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In Memoriam: James O. Hornkohl

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Abstract

In this obituary, the scientific contributions of James O Hornkohl are greatly appreciated. Especially important are the theoretical and computational studies in the interpretation of spectroscopy of diatomic molecules.

Keywords: Molecular Spectroscopy; Diatomic molecules;

Introduction

The contributions of James Hornkohl or "Jim" encompass the spectroscopy of diatomic molecules, the application of such spectroscopy in diagnosis of combustion, plasmas, rocket propulsion and related problems. Especially significant are his support of student theses and dissertations including the application of numerical methods in analysis of experiments. Moreover, his help is greatly appreciated by his collaborators in the design of computational and experimental methods to record digitial data. During his last 30 years prior to his death on Februray 7, 2017, Jim has been strongly engaged in the description of the very details on diatomic spectroscopy. Over and above this summary, two papers "On parity in diatomic molecules and application of a rigorous algorithm for the prediction of nitric oxide spectra" [1] and "Rotational line strengths for the cyanide $B^2\Sigma - X^2\Sigma^+$ (5,4) band" [2] commemorate the last paper efforts of Jim in collaboration with Chris Parigger. Actually Jim and Chris were working on the parity and cyanide paper in late January and early February 2017.

Methods

The challenge to Jim's work has been the prediction of spectra with focus on diatomic spectroscopy. The aim of the lifetime work is the design of an algorithm to predict and fit computed and measured molecular spectra to infer paramters such as temperature. The means to accomplish goals for various diatomic molecules are the consistent application of standard quantum theory of angular momentum. During his career, Jim engaged in efforts to overcome techniques such as Van Vleck's reversed angular momentum [3] approach based on angular momentum commutators [4]. The apparent difficulties included the battles with the established practice [5] to predict and compute spectra [6] and design programs [7] despite the mathemetical inconsistencies asscoiated with the reversed angular momentum practice.

Jim's research output in terms of scientific papers, conference proceedings, lectures and posters is impressive. Recent journal papers during the past 5 years [1, 2, 7-15] and works listed by the "Web of Science" [16] indicate 28 articles; however, the "Publish or Perish" program [17] reveals 98 articles (not counting the two works published in this journal) with an h- and g- index of 14 and 22, respectively.

The scientific response to his research in terms of citations of his published papers is rather extensive. His computer software for diatomic spectroscopy have been used by many of his US colleagues and throughout the scientific community around the globe. His attention was focussed on computer generated spectra, using exact molecular physical models. The software and database he has developed for these purposed have helped countless experimental spectroscopists in many fields of fundamental and applied molecular physics and spectroscopy.

Results

One of the authors of this remembrance article (LN) acknowledges the substantial help received from Jim in the spectral analysis of laser generated plasma of various substances. This help has been instrumental in various research projects that were of interest and rendered quantitative, thus practically useful results through the use of the software Jim has developed and freely distributed. In addition, LN would like to acknowledge the theoretical help received from Jim in various fundamental spectroscopic issues such as molecular symmetry aspects, in particular spin statistics of diatomic energy levels and spectral transitions.

During one personal visit to Jim Hornkohl's house and family, LN and his wife Klára received a very warm reception by

Jim and Jeri in Tullahoma, Tennessee. Figure 1 shows both Jim and Jeri Hornkohl. This visit demonstrated to us the respect and love Jim felt towards nature, including experiences such as watching the flights of fireflies in their large garden in the evening. In general, remarkable are the rare personal traits of Jim, great honesty, personal warmth and empathy and a large degree of unselfishness.

Figure 1 : Jim and Jeri Hornkohl. (Courtesy UTSI photo albums: L. Horton.)

Equally, the other author of this article (CGP) wishes to acknowlegde the 30-year collaboration with Jim on various aspects of experimental and analytical physics, including of course the theoretical basis of symmetry or unitary transformations that preserve the standard angular momentum commutators. A volley of articles has been authored together with Jim and equally, jointly with László and Jim. Most impressive however is the dedication of Jim towards helping MSc and PhD students at the University of Tennessee Space Institute (UTSI) campus in Tullahoma, Tennessee. CGP wishes to express a "Thank you!" on behalf of all the students, staff and faculty that worked with Jim at UTSI and at the Accomplished Center of Excellence, Center of Laser Applications (CLA).

Discussion

The contributions of Jim Hornkohl are largely associated with the fundamental understanding and prediction of diatomic spectra. But of course, the contributions in the use of digital computers in experimental and theoretical work are greatly appreciated. Both LN and CGP will keep Jim in our memory as a true friend and a very valuable scientific colleague who stands as an example of great human values, dedication to science, love of his family, and unselfish help for his scientific colleagues.

Acknowledgments

One of us (CGP) acknowledges support in part by the Accomplished Center of Excellence, Center for Laser Application at The University of Tennessee, University of Tennessee Space Institute. In addition, the outstanding dedication of the late James O. Hornkohl towards diatomic molecular spectroscopy including the work on the final two papers is greatly appreciated: two papers "On parity in diatomic molecules and application of a rigorous algorithm for the prediction of nitric oxide spectra" and "Rotational line strengths for the cyanide $B^2\Sigma - X^2\Sigma^+$ (5,4) band."

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