



# Dark and Quiet Skies at UNCOPUOS – An Update on the Sustainable Use of Outer Space

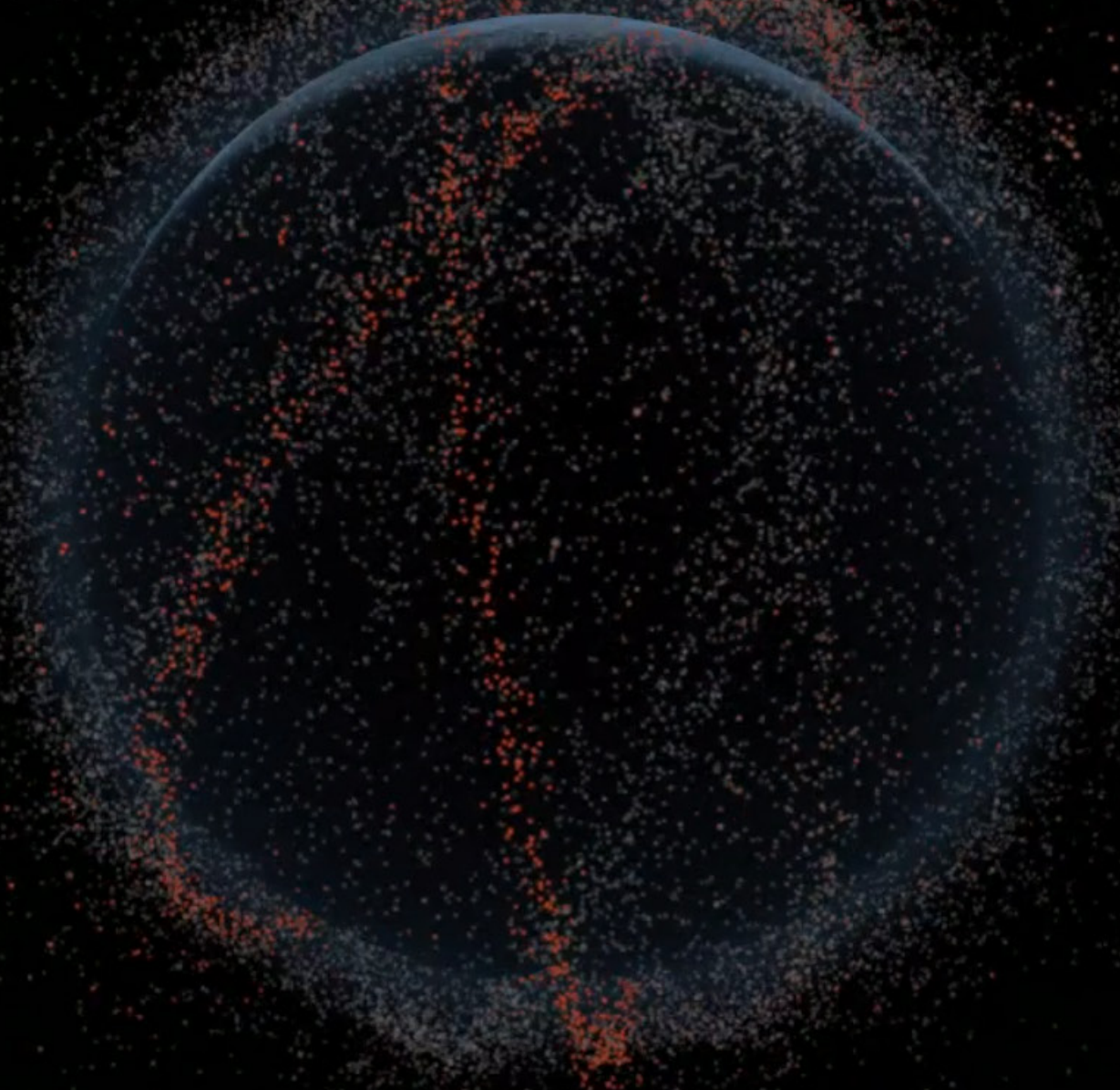
**T. Schildknecht**

*Expert Member of CH-Delegation to COPUOS  
Astronomical Institute, University of Bern,  
Switzerland*

*Swiss SKA Days 2024  
September 3, 2024, UniGE, Geneva*

NOT sustainable...

**business  
as usual**



object  
count



time

**2035**



# Satellite Constellations and Society

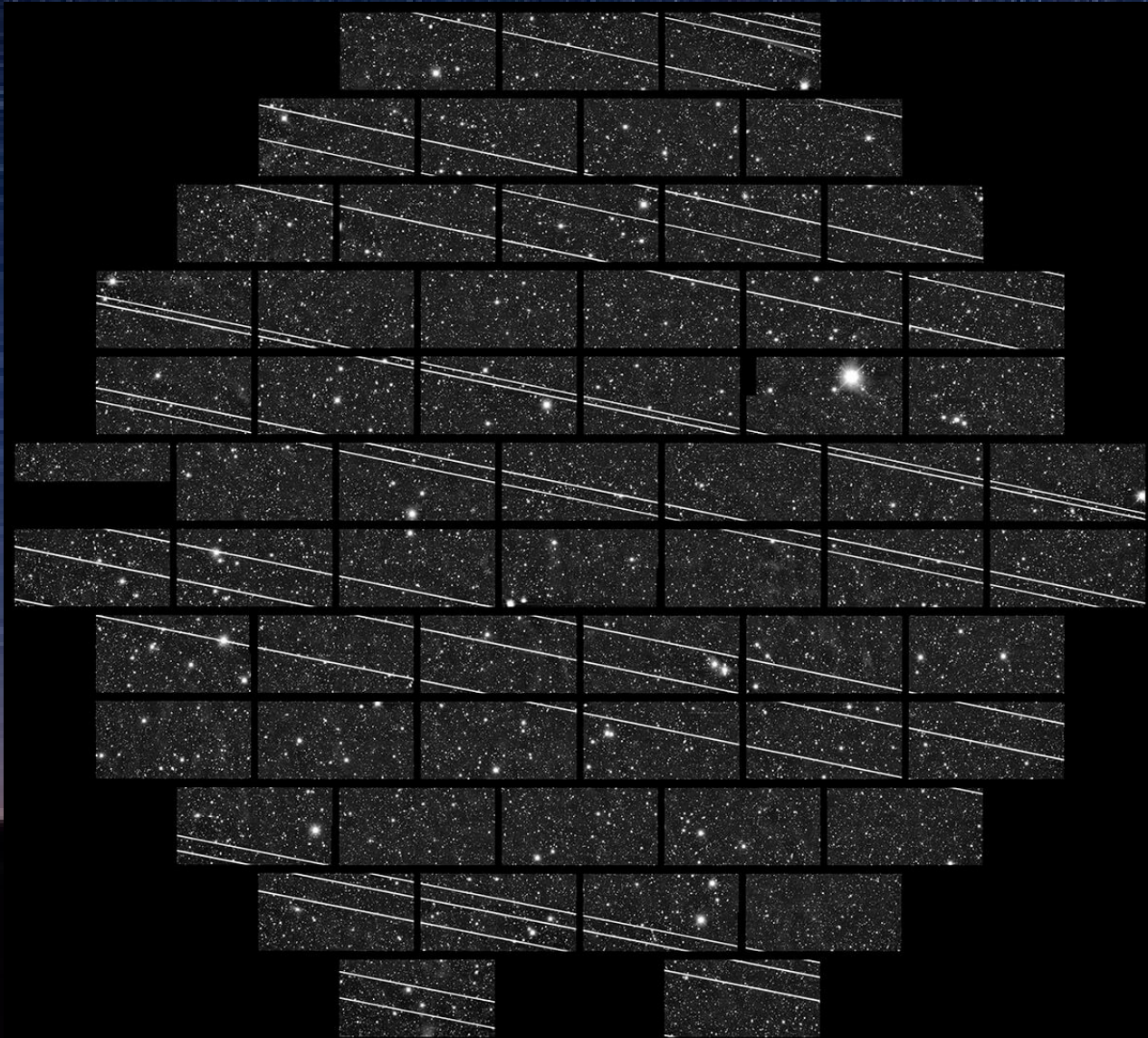


# Dark and Quiet Skies for Humankind

- these strings of pearls may be fascinating, BUT do we want to see them all the time, everywhere on Earth?
- several 100 moving satellites visible by naked eye (always)!
- Is the pristine night sky a human heritage?
- how can we ensure protection of this heritage?



# Dark and Quiet Skies for Science and Society



single exposure from large  
8-meter telescope

- satellite streak expected on every exposure
- diffuse background brightness from artificial objects (debris!)
- radio noise from satellites



# Dark and Quiet Skies for Science and Society

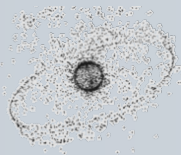
- “light pollution” and radio noise may cut us from
  - accessing the sky
  - accessing knowledge about our universe
- currently ZERO regulation, OST only guarantees
  - freedom for exploration and (peaceful) use
  - free access to space
  - freedom of scientific investigation in outer space

# Dark and Quiet Skies for Science and Society

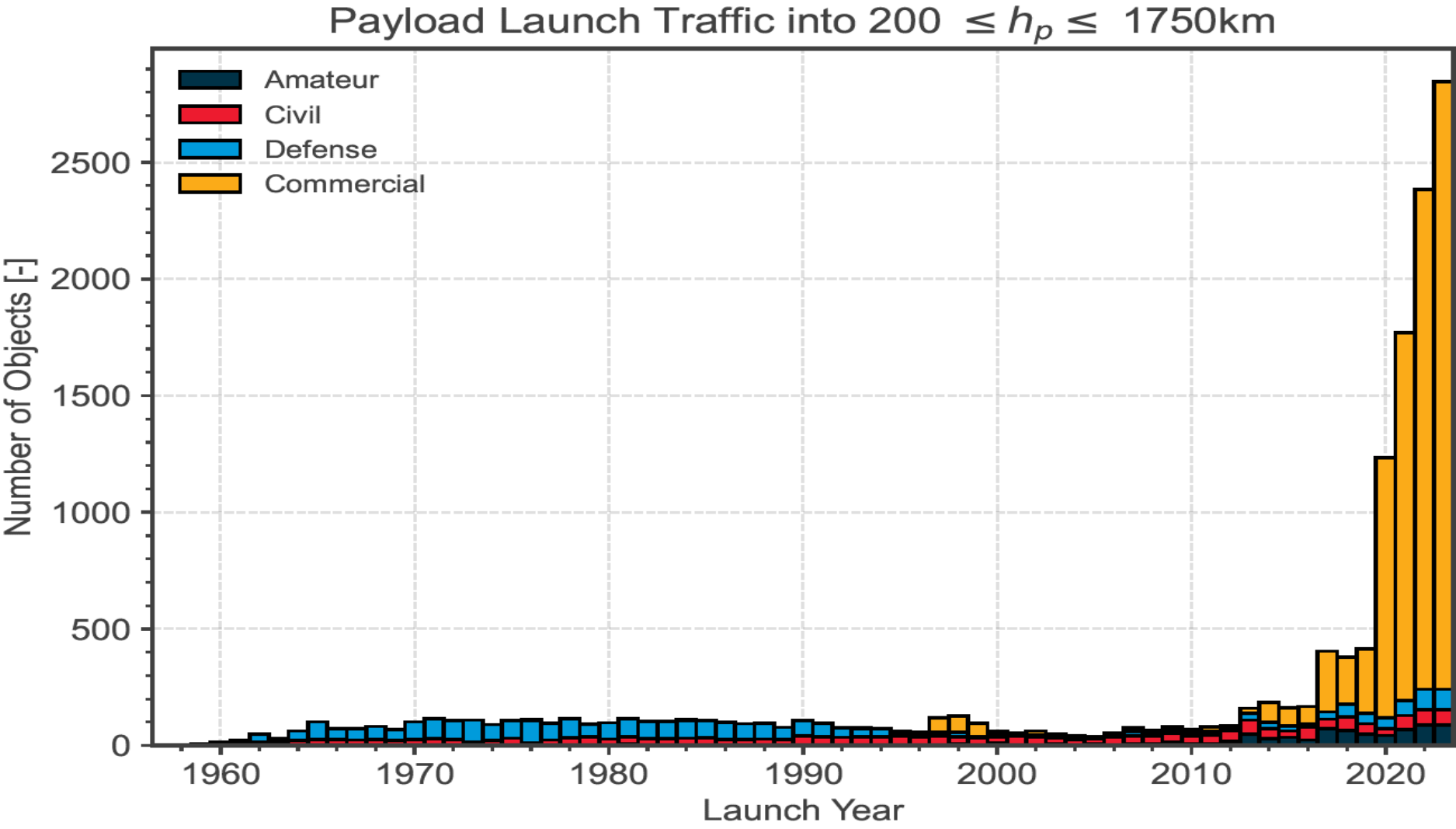
## IAU Recommendations to UNCOPUOS

- Preserve pristine, starry night sky
- Establish dark sky oases
- Limit optical and radio brightness of satellites
- Take into account in licensing process
- Darken satellites
- No high–altitude constellations
- Provide orbit data
- ...

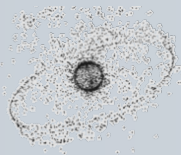




# Evolution of Launch Traffic



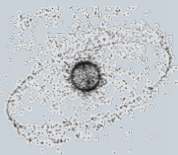




# International Guidelines

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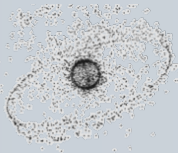
- **2005 IADC Space Debris Mitigation Guidelines**  
revised 2007
  - **2007 UN Space Debris Mitigation Guidelines**  
(7 guidelines)
  - **2010 EU Draft International Code of Conduct for Outer Space Activities**
  - **2010 – 2018 UN COPUOS Working Group on the Long-term Sustainability of Outer Space Activities**  
(21 + guidelines)  
(author was member of Swiss delegation)
  - **2021 – 2025 New UN COPUOS Working Group on LTS**
- **All non-binding guidelines**



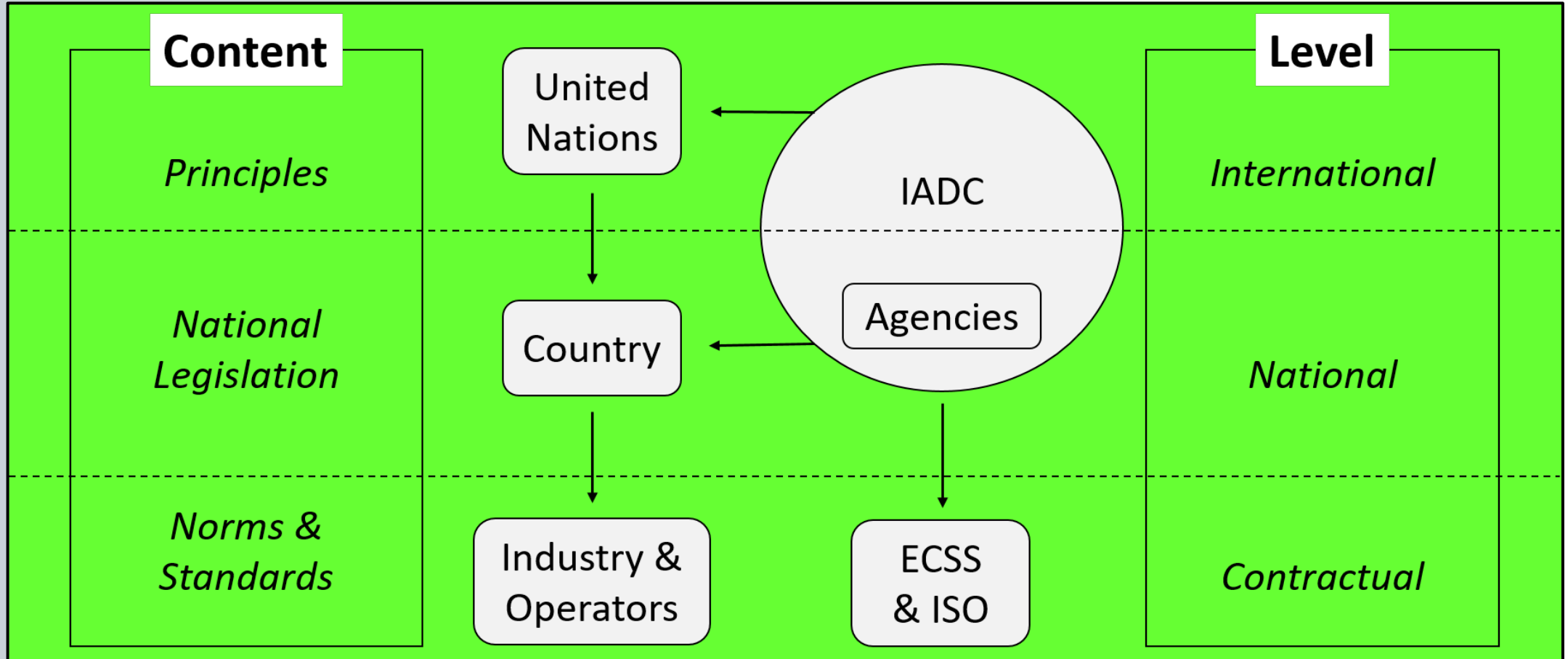
# UN COPUOS, Working Groups and Expert Groups

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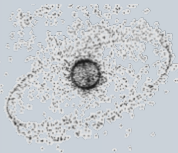
- **UN COPUOS (main committee & subcommittees)**
  - consensus-based (“all parties similarly unhappy”)
  - diplomats and state representatives
- **Working Groups**
  - formal
  - member states at the table
  - diplomats and state representatives
- **Expert Groups**
  - less formal than WGs
  - subject matter experts (nominated by member states)
  - technical discussions, more flexibility concerning working methods



# Guidelines, Laws – Level & Content







# IADC Space Debris Mitigation Guidelines

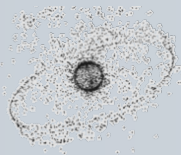
IADC-02-01  
Revision 1  
September 2007

INTER-AGENCY SPACE DEBRIS COORDINATION COMMITTEE



IADC Action Item number 22.4

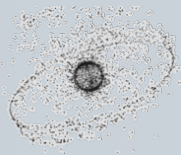
## IADC Space Debris Mitigation Guidelines



# IADC Mitigation Guidelines

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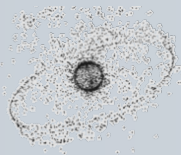
- **IADC Space Debris Mitigation Guidelines** IADC 2005 (rev. 1 2007)
  - **Measure 1: Limit Debris Released during Normal Operations**
  - **Measure 2: Minimise the Potential for On–Orbit Break–ups**
    - Minimise the potential for post mission break–ups resulting from stored energy
    - Minimise the potential for break–ups during operational phases
    - Avoidance of intentional destruction and other harmful activities
  - **Measure 3: Post Mission Disposal**
    - Geosynchronous Region (“graveyard” disposal)
    - Objects Passing Through the LEO Region (“25y lifetime rule”)
    - Other Orbits
  - **Measure 4: Prevention of On–Orbit Collisions**



# UN Mitigation Guidelines

- **UN Mitigation Guidelines** UN General Assembly Resolution 62/217 adopted by UN Committee on the Peaceful Uses of Outer Space (COPUOS) in 2007:
  - Guideline 1: Limit debris released during normal operations
  - Guideline 2: Minimize the potential for break-ups during operational phases
  - Guideline 3: Limit the probability of accidental collision in orbit
  - Guideline 4: Avoid intentional destruction and other harmful activities
  - Guideline 5: Minimize potential for post-mission break-ups resulting from stored energy
  - Guideline 6: Limit the long-term presence of spacecraft and launch vehicle orbital stages in the low-Earth orbit (LEO) region after the end of their mission
  - Guideline 7: Limit the long-term interference of spacecraft and launch vehicle orbital stages with the geosynchronous Earth orbit (GEO) region after the end of their mission



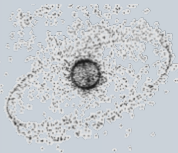


# Example of LTS Guideline

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- B.3 Promote the collection, sharing and dissemination of space debris monitoring information

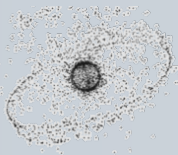
States and international intergovernmental organizations should encourage the development and use of relevant technologies for the measurement, monitoring and characterization of the orbital and physical properties of space debris. States and international intergovernmental organizations should also promote the sharing and dissemination of derived data products and methodologies in support of research and international scientific cooperation on the evolution of the orbital debris population.



# Example of D&QS Recommendations

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- 42. DS\_Oas-1: Dark Sky Astronomy Site, DSAG class 1: no more than 10 per cent more than airglow, or  $<260 \mu\text{cd m}^{-2}$  ( $>21.7 \text{ mag arcsec}^{-2}$ ).
- 43. DS\_Oas-2: Dark Sky Park, Starlight Reserve, DSAG class 2: no more than 50 per cent more than airglow, or  $<360 \mu\text{cd m}^{-2}$  ( $>21.4 \text{ mag arcsec}^{-2}$ ).
- 44. DS\_Oas-3: Dark Sky Heritage Site, DSAG class 3: no more than 2.75 times the airglow, or  $<660 \mu\text{cd m}^{-2}$  ( $>20.7 \text{ mag arcsec}^{-2}$ ).
- 45. DS\_Oas-4: Dark Sky Outreach Site, Starlight Tourist Destination, Starlight Stellar Park, DSAG class 4: given that astro-tourism and amateur astronomy often happen at these places, the recommended limit is 2.0 times the airglow, or  $<480 \mu\text{cd m}^{-2}$  ( $>21.0 \text{ mag arcsec}^{-2}$ ).

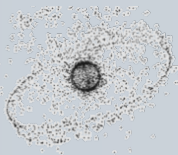


# Dark and Quiet Skies at COPUOS

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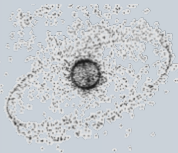
- **February 2020 57<sup>th</sup> STSC**
  - technical presentation
- **September 2021: UNOOSA–IAU Workshop “Dark and Quiet Skies for Science and Society” (online)**  
→ Report as input document for COPUOS
- **April 2021 58<sup>th</sup> STSC**
  - **CRP 17 (A/AC.105/C.1/2021/CRP.17)**  
“Recommendations to Keep Dark and Quiet Skies for Science and Society”  
(Chile, Ethiopia, Jordan, Slovakia, Spain and IAU; 62 detailed recommendations)  
positively commented by 18 Delegations
- **August 2021 64<sup>th</sup> COPUOS**
- **October 2021 2<sup>nd</sup> UNOOSA–IAU Workshop (Canary Island)**





# Dark and Quiet Skies at COPUOS

- **February 2022 59<sup>th</sup> STSC**
  - **Working Paper “Protection of dark and quiet skies”**  
A/AC.105/C.1/L.396  
(Chile, Slovakia, Spain, IAU, ESA, SKA; more high-level recommendations)
    - a. Include astronomical research ... as an instrumental part of space activities
    - b. Raise the attention ... to the harm created by the uncontrolled expansion of artificial light at night...
    - c. Support the adoption of the set of voluntary best practices guidelines...
    - d. Include an item on the agenda of STSC entitled “Impact of satellite constellations on astronomical facilities”.
  - **single-issue Agenda Item “18. General exchange of views on dark and quiet skies for science and society”**
- **June 2022 65<sup>th</sup> COPUOS**



# Dark and Quiet Skies at COPUOS

- **Feb 2023 60<sup>th</sup> STSC**

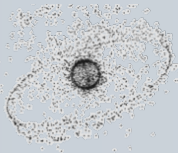
- **CRP 18 (A/AC.105/C.1/2023/CRP.18/Rev.1)**

- (a) The **maintenance of the single-issue Agenda Item** “General Exchange of views on Dark and Quiet Sky” for the next three sessions of the Subcommittee;
- (b) The **creation of an Expert Group** with the task of promoting awareness, providing guidance, and enabling communication and cooperation between member States and stakeholders regarding the impact of the satellite constellations on astronomy, formulating recommendations in agreement with all stakeholders.

- **ESPI UN COPUOS Evening Side Event “Dark and Quiet Skies”**

- **June 2023 66<sup>th</sup> COPUOS**

- **IAU CPS director Piero Benvenuti, and co-directors Connie Walker from NOIRLab and Federico di Vruno from the SKAO**
- **no consensus** → STSC Feb 2024



# Dark and Quiet Skies at COPUOS

- **Feb 2024 61<sup>st</sup> STSC**

- **CRP 18 (A/AC.105/C.1/2024/CRP.18)**

- request to establish a single issue agenda item at STSC for the years 2025, 2026, and 2027

*“Exchange of views on Dark and Quiet Skies for science and society”*

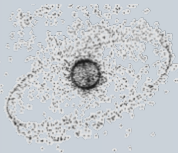
- **Side Event “Dark and Quiet Skies” (Spain, Chile)**

- **“Group of Friends for Dark and Quiet Skies”**

welcomed by many delegations (today 27 members incl. CH)

- **Deliberations in the WG of the Whole**

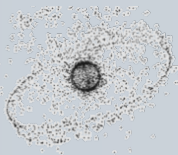
- (1) “Exchange of views on Dark and Quiet Skies for Science and Society”
- (2) “Dark and Quiet Skies: Exchange of views on astronomy and large constellations”
- (3) “Dark and Quiet Skies: impacts of space objects on astronomy”
- (4) “Addressing emerging issues on large constellations including preserving Dark and Quiet Skies”



# Dark and Quiet Skies at COPUOS

- Feb 2024 61<sup>st</sup> STSC (cont.)
  - Deliberations in the WG of the Whole (cont.)
    - Duration: 3y, 5y?
    - Scope:
      - (1) scope of the agenda item is closely linked to its title
      - (2) exchange of views on impact of the large satellite constellations on astronomy ...
  - NO consensus
  - **STSC agreed to propose “single issue/item”**  
***“15. Dark and quiet skies, astronomy and large constellations: addressing emerging issues and challenges.”***  
2025, 2026, 2027, 2028 and 2029 in 2029, the Subcommittee would consider and decide whether to retain the item on its provisional agenda  
  
***Scope of the agenda item was to be closely linked to its title, within the mandate of the Committee and the remit of the Subcommittee.***





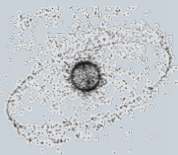
# Dark and Quiet Skies at COPUOS

## ● June 2024 67<sup>th</sup> COPUOS

- Panel Discussion on D&QS (Chile, Spain; ESO, ESPI, IAU, SKAO, IAC)
- IAU proposal for Focus Group “Group of Friends of the D&QS”
  - Objectives:  
develop expert recommendations for implementing mitigations → CRP
  - Chatham House Rules
  - off-line work and virtual meetings
  - CH nominated 2 experts

## ● CH Support

- important topic
- facilitate consensus
- supporting GoF (or eventually creation of EG)
- CH chair of STSC added agenda item at beginning of 58<sup>th</sup> STSC 2021



# Personal Views and Recommendations

- Sustainable use of outer space and D&QS are closely linked
- In the same way as any overarching sustainability goals should include the sustainable use of outer space, the latter should not compromise the sustainable evolution of our societies on Earth – including the advancement of science.
- Need to quantify the impact of large constellations on science
  - what percentage of observations is compromised? how serious?
  - mitigation options when planning observations?
  - technical options to make sensors more resilient (radio domain)?
- Need to devise efficient technical mitigation options at satellite level
  - reduce optical brightness, reduce noise from electronics, switch off transmitters over protected zones (to be established at ITU?), etc.
- Need to trade-off negative and positive impacts of large constellations on science and society

# What do we need?

**Ensure long-term sustainable use of outer space**

**Ensure that the use of outer space does not compromise the sustainable evolution of our societies on Earth – including the advancement of science**

**Ensure protection of dark and quiet skies for science and society**

**Stringent international rules & mechanism to ensure enforcement of rules**

The background of the slide is a dark space scene. A bright, glowing light source, possibly the sun, is positioned in the upper left, creating a wide, diagonal beam of light that stretches across the frame. In the center-right of the image, a thin crescent moon is visible against the dark background. The overall aesthetic is clean and futuristic.

**Our societies, not private companies, need to decide on tradeoffs between the benefits of megaconstellations and protecting the space environment and dark and quiet skies as resources shared by all humankind**

**Thank you for your time!**