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Professor Sakae SHIMIZU
on the Occasion of his Retirement*

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History of Publications

Term	Vol.	Title	Published
Jan., 1929- Dec., 1947	1-16	化学研究所講演集 (The Reports of the Institute for Chemical Research)	Indeterminately
April, 1933	—	10 Jahre Institut für chemische Forschung (化学研究所創立十周年記念号)	—
March, 1949- Dec., 1949	17-19	化研講演集 (The Reports of the Institute for Chemical Research)	Indeterminately
March, 1950- Sept., 1952	20-30	化学研究所報告 (Bulletin of the Institute for Chemical Research)	Quarterly
Dec., 1951	—	The Commemoration Volume for the Silver Jubilee (化学研究所創立二十五周年記念号)	—
Jan., 1953 onwards	31 No. 1-	Bulletin of the Institute for Chemical Research (化学研究所報告)	Bi-monthly
Nov., 1966	44 No. 6	Special Issue on the Commemoration of the Fortieth Anniversary (化学研究所創立四十周年記念号)	—
Nov., 1976	54 No. 6	Special Issue on the Commemoration of the Fiftieth Anniversary (化学研究所創立五十周年記念号)	—



清水 栄 教授
Professor Dr. Sakae Shimizu

Emeritus Professor Sakae Shimizu

On the first of April, 1979, Dr. Sakae Shimizu will retire after 36 years' service at Kyoto University. He will be granted the title of emeritus professor by the University on the following day.

Dr. Shimizu was born in Tokyo on July 18, 1915. He graduated from Kyoto University in March 1940, and became a graduate student, majoring in experimental nuclear physics under the supervision of Professor Bunsaku Arakatsu. In 1943 he was appointed as an instructor of physics in the Physics Department of the University. During the World War II he worked in the field of nuclear physics, particularly on photonuclear reactions of some nuclei by the irradiation of high energy gamma rays, construction of a cyclotron, and separation of ^{235}U by the ultra-high centrifugal method. Immediately after the atomic bomb was dropped in Hiroshima on August 6, 1945, he worked very hard from August 9 to 16 as a member of the special survey party from the University, headed by Professor B. Arakatsu. The party collected the first scientific evidence of the disaster caused by the nuclear explosion. In March 1946 he was promoted to an Assistant Professor. For several years since then his main research concern was on photonuclear reactions and development of various types of nuclear radiation detection instruments.

In July, 1952, he was appointed as Professor of Nuclear Physics at the Institute for Chemical Research of the University. His first project was to reconstruct the Kyoto Cyclotron, 105 cm fixed frequency —15 MeV deuteron acceleration—. This project took him nearly four years, completed with success in the spring of 1956. During this period he worked hard as the leader of a group of young workers who were studying many aspects of the radioactive fallout from the nuclear explosion test at Bikini Atoll on March 1, 1954. The results and pieces of information gained by this research project were compiled by him into a monograph entitled "The Radioactive Dust from the Nuclear Detonation," which was published by the Institute as a supplementary issue of the Institute Bulletin.

After the completion of the cyclotron he initiated the University's research reactor project. In order to gather valuable information on and knowledge of research reactors and experimental nuclear physics, he visited the United States, Canada, and Western European countries for seven months in 1956, with the support extended by the Fund for Peaceful Atomic Development, Inc., Detroit. For a few years thereafter he worked to promote the research reactor project and to render help to the newly-created department, Department of Nuclear Engineering, in the Faculty of Engineering.

In March 1957 he left from the cyclotron laboratory to become the supervisor of the Radioisotope Research Laboratory of the Institute. In June of the same year the Shimizu Laboratory was established and he was able to conduct research on his own. In the beginning, however, he did not have an easy time because he had to work in an old wooden building on the campus of the University Hospital with a few research members. In July 1960, a new building housing the Radioisotope Research Laboratory was built on the north campus of the University through his effort. In this building, he and his young colleagues and students could work in much improved conditions.

From July to September 1965, he was invited to the United States by the U. S.

State Department and U. S. AEC, and visited several national laboratories in the field of nuclear energy and leading universities. In the three months following this period he visited Canada and several European countries again to investigate the current state of experimental nuclear and particle physics in these countries. This second long trip around the globe—a half-year with many invaluable experiences—gave a great impetus to him in developing his research projects based on his own philosophy.

In order to respond to rapid development of research works using radioisotopes in the University, a new Radioisotope Research Center was established in April 1971. He was appointed as Director of this Center in addition to his position as the supervisor. A modern five-story building equipped with many facilities and instruments was completed two years later.

Since 1963 he has been concerned mainly with experimental as well as theoretical research on the higher-order nuclear phenomena involving shell electrons related to nuclear, atomic and solid state physics: 1) Special modes of positron annihilation by *K*-shell electrons, 2) change in decay constant of some radioactive nuclides by external effects—chemical bonding, high hydrostatic pressure, intense internal electric field in ferroelectric substances, extreme low temperature, and ultra-high centrifugal field, 3) internal ionization and excitation accompanying beta decay, *K* capture decay, and internal conversion, and 4) Mössbauer effect. Experimental evidences for occurrences of some phenomena in these fields have first been presented by his study. The results achieved in his Laboratory are highly regarded by both domestic and oversea academic circles.

For the past several years, about ten physicists from the United States and Europe came to work in his Laboratory as visiting professors or visiting scientists of the University. All of his young colleagues had opportunities to study at advanced research centers in Europe for more than one year. Dr. Shimizu himself has visited the United States and Europe several times.

Since 1950 he has served as a member or chairman of various committees in the University to promote research in the fields of nuclear energy and application of radioisotopes. He has also served as a member of the Board of Directors of the Japan Isotope Association since 1962. He is member of Physical Society of Japan, Atomic Energy Society of Japan, Japan Radiation Research Society, American Physical Society, American Nuclear Society, Health Physics Society, and Sigma Xi.

His sincere and warm personality with his enthusiasm for research is respected by his friends, colleagues, students, and all those who come in contact with him. The sense of warm atmosphere and international friendship which fills his Laboratory is well known at home and abroad.

This collection of papers contributed by his friends, colleagues, and students is dedicated to Dr. Shimizu in the honor at the time of his memorable retirement.

January, 1979

Megumi Tashiro

Megumi Tashiro
Director
Institute for Chemical Research
Kyoto University

The Publications of Professor Sakae Shimizu

1941 — 1952

- 1) B. Arakatsu, Y. Uemura, M. Sonoda, S. Shimizu, K. Kimura, and K. Muraoka : Photo-Fission of Uranium and Thorium Produced by the γ -Rays of Lithium and Fluorine Bombarded with High Speed Protons, *Proc. Phys. -Math. Soc., Japan*, **23**, 440-445 (1941).
- 2) B. Arakatsu, M. Sonoda, Y. Uemura, and S. Shimizu : The Range of the Photo-Fission-Fragments of Uranium Produced by the γ -Rays of Lithium Bombarded with Protons, *Proc. Phys. -Math. Soc., Japan*, **23**, 633-637 (1941).
- 3) B. Arakatsu, M. Sonoda, Y. Uemura, S. Shimizu, and K. Kimura : A Type of Nuclear Photo-Disintegration : The Expulsion of α -Particles from Various Substances Irradiated by the γ -Rays of Lithium and Fluorine Bombarded with High Speed Protons, *Proc. Phys. -Math. Soc., Japan*, **25**, 173-178 (1943).
- 4) B. Arakatsu, S. Shimizu, T. Hanatani, and J. Muto : Cloud Chamber Observation of Photo-Alpha Particles Produced by 17 Mev Gamma-Rays, *Journ. Phys. Soc., Japan*, **1**, 24-25 (1946).
- 5) S. Shimizu : Vital Phenomena as Physical Problems (in Japanese), *Saishin Igaku*, **2**, 309-317 (1947).
- 6) S. Shimizu and J. Muto : A Note on the Angular Distribution of Pair-Electrons of 17 Mev γ -Rays, *Memo. Coll. Sci., Univ. of Kyoto, A*, **25**, 61-62 (1949).
- 7) S. Shimizu : Photo-induced Reaction $\text{Cu}^{63}(\gamma, n)\text{Cu}^{62}$ Produced by the Gamma-Rays of Lithium bombarded with High Speed Protons, *Memo. Coll. Sci., Univ. of Kyoto, A*, **25**, 193-208 (1949).
- 8) S. Shimizu, S. Yasumi, Y. Saji, and J. Muto : The (γ, n) Reaction of Molybdenum Produced by the $\text{Li}(p, \gamma)$ γ -Rays, *Memo. Coll. Sci., Univ. of Kyoto, A*, **26**, 85-96 (1950).
- 9) S. Shimizu, Y. Ono, and T. Naiki : On Some Properties of Dewar Vessels, *Bull. Inst. Chem. Res., Kyoto Univ.*, **20**, 42-43 (1950).
- 10) S. Shimizu and O. Horibe : Portable Radiation Detector Instrument, *Bull. Inst. Chem. Res., Kyoto Univ.*, **20**, 43-44 (1950).
- 11) S. Shimizu : Short History of Isotopes (in Japanese), *Saishin Igaku*, **5**, 73-77 (1950).
- 12) Y. Uemura, S. Shimizu, and Y. Saji : On the Properties of 2π -type β -Ray G-M Counter, *Bull. Inst. Chem. Res., Kyoto Univ.*, **21**, 56 (1950).
- 13) S. Shimizu, Y. Uemura, and Y. Saji : On a Stable 2π -type β -Ray Counter, *Bull. Inst. Chem. Res., Kyoto Univ.*, **21**, 57 (1950).
- 14) S. Shimizu, Y. Uemura, R. Ishiwari, O. Horibe, and S. Okamoto : Some Experiments on P^{32} . I. Physical Procedures and Measurements, *Bull. Inst. Chem. Res., Kyoto Univ.*, **22**, 27-73 (1950).
- 15) S. Shimizu, H. Takekoshi, E. Nishimura, and N. Ogura : Operation of an Electron-multiplier, *Bull. Inst. Chem. Res., Kyoto Univ.*, **23**, 53 (1950).
- 16) Y. Uemura, Y. Saji, and S. Shimizu : On Some Properties of 2-type G-M Counter (II), *Bull. Inst. Chem. Res., Kyoto Univ.*, **23**, 56-57 (1950).
- 17) Y. Uemura, S. Shimizu, and Y. Saji : On Some Properties of 2π -type G-M Counter (III), *Bull. Inst. Chem. Res., Kyoto Univ.*, **25**, 52-53 (1951).
- 18) S. Shimizu, T. Hanai, and S. Okamoto : The Absorption of γ -Rays from Co^{60} in Several Elements, *Bull. Inst. Chem. Res., Kyoto Univ.*, **25** 53-54 (1951).
- 19) S. Shimizu, H. Takekoshi, and E. Nishimura : On the Scintillation Counter, *Bull. Inst. Chem. Res., Kyoto Univ.*, **25**, 54 (1951).
- 20) M. Ishibashi, M. Kimura, S. Shimizu, and U. Kusaka : Chemical Studies of Radioactive Indicator (XIII) Preparation of Radioactive Phosphorous (P^{32}) and Bromine (Br^{80} ; Br^{82}) (in Japanese), *Bull. Inst. Chem. Res., Kyoto Univ.*, **23**, 36-43 (1951).
- 21) S. Shimizu, T. Hanai, and S. Okamoto : The Absorption of Gamma-Rays from Co^{60} in Several Elements (II), *Bull. Inst. Chem. Res., Kyoto Univ.*, **26**, 64-65 (1951).
- 22) S. Shimizu, H. Nakamura, and I. Kumabe : On the Backscattering of β -Rays from C^{11} and P^{32} , *Bull. Inst. Chem. Res., Kyoto Univ.*, **23**, 65-66 (1951).
- 23) H. Takekoshi, K. Tsuruoka, and S. Shimizu : The Construction of a Mass Spectrometer without the Use of Magnetic Field, *Bull. Inst. Chem. Res., Kyoto Univ.*, **27**, 52 (1951).
- 24) S. Shimizu and S. Okamoto : The Design of a New High Speed Scaling Circuit, *Bull. Inst.*

Chem. Res., Kyoto Univ., **27**, 54 (1951).

- 25) S. Shimizu, T. Hanai, and S. Okamoto: The Absorption of Gamma-Rays from Co^{60} , *Phys. Rev.*, **85**, 290-294 (1952).
- 26) T. Azuma, H. Nakamura, I. Kumabe, K. Tsumori, and S. Shimizu: On the Backscattering of the β -Rays of P^{32} , *Bull. Inst. Chem. Res., Kyoto Univ.*, **29**, 69-70 (1952).

1953 — 1956

- 27) S. Shimizu, Y. Saji, and M. Sakisaka: Absolute β -ray Counting (I): On the Sensitive Volume of the Counter and the Geometrical Arrangement of the Sample, *Bull. Inst. Chem. Res., Kyoto Univ.*, **31**, 35-36 (1953).
- 28) S. Shimizu, H. Takekoshi, and E. Takekoshi: Efficiency of a Liquid Scintillation Counter, *Bull. Inst. Chem. Res., Kyoto Univ.*, **31**, 41-42 (1953).
- 29) T. Naiki, T. Hanai, and S. Shimizu: Measurement of Viscosity of Liquid Air, *Bull. Inst. Chem. Res., Kyoto Univ.*, **31**, 56-58 (1953).
- 30) T. Azuma, K. Tsumori, and S. Shimizu: On the Backscattering of the Electrons from Co^{60} and Na^{22} , *Bull. Inst. Chem. Res., Kyoto Univ.*, **31**, 201-202 (1953).
- 31) S. Nagayama, K. Tsumori, and S. Shimizu: Radioactive Determination of Potassium in Plant Ashes, *Bull. Inst. Chem. Res., Kyoto Univ.*, **31**, 207-208 (1953).
- 32) S. Shimizu, H. Akagi, H. Goto, S. Okamoto, T. Ishida, and Y. Kawai: Survey on the Radioactive Contamination of the No. 5 Fukuryu Maru, *Bull. Inst. Chem. Res., Kyoto Univ.*, Suppl. Issue, 1-3 (Nov. 1954).
- 33) M. Ishibashi, T. Shigematsu, T. Ishida, S. Okada, T. Nishi, H. Takahashi, C. Matsumoto, S. Shimizu, T. Hyodo, F. Hirayama, and S. Okamoto: Radiochemical Analysis of the Bikini Ashes, *Bull. Inst. Chem. Res., Kyoto Univ.*, Suppl. Issue, 39-59 (Nov. 1954).
- 34) I. Kumabe and S. Shimizu: The Backscattering of Beta-Rays, *Bull. Inst. Chem. Res., Kyoto Univ.*, **32**, 183-193 (1954).
- 35) T. Hyodo and S. Shimizu: A Note on the Effect of the Absorber Position in the Measurement of Beta-Ray Absorption, *Bull. Inst. Chem. Res., Kyoto Univ.*, **32**, 194-198 (1954).
- 36) S. Shimizu, A. Katase, H. Takekoshi, and K. Takumi: On the Short-Circuiting Condenser in Kyoto Cyclotron, *Bull. Inst. Chem. Res., Kyoto Univ.*, **32**, 214 (1954).
- 37) S. Shimizu and T. Hyodo: Rate of Decay of the Bikin Ashes, *Research in the Effects and Influences of the Nuclear Bomb Test Explosions* (Japan Soc. for the Promoton of Science, Tokyo, 1956), pp. 471-474.
- 38) S. Shimizu, F. Hirayama, and S. Okamoto: Studies on Polystyrene Scintillators, *Annual Report of the Radioactive Isotopes in Japan*, **3**, 48-52 (1956).

Since 1957

Since the establishment of Shimizu's Laboratory in 1957, including papers published by research members of his group indicated by asterisk.

- 1) S. Shimizu and R. Ishiwari: Measurements of Radioactivity (in Japanese), *Kagaku-no-Ryoiki*, Suppl. **17**, 33-78 (1957).
- 2)* M. Ise and Y. Nakayama: A Transistorized Dekatron Scaler, *Bull. Inst. Chem. Res., Kyoto Univ.*, **37**, 277-280 (1959).
- 3)* S. Okamoto, Y. Nakayama, and K. Takahashi: Two Kilocurie Cobalt-60 Gamma-Ray Irradiation Facility, *Bull. Inst. Chem. Res., Kyoto Univ.*, **37**, 299-305 (1959).
- 4) S. Shimizu, S. Tanaka, and Y. Nakayama: Gamma-Ray Dosimetry in an Irradiation Cavity of the 2000 Curie Cobalt-60 Facility, *Bull. Inst. Chem. Res., Kyoto Univ.*, **37**, 306-318 (1959).
- 5) K. Nishihara, Y. Uchida, S. Shimizu, T. Hyodo, T. Sonoda, and H. Koga: Quantitative Analysis of ^{235}U in Uranium Samples (in Japanese), *Reports of the 3rd Symposium of Atomic Energy*, **2**, 362-365 (1959).
- 6) T. Saigusa, S. Horikiri, M. Kondo, and S. Shimizu: A Cobalt-60 Irradiation Facility for Radiation Chemistry, *Bull. Inst. Chem. Res., Kyoto Univ.*, **39**, 166-179 (1961).
- 7) T. Hyodo and S. Shimizu: Some Experiments of Gamma-Ray Backscattering, *Bull. Inst. Chem. Res., Kyoto Univ.*, **39**, 180-188 (1961).
- 8) K. Kimura, Y. Uemura, M. Sonoda, S. Shimizu, T. Yanabu, R. Ishiwari, J. Kokame, A. Katase,

- I. Kumabe, S. Yamashita, H. Takekoshi, K. Miyake, H. Ikekami, and H. Fujita : A 105 cm Fixed Frequency Cyclotron of Kyoto University, *Bull. Inst. Chem. Res., Kyoto Univ.*, **39**, 368-406 (1961).
- 9) T. Mukoyama and S. Shimizu : Scintillation Spectroscopy Measurements of Gamma-Ray Energies from the Source of $\text{Eu}^{152, 151}$, *Bull. Inst. Chem. Res., Kyoto Univ.*, **40**, 54-66 (1962).
 - 10)* T. Nakakado and T. Saigusa : The Effects of Gamma Radiation on Electric Characteristics of the Electronic Circuit Components (I), *Bull. Inst. Chem. Res., Kyoto Univ.*, **40**, 67-80 (1961).
 - 11) S. Shimizu and Y. Nakayama : Internal Conversion of the 1119 keV Transition in ^{65}Cu , *Nucl. Phys.*, **31**, 600-610 (1962).
 - 12) T. Mukoyama, F. Makino, and S. Shimizu : Gamma-Gamma Directional Correlations of Some Gamma Ray Cascades in ^{110}Cd , *Bull. Inst. Chem. Res., Kyoto Univ.*, **40**, 307-316 (1962).
 - 13)* Y. Nakayama and H. Hirata : Internal Conversion of the 1277 keV Transition in ^{22}Ne , *Nucl. Phys.*, **40**, 396-399 (1963).
 - 14)* M. Endo, M. Kondo, and T. Saigusa : A Versatile Cobalt-60 Irradiation Facility, *Bull. Inst. Chem. Res., Kyoto Univ.*, **41**, 89-96 (1963).
 - 15)* R. Shibata and R. Katano : Measurements of Gamma-Ray Energies from Eu^{152} by the Scintillation Spectroscopy, *Bull. Inst. Chem. Res., Kyoto Univ.*, **42**, 42-47 (1964).
 - 16) S. Shimizu, Y. Nakayama, H. Hirata, and H. Mazaki : Mono-Energetic Positron Emission in the Decay of ^{152}Eu , *Nucl. Phys.*, **54**, 265-277 (1964).
 - 17) T. Nakamura and S. Shimizu : Experimental Study on the Mössbauer Effect of ^{57}Fe in Several Iron Compounds, *Bull. Inst. Chem. Res., Kyoto Univ.*, **42**, 299-318 (1964).
 - 18) S. Nishiu, T. Nakakado, Y. Nakayama, and S. Shimizu : Lithium-Drifted Silicon Junction Detectors, *Bull. Inst. Chem. Res., Kyoto Univ.*, **42**, 319-337 (1964).
 - 19) H. Kakimoto, T. Saigusa, and S. Shimizu : Streaming of Gamma Rays through Metallic Pipes, *Bull. Inst. Chem. Res., Kyoto Univ.*, **43**, 22-44 (1965).
 - 20)* S. Horikiri and T. Saigusa : The Study of Energy Transfer in Binary Organic Liquid Mixtures under Gamma-Irradiation, *Bull. Inst. Chem. Res., Kyoto Univ.*, **43**, 45-59 (1965).
 - 21) S. Shimizu : Effect of Chemical Binding on the Radioactive Decay Constant (in Japanese), *Kagaku to Kogyo*, **18**, 935-940 (1965).
 - 22) S. Shimizu, Y. Nakayama, and T. Mukoyama : Incoherent Scattering of Gamma Rays by *K*-Shell Electrons, *Phys. Rev.*, **140**, A806-A815 (1965).
 - 23) S. Shimizu and H. Mazaki : The Effect of Chemical State on the Decay Constant of a Nuclear Isomer, $^{235\text{m}}\text{U}$, *Phys. Letters*, **17**, 275-276 (1965).
 - 24) S. Shimizu, T. Mukoyama, and Y. Nakayama : Search for Radiationless Annihilation of Positrons, *Phys. Letters*, **17**, 295-296 (1965).
 - 25) H. Mazaki and S. Shimizu : Effect of Chemical State on the Decay Constant of $\text{U}^{235\text{m}}$, *Phys. Rev.*, **148**, 1161-1167 (1966).
 - 26)* S. Nishiu : Response of a Large Sensitive Volume Lithium-Drifted Silicon Detector to Gamma and Beta Rays, *Bull. Inst. Chem. Res., Kyoto Univ.*, **44**, 74-83 (1966).
 - 27)* R. Katano : Mössbauer Spectrometer Using an Electromechanical Transducer in Conjunction with a Multichannel Pulse-Height Analyzer, *Bull. Inst. Chem. Res., Kyoto Univ.*, **44**, 386-393 (1966).
 - 28) H. Mazaki and S. Shimizu : The Transition Energy of $^{235}\text{U}^{\text{m}}$, *Phys. Letters*, **23**, 137-138 (1966).
 - 29) H. Mazaki and S. Shimizu : Determination of Very Low Transition Energy of $^{235\text{m}}\text{U}$, *Bull. Inst. Chem. Res., Kyoto Univ.*, **44**, 394-400 (1966).
 - 30) S. Shimizu, Y. Isozumi, and Y. Nakayama : Observation of the Nuclear Raman Scattering by ^{181}Ta , *Phys. Letters*, **25B**, 124-125 (1967).
 - 31) H. Mazaki, M. Nishi, and S. Shimizu : Single-Quantum Annihilation of Positrons, *Phys. Rev.*, **171**, 408-416 (1968).
 - 32) S. Shimizu, T. Mukoyama, and Y. Nakayama : Radiationless Annihilation of Positrons in Lead, *Phys. Rev.*, **173**, 405-416 (1968).
 - 33)* M. Nishi and H. Mazaki : Positron Straggling through Thin Foils. *Nucl. Phys.*, **A119**, 467-475 (1968).
 - 34)* R. Katano : A Mössbauer Spectrometer with a Large Driving Force, *Nucl. Instr. & Meth.*, **83**, 187-192 (1970).

- 35)* R. Katano : A Compact Cobalt-60 Irradiation Facility, *Bull. Inst. Chem. Res., Kyoto Univ.*, **48**, 66-71 (1970).
- 36) Y. Isozumi and S. Shimizu : K-Shell Internal Ionization Accompanying Beta Decay, *Phys. Rev. C*, **4**, 522-535 (1971).
- 37)* S. Nasu, Y. Murakami, and R. Katano : Dilute ^{57}Co Mössbauer Study on a Ferromagnetic Ni-Cu Alloy near the Transition Temperature, *Phys. Letters*, **35A**, 117-118 (1971).
- 38)* H. Mazaki : Effect of Ultra-high Pressure on Nuclear Decays (in Japanese), *Butsuri*, **26**, 504-507 (1971).
- 39)* Y. Isozumi and S. Shimizu : A Pulse Shape Discriminator for an X-Ray Proportional Counter and its Application to a Coincidence Experiment, *Nucl. Instr. & Meth.*, **96**, 317-323 (1971).
- 40) Y. Isozumi and S. Shimizu : K-Shell Internal Ionization Accompanying β Decay (in Japanese) *Butsuri*, **27**, 44-48 (1972).
- 41) T. Mukoyama and S. Shimizu : Nuclear Excitation by Positron Annihilation, *Phys. Rev. C*, **5**, 95-99 (1972).
- 42) M. Nishi and S. Shimizu : Change in the Decay Constant of $^{99\text{m}}\text{Tc}$ in BaTiO_3 by the Ferroelectric Transition, *Phys. Rev. B*, **5**, 3218-3221 (1972).
- 43) H. Mazaki, T. Nagatomo, and S. Shimizu : Effect of Pressure on the Decay Constant of $^{99\text{m}}\text{Tc}$, *Phys. Rev. C*, **5**, 1718-1724 (1972).
- 44) T. Nagatomo, H. Mazaki, and S. Shimizu : Study on Geometrical Stability of a Multi-Anvil High Pressure Device by Gamma Rays, *Bull. Inst. Chem. Res., Kyoto Univ.*, **50**, 1-7 (1972).
- 45) T. Kitahara, Y. Isozumi, and S. Shimizu : Summing-Energy Spectrum of the Beta Particles Plus Emitted K Electrons in the K-Shell Internal Ionization Accompanying the Beta Decay of ^{63}Ni , *Phys. Rev. C*, **5**, 1810-1813 (1972).
- 46) S. Shimizu : Recent Developments of the Study on the K-Shell Internal Ionization in Beta Decay, *Proceedings of the International Conference on Inner Shell Ionization Phenomena and Future Applications, Atlanta, April 17-21, 1972, U. S. AEC Report CONF-720404* (1973), Vol. 3, pp. 2050-2078.
- 47) Y. Isozumi, T. Mukoyama, and S. Shimizu : Possible Evidence for a Contribution from Direct Collisions in K-Shell Internal Ionization Accompanying β Decay, *Phys. Rev. Letters*, **29**, 298-301 (1972).
- 48) T. Kobayashi and S. Shimizu : 100 and 200 keV Positron Scattering by Atomic Nuclei, *J. Phys. B: Atom Molec. Phys.*, **5**, L211-L213 (1972).
- 49) T. Kobayashi and S. Shimizu : Elastic Scattering of 100- and 200-keV Positrons by Selenium and Bismuth, *Bull. Inst. Chem. Res., Kyoto Univ.*, **50**, 488-498 (1972).
- 50) S. Shimizu : Nuclear Phenomena Involving Shell Electrons (in Japanese), *Gakujutsu Geppo*, **25**, 562-565 (1972).
- 51)* Y. Nakayama : Two-Photon Decay of the 1.76-MeV 0^+ State of ^{90}Zr , *Phys. Rev. C*, **7**, 322-330 (1973).
- 52)* M. Takafuchi, Y. Isozumi, and R. Katano : A Proportional Counter for Mössbauer Spectroscopy by Scattered Electrons, *Bull. Inst. Chem. Res., Kyoto Univ.*, **51**, 13-18 (1973).
- 53)* R. Katano and T. Mukoyama : Mössbauer Effect in SnI_4 , *Bull. Inst. Chem. Res., Kyoto Univ.*, **51**, 19-26 (1973).
- 54) H. Mazaki, D. I. Lee, and S. Shimizu : Pressure Distribution in a Multianvil High-Pressure Device, *J. Phys. E: Sci. Instrum.*, **6**, 1072-1074 (1973).
- 55) T. Mukoyama, Y. Isozumi, T. Kitahara, and S. Shimizu : Internal Excitation and Ionization Accompanying K Capture, *Phys. Rev. C*, **8**, 1308-1318 (1973).
- 56)* D.-i. Lee and H. Mazaki : Some Properties of Pyrophyllite as a Pressure Medium, *Bull. Inst. Chem. Res., Kyoto Univ.*, **51**, 189-194 (1973).
- 57) S. Shimizu : External Effects on the Radioactive Half-Life (in Japanese), *Radioisotopes*, **22**, 455-465 (1973).
- 58) T. Mukoyama and S. Shimizu : L-Shell Contributions to Internal Ionization Accompanying Electron Capture, *Phys. Rev. C*, **9**, 2300-2306 (1974).
- 59) T. Mukoyama, T. Kitahara, and S. Shimizu : L-Shell Internal Ionization Accompanying L Capture, *Phys. Rev. C*, **9**, 2307-2311 (1974).
- 60) T. Nagatomo, Y. Nakayama, K. Morimoto, and S. Shimizu : Search for Two-Quantum Annihilation of Positrons in Flight with K-Shell Electrons, *Phys. Rev. Letters*, **32**, 1158-1161 (1974).

- 61) Y. Isozumi, T. Mukoyama, and S. Shimizu: On the Total Probability of K -Electron Shake-Off in Beta-Decay, *Lettere al Nuovo Cimento*, **10**, 355-359 (1974).
- 62)* Y. Isozumi, D.-i. Lee, and I. Kádár: A New Detector Assembly for Conversion Electrons and X Rays from Mössbauer Effect, *Nucl. Instr. & Meth.*, **120**, 23-28 (1974).
- 63) T. Mukoyama and S. Shimizu: The Effect of Pressure on Orbital Electron Capture, *Phys. Letters*, **50A**, 258-260 (1974).
- 64)* H. Mazaki: Equations of State of Atoms for the Thomas-Fermi Theory (Applications for Atoms under a High Pressure), *Bull. Inst. Chem. Res., Kyoto Univ.*, **52**, 681-689 (1974).
- 65)* H. Mazaki, E. Yoshioka, and S. Kakiuchi: A Double Ionization Chamber for the Differential Method, *Bull. Inst. Chem. Res., Kyoto Univ.*, **53**, 1-10 (1975).
- 66)* T. Mukoyama: Fitting of Gaussian to Peaks by Non-Iterative Method. *Nucl. Instr. & Meth.*, **125**, 289-291 (1975).
- 67) T. Kitahara and S. Shimizu: K -Shell Internal Ionization in K -Capture Decay of ^{55}Fe , *Phys. Rev. C*, **11**, 920-926 (1975).
- 68) T. Mukoyama and S. Shimizu: Electron Shakeoff Accompanying Internal Conversion, *Phys. Rev. C*, **11**, 1353-1363 (1975).
- 69)* Y. Isozumi and M. Takafuchi: Mössbauer Spectroscopy by Scattered Electrons at 77 K, *Bull. Inst. Chem. Res., Kyoto Univ.*, **53**, 63-67 (1975).
- 70)* T. Mukoyama: Monte Carlo Calculations of Energy Response for Low-Energy γ Rays in Sodium-Iodide Crystals, *Bull. Inst. Chem. Res., Kyoto Univ.*, **53**, 49-62 (1975).
- 71)* T. Mukoyama: Fitting of Lorentzian to Mössbauer Spectra by Non-Iterative Method, *Nucl. Instr. & Meth.*, **123**, 153-154 (1975).
- 72) Y. Isozumi and S. Shimizu: Further Remarks on the Total Probability of K -Electron Shake-Off in Beta-Decay, *Lettere al Nuovo Cimento*, **13**, 422-426 (1975).
- 73) T. Kobayashi and S. Shimizu: Time-Filtering Effect in the Mössbauer Spectrum, *Phys. Letters*, **54A**, 311-312 (1975).
- 74) S. Shimizu: Activities of the Kyoto Municipal Science Center for Youth in Science Education, *Proceedings of the U. S. -Japan Joint Seminar on In-Service Training of Elementary School Science Teachers, Kyoto and Tokyo, October 13-17, 1975*, pp. 37-40.
- 75) Y. Isozumi and S. Shimizu: Comments on the Recent Theory of K -Electron Shake-Off in Beta-Decay, *Lettere al Nuovo Cimento*, **14**, 193-196 (1975).
- 76) T. Mukoyama and S. Shimizu: Internal Ionization Accompanying K Conversion: One-Step Theory, *Phys. Rev. C*, **13**, 377-386 (1976).
- 77) S. Ito, Y. Isozumi, and S. Shimizu: Double K -Hole Creation in the Decay of $^{137\text{m}}\text{Ba}$, *Bull. Inst. Chem. Res., Kyoto Univ.*, **54**, 23-29 (1976).
- 78)* R. Katano, S. Kakiuchi, and H. Mazaki: Measurement of Ion Current by a Conventional Sampling Method. *Bull. Inst. Chem. Res., Kyoto Univ.*, **54**, 30-35 (1976).
- 79)* T. Mukoyama: Determination of Decay Constant by the Maximum Likelihood Method, *Bull. Inst. Chem. Res., Kyoto Univ.*, **54**, 48-53 (1976).
- 80)* T. Mukoyama: Tabulated Value Used for Radiation Shielding against γ Rays from Radioisotopes, *Bull. Inst. Chem. Res., Kyoto Univ.*, **54**, 54-61 (1976).
- 81)* T. Mukoyama: Range of Electrons and Positrons, *Nucl. Instr. & Meth.*, **134**, 125-127 (1976).
- 82) S. Ito, Y. Isozumi, and S. Shimizu: Double K -Hole Creation in the Internal Conversion Decays of ^{141}Pr and $^{137\text{m}}\text{Ba}$, *Abstracts of Contributed Papers, The Second International Conference on Inner Shell Ionization Phenomena, Freiburg, March 29-April 2, 1976 (unpublished)*, pp.174-176.
- 83) Y. Isozumi, S. Shimizu, and T. Mukoyama: Another Possible Origin of K -Shell Internal Ionization and Excitation in β Decay, *Abstracts of Contributed Papers, The Second International Conference on Inner Shell Ionization Phenomena, Freiburg, March 29-April 2, 1976 (unpublished)*, pp. 179-181.
- 84) T. Mukoyama and S. Shimizu: Many-Electron Effect on the K -Shell Internal Ionization Accompanying β Decay, *Abstracts of Contributed Papers, The Second International Conference on Inner Shell Ionization Phenomena, Freiburg, March 29-April 2, 1976 (unpublished)*, pp.182-184.
- 85) S. Ito, Y. Isozumi, and S. Shimizu: Double K -Hole Creation in the 145 keV Internal Conversion of ^{141}Pr , *Phys. Letters*, **59A**, 151-153 (1976).
- 86)* T. Kitahara, Y. Isozumi, and S. Ito: A Pressurized Multiwire Proportional Counter for Electrons, *Nucl. Instr. & Meth.*, **140**, 263-267 (1977).

- 87)* Y. Izawa and R. Katano: Effect of γ Radiation on Gate Trigger Current of Thyristors, *Bull. Inst. Chem. Res., Kyoto Univ.*, **55**, 20-22 (1977).
- 88)* M. Kurakado, T. Takabatake, and H. Mazaki: Superconducting Transition Temperature of Technetium and Lead, *Bull. Inst. Chem. Res., Kyoto Univ.*, **55**, 38-45 (1977).
- 89)* T. Mukoyama and Y. Watanabe: Monte Carlo Calculations of Transmission of Electrons through Thin Foils, *Bull. Inst. Chem. Res., Kyoto Univ.*, **55**, 46-59 (1977).
- 90) Y. Isozumi, S. Shimizu, and T. Mukoyama: K-Shell Internal Ionization and Excitation in Beta Decay: Theoretical Study, *Nuovo Cimento*, **41**, A, 359-376 (1977).
- 91)* R. Sellam, S. Kakiuchi, and H. Mazaki: Mesure de Très Grandes Résistances pour l'Isolation de Détecteurs de Radiations, *Bull. Inst. Chem. Res., Kyoto Univ.*, **56**, 1-5 (1978).
- 92)* T. Mukoyama and Y. Watanabe: A Monte-Carlo Method for Calculations of the Distribution of Angular Deflections due to Multiple Scattering, *Bull. Inst. Chem. Res., Kyoto Univ.*, **56**, 6-10 (1978).
- 93)* T. Mukoyama and Y. Watanabe: On the Energy Loss of Fast Electrons in Thin Absorbers, *Phys. Letters*, **64A**, 442-443 (1978).
- 94) H. Mazaki, S. Kakiuchi, and S. Shimizu: Search for Superconducting Effect on the Decay of ^{99m}Tc , *Zeit. f. Phys., B*, **29**, 285-291 (1978).
- 95)* T. Takabatake, H. Mazaki, and T. Shinjo: Mössbauer Spectroscopy of ^{57}Fe Impurities in Technetium, *Phys. Rev. Letters*, **40**, 1051-1054 (1978).
- 96) T. Mukoyama and S. Shimizu: Many-electron Effect on the K-shell Internal Ionization Accompanying Beta Decay, *J. Phys. G: Nucl. Phys.*, **4**, 1509-1515 (1978).
- 97)* H. Mazaki: Estimation of Ultra-high Pressure by Means of the Change in Nuclear Decay Rate, *J. Phys. E: Sci. Instrum.*, **11**, 739-741 (1978).
- 98)* T. Takabatake and H. Mazaki: Effect of Iron Impurities on the Superconductivity in Granular Technetium, *Phys. Rev. B*, **19**, in press.
- 99) Y. Watanabe, T. Mukoyama, and S. Shimizu: Nuclear Excitation of ^{115}In by Positron Annihilation with K-Shell Electrons, *Phys. Rev. C*, **19**, 32-37 (1979).
- 100) T. Kobayashi, T. Kitahara, and S. Shimizu: Time-Dependent Linewidth and Recoilless Fraction of the Mössbauer Spectrum with $^{57}\text{Co}^{2+}[\text{Fe}^{\text{III}}(\text{CN})_6]^{3-}$, *Proc. International Conference on the Applications of the Mössbauer Effect, Kyoto, August 28-September 1, 1978, Journ. de Phys.*, in press.
- 101) T. Kobayashi, K. Fukumura, T. Kitahara, and S. Shimizu: Gamma-X Coincidence Mössbauer Spectroscopy with Cobalt Chloride, *Proc. International Conference on the Applications of the Mössbauer Effect, Kyoto, August 28-September 1, 1978, Journ. de Phys.*, in press.
- 102)* T. Takabatake, H. Mazaki, and T. Shinjo: Mössbauer Studies on Dilute Tc-(Fe) Alloys, *Proc. International Conference on the Applications of the Mössbauer Effect, Kyoto, August 28-September 1, 1978, Journ. de Phys.*, in press.
- 103) S. Ito, K. Kubota, and S. Shimizu: Comparison of K X-ray Production by Electron and Positron Impact, *Proc. International Conference on X-ray and XUV Spectroscopy, Sendai, August 28-September 1, 1978, Jap. Journ. Appl. Phys.*, **17**, Suppl. 17-2, 338-340 (1978).
- 104) S. Kakiuchi, H. Mazaki, R. Katano, S. Shimizu, and R. Sellam: A Double Ionization Chamber for the Differential Method, *Nucl. Instr. & Meth.*, **158**, 435-441 (1979).
- 105)* Y. Nakayama: Experimental Verification of Positron Creation in Superheavy Ion-Atom Collision Systems (in Japanese), *Butsuri*, **33**, 915-918 (1978).
- 106)* T. Mukoyama and László Sarkadi: Electronic Relativistic Effects in K-Shell Ionization, *Bull. Inst. Chem. Res., Kyoto Univ.*, **57**, 33-44 (1979).
- 107)* T. Takabatake and H. Mazaki: Superconducting and Magnetic Properties of Dilute Tc-(Fe) Alloys, *Bull. Inst. Chem. Res., Kyoto Univ.*, **57**, 45-54 (1979).
- 108)* T. Ishida and H. Mazaki: Complex Susceptibility Measurements of Superconducting Transition of Electrodeposited Technetium, *Bull. Inst. Chem. Res., Kyoto Univ.*, **57**, 55-66 (1979).
- 109)* Y. Watanabe and T. Mukoyama: Excitation of Nuclear Isomers by γ Rays from ^{60}Co , *Bull. Inst. Chem. Res., Kyoto Univ.*, **57**, 72-82 (1979).
- 110)* K. Fukumura, T. Kobayashi, and Y. Nakayama: A Study on Electron Irradiation Effects in Hydrated Cobalt Ferricyanide Using Mössbauer Spectroscopy, *Bull. Inst. Chem. Res., Kyoto Univ.*, **57**, 164-167 (1979).

- 111) A. Ljubičić, Y. Nakayama, Y. Isozumi, and S. Shimizu : Double Internal Bremsstrahlung in the Electron-Capture Decay of ^{55}Fe , *Nucl. Phys. A*, in press.
- 112) R. Katano and S. Shimizu : Production of Centrifugal Fields greater than 100 Million Times Gravity, *Rev. Sci. Instrum.*, **50**, in press.
- 113)* T. Ishida and H. Mazaki : Compositional Analysis with Inner-Shell Ionization by Radioisotopic β Rays, *J. Phys. E: Sci. Instrum.*, in press.
- 114)* T. Ishida and H. Mazaki : Superconducting Transition of Electrodeposited Technetium, *Phys. Rev. B*, in press.
- 115) T. Mukoyama, H. Mazaki, and S. Shimizu : Single-Quantum Annihilation of Positrons with K -Shell Electrons, *Phys. Rev. A*, in press.

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