

EGU24-20446, updated on 02 May 2024

<https://doi.org/10.5194/egusphere-egu24-20446>

EGU General Assembly 2024

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M-Matisse Crosslink experiment MaCro: an intersatellite radio link for the sounding of the Martian atmosphere

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The "Mars Magnetosphere ATmosphere Ionosphere and Space-weather SciencE (M-MATISSE)" mission, currently in Phase A study by the European Space Agency (ESA), is a Medium-class (M7) candidate. M-MATISSE aims to unravel the intricate and dynamic couplings of the Martian magnetosphere, ionosphere, and thermosphere (MIT coupling) in relation to the solar wind (i.e., space weather) and the lower atmosphere. This two-spacecraft mission involves both spacecraft carrying an identical payload suite, each following different orbits with an apocenter at 3,000 km and 10,000 km altitude, and a pericenter at 250 km altitude. The intersatellite radio link, MaCro, operates at two frequencies to probe the ionosphere and atmosphere of Mars during occultation, as one spacecraft disappears behind the planetary disk as seen from the other spacecraft. The instrumentation comprises two transceivers at UHF and S-band, stabilized by an ultrastable oscillator on both spacecraft each. The observables include the shift of the carrier frequencies caused by the bending of the radio ray path in the atmosphere/ionosphere. Onboard data pre-processing precedes the transmission of telemetry to Earth. The orbits allow about eight occultations events (ingress or egress) on average per day starting at an altitude of 1000 km.