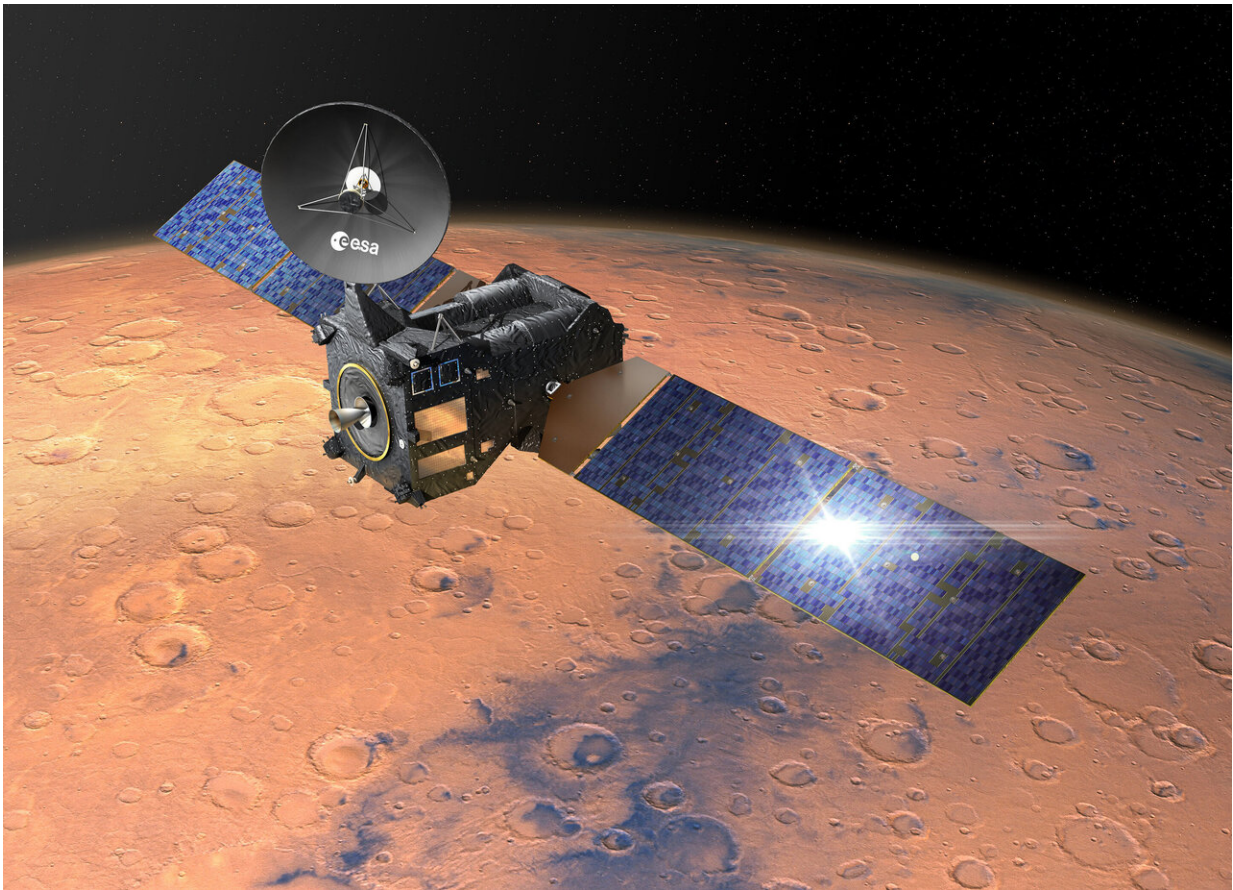


ExoMars orbiter prepares for Rosalind Franklin

May 31 2019



ExoMars Trace Gas Orbiter at Mars. TGO will be launched in 2016 with Schiaparelli, the entry, descent and landing demonstrator module. It will search for evidence of methane and other atmospheric gases that could be signatures of active biological or geological processes on Mars. TGO will also serve as a communications relay for the rover and surface science platform that will be launched in 2018. Credit: ESA–D. Ducros

On 15 June, the ESA-Roscosmos ExoMars Trace Gas Orbiter (TGO) will follow a different path. An "Inclination Change Maneuver" will put the spacecraft in an altered orbit, enabling it to pick up crucial status signals from the ExoMars rover, Rosalind Franklin, due to land on the Red Planet in 2021.

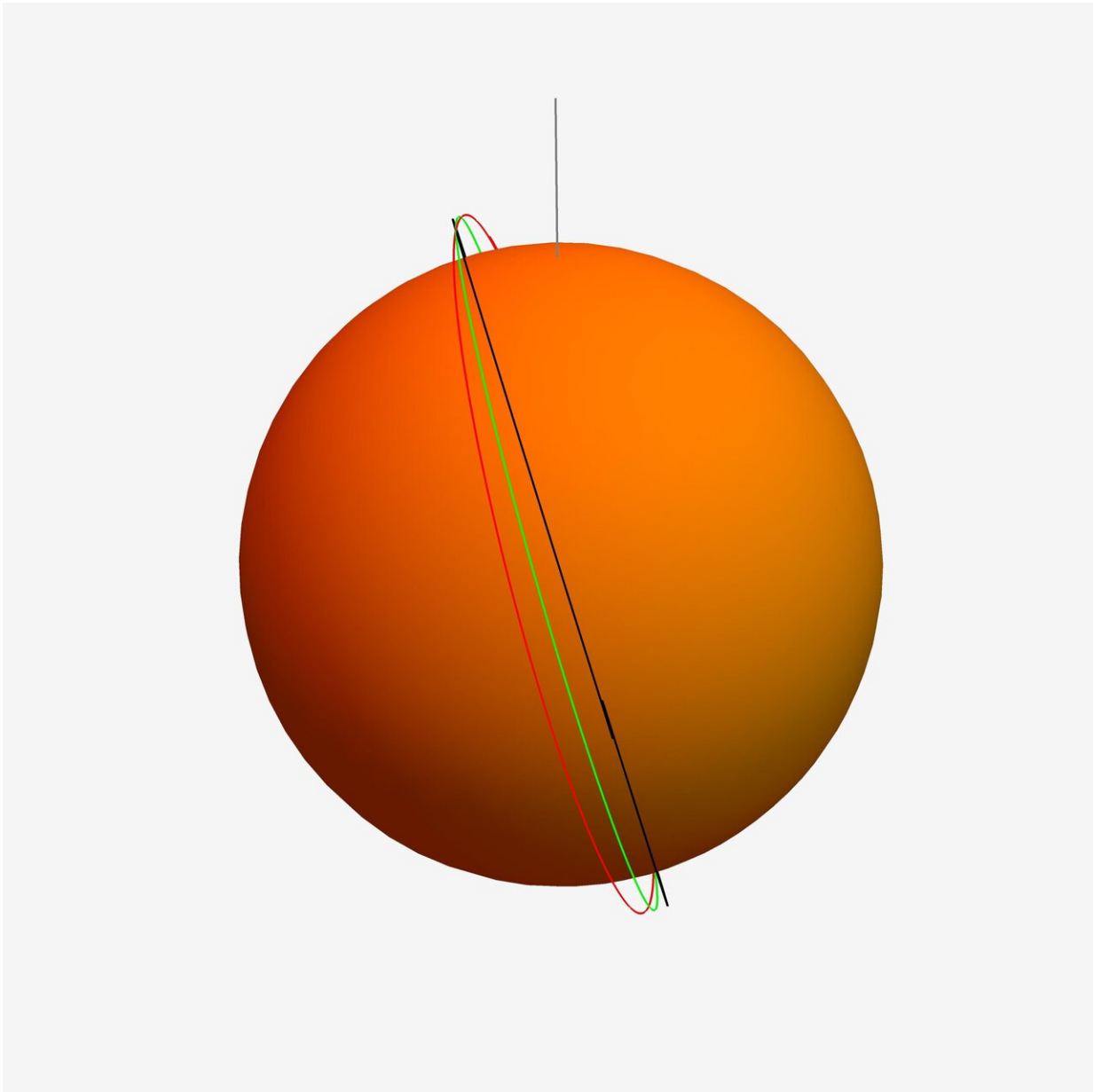
After completing a complex series of [maneuvers](#) during 2017, ExoMars TGO is now orbiting the Red Planet every two hours, collecting scientific data from NASA's surface-bound rover and lander, and relaying it back to Earth. At the same time, the orbiter is gathering its own data on the planet's atmosphere, water abundance and alien surface.

More than a year before Rosalind even lifts off from Earth's surface, flight dynamics experts at ESA's ESOC mission control center have formulated a long-term plan to ensure ExoMars TGO can communicate with the new ESA rover and surface platform, contained in the entry, descent and landing module.

Slight changes to a spacecraft's orbit have a large effect over time, so while the upcoming maneuvers will only slightly alter TGO's speed, it will be in the right position to communicate with the then-incoming rover by 2021.

TGO's natural motion

Mars' uneven gravity field means that TGO's orbit "wanders," so it gradually rotates around Mars over time. As illustrated in this image, the spacecraft first follows the black path, then the green, then the red—continuing until it completes an entire rotation around the planet every four and a half months.



Mars' uneven gravity field means that TGO's orbit wanders, causing it to gradually rotate around Mars over time. Credit: European Space Agency

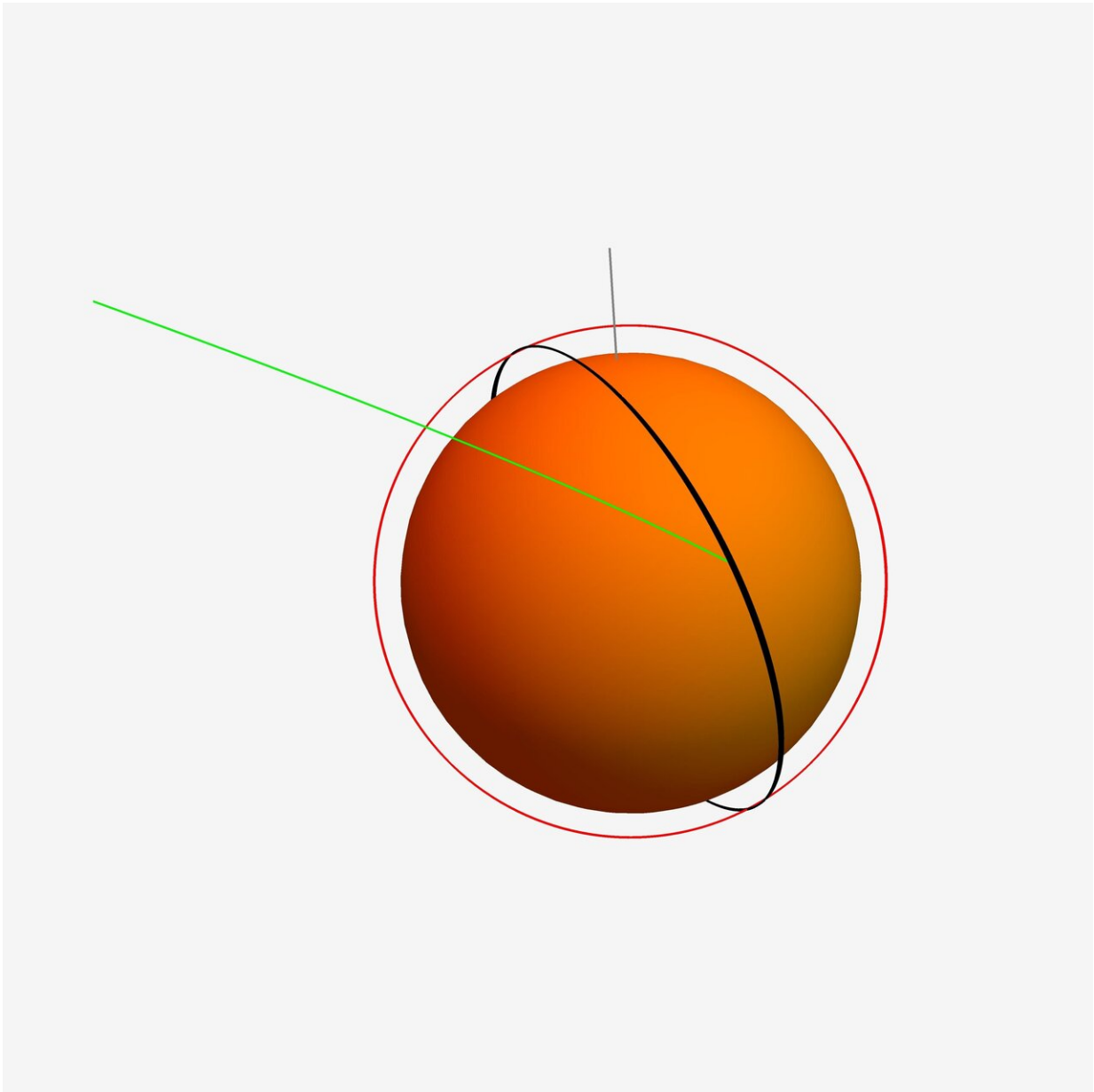
To keep in touch with the descent module as it enters the Martian atmosphere, descends, and lands upon its surface, TGO's orientation needs to change.

Three maneuvers in the month of June will alter TGO's speed, twice by 30.9 metres per second and one final small change of 1.5 metres per second, bringing it slightly closer to the Martian poles.

Inclined to fly

Thanks to these maneuvers, TGO's path will look more like the second graphic shown here, illustrating "snapshots in time" during the 2021 descent of the new rover.

The green line represents Rosalind Franklin's landing approach path.



The green line represents Rosalind Franklin's landing approach path. The black line shows the TGO orbit with its optimised orientation, two years after the upcoming manoeuvres. The red path shows TGO's original orbit. Credit: European Space Agency

The black line shows the TGO orbit with its optimized orientation, two

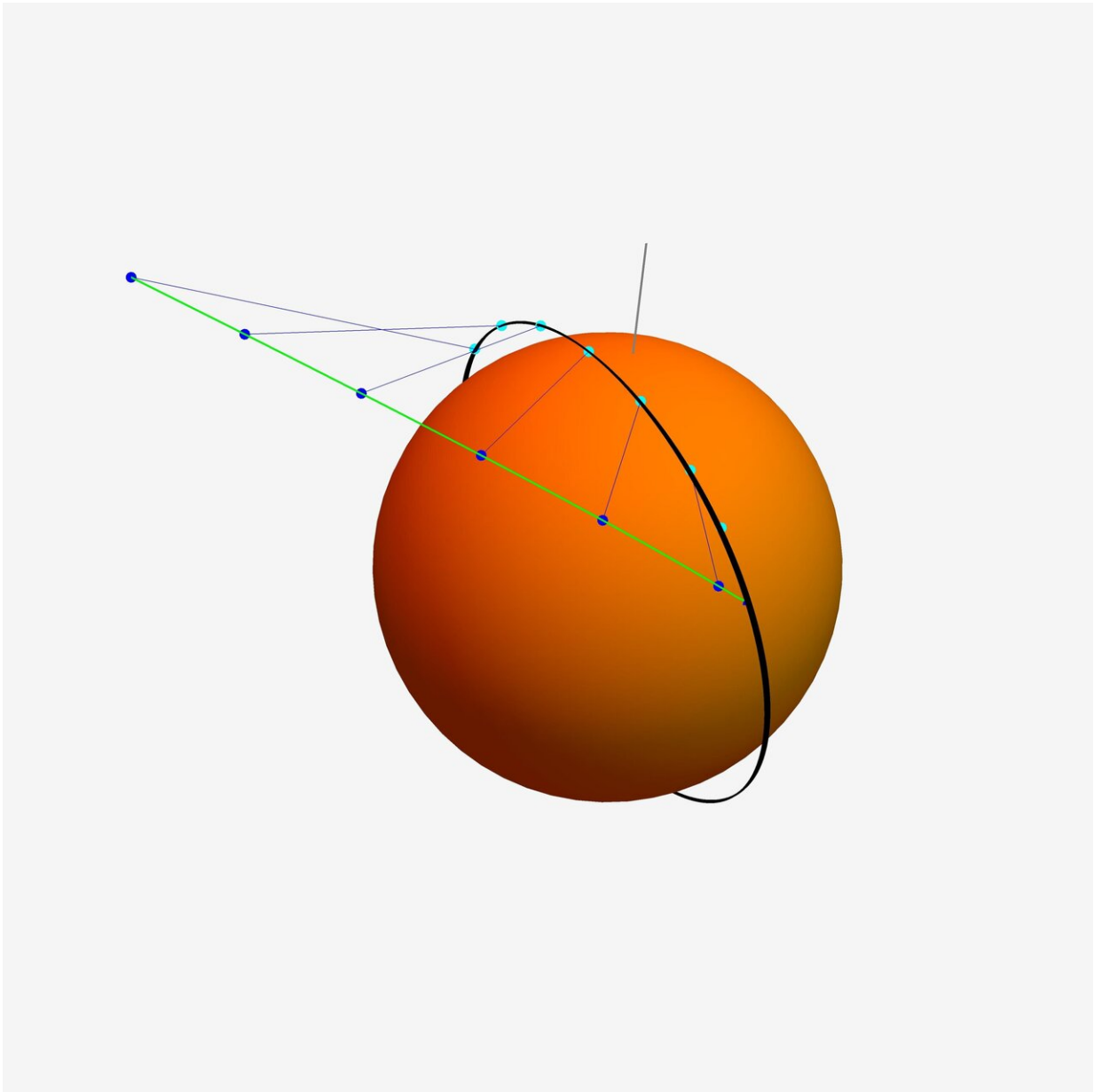
years after the upcoming maneuvers.

The red path shows TGO's original orbit.

In-phase with Rosalind Franklin

Once TGO is set to orbit with its new, optimized orientation around Mars, teams on the ground must also ensure it will be on the correct side of the planet when the rover arrives—in phase" with Rosalind Franklin.

In February 2021, a small maneuver will be performed to ensure TGO is in the right place at the right time for the lander's arrival.



Once TGO is set to orbit with the new, optimised orientation around Mars, it must also be on the correct side of the planet when the rover arrives – ‘in phase’ with Rosalind Franklin. The black line represents TGO’s orbit around Mars at the time Rosalind Franklin begins its descent, itself shown by the green line. Blue dots along the orbits of TGO and Rosalind Franklin are connected by horizontal lines, illustrating the two spacecrafts’ relative positions at different time intervals, and how they are able to ‘see’ each other at every moment, thus ensuring that radio contact can be maintained. Credit: European Space Agency

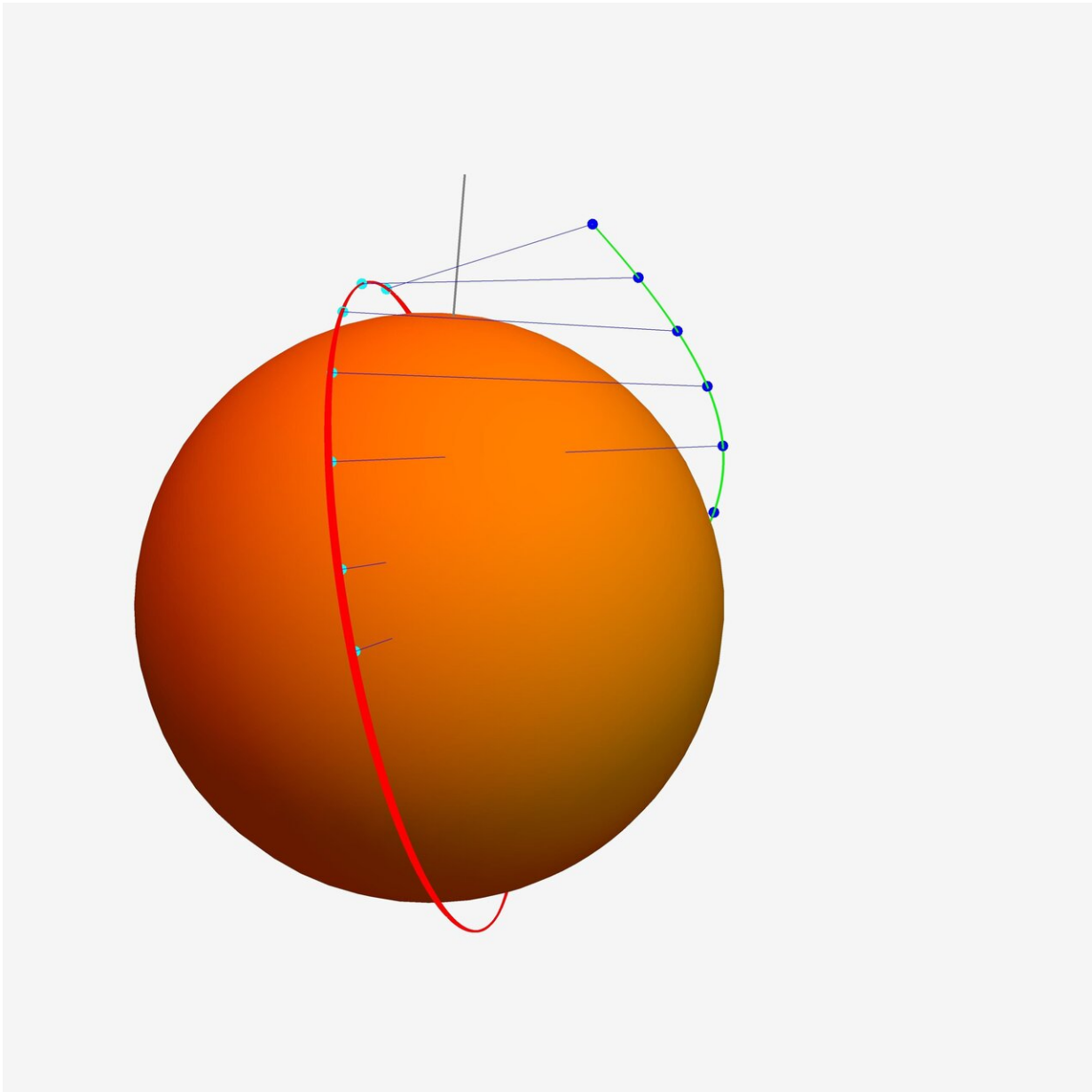
The result of all these maneuvers combined can be seen in the third graphic.

The black line represents TGO's orbit around Mars at the time Rosalind Franklin begins descending, shown by the green line.

Blue dots along the orbits of both spacecraft are connected by horizontal lines, illustrating their relative positions at different time intervals, and how they are able to "see" each other at every moment, thus ensuring that radio contact can be maintained.

Un-phased

If teams at [mission control](#) were to leave ExoMars TGO in its current orbit, without performing any maneuvers, Mars itself would later get between the orbiting spacecraft and the new Mars explorer.



In this final graphic, the red line illustrates TGO's un-phased orbit, and again the green line shows Rosalind Franklin's entry path. Blue dots represent moments in time for each spacecraft and again lines reveal how Mars itself would block their view of each other. Without phasing the orbiter with the Mars rover, the two craft will remain invisible to each other at the crucial moment when the rover descends to the surface. Credit: European Space Agency

In this final graphic, the red line illustrates TGO's un-phased [orbit](#), and again the green line shows Rosalind Franklin's entry path and Blue dots represent moments in time for each spacecraft.

Lines between the dots reveal how in this scenario, Mars would block their view of each other.

Without phasing the orbiter with the Mars rover, the two craft will remain invisible to each other at the crucial moment when the rover descends to the surface.

Not only does the foresight and long-term planning of mission experts ensure communication is maintained between two of ESA's most important Mars missions, it saves fuel—a huge amount of which would be needed to get TGO in the right position in the weeks or even months before the ExoMars [rover](#)'s arrival.

Provided by European Space Agency

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