Asian Journal of Physics
Vol. 30, No 2 (2021) 239-250
Available on: www.asianjournalofphysics.in

ap

An Interview with Wolfgang Kiefer

(On the occasion of 80th birthday of Wolfgang; Feb 12, 2021)

V K Rastogi

Indian Spectroscopy Society, KC-68,1. Old Kavinagar, Ghaziabad-201 002, India

The effect known as Raman Effect was first demonstrated experimentally on Feb 28, 1928 by Prof Chandrasekhara Venkata Raman at the Indian Association for Cultivation of Sciences, Calcutta (India). After the discovery of Raman Effect in 1928, the researchers all over the world became interested in this new technique which is based on the inelastic scattering of light. In 1929, G Joos, wrote a complete chapter: "The Raman Effect" in German "Encylopaedia of Experimental Physics". In the same year (1929), the importance of the effect in relevance to chemistry was given by C Schäfer and F Matossi in a monograph "Fortschritte der Chemie, Physik und Physikalische Chemie". In 1931, K W F Kohlrausch published "Der Smekal-Raman-Effekt", in which he gave 417 references[1]. For the first time, the term " Raman Effect" was introduced to the scientific literature by one of the Raman's junior colleagues, L A Ramdas through a short note which appeared in the 14th July issue of *Nature* in 1928. Also for the first time the term "Raman Effect" appeared in *Title- Index of Vol 122 of Nature in* 1928.

Today Raman Spectroscopy has established itself as an indispensable technique of investigating the molecular species in all phases of matter and a tool for research in interdisciplinary fields encompassing almost all branches of science, as a result of which many new phenomena are being discovered and studied.

Prof Wolfgang is a well known Raman spectroscopist of the world and his contributions to the field of Vibrational Spectroscopy are numerous with more than 19,293 citations and H Index 66 (Status Feb 12, 2021). He is a source of inspiration and motivation for young vibrational spectroscopists. On the occasion of his 80th birthday, I took the liberty to ask him some questions related to his over 50 years career in Raman spectroscopy. He kindly replied to the following questions very happily:

Q 1. Why did you choose Raman Spectroscopy as your career?

Ans: I had been fascinated learning how this spectroscopic technique of unique character is able to give information on the structure of molecules.

Q 2. Your opinion about Raman spectroscopy: Past and future?

Ans: In my opinion, the Raman effect (*Nobel Prize 1930, abb. NP*) *belongs to the four most important discoveries in physics with the highest impact to applications in modern life, the other three being* (*i*) *X-ray scattering by Wilhelm Conrad Röntgen* (*NP 1901*), *used preferentially in medical diagnostics,* (*ii*) *Nuclear Magnetic Resonance by Isidor Isaac Rabi* (*NP 1944*), *used mainly in magnetic resonance imaging, and* (*iii*) *the Laser, for which the NP has been shared by Charles Townes, Nikolay Basov, and Alexander Prokhorov in 1964, allowing innumerable utilizations in daily practice.*

In the past, Raman spectroscopy has been mostly applied in chemistry to investigate the composition and structure of molecules, and in physics to study fundamental effects in solids, liquids, and gases. But it also has been merged into many other research fields such as biology, biochemistry, medicine, mineralogy, art, archaeology, pharmacy, geology, forensic science, and many others.

[1] Rajinder Singh, V K Rastogi, On the Occasion of 90th Anniversary of the Raman Effect, *Asian J Phys*, 27(2018)93-101.

Raman spectroscopy will play an even more important role in the future. Current and future exciting areas are its applications in rapid infectious disease diagnostics including viruses such as Corona virus (*Covid-19*). *Other great events which are related to the Raman effect and to which I am looking forward to, are the various in situ planetary missions coming up in the next few years, such as the international ExoMars programme, which will provide geological and mineralogical context information. I am sure that by identifying mineral products and molecules of biological activities, Raman spectroscopy will help to search for life outside our planet earth.*

Q 3. When did you publish your first paper and in which journal?

Ans: *My first paper had been published in the 1968 in a newly founded German journal "Meßtechnik"* (*J Brandmüller, W Kiefer, and H Hacker, Meßtechnik**1**, 53-58,* (*1968*)*, entitled "Ramanlampe mit einem Heliumbrenner" or in English: "Raman lamp with a helium burner"*). *It summarizes my diploma thesis*.

Q 4. Your most significant contributions to the exciting field of Raman spectroscopy which you would like to be known by young Raman spectroscopists; why this technique seems to be unique and fundamental in character? Could you pl tell me the most excited event of your professional life as Raman spectroscopist?

Ans: *There are mainly three contributions which I think are worthwhile to be mentioned in this context:*

1*) *Fundamental studies on continuum resonance Raman scattering in diatomic halogen and interhalogen* molecules*: *Our detailed experimental and theoretical studies performed over several decades particularly proved the Kramers-Heisenberg-Dirac-* (*KHD-*) *dispersion formula which enabled us to numerically calculate resonance Raman spectra and compare them to experimentally obtained ones. The KHD-relation had been derived before the advent of quantum mechanics by Kramers and Heisenberg* (*NP 1932*) *in 1925, whereas the quantum mechanical derivation was given by Dirac* (*NP 1933*) *in 1927. I still remember vividly the many days and nights in 1982, when I had sabbatical leave from University of Bayreuth, but did not leave Bayreuth University and instead stayed in my laboratories and enjoyed doing Raman scattering experiments by myself. At that time one of my former Ph D students had already calculated continuum resonance Raman spectra of isotopically pure halogen and interhalogen diatomic molecules* ***before*** *experiments had been performed. When I measured such vibrational/rotational Raman spectra consisting of fundamentals and many overtones* (*up to 50!*) *with different excitation laser lines, I had the calculated spectra already in my hands and could follow the - at that time used - pen recorder how it exactly followed the spectra calculated by the coworker. This had been one of my most exciting events in my professional life as a Raman spectroscopist.*

2*) *Physics and chemistry of single microdroplets studied by Raman and elastic light scattering: *By means of optical trapping and optical levitation by radiation pressure, methods pioneered by Arthur Ashkin already in the nineteen seventieth, for which he received Nobel Prize only in 2018, and first applied to Raman spectroscopy in my research group at University of Bayreuth in the early nineteen eighties and later on by many of my students at University of Würzburg in the nineteen nineties, we studied elastic* (*Mie*) *and inelastic* (*Raman*) *as well as its combination* (*Raman-Mie-*) *scattering, where so-called Mie- or Morphology-Dependent Resonances* (*MDRs*) *were found for the first time in the Raman spectra of spherical solid and liquid microparticles. Again, comprehensive experimental and theoretical studies of Raman-Mie scattering particularly on microdroplets enabled us to perform* (*i*) *fundamental research in the physics of microparticles and* (*ii*) *applied research in chemistry evolving inside microdroplets. Such studies allowed us to obtain precise information on, for example, evaporation, acid/base reactions, liquid-solid transitions, and polymerization in single microdroplets.*

3) *Femtosecond Coherent Raman Spectroscopy:* *When commercial lasers with femtosecond pulse durations became available, we had soon set-up a rather expensive, but most universal fs-time-resolved four-wave-mixing spectroscopy instrumentation at University of Würzburg, Germany* (*see Slide 16 in article by Rajinder*

Singh), *for performing mainly femtosecond coherent Raman and degenerate four-wave mixing spectroscopy experiments in order to study molecular and solid-state dynamics. Instead of dispersing a Raman spectrum in the wavenumber range, we now had been able to directly follow wave-packets in molecules and solid systems such as quantum dots on a femtosecond or a picosecond time scale, so we could reveal how vibrations and rotations occur in real time. Fundamental physics experiments such as vibrational and rotational coherences, simultaneous studies of the dynamics of ground and excited states in molecules, quantum control experiments and laser-controlled selective excitation of vibrational modes, energy transfer processes, phonon relaxation in quantum dots, etc., had been performed along with their theoretical descriptions.*

Q 5. Would you pl tell something about the discovery of Rotating Raman Cell and its impact ?

Ans: When I joined Dr Harold Bernstein's lab at National Research Council of Canada (*NRCC*) *in Ottawa, as Postdoc end of 1970 he asked me to continue earlier work on resonance Raman* (*RR*) *spectroscopy performed in his lab by Wolfgang Holzer in the gas phase as well as by Ole Mortensen in the liquid state, both former Postdocs with Harold. Each morning at 11:00 am, Harold's research team met in the cafeteria of NRCC for coffee break where we always had lively discussions about ongoing Raman work in the labs. One day, I mentioned that due to the thermal lens effect it is not possible to get a sharp laser focus in strongly absorbing liquids, and therefore the observed RR signal becomes very low. Harold mentioned that Ole Mortensen already tried to circumvent this problem by using a rectangular cell which he moved forwards and backwards over the laser focus and that he got some, but not sufficient improvement in the observed RR signal. The problem had been at the turning points where there was still a short, but static correlation between Raman cell and laser focus, producing intense hot spots. I remember that I mentioned "why not use a round cell and rotate it while having the laser focus close to the cell window". We discussed together how to construct such kind of a rotating cell. After coffee break, I immediately went to the glass blower of the NRCC chemistry department and within one day the rotating cell was made. In my first paper with Harold* [1], *the following acknowledgement can be read at the end: "The idea for the rotating cell and its construction was the result of break discussion in which Drs P Carey, W F Murphy, and J P Perchard were key figures to whom we are grateful. We also wish to thank J van den Hoff for making the cell".*

After the realization of the rotating cell for absorbing liquid samples and still in Harold's lab, I thought about how to construct a rotating cell for absorbing solid samples [2]. *Both rotating Raman sample techniques improved the signal to noise ratio in RR spectroscopy considerably and enabled to study the RR effect experimentally in many laboratories in great detail, both in liquid and solid state.*

After coming back to the laboratories of Professor Brandmüller in Munich, Germany end of 1972, I developed a divided rotating Raman cell for liquids (*half for solution, half for solvent*) *which allowed to directly scan the Raman signals of only the dissolved materials in liquid solutions* [3]. *This Raman difference spectroscopic technique turned out later to become an efficient technique for accurate wavenumber shift determination of solvent shifts, isotopic shifts, or other Raman shifts of chemical systems* [4]. *In addition, together with a student, we developed a so-called "Raman surface scanning technique", where instead of the Raman cell a lens is rotated, in order to also have a relative movement between laser focus and static solid sample enabling Raman studies also at low temperatures* [5].

Next idea had been to rotate a "divided" polarization rotator. This technique allows the simultaneous and automatic scanning of the "parallel" and "perpendicular" spectra of the scattered Raman light as well as simultaneously the depolarization ratio with high accuracy [6]. *Soon afterwards we published a universal rotating system for Raman spectroscopy* [7] *which is useful to perform all the techniques developed and described above. This system was also useful for simultaneous recording of Raman spectra excited by left- and right-handed circularly polarized laser light which became an important method for the study of vibrational optical activity* [8]. *Also, the direct scanning of the purely isotropic part of the Raman scattered light became possible* [9]. *In a book article in 1977, I had summarized these "Recent Techniques in Raman*

Spectroscopy" [10]. *To close the story of the rotating cell and its impact, I like to mention that at the end of the nineteen seventieth Raman colleagues nicknamed me as the "Rotating Kiefer"!*

References

1. Kiefer W, Bernstein H J, *Appl Spectrosc*, 25(1971)500-501.
2. Kiefer W, Bernstein H J, *Appl Spectrosc*, 25(1971)609-613.
3. Kiefer W, *Appl Spectrosc*, 27(1973)253-257.
4. Laane J, Kiefer W, *J Chem Phys*, 72(1980)5305-5311.
5. Zimmerer N, Kiefer W, *Appl Spectrosc*, 28 (1974)279-281.
6. Kiefer W, Topp J A, *Appl Spectrosc*, 28(1974)26-34.
7. Kiefer W, Schmid W J, Topp J A, *Appl Spectrosc*, 29(1975)434-436.
8. Kiefer W, Nitsch W, *Appl Spectrosc*, 31(1977)50-52.
9. Klöckner W, Kiefer W, Schrötter H W, *Appl Spectrosc*, 31(1977)53-54.
10. Kiefer W, in: Advances in Infrared and Raman Spectroscopy, Vol 3, Clark R J H and Hester R E, eds., Heyden & Son, 1977, pp 1-42.

Q 6. Name of famous Labs in World where Raman spectroscopy is being carried out.

Ans: There are too many labs in the world where Raman spectroscopy is being carried out to be mentioned here. We find them in innumerable University, general research as well as in industrial laboratories. I can only make a guess on such a number by looking into the Proceedings of the International Conference on Raman Spectroscopy (ICORS) *of recent years which contain several hundred of contributions from the various Raman research labs* (*e.g. ICORS Proceedings of 2014 contain about 400 oral as well as about 400 poster presentations*). *These numbers, therefore, give evidence that probably several hundred Raman laboratories have been established over the years worldwide.*

Q 7. Do you think this technique may be helpful in developing CORONA Vaccine?

Ans: Raman spectroscopy is certainly useful to get information on the molecular structure of the virus and may help this way to develop COVID-19 virus vaccines. However, there are other most efficient methods for developing the right vaccine, and in fact it already had been announced on November 8, 2020, that as a result from phase 3 COVID-19 vaccine trial a vaccine with more than 90% efficiency has been developed by German company BioNTech SE and American company Pfizer Inc.

Q 8. What is your opinion about ICOPVS conferences?

Ans: *The first "International Conference on Perspectives in Vibrational Spectroscopy" was organised with great success in 2006* (*Feb 25-28*) *at CCS University Campus in Meerut, India. So far eight conferences of the series have been organised at different places in India and I had been fortunate to already attend six of these conferences, the last one being the* 8^{th} *edition, which took place in Bangalore in February 2020. I always very much enjoyed to attend these meetings not only to meet many of my Indian friends but also to listen to high-quality presentations from national as well as international Raman colleagues. I realized that the topics presented in Bangalore in 2020 have extended considerably since 2006 when the research reports were mainly concentrated on the two classical fields of vibrational spectroscopy, namely Raman scattering and infrared absorption spectroscopy. The 2020 Bangalore meeting covered quite many different aspects of vibrational spectroscopy. Mainly, the new developments in the classical fields, like SERS, imaging, interphase sciences and others had been discussed in detail. Also, research using ultrafast lasers has been reported. Both, the professionals as well as the students benefited immensely from the talks and poster sessions during all meetings. I am sure that future ICOPVS meetings, where we probably will more concentrate on vibrational spectroscopy studies in advanced material and life sciences including new branches of vibrational spectroscopy, will become even more popular and attract many practicing vibrational spectroscopists from India and abroad. I am looking forward to attend more of these meetings.*

Q 9. As Prof Kiefer has produced more than 80 PhDs therefore in the end I was interested in knowing that how many out of these are presently working in universities and what are their research activities?

Ans: Prof Kiefer told that following 12 students became Professors and presently they are working at universities; below we give their names and research activities.

Baia Gheorge Lucian, Professor at Babes-Bolyai University, Cluj-Napoca, Romania, http://www.phys.ubbcluj.ro/~lucian.baia/; Ph D title (PHDT, abb.): *"Theory and applications of confocal micro-Raman spectroscopy on hybrid polymer coating and PDMS membranes and spectroscopic studies of doped B_2O_3-Bi_2O_3 glass systems"*; Current research activity (CRA, abb.): Raman, IR, SERS, glasses, nanoparticles, materials with controllable morphology and structure for environmental (photocatalysis) and biomedical (tissue engineering) applications.

Baia Monica, **born Bolboaca**, Professor at Babes-Bolyai University, Cluj-Napoca, Romania, http://www.phys.ubbcluj.ro/~monica.baia/; PHDT: *"Vibrational characterization of coordination and biologically active compounds by means of IR absorption, Raman and SERS in combination with theoretical simulations"*; CRA: Raman, IR, SERS, UV-VIS absorption, theoretical simulations (DFT), pharmaceuticals, nanostructures, photocatalysts, carbon-based nanomaterials.

Cinta-Pinzaru Simona, Professor at Babes-Bolyai University, Cluj-Napoca, Romania https://www.researchgate.net/profile/Simona_Cinta_Pinzaru/experience; PHDT: *"Raman and SERS spectroscopic studies of the metal-adsorbed complex for the biological interest molecules"*; CRA: Raman, IR, tissues, cells, cancer diagnostics, biomolecules, biomedical.

Deckert Volker, Professor at Friedrich-Schiller University and Leibniz Institute for Photonic Technologies, Jena, Germany; https://www.ters.uni-jena.de/ters-staff-volker-deckert.html; PHDT: *"Investigations of binary liquid systems by four-channel Raman spectroscopy"*; CRA: Raman, SERS, TERS, nanospectroscopy, catalysis, bio applications, near-field optics, micelles, nanoparticles, vesicles.

Dietzek Benjamin, Professor at Friedrich-Schiller University and Leibniz Institute for Photonic Technologies, Jena, Germany; https://www.jcsm.uni-jena.de/en/members/dietzek_+benjamin; PHDT: *"Ultrafast linear and non-linear spectroscopy: from biological light-receptors to artificial light-harvesting systems"*; CRA: Raman, electron-transfer dynamics, photoinduced primary processes, semiconductor molecule and metal-molecule interfaces, self-healing processes in polymeric coatings.

Liang Erjun, Professor at Zhengzhou University, Zhengzhou, China https://www.researchgate.net/profile/Liang_Er-Jun/research; PHDT: *"Selected contributions to surface-enhanced linear and nonlinear Raman spectroscopy"*; CRA: CARS, SERS, surface-enhanced hyper-Raman, photoluminescence, thermal expansions, phase transitions, plasmonic substrates, metal oxides, ceramics, nanocomposites, semiconductors.

Materny Arnulf, Professor at Jacobs University of Bremen, Germany. https://www.researchgate.net/profile/Arnulf_Materny; PHDT: *"Absorption, resonance Raman and resonance CARS spectroscopy on diacetylene single crystals with and without colour zones: experiments and theory"*; CRA: Raman, CARS, SERS, nonlinear spectroscopy with femtosecond time resolution, polymers, inorganic and organic semiconductor nanostructures, ionic liquids, food, bio-samples.

Pavel Ioana, Professor at Wright State University, Dayton, USA https://people.wright.edu/ioana.pavel; PHDT: *"Vibrational spectroscopy of density functional theory calculations, a powerful approach for the characterization of pharmaceuticals and new organometallic complexes"*; CRA: Raman, SERS, biomedical chemistry, environmental chemistry, nanotoxicology, forensic sciences, nanosensors for cellular biomarkers, nanoparticles.

Popp Jürgen, Professor at Friedrich-Schiller University and Leibniz Institute for Photonic Technologies, Jena, Germany; https://www.jcsm.uni-jena.de/en/members/popp_+j%C3%BCrgen; PHDT: *"Elastic and inelastic light scattering from single spherical microparticles"*; CRA: Raman, SERS, CARS, development and application of innovative frequency-, time- and spatially resolved laser micro-spectroscopic methods, molecular multidimensional imaging, localization, identification and structural analysis of biomolecules and biological systems, derivation of structure-property and structure-dynamics relationships, biophotonics and materials science.

Schaschek Karl, Professor at Hochschule der Medien, Stuttgart, Germany https://www.hdm-stuttgart.de/view_news?ident=news20090330093443; PHDT: *"Investigations on morphology-dependent resonances in time-resolved Raman spectra of optically levitated microdroplets"*; CRA: print and process engineering, online quality control in print processes, offset, additive manufacturing, print media technologies.

Schlücker Sebastian, Professor at University of Essen-Duisburg, Germany https://www.uni-due.de/schluecker-lab/; PHDT: *"Linear and nonlinear Raman spectroscopy on biologically relevant model systems"*; CRA: Raman, SERS, iSERS, SERS microscopy, CARS, fluorescence, nanostructure fabrication, organic synthesis, immunohistology, plasmonic nanoparticles, biomedical applications, model analytes, microfluids.

Schmitt Michael, Professor at Friedrich-Schiller University Jena, Germany https://orcid.org/0000-0002-3807-3630; PHDT: *"Femtosecond time-resolved coherent fourwave-mixing spectroscopy for state-selective investigation of molecular dynamics of simple systems"*; CRA: Raman, CARS, vibrational spectroscopy, laser spectroscopy, SERS, biochemical and medical applications, multimode imaging, biophotonics, cells, tissues.

Q 10. What is your message to young Raman Spectroscopist on the occasion of 93rd year of discovery of Raman Effect in India.?

Ans: *My message to young Raman spectroscopists: Get infected by the virus Ramanus spectroscopus and not by Covid-19!; Do both, experiment and theory, and follow the advice our master* ***C V Raman*** *gave us: "The essence of science is independent thinking and hard work".*

Prof Kiefer has co-authored more than 40 papers together with Indian scientists. A selection of some of these publications (with Google scholars citations, ordered by numbers of citations; Feb 26, 2021) is listed below :

1. Hydrogen-bonded pyridine–water complexes studied by density functional theory and Raman spectroscopy
   S Schlücker, R K Singh, B P Asthana, J Popp, W Kiefer, *J Phys Chem A*, 105(2001)9983-9989. **Cited: 160 times**.
2. FT-IR, FT-Raman spectra, density functional computations of the vibrational spectra and molecular geometry of biomolecule 5-aminouracil
   M A Palafox, G Tardajos, A Guerrero-Martínez, V K Rastogi, D Mishra,S P Ojha, *Chem Phys*, 340(2007)17-31; **Cited:111 times**
3. Enhancement of photoluminescence in manganese-doped ZnS nanoparticles due to Aa Silica shell
   A S Ethiraj, N Hebalkar, S K Kulkarni, R Pasricha, J Urban, C Dem, *J Chem Phys*, 118(2003)8945-8953. **Cited:106 times**
4. FTIR and FT-Raman spectra and density functional computations of the vibrational spectra, molecular geometry and atomic charges of the biomolecule: 5-bromouracil
   V K Rastogi, M A Palafox, L Mittal, N Peica, W Kiefer, K Lang, S P Ojha; *J Raman Spectrosc*, 38(2007)1227-1241, **Cited:88 times**
5. Vibrational characterization of E102 food additive by Raman and surface-enhanced Raman spectroscopy and theoretical studies, N Peica, I Pavel, S Cîntă Pînzaru, V K Rastogi, W Kiefer, *J Raman Spectrosc*, 36(2005)657-666, **Cited:68 times**
6. Deconvolution of the Lorentzian linewidth and determination of fraction Lorentzian character from the observed profile of a Raman line by a comparison technique
   B P Asthana, W Kiefer, Applied Spectroscopy 36 (1982)250-257. **Cited: 61 times**
7. Dynamic structure of charge carrier in polyaniline by near-infrared excited resonance Raman spectroscopy
   C Engert, S Umapathy, W Kiefer, H Hamaguchi, *Chem Phys Lett*, 218(1994)87-92, **Cited: 47 times**
8. Dimer and Trimer in Pyridine–Ethanol Mixture Reinvestigated Applying the Scanning Multi-Channel Raman Difference Technique and AM1 Molecular Orbital Calculations
   V Deckert, B P Asthana, P C Mishra, W Kiefer, *J Raman Spectrosc*, 27 (1996)907-913; **Cited:44 times**
9. Vibrational Line Profile and Frequency Shift Studies by Raman Spectroscopy, B P Asthana, W Kiefer, In: Vibrational Spectra and Structure, 20(1992) 67-155; J R Durig, Editor; Elsevier, Amsterdam, **Cited: 41 time**
10. Vibrational Dynamics in Hydrogen-Bonded (Pyridine+ Water) Complexes Studied by Spectrally Resolved Femtosecond CARS. S Schlücker, M Heid, R K Singh, B P Asthana, J Popp, W Kiefer, *Zeitschrift für Physikalische Chemie*, 216(2002)267-278, **Cited:32 times**
11. Vibrational and theoretical study of coumarin-3-carboxylic acid binding mode in Ce (III) and Nd (III) complexes
    I Georgieva, N Trendafilova, W Kiefer, V K Rastogi, I Kostova, *Vib Spectrosc*, 44(2007)78-88; **Cited:29 times**
12. Investigation of hydrogen bonding and self-association in neat $HCONH_2$ and the binary mixture ($HCONH_2$+ CH_3OH) by concentration dependent Raman study and *ab initio* calculations, A K Ojha, S K Srivastava, J Koster, M K Shukla, J Leszczynski, B P Asthana, W Kiefer, *J Mole Struct*, 689(2004)127-135; **Cited:29 times**
13. FT-IR and FT-Raman spectra, ab initio and density functional computations of the vibrational spectra, molecular geometry, atomic charges and some molecular properties of the biomolecule5-iodouracil, V K Rastogi, M A Palafox, A Guerrero-Martínez, G Tardajos, J K Vats, I Kostova, S Schlücker, W Kiefer *J Mole Struct: THEOCHEM*, 940 (2010)29-44; **Cited:26 times**

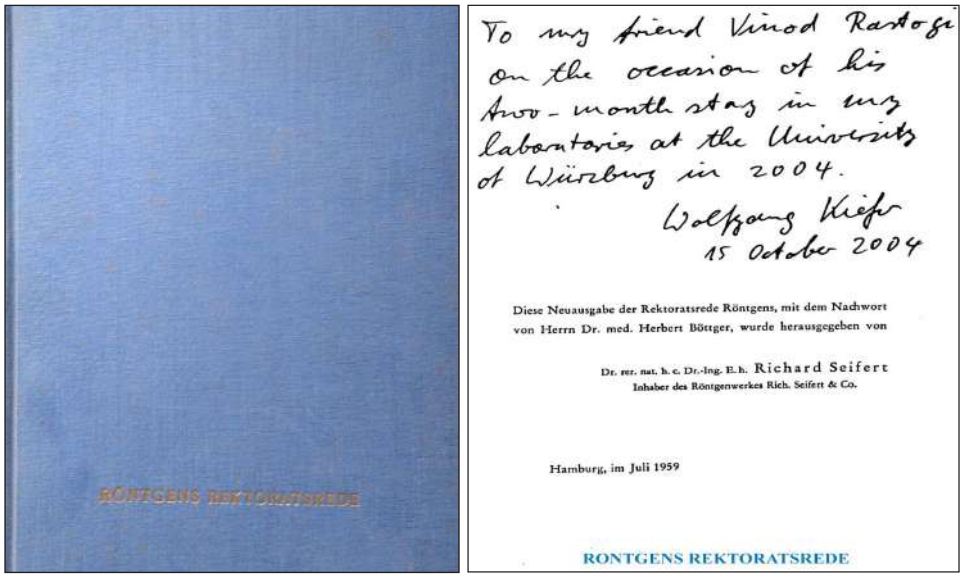
14. The interdependence of small linewidth and frequency changes of a vibration in liquid mixtures of $CDCl_3$ and CCl_4, B P Asthana, W Kiefer, E W Knapp, *J Chem Phys*, 81(1984)3774-3778, **Cited:26 times**
15. Geometrical parameters, vibrational wavenumbers, and relationships established with six difluorobenzonitriles

    V K Rastogi, M A Palafox, S Singhal, S P Ojha, W Kiefer, *Int J Quant Chem*, 107(2007)1099-1114; **Cited:24 times**
16. Isotopic dilution study of self association in (CH_3CN+ CD_3CN) mixture by scanning multichannel Raman difference technique and *ab-initio* calculations, B P Asthana, V Deckert, M K Shukla, W Kiefer, *Chem Phys Lett*, 326 (2000)123-128; **Cited:24 times**
17. Vibrational dephasing and the Raman non-coincidence effect of $CHBr_3$ in isotopic dilution, V Deckert, B P Asthana, W Kiefer, H G Purucker, A Laubereau; *J Raman Spectrosc*, 31(2000)805-811, **Cited:20 times**

Prof Kiefer visited Meerut (India) four times (1999, 2003, 2004, 2006). For the first time he visited Meerut College (one of the oldest and biggest College of Northern India) in Feb 1999 during NCLS-1999, Feb 25-28,1999 and opened the conference on Feb 25, 1999. Next, he visited Meerut College again during NCLS-2003, Feb 25-28, 2003. Third time Prof Kiefer visited, Physics Department, CCS University Campus, Meerut, during NCPEOS-2004 (April 5-7) and delivered his key note address on "Linear Raman and Femtosecond Four Wave Mixing Spectroscopy on Nanostructures" on April 5, 2004. Prof R S Sirohi was Patron and Prof Kehar Singh was Technical Chair of NCPEOS-2004. Finally, he visited Meerut in 2006 to open the 1st International Conference on Perspectives of vibrational Spectroscopy (ICOPVS, Feb 25-28, 2006). In this 4 days conference, 4 Plenary, and 25 Invited Talks, 15 Oral and more than 60 Posters were given and Key Note Lecture on "Application of FTIR and Raman Spectroscopy in medical diagnostics" was delivered by Prof Janos Mink (Hungary), on Feb 25, 2006.

I had the opportunity to visit his Lab in 2004 and 2006; and was able to write a few papers with him. He had also invited me to visit his lab in 2005 along with Dr Irena Kostova, but I was not able to go as the leave was not sanctioned to me and Dr Irena visited alone and performed some work on Metal-Complexes.

How pleasant the days were? I still remember that I used to travel from Guest House to Wuerzburg University by Bus no 10 and railway station by Tram no 4. A day before my return back to India in Oct 2004, he presented me the book "Röntgen Rektorratsrede" which always lies on my Reading Table and reminds me my most pleasant and most productive stay in the beautiful city of Wuerzburg (Germany).



Pleasant Moments

Wolfgang delivering lecture during VII ICOPVS on Nov 25, 2018, at 3:02 P M, BARC, Mumbai, India

Wolfgang lighting the lamp during inauguration of VII ICOPVS on Nov 26, 2018 at 9:16 AM, BARC, Mumbai,

Wolfgang (on chair), standing (from left) Irena, Manoj and Vinod during VII ICOPVS, BARC, Mumbai, India

M Heise (left) and W Kiefer during VII ICOPVS, BARC, Mumbai, India

from left: Chandrabhas Narayana, Wolfgang Kiefer presenting Dayawati Rastogi Lecture Award to Prof T Brixner (third) on Feb 28, 2020 during VIII ICOPVS, Vinod Rastogi

From left: Chandrabhas Narayana, A Sundaresan, W Kiefer presenting Dayawati Rastogi Award for best Oral Presentation to Ms Vidya, on Feb 28, 2020 during VIII ICOPVS, Vinod Rastogi

Vinod Rastogi (left) and W Kiefer in Gandhi Kurta on Feb 24, 2020, JNCASR, Bangalore, India

Vinod Rastogi (left) and C N R Rao on Feb 29, 2020, JNCASR, Bangalore, India

(From left) V S Jayakumar, Vinod Rastogi, W Kiefer, Gisela Kiefer, Sunila Abraham at JNCASR, Bangalore.

Wolfgang Kiefer and Gisela Kiefer on Feb 25, 2020 at JNCASR, Bangalore, India

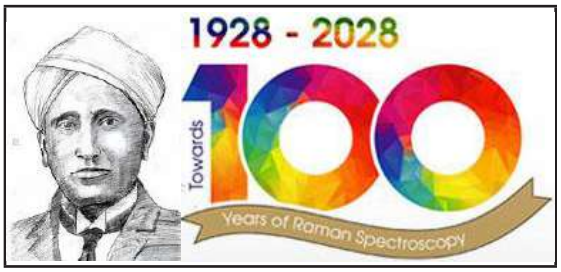
In the words of Bharat Ratna Prof CNR Rao

"*The Raman Effect constitutes the greatest discoveries of the century. Even Raman did not know the far reaching applications. I belong to the evergreen family of spectroscopists*".

In the end, with many many pleasant memories of my association with Wolfgang, I like to quote the words of Raman

"*the face of nature as presented to us is infinitely varied, but to those who love her, it is ever beautiful and interesting. The blue of the sky, the glories of sunrise and sunset, the ever shifting panorama of clouds, the varied colours of the forest and fields and the star sprinkled sky at night- these and many other scenes pass before our eyes on the never ending drama of light and colour which nature presents for our benefit*".

[C V Raman: A pictorial Biography, Indian Academy of Sciences, Bangalore,1988].



Wolfgang Kiefer (left) and Vinod Rastogi (right) during "Corona time" end of 2020.

Sunday; Feb 28, 2021