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Phobos 2/ASPERA data revisited: Planetary ion escape rate from Mars near the 1989 solar maximum

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Insights about the near-Mars space environment from Mars Express observations have motivated a revisit of the ASPERA-Phobos 2 ion data from 1989. The Sun's more active past makes the escape rate measured during the extremely high 1989 solar maximum crucial for understanding the evolution of the Martian atmosphere. Our escape rate analysis is expanded to include all usable heavy ion measurements (O^+, O^{++}, $O_2{}^+$) from the circular orbits of Phobos 2. We used an empirical model for the ion distribution function in the Martian tail, based on Mars Express data, to reexamine the Phobos 2 data. The newly calculated fluxes in the Martian tail were also recalibrated against IMP-8 measurements of the solar wind and Phobos 2-TAUS ion measurements in the tail. Heavy ion flux measurements from 18 circular equatorial orbits around Mars have were bin-averaged to a grid, using the MSE (electric field) frame of reference and data from the MAGMA magnetometer. The heavy ion flux grid reveals a disturbed Martian magnetosphere and is integrated to yield a total planetary heavy ion escape rate of 2.2×10^{25} s^{-1} from Mars for the 1989 solar maximum.