TWO DECADES OF ADVANCES IN HIGH-RESOLUTION SPECTROSCOPY OF LARGE-AMPLITUDE MOTIONS IN N-FOLD POTENTIAL WELLS, AS ILLUSTRATED BY METHANOL

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Methanol is a simple and intensively studied organic molecule possessing one large-amplitude torsional motion. It has, for nearly a century, been a favorite of researchers in many fields, e.g., instrument builders, for whom methanol is often the first molecule chosen for testing an improved or a newly built instrument (including HIFI, the Heterodyne Instrument for the Far Infrared on board the Herschel space mission); theorists and/or dynamicists studying the challenging effects of a large-amplitude motion coupling with small-amplitude motions to enhance intramolecular vibrational energy redistribution; astronomers who have elevated methanol to their #1 interstellar weed because of its rich and omnipresent spectrum in the interstellar garden, where it serves as a unique probe for diagnosing conditions in star-forming regions; astrochemists studying isotopic ratios as clues to the chemical evolution of the universe; and fundamentalists seeking possible time variation of the proton/electron mass ratio in the standard model; just to name a few.

From high-resolution to high-precision spectroscopy, the large-amplitude internal rotation of the methyl top against its OH framework in methanol has never failed to produce new surprises in spectral regions from the microwave all the way to the near IR. The very recent observation of completely unexpected large methanol hyperfine splittings is a vivid testimonial that the large-amplitude torsional motion can still lead us to unexplored landscapes. This talk will focus on the complicated vibration-torsion-rotation energy networks and interactions deduced from high resolution spectra; our efforts to understand some of them using ab-initio-assisted approaches and the modeling of torsion-rotation and torsionally mediated spin-rotation hyperfine splittings in methanol. These topics represent one part of the much larger fascinating world inhabited by methanolics.