ABSTRACT:
It is well known that hydrogen, along with other types of nuclei within a molecule “rotate” and that furthermore these nuclei can be made to rotate coherently, altogether through the use of applied magnetic fields and radio frequencies. This is the principle behind nuclear magnetic resonance (NMR) spectroscopy, a technique so common that it forms an important part of any undergraduate chemistry curriculum. Just as nuclei can be made to rotate coherently, it is also possible to cause entire molecules to rotate coherently. Molecular rotational resonance (MRR) spectroscopy is a new type of spectroscopy with a wide array of potential applications. In this talk I will explain the principles of the MRR technique and outline the design and operation of an MRR instrument. For several years we have been using MRR spectroscopy to explore unusual features of organofluorine compounds. We will present our most recent findings concerning the observation of some very surprising large amplitude motions.
BIOGRAPHY:
Dr. Stephen Anthony Cooke is an Associate Professor of Chemistry at Purchase College, SUNY. He received his B.Sc. (Hon.) in Chemistry in 1995 and his Ph.D. in Physical Chemistry in 2000, both from the University of Exeter, Devon, England. His first publication was completed as an undergraduate, doing research with Prof. A. C. Legon. This encouraged him to go on to his graduate and post-doctoral work and to “pay it forward” by providing opportunity and encouragement to undergraduates to do meaningful and publishable research. He has mentored high school and undergraduate students, even as a post-doctoral fellow. He has been a post-doc at the Technical University of Denmark (with Prof. S. O. Jonsdottir) and at the University of British Columbia (with Prof. M. C. I. Geary), where he continued as a research assistant. He has been an assistant, and associate, professor at the University of North Texas, and at Purchase College of the State University of New York, where he is currently Doris and Carl Kempner Distinguished Professor. He has also been a visiting scholar at Wesleyan University and a Research Scientist for Globol (sic) Chemicals Ltd., Tiverton, England.

Dr. Cooke has had numerous publications, invited and conference presentations, and posters. He has also won several awards. He is a member of numerous professional societies, and serves on their governing boards and on editorial boards of several journals. His research interests have included the design and construction of novel instruments, such as Fourier-transform microwave spectrometers. He has used these in the study of halogenated, particularly fluorinated, compounds, finding unexpected phenomena, such as a “bis-trifluoromethyl effect” in which two –CF\textsubscript{3} groups connected by one central carbon atom can give rise to a double minimum potential energy well in which the two CF\textsubscript{3} groups undergo a dis-rotary motion against each other; and observation of “dipole forbidden” rotational transitions in the spectra of very heavy molecules containing bromine and iodine. He has also studied small, often diatomic, metal containing molecules, including, e.g., PbCl, SnCl, SnO, BaS, SrO, SrS, LuO, SbN, SbP, SbF, SbCl, WO, BiN, HfO, ThO. Finally, he has studies noble gas, heavy metal ternary halides including KrCuF, KrCuCl, KrAgF, KrAgBr, KrAuF, XeAgF, XeAgCl and XeAuF.

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