

FORMATION OF HELIUM-CONTAINING DIATOMICS IN INTERSTELLAR ENVIRONMENT

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Depopulation of the metastable levels of He(2³S), having a unusually long lifetime [1], and He(2¹S) by radiative collisions with hydrogen, lithium and helium ions is investigated [2,3,4]. Through the process of radiative association these collisions result in the formation of molecular cations HeH⁺ and HeLi⁺, in singlet or triplet electronic states, and He₂⁺ in doublet or quartet electronic states. . Energy dependent cross-sections for spontaneous and stimulated processes on a particular spin manifold are calculated using a fully quantal approach and considering the association to rotational-vibrational states of the lowest electronic states from the initial continuum states of the B ¹Σ⁺ [He(2¹S) + A⁺ → HeA⁺], b ³Σ⁺ [He(2³S) + A⁺ → HeA⁺], where A = H or Li, B ²Σ⁺_u [He(2¹S) + He⁺ → He₂⁺] and D ²Σ⁺_u [He(2³S) + He⁺ → He₂⁺] electronic state. Evaluation of the cross-sections is based on highly accurate quantum calculations taking into account all possible state-to-state transitions at thermal energies (for spontaneous association) or at higher background temperatures (stimulated association). The corresponding rate coefficients are presented as function of temperature. A noticeable effect on the radiative association by black-body background radiation is only obtained for the one state process.

References:

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