Coordinated science observations with Solar Orbiter

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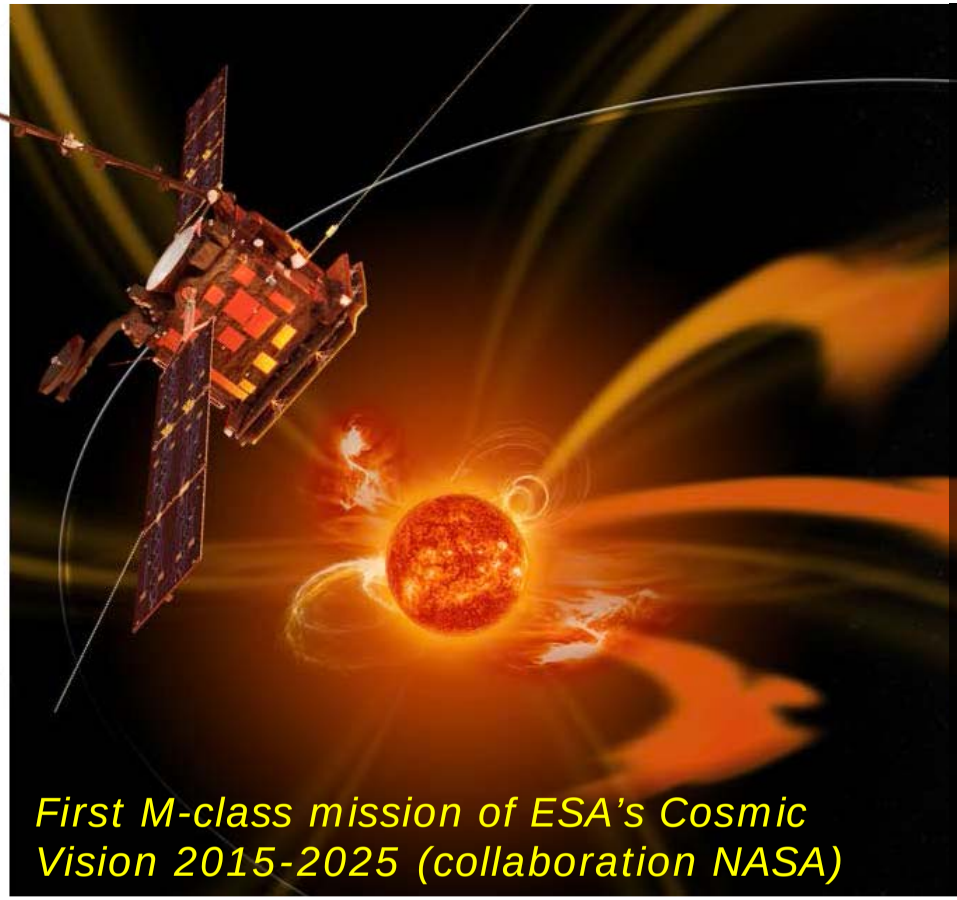
Solar Orbiter: Linking Sun & Heliosphere

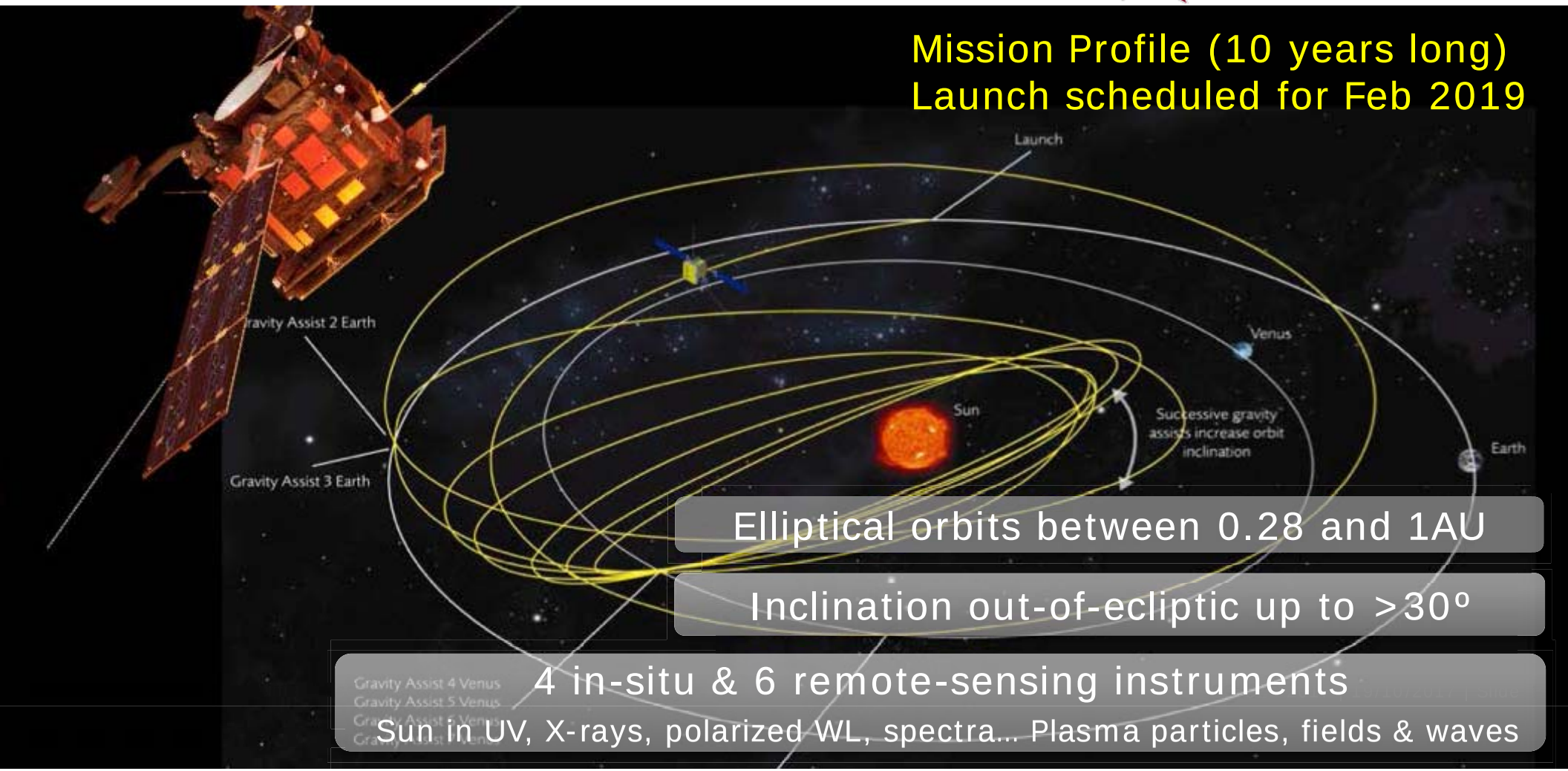


First M-class mission of ESA's Cosmic Vision 2015-2025 (collaboration NASA)

How does the Sun create and control the Heliosphere – and why does solar activity change with time ?

- What drives the solar wind and where does the coronal magnetic field originate?
- How do solar transients drive heliospheric variability?
- How do solar eruptions produce energetic particle radiation that fills the heliosphere?
- How does the solar dynamo work and drive connections between the Sun and the heliosphere?

Solar Orbiter: The mission



Solar Orbiter: A different solar mission

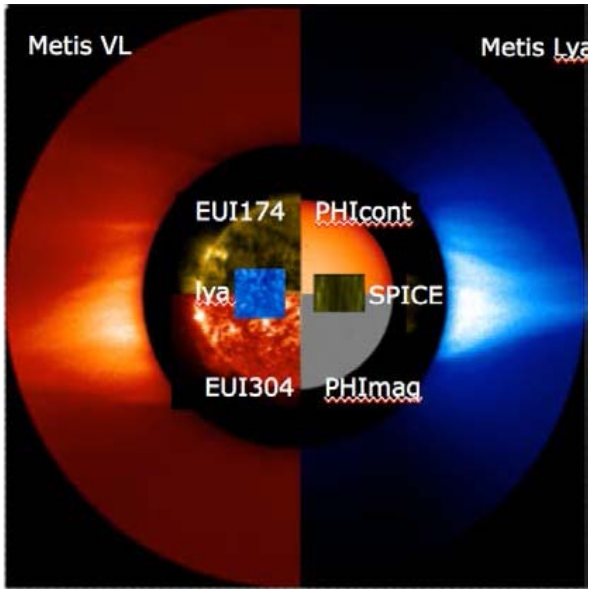
PREVIOUS MISSIONS

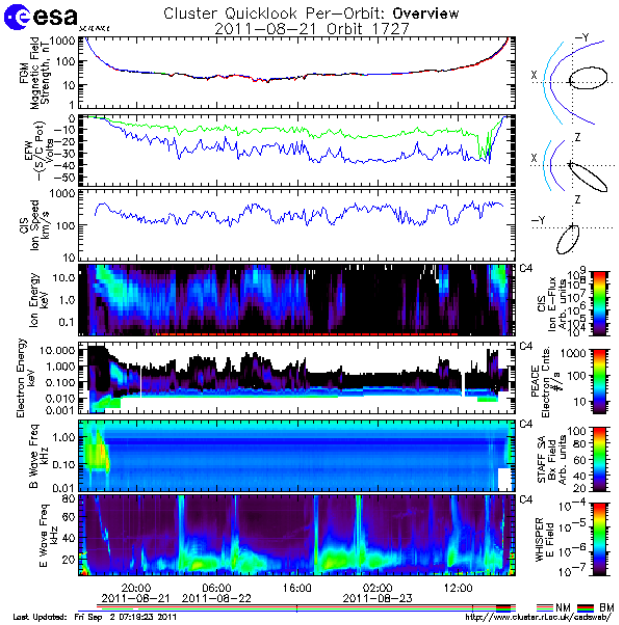
- Focus on in-situ **plasma** OR remote-sensing **solar** data
- **Stable** viewpoint or distance
- Quasi-**continuous** observations
- **Flexible** commanding
- **Quick data** availability to whole community

Solar Orbiter: A different solar mission

SOLAR ORBITER

- Combines 2 worlds: **in-situ** + **remote-sensing** observations





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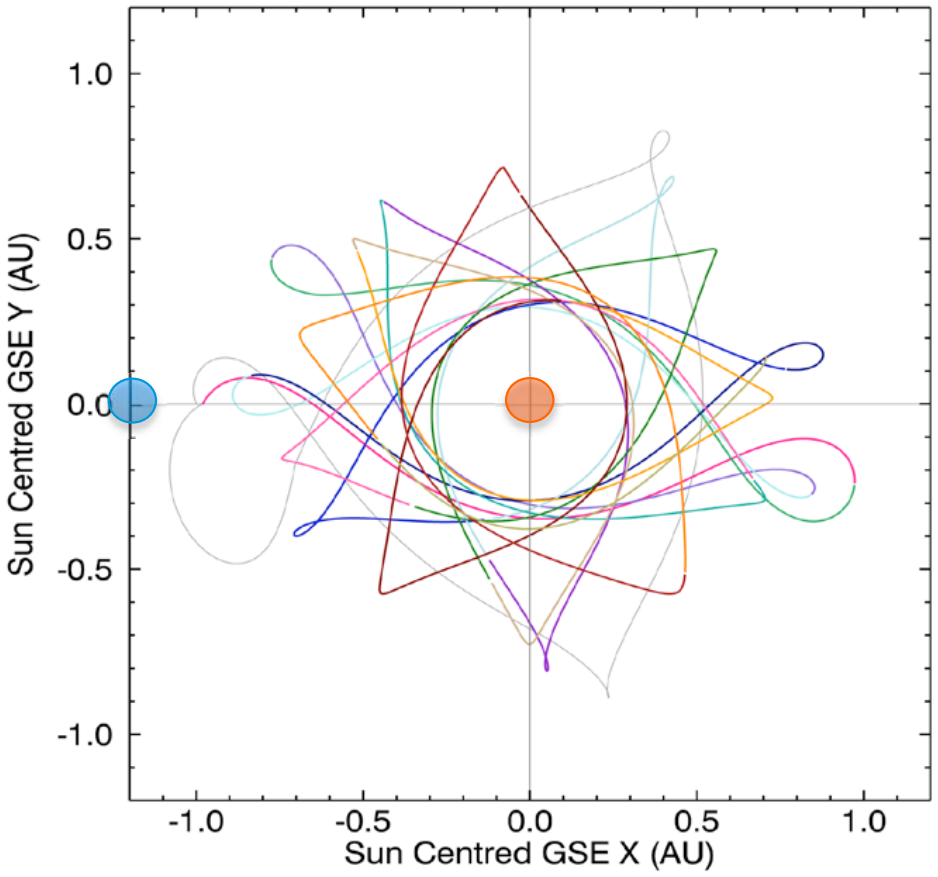

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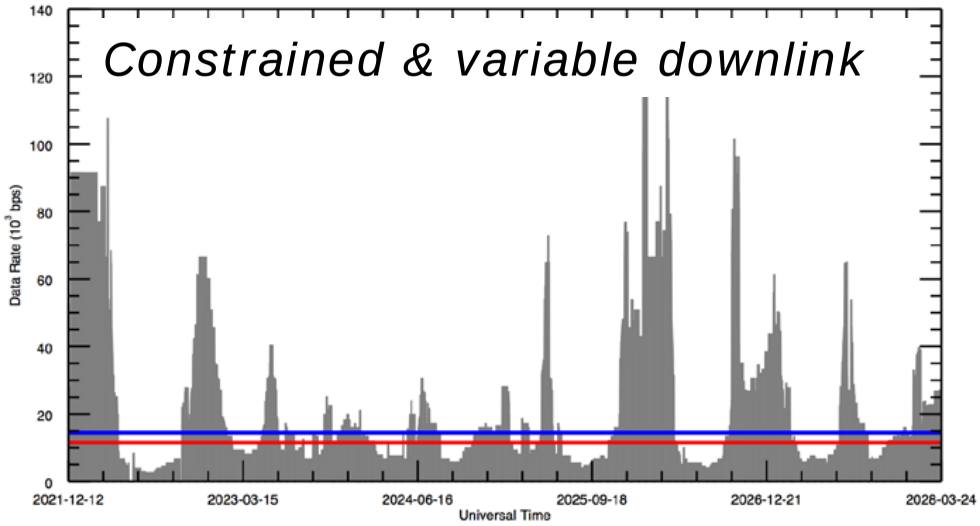
- **Variable** viewpoint, distance from Sun and from Earth: data **latency** up to 6m



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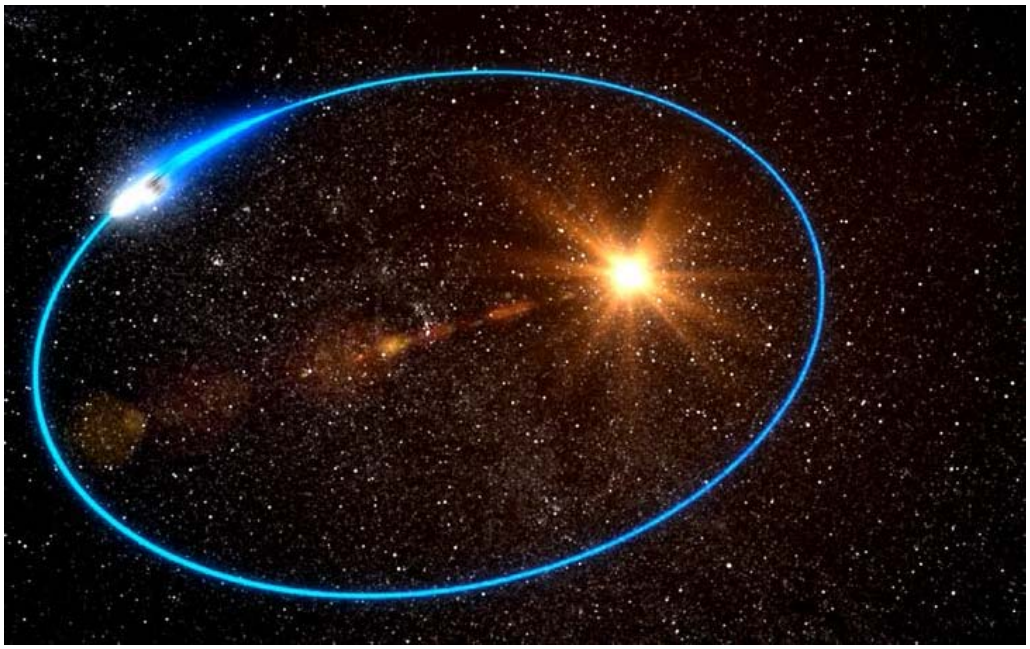

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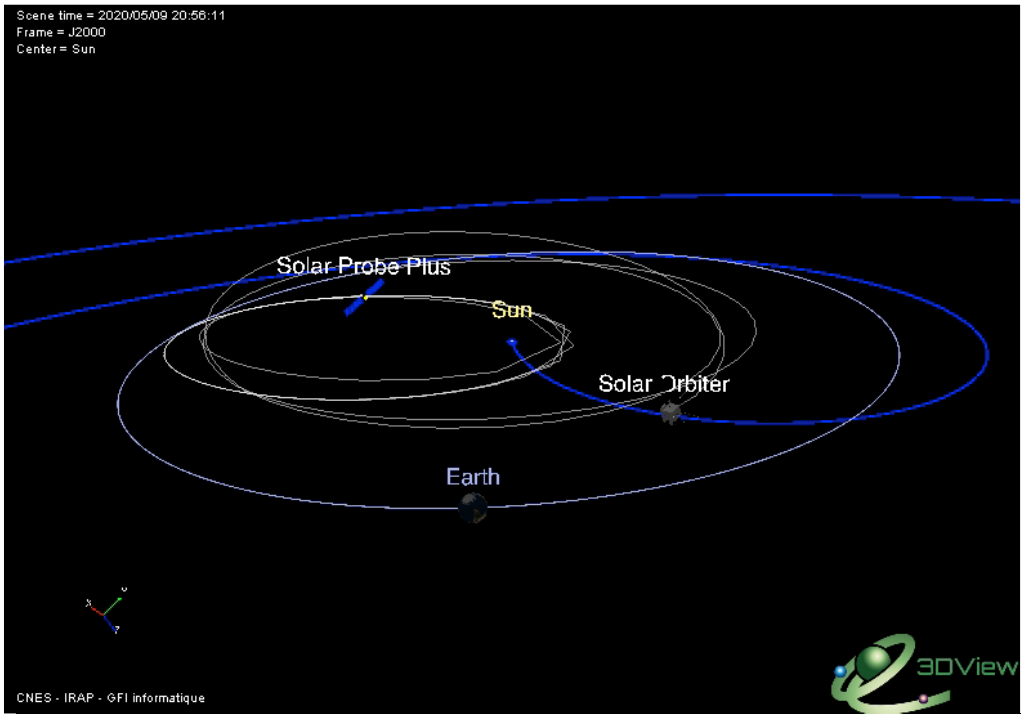
Solar Orbiter: A different solar mission



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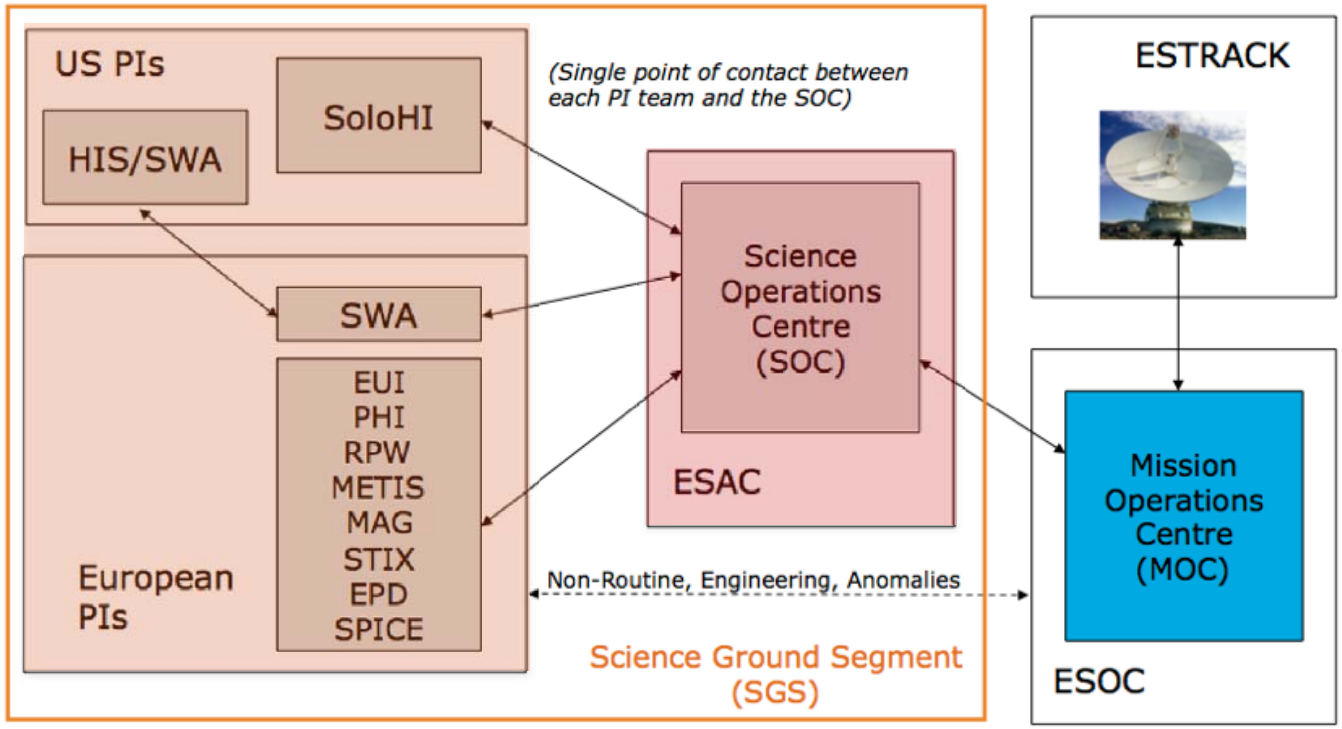
- Most scientific objectives need **coordinated observations** with **whole payload**, at speci
  + coordination wi round (DKIST, ...)

WE NEED A COORDINATED PLAN!

Science Ground Segment

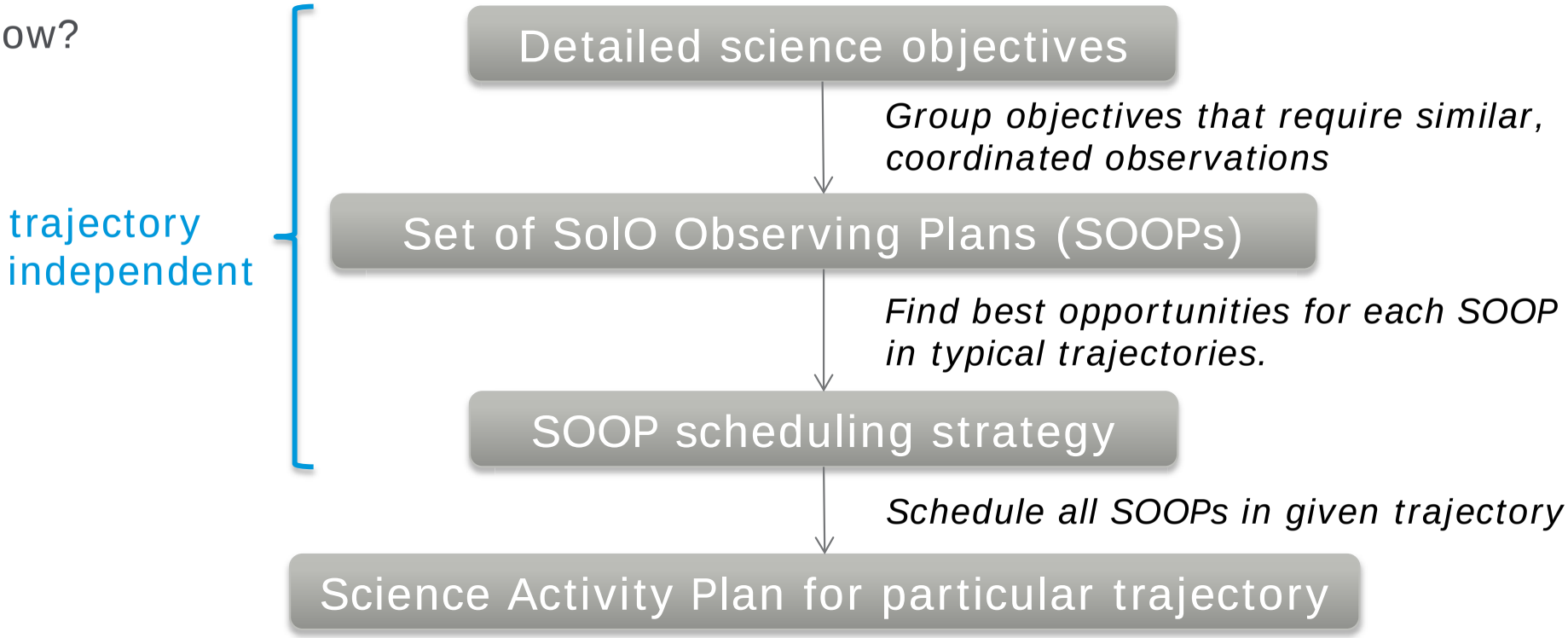


- Science Planning **Coordination**
- Pointing Requests
- Low-Latency science data visualisation
- Auxiliary data processing
- Data Archive

- Instrument Operations Requests
- Science data Processing

Solar Orbiter's Science Activity Plan

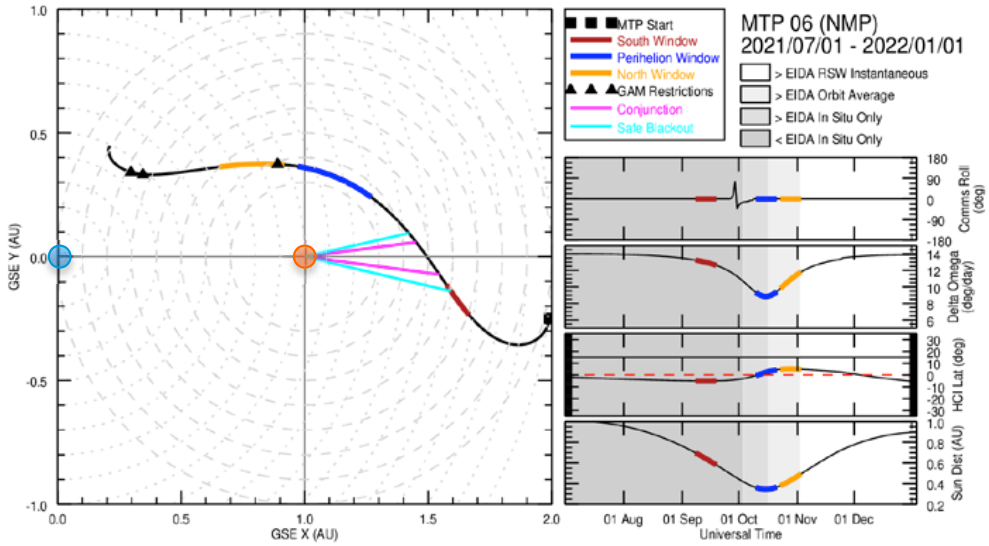
- Strategic plan covering the science we are going to do and when over the whole mission (Science Working Team + SOC).
- How?



Solar Orbiter's Science Activity Plan

- Solar Orbiter's SAP lives on the online Wiki pages, so that all involved scientists have visibility and can take part in mission planning process

- Orbit Plots
- Instruments: observables, modes and operational constraints
- SAP-related work
  - Solar Orbiter detailed science objectives
  - SOOP pages
  - General Planning strategy for first version SAP v0
  - Planning periods Option E (LTP/MTP)



Solar Orbiter's Planning Cycles

solar orbiter esa

- Mission-level Planning *(now)* -> **SAP**
- Long-Term Planning *(6-12m ahead)*

Planning coordination & high-level constraint checking

Science Operations Working Group schedules SOOPs in more detail. Covers 6 months.

- Medium-Term Planning *(1m ahead)*

Instrument commanding & detailed constraint checking

Detailed commanding per instrument over 6 months, validated against mission constraints.

- Short-Term Planning *(1-2w ahead)*

Covers 1 week, last call for changes in instrument modes

- Very-Short-Term Planning *(2-3 days)*

Adapting to the changing Sun

  - p-VSTP: adjust S/C pointing to solar activity
  - i-VSTP: limited instrument fine-tuning (resource-neutral)

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LTP: Coordinated SOOP scheduling

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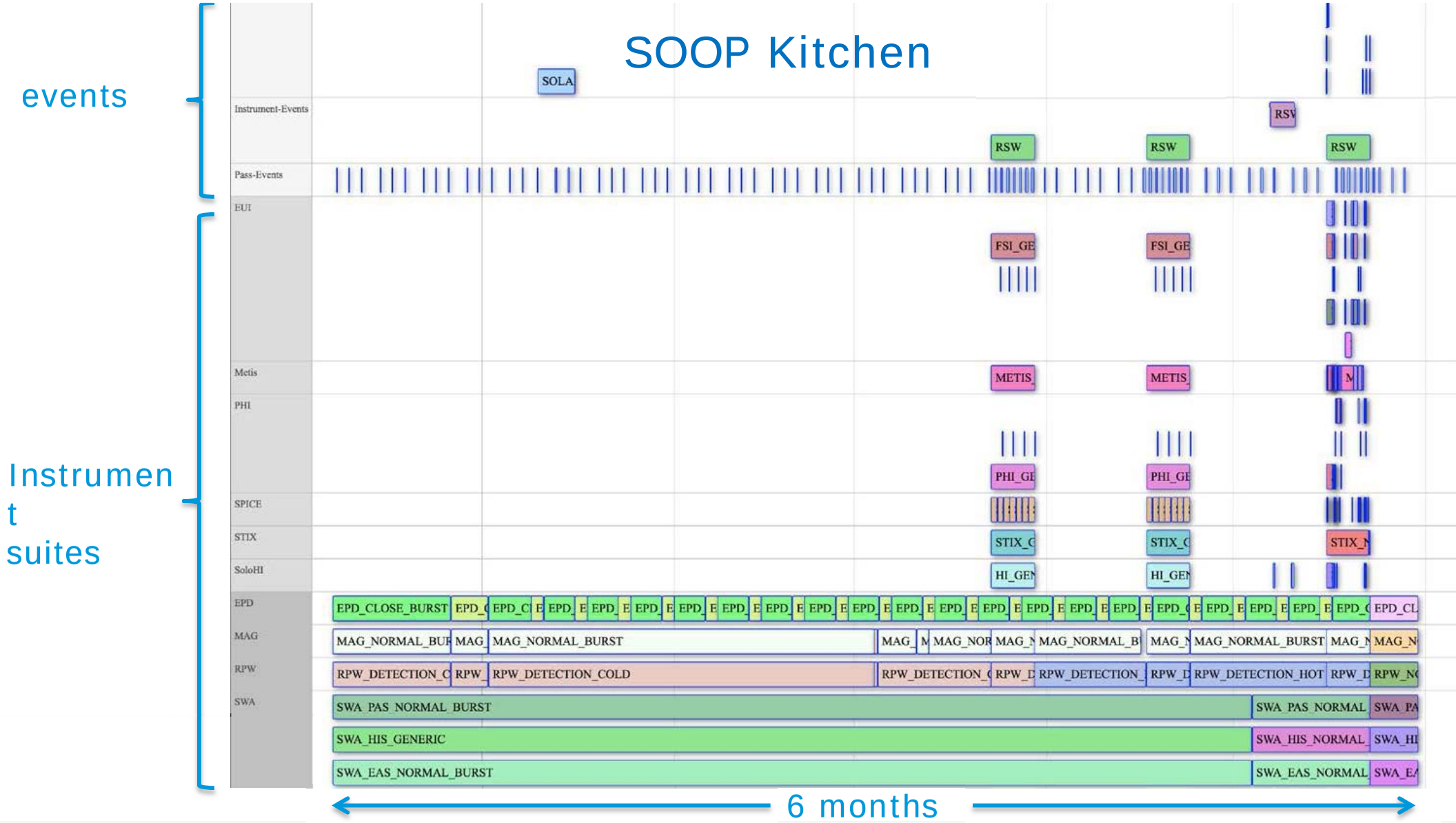
10 instrument suites with specific limitations
+ variable operations restrictions
+ changing orbits
+ mission goals need payload-wide datasets
= need for **coordinated planning** of **common Observing Campaigns** (SOOPs)

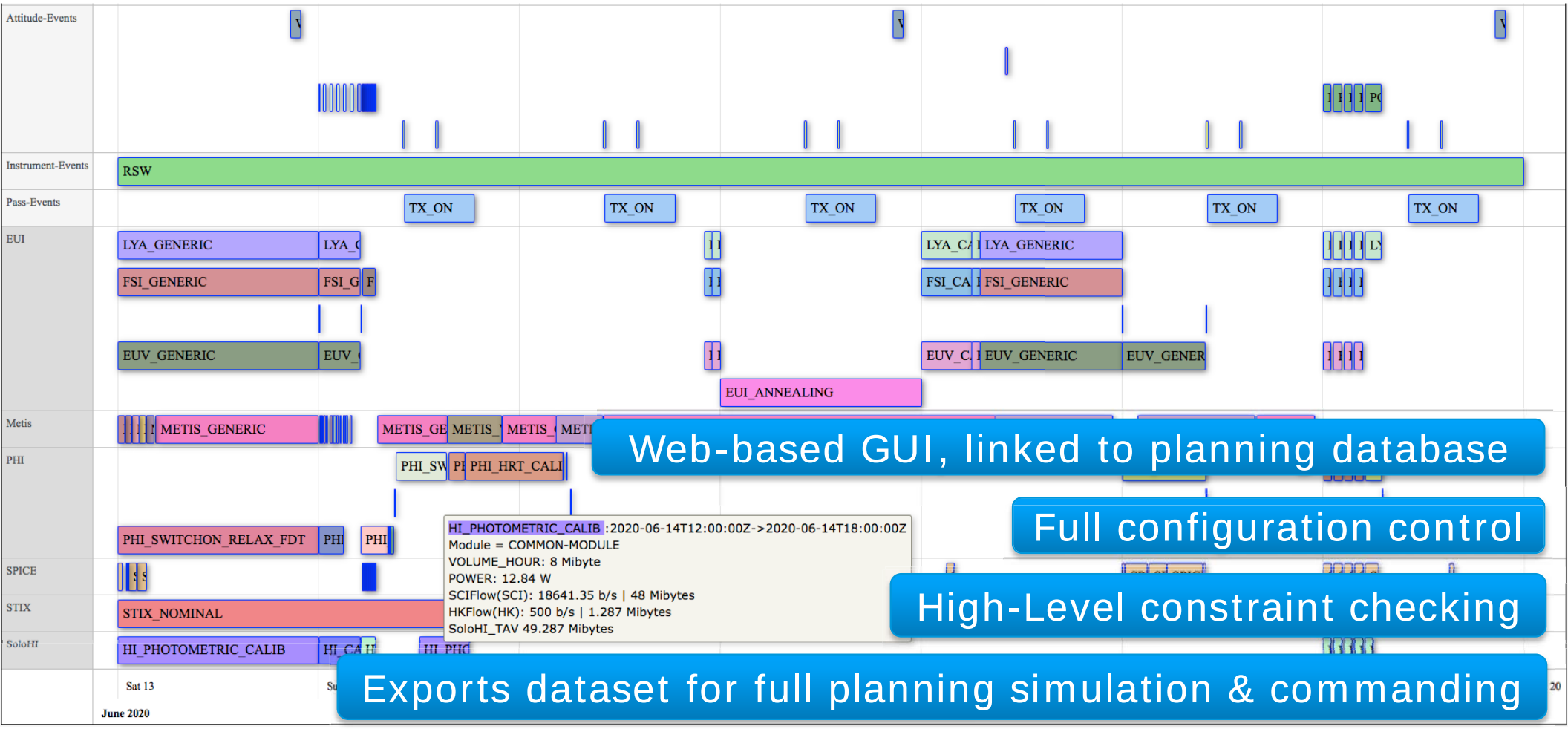
Solar Orbiter's Long Term Planning takes place during an SOWG meeting

We need a visual and interactive planning tool: **SOOP Kitchen**

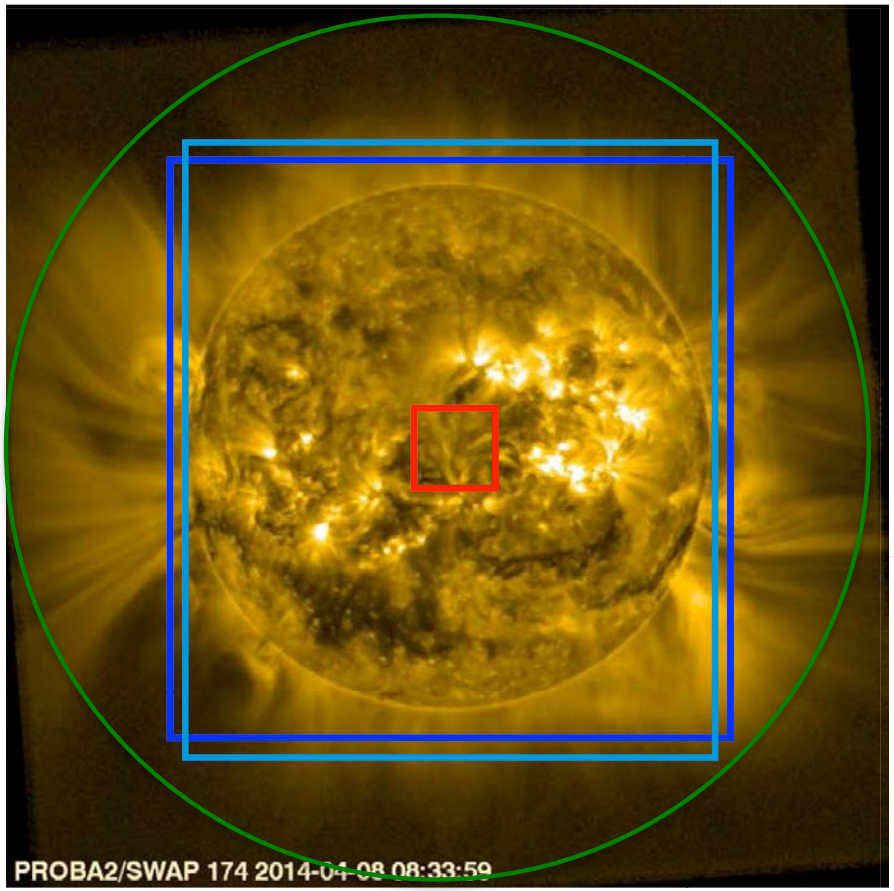
SOOP Kitchen

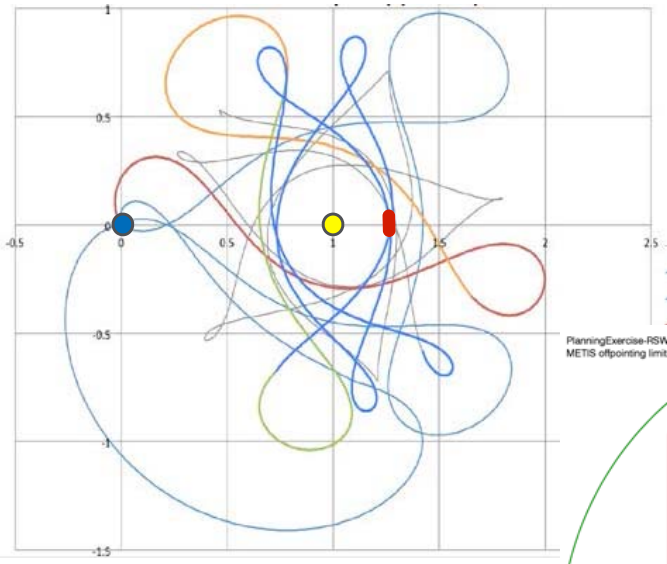


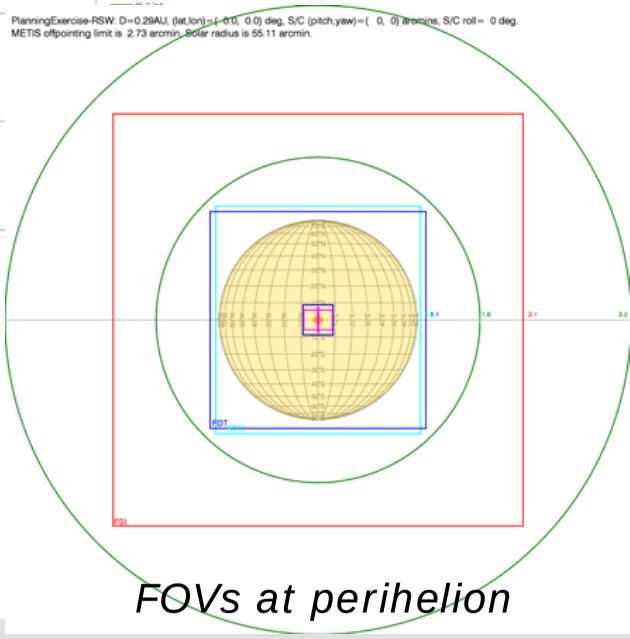
SOOP Kitchen: Multi-user planning tool



VSTP: How to react to changing Sun?





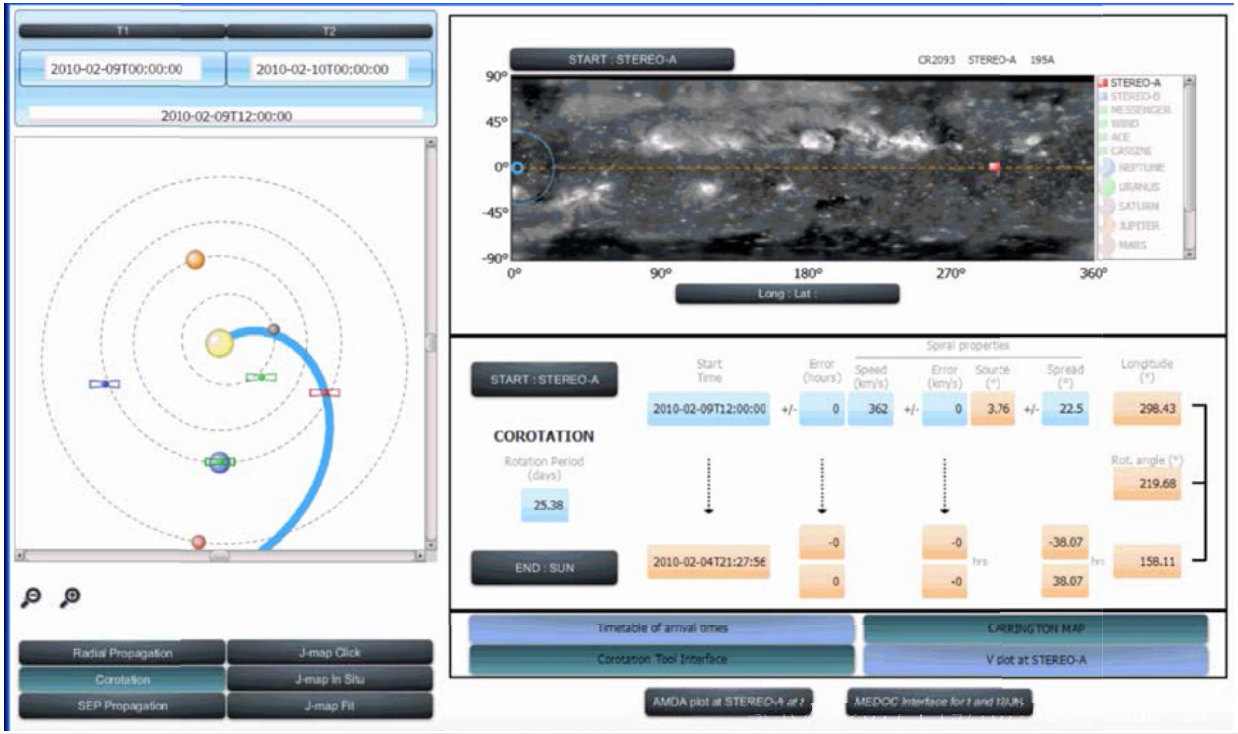


All instruments share the same pointing!

FOVs at perihelion

VSTP: How to react to changing Sun?

- Remote-sensing windows: update S/C fine-pointing to track features
  - Fine-pointing can be updated daily, but takes ~3 days to execute!
- Based upon
  - **Low-Latency data**: minimal set of science data, downlinked daily
  - **Modelling** Sun-S/C connection (magnetic field)



Conclusions

- Solar Orbiter is a heliophysics mission which is very different from previous ones.
- Mission science depends on datasets combining data from up to 10 instrument suites (both remote-sensing and in-situ).
- This need + changing opportunities + limited and variable resources ask for a high level of coordination in science planning and resource simulations.
- We prepare new planning tools and perform planning exercises with the instrument teams to get ready for this exciting mission.

www.cosmos.esa.int/web/solar-orbiter/home