In order to observe quantitatively organic molecules in interstellar gas, it is necessary to understand the relative importance of photonic and collisional excitations. In order to do so, collisional excitation transfer rates have to be computed. We undertook several such studies, in particular for H$_2$CO and HCOOCH$_3$. Both species are observed in many astrochemical environments, including star-forming regions. We found that those two molecules behave in their low-lying rotational levels in an opposite way.

For cis methyl-formate, a non-equilibrium radiative transfer treatment of rotational lines is performed, using a new set of theoretical collisional rate coefficients. These coefficients have been computed in the temperature range 5 to 30 K by combining coupled-channel scattering calculations with a high accuracy potential energy surface for HCOOCH$_3$ – He. The results are compared to observations toward the Sagittarius B2(N) molecular cloud. A total of 2080 low-lying transitions of methyl formate, with upper levels below 25 K, were treated. These lines are found to probe a cold (30 K), moderately dense ($n \sim 10^4 \text{ cm}^{-3}$) interstellar gas. In addition, our calculations indicate that all detected emission lines with a frequency below 30 GHz are collisionally pumped weak masers amplifying the background of Sgr B2(N). This result demonstrates the generality of the inversion mechanism for the low-lying transitions of methyl formate.

For formaldehyde, we performed a similar non-equilibrium treatment, with H$_2$ as the collisional partner, thanks to the accurate H$_2$CO – H$_2$ potential energy surface. We found very different energy transfer rates for collisions with para-H$_2$ ($J = 0$) and ortho-H$_2$ ($J = 1$). The well-known absorption against the cosmological background of the $1_{11} \rightarrow 1_{01}$ line is shown to depend critically on the difference of behaviour between para and ortho-H$_2$, for a wide range of H$_2$ density.  

*We thank the CNRS-PCMI French national program for continuous support and the CHESS Herschel KP program for travel supports. Discussions with C. Ceccarelli, P. Hily-Blant and S. Maret are acknowledged.