Pumping of interstellar molecules by near infrared PAH photons

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Abstract

We have developed an excitation model for small molecules which includes radiative pumping by dust photons from near infrared to submillimeter wavelengths. This model applies to molecules within bright photodissociation regions in galactic star-forming regions and starburst galaxies. In such environments, the near infrared photons emitted by polycyclic aromatic hydrocarbon molecules (PAHs) or small carbon grains, $5\mu m < \lambda < 20\mu m$, are able to penetrate molecular regions and pump the molecules in an excited vibration state. The far infrared and submillimeter transitions involved in the de-excitation cascade are strongly affected by this process. Their intensities can be enhanced by several orders of magnitude. We will show for H_2O and NH_3 how the behaviour of the FIR rotation lines with respect to the gas density and the molecule column density is strongly modified compared to pure collisional models. At moderate densities, $nH_2 < 10^5 cm^{-3}$, radiative pumping dominates the excitation of the rotation ladder, and the FIR lines are good probes of the molecule column density. Concerning $orthoH_2O$, a quasi resonant pumping of the ν_2 $6.18\mu m$ transition by photons of the 6.2 μm PAH band occurs.