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RADIATIVE TRANSFER IN MARS ATMOSPHERIC ENTRY FLOWS

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ABSTRACT Space capsules aiming to land on the planet Mars enter its thin atmosphere at typical velocities of 6 km/s. Partial transformation of kinetic energy into thermal energy leads to molecular dissociation and partial ionization of the constitutive atmospheric gases, and to an important amount of convective and radiative fluxes on the heat shields. The aim of this talk is to present the models we developed for radiative transfer prediction during the descent in Martian atmosphere (mainly a CO_2-N_2 mixture) with different levels of refinement, including line-by-line calculations and band models in the Voigt line-broadening regime. Emphasis will be given to model requirements for both thermodynamic non-equilibrium states of the flow at high altitudes, and to situations close to thermal equilibrium at lower altitudes. The developed models are first applied for the simulation of radiative fluxes on the front and back shields of a hypothetical Mars Sample Return vehicle to analyze the IR and UV parts of the spectrum. Then, numerical simulations are carried out for actual Martian entries for which some experimental data are or would be available (back shields of Viking and of Exomars-2016 capsules). Comparison between numerical predictions and experimental data will be discussed.