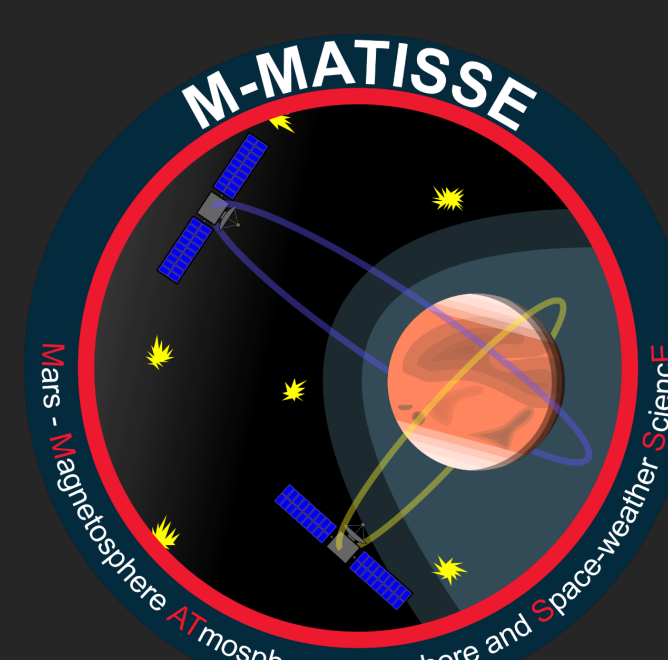


The Mars Aurora and dust Camera (M-AC) onboard M-MATISSE mission

***Yuki Nakamura (UTokyo)**, Hiromu Nakagawa, Yuki Harada, Lauriane Soret, Yoichi Yatsu, Norihide Takeyama, Jean-Claude Gérard, Robert J. Lillis, Nicholas Schneider, Sonal Jain, Justin Deighan, Jean-Yves Chaufray, Takeshi Sakanoi, Atsushi Yamazaki, Keigo Enya, Ko Ishibashi, Peng Hong, Takeshi Takashima, Shohei Aoki, Shotaro Sakai, Kei Masunaga, Akinori Saito, Yuta Hozumi, Mizuki Fukizawa, Takuya Hara, Kanako Seki, François Leblanc, and Beatriz Sánchez-Cano



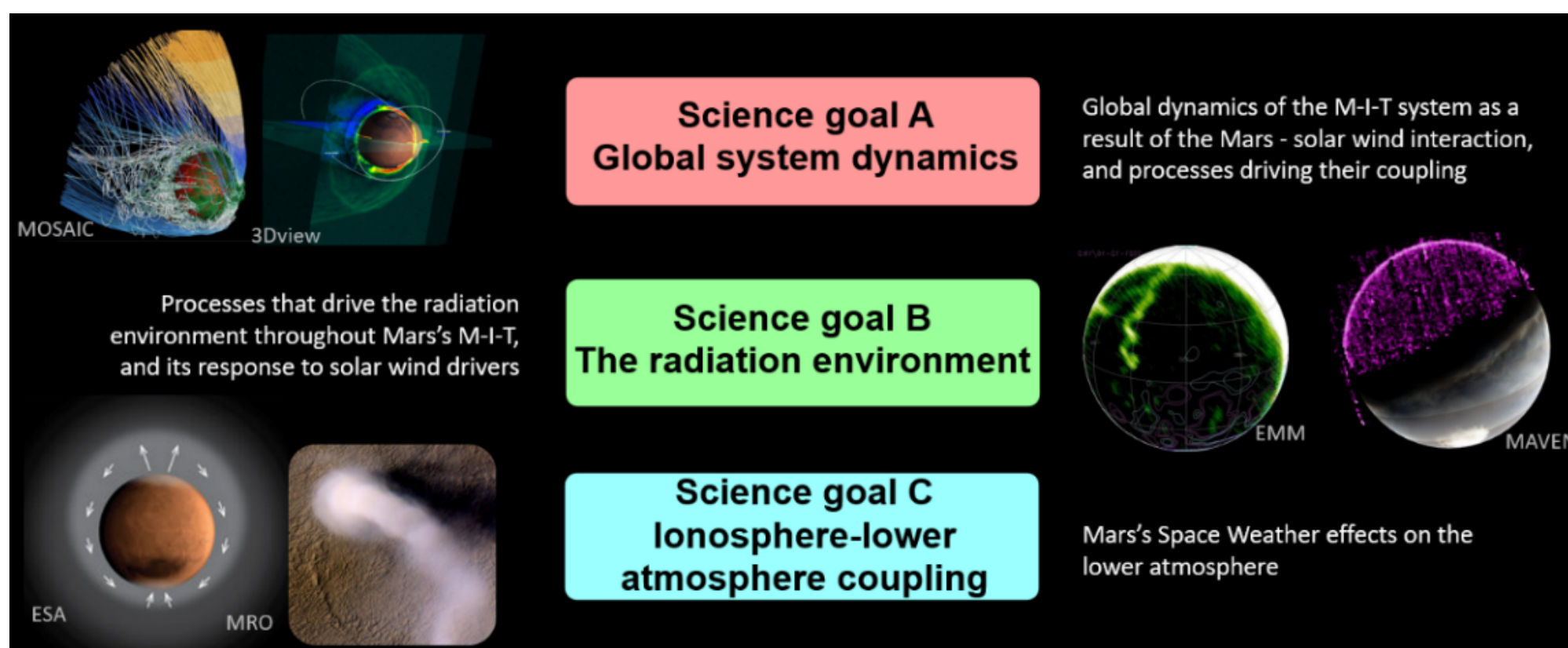
M-MATISSE Mission

Mars-Magnetosphere-ATmosphere-Ionosphere and Space-weather ScienceE

- ESA M-class (M7) mission candidate, final down-selection in June.
- The first global, multipoint view of how Martian space weather shapes the planet's atmosphere
- Planned launch year: 2037 / Nominal Mission Period: 2 yr (+2 yr ext.)

Science Goals

- Quantifying the energy flow through the system from space to the surface



Twin Satellite Strategy

Fathership (HENRI)

- Altitude: 250 – 3,000 km

Daughtership (MARGUERITE)

- Altitude: 250 – 10,000 km

Coordinated Orbits

- Simultaneous measurements of upstream solar wind and response of the system
- Resolving temporal and spatial variability of the system
- Mutual radio occultation between the two S/C to obtain global picture of the ionosphere

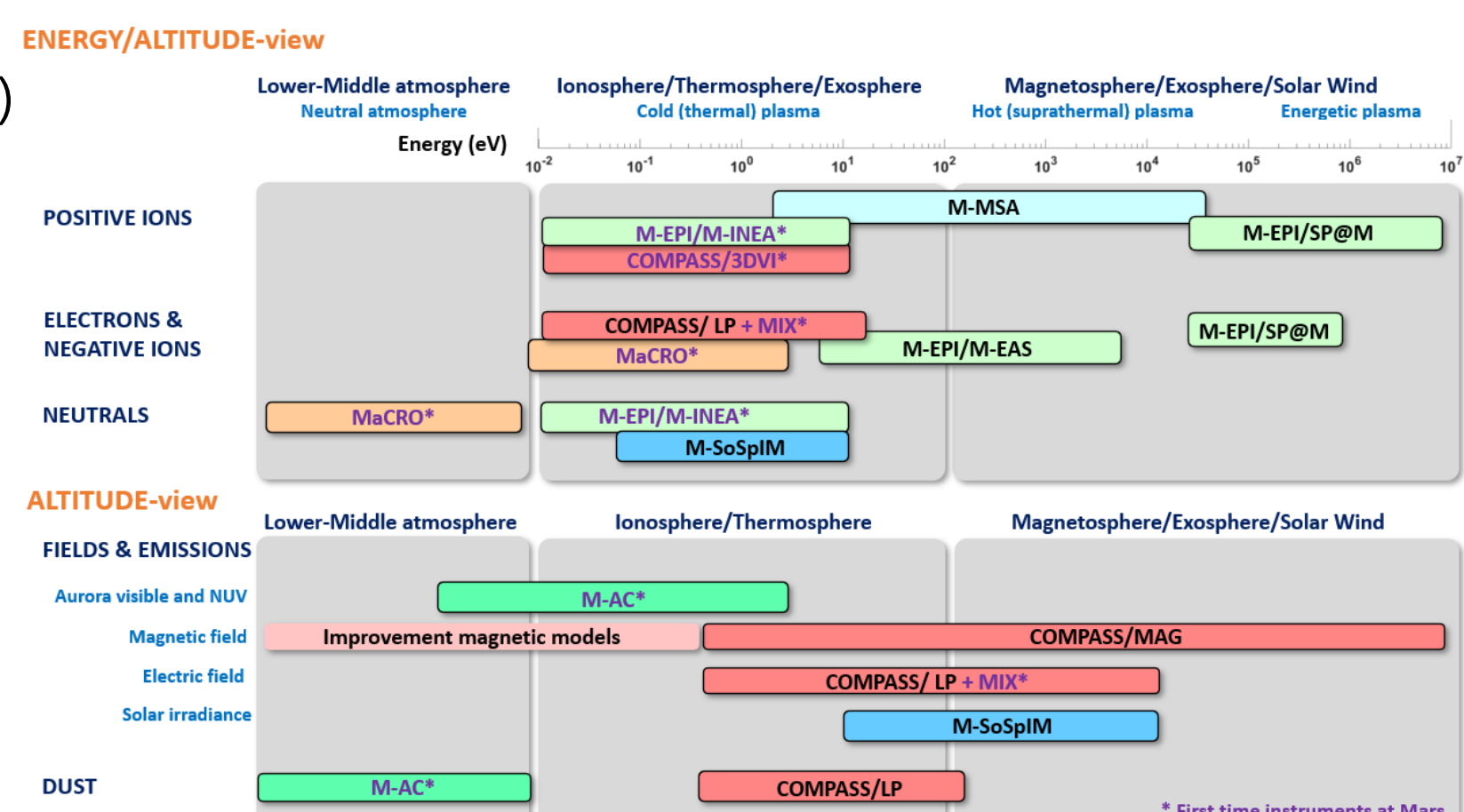
Science Payloads (3 In-situ + 3 Remote)

In-situ Measurements

- Magnetic & Plasma Sensor (COMPASS)
- Particle Detector (M-EPI)
- Ion Mass Spectrometer (M-MSA)

Remote Sensing

- Solar EUV Monitor (M-SoSpIM)
- Mutual Radio Occultation (MaCro)
- Aurora & Dust Camera (M-AC)



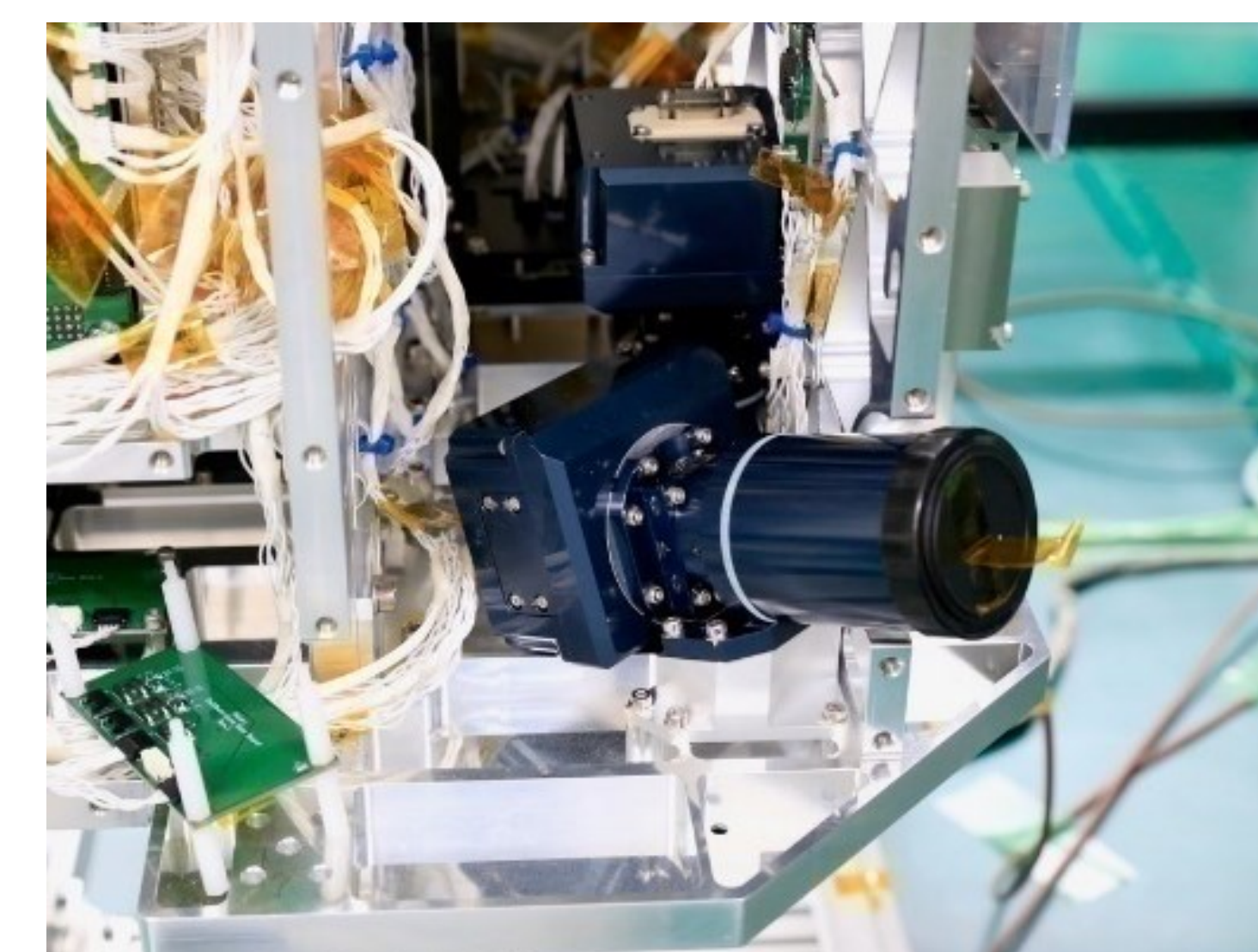
Mars Aurora and dust Camera (M-AC)

Remote-sensing instrument capable of operating on both the day and nightsides of Mars.

M-AC Design

Compact Design

- OBOX 160x110x100 mm³ / 0.8 kg
- EBOX 200x200x80 mm³ / 1.1 kg
- Power: 7-9 W



Wide Field of View (FoV)

- FoV: 100 deg

High Sensitivity

- SNR 1 at 10 R

Two Filters in Visible & NUV

Green Bandpass Filter

- 557.7 nm ± 2.5 nm
- OI Aurora + Dust Reflectance

NUV Bandpass Filter

- 367-393 nm
- CO₂⁺ FDB* Aurora + Icy Cloud
- ✓ Capable of observing SEP aurora at low altitudes

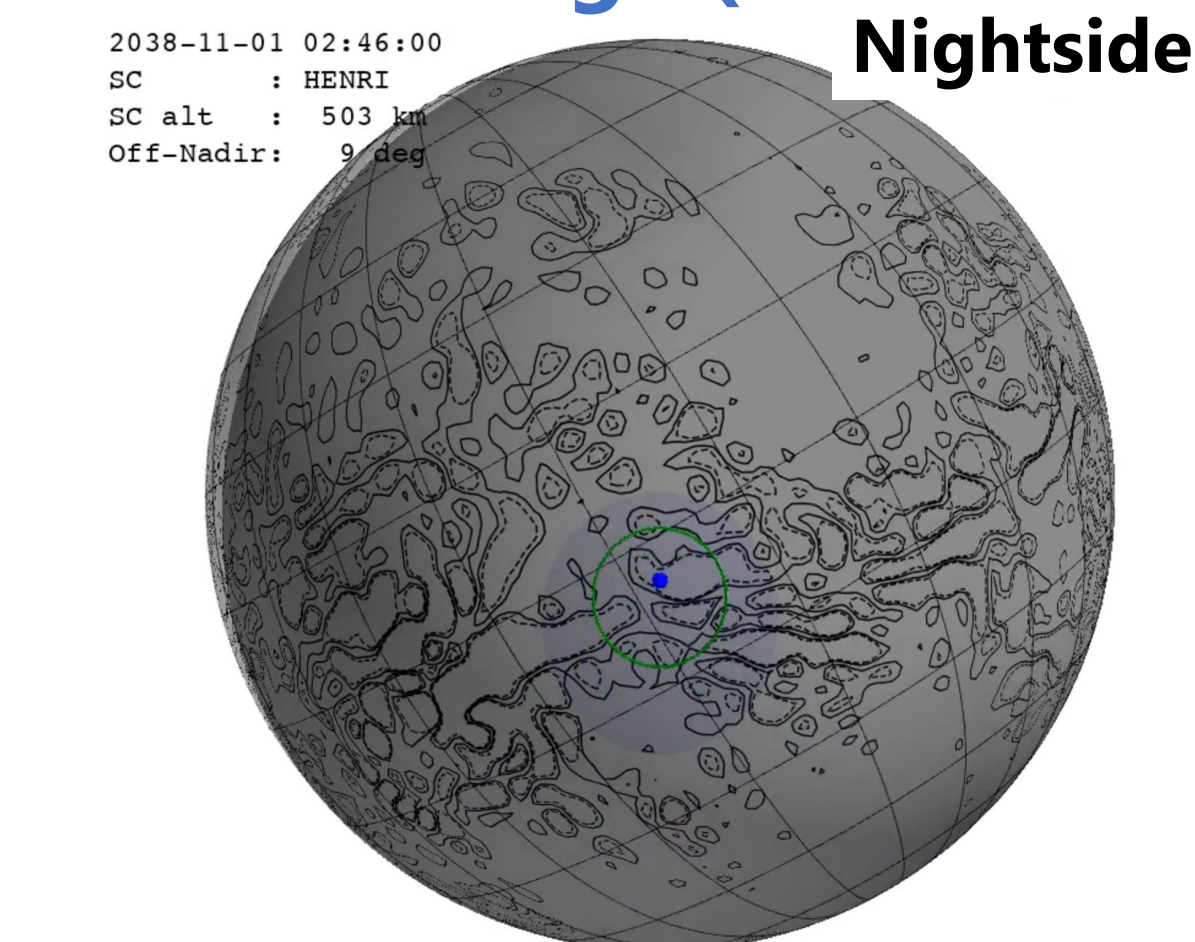
*FDB : FoxDuffendack-Barker bands

M-AC Heritage

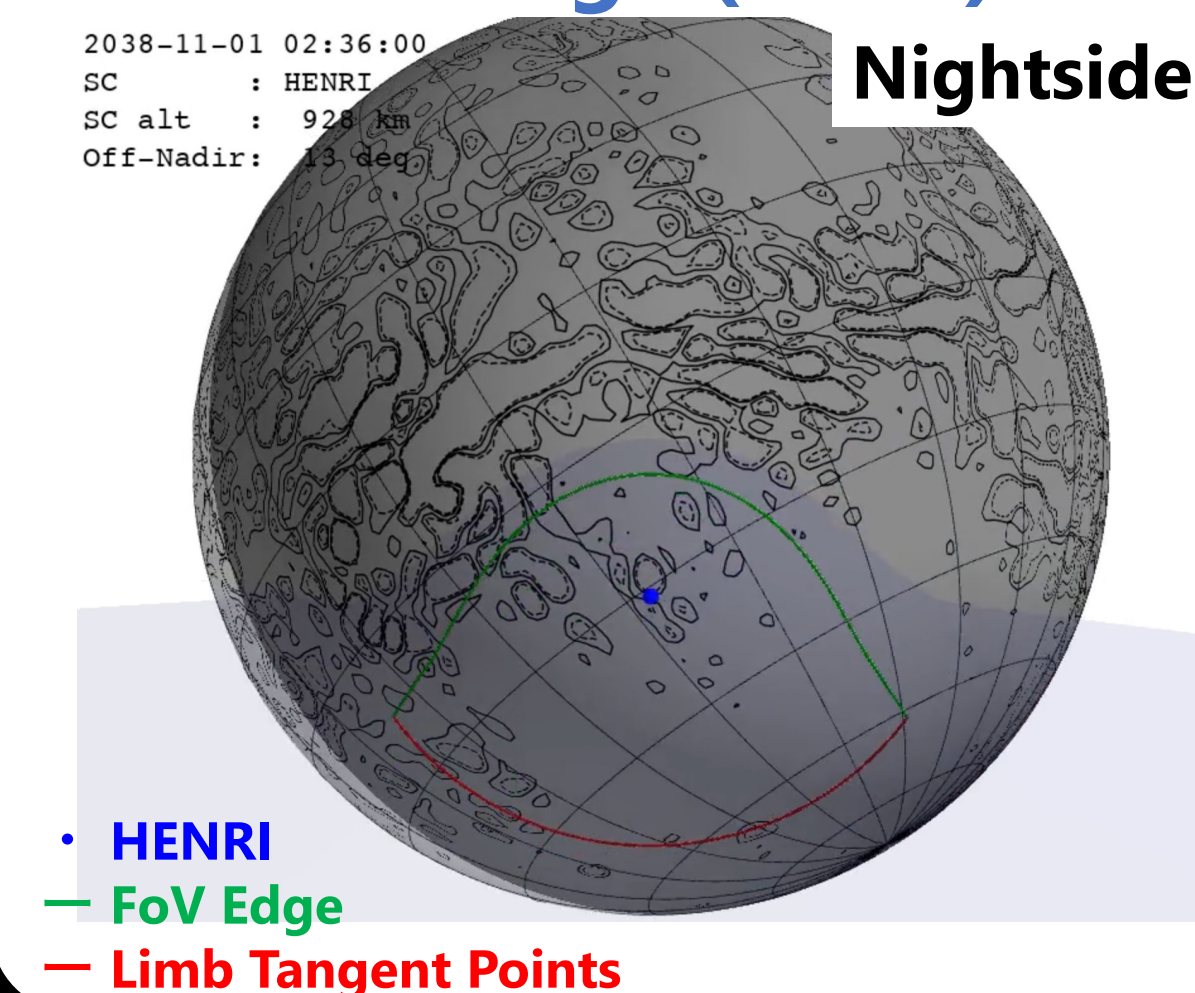
- ✓ The compact design of the imaging system of M-AC is based on the current heritages of micro-satellite missions (HIBARI's Star Tracker) and well validated in space-born at Low Earth Orbit (LEO).

M-AC Coverage (FoV / Timeline / SZA&LAT)

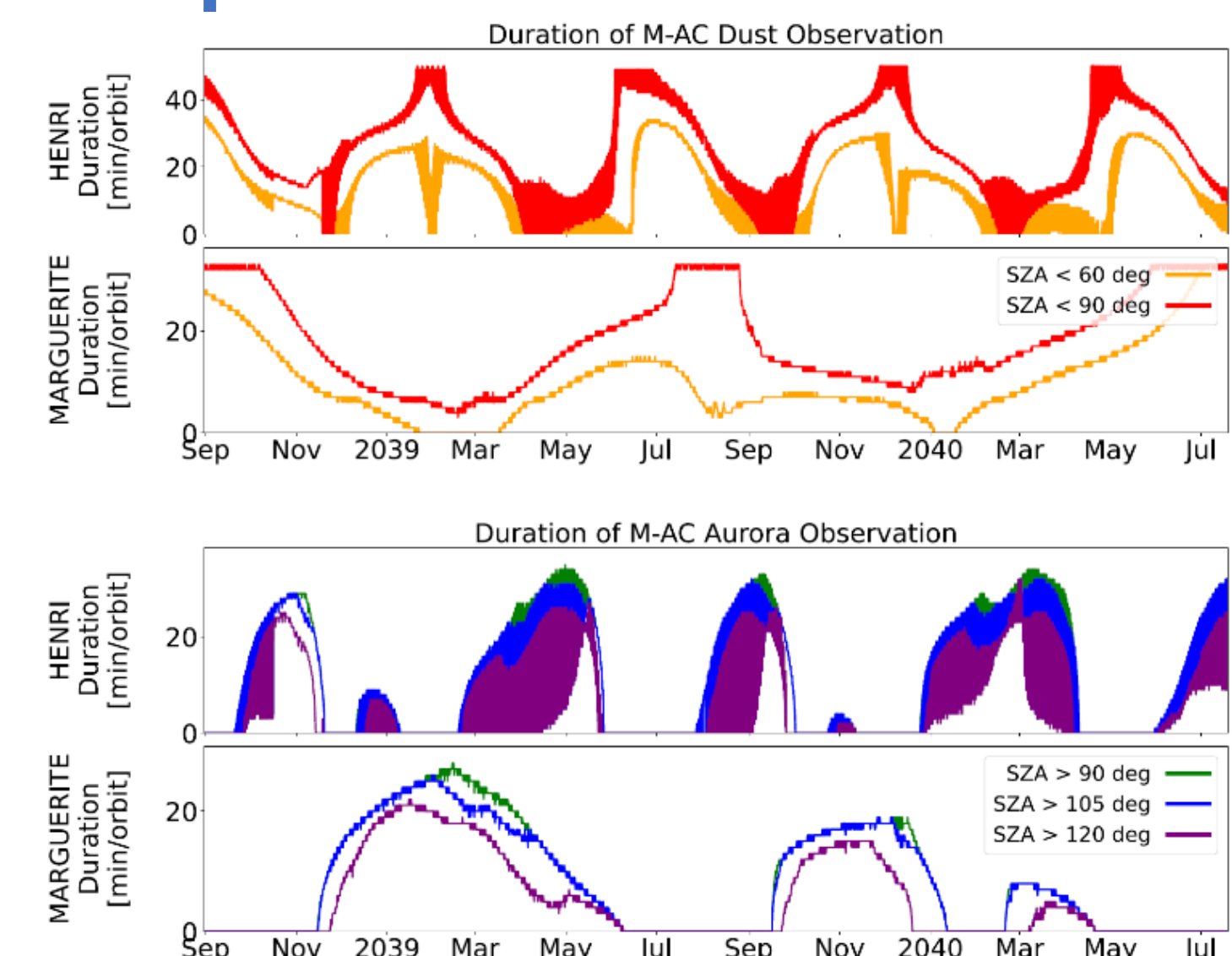
FoV Coverage (Nadir)



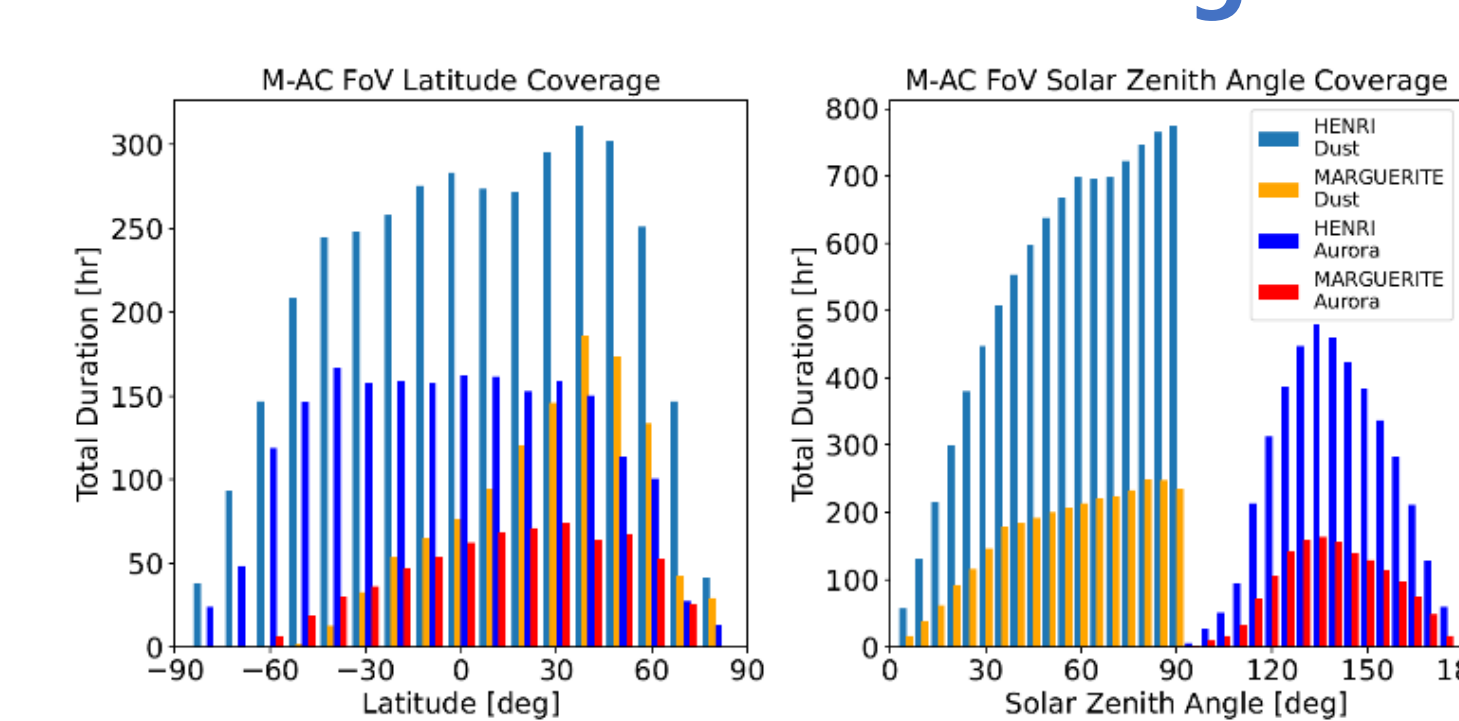
FoV Coverage (Limb)



Operation Duration Timeline

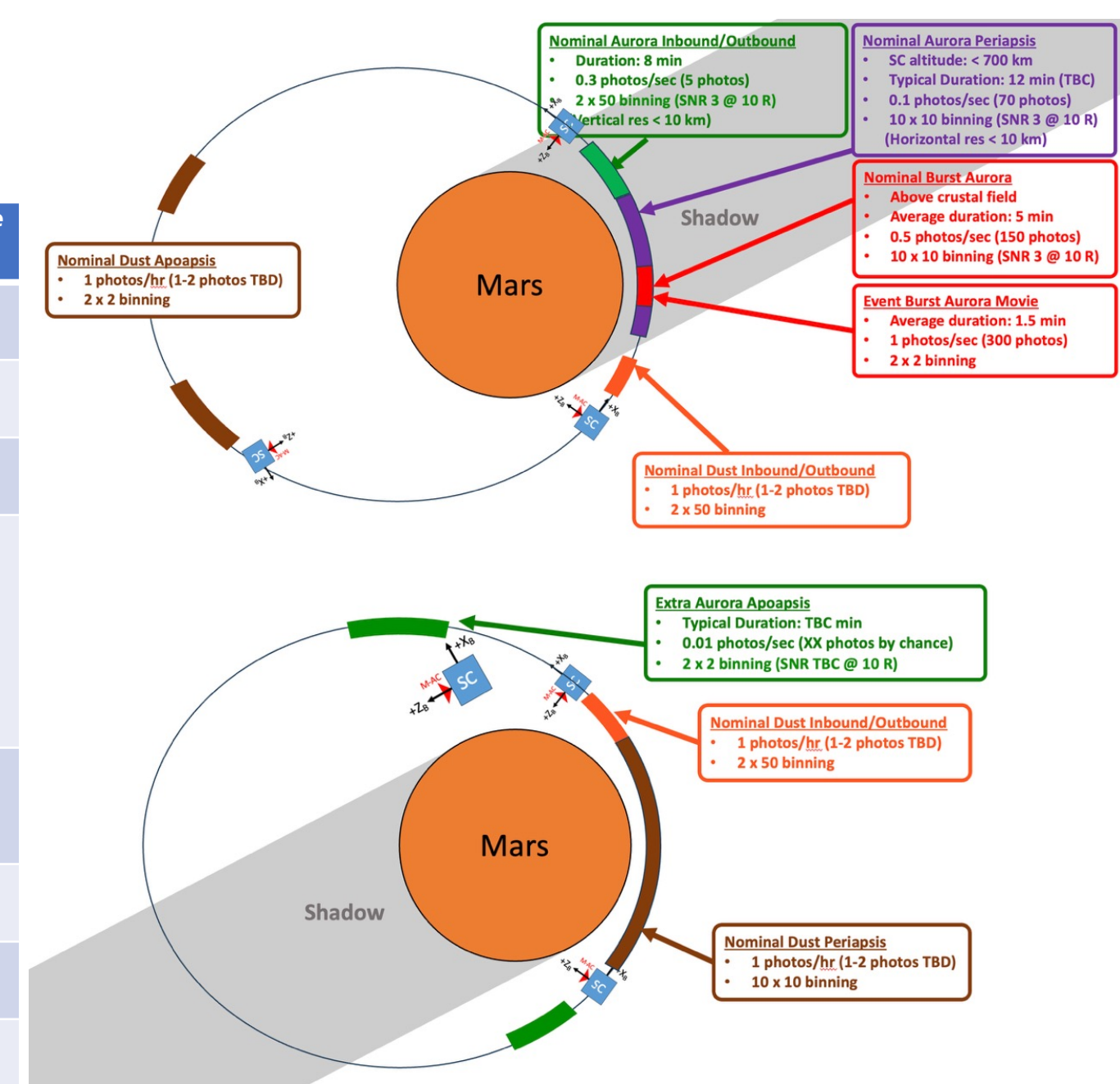


SZA & Latitude Coverage



Operation Modes

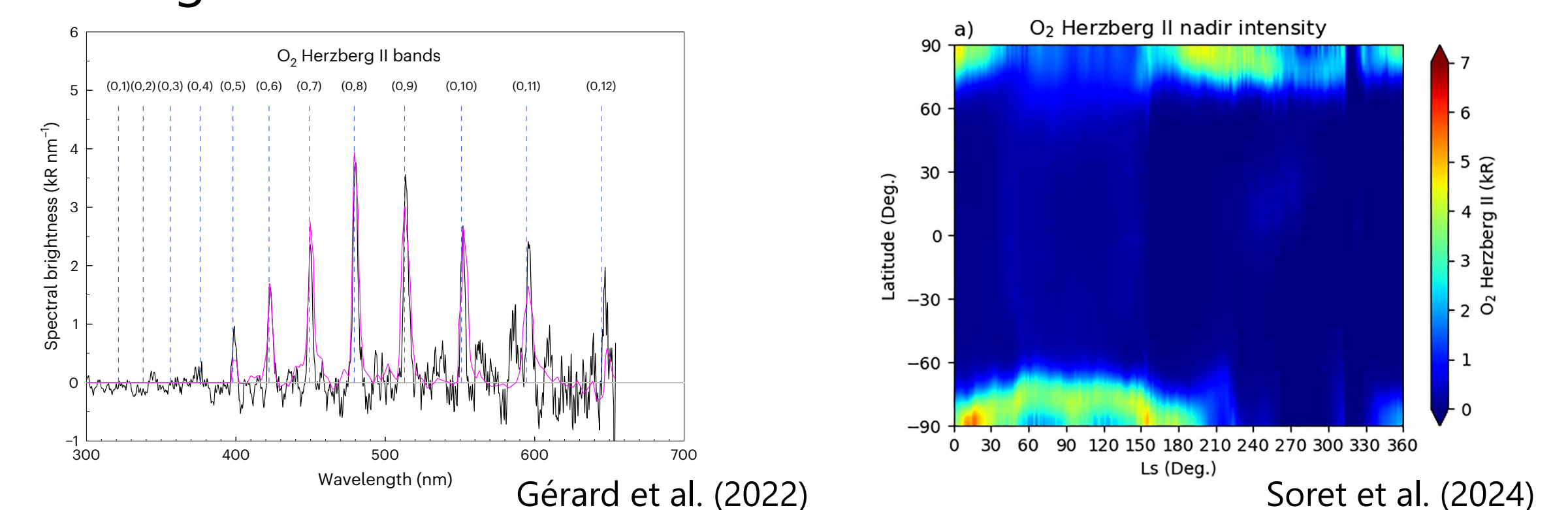
Sequence	Trigger	Time res.	Average duration	Images per Orbit	Image size (kbit)
Nominal Aurora Periapass	Nightside, < 700 km	0.1 Hz	12 min (TBC)	70	320
Nominal Aurora Inbound/Outbound	Nightside, 700 - 1,000 km	0.01 Hz	8 min	5	320
Extra Aurora Apopsis	> 1,000 km, by chance	Up to 0.01 Hz	-	1 (TBD)	8000
Nominal Burst Aurora	Nightside, < 700 km	0.5 Hz	5 min in average or consecutive 20 min per every 4 orbits (TBD)	150	320
Event Burst Aurora Movie	SC passage over ROI (crustal field, TBD)	1.0 Hz	1.5 min	300	8000
Nominal Dust Periapass	Dayside, < 700 km	-	-	2	320
Nominal Dust Inbound/Outbound	Dayside, 700 - 1,000 km	-	-	1	8000
Nominal Dust Apopsis	> 1,000 km	-	-	1	320



Feasibility Study

Oxygen Nightglow Contamination

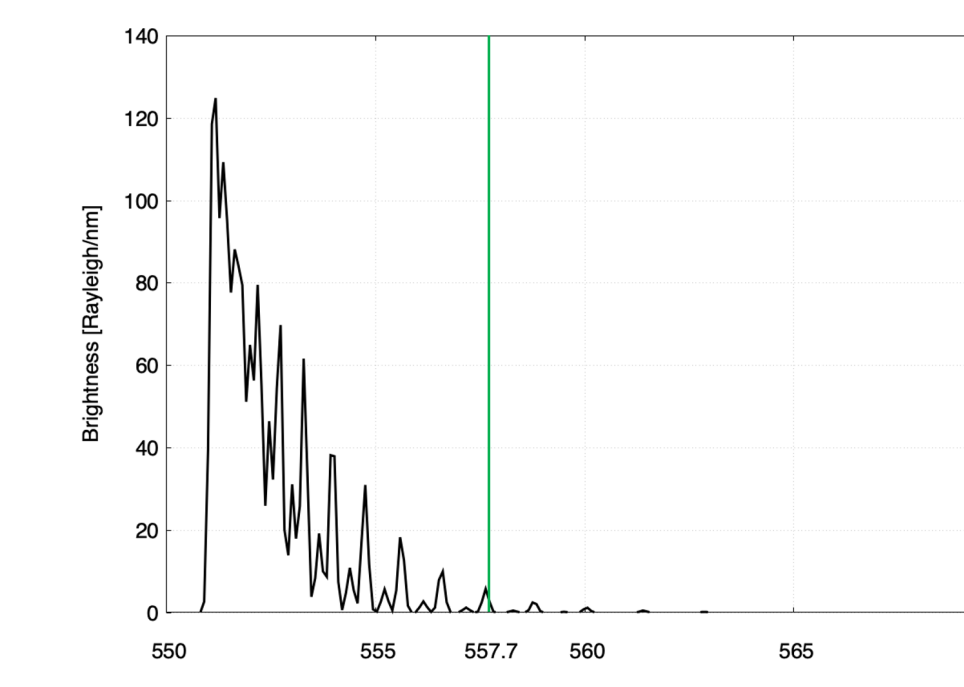
- The Oxygen Herzberg II airglow emission has discovered on the nightside by the Trace Gas Orbiter (TGO) mission.
- The nightglow emission overlaps the OI 557.7 nm emission and can be regarded as contamination risk for aurora observation.



- A bandpass filter with a 5 nm FWHM reduces contamination from the nightglow to less than 10 R at mid-low latitudes.

- The capability to observe bright nightglow in the winter high-latitude region allows monitoring atmospheric circulation.

O ₂ total (R)	10 nm BW	5 nm BW	4 nm BW	3 nm BW
55 x 10 ³ (min NOMAD observations at limb)	3491	719	395	210
110 x 10 ³ (mean NOMAD observations at limb)	6982	1438	791	421
300 x 10 ³ (max NOMAD observations at limb)	19043	3923	2157	1149
1 x 10 ³	63	13	7.2	3.8
0.6 x 10 ³ (max at mid-latitudes from nadir simulations)	38	8	4	2
4.9 x 10 ³ (max in northern polar regions from nadir simulations)	311	64	35	19



Summary

- M-AC is the first instrument dedicated to measure visible/NUV aurora on Mars.**
- Wide FoV and higher sensitivity than previous missions will advance our understanding of the spatial & temporal dynamics of Martian aurorae.**