International Academy of Astronautics

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IAA Space Debris Committee

Paris, March 17st, 2022

Open exchanges among members

- US update guide line
- Update of the Technical Regulation associated to the French Space Operation Act (FSOA)
- Feedback on past and incoming workshops,

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Update of the Technical Regulation associated to the French Space Operation Act (FSOA)

Pierre Omaly

CNES

Update of the Technical Regulation associated to the French Space Operation Act (FSOA)

- Florent LACOMBA -
- Orbital Systems Technical Regulation Lead -

Space Safety Office
Orbital Systems Directorate

French Technical Regulation update

- **Context** :
  - Update of the French Space Operation Act (FSOA)
  - Need to adapt the contents of the associated Technical Regulation (RT) in particular due to the New Space environr
    - ✓ Increased space traffic
    - ✓ Diversification and multiplication of space actors
    - ✓ Development of innovative systems (e.g. OOS, Large Constellations, …)
  - Emergence of « Space Traffic Management » concept

- **Aim** :
  - Overcome the risk related to debris in orbit
  - Limit debris generation through preventive measures
  - Pushing technological developments: vector of innovation
  - Provide a regulatory framework for new innovative activities (e.g. On-Orbit Servicing)

- **Methods** :
  - Work started in July 2020 with a feedback on the application of the current RT
  - Ensure coherence with International regulations (FCC, ODMSP, ISO, WG ESA, …)
  - Close coordination with French Operators and Industrial partners
    - ✓ Consultation of ~20 french entities
    - ✓ Next step foresees to include international operators (in particular Starlink, Oneweb, Viasat, Lynk)

French Technical Regulation update

Identification and tracking of space objects

- **Space object identification:** Systems shall be designed implemented and their mission defined in such a way that the space object is unambiguously identifiable by space surveillance systems as soon as possible after injection.
- **Space object orbit knowledge:** Systems shall be designed and implemented and their mission defined in such a way that the measures necessary for orbit determination are available as soon as possible and within the limit of 3 days after the injection either by means of the operator itself, or by means of a space surveillance systems
- **Data sharing:** Any operator should share with any relevant actor or entity all sufficient, necessary and updated information to manage collision risks with catalogued space objects that might be encountered, and in particular: ephemerides, maneuver plans and covariances

Enhanced consideration of the risk of collision

- **Avoidance maneuvre priority rule:** In case of conjunction that raises a collision alert between two maneuvering spacecraft, a coordination shall be initiated between the two operators. The object with the highest eccentricity should by default plan and perform an avoidance maneuver unless a different agreement has been priorly set up between both parties, in which case this agreement should be followed.
- **Availability of collision avoidance maneuvers:** Maneuvering spacecraft systems shall be designed and implemented such that they allow the implementation of an anti-collision maneuver within a maximum period of 5 days after injection, or at the earliest after injection in the case of a launch of multiple spacecraft from the same operator.

French Technical Regulation update

Restriction of orbital lifetime

- **Maximum orbital lifetime before atmospheric re-entry:** In the event that disposal leads to an atmospheric re-entry, the remaining orbital lifetime following disposal shall be less than 5 times the operational lifetime and in any case, shall be less than 25 years.

Technical requirements for On-Orbit-Servicing

- **Safe mode entry and collision risk:** The Servicer's systems shall be designed and implemented in such a way that its entry into safe mode of does not induce a collision risk with the Client.
- **Mission impact on third parties:** A servicing operation shall be conducted without interfering with third parties not involved in the operation
- **Security of in-orbit servicing communications:** The Servicer's systems shall be designed, produced and implemented in such a way as to secure the board/ground and board/board connections and thus be resilient to any corruption that could threaten the security of operations.

Technical requirements for Constellations

- **Casualty risk following re-entry of a large constellation:** The quantitative safeguard objective including all the re-entering objects of a large constellation, expressed as the maximum admissible probability of causing at least one victim (collective risk), shall be less than 1E-2.
- **Large constellations separation:** The geometry of a large constellation shall not intercept the geometry of another large

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USG Debris Highlights September 2022

Darren McKnight

LeoLabs

Two Quick Topics

- FCC proposing debate on updating mitigation guidelines
  - ✓Nothing decided yet…
- US Congress initiating bill to address more space safety issues
  - ✓Focus on ADR (finally)

Debris Mitigation Guidelines Tightening in US

- FCC listens to ALL public comments on what they should do relative to space licensing process
  - ✓ Competitors are ruthless
  - ✓ Not filtered by relevancy or quality
  - ✓ Literally hundreds of filings a year
- Other options being considered
  - ✓ Shorter mission lifetimes for satellites in constellations
  - ✓ Maneuverability requirements
  - ✓ Performance bond as financial incentive to adhere to disposal guideline

FCC to set five-year deadline for deorbiting LEO satellites

by **Jeff Foust** — September 8, 2022

The new FCC order is designed to limit the creation of orbital debris by requiring operators of LEO satellites to deorbit them within five years of the end of their missions. Credit: iStock

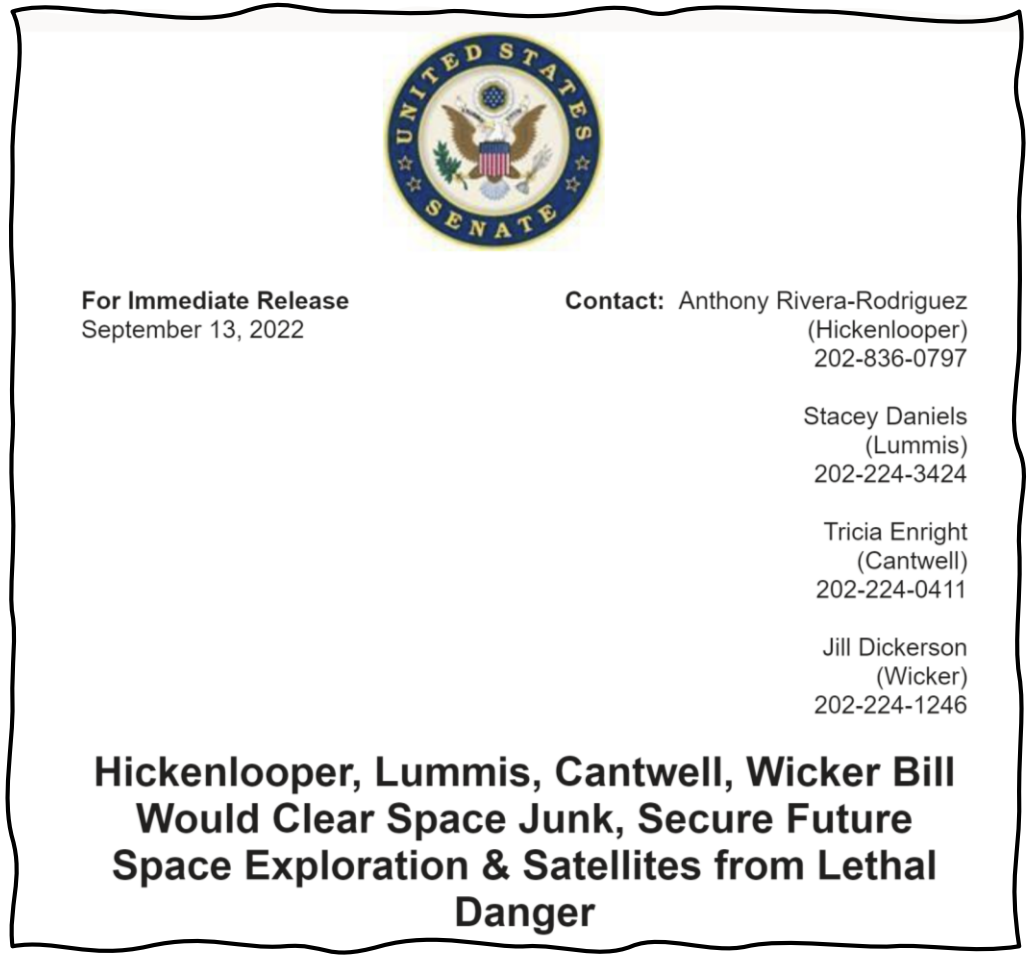
WASHINGTON — The Federal Communication Commission wants to require operators of low Earth orbit satellites to deorbit their spacecraft within five years after their mission ends, a much shorter timeframe than currently required.

The FCC issued a draft order Sept. 8 setting a “five-year rule” for post-mission disposal of LEO satellites. The commission will take up the order at its Sept. 29 open meeting.

This Has Happened Before…

- Government and industry players already taking sides
- The lines "for" and "against" are not set by stakeholder role
  - ✓Government and industry mixed
  - ✓Some industry already executing at proposed levels
  - ✓Some government sticking to decades-old analysis
  - ✓Some industry reject need for change

New Bill Making Its Way Through US Congress



For Immediate Release
September 13, 2022

Contact: Anthony Rivera-Rodriguez
(Hickenlooper)
202-836-0797

Stacey Daniels
(Lummis)
202-224-3424

Tricia Enright
(Cantwell)
202-224-0411

Jill Dickerson
(Wicker)
202-224-1246

Hickenlooper, Lummis, Cantwell, Wicker Bill Would Clear Space Junk, Secure Future Space Exploration & Satellites from Lethal Danger

- *"ORBITS Act would create landmark program to clear orbital debris which currently threatens space exploration, satellites, and commercial space operations"*
  - ✓ Orbital Debris Remediation List
  - ✓ Active Orbital Debris Remediation Demonstration Program
  - ✓ Active Debris Remediation (ADR) Services
  - ✓ Uniform Orbital Debris Standards (update ODMSP)
  - ✓ Space Traffic Coordination Standard Practices

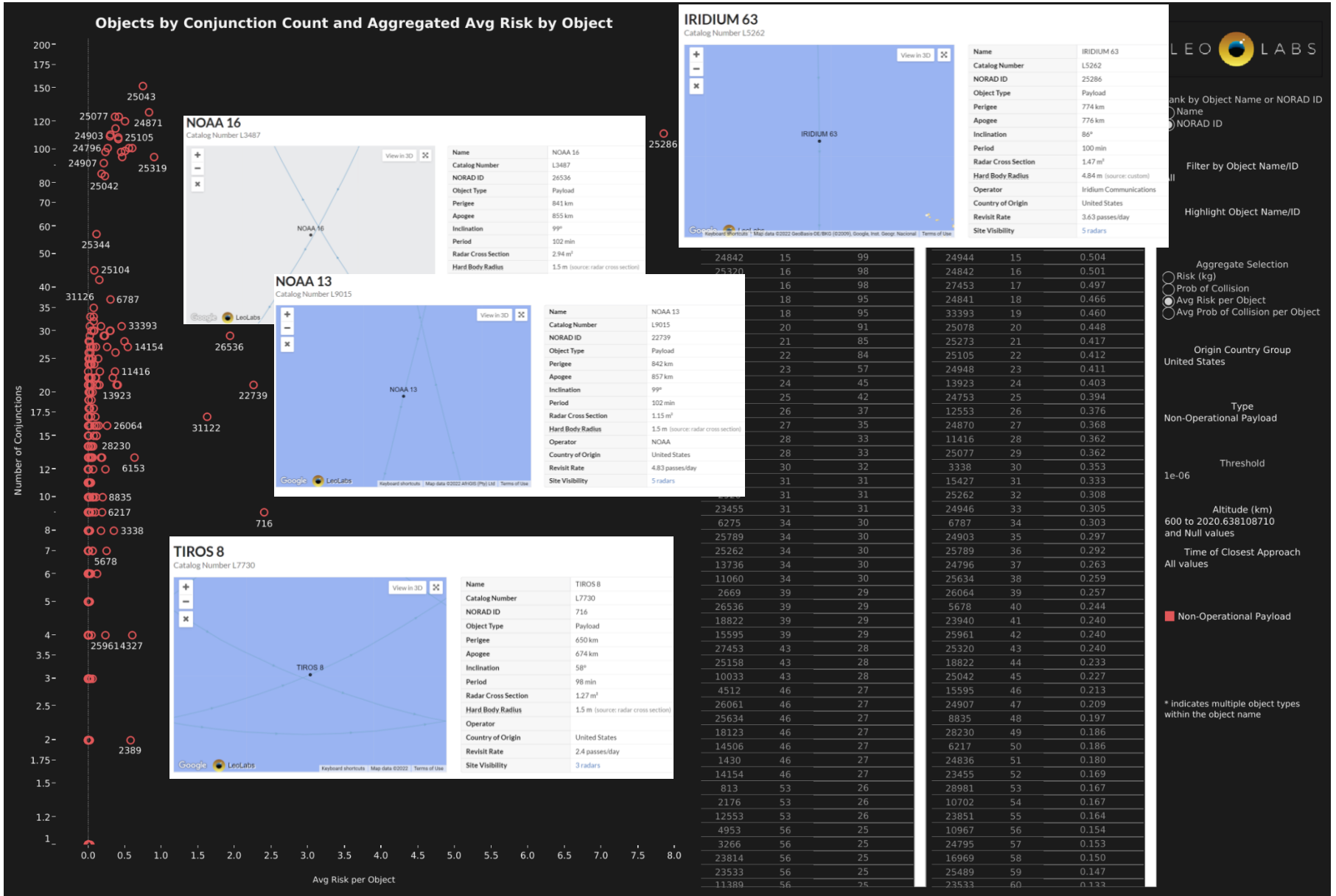
Top “18” ala Top 50 Process

https://spacenews.com/op-ed-space-debris-management-is-even-more-urgent-than-space-traffic-managemen

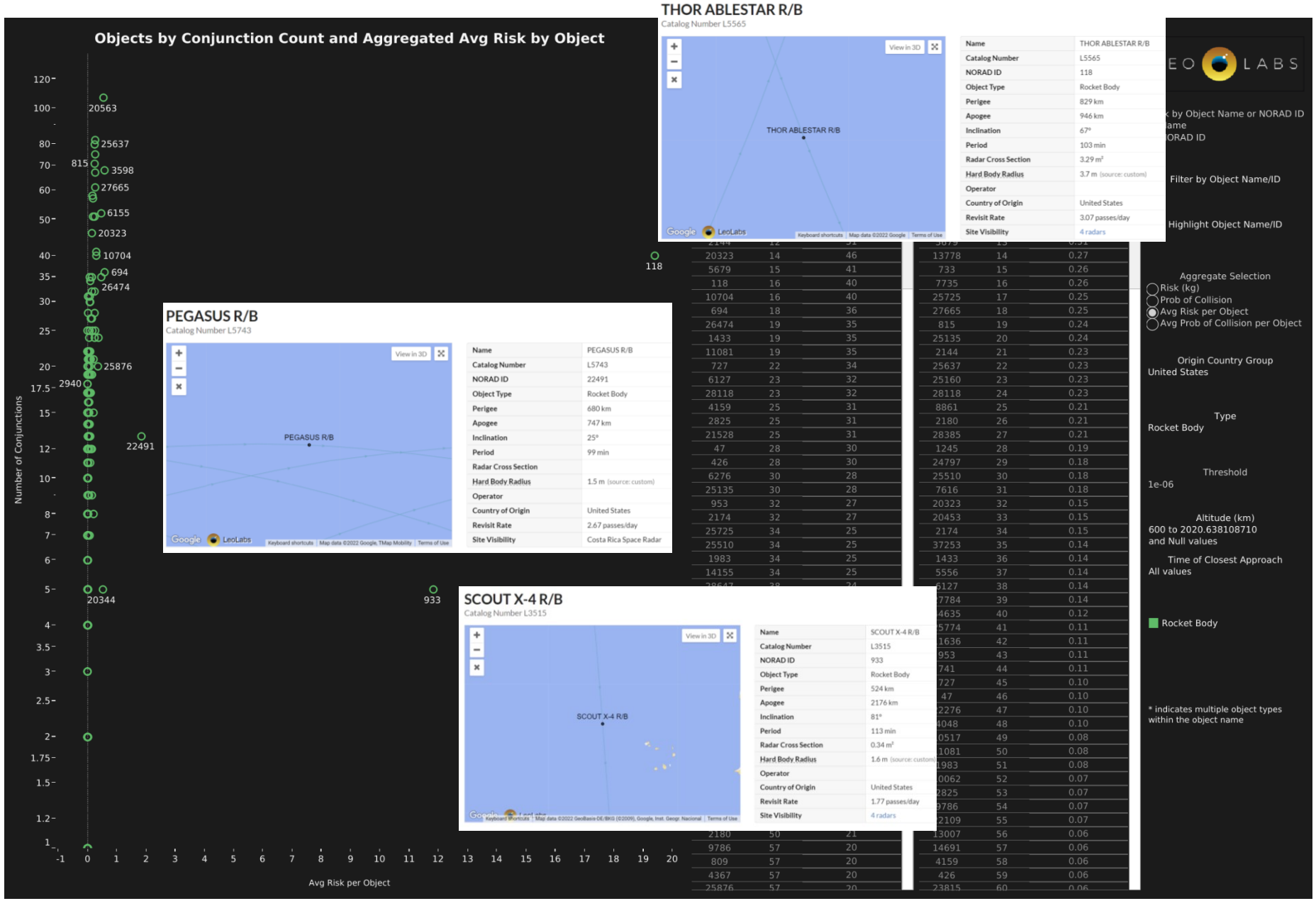
- Three general families of payloads
  - ✓~300 kg and less (green)
    - Uncontrolled reentry
  - ✓~500 kg to 1,000 kg (tan)
    - Not in “bad neighborhood” (800 to 900 km), but above and below (~775 and ~975 km)
    - May require controlled reentry
  - ✓> ~ 1,000 kg (red)
    - Mostly “bad neighborhood” and definitely need controlled reentry

Object Name or ID Selection	Aggregate Risk, kg	Altitude, km	Mass, kg
OPS 8579 (DMSP 5B F5)	46.9	750/830	195
OPS 6182 (DMSP 5D-1 F3)	9.3	780/767	150
OPS 6226	7.0	851/774	195
OPS 9845 (DMSP 5D-2 F6)	5.8	798/789	751
TIROS 10	4.1	716/798	138
OPS 5268 (DMSP 5A F3)	3.6	729/785	195
OPS 6630 (2)	3.5	1414/1451	2653
TOMS EP	3.5	688/728	295
OPS 7898 (P/L 2)	2.7	977/990	1000
ASTEX 1	2.6	720/743	1497
ORBVIEW 2 (SEASTAR)	2.5	777/782	309
NOAA 17	2.3	800/816	2232
NOAA 16	2.2	840/856	2232
NOAA 11	2.1	833/850	1712
NOAA 12	2.0	796/814	1712
NOAA 10	1.9	790/806	1712
OAO 1	1.9	773/784	1769
NOAA 13	1.7	844/856	1712

Non-Operational Payloads Above 600 km



US Rocket Bodies Above 600 km

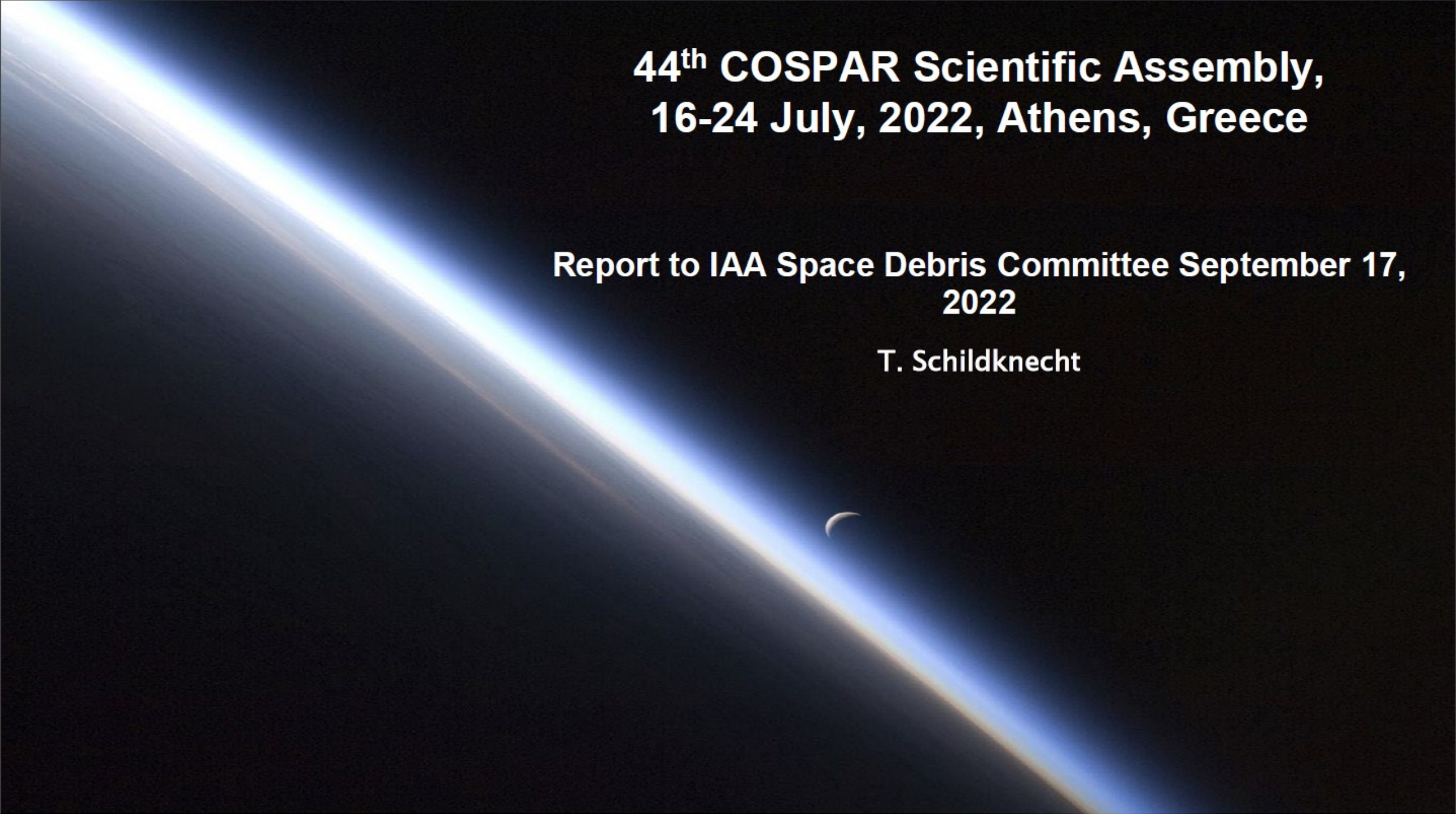


Thomas Schildknecht

44th COSPAR Scientific Assembly, 16-24 July, 2022, Athens, Greece

Report to IAA Space Debris Committee September 17, 2022

T. Schildknecht



COSPAR 2022 PEDAS Event

The Science of Human-Made Objects in Orbit: Space Debris and Sustainable Use of Space

MSO: Carolin Früh
DO: Carmen Pardini

- **Sensors, Sensing, and Monitoring**
  Chair: Thomas Schildknecht
- **Real Data Processing, Data Simulation and Orbit Estimation**
  Chair: Carolin Früh
- **Maneuvres, Orbit Control, and Propulsion**
  Chair: Tim Flohrer
- **Passive Space Object Characterization**
  Chair: Jiri Silha

COSPAR 2022 PEDAS Event

The Science of Human-Made Objects in Orbit: Space Debris and Sustainable Use of Space

- Statistics of PEDAS at COSPAR 2022:
  - 4 half-day sessions
  - presentations: oral/virtual ⇨ 30

- 45th COSPAR Scientific Assembly (COSPAR 2024), 13 – 21 July 2024, Busan, South Korea

PEDAS Business Meeting (virtual)

1. Discussion of scientific matters & coordination (among others)
   - Reentry events
   - Bright satellites in the night sky
   - Debris on Debris collision – not space traffic management, detrimental long-term effects, near-term risk
   - Nontrackable population (ISS), micrometeoroids (cislunar, James Webb, ejecta from moon)
   - Cislunar space – how do we handle that?
   - Best practices in CA. autonomous collision avoidance strategies
2. Election/appointment of PEDAS officers
   - **Carolin Früh (USA, chair and MSO): 2022 to 2026**
   - **Carmen Pardini (Italy, vice-chair and DO): 2022 to 2024**
3. Proposals for COSPAR meetings (among others)
   - More advertisement needed
   - Interlacing with other fields in this bigger COSPAR venue
   - Highlight link to UNCOPOUS
   - Change of the name and focus of PEDAS
   - Intersessional virtual meetings

Riccardo Bevilacqua, Ph.D.

Propose to present the upcoming conference 2nd International Stardust Conference (URL: http://www.stardust-network.eu/starcon2/)

workshop 3rd European Operations Framework EOF workshop (URL: https://event.dlr.de/en/event/the-european-operations-framework-eof-workshop-no-3/).

3rd IAA Conference on Space Situational Awareness (ICSSA)
Tres Cantos, Madrid, Spain April 4-6, 2022

"The ICSSA was a valuable gathering of global experts focused on the technical issues related to space situational awareness (SSA). The collaborative environment prompted a variety of off-line discussions that epitomized the need for joint efforts that spanned measurement modalities, national borders, and stakeholder domains."

ICSSA 2022 Stats:

1. 85 attendees
2. 16 countries (including Australia, Brazil, Canada, France, Germany, India, Italy, Japan, Netherlands, Romania, Slovak Repuplic, Spain, Switzerland, Turkey, United Kingdom, and United States).
3. 9 US States (Colorado, Florida, Indiana, New York, Ohio, Pennsylvania, Texas, Utah, and Virginia)
4. 5 Keynote Speakers
5. 54 Papers

The Future Looks Bright:

1. ICSSA 2023 - TBA
2. Collaborating with IAA Committee on SSA, with the following goals:
   - Sensitize the public about the future of space accessibility
   - Run ICSSA conferences
   - Make recommendations for space traffic management
   - Create an international body above government agencies

Emiliano Cordelli

2nd ESA NEO and Debris Detection Conference

24-26 January 2023

Great success from 1st conference in January 2019 at ESOC in connection NEO and debris observers

Conference Focus is on NEO and Debris Detection Research, including:

- Observation strategies - technology improvements of radar, passive optical, and laser systems
- Instrumentation component developments (CCDs, CMOS, ...)
- New telescope & radar projects (e.g. fly-eye telescope)
- Space-based observation concepts
- Space surveillance system architectures & applications for space traffic management
- Detection systems for fireball and other events
- Orbit prediction & determination in near-Earth and cislunar space
- On-orbit & re-entry risk assessments
- Data processing concepts
- Data exchange mechanisms & standardisation

A final decision for an in-person or virtual event will be taken on 01 October 2022.

Deadline for the submission of abstracts is 01 October 2022.

http://neo-sst-conference.com/

Marko Jankovic

2nd International Stardust Conference: STRCON2

- Location: **ESA/ESTEC, The Netherlands**
- Period: **7-11 November 2022**
- Chair: **M. Vasile, University of Strathclyde**
- Registration fee**: none**
- Two parallel tracks:
  - **Space Environment Management & Sustainability**
    - Space environment management & modelling
    - In-orbit servicing, manufacturing and recycling, etc.
  - **Exploration of Asteroids**
    - Asteroid deflection & exploration
    - Autonomy & reliability of small satellites for deep-space exploration, etc.
- Abstract submission deadline: **30.09.2022**
- Paper submission (after conference) to Nature Scientific Reports or Advances in Space Technology
- URL: http://www.stardust-network.eu/starcon2/
- E-mail: mailto:info@stardust-network.eu

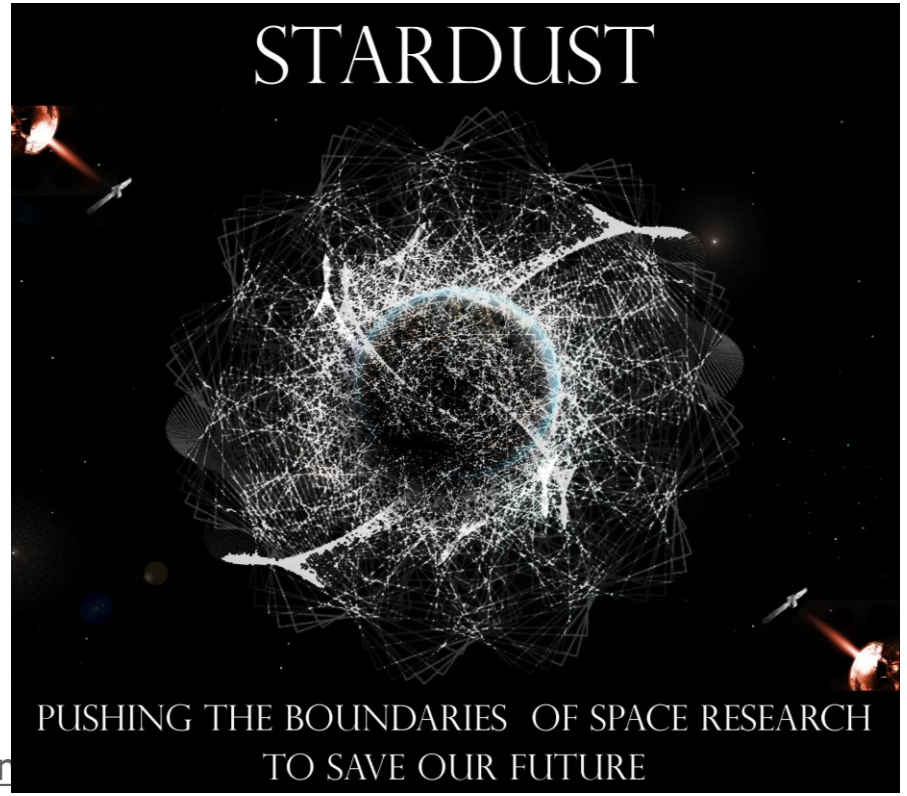


Image credit: Stardust Reloaded consortium

3rd European Operations Framework (EOF)

"*To lift European actors in the global OOS arena*"

- Organized by the PERASPERA team under the umbrella of H2020 and Horizon Europe programs of the European Union
- Date: 28-29 September 2022 (on-site and on-line)
- Scope of the EOF:

  Achieve a **coordinated position of the European parties on operations in space** (e.g. On-Orbit Servicing, Assembly and Manufacturing, etc.) by generating guidelines, principles, proposals for standards
- EOF topics:
  - Technology and operations
  - Standards and definitions
  - Legal and risks
  - Business and development
- URLs:
  - https://www.h2020-peraspera.eu/eof/
  - https://event.dlr.de/en/event/the-european-operations-framework-eof-workshop-no-3/
  - https://period-h2020.eu/news-events

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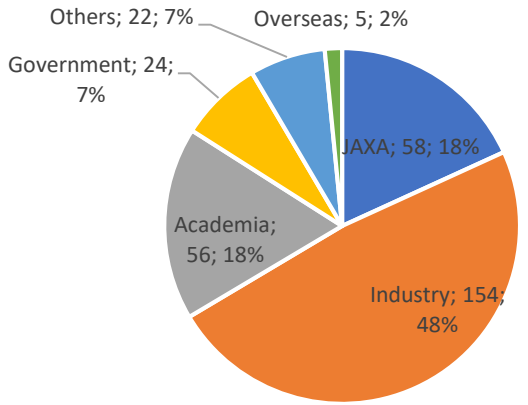
Satomi Kawamoto

10th JAXA's Space Debris Workshop
@ JAXA Chofu Aerospace Center (Tokyo, JAPAN)

- November 28-30 2022, both onsite and online
- https://www.kenkai.jaxa.jp/event/2022/debrisws2022_e.html
  - Registration will start early October. No registration fee
  - Call for Abstract has been closed at the end of August. Program under review
  - Held every 2 years, ~50 presentations, ~10 posters, >300 participants (9th WS)
  - Sessions: observation, SSA/STM, modelling, protection, mitigation, remediation, legal, etc.
- Presentation files will be available at JAXA Web site
  - Proceedings of the 9th Workshop: http://id.nii.ac.jp/1696/00047748/
- If you have questions or interests, please contact at kawamoto.satomi@jaxa.jp

9th Workshop (only panel discussions were held at the venue)



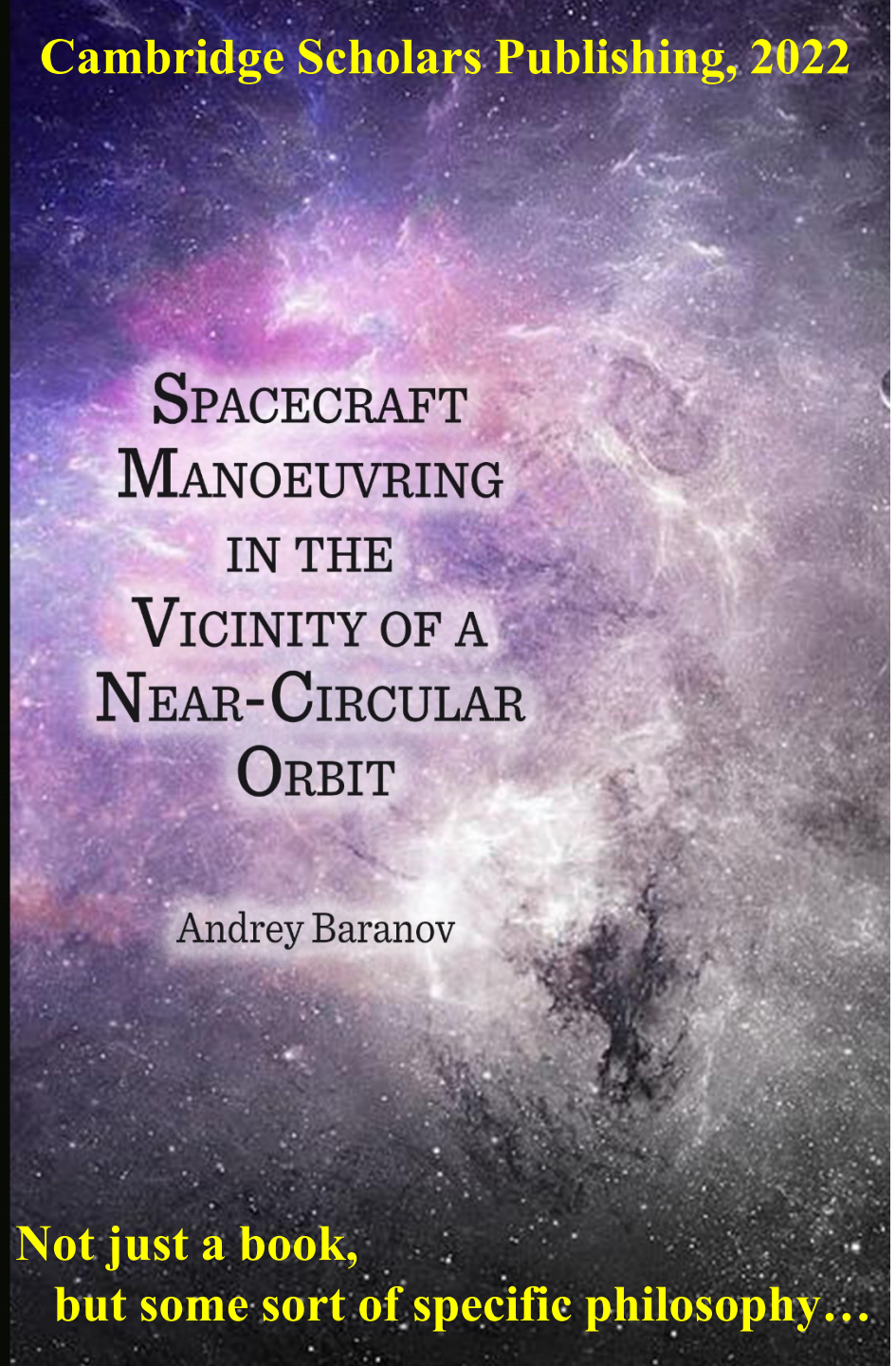
Participants of 9th Workshop

JC Liou

- **The 4-day conference will cover all aspects of meteoroid and orbital debris research, mission support, and other related activities**
  - Measurements: radar, optical, *in-situ*, laboratory, *etc*.
  - Modeling: engineering, long-term environment, near-term risk assessments, reentry, *etc*.
  - Operations and mission support: hypervelocity impacts and protection, satellite anomalies, conjunction assessments, *etc.*
  - Environment management: mitigation, remediation, space traffic coordination, policy, *etc.*
- **The first conference announcement will be available later this year**

All are invited to attend the 2023 IOC!

Roberto Opromolla / Dmitriy



Why did this book appear?

- ✓ 50 years of successful experience in calculating the manoeuvers of real spacecraft in various projects in Russia and abroad;
- ✓ a theory of manoeuvring in the vicinity of a circular orbit;
- ✓ possible optimal solutions of transfer and rendezvous problems, covering both impulsive and low-thrust manoeuvers;
- ✓ the simplest and therefore most reliable algorithms for solving the main problems encountered in practical work.

What is inside?

- transfer and rendezvous problems;
- forming and maintaining a given configuration of satellite systems and satellite groups (formation flying);
- Manoeuvring in the space debris problem:
  - collision avoiding when performing rendezvous manoeuvers;
  - algorithms for estimating manoeuvers of active space objects;
  - transferring large-size debris to disposal orbits.

BAUMAN MOSCOW STATE TECHNICAL UNIVERSITY

International Meeting

FUNDAMENTAL AND APPLIED PROBLEMS OF MECHANICS

06-09 December 2022

In person / Online

The program includes reports on the following main areas:

- Simulation of mechanical systems, stability, vibrations, motion control;
- Theoretical mechanics. Orbital Dynamics;
- Applied mechanics;
- Aero and hydromechanics;
- Optimization and diagnostics of mechanical and hydromechanical systems.

What is required?

- A will to share experience with colleagues;
- Interesting topic;
- 3-4 pages thesis

There is no claim for research to be extra fresh, it can be already published

Pierre Omaly

9th Satellites End of Life and Sustainable Technologies Workshop CNES Headquarters

18th and 19th of January, 2023

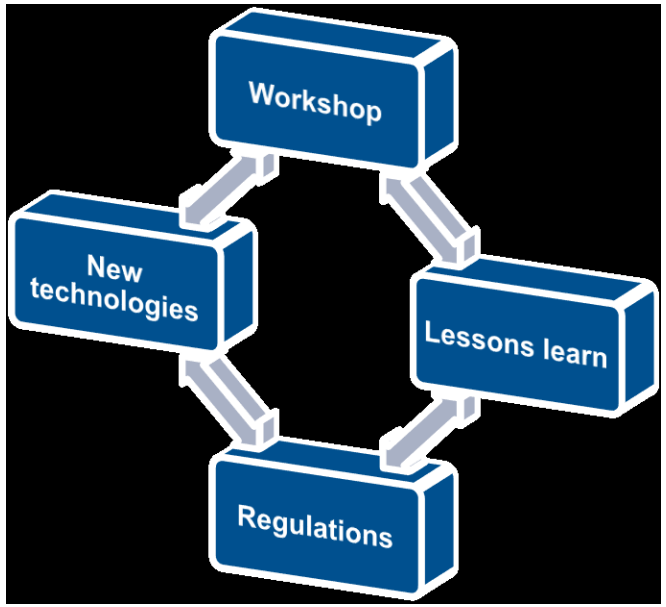
Some previous participants

esa
JAXA
ThalesAlenia Space
OneWeb ACCESS FOR EVERYONE
European Commission
AIRBUS
SAFRAN
etamax MEMBER OF FEV GROUP
cnes
eutelsat
SES beyond frontiers
EUMETSAT
POLITECNICO MILANO 1863
NASA
CSSI CENTER FOR SPACE STANDARDS & INNOVATION
AGI
Space Flight Dynamics Laboratory
ISTI/CNR, Pisa, Italy

The objectives of this two-days workshop are to get an overview of the state of the art in technologies and concepts and discuss ways to address current and future challenges.

Session 1 : End of life

- Standards & Best practices
- Post Mission Disposal concepts
- End of life Operation lessons learned
- Reentry & desorbitation concepts
- Reentry Observations
- Mission extension vs end of life



Session 2 : Sustainable Technologies

- Spacecraft reliability vs PMD Probability
- Design for Demise
- ADR Ready,
- Equipment
- Protecting spacecraft against micro-meteoroid
- Spacecraft Health Monitoring
- Tools, methodology, initiatives
- Environment footprint