12th International Workshop on Real and Complex Singularities

July 16th – 27th, 2012

Celebrating the 60th birthday of Shyuichi Izumiya

Preface by proceedings editors

This 12th edition of the Workshop on Real and Complex Singularities was organized by both the Brazilian group of singularities and the Japanese researchers community, and had the great pleasure to celebrate the 60th birthday of Professor Shyuichi Izumiya from Hokkaido University, Sapporo, Japan.

For the first time, the workshop was held in two weeks, where in the first week (July 16—20, 2012) elementary and basic mini-courses were delivered for PhD students, post-docs and young researchers, by Lê D. Tráng, David Mond, Nicolas Dutertre, Hans Schönemann and Valery Romanovsky. In the second week (July 23—27, 2012), in addition to the plenary and parallel talks on specialized topics, two mini-courses on current topics of researches were also delivered by Toru Ohmoto and Anne Pichon.

We thank all members of the scientific and organizing committees for their contributions and help for building fruitful and high level school and workshop during the two weeks.

We especially thank the Fapesp agency, Capes, INCT-Mat, USP (Brazil) and JSPS (Japan) for their fundamental financial support. Without their help it would have been impossible to develop these important scientific meetings.

Also, we would like to thank all administrative staffs of ICMC-USP for their important and fundamental technical supports.

O. Saeki, V.H. Jorge Pérez, T. Nishimura and R. Araújo dos Santos

Preface by Goo Ishikawa

Professor Shyuichi Izumiya is our leader, collaborator, colleague and our friend. He has written over 100 papers and enjoyed over 460 citations by 142 authors (up to 21 July 2012). He supervised lots of graduate students (Doctors and Masters) and undergraduate students as well.

Shyuichi Izumiya was born on 7th July 1952 at Sapporo city, Hokkaido prefecture, Japan. 7th July is the day of "Tanabata" (the star festival). He lived in Takikawa city, in Hokkaido, and studied at Nishi Elementary School in Takikawa until the autumn of his 6th grade year. Then he moved back to Sapporo and graduated at Misono Elementary School in Sapporo city, Ryoyo Junior High School and Asahigaoka High School also in Sapporo.

From 1971 to 1975, he studied in Department of Mathematics, Faculty of Science, Hokkaido University, and he was awarded the degree of BSc in Mathematics. From 1976 to 1978, he studied and got the degree of MSc in Mathematics in Department of Mathematics, Faculty of Science, Hokkaido University, for the thesis entitled "Homotopy classification of regular sections which are equivariant with respect to finite group actions", which was a work supervised by Professor Haruo Suzuki. Then from 1978 to 1984, he studied in Department of Mathematics, Faculty of Science, Hokkaido University, where he was awarded the degree of DSc in Mathematics for the thesis entitled "Generic bifurcation of varieties", supervised by Professor Haruo Suzuki.

As for the research and professional experience of Shyuichi Izumiya, he was an assistant professor at the Department of Mathematics, Faculty of Science, Nara Women's University,

from 1978 to 1985. From 1985 to 1987, he was a lecturer at the Department of Mathematics, Faculty of Science, Hokkaido University, where from 1987 to 1995, he was an associate professor and after 1995 he became a professor. Currently, he is a professor at Research Center for Integrative Mathematics, Hokkaido University.

A partial list of academic activities follows:

1990.9 Visiting fellow at the Chinese Academy of Science.
1991.4–1992.2 Visiting fellow at the Department of Pure Mathematics, Liverpool University, UK.
1993.2 Visiting fellow at the center for non-linear analysis, Carnegie Mellon University, USA.
1995.4–5 Visiting fellow at the Banach International Mathematical Center, Warsaw, Poland.
1996.8 Visiting fellow at the Department of Pure Mathematics, Liverpool University, UK.
2000.9–12 Researcher at Isaac Newton Institute for Mathematical Sciences, University of Cambridge, UK.
2010.3 Honorary professor at Northeast Normal University, China.

A partial list of Shyuichi's students supervised during the master degree:

Asayama, Mikuri / Ashino, Takashi / Chino, Sachiko / Fusho, Takesi / Hayashi, Ryota / Ichiwara, Hisatoshi / Ito, Hiroki / Kikuchi, Makoto / Kanazawa, Sunao / Kogo, Yasuko / Kurokawa, Hitoshi / Kurokawa, Yasuhiro / Maruyama, Kunihide / (Matsuoka, Sachiko) / (Minami, Tatsuya) / Miyawaki Norio / Murata Yusuke / Nagai, Takayuki / (Nakai, Hitoshi) / Ohtani, Saki / Sano, Takashi / Sato, Takami / Takahashi, Masatomo / Takiyama, Akihiro / Tamaoki, Aiko / Torii, Erika / (Watanabe, Kazuo) / (Yamamoto, Takahiro) / (with a lot of omission).

--- Mother's teaching ---

Shyuichi remembers that his mother said to him in his Childhood: "Be gentle to girls !" Following her saying, Shyuichi keeps to support women's activities and women mathematicians. He is proud of that.

Shyuichi supervised the following students during the PhD degree:

Yasuhiro Kurokawa / Takashi Sano / Wei-Zhi Sun / Donghe Pei / Nobuko Takeuchi / Takaharu Tsukada / Masatomo Takahashi / Liang Chen / Masaki Kasedou / Takayuki Nagai / Yang Jiang

Shyuichi's mathematical works cover the following three major areas:

— Basic Singularity Theory
— Applications to Differential Equations
— Applications to Differential Geometry

Shyuichi started his mathematical carrier by Equivariant Topology and Singularity Theory, and then he studied on generic bifurcation of varieties and global theory, characteristic classes and obstructions. Shyuichi says that the motivation to study new topics was just to provide problems for his Master Students. Then always, he completes the joint-work by writing joint papers.

Then Shyuichi showed that stability in the tangent sense for mappings between foliated manifolds, implies infinitesimal stability in the tangent sense, (the converse of L. A. Favaro's theorem). After that, Shyuichi began to make good connections with São Carlos's singularity group in São Paulo, Brazil.

In the paper with Sachiko Matsuoka, Shyuichi studied functions on varieties from the viewpoint of Thom-Mather's theory. He continued to study on topology of Legendre singularities, Legendrian unfoldings and differential equations, and how to define singular solutions, Complete integrability and Clairaut-type equations and Geometric singularities of weak solutions of PDE.

In the paper with Georgios T. Kossioris, Shyuichi classified generic bifurcations of singularities of viscosity solutions to Hamilton-Jacobi equations (shock waves). In particular, he discovered the phenomena that viscosity solutions are not necessarily covered by characteristic curves starting from the initial fronts. The discovery gave shocks to specialists of PDE for several years.

Then Shyuichi started to apply singularity theory to affine differential geometry. Frederic Gauss used "Gauss maps" and height functions for his famous surface theory. Then René Thom suggested Ian Porteous to apply singularity theory to submanifold theory in Euclidean geometry: I.R. Porteous, The normal singularities of a submanifold, J. Diff. Geom. 5 (1971), 543–564. Moreover, by applying Arnol'd-Zakalyukin's Lagrange and Legendre singularity theory and its improvements to those situations, Shyuichi has found that geometric meanings of singularities of families of functions become clearer. Then Shyuichi began to develop Thom-Porteous's idea by applying to affine geometry, hyperbolic geometry, Minkowski geometry and so on.

In the joint paper with Takashi Sano, Shyuichi has found the relation of affine curvature, sextactic points etc. with singularities of affine-cubed functions or affine height functions. Then Shyuichi had many works on time-like surfaces

in Minkowski space, light-cone Gauss maps, special curves and special surfaces, hyperbolic Gauss maps, and so on.

After the investigation in those paper, Shyuichi discovered a new geometry, horospherical geometry, in the hyperbolic space. In horospherical geometry, horospheres are regarded as the totally umbilic flat surfaces. Moreover, Shyuichi wrote a joint paper with S. Janeczko on gravitational lensing.

Shyuichi's co-authors are: Asayama, Mikuri / Buosi, Marcelo / Chen, Liang / Chino, Sachiko / Davydov, Aleksey / Fusho, Takesi / Hayakawa, Atsushi / Honda, Atsufumi / Ishikawa, Goo / Janeczko, Stanisław / Jiang, Yang / Katsumi, Haruyo / Kikuchi, Makoto / Kogo, Yasuko / Kossioris, Georgios T. / Kossowski, Marek / Kurokawa, Yasuhiro / Li, Bing / Makrakis, George N. / Marar, Washington Luiz / Maruyama, Kunihide / Nagai, Takayuki / Nishimori, Toshiyuki / Nuño Ballesteros, Juan José / Pei, Dong He / Romero Fuster, Maria del Carmen / Ruas, Maria Aparecida Soares / Saito, Sachiko / Saji, Kentaro / Sano, Takashi / Sato, Takami / Sun, Wei Zhi / Takahashi, Masatomo / Takeuchi, Nobuko / Takiyama, Akihiro / Tamaoki, Aiko / Tari, Farid / Torii, Erika / Watanabe, Kazuo / Yamaguchi, Keizo / Yamasaki, Takako / Yıldırım, Handan / Yu, Jian Ming / (over 43 mathematicians).

Shyuichi has projects (ongoing and in near future):

(1) To construct lightlike geometry in Lorentz-Minkowski space (with several people). To study on tightness which depends on causality.

(2) To obtain mathematical interpretations and generalisations of Randall-Sundrum model and Karch-Randall model in brane world scenario by applied singularity theory.

(3) Recurrence to applications of singularity theory to nonlinear partial differential equations.

Shyuichi Izumiya wrote the following books:

---Matrices and Systems of Linear Equations (Japanese, with Rentaro Agemi, Goo Ishikawa, Atsuro Sannami, Ungou Chin, Toshiyuku Nishimori), Kyoritsu Shuppan Co., Ltd. (1996).

---Linear Mappings and Eigen Values (Japanese, with Goo Ishikawa, Rentaro Agemi, Atsuro Sannami, Ungou Chin, Toshiyuku Nishimori) Kyoritsu Shuppan Co., Ltd. (1996).

---Applied Singularity Theory (Japanese, with Goo Ishikawa), Kyoritsu Shuppan Co., Ltd. (1998).

---Geometry and Singularities (Japanese, with Takashi Sano, Osamu Saeki, Kazuhiro Sakuma), Kyoritsu Shuppan Co., Ltd. (2001).

Mathematics on Shapes Understandable by Cutting, Looking and Touching (Japanese, with Nobuko Takeuchi), JUSE Press. Ltd. (2005).

---Elementary Linear Algebra (Japanese), Kyoritsu Shuppan Co., Ltd. (2008).

---Coordinates Geometry—An Introduction to Analytic Geometry (Japanese, with Nobuko Takeuchi, Mitsutaka Murayama), JUSE Press. Ltd (2008).

---Exercises of Coordinates Geometry (Japanese, Nobuko Takeuchi, Mitsutaka Murayama), JUSE Press. Ltd (2008).

Moreover, Shyuichi is now preparing a book on singularity

theory and applications, with Maria Aparecida Soares Ruas, Maria Carmen Romero Fuster and Farid Tari.

Shyuichi is an editor of several Journals and contributes as referees of lots of papers.

Shyuichi has sent me a message on his dream (future plan):

— Shyuichi's Dream —

"I (Shyuichi) am observing the restoration of submanifold theory in physics by recent movements in brane cosmology and particle physics. I suppose that, also in mathematics, it should be the time to reconstruct the extrinsic geometry. The approach by singularity theory should be most appropriate for that. Through my recent investigations along this direction, I feel that several analogies to Gauss' idea of extrinsic geometry have appeared in theoretical physics, like AdS/CFT correspondence, covariant entropy bound, the holographic principle etc.. Then I hope to clarify, mathematically, such correspondences between extrinsic geometry and physics. It is my present dream.

I would be happy if I could continue to extend the areas and viewpoints of my investigations by the communications with worldwide mathematicians."

The 60th birthday is called "Kanreki" in Japan. "Kanreki" means a "cycle of calendar". It is regarded that one will be re-born at his/her 60th birthday. Shyuichi, please keep, even after Kanreki, being attractive, friendly, young, active, gentle and mad on Mathematics !

Happy Birthday to Shyuichi ! Thank you. Obrigado.
Goo Ishikawa

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Program of Talks

	Monday 23rd	Tuesday 24th	Wednesday 25th	Thursday 26th	Friday 27th
8:00		T. Ohmoto	T. Ohmoto		
9:00	A. Hefez	A. Parameswaran	Lê Dung Tráng	P. Popescu-Pampu	J. Seade
10:00	C. Bivià Ausina	M. Umehara	A. Fernandes	J.J.Nuño Ballesteros	R. Callejas Bedregal
11:00	COFFEE	COFFEE	COFFEE	COFFEE	COFFEE
11:20	1: K. Saji 2: L. Câmara 3: L. Kushner	1: Z. T. Jelonek 2: H. Aguilar 3: T. Yamamoto	1: T. Nishimura 2: A. Szücs 3: I. Laboriau	1: L. Chen 2: J.A. Moya Pérez 3: T. Sano	1: C. Mendes 2: D. Trotman 3: J. Sotomayor
11:50	1: R. Oset Sinha 2: M. Silva 3: T. Fukunaga	1: M. Fernández 2: S. Agafonov 3: M. Kobayashi	1: T. Fukui 2: J. Adachi 3: M. Roberts	1: M. Kasedou 2: I. Ahmed 3: P. Giblin	1: H. Yildirim 2: S. Trivedi 3: J.Basto-Gonçalves
12:20	LUNCH	LUNCH		LUNCH	LUNCH
14:00	A. Pichon	A. Pichon		A. Pichon	1: F. Schez. Bringas 2: A. Menegon Neto 3: P. Rios
14:50	1: W. Neumann 2: D. Lehmann 3: F. Tari	1: M. Yamamoto 2: B. Oréfice 3: V. Grandjean		T. Ohmoto	1: J. J. Risler 2: H. Möller Pedersen 3: R. Garcia
15:20	Poster Session	Poster Session	B B Q		15:00 – 16:00 M. Manoel
15:40	COFFEE	COFFEE		COFFEE	COFFEE
16:00	T. Gaffney	S. Ishii		J. Vitório	16:30 – 17:30 S. Janeczko
17:00	M. Saia	J. F. Bobadilla		G. Ishikawa	
18:00				CONFERENCE DINNER	

Poster sessions

- <u>Monday</u>: A. J. Miranda, A. C. Rezende, A. P. Francisco, A. Tsuchida, A. Yano, C. Wolf, C. Casonatto, C. A. Buzzi, D. Nakajo, E. C. Rizziolli, J. C. F. Costa, L. N. de Oliveira, J. V. Santos, G. Peñafort, N. R. Ribeiro, E. S. F. Ruth, A. C. Felippe, I. Oliveira, G. Miranda, J. A. Coripaca Huarcaya.

- <u>Tuesday</u>: L. R. dos Santos, L. Roberto, M. F. H. Iglesias, M. Milijevic, N. Hu, P. B. Riul, P. T. Cardin, R. Martins, T. Sato, T. de Carvalho, W. Yukuno, Y. Jiang, K. Takao, Y. Izumikawa, Y. Mizota, F. de M. Viríssimo, B. R. P. Sampaio, Y. Kurokawa, H. Kurokawa, R. Mendes, F. Antoneli.