Phenyl radical (C₆H₅) is one of the most important reactive intermediates, as it is formed from the homolytic cleavage of a CH bond in benzene (C₆H₆), and hence it plays a central role in the combustion of fossil fuels that are typically rich in aromatics. We recently recorded the first high resolution infrared spectra of jet-cooled phenyl radical in the gas phase. This was obtained by direct absorption laser spectroscopy in a slit-jet discharge supersonic expansion of a phenyl halide precursor (C₆H₅X, i.e. C₆H₅I and C₆H₅Br) diluted in a Neon/Helium gas mixture. We observed an A-type band, which arises from a fundamental excitation of the out-of-phase symmetric CH stretch ($ν_{19}$). The unambiguous assignment of the rotational structure in this band to C₆H₅ is facilitated by comparing 2-line combination differences with the Fourier transform microwave (FTM) and direct absorption millimeter-wave (mm-wave) measurements of the ground state by McMahon et al.\(^a\). A least-squares fit to an asymmetric top Hamiltonian of the rotationally-resolved vibrational band is done to determine upper-state rotational constants and a gas-phase band origin ($ν_0$) of 3071.8904 (10) cm\(^{-1}\). This is in very good agreement with the value of 3071 cm\(^{-1}\) for the out-of-phase symmetric CH stretch of phenyl reported by Friderichsen et al.\(^b\) from matrix isolation studies, which indicates a surprisingly small red shift due to the low-temperature argon environment.
