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R E P O R T 1983

OF THE

SECTION "KARL SCHÖNHERRSTR. 3" (FORMERLY "INSTITUTE
OF ATOMIC PHYSICS") OF THE "INSTITUTE OF EXPERIMENTAL-
PHYSICS"

AT THE

LEOPOLD FRANZENS UNIVERSITY

INNSBRUCK, AUSTRIA.

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P R E F A C E

1983 was a successful year in scientific terms, as can be seen from the enclosed list of publications, including results on elementary processes in plasmas, properties of ions, the physics of clusters as well as radiation damage in solids. We enjoyed the visits of many colleagues and friends and were able to extend our cooperations with foreign research groups working in our field.

Despite all the success achieved in 1983, this 31st of December is a sad day in our career. It is the ending date of the "Forschungsschwerpunkt Plasmaphysik", which had been financed over the past 10 years by the "Fonds zur Förderung der wissenschaftlichen Forschung". This "Forschungsschwerpunkt Plasmaphysik" allowed us to construct a variety of most powerful scientific apparatus and to form an efficient group of young scientists.

Despite of our intense efforts over the past 18 months we were not able to reach a continuation of the "Forschungsschwerpunkt Plasmaphysik". The consequences are that some of our coworkers already had to leave us and more will have to do so over the next months and thus valuable Know-How will be lost. The Austrian "Forschungsrat", the highest ranking scientific advisory committee has pointed out the necessity of a continuation of the "Forschungsschwerpunkt Plasmaphysik", but neither that, nor our pleas to our Minister of Science and Research, Dr. Heinz Fischer, Minoritenplatz 5, 1010 Wien, has brought a definitive promise of support of our future work.

Innsbruck, Dec. 31st 1983

F. Howorka

Univ. Prof. Dr. F. Howorka

T. Märk

Univ. Prof. Dr. T.D. Märk

W. Lindinger

Univ. Prof. Dr. W. Lindinger

ORGANIZATION

Our section "Karl Schönherrstr. 3" of the Institute of Experimental physics, formerly (till 1978) "Institut für Atomphysik" consists of three groups, using jointly administrative and teaching facilities, as well as a small laboratory at "Karl Schönherrstr. 3". Most of our laboratories however are located at Peter Mayr-Str. 1a.

- I. Atomic and Molecular Physics (W. Lindinger)
- II. Nuclear Physics, Applied Solid State Physics, and Gaseous Electronics (Tilman D. Märk)
- III. Spectroscopy and Laser Physics (Franz Howorka)

PERSONNEL AND COWORKERS

Full time University staff:

- a.o. Univ. Prof. Dr. F. Howorka (III)
- a.o. Univ. Prof. Dr. W. Lindinger (I)
- a.o. Univ. Prof. Dr. T.D. Märk (II)
- M. Heigl (Secretary) (I,II,III)
- W. Gapp (Mechanical Engineering Technicum) (I,II,III)
- M. Senn (Electronic Engineer) (I,II,III)

Staff hired mainly through "Forschungsschwerpunkt Plasmaphysik"

- Mag. W. Dobler (V.Ass) (I,III)
- Mag. W. Federer (I,III)
- Mag. A. Girstmair (II)
- Mag. P. Girstmair (II)
- M. Grindhammer (III)
- M. Hesche (II) (Stud.Ass.)

M. Kriegl (I)
Dr. I. Kuen (V.Ass.) (III)
Mag. K. Leiter (II) (V.Ass.)
Prof. Dr. Mag. E. Märk (II)
St. Niccolini (I)
em. o. Univ. Prof. Dr. M. Pahl (I,II,III)
M. Placheta (TA) (II)
K. Peska (I)
H. Ramler (I)
R. Richter (I)
Mag. W. Ritter (V.Ass) (II)
A. Saxer (I)
S. Schöpf (II)
Dr. G. Sejkora (II) (V.Ass.)
Dr. K. Stephan (V.Ass) (II)
Mag. P. Tosi (I)
Dr. H. Villinger (V.Ass) (I)

Fulbright-Guestprofessor during 1982/83:

Prof. Dr. Howard Bryant (Dept. Physics, University of New Mexico,
Albuquerque, USA)

HONORARY DSc TO ROBERT VARNEY

Prof. Robert Varney, Palo Alto, California, USA, a frequent visitor, lecturer and guest professor of the former Institut für Atomphysik was awarded the honorary DSc of the Science-Faculty of our University.

The academic ceremony took place at the Aula of the Leopold Franzens University, on July 5th, 1983.

The PROMOTION was performed by Univ. Prof. Dr. J. Rothleitner, presently the Rektor of the University, and the LAUDATIO was held by em. Univ. Prof. Dr. Max Pahl.

RESULTS

The following represents a brief summary of results obtained and published during 1983. Details of these results are given in the publications listed in the next section.

I. Atomic and molecular physics:

State selected ion neutral interactions

The quenching and reactive collisions of vibrationally excited ions (such as $N_2^+(X, v=1)$, $N_2H^+(v=1,2)$, $NO^+(X, v=1,2,3)$) with neutrals have been investigated in the energy regime from thermal to ~ 1 eV, KE_{cm} . State to state reactions were also investigated in a few cases, e.g. in reactions of the type $N_2^+(X, v=0,1) + H_2 \rightarrow$ Products, where especially the product distribution $N_2H^+(v=0,1$ and $\geq 2)$ was investigated.

Vibrational temperature of ions

The internal temperature of ions, such as O_2^+ , N_2^+ , N_4^+ drifting in various buffer gases has been investigated as a function of E/N . With these data it is now possible to investigate the reactions of these ions with neutrals both as a function of the relative kinetic energy between the reactants and as a function of the ion internal temperature.

Interstellar molecular synthesis

The ion chemistry of protonated formic acid and its projection have been studied with respect to possible implications for interstellar molecular synthesis. With the same emphasis a variety of ion reactions with atomic hydrogen is being performed.

Fusion related research

A method has been developed for the investigation of reactions between ions and atomic hydrogen in the energy regime from thermal to ~ 1 eV. Reactions of this type are important for the understanding of the plasma wall interaction and of the ion physics in the vicinity of the limiters of fusion reactors. For the same purpose the investigation of reactions between singly and multiply charged ions with H_2 and neutrals expected to be present in fusion devices as impurities is being continued.

II. Nuclear Physics, Applied Solid State Physics and Gaseous Electrons:

Electron impact ionization

Determination of absolute, partial and total ionization-cross sections up to 180 eV, as well as appearance potentials in molecular gases which are of importance for plasma etching (CF_4 , CCl_4 and CF_2Cl_2). Theoretical calculations of cross sections.

Development of a new experimental method to investigated energetic fragment ions.

Physics of Clusters

Determination of appearance potentials and dissociation energies of clusters involving N_2 , CO_2 and NH_3 . Investigations on the stabilities of small cluster ions (unimolecular and collision induced dissociation of Ar and N_2 bearing cluster ions).

Transport in Plasmas

Determination of transverse diffusion coefficients with high accuracy as a function of E/N for singly and doubly charged rare gas ions in their parent gases, as well as for N_2^+ and N_4^+ in N_2 .

Ion neutral interaction potentials are being calculated from these results.

Radiation damage in solids

Investigations on the annealing and time dependences of the structures of radiation damages in Apatit and Titanit. Absorption spectroscopy of HII centers in Apatit. Investigation of age-temperature of Minerals from Austria, Sweden, Italy and Iran.

III. Spectroscopy and Laser Physics:

Excitation in ion-molecule and ion-atom collisions

Excitation of N_2^+ in collisions with He, Ne, Ar; measurement of the excitation cross section in collisions of He^+ with Ar and Ar^+ with He; measurement of the excited branching in reactions of He^+ with Xe in the energy range 0.04 - 2 eV.

Hollow-cathode discharges

Charge transfer and direct excitation in collisions of fast ions with neutrals in the sheath; development of special geometrics to use charge exchange excitation for many-line lasers (collaborating with CRIP Budapest); some optogalvanic measurements in the neon hollow cathode discharge using an argon ion pumped dye laser; production and loss of H^- ions in the negative glow of an H_2 discharge.

Publications in International Journals, Books, and Book Chapters published
1983 or in print.

- K. Stephan, J.H. Futrell, T.D. Märk and A.W. Castleman, Jr., Mass spectrometric investigation of NH_3 and CO_2 Van der Waals clusters: appearance potentials and stability, Vacuum TAIP, 33m (1983) 77-85
- K. Stephan and T.D. Märk, Unimolecular and collision induced dissociation of cluster ions, Int. J. Mass Spectrom. Ion Phys., 47 (1983) 195-198
- E. Bertel and T.D. Märk, Fission tracks in minerals: annealing kinetics, track structure and age correction, Phys. Chem. Minerals, 9 (1983) 197-204
- K. Stephan, T.D. Märk, E. Märk, A. Stamatovic, N. Djuric and A.W. Castleman, Jr., Metastable decomposition of Ar_3^+ cluster ions into Ar_2^+ and Ar^+ , Beitr. Plasmaphysik, 23 (1983) 369-372
- A. Girstmair, W. Ritter, E. Märk and T.D. Märk, Annealing of etchable fission induced defects at high temperatures in natural fluorapatite, Rad. Effects, 74 (1983) 175-179
- W. Ritter and T.D. Märk, Absorption spectroscopy of the annealing of absorbing defects in natural fluorapatite, Rad. Effects, 73 (1983) 185-191
- G. Sejkora and T.D. Märk, Transverse diffusion of mass identified N_2^+ ions in nitrogen, Chem. Phys. Lett., 97 (1983) 123-126
- E. Bertel, W. Ritter, E. Bertagnolli and T.D. Märk, Fission damage induced color centers in apatite, Phys. Rev., B 27 (1983) 3730-3734
- K. Stephan, T.D. Märk and A.W. Castleman, Jr., Metastable dissociation of N_4^+ , J. Chem. Phys., 78 (1983) 2953-2956
- K. Stephan, A. Stamatovic and T.D. Märk, Unimolecular and collision induced dissociation of Ar_2^+ , Phys. Rev. A 28 (1983) Nov. 1

- W. Dobler, W. Federer, F. Howorka, W. Lindinger, M. Durup-Ferguson and E.E. Ferguson, Vibrational relaxation of $\text{NO}^+(v)$ ions in neutral collisions, *J. Chem. Phys.* **79**, 1543 (1983)
- P. Tosi, S. Ianotta, D. Bassi, H. Villinger, W. Dobler and W. Lindinger, *J. Chem. Phys.* Feb. (1984)
- W. Lindinger, State Selected Ion-Neutral Interactions at Low Energies, In XIII Internat. Conference on the Physics of Electronic and Atomic Collisions - Book of Invited Papers (eds. J. Eichler, I.V. Hertel and N. Stolterfoht). North Holland Publ. Company, in press
- W. Lindinger, The role of internal energy in ion molecule reactions, in "General and Topical Lectures of XVth ICPIG" (eds. W. Böttcher, H. Wenk and E. Schulz-Gulde) Univ. Duisburg, 1983
- W. Lindinger, H. Villinger and W. Federer (eds.) "3rd International Swarm Seminar - Proceedings", Inst. f. Experimentalphysik, Univ. Innsbruck, 1983
- W. Lindinger, F. Howorka and T.D. Märk (Editors) "Swarms of Ions and Electrons in Gases", Springer-Verlag, Wien (1984), in print
- W. Lindinger, Kinetic and internal energy effects in ion-neutral reactions, in "Swarms of Ions and Electrons in Gases", Springer-Verlag, Wien (1984) in print
- W. Lindinger and F. Howorka, Application of electron impact ionization to plasma diagnostics, in "Electron impact ionization", (T.D. Märk and G.H. Dunn, Eds.) Springer-Verlag (1984) in press
- H. Böhringer, D.W. Dahey, W. Lindinger, F. Howorka and D.L. Albritton, Mobilities of Various Mass-Identified Positive and Negative Ions in Air, *J. Geophys. Res.*, in press
- F. Howorka, I. Kuen and W. Federer, Excited state formation in the interaction of mass resolved ion beams with molecular and atomic targets (1 - 4000 eV, 200 - 800 nm). *Int. J. Mass Spectrom. Ion Phys.* **47**, 151 (1983)
- I. Kuen, H. Störi and F. Howorka, Measurement of direct and charge-exchange excitation cross section in collision of 1 - 1800 eV (laboratory frame) He^+ , Ne^+ , Ar^+ , Kr^+ and B^+ ions of 1 - 3600 eV He^{2+} , Ne^{2+} and Ar^{2+} ions with O_2 (wavelength region 2000-8000 Å). *Phys. Rev. A* **28**, 119 (1983)

- T.D. Märk, Transverse diffusion of ions, Chapter 4 in book "Swarms of ions and electrons in gases" (W. Lindinger et al., Ed.) Springer Verlag, 1983, in print, 30 pages
- W. Lindinger, Reactions of doubly charged ions at near thermal energies, *Physica Scripta*, T3, 115 (1983)
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- W. Dobler, H. Villinger, F. Howorka and W. Lindinger, Energy dependences of reactive and quenching collisions of N_2^+ ($X, v>0$) with O_2 and NO, *Int. J. Mass Spectrom. Ion Phys.* 47, 171 (1983)
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- H. Villinger, A. Saxer, R. Richter and W. Lindinger, Collisional dissociation of $CH_3O_2^+$, *Chem. Phys. Lett.* 96, 513-516 (1983)
- W. Dobler, H. Ramler, H. Villinger, F. Howorka and W. Lindinger, Reactive and quenching collisions of N_2^+ ($X, v>0$) with Kr and NO, *Chem. Phys. Lett.* 97, 553 (1983)
- H. Villinger, R. Richter and W. Lindinger; On the structure of $CH_3O_2^+$, *Int. J. Mass Spectrom. Ion Phys.* 51, 25-30 (1983)
- F. Handle, W. Lindinger, F. Howorka and M. Pahl, Density of fast electrons in the axis of a cylindrical hollow-cathode discharge, *Beitr-Plasmaphysik*, in press
- H. Villinger, J.H. Futrell, A. Saxer, R. Richter and W. Lindinger, An Evaluation of the Role of Internal Energy and Translational Energy in the Endothermic Proton Transfer Reaction of N_2H^+ with Kr, *J. Chem. Phys.*, in press
- W. Lindinger, E.E. Ferguson, Laboratory Investigation of the Ionospheric $O_2^+(X^2\Pi_g, v \neq 0)$ Reaction with NO. *Planetary and Space Science*, 31, 118 (1983)

- W. Ritter and T.D. Märk, Optical studies of fission induced radiation damage and its annealing in natural calcium fluorophosphate, Nuclear Instruments and Methods, in print
- K. Stephan, T.D. Märk, J.H. Futrell and H. Helm, Electron impact ionization of $(N_2)_2$: appearance energies of N_3^+ and N_4^+ , J. Chem. Phys., in print
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- W. Ritter and T.D. Märk, Optical studies of fission tracks in apatite, Nuclear Tracks, in print
- W. Ritter, F. Kronthaler, A. Girstmair, R. VArtanian, H.J. Koark, F. Purtscheller, E. Märk, and T.D. Märk, Fission track temperature ages, Nuclear Tracks, in print
- A. Girstmair, W. Ritter, E. Märk, and T.D. Märk, High temperature fission track annealing in natural fluorapatite, Nuclear Tracks, in print
- T.D. Märk, Ionization of Molecules by Electron Impact, Chapter 3 in book "Electron-Molecule Interactions and their Applications", (Ed. L.G. Christophorou, Academic Press, (1983) in print, 84 pages
- T.D. Märk and G.H. Dunn (Editors) "Electron impact ionization", Springer Verlag, 1983, in print, 320 pages
- S. Younger and T.D. Märk, Classical approximations and empirical formulae, Chapter 3 in book "Electron impact ionization", (T.D. Märk and G.H. Dunn, Ed.), Springer Verlag, 1983, in print, 25 pages
- T.D. Märk, Partial cross sections, Chapter 6 in book: "Electron impact ionization", (T.D. Märk and G.H. Dunn, Ed.), Springer Verlag, 1983, in print, 50 pages
- T.D. Märk and A.W. Castleman, Jr., Experimental Studies on Cluster Ions, Advances in Atomic and Molecular Physics, 20 (1984), in print 50 pages

PUBLICATIONS IN PREPARATION

- K.I. Peterson, T.D. Märk, R.G. Keesee and A.W. Castleman, Jr., Thermochemical properties of gas-phase mixed clusters: $\text{H}_2\text{O}/\text{CO}_2$ with Na^+ , J. Chem. Phys., submitted (1983)
- G. Sejkora, P. Girstmair, H.C. Bryant and T.D. Märk, The transverse diffusion of Ar^+ and Ar^{2+} in Ar, Phys. Rev. A, submitted (1983)
- D. Hunton, C.A. Albertoni, T.D. Märk, and A.W. Castleman, Jr., Unimolecular decay of metastable CO_3^- , Chem. Phys. Lett., submitted (1983)
- K. Stephan and T.D. Märk, Appearance energies for the electron impact ionization of rare gas dimers, Phys. Rev. A, to be submitted
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- K. Stephan, H. Helm and T.D. Märk, Metastable decay of Ar_2^+ produced by associative ionization, Phys. Rev. A, to be submitted
- T.D. Märk, P. Girstmair, G. Sejkora, M. Hesche, H.C. Bryant, Transverse diffusion of He^+ in He, Ne^+ and Ne^{2+} in Ne and N_2^+ N_4^+ in N_2 , Phys. Rev. A, to be submitted
- K. Stephan and T.D. Märk, Absolute partial ionization cross sections for $\text{Xe} + e$, J. Chem. Phys., to be submitted
- K. Leiter, K. Stephan, E. Märk and T.D. Märk, Electron impact ionization of CCl_4 : ionization cross sections and appearance energies, J. Chem. Phys., to be submitted
- K. Stephan, H. Deutsch and T.D. Märk, Electron impact ionization of CF_4 ionization cross sections and appearance energies, J. Chem. Phys., to be submitted

- I. Kuen, W. Federer, F. Howorka and A. Ding, Direct and charge exchange excitation in collisions of He^+ with Ar and Ar^+ with He in the energy range 1 - 4200 eV Lab (2000 - 8000 Å), submitted (1983)
- H. Deutsch, F. Howorka, W. Federer and I. Kuen, Excitation processes in collisions of C^+ ions with Ar atoms in the energy range 10 - 4200 eV Lab (2000 - 8000 Å), submitted (1983)

DIPLOM- AND THESIS WORKS

A) Diplom and thesisworks completed during 1983:

Elektronenstoßionisierung von Tetrachlorkohlenstoff mit mikroprozessorgesteuerter Massenspektrometrie (K. Leiter, 1983 Diplom)

Produktion und Verlust negativer Wasserstoffionen in einer stationären Hohlkathodenentladung. (M. Grindhammer, 1983, Diplom)

Entwicklung und Anwendung einer Elektronenstoß-Hochdruck-Ionenquelle (R. Richter, Diplom, 1983)

B) Diplom and thesisworks still in progress

Transversale Diffusion von einfach und zweifach geladenen Edelgas-Ionen (P. Girstmair, Diss.)

Transversale Diffusion von Dimer-Ionen (M. Hesche, Diplom)

Strahlenschäden in Festkörpern: Entstehung, Struktur und Ausheilung (W. Ritter, Diss.)

Strahlenschäden in Einbettmaterialien für hochradioaktive Abfälle (A. Girstmair, Diss.)

Elektronenstoßionisierung von Clustern (K. Leiter, Diss.)

Altersbestimmung von Mineralien aus Schweden (S. Schöpf, Dipl.)

Spektroskopische Bestimmung der Anregungsrate für quasiresonante Xe^+ -Resonanzlinien in Energiebereich 0.04 - 2eV (Wellenlängenbereich 584 - 1470 Å)

Entwicklung einer Alkaliionenquelle (M. Kriegl, Dipl.)

Einfluß der ionischen Anregung auf spezielle Ionen-Molekül-Reaktionen (A. Saxer, Diss.)

Analyse von zustandsselektierten Ionen-Neutral-Reaktionen (H. Ramler, Diss.)

INVITED LECTURES AND INVITED PROGRESS REPORTS PRESENTED AT
INTERNATIONAL MEETINGS

- W. Lindinger, State Selected Ion-Neutral Interactions at Low Energies, XIIIth Int. Conf. on the Physics of Electronic and Atomic Collisions (ICPEAC), Berlin, July 27 - Aug. 2, 1983
- W. Lindinger, The role of internal energy in ion molecule reactions, XVth International Conference on Phenomena in Ionized Gases (ICPIG), Düsseldorf, BRD, 29. Aug. - 2. Sept. 1983
- W. Lindinger, Drift Tube Methods; Workshop on Gas Phase Ion Chemistry, Snowbird, Utah, Sept. 12-16, 1983
- W. Lindinger, Positive Ion Reactions, I: Chemistry of the Cosmos, Workshop on Gas Phase ion Chemistry, Snowbird, Utah, Sept. 12-16, 1983
- W. Lindinger, Positive Ion Reactions, II. Internal Energy Effects, Workshop on Gas Phase Ion Chemistry, Snowbird, Utah, Sept. 12-16, 1983
- H. Villinger, A. Saxer, E.E. Ferguson, H.C. Bryant and W. Lindinger, On the role of HC(OH)_2^+ in interstellar molecular synthesis, 3rd International Swarm Seminar, Innsbruck, Aug. 3-5, 1983
- W. Lindinger, A. Saxer, H. Ramler, R. Richter and H. Villinger, The internal energy of N_4^+ drifting in N_2 and He, 3rd International Swarm Seminar, Innsbruck, Aug. 3-5, 1983
- T.D. Märk, Electron Impact Ionization, Invited lecture, Utah Workshop on Gaseous Ion Chemistry, Utah (1983)
- T.D. Märk and A.W. Castleman, Jr., Ions becoming liquids - cluster ions and nucleation phenomena, Invited lecture, Utah Workshop on Gaseous Ion Chemistry, Utah (1983)
- G. Sejkora, H. Bryant, P. Girstmair, M. Hesche, N. Djuric and T.D. Märk, Transverse diffusion of mass identified ions in their parent gas, Invited paper, 3rd International Swarm Seminar, Innsbruck (1983) 201 - 205

PRESENTATIONS AT MEETINGS AND CONTRIBUTIONS IN PROCEEDINGS

- H. Villinger, A. Saxer, E.E. Ferguson, H. Bryant, R. Richter and W. Lindinger, Some production and destruction reactions of protonated formic acid, $\text{HC}(\text{OH})_2^+$, in "Electronic and Atomic Collisions", (eds. J. Eichler, W. Fritsch, I.V. Hertel, N. Stollerfoth, U. Wille) p. 656. XIII ICPEAC, Berlin 1983
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- W. Federer, I. Kuen, W. Lindinger, W. Dobler and F. Howorka, Population of nearly resonant Xe^{++} states by charge transfers escalation from He^+ as studied spectroscopically in a Flow-Drift Tube (energy range: 0.04 - 2 eV; Wavelength region: 584-1470 Å). 3rd Int. Swarm Seminar, Innsbruck Aug. 3-5, (1983) Proceedings p. 174-179
- P. Tosi, S. Ianotta, D. Bassi, H. Villinger, W. Dobler and W. Lindinger, A method to study reactions between ions and atomic hydrogen in a quasistatic drift tube, 3rd Int. Swarm Seminar, Innsbruck, Aug. 3-5 (1983), Proceedings p. 186-190
- W. Federer, W. Dobler, H. Ramler, W. Lindinger, P. Tosi and D. Bassi, Reactions of CO_2^+ and CH_5^+ with atomic hydrogen studied in a flow drift experiment. 3rd Int. Swarm Seminar, Innsbruck, Aug. 3-5 (1983), Proceedings, p. 191-195
- W. Dobler, W. Federer, E.E. Ferguson, F. Howorka, M. Durup-Ferguson and W. Lindinger, Vibrational relaxation of NO^+ ($v=3,2,1$) by various neutrals, 3rd Int. Swarm Seminar, Innsbruck, Aug. 3-5, (1983) Proceedings p. 196-200

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- H. Villinger and W. Lindinger, Schwarmexperiment zur Untersuchung von Ionen-Neutral-Wechselwirkungen, ÖPG-Jahrestagung, Linz, 28. - 30. Sept. 1983, Abstracts p. 57
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- W. Dobler, W. Federer, F. Howorka, M. Durup-Ferguson, E.E. Ferguson and W. Lindinger, Collisional quenching of NO^+ ($X, v o$) by neutrals at low energies; XVI ICPEAC, Düsseldorf (Aug. 29. - Sept. 2, 1983) Proceedings, p. 570, 571
- H. Villinger, A. Saxer, H. Bryant and W. Lindinger, Termally association reaction of CH_3^+ and $CH(OH)_2^+$ with H_2O in He buffer. XVI ICPEAC, Düsseldorf (Aug. 29. - Sept. 2, 1983), Proceedings, p. 572, 573
- T.D. Märk, K. Stephan, J.H. Futrell, A.W. Castleman, Jr., and H. Helm, Properties of N_4^+ , Proceedings of 31st Annual Conference on Mass Spectrometry and Allied Topics, Boston (1983) p. 735
- K. Stephan, H. Deutsch and T.D. Märk, Mass Spectrometric study of the electron impact ionization of CF_4 , Proceedings of 31st Annual Conference on Mass Spectrometry and Allied Topics, Boston (1983) p. 734
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- K. Stephan and T.D. Märk, Electron impact ionization of CF_4 and CCl_4 , Utah Workshop on Gas Phase Ion Chemistry Mass Spectrometry, Snowbird (1983)
- K. Stephan, A. Stamatovic and T.D. Märk, Electron attachment and ionization of CO_2 clusters, Utah Workshop on Gas Phase Ion Chemistry Mass Spectrometry, Snowbird (1983)
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- C. Albertoni, D. Hunton, T.D. Märk and A.W. Castleman, Jr., Laser Photo-dissociation Spectroscopy of negative cluster ions, Poster at Research in Progress, Penn State University, State College (1983)
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- I. Kuen and F. Howorka, Collisions of singly and doubly charged ions with oxygen molecules in the energy range 1 - 1800 (3600) eV. Symposium on surface science, Obertraun, Jan. 31 - Feb. 4, 1983
- I. Kuen, B. Jeļenković and F. Howorka, Excitation in collisions of N_2^+ with He, Ne and Ar in the energy range 1 - 2000 eV (2000-8000 Å) Abstr. 13th ICPEAC Berlin, p. 612 (1983)
- F. Howorka, I. Kuen, Excitation of NII resonant lines (645-1086 Å) by He^+ ions in the cathode sheath of a cylindrical hollow cathode discharge in He + 4% N_2 . Contr. XVIth ICPIG Düsseldorf, p. 560 (1983)
- M. Grindhammer, I. Kuen, H.C. Bryant and F. Howorka, Production and loss of H^- in a hollow cathode discharge. Proc. 3rd Int. Swarm Seminar, ed. W. Lindinger (Innsbruck), p. 136-143 (1983)
- F. Howorka, I. Kuen, Optische Anregung in Stößen mit He, Ne, Ar and Xe im Energiebereich 1 - 2000 eV. ÖPG Jahrestagung Linz, p. 57 (1983)

EXTENDED VISITS OF RESEARCHERS AND GUESTPROFESSORS; INVOLVING TEACHING
AND/OR RESEARCH ACTIVITIES.

- Prof. Dr. H.C. Bryant (Dept. Chemistry, University New Mexico, Albuquerque, USA): Fulbright Gastprofessor WS 82/83 und SS 83 (Atomphysik, Gaselektronik)
- Prof. Dr. A. Stamatovic (Institute of Physics, Belgrad, Jugoslavien): Jänner, Feber 1983; Mai-Juni 1983 (Clusterionen)
- Dr. B. Jelnekovic (Univ. Beograd, Jugoslavien): Feb. - März 1983 (Stoßanregung bei Wechselwirkung von N_2^+ Ionen mit Atomen)
- Dr. David Smith (Dept. Space Research, Univ. Birmingham, England): Feb. 1983 (IMR)
- Dr. N.G. Adams (Dept. Space Research, Univ. Birmingham, England): Feb. 1983 (Ion Molecule Reactions)
- Prof. Dr. Marie Durup-Ferguson (Laboratoire de Resonance Electronique et Ionique, Orsay, France): März 1983 (IMR)
- Prof. Dr. Eldon Ferguson (Aeronomy Laboratory, NOAA, Boulder, Colorado, USA) March-April 1983, and Dec. 1983 (Excitation and Quenching of Ions)
- Prof. Dr. M.T. Elford (Institute of Advanced Studies, Australian National University, Canberra, Australia): Juli, August 1983 (Transversale Diffusion)
- Dr. R. Vartanian (Nuclear Research Center, Atomic Energy Organization Iran, Tehran, Iran): Oct., Nov. 1983 (Strahlenschäden in Festkörpern)
- Dr. Hans Erich Wagner (Univ. Greifswald, DDR): Dezember 1983 (Ion Molecule Reactions)
- Dr. Juray Glosik (Charles University, Prag): Oct.-Dec. 1983 (Ion Molecule Reactions)

Dr. R.A. Cassidy (Hahn-Meitner-Institut Berlin): Nov. 1983 (Niederenergetische Wechselwirkungen von Ionen mit Atomen)

**Doz. Dr. Adalbert Ding (Hahn-Meitner-Institut, Berlin): Nov. 1983
(Ab initio Berechnungen des Stoßsystems He^+ -Ar und Ar^+ - He)**

Doz. Dr. H. Deutsch (Universität Greifswald): Dez. 1983 (Anregung bei Stößen von C^+ -Ionen auf Ar-Atome im Energiebereich 10-4200 eV)

INVITATIONS TO LECTURES AT FOREIGN UNIVERSITIES OR RESEARCH INSTITUTES

Date	Person	Institution	Title
5. May	W. Lindinger	Physics Dept. Univ. of Trento, Italy	Recent Results on Ion Molecule Reactions
18. May	F. Howorka	Dept. Chemistry Univ. of Utah, Salt Lake City, UT, USA	Population of excited states in low energy collisions of He ⁺ with Xe
May	T.D. Märk	Dept. Chemistry, Penn State Univ., USA	Atomic Physics in Innsbruck
Sept.	T.D. Märk	--	Electron ionization of rare gas atoms and clusters
7. Sept.	F. Howorka	Universität Greifswald, DDR	Anregung im Ionenstoß bei niedrigen und mittleren Energien
12. Sept.	F. Howorka	Hahn-Meitner-Institut Berlin, BRD	Quasimolekulare Betrachtung der Stoßvorgänge von Ionen mit Atomen
Oct.	T.D. Märk	Dept. Chem., Penn State University, USA	Transverse diffusion
4. Nov.	W. Lindinger	JILA (Joint Institute for Laboratory and Astrophysics), Boulder, Colo, USA	Ions adrift
14. Nov.	W. Lindinger	Oak Ridge, Tenn., USA	Influence of kinetic energy and internal excitation on Ion-Molecule-Reactions.

COOPERATIONS HAVE BEEN CONTINUED DURING 1983 WITH THE FOLLOWING SCIENTISTS

- Prof. Dr. A.K. Castleman, Jr., (Dept. Chemistry, Penn State University, University Park, USA): Gemeinsame Untersuchungen zur Physik der Kondensate: Bildung, Eigenschaften und Reaktionen von neutralen und ionisierten Clustern (gefördert vom Österr. Fonds zur Förderung der wissenschaftlichen Forschung)
- Prof. Dr. J.H. Futrell (Dept. Chemistry, University Utah, Salt Lake City, USA): Untersuchungen über die Stabilität von Clusterionen (gefördert vom Österr. Fonds zur Förderung der wissenschaftlichen Forschung und der Fulbright Kommission)
- Prof. Dr. A. Rutscher und Doz. Dr. H. Deutsch (Sektion Physik, Universität Greifswald, DDR): Untersuchungen über die Eigenschaften von reaktiven Gasen (Plasmachemie) (gefördert vom Österr. Fonds zur Förderung der wissenschaftlichen Forschung und durch das Kulturabkommen Österreich-DDR)
- Prof. Dr. A. Stamatovic (PMF Kragujevac, Jugoslavien): Massenspektrometrische Untersuchungen von Clusterionen, Mikroprozessoren in der atomphysikalischen Forschung
- Dr. Károly Rózsa: Projekt 5.4. der wissenschaftlich-technischen Zusammenarbeit zwischen Österreich und Ungarn: Laserphysik (gefördert vom Fonds zur Förderung der wissenschaftlichen Forschung und der Österr. Akademie der Wissenschaften)
- Prof. Dr. Fabio Ferrari und Prof. Dr. Davide Bassi (Faculty of Science, University of Trento, Italy): Drift-Experimente zur Untersuchung von Ladungstausch-Reaktionen
- Dr. D.L. Albritton, Dr. F.C. Fehsenfeld und Dr. E.E. Ferguson (NOAA, ERL, Boulder, Colorado) Gemeinsame Untersuchungen von Ionenbeweglichkeiten, Ionen-Molekülreaktionen und deren Energieabhängigkeit (gefördert vom Österr. Fonds zur Förderung der wissenschaftlichen Forschung)

- Prof. Dr. David Smith and Dr. N.G. Adams (Dept. Space Res., Univ. Birmingham, England) SIFT Experimente und Drift Untersuchungen zu Ionen-Molekül-Reaktionen (gefördert vom Österr. Fonds zur Förderung der wissenschaftlichen Forschung)
- Prof. Dr. Normal D. Twiddy, University of Aberystwyth, Wales, GB, SIFT und DRIFT-Experimente
- Prof. Dr. F. Viehböck, Prof. Dr. H. Winter, Dr. W. Hunsinsky, Dr. P. Varga, Institut für Allgemeine Physik der TU Wien: Plasma-Wand-Wechselwirkung, Laserphysik (gefördert vom Fonds zur Förderung der wissenschaftlichen Forschung)
- Prof. Dr. H.J. Koark (Inst. f. Mineralogie der Universität Uppsala, Schweden): Altersbestimmung von Mineralien (gefördert vom Österr. Fonds zur Förderung der wissenschaftlichen Forschung)

EXTENDED VISITS OF MEMBERS OF OUR SECTION AT FOREIGN UNIVERSITIES OR
RESEARCH INSTITUTES

VAss. Dr. K. Stephan: Feber-April 1983: Molecular Physics Group, SRI International, Menlo Park, CA 94025, USA (Photodissociation of metallclusterions)

Univ. Prof. Dr. W. Lindinger: April 1983: Department of Space Research, University of Birmingham, England

VAss. Dr. H. Villinger: Juli 1983: CEN Saclay, Frankreich

Univ. Prof. Dr. T. Märk: Mai bis Oktober 1983: Professor of Chemistry, Dept. Chemistry, Penn State University, University Park, PA 16802, USA (Cluster Physics)

Univ. Prof. Dr. T. Märk: September 1983: JILA, University of Colorado, Boulder, USA (Electron impact ionization)

VAss. Mag. W. Ritter: Juni-August 1983: Materials Research Laboratory, Penn State University, University Park, USA (Radiation damage in solids)

Univ. Prof. Dr. W. Lindinger: Sept. - Nov. 1983: Department of Chemistry, University of Utah, Salt Lake City, USA (Kinetics of IMR).

TEACHING DURING SS 83 AND WS 84

performed by members of the "Section Karl Schönherrstr. 3" of the Institute for Experimentalphysics

SS 83

Aufbau d. Materie I (Strahlung u. ihre Wechselwirkung m. Materie, Atommodelle, Wellennatur v. Teilchen, Teilchennatur v. Photonen, Einelektronen-Mehrelektronensysteme, Moleküle)	Lindinger	VL 5
Übungen zu Aufbau d. Materie I Gruppe A	Villinger	UE 2
Übungen zu Aufbau d. Materie I, Gruppe B	Kuen	UE 2
Prakt. f. Fortgeschr. A(Z), gem.m. Bertagnolli, Denoth, Kuen, Ritter, Stephan, Villinger	Gornik Howorka Kolb Lindinger Märk T.	PK 4
Massenspektrometrie	Märk T.	VL 1
Teilchennachweis f. Dipl. u. Diss.	Howorka	VL 1
Experim. Laserphysik f. Dipl. u. Diss.	Howorka	VL 2
Spektroskopie	Kuen	VL 1
Reaktionskinetik II (Methoden z. Untersuchung v. Ionen-Neutral-Wechselwirkungen im Energiebereich v. 80 K bis 1 eV)	Villinger	VL 2
Gasentladungen f. Dipl. u. Diss.	Märk E.	VL 2

Oberflächen- u. Festkörperphysik f. Dipl. u. Diss.	Märk T.	VL 1
Elektronen- u. Ionenoptik f. Dipl. u. Diss.	Stephan	VL 1
Energy	Bryant	VL 1
Mikroprozessorsteuerung im Labor f. Diss., gem. m. Stephan, Sejkora	Märk T.	PK 2
Mikroprozessoren i.d. atomphys. Forschung	Stamatovic	PK 3
Seminar a. Atomphysik	Bryant Howorka Lindinger Märk T. Rothleitner	SE 2
Vakuum-Ultraviolettspektroskopie, gem. m. Kuen	Howorka	SE 1
Sem. a. Angew. Kern- u. Festkörper- physik	Märk T.	SE 1
Atomic and Molecular Collisions	Bryant	KO 3
Exp. Plasmaphysik II, gem. m. Kuen	Howorka	KO 2
Ionen-Molekül-Reaktionen, gem. m. Villinger	Lindinger	KO 2
Gaselektronik, gem. m. Stephan, Sejkora	Märk T.	KO 2
Strahlenschäden in Festkörpern, gem. m. Märk E., Ritter	Märk T.	KO 2
Negative Ionen	Stamatovic	KO 3
Spektroskopie u. Laserphysik, gem. m. Kuen	Howorka	PV 5
Driftexperimente, gem. m. Villinger	Lindinger	PV 5

Priv. f. Diss. angew. Kern- u. Festkörperphysik, gem. m. Märk E.	Märk T.	PV 5
Priv. f. Diss. a. Gaselektronik, gem. m. Stephan	Märk T.	PV 5
Geochronologie	Märk T.	VL 2

WS 83/84

Aufbau d. Materie II	Märk T.	VL 3
Übungen zu Aufbau d. Materie II, Gruppe 1, gem. m. Stephan	Howorka	UE 1
Übungen zu Aufbau d. Materie II, Gruppe 2, gem. m. Stephan	Märk T Howorka	UE 1
Einführung i.d. Betrieb wiss. App.	Howorka	VL 1
Geschichte d. Physik	Lindinger	VL 2
Gaselektronik (Elementarprozesse)	Märk E.	VL 2
Plasmaphysik I: Plasmaätzen Anwendung v. Plasmen zur Herstellung v. mikroelektronischen Bauteilen u. Diagnostik an diesen Plasmen	Lindinger	VL 1
Molekülphysik	Howorka	VL 1
Plasmadiagnostik	Howorka	VL 1
Vakuumphysik	Howorka	VL 1
Physikalische Arbeitsmethoden	Ritter	VL 2
Laborpraktikum Atomphysik, gem. m. Kuen, Ritter, Stephan, Villinger, Dobler	Howorka Lindinger Märk T.	PK 5
Seminar aus Atomphysik	Howorka Lindinger Märk T.	SE 2

Defekte u. Diffusion i. Festkörper (f. Diss.), gem.m. Ritter	Märk T.	AG 1
Experimentelle Plasmaphysik I, gem. m. Kuen	Howorka	KO 2
Angew. Kern- u. Festkörperphysik, gem. m. E. Märk, Ritter.	Märk T.	KO 2
Gaselektronik, gem. m. Stephan	Märk T.	KO 2
Ionen-Molekül-Reaktionen, gem. m. Villinger	Lindinger	KO 2
Plasmaphysik: Xtzplasmen, gem. m. Villinger	Lindinger	KO 2
Spektroskopie u. Laserphysik, gem. m. Kuen	Howorka	PV 5
Priv. f. Diss. a. Gaselektronik, Kern- physik u. Festkörperphysik, gem. m. E. Märk, Stephan	Märk T.	PV 5
Driftexperimente, gem. m. Villinger	Lindinger	PV 5

TEACHING AT FOREIGN UNIVERSITIES

W. Lindinger "Ion Molecule Reaction Kinetics" Autumn term, Course 709-2
at the Department of Chemistry,
University of Utah, Salt Lake
City, USA

S E M I N A R L E C T U R E S

The following lectures were held during the year 1983 in our "atomic physics seminar"

Date	Lecturer	Title
25.1.83	Prof.Dr. H.J. Oskam (Dept. Electrical Engineering, Univ. Minnesota, Minneapolis, USA)	The properties of plasma and plasma-surface sheaths of rf excited (plasma etching) dis- charges
27.1.83	Dr. Wendy A. O'Brien (MS) (Univ. of New Hampshire, USA)	Biology of Magnetic Bacteria
11.2.83	Dr. N.G. Adams (Dept. Space Research, Univ. Birmingham, England)	The $H_3^+ - H_2$ -System
14.2.83	Dr. David Smith (Dept. Space Research, Univ. Birmingham, England)	Electron-Ion-Recombination
10.3.83	Prof. Dr. H.C. Bryant (Fulbright Professor vom Dept. Physics, Albuquerque, USA)	Outdoor drift tube: the physics of the salt gradient solar pond
9.3.83	Prof. Dr. Marie Durup-Ferguson (Laboratoire de Resonance Elec- tronique et Ionique, Orsay, France)	Selective relaxation and reactions of $O_2^+(v>0)$
17.3.83	Prof.Dr. Eldon E. Ferguson (Aeronomy Laboratory, NOAA, Boulder, Colorado, USA)	Charge transfer reactions of vibrationally excited ions
14.3.83	Dr. Brana Jelenkovic (Univ. Belgrad)	Beam foil spectroscopy

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| 21.4.83 | Dr. C. Cohen Tannoudji
(Univ. Paris) | Atoms in intense resonant
laser beams |
| 28.4.1983 | Univ.Prof.Dr. H. Winter
(Institut f. Allgemeine Physik,
TU Wien) | Neue Verfahren zur Unter-
suchung der Verunreinigungen
von magnetisch eingeschlossenen
Plasmen |
| 10.5.1983 | Prof. Dr. W.R. Johnson
(Notre Dame University) | Relativistic Effects in
Many-Electron Systems |
| 23.6.1983 | Prof. Dr. Ch. Schlier
(Institut f. Physik,
Univ. Freiburg, BRD) | Kollineare und nichtkollineare
Stöße im Potentialtopf |
| 20.10.83 | Dr. Bob Keesee
(Pennsylvania State Univ.) | Gas phase ion molecule
association complexes |
| 10.11.83 | Robyn Anne Cassidy
(Australian National Univ.,
Canberra) | Alkaline ions inert gas
interaction potentials using
mobility experiments |
| 17.11.83 | Univ.Doiz. Dr. Peter Zoller
(Inst. f. Theoretische Physik,
Univ. Innsbruck) | Multiphoton - Ionisation und
Konfigurations-Wechselwirkung |
| 24.11.83 | Doz. Dr. A. Ding
(Hahn-Meitner Institut, Berlin) | Untersuchungen der Stabilität
und Dynamik von homogenen und
heterogenen Clustern |
| 1.12.1983 | Priv.Doiz.Dr. H.J. Paus
(Physikalisches Institut d.
Univ. Stuttgart, BRD) | Spin-Bahn-Wechselwirkungen von
anisotropen Farbzentren in
Alkalihalogenid-Kristallen |
| 9.12.1983 | Dr. Olaf Echt
(Nukleare Festkörperphysik,
Inst. f. Phys., Univ. Konstanz) | Cluster in Molekularstrahlen |

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| 16.12.83 | Dr. Hans Erich Wagner
(Univ. Greifswald, DDR) | Chemische Quasigleichgewichte
in anisothermen Plasmen |
| 19.12.83 | Dr. Juray Glosik
(Charles University,
Prag) | Energy distribution functions
of electrons in a flowing
afterglow |
| 20.12.83 | Dr. Hans Deutsch
(Univ. Greifswald, DDR) | Zur Berechnung von Ionisations-
querschnitten in Molekülgasen |

ORGANIZATION OF MEETINGS

The 3rd International SWARM SEMINAR was held, Aug. 3.-5., 1983 in Innsbruck as a satellite meeting of the XIII ICPEAC, Berlin 1983.

Organizing and Program Committee:

W. Lindinger, Chairman	L.G. Christophourou, USA
F. Howorka, Co-chairman	R. Crompton, Australia
T. Märk, Co-Chairman	R. Deloch, France
H. Villinger, Secretary	I. Ogawa, Japan
W. Federer, W. Dobler (all Innsbruck)	

Proceedings of the 3rd SWARM SEMINAR (263 pages) are still available and can be purchased from the following address:

Institut für Experimentalphysik
der Universität Innsbruck
Karl Schönherrstr. 3
A 6020 Innsbruck
Austria.