

MODELLING RADIATIVE PROPERTIES OF GAS MIXTURES IN NONEQUILIBRIUM HIGH-ALTITUDE ROCKET PLUMES

G. Janodet,^{1,2,3} Ph. Rivière,^{1,*} J.-M. Lamet,² V. Rialland,³ L. Tessé,² A. Soufiani¹

¹ Laboratoire EM2C, CNRS CentraleSupélec Université Paris Saclay, Gif-sur-Yvette, 91192, France

² ONERA/DMPE, Université de Toulouse, Toulouse, 31000, France

³ ONERA/DOta, Université Paris-Saclay, Palaiseau, 91123, France

ABSTRACT. This paper presents the development of a Statistical Narrow Band model (SNB) in a nonequilibrium vibrational state for HCl and CO molecules. The population densities of the energy levels are obtained by a multi-temperature approach to compute nonequilibrium Line By Line (LBL) spectra. The SNB parameters are obtained by fitting the curves of growth from the LBL approach by a least squares error minimization using a Newton method for pure Lorentz and Doppler broadening regimes. The model is tested in Voigt broadening regime using a mixing rule and agrees well with the LBL approach. Finally, spectral correlation problems between $\eta_\sigma/\kappa_\sigma$ and κ_σ , where η_σ and κ_σ are the emission and absorption coefficients respectively, have been exhibited for CO₂.

*Corresponding Ph. Rivière: philippe.riviere@centralesupelec.fr