



**International
Academy of
Astronautics**



International Academy of Astronautics

IAA Space Debris Committee
Jerusalem, October 10th, 2015



1. IAC

- 1.1. IAA Space Debris Committee
- 1.2. Lessons learned from Toronto 2014
- 1.3. Status of Space Debris Symposium for Jerusalem 2015
- 1.4. Preparation of Space Debris Symposium for Guadalajara 2016

2. Exchanges

- 2.1. Past events: workshops, conferences, congresses, ...
- 2.2. Ongoing
- 2.3. On the Agenda
- 2.4. New achievements
- 2.5. Round table – Open discussion

3. IAA SG 5.14

Situation Report



1.1. IAA Space Debris Committee

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 in 2013**
 - **Participation to SG 5.10 on Orbital Debris Removal: Policy, Legal, Political and Economic considerations**
 - **Situation Report Paper SG 5.14 ongoing, to be discussed today**



1.1. IAA Space Debris Committee

Terms of Reference (recall):

Scope

Coordination of all activities related to Space Debris within the Academy

- **Organization of the IAA Symposium on Space Debris A6 for the IAC, 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,**
- **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,**
- **Dissemination of information among the members of the Committee, mainly during regular meetings taking place twice a year, before the IAC and during the IAA March meetings in Paris.**



1.1. IAA Space Debris Committee

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**
- **Contribution to studies and reports**

Two meetings per year:

- **One just before each year's IAC**
 - ↳ **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**



**International
Academy of
Astronautics**

1.1. IAA Space Debris Committee

Official membership:

Co-Chairs:

Christophe Bonnal
Heiner Klinkrad
Jer-Chyi Liou

Committee Membership:

Adimurthy Vipparthi
Agapov Vladimir
Ailor William H
Akahoshi Yasuhiro
Alby Fernand
Anselmo Luciano
Anz-Meador Phillip
Berend Nicolas
Brachet Gerard
Cazaux Christian
Christiansen Eric L
Crowther Richard
DiPentino Frank
Dolado-Perez Juan-Carlos
Faucher Pascal
Finkleman David
Flury Walter
Francesconi Alessandro
Ganeshan A S
Hanada Toshiya

Hussey W John
Hyde James
Jah Moriba
Kelso T. S
Kibe Seishiro
Heiner Klinkrad
Kouprianov Vladimir
Krag Holger
Krisko Paula H
Masson-Zwaan Tanja
Mathieu Charlott
Matney Mark
McKnight Darren S
Meshcheryakov Sergei A
Mulrooney Mark
Pardini Carmen
Perek Lubos
Piergentili Fabrizio
Prasad MYS
Schaefer Frank
Schildknecht Thomas
Seitzer Patrick
Stansbery Gene
Stokes Hedley
van Breukelen Eddy D
Wiedemann Carsten
Yakovlev Michael
Yasaka Tetsuo

Anyone missing?

Michele Lavagna

Anyone to be removed?

Kouprianov Vladimir
van Breukelen Eddy D

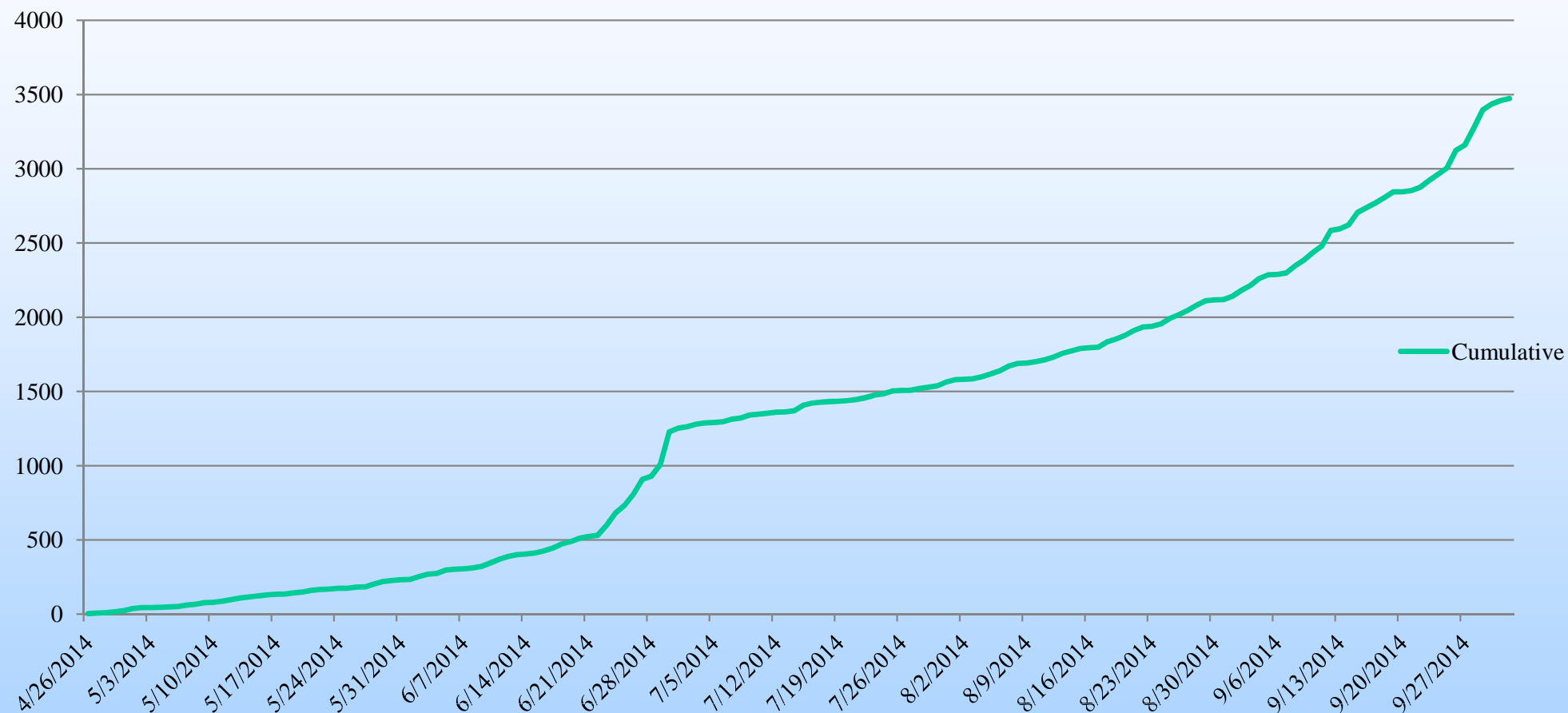
Note:

Numerous members never give any sign of life, and never answer to any of the e-mails



1.2. Feedback from Toronto 2014

IAC 2014 Registration History

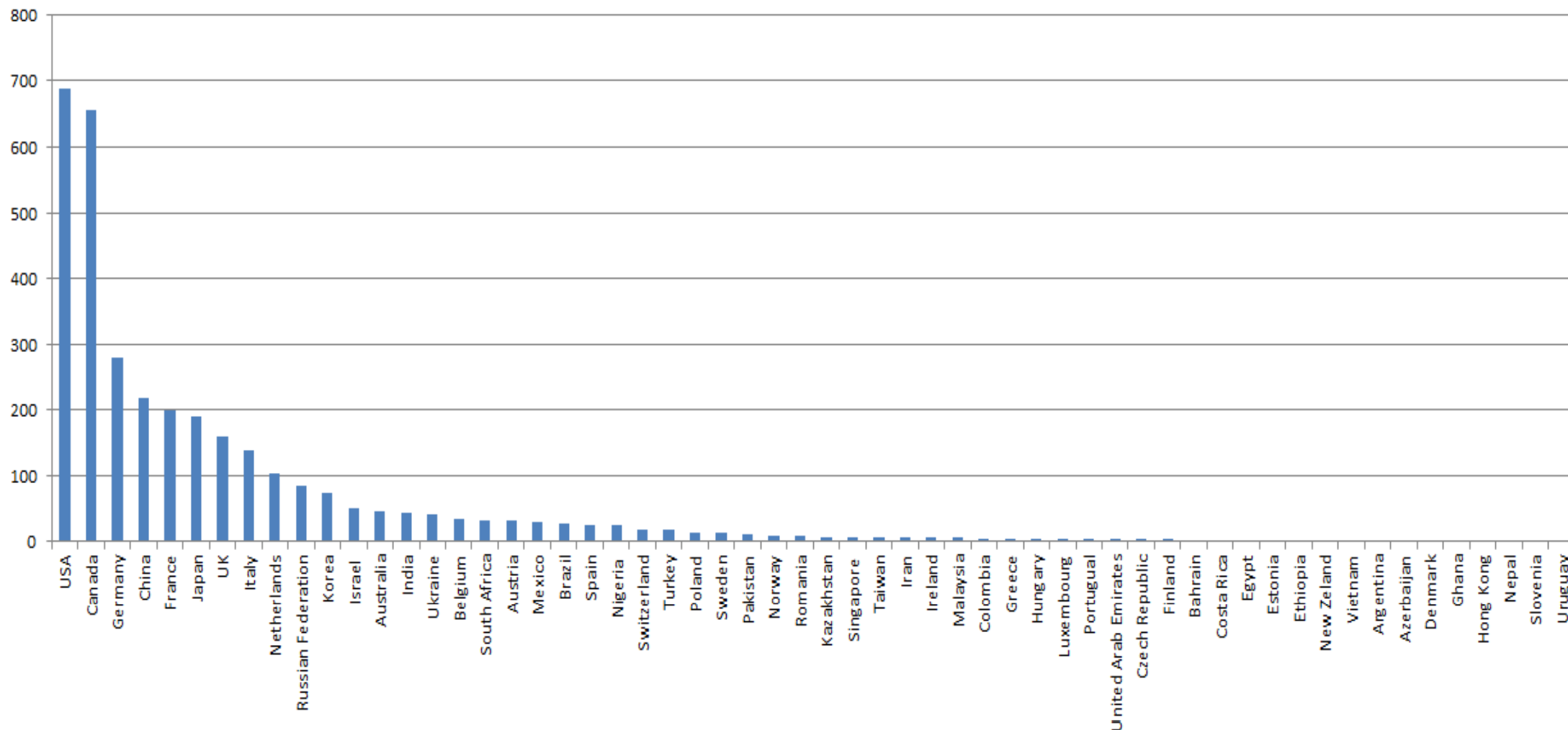


Participation:

- Nearly 3500 participants !



1.2. Feedback from Toronto 2014



Participation per countries:

- Most represented countries: USA, Canada, Germany, China, France, Japan, UK, Netherlands (> 100 delegates)



1.2. Feedback from Toronto 2014

Wow...

3rd best

TECHNICAL SESSIONS	Min Att	Max Att	Papers Sched	Papers Pres	Notified Withdraw	No Show	% Papers Present	% Notified Withdraw	% No Show
A1. SPACE LIFE SCIENCES SYMPOSIUM	160	223	59	29	28	2	54%	46%	0%
A2. MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM	130	210	82	56	7	19	68%	9%	23%
A3. SPACE EXPLORATION SYMPOSIUM	519	621	89	63	16	10	74%	15%	11%
A4. 43rd SYMPOSIUM ON THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE (SETI) – The Next Steps	73	88	18	13	5	1	73%	28%	0%
A5. HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM	189	338	43	33	5	4	76%	13%	12%
A6. SPACE DEBRIS SYMPOSIUM	492	653	95	77	14	4	81%	14%	5%
A7. SYMPOSIUM ON TECHNOLOGICAL REQUIREMENTS FOR FUTURE SPACE ASTRONOMY AND SOLAR-SYSTEM SCIENCE MISSIONS	67	120	21	18	2	1	85%	9%	4%
B1. EARTH OBSERVATION SYMPOSIUM	180	380	61	43	13	5	70%	23%	9%
B2. SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM	164	239	87	44	21	22	52%	24%	25%
B3. HUMAN SPACEFLIGHT SYMPOSIUM	289	561	95	65	24	6	69%	26%	5%
B4. 21st IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS	293	561	100	82	14	4	83%	14%	4%
B5. SYMPOSIUM ON INTEGRATED APPLICATIONS	32	50	24	9	9	6	38%	38%	25%
B6. SPACE OPERATIONS SYMPOSIUM	75	157	43	31	11	1	73%	24%	3%
C1. ASTRODYNAMICS SYMPOSIUM	365	551	116	88	20	8	76%	21%	9%
C2. MATERIALS AND STRUCTURES SYMPOSIUM	227	362	111	74	19	18	66%	18%	16%
C3. SPACE POWER SYMPOSIUM	90	117	33	20	7	6	56%	19%	26%
C4. SPACE PROPULSION SYMPOSIUM	259	403	97	60	25	12	62%	19%	21%
D1. SPACE SYSTEMS SYMPOSIUM	159	270	77	51	18	7	67%	24%	8%
D2. SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM	348	534	93	61	23	9	66%	24%	11%
D3. 12th IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT	81	114	48	31	11	4	64%	27%	9%
D4. 12th IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE	91	122	44	24	15	5	54%	34%	12%
D5. 47th SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE ACTIVITIES	41	62	36	25	7	4	69%	20%	11%
D6. SYMPOSIUM ON COMMERCIAL SPACEFLIGHT SAFETY ISSUES	42	63	19	14	4	1	75%	20%	11%
E1. SPACE EDUCATION AND OUTREACH SYMPOSIUM	163	239	102	70	19	13	68%	20%	12%
E2. 44th STUDENT CONFERENCE	72	96	35	22	9	5	60%	25%	13%
E3. 27th SYMPOSIUM ON SPACE POLICY, REGULATIONS AND ECONOMICS	112	244	53	42	5	6	81%	8%	11%
E4. 48th IAA HISTORY OF ASTRONAUTICS SYMPOSIUM	69	100	25	17	4	4	69%	16%	15%
E5. 25th IAA SYMPOSIUM ON SPACE ACTIVITY AND SOCIETY	85	131	53	37	9	7	70%	16%	14%
E6. BUSINESS INNOVATION SYMPOSIUM	60	101	37	28	6	5	76%	8%	19%
E7. 57th IISL COLLOQUIUM ON THE LAW OF OUTER SPACE	168	303	62	43	11	8	74%	17%	10%
E8. 12th IAA SYMPOSIUM ON MULTILINGUAL ASTRONAUTICAL TERMINOLOG	7	9							

Statistics:

- Based on available information, #1 Symposium in Toronto in terms of maximal attendance !...☺
- Good work of the Chairs and Rapporteurs, with only 5% No-Show: among the best score of the Congress



1.2. Feedback from Toronto 2014

Based on available, incomplete, information

SESSION ID	TECHNICAL SESSIONS	Min Att	Max Att	Papers Sched	Papers Pres	Notified Withdraw	No Show	% Papers Present	% Notified Withdraw	% No Show
	A6. SPACE DEBRIS SYMPOSIUM									
A6.1.	Measurements	85	100	10	8	1	1	80%	10%	10%
A6.2.	Modeling and Risk Analysis	65	89	10	10	0	0	100%	0%	0%
A6.3.	Hypervelocity Impacts and Protection	28	37	15	10	5	0	67%	33%	0%
A6.4.	Mitigation and Standards	51	84	12	10	2	0	83%	17%	0%
A6.5.	Space Debris Removal Technologies	65	85	10	9	0	1	90%	0%	10%
A6.6.	Space Debris Removal Concepts	78	95	11	9	2	0	82%	18%	0%
A6.7	Operations in Space Debris Environment, Situational Awareness	38	70	10	8	1	1	80%	10%	10%
A6.8	Policy, Legal, Institutional and Economic Aspects of Space Debris Detection, Mitigation and Removal	45	50	7	4	2	1	57%	26%	17%
A6.9	Modelling and Orbit Determination	37	43	10	9	1	0	90%	10%	0%
	TOTAL	492	653	95	77	14	4	81%	14%	5%

Statistics:

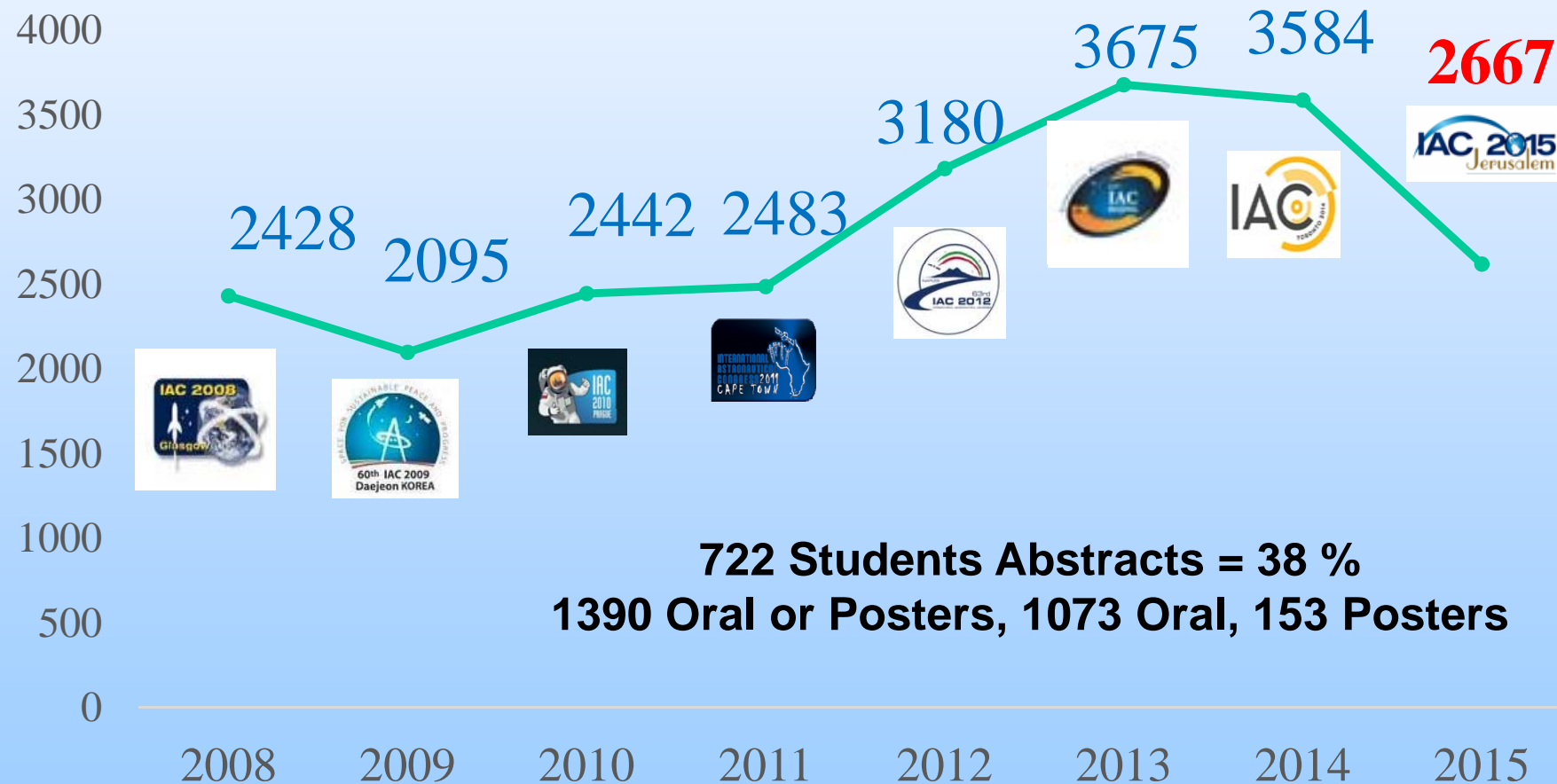
- Rather well equilibrated among sessions
- HVI A6.3 a bit weaker but hyper-specialized
- Average of 73 participants, maximal, per session: very good.
- Low number of No Shows: good work of the Chairs and Rapporteurs
- Low number of Notified Withdraw (except for A6.3 HVI...)
- 20 papers proposed for publication in Acta Astronautica, but only 10 finally published



1.3. Jerusalem 2015 A6 Symposium

Number of IAC abstracts since 2008

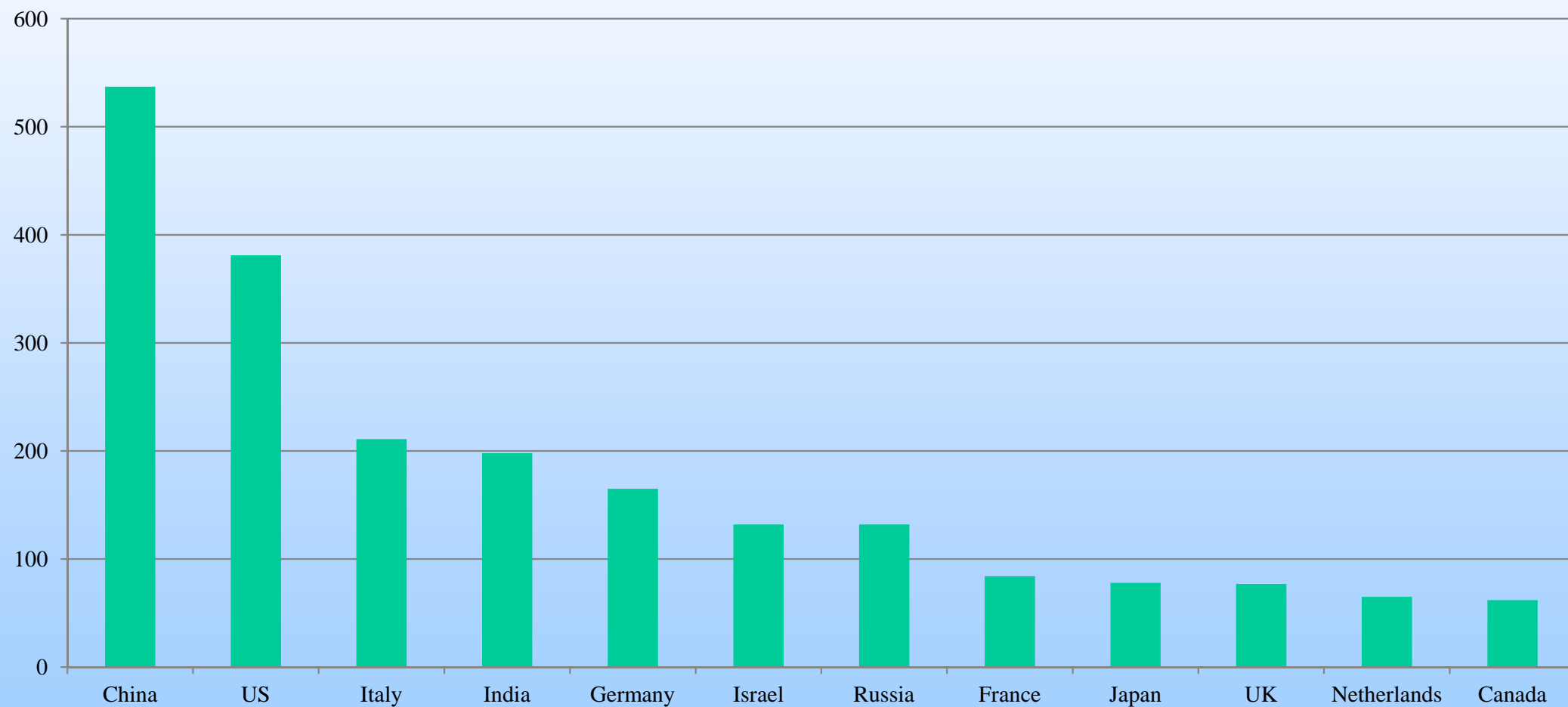
-25,7% since Toronto, - 25,5% since
Beijing





1.3. Jerusalem 2015 A6 Symposium

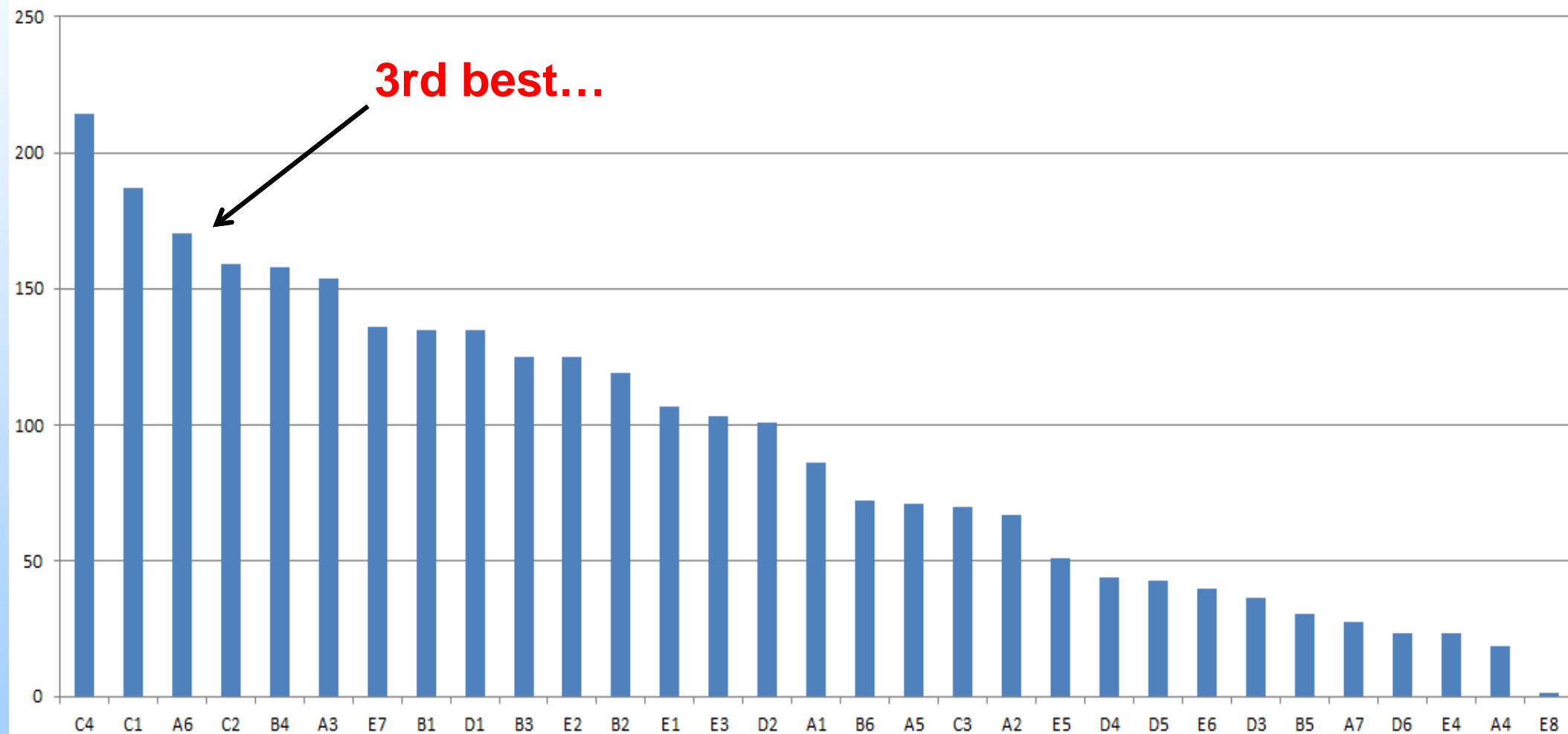
Abstracts coming from 63 countries





1.3. Jerusalem 2015 A6 Symposium

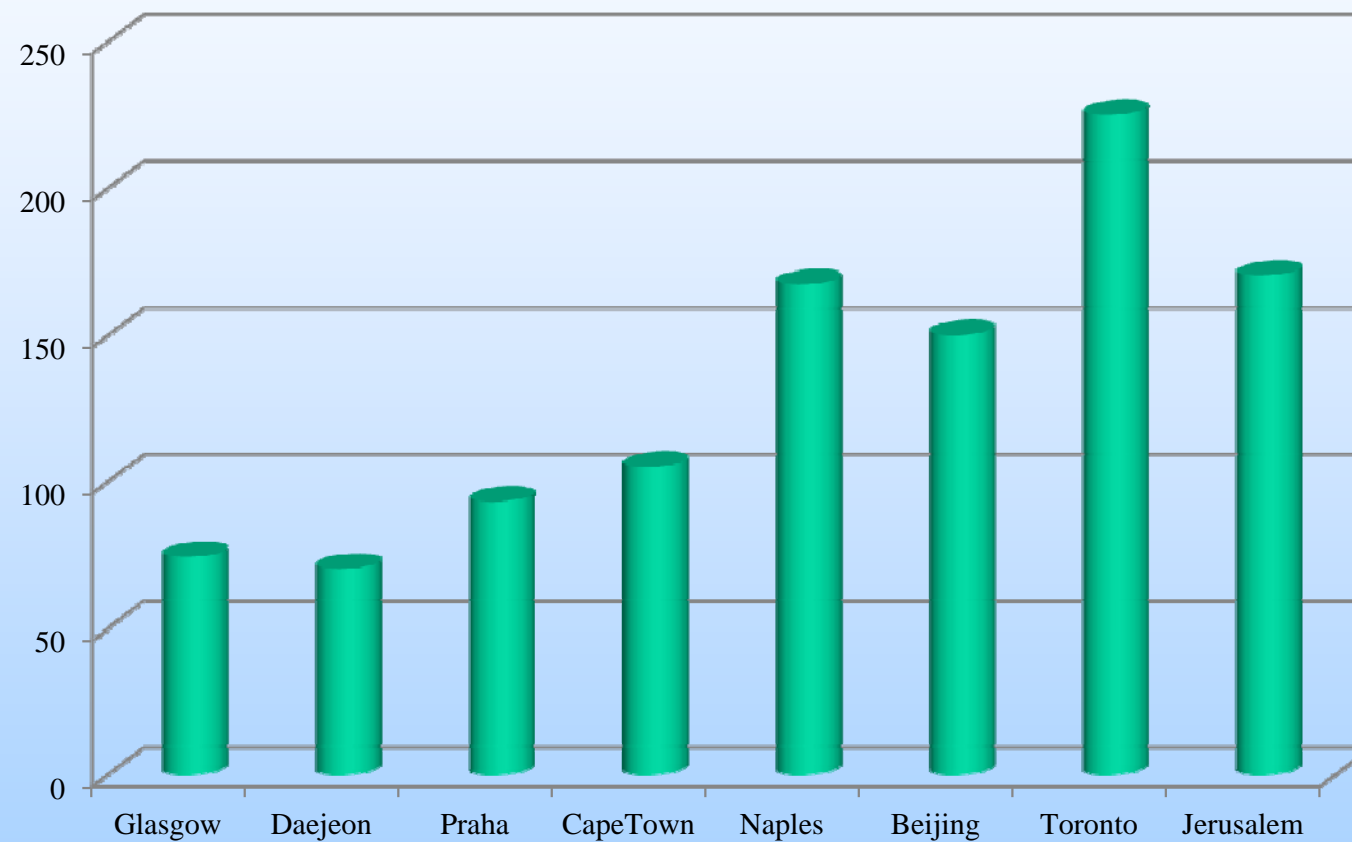
Abstracts per symposium





1.3. Jerusalem 2015 A6 Symposium

Number of abstracts, Space Debris Symposium, since 2008



Status before the selection, IPC March 25 meeting: 166 abstracts

- Thank you to all chairs and rapporteurs for proactive actions just before the official deadline; it really helped...



1.3. Jerusalem 2015 A6 Symposium



Technical Programme Status



Figures as of
10/10/2015

- Abstracts in total: **2,667**
- Abstracts accepted: **2,128** – incl. **1695** Oral Presentations and **433** Interactive Presentations (2,392 in 2014; 2,323 in 2013)
- Abstracts rejected: **489** (1084 in 2014; 1284 in 2013)

Figures as
10/10/2015

- Manuscripts uploaded: **1,311**
- Interactive Presentations uploaded: **221**

Figures as of
10/10/2015

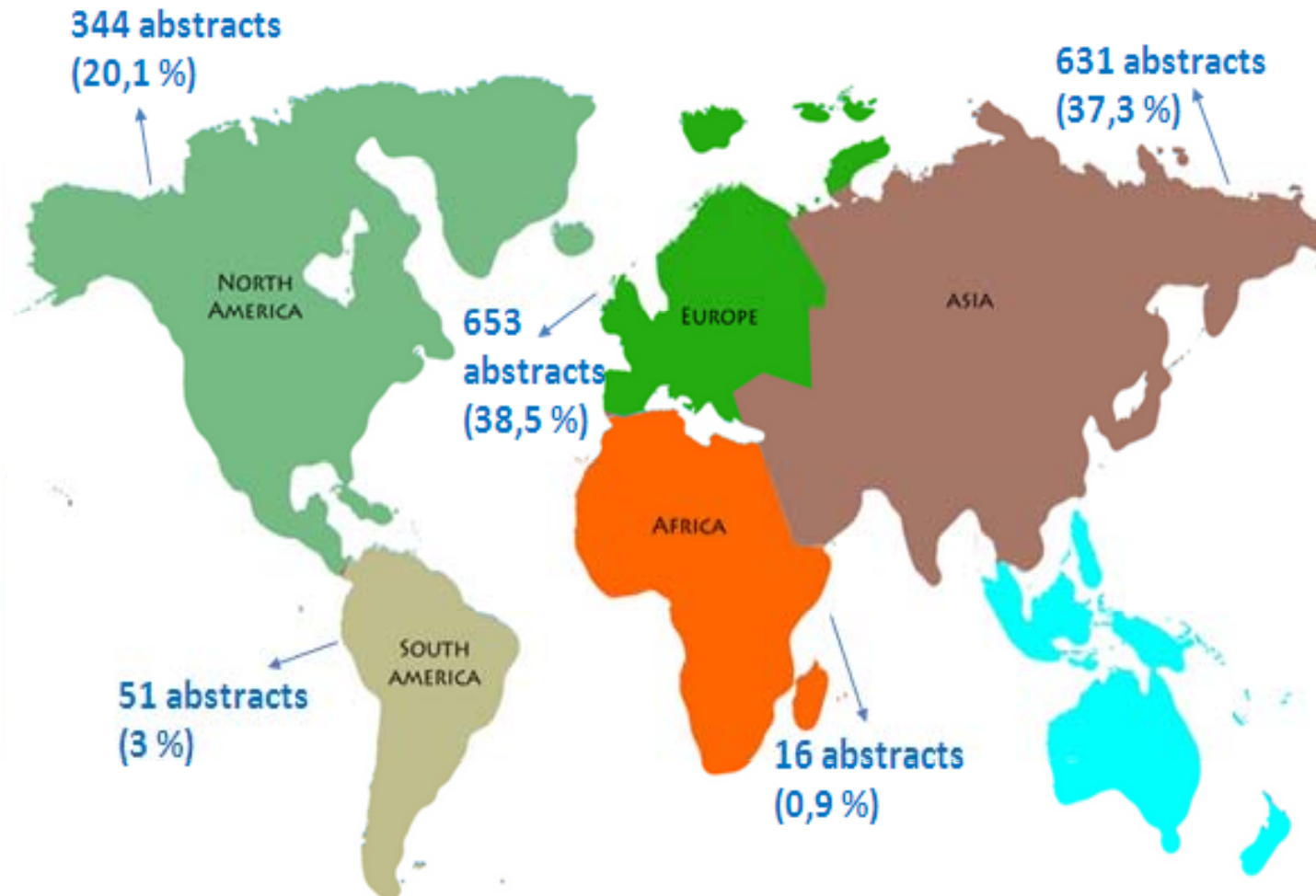
- Confirmed presentations: **1598**
- Withdrawn presentations: **419**
- Unconfirmed: **111**



1.3. Jerusalem 2015 A6 Symposium



Accepted IAC Papers by regional group





1.3. Jerusalem 2015 A6 Symposium

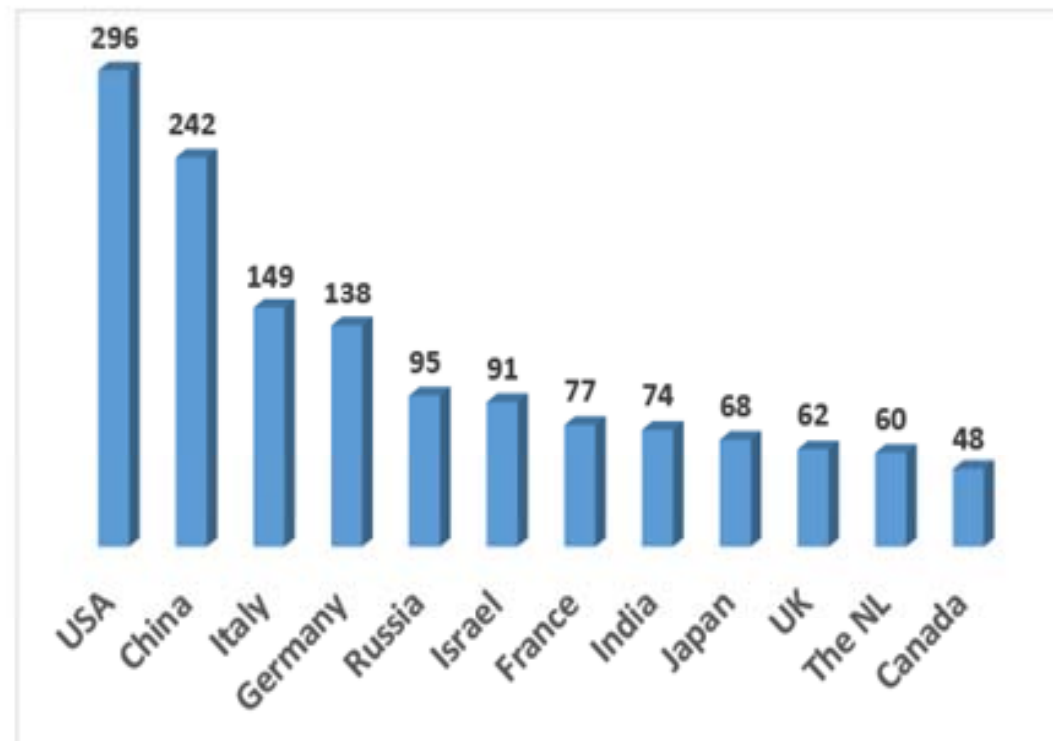


Accepted



IAC Papers by country

- 56 countries have contributed to IAC 2015 technical programme



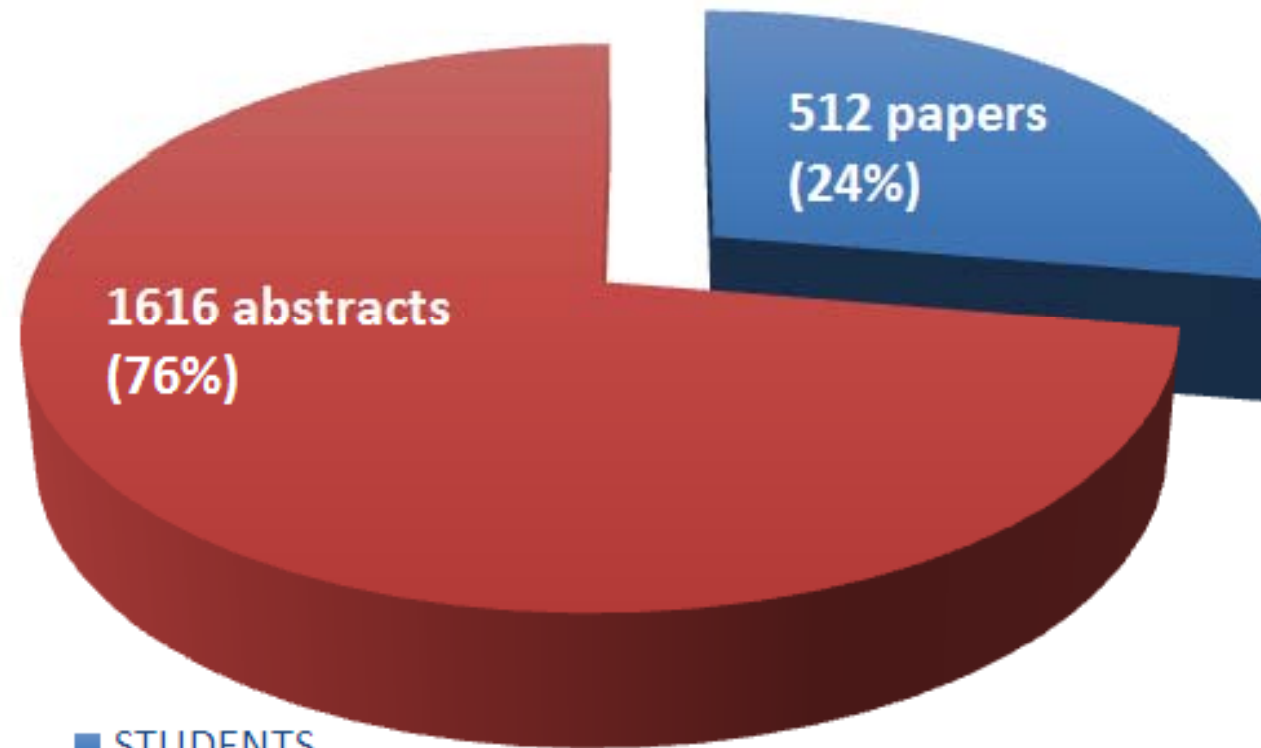


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1.3. Jerusalem 2015 A6 Symposium



Students/ Professionals



For memory, the share was 73% (professionals) vs 27% (students) in 2014



1.3. Jerusalem 2015 A6 Symposium

Number of sessions, Space Debris Symposium, since 2000
+ Poster session, which is gaining importance

IAC	Year	Location	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8	Session 9	Session 10
51st	2000	Rio de Janeiro										
52nd	2001	Toulouse										
53rd	2002	Houston										
54th	2003	Bremen										
55th	2004	Vancouver										
56th	2005	Fukuoka										
57th	2006	Valencia										
58th	2007	Hyderabad										
59th	2008	Glasgow										
60th	2009	Daejeon										
61st	2010	Praha										
62nd	2011	Capetown										
63rd	2012	Naples						Joint				
64th	2013	Beijing										
65th	2014	Toronto								Joint		
66th	2015	Jerusalem								Joint		Joint



A6: Space Debris Symposium

Liou – 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: DiPentino - Schildknecht – Agapov

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: Pardini – Sorge – XXX

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: Fitz-Coy – Schäfer – Francesconi

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: Krag – Cazaux – Funke

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.

A6.5: Space Debris Removal Issues: Cardona – Prasad – Santoni

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



1.3. Space Debris Symposium Jerusalem 2015

A6.6: Space Debris Removal Concepts: Berend – Kibe – Liou

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 – Dolado-Perez – Finkleman

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

Biddington – McKnight – XXX

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

A6.9: Orbit Determination and Propagation: Jah – Klinkrad – XXX

This session will address aspects of space debris orbit determination related to assessment of raw and derived data accuracy, optical measurements processing and modelling and risk analysis of space debris

A6.10-YPVF.5: Space Debris Young Professionals Virtual Forum

XXX – Stube – Bonnal

This virtual session will be organised by the IAF Technical Committee on Space Security and the IAF Space Debris Committee. This virtual session will be a multi-disciplinary forum on emerging issues related to space debris, aimed at raising awareness around this critical threat to space activities.

A6.P: Posters, Yasaka – McKnight – Bonnal



1.3. Space Debris Symposium Jerusalem 2015

A6: Space Debris Symposium Number of Abstracts

Selected – Confirmed – Withdrawn – Paper - Presentation

A6.1: Measurements: 9 – 8 – 1 – 7 – 6

A6.2: Modelling and Risk Analysis: 11 – 11 – 0 – 11 – 8

A6.3: Hypervelocity Impacts and Protection: 9 – 7 – 2 – 8 – 6

A6.4: Mitigation and Standards: 11 – 9 – 2 – 9 – 6

A6.5: Space Debris Removal Issues: 9 – 8 – 1 – 7 – 5

A6.6: Space Debris Removal Concepts: 11 – 8 – 2 – 6 – 4

A6.7: Operations in Space Debris Environment, Situational Awareness: 9 – 9 – 1 – 7 – 5

A6.8 (joint with Space Security Committee): Political, Legal, Institutional & Economic Aspects of Space Debris Mitigation and Removal: 8 – 8 – 1 – 7 – 4

A6.9: Orbit Determination and Propagation: 9 – 4 – 5 – 5 – 6

A6.10-YPVF.5: Space Debris Young Professionals Virtual Forum: 6 – 1 – 2 – 1 – 1

A6.P: Interactive Presentations: 50 – 37 – 12 – 19 – 26

Total without IP: 92 – 74 – 19 – 68 – 51



Recall of a few basic rules

- ⇒ **No paper, no show:**
 - ⇒ check that the paper is effectively loaded before the session
- ⇒ **No show, no paper:**
 - ⇒ If the author doesn't present, the paper will be removed from proceedings

- ⇒ **Status of the presenters:**
 - ⇒ Are we sure the authors will show up ?
 - ⇒ Do we have their short bios ?
 - ⇒ Try to contact them and ask 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
 - ⇒ 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

- ⇒ **The synthesis session sheets shall be given back to IAF secretariat, but please keep a copy and send it to JC, Heiner and me, or just hand them directly to me**



1.3. Space Debris Symposium Jerusalem 2015

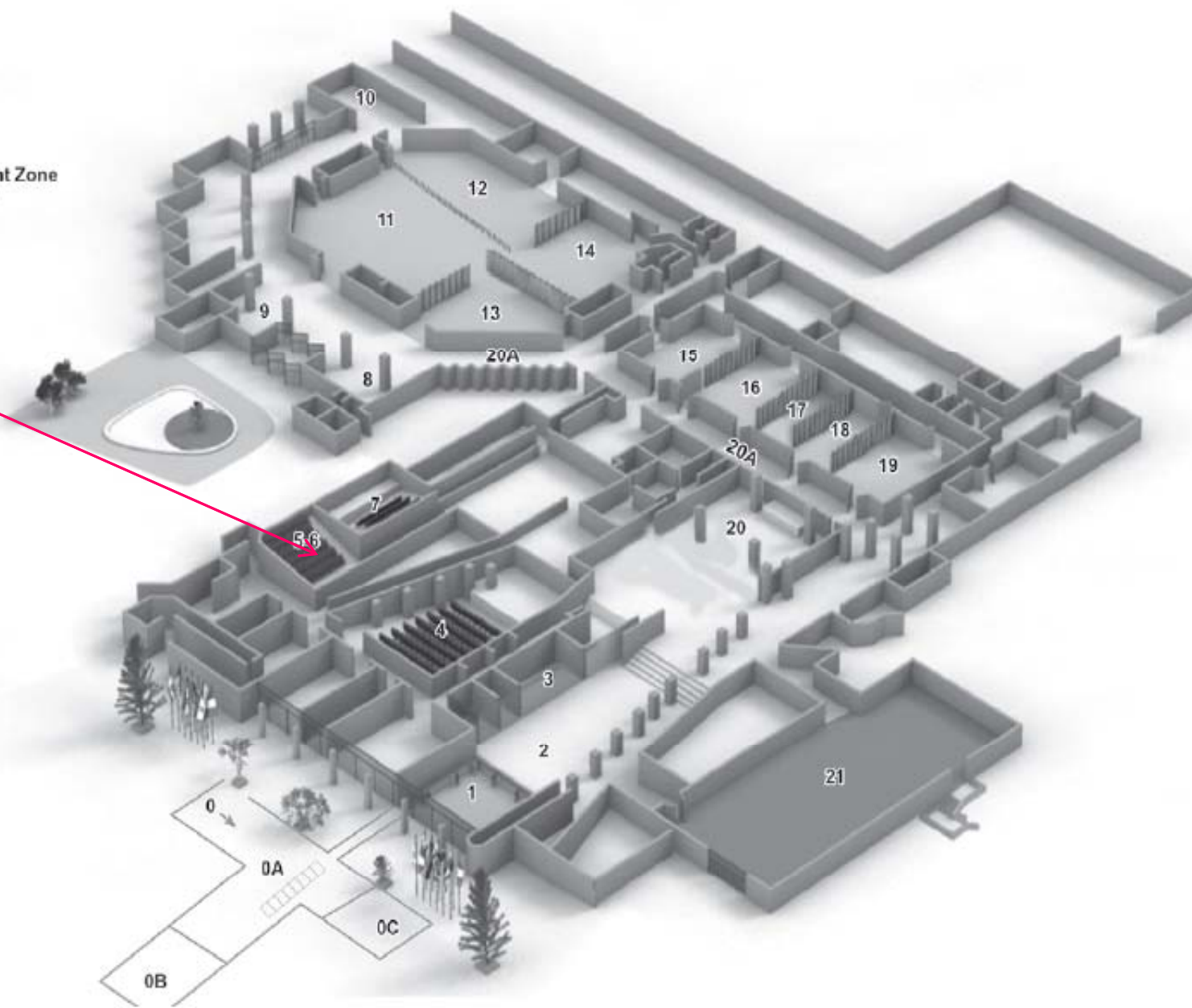


Don't miss the IP award
and cocktail



1.3. Space Debris Symposium Jerusalem 2015

- 0. Marquise A: Entrance
- 0A. Registration
- 0B. Student Zone
- 0C. IAF Secretariat
- 0. Marquise A: Registration & Student Zone
- 1. Main Entrance Foyer & Exhibition
- 2. Entrance Lobby & Exhibition
- 3. Speakers' Preparation Room
- 4. Schwartz Hall
- 5 - 6. Eshkol 2
- 5 - 6. Eshkol 3
- 7. Eshkol 1
- 8. B2B Area
- 9. IAF Members Lounge
- 10. Teddy D Hall Press Center
- 11. Teddy A
- 12. Teddy A
- 13. Teddy B
- 14. Teddy C
- 15. Oranim 1
- 16. Oranim 2
- 17. Oranim 3-A
- 18. Oranim 3-B
- 19. Oranim 4
- 20. Pincus Hall
- 20A. Interactive Presentation Area
- 21. Exhibition Hall





1.4. Space Debris Symposium Guadalajara 2016

A6: Space Debris Symposium

Liou – 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: XXX - Schildknecht – Agapov

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: Pardini – Sorge – Bastida-Virgili

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: Fitz-Coy – Francesconi - 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: Krag – Cazaux – XXX

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.

A6.5: Space Debris Removal Issues: Piergentili – Prasad ? – Santoni

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



A6.6: Space Debris Removal Concepts: Berend – Innocenti – Haussmann

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 – Dolado-Perez – Wiedemann

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

Biddington – Finkleman – ~~XXX~~

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

A6.9: Orbit Determination and Propagation

Jah – Klinkrad – Lewis

This session will address aspects of space debris orbit determination related to assessment of raw and derived data accuracy, optical measurements processing and modelling and risk analysis of space debris

A6.P: Posters, Yasaka – McKnight – Bonnal



1.4. Space Debris Symposium Guadalajara 2016

IAC	Year	Location	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8	Session 9	Session 10	Posters
58th	2007	Hyderabad	K. Abercromby [C] T. Schildknecht [C] H. Lewis [R]	J.-C. Liou [C] C. Wiedemann [C] C. Portelli [R]	F. Alby [C] A. Ganeshan [C] A. Kato [R]	T. Hanada [C] M. Lambert [C]							
59th	2008	Glasgow	T. Nakajima [C] T. Schildknecht [C] V. Agapov [R]	M. Matney [C] C. Pardini [C] A. Ganeshan [R]	M. Lambert [C] S. Meshcheryakov [C] F. Schaefer [R]	F. Alby [C] P. Krisko [C] R. Crowther [R]	A. Kato [C] H. Klinkrad [C]						
60th	2009	Daejeon	T. Schildknecht [C] F. Alby [C] P. Seitzer [R]	H. Klinkrad [C] V. Agapov [C] M. Matney [R]	F. Schaefer [C] E. Christiansen [C] Y. Akahoshi [R]	R. Crowther [C] C. Portelli [C] T. Hanada [R]	Li Ming [C] A. Kato [C] Mense [R]						
61st	2010	Praha	G. Stansbery [C] S. Kibe [C] T. Schildknecht [R]	C. Martin [C] P. Krisko [C] L. Anselmo [R]	Adimurthy [R] H. Stokes [C] C. Wiedemann [R]	J. Hussey [C] F. Alby [C] H. Klinkrad [R]	H. Krag [C] V. Agapov [C] M. Matney [R]						
62nd	2011	Capetown	T. Schildknecht [C] V. Agapov [C] P. Seitzer [R]	C. Pardini [C] D. McKnight [C] C. Wiedemann [R]	S. Meshcheryakov [C] F. Schaefer [C] J. Hyde [R]	F. Alby [C] R. Crowther [C] V. Adimurthy [R]	H. Klinkrad [C] S. Kibe [C] P. Anz-Meador [R]	F. Piergentili [C] V. Kuprianov [C] M. Mulrooney [R]					
63rd	2012	Naples	P. Seitzer [C] V. Agapov [C] T. Schildknecht [R]	L. Anselmo [C] C. Wiedemann [C] T. Hanada [R]	J. Hyde [C] A. Francesconi [C] F. Schaefer [R]	F. Alby [C] J. Hussey [C] F. Piergentili [R]	H. Klinkrad [C] D. McKnight [C] S. Kibe [R]	M. Yakovlev [C] K. Suzuki [C] C. Mathieu [R]	N. Johnson [C] C. Bonnal [C] M. Rudolph [R]				
64th	2013	Beijing	T. Schildknecht [C] V. Agapov [C] P. Seitzer [R]	C. Pardini [C] P. Krisko [C] C. Wiedemann [R]	D. McKnight [C] A. Francesconi [C] M. Rudolph [R]	F. Alby [C] H. Klinkrad [C] M. Yakovlev [R]	V. Adimurthy [C] J. Hussey [C] F. Santoni [R]	P. Anz-Meador [C] S. Kibe [C] M. Rudolph [R]	D. Finkleman [C] D. McKnight [C] H. Krag [R]	K. Suzuki [C] P. Krisko [C] C. Mathieu [R]			D. McKnight C. Bonnal
65th	2014	Toronto	T. Schildknecht [C] V. Agapov [C] J. Carroll [R]	L. Anselmo [C] J.-C. Liou [C] T. Hanada [R]	A. Francesconi [C] Sen Liu [C] F. Schaefer [R]	C. Cazaux [C] H. Klinkrad [C] M. Yakovlev [R]	VIP. Prasad [C] F. Piergentili [C] N. Berend [R]	F. Di Pentino [C] S. Kibe [C] C. Bonnal [R]	T.S. Kelso [C] D. Finkleman [C] JC. Dolado-Perez [R]	B. Biddington [C] D. McKnight [C] C. Mathieu [R]	M. Jah [C] S. Flegel [C] H. Lewis [R]		C. Bonnal
66th	2015	Jerusalem	F. DiPentino [C] T. Schildknecht [C] V. Agapov [R]	C. Pardini [C] M. Sorge [C] S. Flegel [R]	N. Fitz Coy [C] F. Schaefer [C] A. Francesconi [R]	H. Krag [C] C. Cazaux [C] A. Kato [R]	MYS. Prasad [C] F. Piergentili [C] F. Santoni [R]	N. Berend [C] S. Kibe [C] JC. Liou [R]	T.S. Kelso [C] J.-C. Dolald-Perez [C] D. Finkleman [R]	B. Biddington [C] D. McKnight [C] C. Mathieu [R]	M. Jah [C] H. Klinkrad [C] H. Lewis [R]	C. Mathieu [C] K. Stube [C] C. Bonnal [R]	T. Yasaka D. McKnight C. Bonnal



- ***Proposal for a Plenary Event or a Highlight Lecture***

Proposal to hold a Plenary Event in Guadalajara

- Evolution of the traffic
- Importance in number, not size
- Mega constellations
- Emphasize advantages and disadvantages Big money
- Commercial
- Kids just out of college...
- Large and frequent deployment of
- Changes between past and future: 100 to 1000 sats /year
- Traffic mgt
- Interactions between launch service providers and sat operators
- Post mission disposal – tracking
- Theme for IAC 2016: Making space accessible and affordable to all countries
- Theme for IAC 2017: Unlocking imagination, fostering innovation, strengthening security
- It requires a good preparation
- Thematics, title, organization (Heiner and JC? Moderator? Round table?...)

👉 Ideas are due within a couple of months: selection to be made during March 2016 meeting



2.1. Past events

- **6th EUCASS**
 - Krakow, 29 June – 3 July 2015
 - Nice Plenary Event on Small Satellites
 - See following pages
- ***International Conjunction Assessment Workshop***
 - CNES-HQ, Paris, 19-20 May 2015
 - See Appendix 1
- ***Workshop on Laser solutions for Orbital Space Debris***
 - Paris, 27-28 April 2015
 - See following pages
- **30th ISTS and AMOS**
 - 4-10 July 2015, Kobe-Hyogo, Japan
 - See Appendix 2
- ***IADC Houston***
 - Oral debriefing by JC
 - Ongoing subject on cubesats and constellations
- **COPUOS**
 - See Appendix 7
- **COSPAR**
 - See Appendix 8



2.1. Past events

- **6th EUCASS**
 - **3 Space Debris sessions – Coordinator: Luciano Anselmo**

Title	Submitted by	Company	Country	paper N°	Title
Ranking Upper Stages in Low Earth Orbit for Active Removal	ANSELMO Luciano	ISTI Inst.. CNR	ITALY	1.01.01	SPACE DEBRIS REMOVAL
Laser reorbiting of large debris in GEO	BONNAL Christophe	CNES	FRANCE	1.01.02	SPACE DEBRIS REMOVAL
A SATELLITE DEDICATED DECOMMISSIONING DEVICE BASED ON SOLID STATE	TOSON Elena	D-Orbit	ITALY	1.01.03	SPACE DEBRIS REMOVAL
On problems of active space debris removal using tethered towing	ASLANOV Vladimir	U. Samara Aerc	RUSSIA	1.01.04	SPACE DEBRIS REMOVAL
Modeling of the Ion Beam Erosive Action on a Large-Sized Object of Technology	POPOV Garri	RIAME	RUSSIA	1.01.05	SPACE DEBRIS REMOVAL
Attitude determination of a small satellite during plasma brake deorbiting experiment	KHURSHID Osama	U. Aalto	FINLAND	1.01.06	SPACE DEBRIS REMOVAL
EVOLUTION OF THE CLOUD OF FRAGMENTS AFTER AN EXPLOSION OF A SATELLITE	KEBE Fatoumata	Institute of Celestial Mechanics and Cosmodynamics	FRANCE	1.01.07	SPACE DEBRIS REMOVAL
A Genetic Algorithm to associate optical measurements and estimate orbits of space debris	ZITTERSTEIJN Michiel	U. Bern Astronomical Observatory	SWITZERLAND	1.02.01	SPACE DEBRIS OBSERVATION, PROTECTION AND MITIGATION
OPTIMIZATION OF OPTICAL FOLLOW-UP STRATEGIES BASED ON COVARIANCE ANALYSIS	CORDELLI Emiliano	U. Bern Astronomical Observatory	SWITZERLAND	1.02.02	SPACE DEBRIS OBSERVATION, PROTECTION AND MITIGATION
STRATEGIES OF DIRECTIVE PLANNING OF SHORT OBSERVATION SESSIONS	LABUTKINA Tatiana	U.Oles Honchar	UKRAINE	1.02.03	SPACE DEBRIS OBSERVATION, PROTECTION AND MITIGATION
Behaviors of three types of debris in oblique collision	SHIOTA Ichiro	Tohei Sangyo co	JAPAN	1.02.04	SPACE DEBRIS OBSERVATION, PROTECTION AND MITIGATION
Engineering and Operational Issues Related to Just-In-Time Collision Avoidance	MCKNIGHT Darren	Integrity Applications	USA	1.02.05	SPACE DEBRIS OBSERVATION, PROTECTION AND MITIGATION
METHODS OF FAST DETECTION OF POLYCONFLICT ZONES OF ORBITAL OBJECTS	LABUTKINA Tatiana	U.Oles Honchar	UKRAINE	1.02.06	SPACE DEBRIS OBSERVATION, PROTECTION AND MITIGATION
TRADE-OFF Atmospheric Re-entry: Design for Demise vs Controlled Re-entry	HEINRICH stephane	ALTRAN	FRANCE	1.02.07	SPACE DEBRIS OBSERVATION, PROTECTION AND MITIGATION
Guidance and Navigation for Rendezvous with an Uncooperative Target	TELAAR Jürgen	AIRBUS D&S	GERMANY	4.01.01	ACTIVE DEBRIS REMOVAL: GNC AND CAPTURE
Novel Dynamical Model for an Object-Oriented Space Tether Simulator	RODRIGUEZ-LUCAS F	UPM Space Dynamics	SPAIN	4.01.02	ACTIVE DEBRIS REMOVAL: GNC AND CAPTURE
DETAILED AOCS & FDIR ARCHITECTURE OF A NEW DE-ORBITATIONAL MODE	DELLANDREA Brice	Thales Alenia Space	FRANCE	4.01.03	ACTIVE DEBRIS REMOVAL: GNC AND CAPTURE
Model - Based Control Design for a Free - Floating Space Manipulator Capture	JARZEBOWSKA Elzbieta	TU Warsaw	POLAND	4.01.04	ACTIVE DEBRIS REMOVAL: GNC AND CAPTURE
Control system for a robotic arm in the Active Debris Removal IOD (ANDROID)	BARCINSKI Tomasz	Space Research Institute	POLAND	4.01.05	ACTIVE DEBRIS REMOVAL: GNC AND CAPTURE
Manipulator trajectories during orbital servicing mission: numerical simulation	RYBUS Tomasz	Centrum Badan Kosmicznych	POLAND	4.01.06	ACTIVE DEBRIS REMOVAL: GNC AND CAPTURE



2.1. Past events

- **Workshop on Laser solutions for Orbital Space Debris**

- Paris, 27-28 April 2015
- Co-organized by Ecole Polytechnique and CEA, with support from CNES
- 64 participants from 17 countries
- 20 presentations + 6 posters
- ⇒ Proceedings are available

- **Debris ranging, tracking et orbitography**

#2 : CRC-SEM – a New Horizon of Australian Space Tracking Research Professor Kefei Zhang , Australia

#3 : Solid State Photon Counters for Laser Ranging to Orbital Space Debris

I. Prochazka, Czech TU in Praha ; J. Kodet, TU Munich ; et al.

#4 : Laser Ranging with Titanium Sapphire – a hybrid solution with high power infrared option

S.Riepl, Geodatisches Observatorium Wettzell (D) ; F.Falcoz, Amplitude Technologies (F) ;

M.Schmidt (A) ; et al

#5 : Laser Ranging to Space Debris in Graz

Georg Kirchner, Franz Koidl, Austrian Academy of Sciences Space Research Institute

- **Navigation sensors**

#21 : LIRIS: A Lidar and Infrared experiment on-board ATV5 ; Alain Donnard, Airbus Defense and Space



2.1. Past events

- **Workshop on Laser solutions for Orbital Space Debris (ctd)**

- **Orbital change by laser-matter coupling**

#11 : *Space debris removal by ground based laser Main conclusions ; H. Haag, Airbus, et al.*

#20 : *Pulsed UV Laser System Design for Re-entering or Nudging Debris in LEO and Re-orbiting GEO Debris - C. Phipps , Photonics ; Ch. Bonnal, CNES*

#16 : *Space debris removal by a space based laser: which laser for large objects in GEO?
Jules Boiteux, Victor Le Meur,, Opto Service, SupOptique*

#17 : *Demonstration for cm-size space debris REDUCTION/REMEDIATION from the International Space Station Toshikazu Ebisuzaki, RIKEN, Japon ; M. Quinn, IZEST, Polytechnique, France ; et al.*

#8 : *Can laser nudging prevent most debris creation in LEO? Joe Carroll, Tether Applications, USA*

#7 : *Short Pulse reflectivity and energy coupling for Orbital Debris Removal?
D Neely and R Allott, Rutherford Appleton Laboratory, UK*

#6 : *Experimental Study of Laser-Pulse Ablation Impulse and Associated Physical Mechanisms
Akihiro Sasoh et al., Nagoya University, Japan*



- **IAA studies: general status for your information**

IAA Study Groups as of October 8, 2015			1	2	3	4	5	6	7	8	9	10	11	12	
SG No	ongoing IAA Studies	Chair/Co-Chair/Secretary	Proposal	Com. ok	SAC ok	Appoint.	1st Draft	Final Draft	Peer Review	Final Report	SAC ok	BOT ok	Edition	Publication	Comments
Commission 1															
1.5	Particle Radiation Hazards en route to and at Mars	Mckenna-Lawlor													Final corrections
1.6	Protected Antipode Circle on Lunar Farside	Maccone/Shuch													Final draft expected
1.8	Global Satellite System for monitoring and forecasting	Degtyarev													Final report expected
1.9	Satellite remote sensing of aerosols in the Earth atmo	Yatskiv/Milinevsky													status report uploaded
1.10	Terrestrial Analogue - Comparison of Terrestrial & Pla	Coradini/McBride/Hipkin													
1.11	Comparative Climatology - Studying Planetary Climat	Ramachandran/Ocampo													status report uploaded
1.12	Virtual Reality - Virtual Exploration of Planets	Coradini/Flamini													
1.13	Planetary Science Enabled by the New Generation of	Baker/Vane/Bousquet													
1.14	Integrated Precursor Distinguish in Multi-Geophysical	Bao Weimin/Contant/Kuznetsov													status report uploaded
Commission 2															
2.8	e-Learning, education content sharing; Technical and	Kourtidou/Horneck/Bamidis													Edition process
2.12	Effectiveness of different physiological countermeasur	Charles/Kozlovskaya/Norsk													
2.13	Space Life Sciences, Physiology and Medicine in the	Gerzer/Davis/Li/Mukai/Orlov/Graef													Final report expected
2.14	Medical Support for an International Human Expeditio	Orlov/Davis/Kusmaul													status report uploaded
2.15	Immersion Model: Importance for Space Life Sciences	Mano/Tomilovskaya													
2.16	Space Adaptation Markers	Gharib/Vernikos													
Commission 3															
3.14	Public/Private Human Access to Space - Vol. 2 - Earth	Di Pippo/Davidian/Dupas													status report uploaded
3.15	Long Term Space Propellant Depot	Saccoccia/Lu Yu/Wang Xiaowei													
3.16	Global Human Mars System Missions Exploration – G	Genta/Dupas/Yamazaki/Salotti													Peer review process
3.17	Space Mineral Resources - Challenges & Opportunitie	Dula/Friedman													Edition process
3.18	Possible International Protocol to handle Crisis/Emerg	Ramakrishnan/Unnikrishnan Nair													status report uploaded
3.19	Feasibility study of Standardized Career Dose Limits i	Mckenna-Lawlor													status report uploaded
3.20	Expanding Options for Implementing Planetary Protec	Conley/Race													transfer to Commission 1
3.21	Space Disposal of Radioactive Waste	Degtyarev													
3.22	Next-Generation Space System Development Basing	Razoumny/Agrawal/Ji Simei													
3.23	Human Space Technology Pilot Projects With Develop	Reibaldi/Zhuang/Unnikrishnan Nair													
3.24	Road to Space Elevator Era	Tsuchida/Raitt/Swan/Takahashi													status report uploaded



- **IAA studies: general status for your information (ctd)**

[illegible]



2.3. On the agenda

- **8th IAASS**
 - Melbourne, Florida - USA, 18 – 20 May 2015
 - See following pages and Appendix 6

- **4th Workshop on Space Debris Modeling and Remediation**
 - **CNES-HQ, Paris, 6 – 8 June 2016**
 - Modeling, including uncertainties and specificities coming from small satellites and constellations;
 - High level actions, road-maps, associated to debris remediation;
 - Remediation system studies, including those relative to small debris;
 - Design of specific concepts;
 - Associated technologies;
 - GNC aspects, rendezvous sensors and algorithms, de-spin, control during de-boost, ... ;
 - Lasers;
 - Economics, insurance, intellectual property;
 - Policy, national security, international cooperation... aspects on aspects of debris remediation.
 - **Program Committee:** ESA-HQ (Luisa Innocenti), ESA-ESOC (Holger Krag), DLR (Manuel Metz), JAXA (Satomi Kawamoto), NASA-JSC (Jer-Chyi Liou), SWF (Brian Weeden), Roscosmos, (Valeriy Trushlyakov), UK Space Agency (Richard Crowther) , CNSA (Li Ming), and CNR-ISTI (Luciano Anselmo), in addition CNES, CNES-HQ (Pascal Faucher), CNES-Toulouse (Christian Cazaux & Marie-Christine Desjean) and CNES- Launchers (Bonnal)



2.3. On the agenda

- ***6th Workshop on End of Life***
 - CNES-HQ, Paris, 28 January 2016
- ***Reinvent Space Conference***
 - Nov 9-13 Oxford, UK
 - Small sats, debris



International Academy of Astronautics

2.3. On the agenda

EVENT TIMETABLE

11 December 2015	Deadline for abstracts & notice of intent to exhibit
29 January 2016	Notification to authors
15 February 2016	Final program
22 April 2016	Deadline for paper submission
18-20 May 2016	Conference
August 2016	Publication of Proceedings

LOCATION

Florida Institute of Technology
Melbourne - Florida (USA)

REGISTRATION

The registration fee of USD 850 covers the conference proceedings, the first day luncheon, and the gala dinner. Additional information on registration fees for IAASS members, presenting authors, programme committee members and sessions chairpersons are available on the conference website.

CONFERENCE TOPICS OVERVIEW



CO-ORGANIZERS



CONTACTS

Organiser

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Conference Secretariat

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IAASS Logistics & Administrative Manager
Email: secretariat@iaass.org

Conference website:

<http://iaassconference2016.space-safety.org/>



8th IAASS Conference

International Association for the Advancement of Space Safety

SAFETY FIRST SAFETY FOR ALL

FLORIDA INSTITUTE OF TECHNOLOGY

MELBOURNE - FLORIDA (USA) - 18-20 MAY 2016

**FIRST ANNOUNCEMENT
AND CALL FOR PAPERS**

INTRODUCTION

The International Association for the Advancement of Space Safety (<http://iaass.space-safety.org>) is a non-profit organisation dedicated to furthering international cooperation and scientific advancement in the fields of space systems safety and sustainability.

IAASS is a member of the International Astronautical Federation (IAF), and Permanent Observer at the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). The association exists to help shape and advance an international culture of space safety (technical, organisational and socio-political) which could contribute to make space missions, vehicles, stations, extra-terrestrial habitats, equipment and payload safer for the general public, ground personnel, crews and flight participants. The association also pursues the safeguarding of the on-orbit, atmospheric, and ground environment during space systems and associated ground infrastructure operations.

The eighth IAASS Conference "*Safety First, Safety for All*" is an invitation to reflect and exchange information on a number of topics in space safety and sustainability of national and international interest. The conference is also a forum to promote mutual understanding, trust, and the widest possible international cooperation in such matters. The once exclusive "club" of nations with autonomous space access capabilities is becoming crowded with fresh, and ambitious new entrants. New commercial spaceports are starting operations and others are being built.

In the manned spaceflight arena a commercial market is becoming reality with government use of commercial services for cargo and crew transportation to orbit, and the addition of a commercial habitable volume to the international space station. Besides the national ambitions in space, the international cooperation both civil and commercial is also gaining momentum.

Space bound systems and aviation traffic will share more and more a crowded airspace, while aviation will increasingly rely on space-based safety-critical services. Air launches may become an important segment of the launch business and could drive the establishment of ad-hoc regulations. Finally, most nations own nowadays space assets, mainly satellites of various kinds and

purpose, which are under the constant threat of collision with other spacecraft and with the ever increasing number of space debris. Awareness is increasing internationally (as solemnly declared since decades in space treaties) that space is a mankind asset and that we all have the duty of caring for it. Without proactive and courageous international initiatives to establish an international regulatory framework for space traffic management we risk to negate access and use of space to future generations.

The 8th IAASS Conference will in addition to normal sessions dedicate a set of panel sessions to four topics which need to get better attention in space programs: *Space Debris Reentry Safety, Space Traffic Management, Safety Standards for Commercial Human Spaceflight, and Human Performance and Safety on Long Duration Missions.*

CONFERENCE MAIN TOPICS

- Designing safety into space vehicles
- Safety on long duration manned missions
- Safety of extravehicular activities
- Launch safety
- Space debris remediation
- Re-entry safety
- Human spaceflight payloads safety
- Nuclear safety for space systems
- Human factors and performance for safety
- Safety critical software design and IVV
- Safety risk management
- Probabilistic risk assessment
- Organisational culture and safety
- Regulations and standards for safety
- Space-based safety critical systems
- SSA & Space traffic control
- Operations safety
- Space materials safety
- Commercial human spaceflight safety
- Lessons learned
- Safety Management System
- Space Weather Hazard
- Launch and In-Orbit Collision Risk
- NEO (Near Earth Orbit) Hazard

PROGRAMME COMMITTEE

A Programme Committee composed by leading experts in space safety and related fields from world's major aerospace industries, space agencies, government organisations, academy and institutes are responsible for organising the event and selecting the papers to be presented. The names of the Programme Committee members are published on the conference website.

ABSTRACT SUBMISSION

Contributed papers are welcome. Papers will be selected based on submitted abstracts. The abstract (approximately 500 words) should clearly outline the paper's major elements of interest and its originality. Papers will be selected based on:

- Relevance to the scope of the Conference
- Quality of the content
- Originality of the content

The Authors will be notified of the selection outcome by 29 January 2016.

**All abstracts should be submitted by
11 December 2015**

Authors are invited to submit an abstract on-line at:
<http://iaassconference2016.space-safety.org/>

The language of the Conference is English.

TRAINING COURSES AND EXHIBITIONS

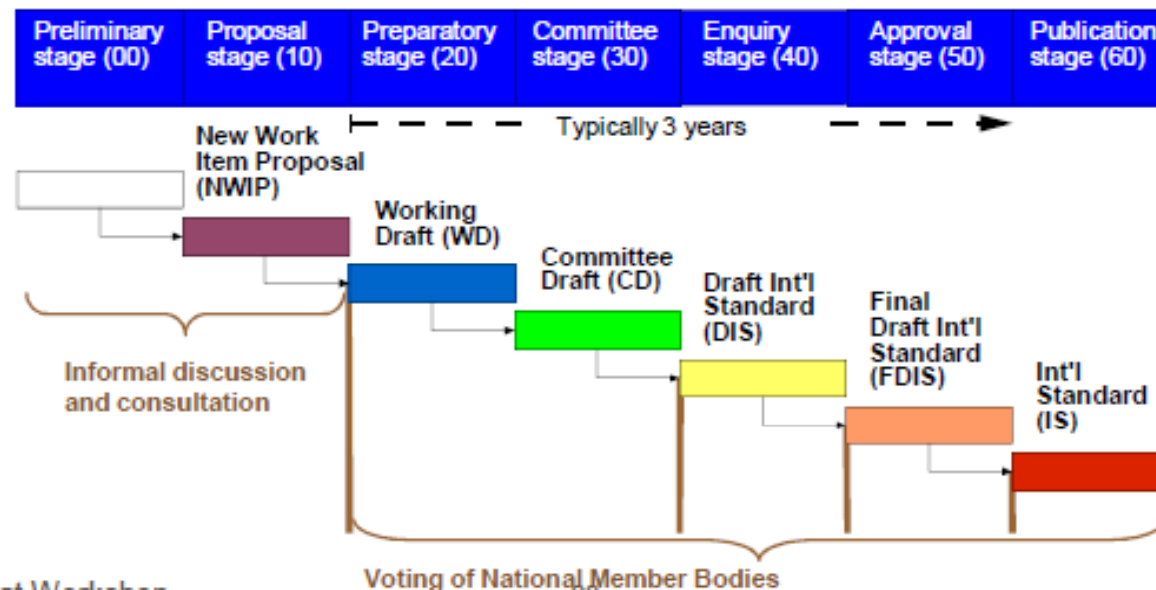
Several unique training courses will be offered in the week preceding the conference. Also exhibitions opportunities for companies products and services are available during the conference. Related fees will be announced on the conference website.

2.4. New achievements

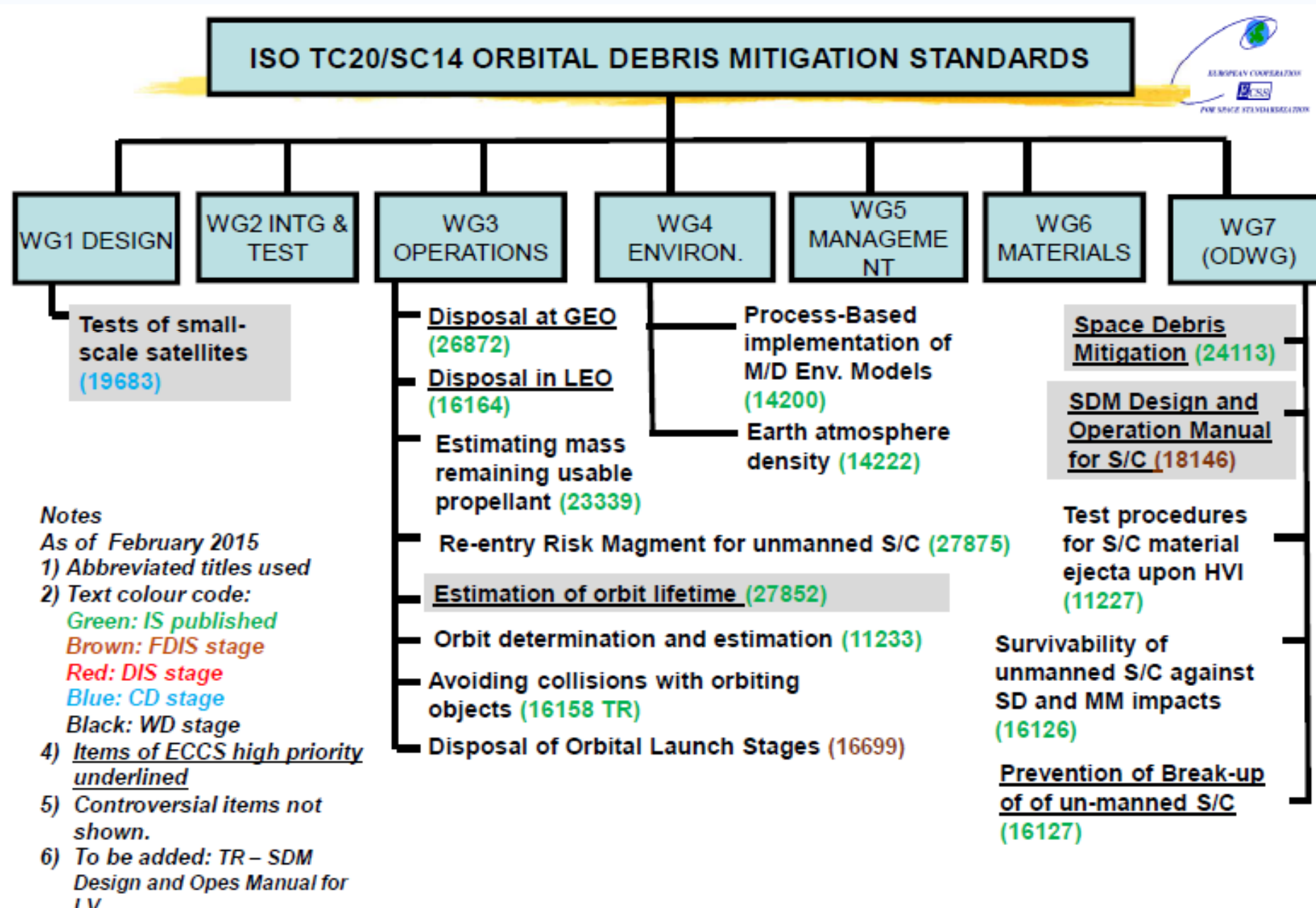
ISO TC20 SC14



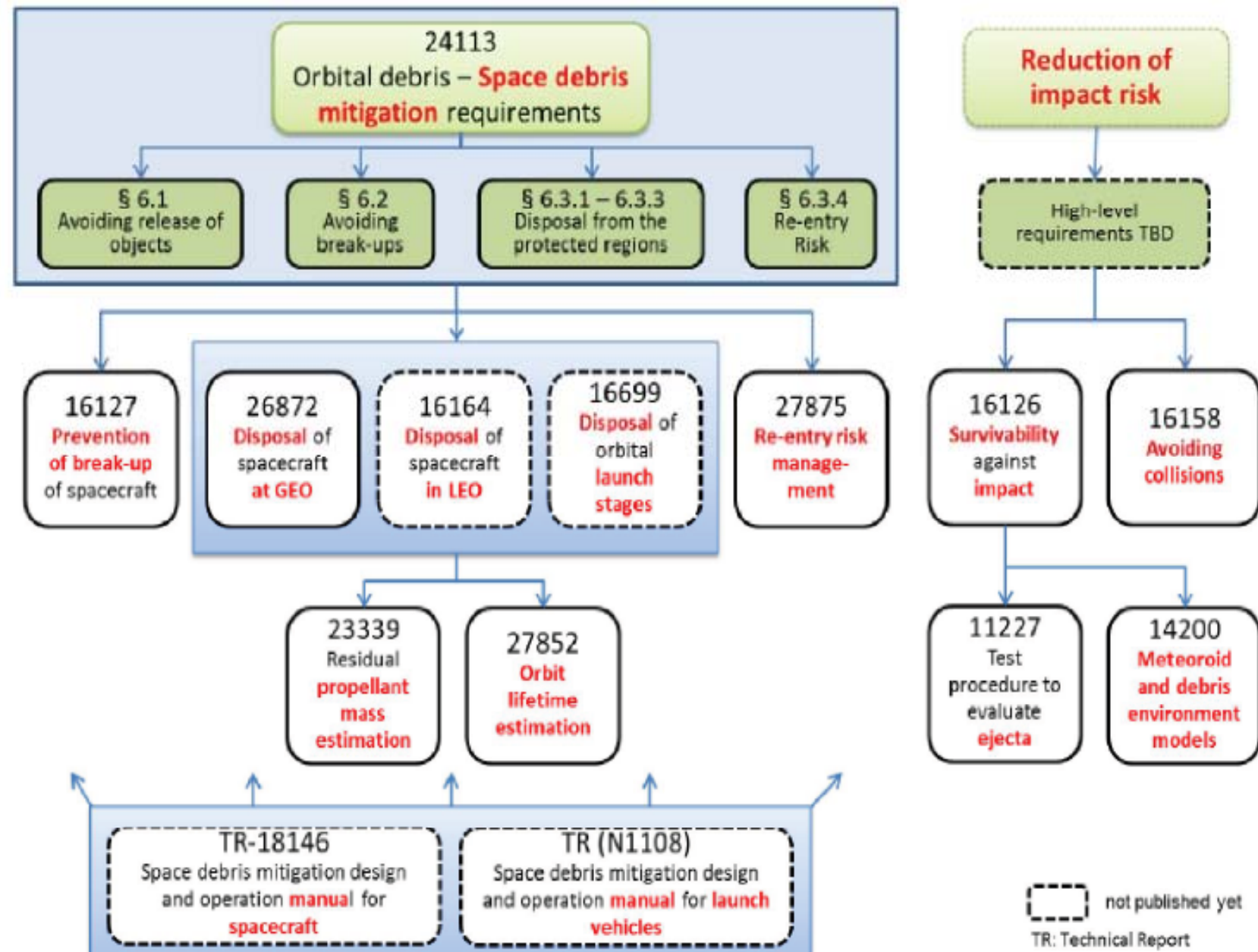
- Level playing field: development of key standards in the international arena
- Long development process (typically 3 years or more)
- Unstructured set of standards, many items related to space debris issue, content variable both in terms of quality and usefulness:
- WG7 (ODWG) attempt to develop and coordinate a framework of SDM standards, consolidating the debris standards into a smaller more coherent set of documents



2.4. New achievements



2.4. New achievements





2.5. Round table - Open discussion

- *Effect of macro-constellations on orbital populations?*
See appendix 3
- *Review of mitigation rules compliance in LEO*
See appendix 4
- *SPACE SECURITY AUSTRALIAN DEVELOPMENTS*
See appendix 5



3. IAA SG 5.14 Situation Report

Goal

Reference status of the Space Debris problematic, acting as an update of the IAA Position Papers 1993 and Revision from 2001, taking into account the IAA Position Papers on Space Debris Mitigation (SG5.1) and on Space Debris Remediation (SG5.5). Available elements from on-going SG5.10 devoted to Policy, Legal and Economic Issues in Orbital Debris Removal will also be included.

Today: 126 pages, Completed at 95%

Status:

Done:

First Draft in Toronto reviewed within the September meeting of the IAA Space Debris Committee

First complete draft in January 2015

First draft polishing following meeting in March 2015

Draft in July 2015, sent for initial reviewing by a few experts outside the contributors group

Expected:

Final draft end September 2015

Final discussions in Jerusalem October 2015

Delivery to IAA for Peer Reviewing mid November 2015

Effective publication expected by March meeting 2016



3. IAA SG 5.14 Situation Report

Status before the meeting

Co-Editors:	Darren McKnight & Christophe Bonnal	<u>Planned</u>	<u>Is today</u>
Executive Summary	Darren McKnight	4 pages	3
Table of Contents	Christophe Bonnal	2 pages	2
1. Introduction, recall of scope and past studies:	Darren McKnight	4 pages	3
2. Present status:	Heiner Klinkrad , Holger Krag	10 pages	11
3. Measurements:	Thomas Schildknecht & Vladimir Agapov	10 pages	6
4. Space surveillance:	Christian Cazaux, Dave Finkleman, Fernand Alby, Dan Oltrogge	10 pages	15
5. Collision avoidance:	Christian Cazaux, Dave Finkleman, Fernand Alby, Dan Oltrogge	10 pages	4
6. Protection:	Frank Schäfer & Eric Christiansen	10 pages	12
7. Reentering space objects:	Holger Krag & Marlon Sorge	10 pages	13
8. Future environment:	Paula Krisko & Juan-Carlos Dolado-Perez	10 pages	11
9. Debris mitigation:	Manuel Metz & J-C. Liou	10 pages	10
10. Remediation:	Darren McKnight & Seishiro Kibe	10 pages	12
11. Legal:	Tanja Masson-Zwaan	10 pages	9
12. International aspects:	Charlotte Mathieu & MYS Prasad	6 pages	5
13. References & Standards:	Christophe Bonnal	7 pages	7
Appendixes		3 pages	3
		<hr/> 126 pages	<hr/> 126