BEESAT EOL campaigns

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Mission description and EoL strategy

- 1U Technology demonstration CubeSat's

- primary mission long complete

- No more funding for ongoing operations

- Operations taken over by Student group

- Sequential re-entries → Applying lessons learned from previous re-entries to subsequent re-entries

- EOL Campaign goals:

  - Maintain contact as long and low as possible

  - Gather data on S/C behaviour until the latest possible moment and lowest possible altitude

  - Evaluate EoL status of the S/C and possible degradation of performance

▲ BEESAT-4 FM

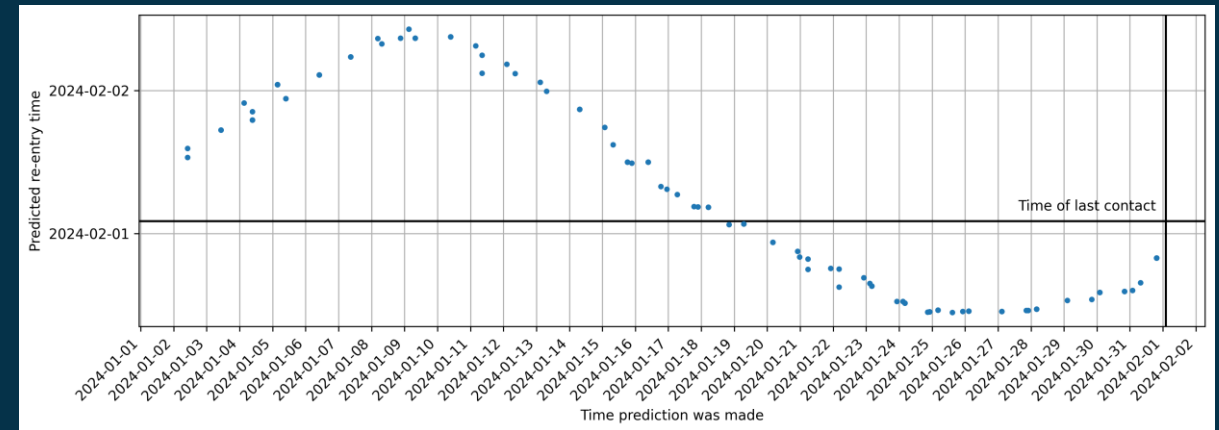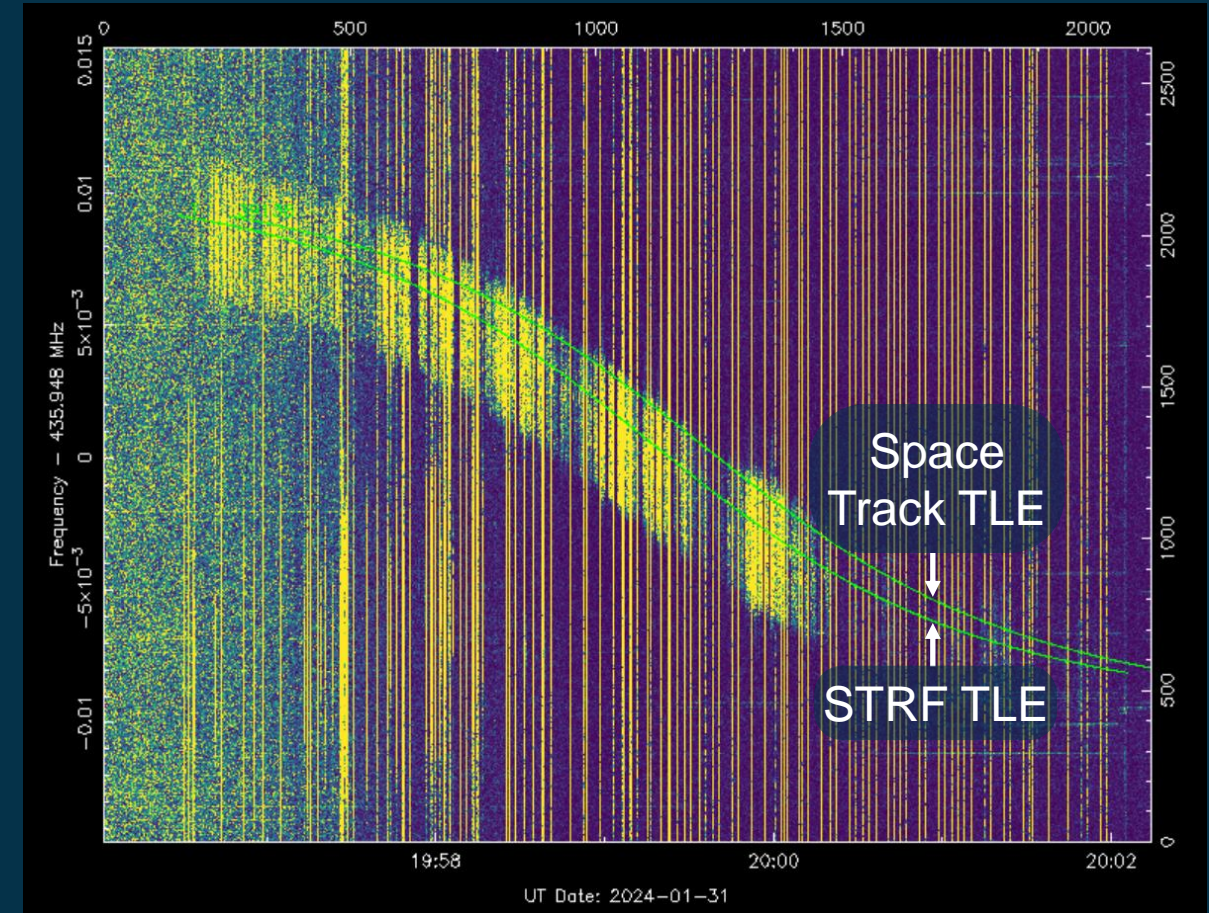| BEESAT-4 | BEESAT-3 | BEESAT-2 | BEESAT-9 |
| 2023-09 | 2023-12 | 2024-02 | 2024-06 |

Mission description and EoL strategy

- Continues prediction of all re-entries

- Conduct final experiments

- Reducing onboard telemetry backlog as re-entry approaches

▲BEESAT-2 re-entry predictions [1]

Mission description and EoL strategy

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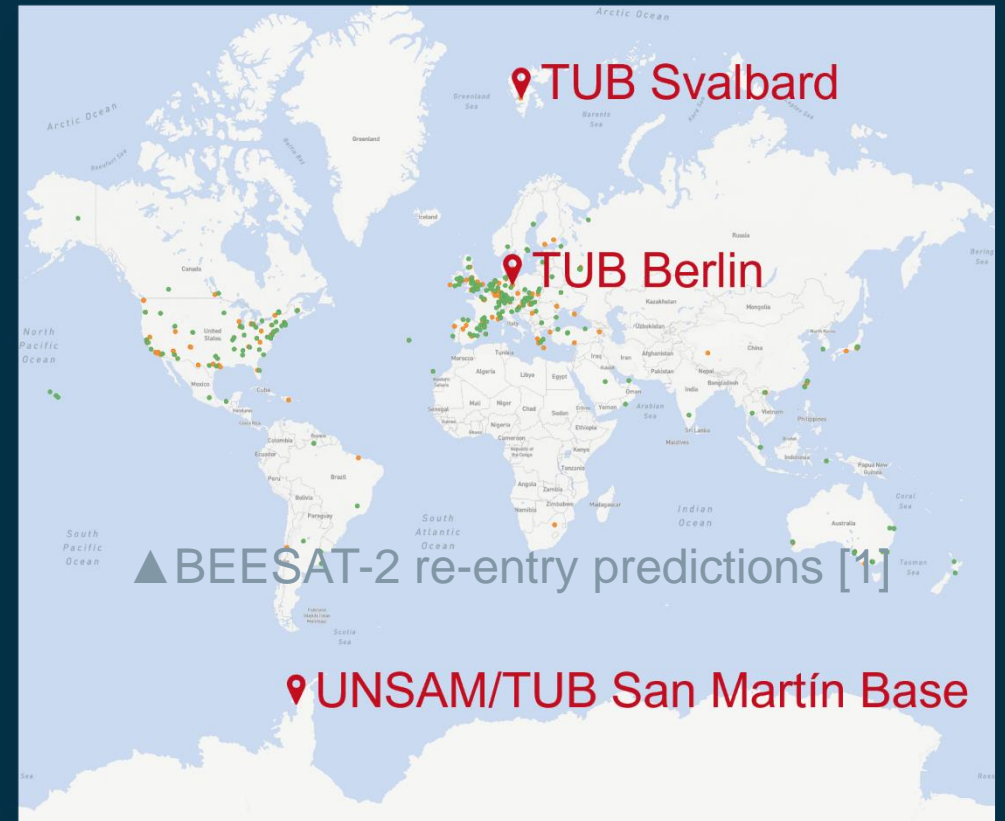- Monitor TLE accuracy through Radio frequency tracking

▲ rfplot: Overlaying official and generated TLEs [1]

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Mission description and EoL strategy

- Continues prediction of all re-entries
- Conduct final experiments
- Reducing onboard telemetry backlog as re-entry approaches
- Monitor TLE accuracy through Radio frequency tracking
- Utilizing SatNOGS and Involving HAM community
 - Transmitting Telemetry beacons over SatNOGS stations

SatNOGS NETWORK

TUB Svalbard

TUB Berlin

▲ BEESAT-2 re-entry predictions [1]

UNSAM/TUB San Martín Base

▲ SatNOGS & TUB ground stations

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# Mission description and EoL strategy

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- Conduct final experiments

- Reducing onboard telemetry backlog as re-entry approaches

- Monitor TLE accuracy through Radio frequency tracking

- Utilizing SatNOGS and Involving HAM community

  - Transmitting Telemetry beacons over SatNOGS stations

- Prepare S/C for EoL

  - Enter predefined EoL State

  - Close monitoring of all space and ground systems
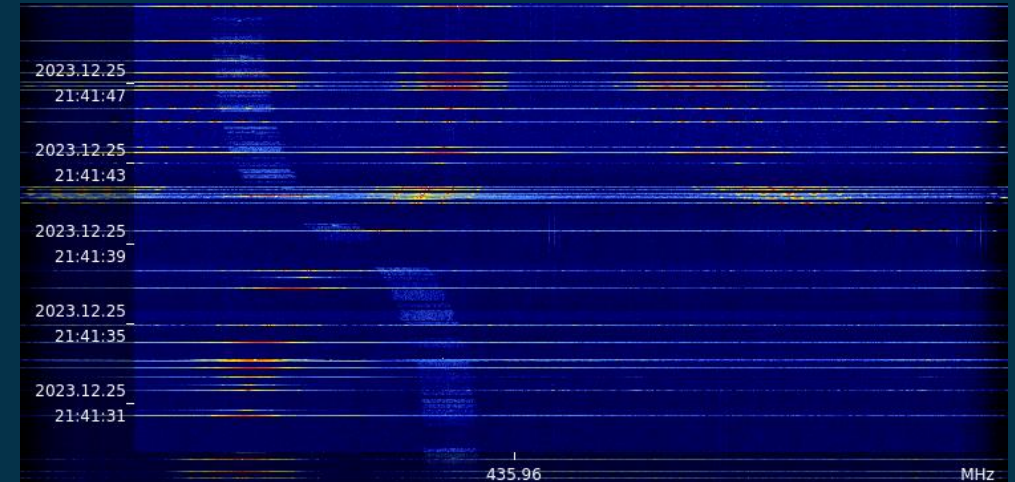
▲Live RF spectrum monitoring during final passes

# Mission description and EoL strategy

- Continues prediction of all re-entries
- Conduct final experiments
- Reducing onboard telemetry backlog as re-entry approaches
- Monitor TLE accuracy through Radio frequency tracking
- Utilizing SatNOGS and Involving HAM community
  - Transmitting Telemetry beacons over SatNOGS stations
- Prepare S/C for EoL
  - Enter predefined EoL State
  - Close monitoring of all space and ground systems
- Prepare a complete decision tree for the final passes
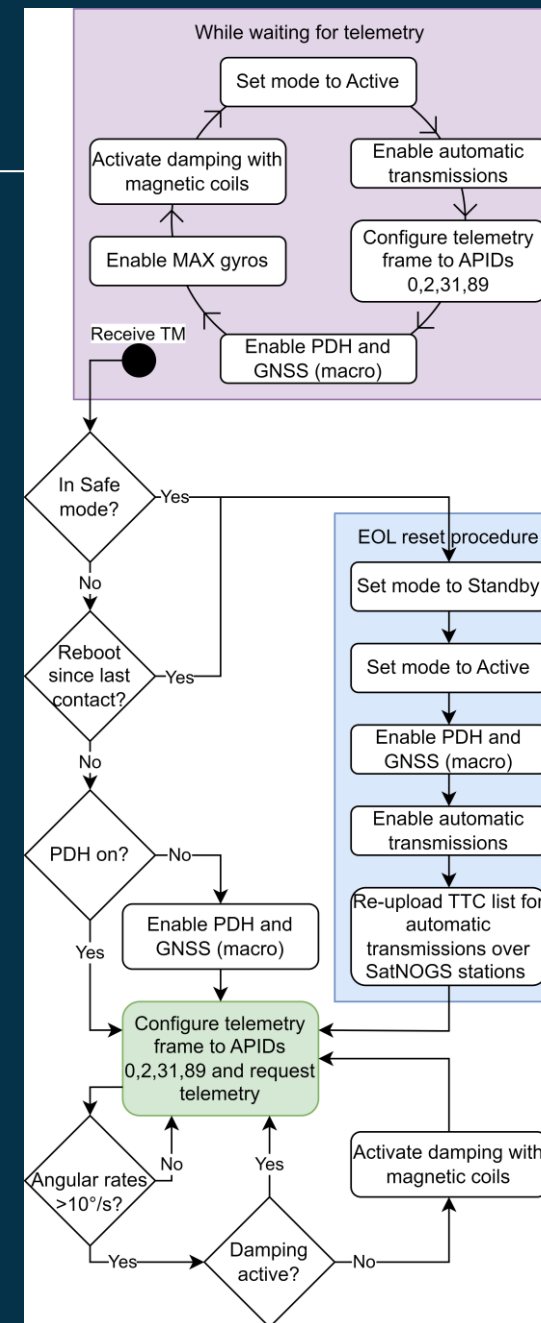
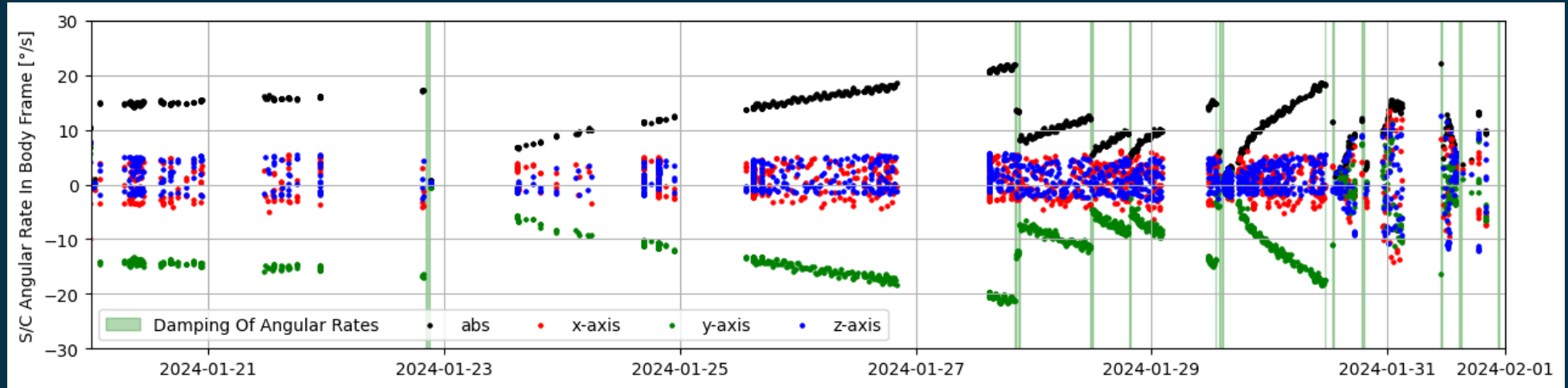◄ Procedure final passes [2]

Available Data
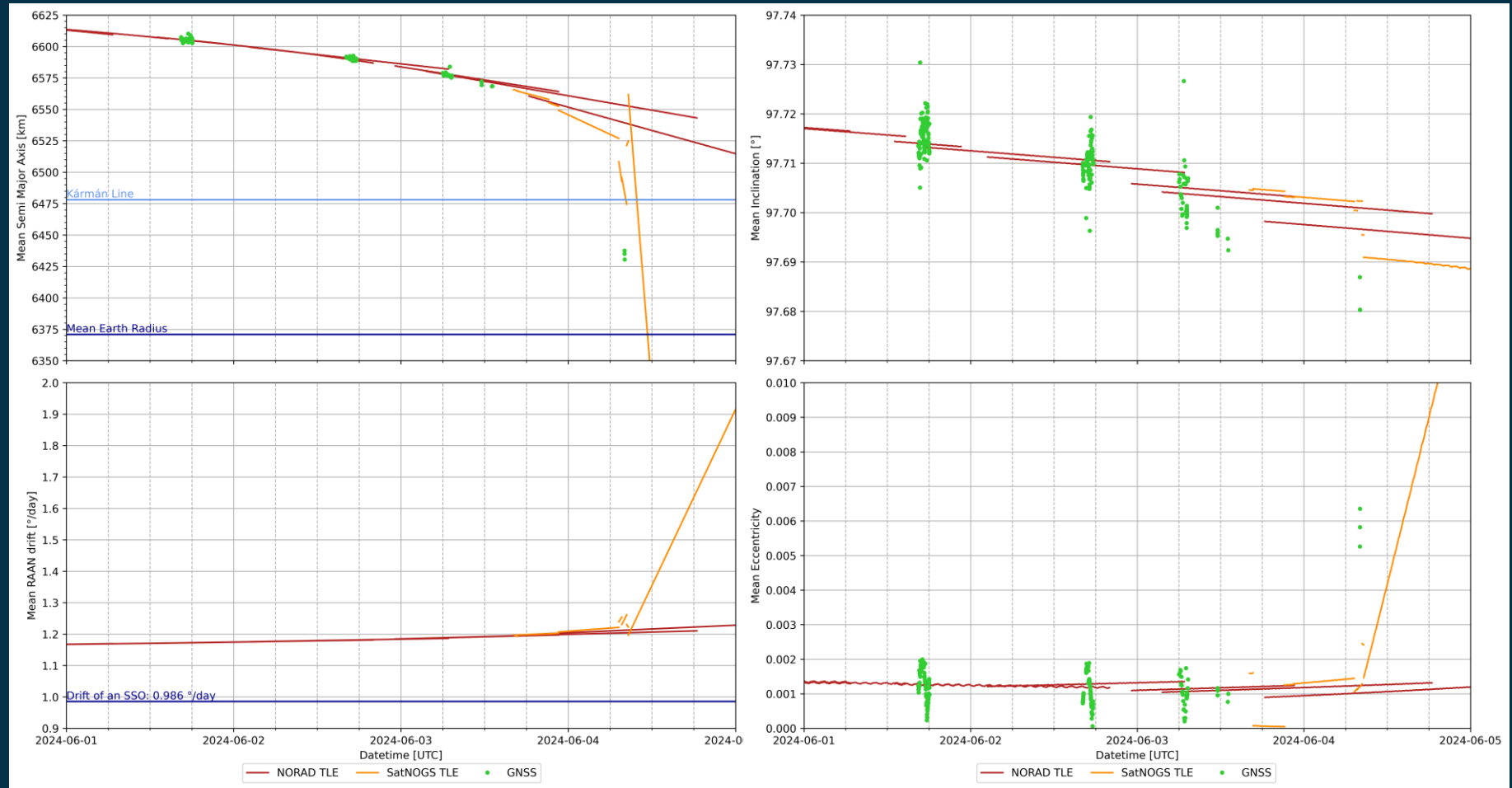
- GNSS Data (BEESAT-9)

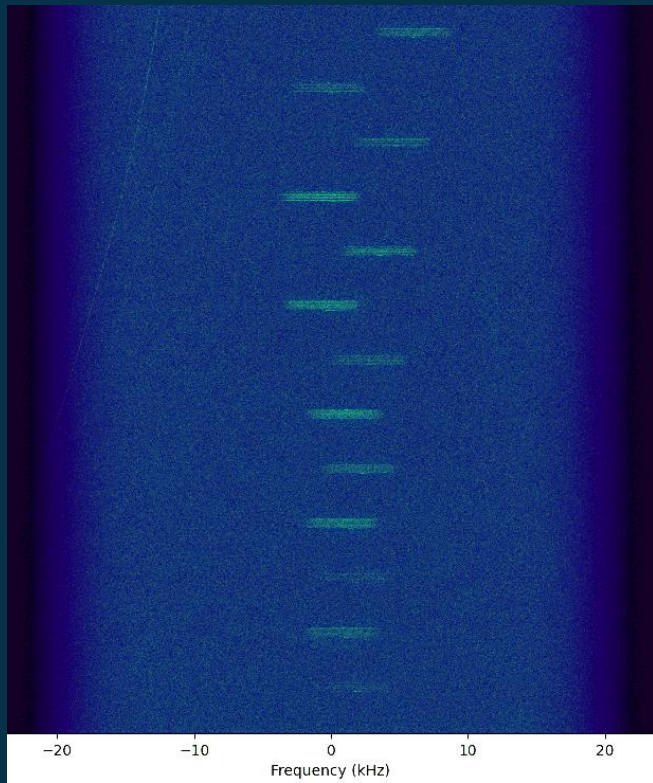▲ mean orbital elements BEESAT-9, TLE and GNSS [2]

Available Data

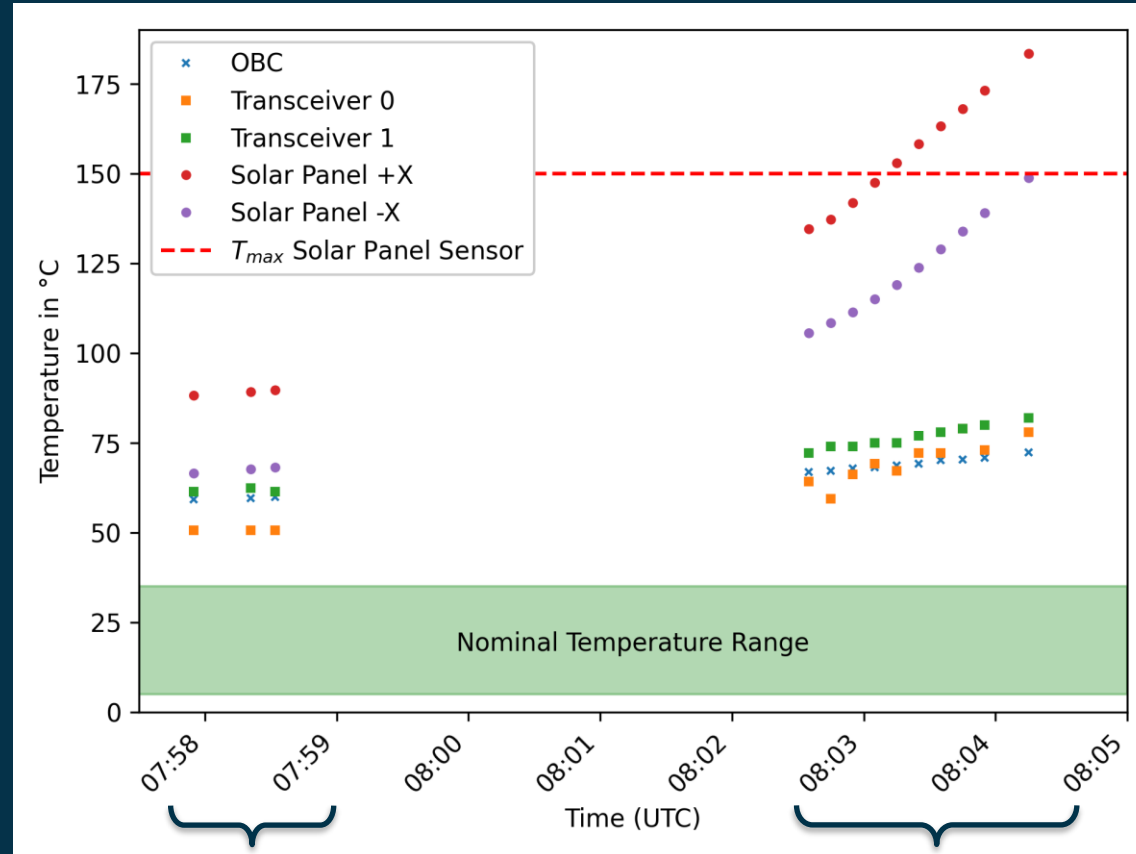- GNSS Data (BEESAT-9)

- AOCS Data (BEESAT-2,4 and 9)

▲ Angular rates BEESAT-2 [1]

Available Data

- GNSS Data (BEESAT-9)
- AOCS Data (BEESAT-2,4 and 9)
- Thermal Data (BESAT-2,4 and 9)

Temperatures of selected BEESAT-9 sensors
▼ shortly before re-entry [2]

▲ Final BEESAT-9 SatNOGS observation [2]

TUB Svalbard

SatNOGS Ireland

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Associated Publications and links

[1] Lessons Learned from Operating Three CubeSats until Their Consecutive Re-Entries, 4S Symposium 2024

[Available on ResearchGate](#)

[2] BEESAT-9 Re-Entry: Applying Lessons Learned from Operating Previous BEESAT Re-Entries, IAC 2024

[Available on ResearchGate](#)

Available Data

Last 6 months of telemetry from BEESAT-2,4 and 9 are available for download in .csv format on the TU-Berlin Website
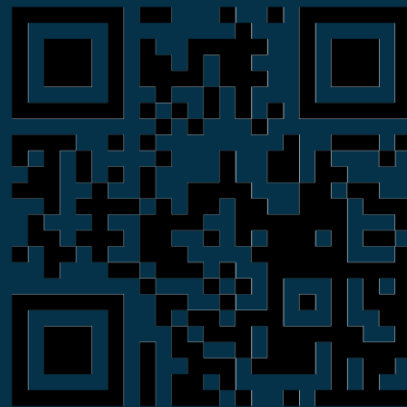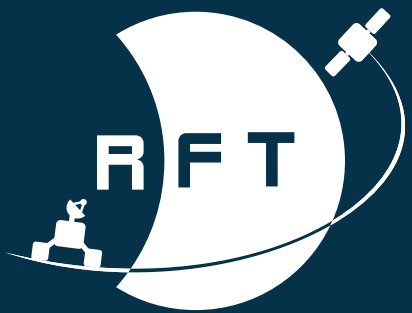
BEESAT-9

- Standard housekeeping data
- GNSS Data
- TM from Electrical and Thermal subsystems
- AOCS TM

BEESAT-4

- Standard housekeeping data
- TM from Electrical and Thermal subsystems
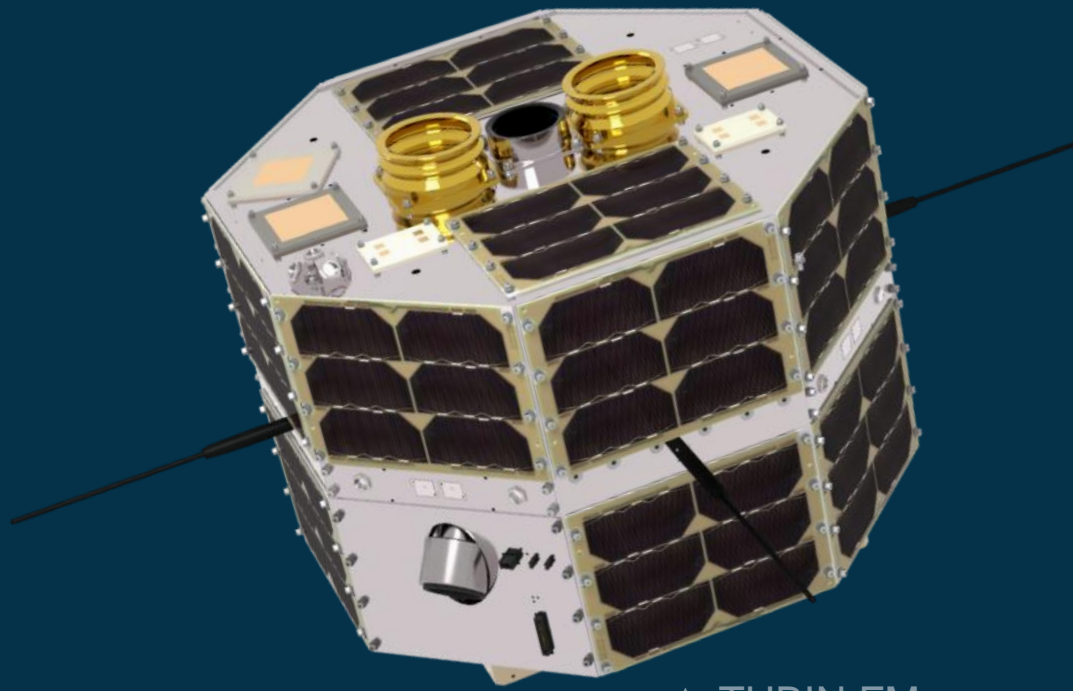- AOCS TM
- Extended AOCS TM

BEESAT-2

- Standard housekeeping data
- TM from Electrical subsystem
- TM from Thermal subsystem
- AOCS TM
- Extended AOCS TM

https://www.tu.berlin/en/raumfahrttechnik/teaching/student-initiatives/studops/experiments#c2358487

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Outlook TUBIN Re-Entery Q3 2025

- 22.5 kg earth observation spacecraft
- S and X – Band Downlink
- Continuous GNSS observations
- Drag reduction campaign

▲ TUBIN FM

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