Torsional tunnelling about the C-O bond splits the vibrational ground state of methanol into $A$ and $E$ states. For $K=0$, the $A$ state is 9.11 cm$^{-1}$ below the $E$ state; for $K > 0$, the torsional energies follow the expected cosine pattern. For the $\nu_3$ asymmetric C-H stretch, the splitting is inverted, i.e., $E$ below $A$ at $K=0$, and smaller in magnitude (-3.26 cm$^{-1}$), but the torsional energies still follow an approximately regular cosine pattern. The limited information available on the $\nu_3$ asymmetric C-H stretch indicates that it is also inverted (about -5 cm$^{-1}$). However, the $\nu_3$ symmetric C-H stretch is normal with $A$ below $E$ (+9.07 cm$^{-1}$).

In order to treat the inverted torsional tunnelling behavior, a local mode Hamiltonian with $G_6$ symmetry has been developed. Three parameters are sufficient to fit the frequencies of the three C-H stretch band origins. These are the harmonic local C-H stretch frequency $\omega=2935.8$ cm$^{-1}$, the local-local coupling $\lambda=-43.9$ cm$^{-1}$, and the lowest order torsion-vibration interaction constant $\mu=10.5$ cm$^{-1}$. Qualitatively, the torsion-vibration interaction $\mu$ results from the fact that the force constant for the C-H bond to the O-H is higher than for the gauche C-H bonds. When combined with the known ground state torsional potential, the same three parameters are sufficient to account for the sign and magnitude of the torsional tunnelling splitting of all three C-H stretch fundamentals. The inversion of the torsional tunnelling for the $\nu_2$ and $\nu_3$ vibrations is a systematic property of the Hamiltonian and not the result of an accidental stretch-torsion resonance. Therefore, the inverted torsional tunnelling is a general result attributable to the molecular symmetry.