO (16164)
- Estimating mass remaining usable propellant (23339)
- Re-entry Risk Managment for unmanned S/C (27387)
- Estimation of orbit lifetime (27852)
- Orbit determination and estimation (11233)
- Avoiding collisions with orbiting objects (16158)
- Disposal of Orbital Launch Stages (16699)
- Relative motion analysis LV/SC (16679)

WG4 ENVIRON.

- Process-Based implementation of M/D Env. Models (14200)
- Earth atmosphere density (14222)

WG5 MANAGEMENT

WG6 MATERIALS

- Test procedures for S/C material ejecta upon HVI (11227)

WG7 ODCWG

- Space Debris Mitigation (24113)
- Design and ops manual for S/C in debris envt (18146/N817)

Notes

1) As of April 2012

2) Abbreviated titles used

3) Text colour code:

Orange: IS published

Green: FDIS stage

Red: DIS stage

Blue: CD stage

Black: WD stage

4) Items of ECCS high priority underlined

6. General information

6.2. Upcoming Working Groups, Congresses, Workshops

- EU FP7 REVUS Workshop → 15 October 2013 in Paris
- 5th satellites end of life workshop → 28 January 2014 in Paris

(see appendix 5)

- 3rd European Workshop on Space Debris Remediation → 16 to 18 June 2014 in Paris

Any other announcement ?

6.3. Publications

Don't forget the "NASA Orbital Debris Quarterly News"
Latest Issue: Volume 17, Issue 3, July 2013
(see appendix 9)

6. General information

6.4. General information relative to IAASS

From Tommaso Sgobba, President, IAASS

- **Space Debris Re-entries and Aviation Safety**
  - **Within the thematics of « management of aviation emergencies »**
  - **Presentation made at EUROCONTROL workshop**

  (see appendix 6)

- **Book “Safety Design for Space Operations”**
  - **http://iaass.space-safety.org/wp-content/uploads/sites/24/2012/12/Safety-Design-for-Space-Operations.pdf**

  (see appendix 7)

- **Space Safety Magazine, every 3 months**
  - **http://www.spacesafetymagazine.com/**

  (see example apendix 8)

- **IAASS Journal of Space Safety Engineering (JSSE)**
  - **http://iaass.space-safety.org/publications/journal/**
  - **1st issue planned for November 2013**