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A Zero Energy Scaling Technique for Predicting Collisional Rate Coefficients

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Collisional excitation rate coefficients of carbon monoxide due to light colliders such as H, H_2, He, and electrons are necessary to produce accurate models of many astrophysical environments. CO is easily collisionally excited to high rotational levels in moderately energetic environments, but in these regions it is not appropriate to assume a thermal population of levels. Therefore, in order to model the non-thermal gas, collisional rate coefficients must be provided. The calculation of inelastic collisional rate coefficients for CO has been the focus of many studies (e.g. Yang et al. 2006, Yang et al. 2013). However, where explicit calculations have not been performed, a common approach is to estimate unknown values from known rate coefficients, such as in reduced potential scaling (Walker et al. 2014). Here we present a zero energy scaling technique for predicting inelastic collisional rate coefficients of rotationally excited CO($v = 0, j$) in collisions with H. Our predicted state-to-state rates are compared with explicit quantum scattering calculations for temperatures below 3000 K, and when combined, these data form an extensive set of collisional excitation rate coefficients for the H-CO system.

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