THZ SPECTROSCOPY OF DEUTERATED ETHANE

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Over 200 rotational transition frequencies in ground vibrational state of C_2H_5D, with $J < 38$, were measured up to 1.6 THz with accuracies of 50-100 kHz and fitted to an effective Hamiltonian. These measurements extend the work of Hirota *et al.*, who measured and analyzed the millimeter-wave spectrum more that 30 years ago[a] and observed that the relatively high barrier of 1007 cm^{-1} produced $A - E$ splittings on the order of 10 MHz in the vibrational ground state. The effective Hamiltonian fit to all data requires 17 parameters, including ρ, β, 11 rotational and distortion parameters, and 4 tunneling parameters. The experimentally determined value of ρ is 0.434308(19) and the primary tunneling parameter ϵ_1 is -24.7323(58) MHz. The data-set is limited by the vanishingly small dipole moment, such that we recorded rotational R branch transitions up to 1.6 THz and rotational Q branch transitions up to 600 GHz in a three or six meter path with 0.2 Torr sample pressure. This data set is sufficient to locate all of the thermally populated energy levels of the ground state up through the Boltzmann peak near J = 18, which may enable the assignment of the complex infrared spectrum in the 700-900 cm^{-1} range.

[a] Hirota *et al.* J. Molec. Spectrosc. 89, 285 (1981).