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Dynamical erosion of the asteroid belt by high-order Martian resonances

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Resonance in the solar system can occur whenever a ratio of two orbital frequencies is close to a ratio $p/(p+q)$ where p and q are positive integers. The number of possible resonances increases markedly as the order q increases. Here we show that in contrast to the broad Kirkwood gaps in the asteroid belt that are associated with a few low-order resonances with Jupiter and display a lack of asteroids, the dominant features of the orbital frequency distribution in the inner asteroid belt are numerous, narrow, high-order resonances associated with Mars that display an excess of asteroids. We also show that the mean orbital eccentricities of the asteroids trapped in these Martian resonances are lower than those of their non-resonant neighbors. Surprisingly, for orbits with above average eccentricity, a correlation exists between asteroid number density and mean eccentricity that extends across the whole inner belt, showing that a dense web of high-order resonances has contributed to the dynamical erosion of the asteroid belt.

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