DARK & QUIET SKIES

IAU Symposium on Astronomy and Satellite Constellations: Pathways Forward

Connie Walker on behalf of the IAU (IAU CPS, Co-Director;
NOIRLab Office of Observatory Site Protection, Head)

IAU CPS (Center for the Protection of the Dark & Quiet Sky from Satellite Constellation Interference)

The Center

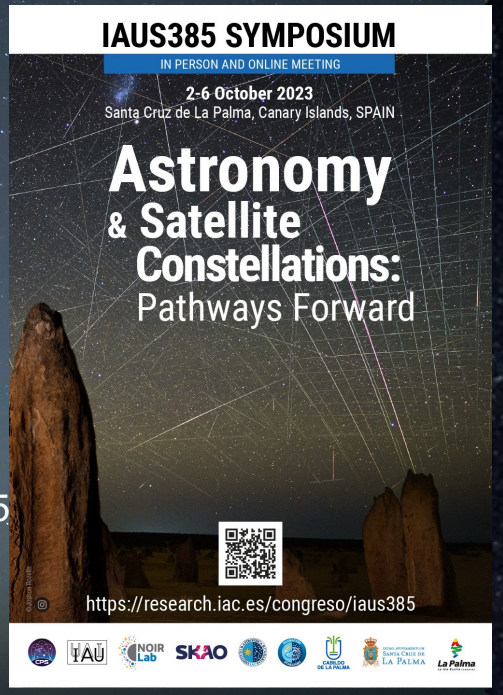
- Coordinates efforts and aims to unify voices
- Brings together different communities
- Collects, produces and disseminates information and resources
- Provides open and free products

- ***4 Hubs*** (Policy, Industry, SatHub & Community Engagement)
- ***> 250 members*** (astronomers, space lawyers, industry staff, etc)

IAU Symposium 385
(2-6 October 2023)

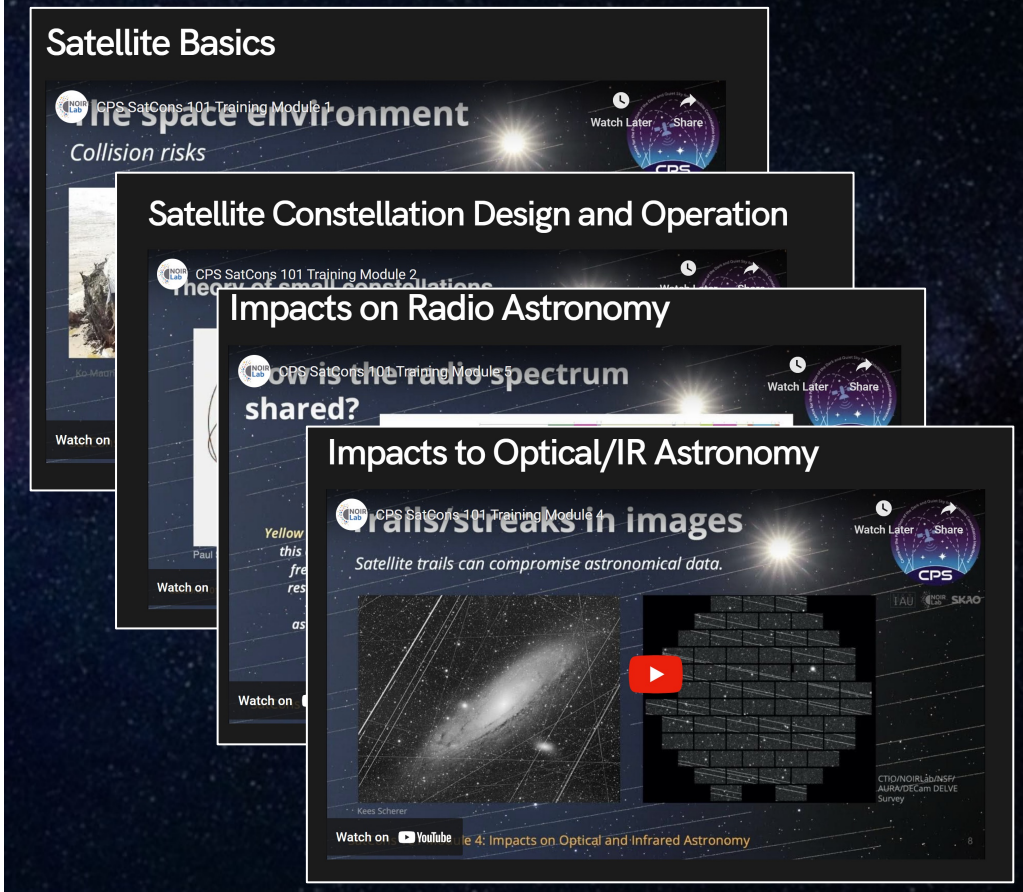
- ***> 200 participants*** (in-person + virtual)
- ***> 80 talks*** on Community Engagement, Software & Observations, Policy, & Industry
- ***Slides & recordings*** available at https://research.iac.es/congreso/iaus385/pages/programme.php

https://bit.ly/IAUS385programme



Community Engagement Sessions

Session Leads: John Barentine and Jessica Heim ✉ community-engage@cps.iau.org



Awareness-building

- ***Indigenous Cultural Perspective*** (shared by members of 3 North America Nations)
- ***Past vs present space & astronomy issues*** through the lense of environment and culture (shared by historians)
- ***8 informative videos*** "SATCONS 101": *https://cps.iau.org/community-engagement-hub/satcons-101/*

``SatHub'' Sessions on Observations

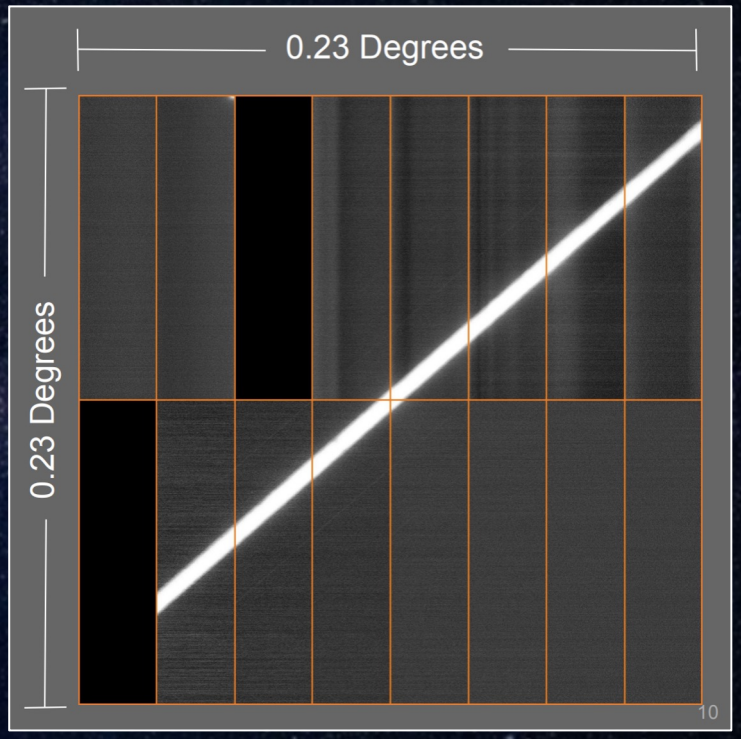
Session Leads: Siegfried Eggl, Mike Peel and Meredith Rawls ✉ sathub@cps.iau.org

- ***Ultra-bright beams*** from satellite downlinks
- Unintended ElectroMagnetic Radiation (***UEMR***)
- National borders & polices → limits on ***radio quiet protection zones***

Unintended Starlink Emissions at SKA - Low (D. Grigg)

Rubin Observatory CCDs (D. Polin)

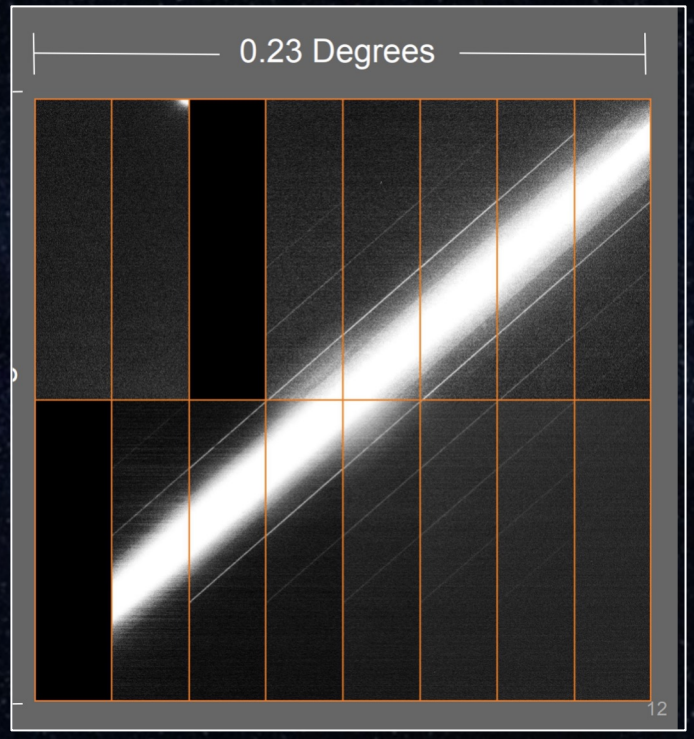
IAU CPS recommendation



Crosstalk Correctable with <10%
Error = 5,000 peak electron count
= 7-8th magnitude*

Faint brightness science affected

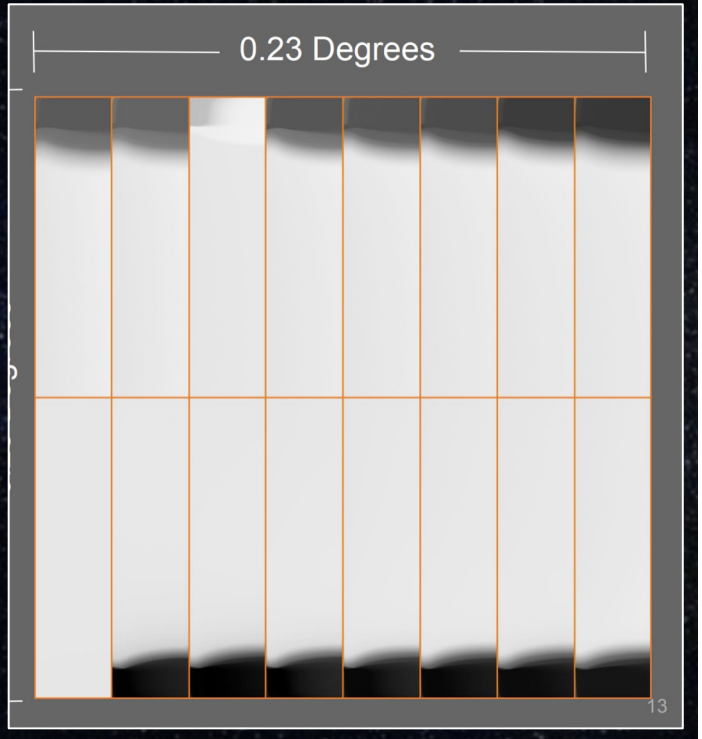
Current Starlinks



Saturation/ “Correctible” with large
Error = 100,000 electrons =
4th mag

Most science programs affected

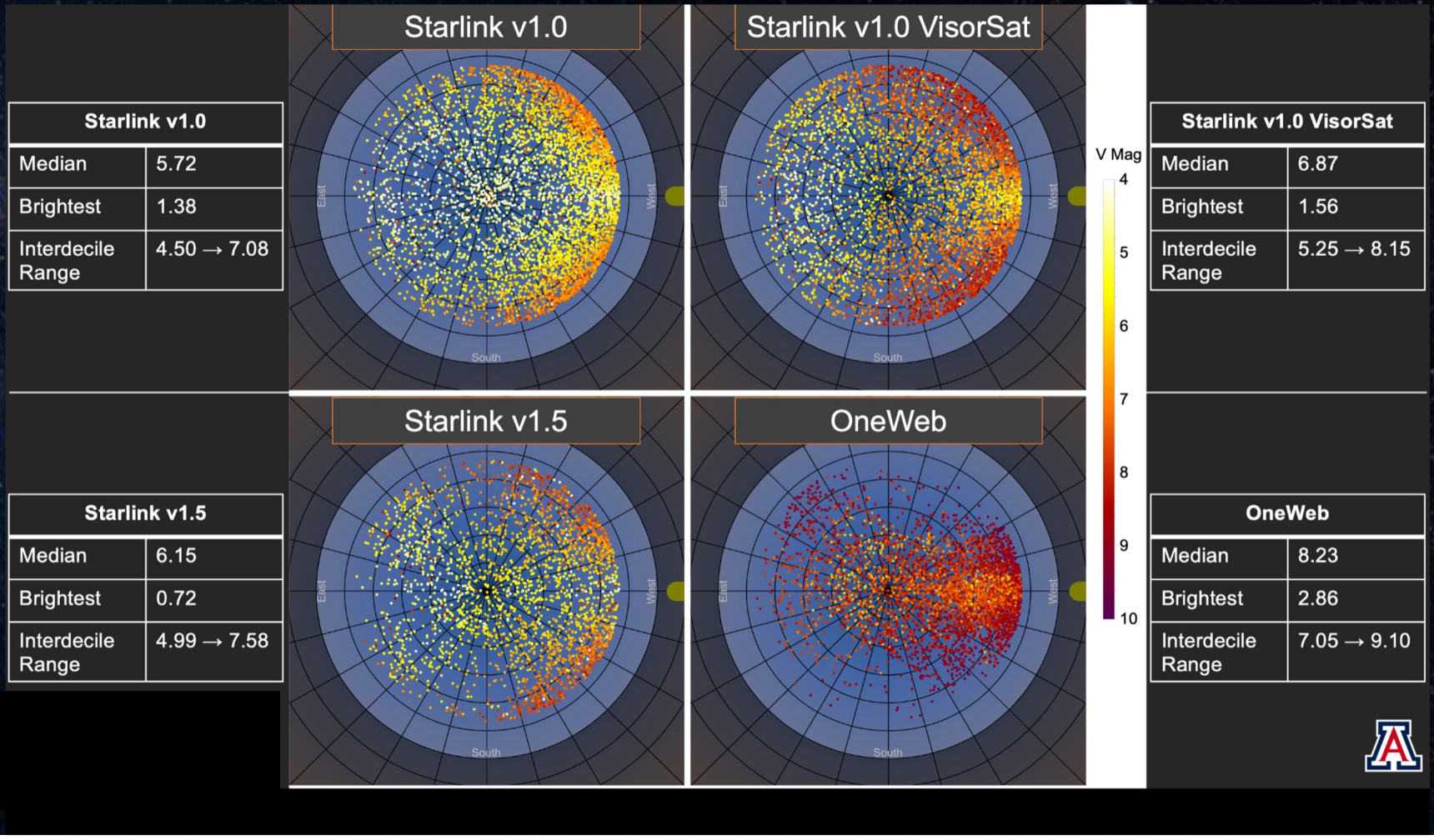
BlueWalker 3



Blooming/ Not Correctable =
1 Million electrons = 0-1 Mag

Measured brightness statistics of Starlink & OneWeb sats

(H. Krantz, UArizona)



Starlink v1.0	
Median	5.72
Brightest	1.38
Interdecile Range	4.50 → 7.08

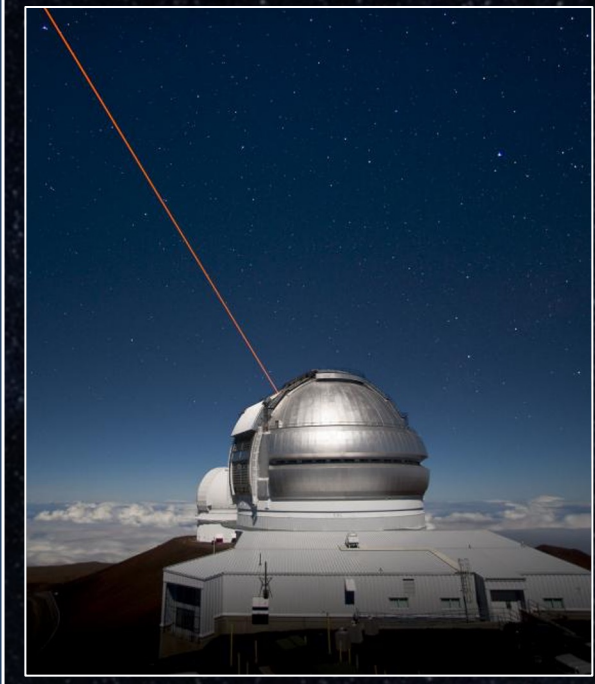
Starlink v1.0 VisorSat	
Median	6.87
Brightest	1.56
Interdecile Range	5.25 → 8.15

Starlink v1.5	
Median	6.15
Brightest	0.72
Interdecile Range	4.99 → 7.58

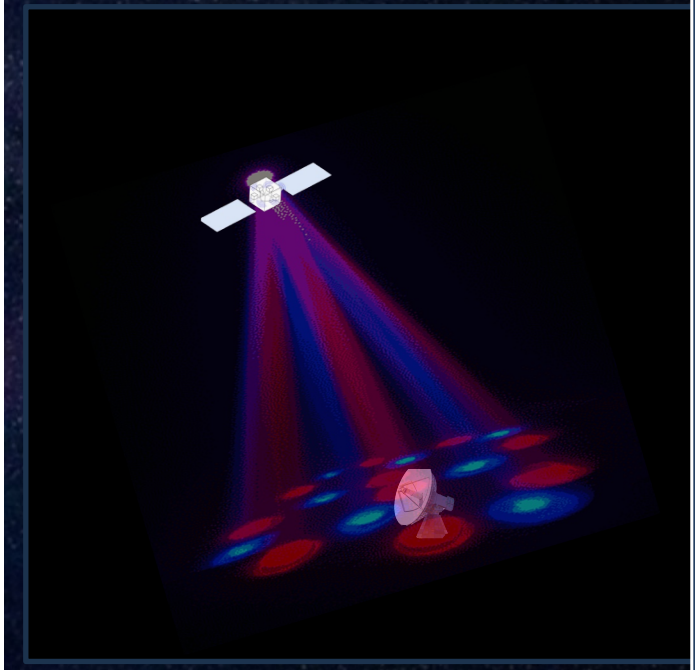
OneWeb	
Median	8.23
Brightest	2.86
Interdecile Range	7.05 → 9.10

Crowded Space at LEO

- The crowding of LEO hampers satellite ***avoidance strategies*** for telescopes due to increasing rate of satellite maneuvers.
- Crowded near-Earth space comes with additional challenges for ***adaptive optics as artificial guide stars*** must be turned off when certain satellites pass overhead
- A large number of constellation satellites will to ***changing the appearance of the night sky*** forever.
- However, both astronomers and industry partners of the CPS are working on ***strategies for co-existence***.



Minimizing Interference



- ***To minimize interference for radio astronomy*:** Satellite beam steering, conscious choices of the positioning of ground stations, & clear ITU regulation
- ***To minimize interference for optical astronomy*:** Reducing backscattered light, predictive models for satellite spectra and brightness, studies of detectors response to bright streaks, and satellite monitoring capabilities
- ***Key to mitigating satellite constellation interference*** is to engage with all stakeholders in an open and constructive manner.

Policy Sessions

Session Leads: Richard Green and Andy Williams

policy@cps.iau.org

IAU Symposium #385 Presentations on

- Increasing recognition evidenced by proclamations and initiatives:
  - The ***European Union Council*** Conclusions on Fair & Sustainable Space
  - The ***European Space Agency***-led Clean Space Charter and Zero Debris initiatives
  - The Science Ministerial declaration from the ***G7 summit*** in May 2023
  - The ***UK Earth Space Sustainability Initiative*** and
  - Endeavours at ***UN COPUOS*** & establishment of the ***Group of Friends***

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- US ***Federal Communications Commission*** mandates coord agreement with NSF for space operators
- ***EU*** authorized spending on an independence sat con – ***IRIS2***
  - Design requirements include provisions to minimize brightness
- In ***Chile***, the new ***norma luminica*** includes environmental assessment before licensing
- The ***UK's Astra-Carta*** has elements dedicated to dark and quiet skies protection.

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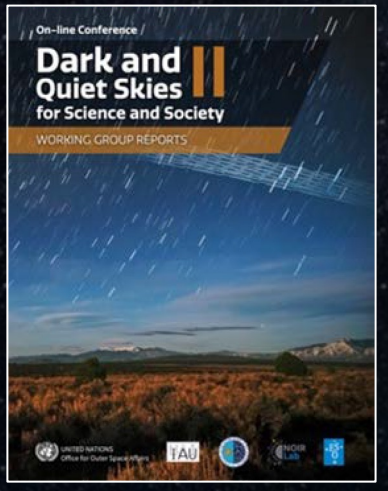
IAU Symposium #385 Presentations on

- The ***IAU CPS Position Document***
- Space Policy and Law Research Team → detailed ***analysis of legal & policy questions***
- ***Space Sustainability Rating*** → creation of a D&QS module
- ***Consolidated set of recommendations*** (from SATCON 1&2 & D&QS 1&2)
- A ***lunar policy study*** completed → establishment of lunar working group



Industry & Technology Session

Session Leads: Chris Hofer and Tim Stevenson; Advisor: Patricia Cooper ✉ industry@cps.iau.org

IAU Symposium #385 Presentations on

- ***Keynote*** on published US GAO position paper on ***space sustainability***
- ***Panel*** Session with ***SpaceX***
  - SpaceX developed dielectric film and offers it at cost to other companies
- ***Technical Advisory Committee*** with 12 members from Industry
- ***Astronomy Guides programme*** where astronomers paired with industry
- Promoting test labs for ***bi-directional reflectivity measurements***

Summary

- We are making ***good progress*** with respect to mitigation techniques, policy and industry cooperation.
- However there is ***a long way to go*** – these challenges will be with us for a long time.
- Join us in ***continuing to move forward*** with efforts to mitigate brightness and radio interference as well as other concerns.
- Here are ***QR codes*** for our IAUS385 programme and our CPS IAU website.
- We ***appreciate your active engagement***.
- For more information, ***contact***: admin@cps.iau.org

https://bit.ly/IAUS385programme

http://bit.ly/47l93vi or cps.iau.org