IAU CPS SatHub

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What is the IAU CPS?

The IAU Centre for the Protection of the Dark and Quiet Sky
from Satellite Constellation Interference (CPS) established in 2022

- coordinates collaborative multidisciplinary international efforts,

- works with institutions and individuals across multiple geographic areas,

- helps to mitigate the negative impact of satellite constellations,

- is so far concerned with ground-based optical and radio astronomy,

- protects humanity's enjoyment of the night sky.

https://cps.iau.org/

Organization of the IAU CPS
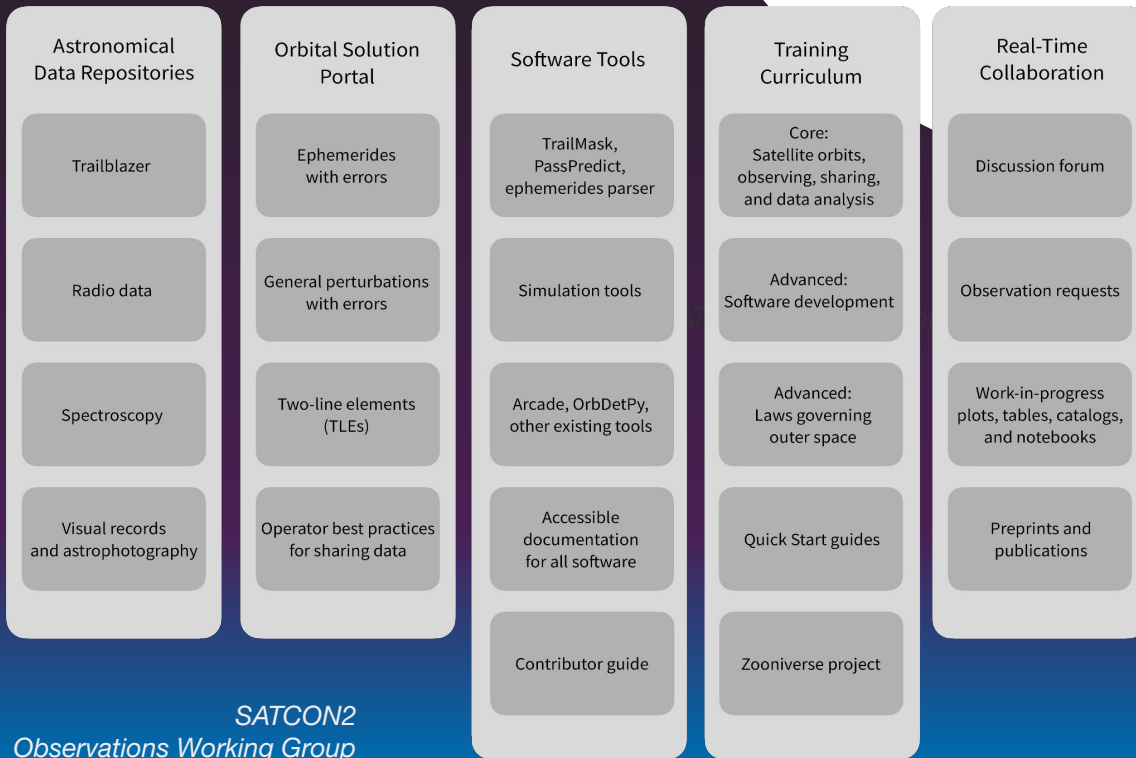

https://cps.iau.org/
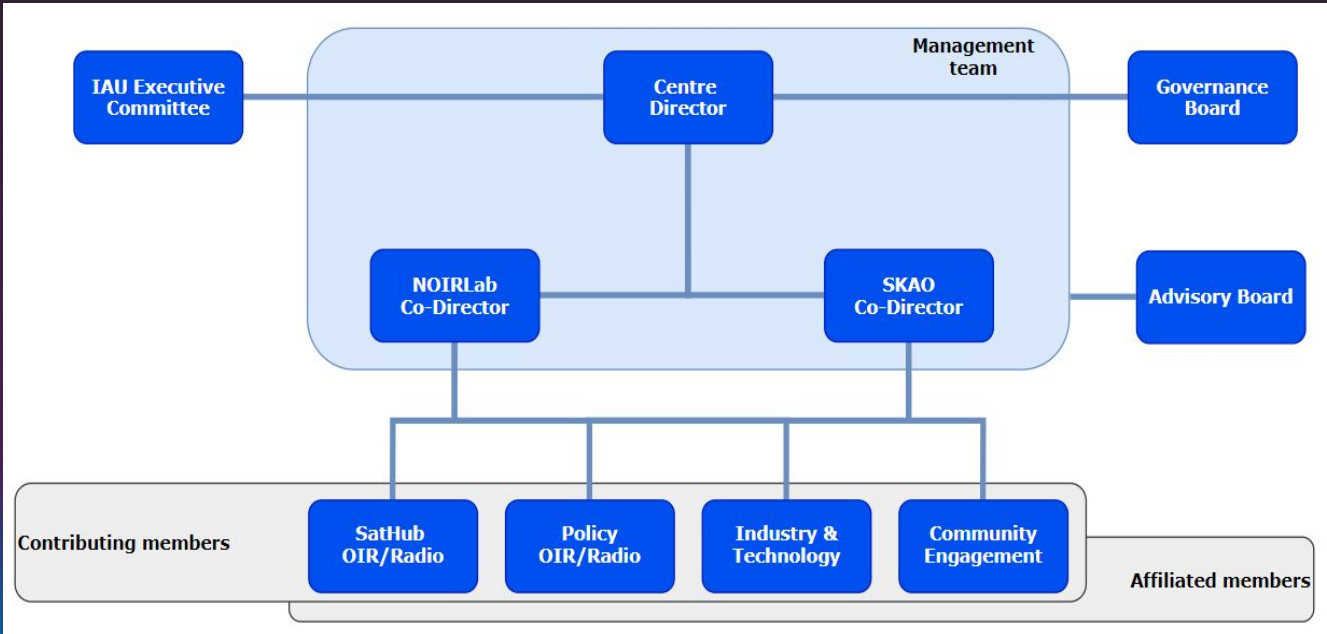
What is the IAU CPS SatHub?

A public, community driven, coordinated hub for

- training,
- outreach,
- collection and
- analysis of

artificial satellite observations.

SatHub is still under construction. May see changes based on community feedback.

SATCON2
Observations Working Group

Astronomical Data Repositories	Orbital Solution Portal	Software Tools	Training Curriculum	Real-Time Collaboration
Trailblazer	Ephemerides with errors	TrailMask, PassPredict, ephemerides parser	Core: Satellite orbits, observing, sharing, and data analysis	Discussion forum
Radio data	General perturbations with errors	Simulation tools	Advanced: Software development	Observation requests
Spectroscopy	Two-line elements (TLEs)	Arcade, OrbDetPy, other existing tools	Advanced: Laws governing outer space	Work-in-progress plots, tables, catalogs, and notebooks
Visual records and astrophotography	Operator best practices for sharing data	Accessible documentation for all software	Quick Start guides	Preprints and publications
		Contributor guide	Zooniverse project	

SatHub: Astronomical Data Repositories

Publicly available, easily accessible, user-friendly, well documented

- Collections of optical/near-IR images with satellite streaks (e.g., Trailblazer),

- Spectra contaminated with reflected solar spectrum,

- Space-based observations from low-Earth orbit (e.g., Hubble),

- Radio data affected by satellite interference,

- DSLR images, visual sightings, other formats.

How to contribute?

- Share your observing campaign plans and data

- We aim to have easy-to-use interfaces for both professional and amateur astronomers to upload and download satellite-affected images

- Software developers/contributors are welcome to contact Meredith Rawls and/or Mike Peel

TRAILBLAZER

An open data repository for astronomical images affected by satellites

http://trailblazer.dirac.dev
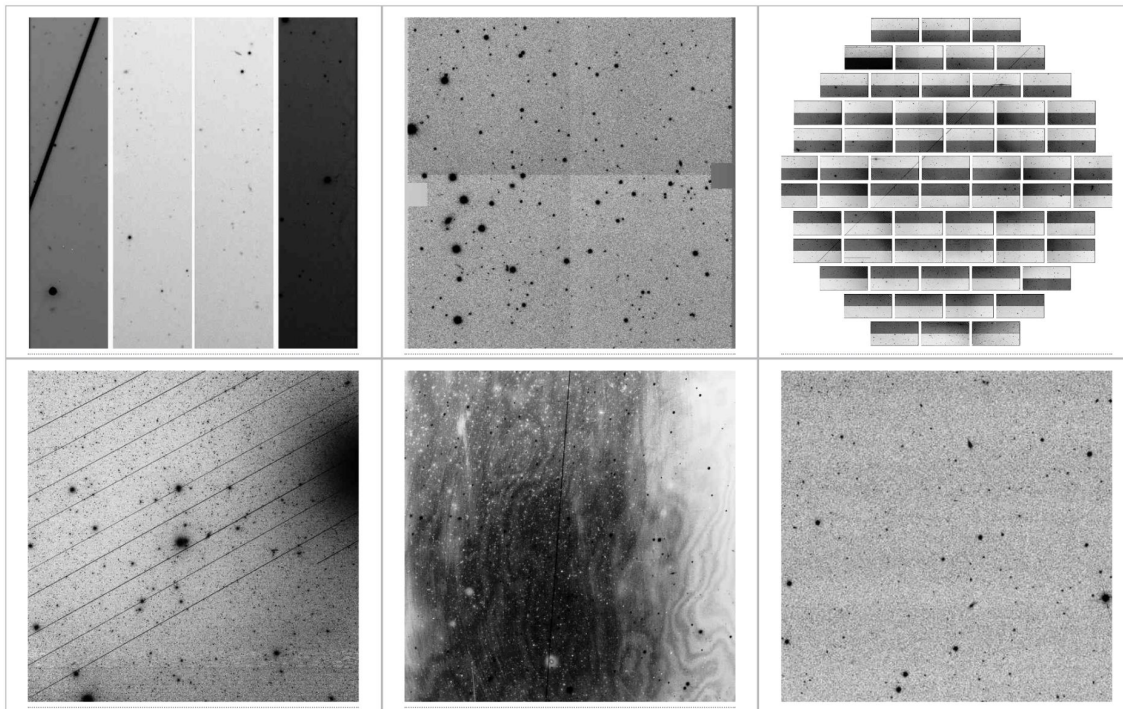
SatHub: Orbital Solution Portal

Public, standardized access to orbital solutions of artificial satellites

- Updated every 8 hours or immediately following a maneuver (current standard: update every 24 hrs)
- Include error bars with all orbital solutions
- Ephemerides-style and general perturbation-style ("TLE") solutions
- Automatic synchronization with complementary services
- Recently hired software developer, who is working on this!

How to contribute?

- We need industry to cooperate and share their orbits in a timely, regular manner
- We need astronomers to check that orbits are accurate by observing and measuring satellites
- Collaboration with existing databases
- Collaboration with for-profit radar-based satellite tracking companies


Mark Handley
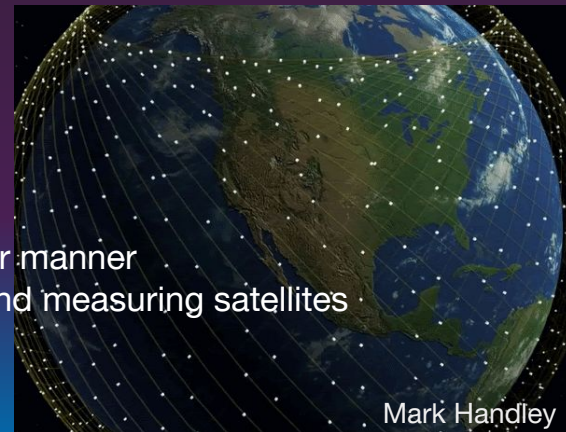
SatHub: Software Tools

PassPredict, TrailMask, Simulation & Modeling…

- User-friendly documentation, support, and maintenance

- Standard test suite supporting a wide range of instrument and satellite signature properties to support software development

How to contribute?

- Contribute to open-source software development

- Test the software with data from many different telescopes and cameras

- Funding to work on software

TU-Wien
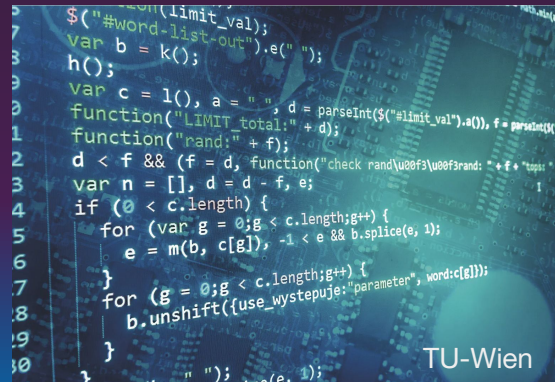
SatHub: Training curriculum
for observers worldwide

Outline of a training curriculum for observers

- Core curriculum (introduction, observing satellites, reporting observations, image and data analysis)

- Advanced modules (software development, radio astro, space law)

- Quick start recipes (for different observer hardware scenarios)

How to contribute?

- Funding needed for curriculum design, including building assessments within the curriculum

- (This is mostly on hold until we find someone who can lead this effort!)

SatHub: Real-time collaboration

Establish communication and collaboration

- Website (http://sathub.org) that will direct to new and existing resources,

- SatHub channel in the IAU CPS Slack (access for IAU CPS members),

- SatHub GitHub organization,

- Documentation that follows Write the Docs best practices.

How to contribute?

- Join SatHub at the IAU CPS!

- Join in discussions on the Slack workspace

- Share your code and work plans

- Contribute to open-source software and documentation development

Potential impact at radio frequencies

- We don't know much yet - need observations to assess actual impact
- Active 10-20GHz transmissions - plus 40GHz soon? (and octaves!)
- Unintended emission at low frequencies - observed recently by LOFAR!
  - https://arxiv.org/abs/2307.02316
- Sidelobe coupling also a concern, particularly for CMB experiments
- Difficult to filter out with broadband detectors, unless using FPGAs
- Highly variable - need to accurately know satellite positions, or see as transients?
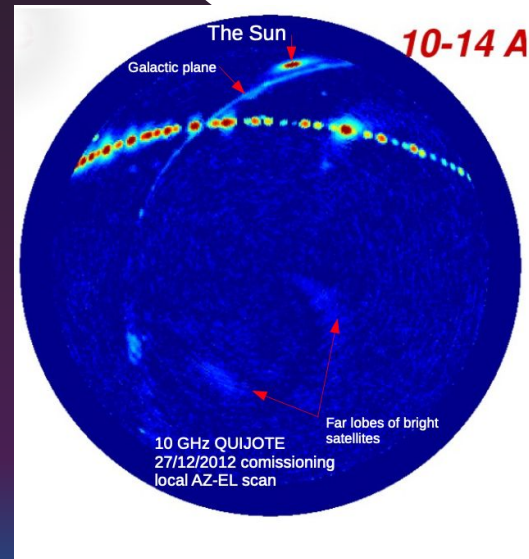

Above: QUIJOTE 10-14GHz observations from Tenerife in 2012 - pre-starlink.
Left: satellite dish observations, F. Di Vruno
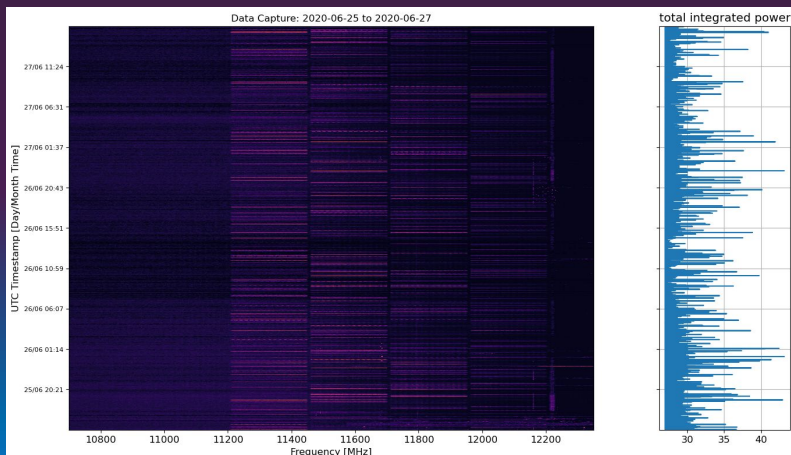
Observing campaigns: BlueWalker3

- Prototype satellite for mobile phone connectivity

- $64m^2$ phased array

- One of the brightest objects in the sky once unfolded!

- + launch vehicle adapter (also bright), position accuracy issues

- Will be published in Nature shortly

- Preprint at:
  https://www.researchsquare.com/article/rs-2557594/v1
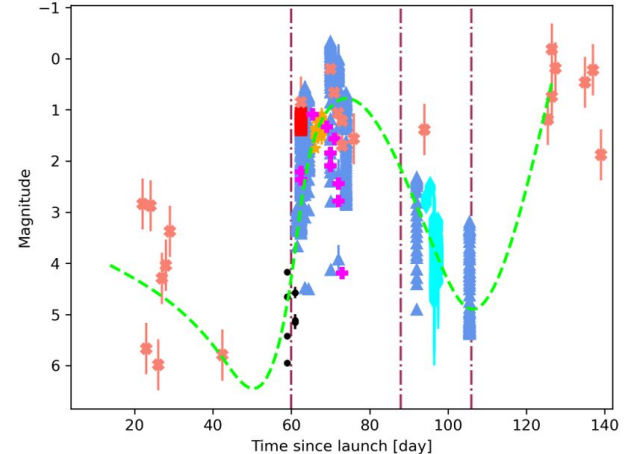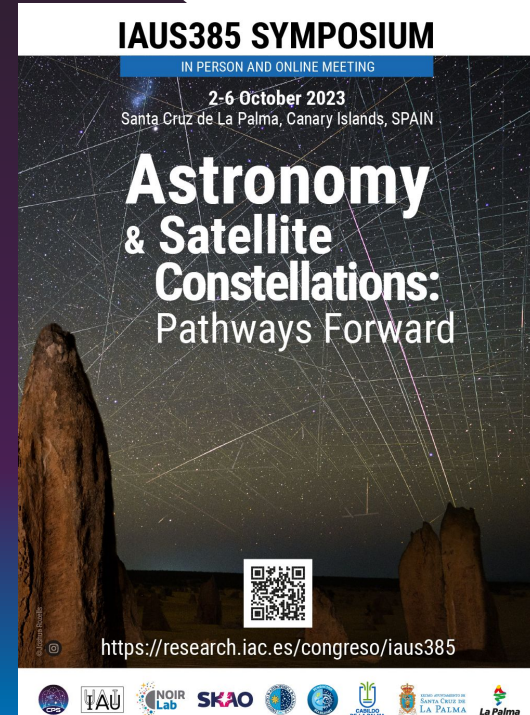
Observing campaigns: ongoing

- Starlink Gen 2 mini's launched

  - These have optical mitigations: how well have they worked?

  - Mixed results so far, some faint, some bright still (+Gen2 bigger)

  - Letter to be published towards the end of the year

- BW3 (+International Space Station) at submm with SCUBA2/JCMT

  - Don't know how thermally bright satellites are!

  - Observations just approved, starting shortly

  - Prototype for future observations of smaller satellites

- Preparing for other campaigns in the future (Amazon Kuiper? China?)

  - Participation & ideas very welcome!

- (thoughts on how to do radio campaigns beyond Onsala?)

IAU Symposium 385

- Astronomy and Satellite Constellations: Pathways Forward

- Hybrid meeting: online/in-person in La Palma

- Part of an ongoing series of conferences (SATCON1/2, D&QS1/2)

- 2-6 October, UTC+1 timezone

- (Presentation deadline has passed - ~80 talks, ~40 posters)

- (In-person attendance deadline has passed)

- Online attendance open until 17th September!

- See website for more info:
  https://research.iac.es/congreso/iaus385/

- Also sessions at the IAU General Assembly in Cape Town 2024

- AAS January 2024 meeting will also have a CPS session

IAUS385 SYMPOSIUM
IN PERSON AND ONLINE MEETING
2-6 October 2023
Santa Cruz de La Palma, Canary Islands, SPAIN
Astronomy & Satellite Constellations: Pathways Forward
https://research.iac.es/congreso/iaus385

SatHub wants YOU!

- Sky observers, data analysts, software developers, industry experts, students…

- As the satellite population changes, evolving impacts require observer-operator dialogs

- Information in SatHub will be public, open, and accessible to support real-time collaboration

- We aim to join innovation with existing solutions, prioritize ease of use, and enable coordination among multiple stakeholders

Apply for membership NOW at https://cps.iau.org/

Join the IAU CPS!

https://cps.iau.org/