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One year of combined observations of Mars' Atmosphere by ESA's Mars Express and Trace Gas Orbiter

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Abstract

In this contribution we provide an overview of the first combined observations performed by the two European satellites around Mars: Mars Express (MEX) and ExoMars 2016 Trace Gas Orbiter (TGO). The nominal science operations of TGO started in April 2018 and since then the first combined science observations have been executed both in sun occultation and nadir mode, providing useful data for cross-calibration of the instruments, comparison of atmospheric vertical profiles and other potential synergies contributing to the study of the atmosphere and the understanding of the composition and climate of Mars. These observations have been prepared for the past years in a collaboration between the Science Operations Centers (SOCs) of both missions [1,2] and the instrument teams, in particular the spectrometers NOMAD and ACS onboard TGO [3,4] and SPICAM, OMEGA and PFS onboard MEX [5,6,7].

1. MEX and TGO missions

The Mars Express mission is still fully operational and has been providing great amounts of data since its arrival at Mars in December 2003, covering a wide range of science objectives from the surface and sub-surface geology, atmosphere dynamics and composition, up to the interaction with the magnetosphere and the characterization of the Martian system including Phobos and Deimos.

The Trace Gas Orbiter is the first mission of the ExoMars programme. It arrived at Mars in October 2016 and started the nominal science operations phase in April 2018, following the scientific goals set out for the mission: atmospheric trace gases, climatology, surface geology and subsurface ice detection.

The scientific objectives of both missions are very complementary and there is a lot of synergy and potential for collaboration between the various science teams, especially those devoted to the study of the atmosphere.

The orbits of the two satellites are very different, which proves very useful and flexible to cover the wide range of scientific observation requirements. While Mars Express has a high eccentricity polar orbit with a wide range of distances and long seasonal variations, the TGO has a near-circular approx. 400-km altitude orbit with a 2-hour orbital period, causing many orbital crossings between the two missions.

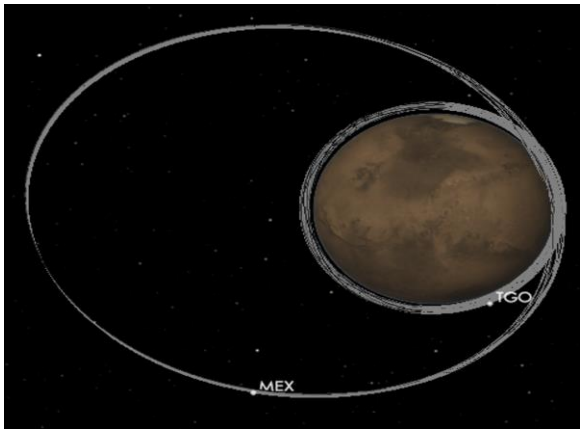

Figure 1: Orbits of MEX and TGO around Mars, simulated with the new SPICE-Enhanced Cosmographia 3D software. [8]

2. Combined Science Observations

During the first year of combined operations around Mars there have been a lot of scientific opportunities that have been identified in advance by the Science Operations Centres (SOCs) and the instrument teams. The computations have been done using SPICE [8] and the focus has been given to combined solar occultations and nadir crossings. [1]

All the MEX-Mars-Sun and TGO-Mars-Sun occultations have been studied for both ingress and egress points (i.e. dusk and/or dawn terminator) identifying many quasi-simultaneous opportunities that could be observed in the same region of the planet within a few minutes difference. In nadir geometry, we have identified the crossing points where the orbits overlap, with many opportunities at various distances of the planet.

3. Conclusions

We have already successfully planned the first combined science observations between Mars Express and Trace Gas Orbiter satellites both for solar occultations and nadir observations These are being planned regularly by both teams during their nominal planning cycles [1][2]. We have also identified other possible opportunities for future collaborations, such as simultaneous TGO solaroccultation and MEX nadir measurements that will be performed in the near future.

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References

[1] Geiger, B et al: Long Term Planning for the ExoMars Trace Gas Orbiter Mission: Opportunity Analysis and Observation Scheduling, Proceedings of SpaceOps Conference, 2018

[2] Cardesin Moinelo, A. et al: ExoMars 2016 Trace Gas Orbiter and Mars Express Coordinated Science Operations Planning, Proceedings of SpaceOps Conference 2018

[3] Vandaele, A. C. et al: NOMAD, an Integrated Suite of Three Spectrometers for the ExoMars Trace Gas Mission: Technical Description, Science Objectives and Expected Performance, Space Sci Rev 214: 80. 2018

[4] Korablev, O. et al: The Atmospheric Chemistry Suite (ACS) of Three Spectrometers for the ExoMars 2016 Trace Gas Orbiter Space Sci Rev 214: 7. 2018

[5] Montmessin et al, SPICAM on Mars Express: A 10 year in-depth survey of the Martian atmosphere. Icarus, Volume 297, p. 195-216. 2017

[6] Bibring, J.-P., et al., OMEGA: Observatoire pour la Minéralogie, l'Eau, les Glaces et l'Activité, ESA SP-1240, pp. 3–16. 2004

[7] Formisano V. et al: The Planetary Fourier Spectrometer (PFS) onboard the European Mars Express mission, Planetary and Space Science, Volume 53, Issue 10, p. 963-974. 2005

[8] Acton, C.H. et al: A look towards the future in the handling of space science mission geometry. Planetary and Space Science. Volume 150, Pages 9-12, Jan 2018