

Collision-induced Absorption in Gases

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Collision Induced Absorption In Gases

Rachel Sandford



Collision Induced Absorption In Gases:

Collision-induced Absorption in Gases Lothar Frommhold, 1993 This book reviews the present knowledge of collision induced absorption of infrared radiation in the dense common gases Following a brief introduction and review of essential background information such as dipole radiation molecular collisions and interactions numerous experimental results for the absorption spectra of dense gases are presented Other chapters review the causes and properties of dipole moments induced by molecular interactions the theory of collision induced absorption in monatomic gas mixtures and in molecular gases and mixtures The final chapter discusses related phenomena and the important applications in astrophysics Throughout the book the emphasis is on the absorption by binary molecular complexes but the onset of many body effects such as the ternary contributions and the intercollisional process are also considered The volume is meant to be a practical guide and sourcebook for the researcher interested in the spectroscopy of dense neutral fluids This edition includes a new appendix reviewing recent work Collision-induced Absorption of Compressed Gases in the Very Far Infrared Douglas R.

Bosomworth, H. L. (supervisor) Welsh, 1964 **Weakly Interacting Molecular Pairs: Unconventional Absorbers of Radiation in the Atmosphere** Claude Camy-Peyret, Andrei A. Vigasin, Collision-induced Absorption in Diatomic Molecule/rare-gas Mixtures H. T. Yura, 1967 A quantum mechanical calculation is given for collision induced absorption in the infrared and far infrared spectral regions for mixtures consisting of symmetrical diatomic molecules and rare gas atoms The induced moment consists of a short range overlap term and a long range quadrupole term Near molecular transition lines the quadrupole term gives the main contribution to the absorption while in the far wings the overlap term is dominant The H₂ He H₂ Ar N₂ Ar systems are considered and an estimate is given of the absorption coefficient near 10 millimicrons for N₂ N₂ systems Author **Collisional Effects on Molecular Spectra** Jean-Michel Hartmann, Christian Boulet, Daniel Robert, 2021-01-12 Gas phase molecular spectroscopy is a powerful tool for obtaining information on the geometry and internal structure of isolated molecules and their interactions with others It enables the understanding and description through measurements and modeling of the influence of pressure on light absorption emission and scattering by gas molecules which must be taken into account for the correct analysis and prediction of the resulting spectra Collisional Effects on Molecular Spectra Laboratory Experiments and Models Consequences for Applications Second Edition provides an updated review of current experimental techniques theoretical knowledge and practical applications After an introduction to collisional effects on molecular spectra the book moves on by taking a threefold approach it highlights key models reviews available data and discusses the consequences for applications These include areas such as heat transfer remote sensing optical sounding metrology probing of gas media and climate predictions This second edition also contains with respect to the first one significant amounts of new information including 23 figures 8 tables and around 700 references Drawing on the extensive experience of its expert authors Collisional Effects on Molecular Spectra Laboratory Experiments and Models

Consequences for Applications Second Edition is a valuable guide for all those involved with sourcing researching interpreting or applying gas phase molecular spectroscopy techniques across a range of fields Provides updated information on the latest advances in the field including isolated line shapes line broadening and shifting line mixing the far wings and associated continua and collision induced absorption Reviews recently developed experimental techniques of high accuracy and sensitivity Highlights the latest practical applications in areas such as metrology probing of gas media and climate prediction

Opacity Walter F. Huebner, W. David Barfield, 2014-01-02 This book covers all aspects of opacity and equations of state for gases plasmas and dust The discussion emphasizes the continuous transformation of the equilibrium compositions of these phases as a function of temperature and density

Computational Chemistry: Reviews Of Current Trends, Vol. 2 Misako Aida, Jerzy Leszczynski, Hans Peter Luthi, Hiroshi Nakatsuji, Maciej J Nowak, J V Ortiz, 1997-05-01 The contributions collected in this volume complement volume 1 of this series disclosing results of current developments in methodologies and applications of computational chemistry methods The covered topics include fundamentals and applications of propagator calculations as well as recent developments in the computationally efficient and accurate SAC CI method which allows calculation of various electronic states at the same time SAC CI studies of excited states of large molecular systems like porphyrins are reviewed and its application to investigations of surface phenomena is discussed The book also features a review of recent work on quantum Monte Carlo simulations Furthermore the book discusses the application of computational methods to biomolecules and in particular the application of the DFT methods to prediction of molecular structures and the IR spectrum of the DNA bases as well as currently developed force field parameters and their application in molecular dynamics calculations of biologically important molecules Lastly there is a review of a quantum chemistry course which prepares students at the Department of Chemistry of ETH Zurich to perform their own ab initio studies

Phenomena Induced by Intermolecular Interactions G. Birnbaum, 2013-03-09 This book is concerned with recent experimental and theoretical work dealing with phenomena created by the transient dipoles and polarizabilities produced by intermolecular interactions The former produce absorption from the microwave to the optical regions of the spectrum and the latter produce Rayleigh and Raman scattering such absorption and scattering would be absent without collisions Static properties such as dielectric constant refractive index and Kerr effect also exhibit the effects of induced dipoles and polarizabilities The first observation of an infrared absorption spectrum produced by the collisions of molecules which ordinarily do not have an allowed dipole transition was reported in 1949 Crawford Welsh and Locke The first observation of depolarized Rayleigh spectra due to collisions in atomic gases appeared in 1968 McTague and Birnbaum However it was not until 1977 that the first conference dealing with collision induced phenomena was organized by J D Poll at the University of Guelph This conference was mainly concerned with studies of collision induced absorption in gases Light scattering received more attention at the second meeting of the collision induced community in 1978 at the E Fermi

Summer School on Intermolecular Spectroscopy and Dynamical Properties of Dense Systems organized by J Van Kranendonk. However the emphasis was still on collision induced absorption in compressed gases although some work on liquids solid H₂ and related subjects such as rotational relaxation was included. The third induced phenomena conference organized by F

Publications of the National Institute of Standards and Technology ... Catalog National Institute of Standards and Technology (U.S.), 1983 **NBS Special Publication**, 1968 *International Journal of Infrared and Millimeter Waves*, 1987 **Publications of the National Bureau of Standards** United States. National Bureau of Standards, 1982

Conference Digest, 1984 Collision-induced Absorption in the Rototranslational Band of H₂-H₂ and in the Fundamental Band and First and Second Overtone of H₂ in Dense Hydrogen Gas Martin Andreas Abel, 2009. The absorption due to pairs of H₂ molecules is an important opacity source in the atmospheres of various types of planets and cool stars such as late stars low mass stars brown dwarfs certain white dwarfs etc and therefore of special astronomical interest. The emission spectra of cool white dwarf stars differ significantly from the expected blackbody spectra of the cores due to collision induced absorption by collisional complexes of hydrogen and helium in the stellar atmospheres. In order to model the radiative processes in these atmospheres which have temperatures of several thousand kelvin one needs accurate knowledge of the induced dipole and potential energy surfaces of collisional complexes such as H₂-H₂. These come from quantum chemical calculations with the H₂ bonds stretched or compressed far from equilibrium length. Since no measurements of the collision induced absorption for these high temperatures exist one has to undertake ab initio calculations which take into account the high vibrational excitations of the hydrogen molecules. However before one attempts to proceed to higher temperatures where no laboratory measurements exist it is good to know that the formalism is correct and reproduces the results at temperatures where measurements exist. Therefore in order to make sure that the calculations are reliable one compares the results of the calculations with existing laboratory measurements where possible before proceeding to higher temperatures. Molecular hydrogen has always played a special role in the collision induced spectroscopies. The rotational transition frequencies of H₂ are widely separated so that translational rotational and vibrational induced spectral bands can be studied separately. Moreover the H₂ molecule has a small anisotropy of the intermolecular interactions which may often be ignored in first order approximations. In general hydrogen gas is a mixture of para and ortho hydrogen. Para hydrogen at sufficiently low temperature is not rotationally excited and is therefore an isotropic system. However the anisotropy can be turned on and off by raising and lowering the temperature because the ratio of para to ortho hydrogen depends on the temperature. What is even more roughly 90% of all the known matter in the universe is hydrogen in the ionized atomic or molecular states which makes hydrogen one of the most important species in astrophysics. The hydrogen molecule is non polar and some of the most important spectra in the near and far infrared and microwave region are collision induced due to H₂-H₂ complexes. At the temperature of 297.5 K measurements of the collision induced absorption spectra of H₂-H₂ gas are

reported in the frequency range from 1900 to 2260 cm⁻¹. The gas densities for these measurements ranged from 51 to 610 amagat. These measurements were compared with ab initio calculations of the absorption. For these calculations the isotropic potential approximation was used. In contrast to previous ab initio calculations, agreement between calculations and measured spectra is now observed over the full frequency range considered. A major difference to the earlier calculations is that in this work new dipole and potential energy surfaces were used. Furthermore, measurements exist of the fundamental band and first and second overtone of H₂ in dense hydrogen gas. They have been compared with ab initio calculations based on the new method. Over the full range of frequencies considered, the agreement between calculations and measurements is remarkable. This work demonstrates that the new method is capable of reproducing the measured spectra where those exist with high accuracy and predicts reliable opacities where no laboratory measurements exist.

Physical Review & Physical

Review Letters: A-L Nichigai Asoshietsu, 1974 Collision- and Interaction-Induced Spectroscopy G.C. Tabisz, Murray N. Neuman, 2012-12-06. Collision or interaction induced spectroscopy refers to radiative transitions which are forbidden in free atoms or molecules but which occur in clusters of interacting atoms or molecules. The most common phenomena are induced absorption in the infrared region and induced light scattering which involves inelastic scattering of visible laser light. The particle interactions giving rise to the necessary induced dipole moments and polarizabilities are modelled at long range by multipole expansions; at short range, electron overlap and exchange mechanisms come into play. Information on atomic and molecular interactions and dynamics in dense media on a picosecond timescale may be drawn from the spectra. Collision induced absorption in the infrared was discovered at the University of Toronto in 1949 by Crawford, Welsh and Locke who studied liquid O₂ and N₂. Through the 1950s and 1960s, experimental elucidation of the phenomenon, particularly in gases, continued and theoretical underpinnings were established. In the late 1960s, the related phenomenon of collision induced light scattering was first observed in compressed inert gases. In 1978, an Enrico Fermi Summer School was held at Varenna, Italy, under the directorship of J. Van Kranendonk. The lectures there reviewed activity from the previous two decades during which the approach to the subject had not changed greatly. In 1983, a highly successful NATO Advanced Research Workshop was held at Bonas, France, under the directorship of G. Birnbaum. An important outcome of that meeting was the demonstration of the maturity and sophistication of current experimental and theoretical techniques.

Journal of the Optical Society of America, 1979 **Memorandum**, 1961 **Physics, Uspekhi**, 2002 **Proceedings of the ... AIRAPT and the ... EHPRG Conference**, 1979

Reviewing **Collision Induced Absorption In Gases**: Unlocking the Spellbinding Force of Linguistics

In a fast-paced world fueled by information and interconnectivity, the spellbinding force of linguistics has acquired newfound prominence. Its capacity to evoke emotions, stimulate contemplation, and stimulate metamorphosis is actually astonishing. Within the pages of "**Collision Induced Absorption In Gases**," an enthralling opus penned by a very acclaimed wordsmith, readers attempt an immersive expedition to unravel the intricate significance of language and its indelible imprint on our lives. Throughout this assessment, we shall delve in to the book is central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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