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**Computation of Hypersonic Shock Structure in Diatomic Gases with Rotational and Vibrational Relaxation Using the Generalized Boltzmann Equation**[1] RAMESH AGARWAL, Washington University in St. Louis, FELIX CHEREMISIN, Russian Academy of Science, RUI CHEN, Washington University in St. Louis — The paper describes the computational methodology for computing hypersonic non-equilibrium shock wave (SW) flows of diatomic gases such as Nitrogen and Oxygen using the Generalized Boltzmann Equation (GBE) at Knudsen numbers in transitional and rarefied flow regimes. In the GBE (similar to Wang-Chang Uhlenbeck equation (WC-UE)), the internal and translational degrees of freedom are considered in the framework of quantum and classical mechanics respectively. The computational framework available for the classical Boltzmann equation is extended by including both the rotational and vibrational degrees of freedom in the GBE. The whole problem that includes both the vibrational - translational (VT) and rotational - translational (RT) energy transfers is solved by applying a three-stage splitting procedure to the WC-UE. The three stages consist of free molecular transport, VT relaxation, and RT relaxation. Computations are performed for the shock structure at high Mach numbers accounting for both the vibrational and rotational excitations, and are compared with the available experimental data.

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