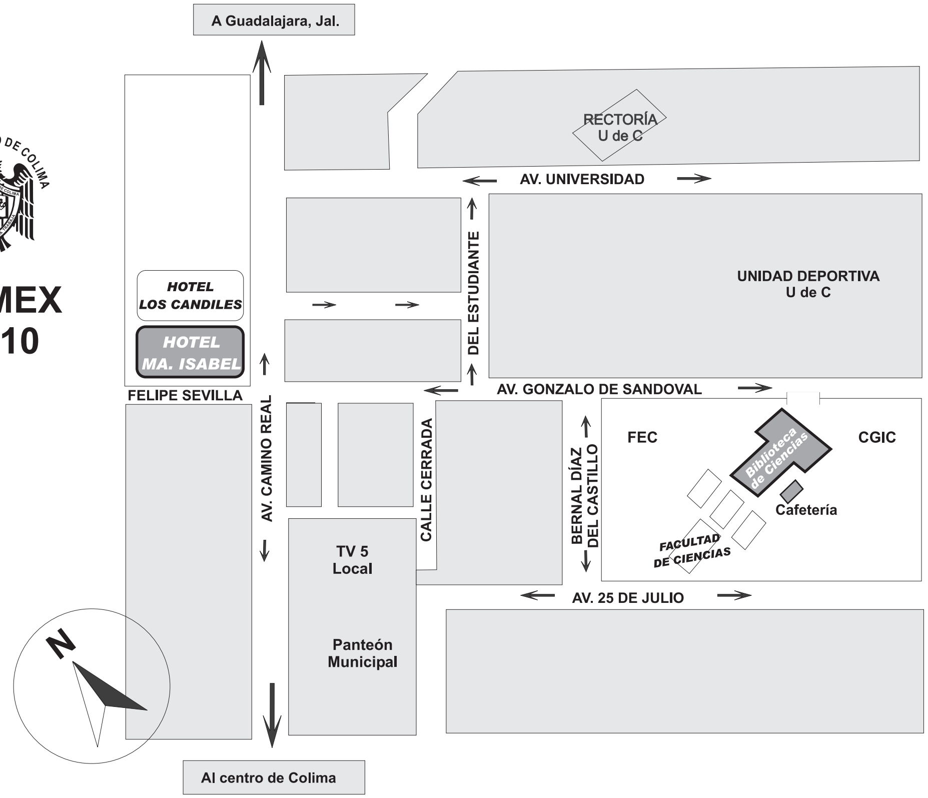
JAMEX 2010



A Guadalajara, Jal.
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AV. UNIVERSIDAD
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HOTEL LOS CANDILES
HOTEL MA. ISABEL
FELIPE SEVILLA
AV. GONZALO DE SANDOVAL
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CALLE CERRADA
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Biblioteca de Ciencias
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N
Al centro de Colima

Contents

Welcome to the

International Conference Japan-México on Topology and its Applications

Colima, México

September 27 - October 1, 2010

The Facultad de Ciencias of the Universidad de Colima will host the International Conference Japan-Mexico on Topology and its Applications (V-JAMEX). The purpose of this international meeting is to gather topologists from around the world to explore some of the recent achievements in topology with the hope to promote scientific exchange among them.

This conference will provide an opportunity for interaction between people who work on different aspects of topology. All areas of topology will be covered with special emphasis on Algebraic Topology, Continuum Theory, Geometric Topology, Knot Theory, Set-Theoretic Topology, Set-Theory and Symplectic Topology.

History

This is the fifth of a series of meetings organized by Japanese and Mexican topologists. The first one took place in Morelia, Mexico, July 1999; the second one in Matsue, Japan, June 2002; the third in Oaxaca, Mexico, December 2004; and the fourth in Kyoto, Japan, December 2007.

General Information

Place

The Conference Place will be the "Biblioteca de Ciencias Miguel de la Madrid Hurtado", located in the campus of Colima University, about 15 minutes walking distance from Hotel Maria Isabel (see map). All the conference rooms are inside of this library. The "Sala de Lectura Informal" is located in the first floor; all other rooms are located in the ground floor.

Session	**Room**
Plenary Lectures	Auditorio
Algebraic Topology	Sala de Lectura Informal
Continuum Theory	Sala Audiovisual no. 1
Geometric Topology	Sala Audiovisual no. 2
Knot Theory	Auditorio
Set Theory and Set-Theoretic Topology	Sala de Usos Múltiples
Symplectic Topology	Sala de Lectura Informal

General schedule

There will be two sessions every day, one in the morning from 9:00 a.m. to 2:00 p.m., and one in the afternoon, from 4:00 p.m. to 8:00 p.m. But note that times may vary according to each session. The opening ceremony will be held on Monday 27th., at 10:00 a.m. On Wednesday there will be only morning session.

Registration

The registration desk will be open on Sunday 26th of September from 18:00 to 21:00 in the lobby of the Hotel Maria Isabel. The registration will continue the next days at the conference place (9:00-14:00 and 16:00- 18:00).

Conference fee

The conference fee is $ 1000.00 pesos (approximately $ 55.00 EUR or $ 80.00 USD, for currency exchange see xe.com). This will be paid in cash (either in pesos, euros or USA dollars) at the registration desk. The fee covers registration, welcome reception, conference materials, coffee-break and refreshments. Students are exempt from the registration fee.

Internet access for conference participants

Internet access is offered to the participants at the conference place:

1) Wireless connection:

Name of the wireless net:	WUCOL
User:	jamex
Password:	topology

2) Computer Laboratory (first floor): To use a computer there you need neither 'user' nor 'password' .

Social program

Welcome reception

Monday September 27th, 2010, starting at 8:00 pm in the museum Pinacoteca Universitaria “Alfonso Michel”, st. Vicente Guererro # 35 and Av. Constitución, downtown, Colima:

http://www.ucol.mx/universidad/pinacoteca.php

The welcome reception gives you the opportunity to meet the other conference attendees in a beautiful museum of the university.

Excursion

Wednesday September 29th, from 14:00 to 20:00.

We shall organize a tour around some small towns of Colima state. The lunch is included and will be in a typical restaurant in Comala. After that, we shall visit the town Nogueras. Depending on the weather, we could visit some natural attractions. Details will be available at the registration desk. Tickets will be available for purchase at the conference desk. Please buy the tickets in advance before Tuesday 28th, since we need to know the number of participants to make the reservations.

Conference Dinner

Friday October first, 20:00–∞, 2010, at the restaurant LA CASA DE PIEDRA (Ave. Puerta Paraiso Nte. # 1, Colonia Puerta Paraiso, Colima; phone (312) 330-6710). Tickets will be available for purchase at the conference desk. There will be mexican food and mexican drinks.

Homage to Ángel Tamariz-Mascarúa on his 60th birthday

The session of Set Theoretical Topology will be dedicated to Professor Ángel Tamariz-Mascarúa from Facultad de Ciencias, Universidad Nacional Autónoma de México, on occasion of his 60th birthday. On Tuesday September 28th there will be a dinner on his honor at Restaurant "El Charco de la Higuera" (Jardín San José s/n, in Plaza San José, Centro, Colima, phone (312) 313-0192). Before the dinner, S. Antonyan, S. García-Ferreira and M. Ibarra-Contreras will talk about Prof. Tamariz-Mascarúa's work and life (in Spanish). Prof. Tamariz has been an active researcher in General Topology and he has been an excellent teacher for several generations of Mexican topologists. Several young Mexican topologists have been influenced by Prof. Tamariz-Mascarúa in a direct or indirect way. We invite all participants to joint us in this celebration. Each person will pay his/her own dinner and drinks.

Proceedings

The proceedings of the *International Conference Japan-México on Topology and its Applications* will be published in a special issue of the journal *Topology and its Applications*. Only original research papers in its final form will be considered for its publication. The articles to be submitted shall be refereed and evaluated in accordance with the usual high standards of the journal. To prepare a paper for submission, please follow the usual guidelines of the journal Topology and its Applications; these can be found in a recent issue of the journal or in the journal's web page.

The proceedings will have four guest editors for this volume. Articles should be submitted in electronic form, a .ps or .pdf file, to anyone of the guest editors, indicating that the paper is for consideration in this issue.

Deadline for submission of papers: January 31, 2011.

Guest Editors

M. Eudave-Muñoz, Universidad Nacional Autónoma de México
e-mail: mario@matem.unam.mx

S. García-Ferreira, Universidad Nacional Autónoma de México
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T. Nogura, Ehime University, Japan
e-mail: nogura@dpc.ehime-u.ac.jp

A. Kawauchi, Osaka City University, Japan
e-mail: kawauchi@sci.osaka-cu.ac.jp

Organizing Committee

Chair

Salvador García-Ferreira, Instituto de Matemáticas, Unidad Morelia, Universidad Nacional Autónoma de México

Akira Kono, Kyoto University

Local organizers

Andrés Pedroza, Universidad de Colima

Ricardo A. Sáenz, Universidad de Colima

Algebraic Topology

Norio Iwase, Kyushu University

Silvia Millán López, Universidad Autónoma de Guerrero

Continuum Theory

Hisao Kato, Institute of Mathematics, University of Tsukuba

Verónica Martínez de la Vega, Instituto de Matemáticas, Universidad Nacional Autónoma de México

Geometric Topology

Akira Koyama, Shizuoka University

Sergey Antonyan, Facultad de Ciencias, Universidad Nacional Autónoma de México

Knot Theory

Akio Kawauchi, Osaka City University

Mario Eudave-Muñoz, Instituto de Matemáticas, Universidad Nacional Autónoma de México

Set Theory

J. Brendle, Kobe University

Michael Hrusak, Instituto de Matemáticas, Universidad Nacional Autónoma de México

Set-Theoretic Topology

Tsuigunori Nogura, Ehime University

Fernando Hernández-Hernández, Facultad de Física y Matemáticas, Universidad Michoacana de San Nicolás de Hidalgo

Symplectic Topology

Tomoo Matsumura, Cornell University

Andrés Pedroza, Facultad de Ciencias, Universidad de Colima

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Carretera Colima-Guadalajara Km 2

phone (312) 316 1900

Cruz Roja Mexicana

Esquina Aldama y Obregón Col. Centro

phone (312) 312 6622

Restaurants

Regional food	
Name	*Address*
La Terraza de la Abuela	Ignacio Sandoval 901
El Charco de la Higuera	Jardín de San José, Centenario y 5 de Mayo
Los Naranjos	Gabino Barreda 34
Los Naranjos Campestre	Av. Constitución 1750
Carnitas Sahuayo	Felipe Sevilla 477
El Trébol	16 de Septiembre 59

Sea food	
Name	*Address*
El Atracadero	Av. Felipe Sevilla del Ro 646
El Delfín Azul	Calzada Galván Sur 289
La Troje	Carlos de la Madrid 469
La Medusa	Felipe Sevilla 552
La Ballena Blanca	Camino Real 595
Mariscos Mazatlán	Av. Pino Suárez 289
Mariscos Silva	Matamoros 259
Mariscos Mandinga	20 de Noviembre 658
Mariscos El Aguachile	Aniceto Castellanos 93
Mariscos El Plebe	Gabino Barrera 439

Italian	
Name	*Address*
La Pasta	Genoveva Sánchez 1265
Fellini	Sevilla del Río 335
La Strada	Camino Real 715-A

International	
Name	*Address*
Vips	Calzada Galván 120
Cronos	J. Jesús Ponce 1110
Origen Latino	José Alcaraz 1625

Japanese	
Name	*Address*
Banzai of Chuy Lee	Camino Real 865
Sushi Jashi	Sevilla de Río 192

Meats	
Name	*Address*
La Casa de Piedra	Av. Puerta Paraiso Nte. 1
Los Olivos	Av. Constitución 1659
Carnes Asadas Las Brasas	Av. Camino Real 552
Carnes Asadas Muñoz	Constitución 761
Mi Ranchito	Felipe Sevilla 602
La Enramada Campestre	Tercer Anillo Periférico 821

Pizza	
Name	*Address*
Benedettis Pizza	Felipe Sevilla del Río 252
Benedettis	Galván Sur 203
Napoli	Av.Camino Real 820

Deli	
Name	*Address*
Jugo Lunch	Sevilla del Río 572
Jugos Periférico	Tecnológico 33

Various		
Name	*Address*	
El Gordo	Constitución 625	Tacos
A Qué Nanishe	5 De Mayo 267	Oaxacan
El Pollo Feliz	Av. San Fernando 201	Chicken

Schedule for Session

PLENARY LECTURES

	M	T	W	Th	F
9:00-10:00	Registration	T. Kohno	A. Dow	L. G. Valdez	K. Ono
10:00-10:30	Open Ceremony				
10:30-11:00	*Coffe*				
11:00-11:30	11:00-11:50 S. Kamada		*Coffee*		
12:00-13:00					
13:00-14:00		T. Farrell	H. Sakai	A. Koyama	V. Gutev
14:00-16:00			*Lunch*		
16:00-17:00	P. Pellicer				
17:00-17:30	*Coffee*		*Excursion*	*Coffee*	
20:00 - 22:00	Welcome Party	Tamariz's Dinner			Banquet

Algebraic Topology

	M	T	W	Th	F
9:00-10:00	Registration	**T. Kohno**	**A. Dow**	**L. G. Valdez**	**K. Ono**
10:10-10:55	Open Ceremony	M. Xicotencatl	B. Nucinkis		
11:00-11:30	**S. Kamada**	*Coffee*			
11:35-12:20		N. Iwase	S. Kaji		
12:25-12:50	E. Lupercio 12:00-12:45	R. Hernández	E. Munguía		
13:00-14:00	D. Juan 12:50-13:35; H. Rodríguez 13:40-14:05	**T. Farrell**	**H. Sakai**	**A. Koyama**	**V. Gutev**
14:00-16:00	*Lunch*				
16:05-16:30	**P. Pellicer**	D. Tamaki 16:05-16:50	*Excursion*	C. Segovia	
16:35-17:00				J. A. Arciniega	
17:00-17:30	*Coffee*			*Coffee*	
17:35-18:00	R. Díaz 17:35-18:20	J. F. Espinoza			
18:05-18:50	D. Kishimoto 18:25-19:10	N. Barcenas			
18:55-19:40	J. González 19:15-20:00	M. A. Velázquez			
20:00-22:00	Welcome Party				Banquet

Continuum Theory

	M	T	W	Th	F
9:00-10:00	Registration	**T. Kohno**	**A. Dow**	**L. G. Valdez**	**K. Ono**
10:00-10:30	Open Ceremony	M. Chacón	P. Oprocha	J. Gómez	
10:30-11:00	*Coffe*	H. Villanueva		S. Macías	
11:00-11:30	**S. Kamada**	*Coffee*			
11:30-12:00		A. Illanes	H. Kato	C. Mouron	
12:00-12:30	A. Santiago				
12:30-13:00	V. Martínez de la Vega	N. Ordoñez	J. Martínez	J. Sánchez	
13:00-13:30	M. E. Aguilera	**T. Farrell**	**H. Sakai**	**A. Koyama**	**V. Gutev**
13:30-14:00	I. Puga				
14:00-16:00	*Lunch*				
16:00-16:30	**P. Pellicer**	D. Bellamy		D. Maya	
16:30-17:00					
17:00-17:30	*Coffee*		*Excursion*	*Coffee*	
17:30-18:00					
18:00-18:30					
20:00- 22:00	Welcome Party				Banquet

Geometric Topology

	M	T	W	Th	F
9:00-10:00	Registration	**T. Kohno**	**A. Dow**	**L. G. Valdez**	**K. Ono**
10:00-10:45	Open Ceremony	S. Antonyan	A. Chigogidze	V. Valov	T. Dobrowolski
11:00-11:30	**S. Kamada**	*Coffee*			
11:30-11:55		N. Chinen	K. Tomoyasu	K. Mine	P. Suárez
12:00-12:25	T. Yagasaki 12:00-12:35	A. Bykov	D. Varela	G. Romero	
12:30-12:55	N. Jonard 12:40-13:05	A. Kantún	F. Valdez	L. Rodríguez	
13:00-14:00	S. Illman 13:10-13:45	**T. Farrell**	**H. Sakai**	**A. Koyama**	**V. Gutev**
14:00-16:00	*Lunch*				
16:00-16:30	**P. Pellicer**		*Excursion*		
16:30-17:00					
17:00-17:30	*Coffee*			*Coffee*	
20:00- 22:00	Welcome Party				Banquet

Knot Theory

	M	T	W	Th	F
9:00-10:00	Registration	**T. Kohno**	**A. Dow**	**L. G. Valdez**	**K. Ono**
10:00-10:30	Open Ceremony	E. Hironaka	M. Motegi	T. Kanenobu	A. Kawauchi
10:30-11:00	*Coffe*	H. Cabrera	K. Ichihara	N. Kamada	In Dae Jong
11:00-11:30	**S. Kamada**	*Coffee*			
11:30-12:00		T. Abe	T. Saito	K. Kishimoto	K. Oshiro
12:00-12:30	F. González-Acuña	F. Jasso	J. Rodríguez	A. Shimizu	O. Hermosillo
12:30-13:00	A. Ido	N. Ito	M. Ozawa	M. Neumann-Coto	Y. Jang
13:00-13:30	F. Manjarrez	**T. Farrell**	**H. Sakai**	**A. Koyama**	**V. Gutev**
13:30-14:00	M. Zhang				
14:00-16:00	*Lunch*				
16:00-16:30	**P. Pellicer**	M. Eudave-Muñoz	*Excursion*	G. Hinojosa	Y. Nakanishi
16:30-17:00		F. Nagasato		M. Iwakiri	Y. Miyazawa
17:00-17:30	*Coffee*			*Coffee*	
17:30-18:00	A. Cruz-Cota	G. Santiago		K. Tanaka	L. Armas
18:00-18:30	N. Monden				
20:00- 22:00	Welcome Party				Banquet

Set Theory and Set Theoretic Topology

	M	T	W	Th	F
9:00-10:00	Registration	**T. Kohno**	**A. Dow**	**L. G. Valdez**	**K. Ono**
10:00-10:50	Open Ceremony	M. Sanchis	J. Cao	Y. Hattori	N. Kemoto
11:00-11:30	**S. Kamada**	*Coffee*			
11:30-12:00		T. Yorioka	S. Fuchino	M. Kada	D. Meza-Alcántara
12:00-12:20	A. Tamariz	U. A. Ramos	B. Zamora	J. Verner	H. Tsuiki
12:30-12:50		J. Brendle	R. Bouziakova	S. Gomes da Silva	A. García-Máynez
13:00-13:20	T. Yamauchi	**T. Farrell**	**H. Sakai**	**A. Koyama**	**V. Gutev**
13:30-13:50	C. Martínez				
14:00-16:00	*Lunch*				
16:20-16:40	**P. Pellicer**	M. Tkachenko	*Excursion*	R. Hernández	C. Uzcátegui
16:40-17:00				I. M. Rubio	
17:00-17:30	*Coffee*			*Coffee*	
17:30-18:10	D. Raghavan	T. Mátrai		Y. Yajima	A. H. Tomita
18:10-18:30	O. Téllez Nieto	H. S. Pino-Villela		Y. F. Ortiz	A. C. Boero
18:30-18:50	V. Torres Pérez	M. Hrušák		N. R. Paul	P. J. Szeptycki
19:00-19:20	M. L. Thivagar				
20:00- 22:00	Welcome Party	Tamariz's Dinner			Banquet

Symplectic Topology

	M	T	W	Th	F
9:00-10:00	Registration	**T. Kohno**	**A. Dow**	**L. G. Valdez**	**K. Ono**
10:00-10:30	Open Ceremony			T. Yagasaki	F. Ziltener
10:30-11:00	*Coffe*				
11:00-11:30	**S. Kamada**	*Coffee*		E. González	*Coffee*
11:30-12:00					C. Campos
12:00-12:30				P. Suárez	E. Lupercio
12:30-13:00					
13:00-13:30		**T. Farrell**	**H. Sakai**	**A. Koyama**	**V. Gutev**
13:30-14:00					
14:00-16:00	*Lunch*				
16:00-16:30	**P. Pellicer**		*Excursion*		
16:30-17:00					
17:00-17:30	*Coffee*			*Coffee*	
17:30-18:00					
18:00-18:30					
20:00- 22:00	Welcome Party				Banquet

Plenary Lectures

Alan Dow,
UNC Charlotte, USA
adow@uncc.edu

PFA and converging sequences

Let X be a sequentially compact space containing the integers N. Then there are maximal almost disjoint families of subsets of N consisting of sets which converge in X. Does this point of view help us analyze X? Could the proper forcing axiom, PFA, help in this analysis. We survey some problems in which it has and we attempt to make it an accessible analytical tool for further applications.

F. Thomas Farrell,
SUNY-Binghamton, USA
farrell@math.binghamton.edu

Space of negatively curved metrics; bundles with negatively cuved fibers

This is a report on joint work with Pedro Ontaneda. Let R, G and T denote the spaces of all negatively curved Riemannian metrics, geometries and marked geometries (respectively) on a n-dimensional closed smooth manifold M; G and T are quotient spaces of R where isometric and marked isometric metrics (respectively) are identified. We focus attention on the case where n is large instead of the classical setting $n = 2$. And obtain results on the homotopy and homology of R, G and T; e.g. R has infinitely many components when $n > 9$. And if M supports a real hyperbolic metric (and $n > 9$) then G is also disconnected for sufficiently large finite sheeted covers of M. These results relate to studying bundles equipped with negatively curved fibers.

Valentin Gutev,
School of Mathematical Sciences, University of KwaZulu-Natal, South Africa
gutev@ukzn.ac.za

Cover Properties, Discrete-Valued Mappings and Multiselections

As a rule, the classical Michael theorems for the existence of single-valued continuous selections for lower semi-continuous set-valued mappings are analogues and in certain respects generalisations of ordinary extension theorems. For instance, such familiar extension theorems as Urysohn's characterisation of normality, Kuratowski's extension theorem for finite-dimensional spaces, and the homotopy extension theorem were transformed and thereby essentially generalised into selection theorems. In contrast to this, most theorems for the existence of multiselections have no proper analogues in the extension theory, but are natural generalisations of cover properties of topological spaces. Indeed, such familiar cover properties as paracompactness, metacompactness, collectionwise normality, etc., were transformed and thereby essentially generalised in terms of multiselections for lower semi-continuous mappings in completely metrizable spaces. The present talk is concerned with the latter, and aims to discuss certain relations between cover properties and discrete-valued mappings, also a possible way to transform these relations into theorems for multiselections.

SEIICHI KAMADA,
Hiroshima University, Japan
kamada@math.sci.hiroshima-u.ac.jp

Graphic descriptions of monodromy representations II: On stabilization of genus-two Lefschetz fibrations

Various topological objects: 2-dimensional braids, Lefschetz fibrations of 4-manifolds, algebraic curves, hyperplane arrangements, etc., are treated by use of their monodromy representations. At the third JAMEX meeting in Oaxaca, 2004, I introduced a graphic method to describe monodromy representations, which we call a chart description. First we recall it for 2-dimensional braids and for genus-one Lefschetz fibrations. And then we give another application to it on genus-two Lefschetz fibrations. Genus-two Lefschetz fibrations can be stabilized by fiber-sum with certain basic Lefschetz fibrations.

TOSHITAKE KOHNO,
The University of Tokyo, Japan
kohno@ms.u-tokyo.ac.jp

Quantum representations of mapping class groups

By means of conformal field theory on Riemann surfaces we can construct a series of linear representation of mapping class groups. These representations are parametrized by positive integers called levels and it was shown by J. Andersen that they are asymptotically faithful as the level tends to infinity. We give qualitative estimate for the images of such representations. In particular, we show that the image of any Johnson subgroup contains a non-abelian free group. As an application we give an answer to conjectures by Squier on Burau representations of braid groups. This is a joint work with L. Funar.

Akira Koyama,
Department of Mathematics, Faculty of Science, Shizuoka University, Japan
sakoyam@ipc.shizuoka.ac.jp

Embeddings of n-dimensional compacta into products of curves

This talk is based on a series of joint works by Kransinkiewiczn Speiż and Koyama. We present some results on n-dimensional compacta embeddable into n-dimensional Cartesian products of compacta. We pay special attention to compacta embeddable into products of 1-dimensional continua (= curves). Most of our basic results are proven under the assumption that the n-dimensional compacta X admit essential maps into the n-sphere $\mathbb{S}^n$ (equivalently, the Čech cohomology $H^n(X) \neq 0$). Our investigations have been inspired by some results in this direction established by Borsuk, Cauty, Dydak, Koyama and Kuperberg. The results of the present paper may be viewed as an extension of the theory developed so far by those authors.

First we prove that if X is an n-dimensional compactum with $H^n(X) \neq 0$ that embeds in a product of n *curves* (i.e. 1-dimensional continua) then there exists an algebraically essential map $X \to T^n$ into the n-torus. Then we show that the same is true if X embeds in the nth symmetric product of a curve.

Next we introduce some new classes of n-dimensional continua and show that embeddability of locally connected *quasi n-manifolds* into products of n curves also implies $\text{rank} H^1(X) \geq n$. Applying this (with $n = 2$) to either the "Bing house" or the "dunce hat" we infer that neither is embeddable in a product of two curves. So, each is a 2-dimensional contractible polyhedron not embeddable in any product of two curves. On the other hand, we show that any collapsible 2-dimensional polyhedron (e.g. the cone over a graph) can be embedded in a product of two *trees* (i.e. acyclic graphs). We present several results on 2-manifolds lying in products of two curves.

Kaoru Ono,
Hokkaido University, Japan
ono@math.sci.hokudai.ac.jp

Lagrangian Floer theory on compact toric manifolds

I will explain how Floer theory of Lagrangian torus fibers in compact toric manifolds is governed by their potential functions. I also want to explain some of its applications: non-displaceable torus fibers, the quantum cohomology of the compact toric manifold and the Jacobian ring of the potential function, etc. This talk is based on my joint works with K. Fukaya, Y.-G. Oh and H. Ohta.

Patricia Pellicer Covarrubias,
Facultad de Ciencias, UNAM, México
paty@ciencias.unam.mx

Old and new results on $\frac{1}{2}$-homogeneity

We say that a space is $\frac{1}{2}$-homogeneous provided that the action on the space of the group of homeomorphisms of the space onto itself has exactly 2 orbits.

Note that if C is an n-cell for some positive integer n, then the points in the manifold boundary of C belong to one orbit of C, while points in the manifold interior of C belong to another orbit. This means that C has exactly two orbits and is, thus, $\frac{1}{2}$-homogeneous. Hence, $\frac{1}{2}$-homogeneity is a geometrically natural property of any finite-dimensional cell.

In this talk, we give a survey of results on $\frac{1}{2}$-homogeneity on continua, as well as on hyperspaces (particularly on symmetric products).

HIROSHI SAKAI,
Graduate School of Engineering, Kobe University, Japan
hsakai@people.kobe-u.ac.jp

Reflection principles and large cardinals

Reflection principles are mathematical propositions stating that some mathematical structures have small substructures reflecting the properties of the whole structures. The following is an example:

> (n: natural number) Every graph of coloring number $> n$ has a finite subgraph of coloring number $> n$.

The above example is proved in ZFC. But there are also reflection principles undecidable in ZFC. For example consider the following variation of the above reflection principle:

> Every graph of coloring number $> \aleph_0$ has a subgraph of cardinality $\leq \aleph_1$ and of coloring number $> \aleph_0$.

Both of this reflection principle and its negation are not provable in ZFC. In other words, both of this reflection principle and its negation are consistent with ZFC.

Besides this example, many set theoretical reflection principles and topological ones are known to be undecidable in ZFC. In general these reflection principles are closely related to large cardinal axioms, and their consistency are deduced from those of large cardinal axioms.

In this talk we will survey the recent development on reflection principles and their relationships to large cardinal axioms.

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Dehn fillings of hyperbolic 3-manifolds

Let M be a compact 3-manifold with a torus boundary component T_0 and $r \subset T_0$ a slope in T_0. The Dehn filling $M(r) = M \cup_{T_0} S^1 \times D^2$ of M along a slope $r \subset T_0$ (where r bounds a disk in $S^1 \times D^2$) has been an object of much interest in mathematics ever since Poincaré used such a construction to give an example of a homology 3-sphere which is non-homeomorphic to the standard 3-sphere. For M a hyperbolic manifold (with boundary a union of tori), Thurston's hyperbolic Dehn surgery theorem states that, with finitely many exceptions, $M(r)$ is also hyperbolic; this result naturally gives rise to the question of which Dehn fillings of M are not hyperbolic, or exceptional. In recent years much work has been devoted to classifying the exceptional cases when $M(r)$ is reducible, annular, or toroidal. In this talk we will present an overview of the graph-topological methods used in some of these classification problems, and present some partial results on the classification of toroidal Dehn fillings of M at distance 3.

Algebraic Topology

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Torsion Elemens in Algebraic K-Theory

Given a representation α of the fundamental group of a homological 3-sphere Σ on the general linear group $GL_n(\mathbb{C})$, one obtains an element $[\Sigma, \alpha]$ of $K_3(\mathbb{C})$. There is a natural representation of $GL_n(\mathbb{C})$ on $GL_{2n}(\mathbb{R})$ that induces a homomorfism in K-theory, the image of $[\Sigma, \alpha]$ under this homomorphism gives an element of $K_3(\mathbb{R})$. We have generalized this representation for finite simple extensions of a field in order to obtain generators of K_3 of some fields, in particular cyclotomic fields.

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Nonlinearity, proper actions and equivariant cohomotopy

We construct equivariant cohomotopy for proper actions of lie groups. The ideas used to do so come from three sources: nonlinear analysis of PDE, Phillip's equivariant K theory for proper actions and Gauge theoretical invariants of Bauer and Furuta. The coincidence with previous approaches uses a nonlinear parametrized index theory.

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Knots and planar curve invariants from classical field theory

We introduced a general method for obtaining invariant functions from equivariant classical field theories. Applying our method to the 3d Chern-Simmons-Wong and the 2d Yang-Mills-Wong action, we obtain invariants for knots and planar curves, respectively. The invariants obtained for knots are closely related to Milnor's invariants.

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Twisted Equivariant K-Theory

K-theory (complex topological) was born with the work of Atiyah and Hirzebruch about 1959, based on the fundamental work of Grothendieck and Bott. This became the first example of a generalized cohomology theory, ie, a theory that satisfies all the Eilenberg-Steenrod axioms for a cohomology theory except the axiom of dimension; and as such, is representable. In fact, Atiyah and Jänich independently showed that a model for the corresponding Ω-spectrum is given by the space of Fredholm opera-

tors $Fred(\mathcal{H})$ on a separable infinite-dimensional Hilbert space $\mathcal{H}$. It is precisely the key ingredient to define twisted versions associated with K-theory. More precisely, from the Atiyah-Jänich theorem we have that the K-theory of a CW-complex X satisfies

$$K^0(X) \cong [X, Fred(\mathcal{H})],$$

equivalently, if $E := X \times Fred(\mathcal{H})$ is the trivial vector bundle over X with fiber $Fred(\mathcal{H})$ and $\Gamma(E, X)$ denotes the space of sections, then the Atiyah-Jänich theorem tells us that

$$K^0(X) \cong \pi_0(\Gamma(E, X)).$$

Heuristically, we can define "twisted" versions of K-theory by replacing the trivial bundle $X \times Fred(\mathcal{H})$ for an arbitrary bundle E whose fiber is $Fred(\mathcal{H})$, and defining a corresponding E-twisted version by

$$K^0_E(X) := \pi_0(\Gamma(E, X)).$$

A thorough study of these twisted versions of K-theory has been developed by Atiyah and Segal, as well as the corresponding equivariant version. In the non equivariant context, Atiyah and Segal showed that twisted K-theory admits a spectral sequence whose second term corresponds to ordinary cohomology, and in their analysis of the higher differentials they prove that they correspond to Massey products, which in general do not become trivial by taking the tensor product with $\mathbb{Q}$, ie, the spectral sequence does not converge on the second page after tensoring with $\mathbb{Q}$ as in the ordinary case. It presents an essential different picture from the ordinary case, involving new and interesting questions. In this talk I will discuss some results and examples, derived from the analysis of the spectral sequence corresponding to twisted equivariant K-theory.

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Symmetric n-th topological complexity of spheres

In this talk I will introduce symmetrized higher dimensional versions of Farber's concept of topological complexity (TC). Using information on the homotopy cellular dimension of configuration spaces, it is possible to give upper bounds for this TC invariant in the case of spheres. This is joint work with Ibai Basabe, Yuli Rudyak, and Dai Tamaki.

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Equivariant characteristic classes

Let $\mathbb{F} \in \{\mathbb{R}, \mathbb{C}\}$, $b \in \{1, 2\}$, $K_1 = \mathbb{Z}_2$ and $K_2 = \mathbb{Z}$. Let us consider a smooth G-vector bundle $\xi \to M$ of rank n and a G-morphism

$$h : M \times V \to \xi$$

with V some representation of G of $\dim_{\mathbb{F}}(V) = n - i + 1$. Lets denote $\bar{Z}(h)$ the set of points $x \in M$ such that h is not injective. $\bar{Z}(h)$ is a G-set, but in general it is not a manifold; however if h is "generic" $\bar{Z}(h)$ is a stratified manifold with G-invariant strata. In this case we can define certain desingularization of $\bar{Z}(h)$, this means, a corresponding differentiable manifold $\tilde{Z}(h)$ with a map $\phi : \tilde{Z}(h) \to M$ whose image is $\bar{Z}(h)$ and it is a diffeomorphism restricted to some open submanifolds. In fact this desingularization becomes a compact G-manifold of dimension $m - bi$.

The importance of studying this G-manifold $\tilde{Z}(h)$ can be seen, for example, by taking singular (non-equivariant) (co)homology, since it can be shown that it has a fundamental class $[\tilde{Z}(h)] \in H_{m-bi}(\tilde{Z}(h))$. Then, if $D : H_*(M; K_b) \to H^*(M; K_b)$ denotes the Poincaré duality isomorphism, we obtain ordinary characteristic classes of Stiefel-Whitney or Chern as follows

$$\mathrm{cl}_i(\xi) = D \circ \phi_*([\tilde{Z}(h)]) \in H^{bi}(M) \quad 0 \leq i \leq n.$$

In this talk we will discuss an analogous construction in some specific equivariant cohomology theories, to try to construct equivariant characteristic classes.

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A topological complexity is a fibrewise L-S category

We show that a topological complexity is a fibrewise L-S category. There is also a concordance between the related computable invariants including cup-length and category weights.

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Algebraic K theory of braid groups

I will present recent computations of algebraic K theory group of group rings of closed surfaces. This is joint work with J. Guaschi and S. Millan.

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Equivariant Schubert calculus of Coxeter groups

Let G be a Lie group and T be its maximal torus. The homogeneous spaces G/T is known to be a smooth variety and called the *flag variety* of type G. Its cohomology group has a distinguished basis consisting of Schubert classes, which arise from a certain family of sub-varieties. The ring structure of $H^*(G/T)$ with respect to this basis reveals interesting interactions between topology, algebraic geometry, representation theory, and combinatorics, and has been studied under the name of *Schubert calculus.*

One way to study $H^*(G/T)$ is to identify it with the coinvariant ring of the Weyl group W of G, i.e. the polynomial ring divided by the ideal generated by the invariant polynomials of W.

From this point of view, the problem can be rephrased purely in terms of W and extended to any Coxeter group including noncrystallographic ones. In fact, H. Hiller pursued this way in his book "The geometry of Coxeter groups" and gave a characterization of a "Schubert class" in the coinvariant ring.

On the other hand, G/T has the canonical action of T and we can consider the equivariant topology with respect to this action. A similar story goes for the equivariant cohomology $H_T^*(G/T)$ and we can consider *equivariant Schubert calculus* for Coxeter groups.

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Postnikov length

The Postnikov length of a space X is the least height of the tower of principal generalized Eilenberg-MacLane space fibrations whose limit is weakly equivalent to X. I will show its basic properties, and give a tractable form when the spaces are rationalized.

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Nearly Frobenius Structures

In this talk I will survey the theory developed with Ana Gonzalez, Carlos Segovia and Bernardo Uribe on Nearly Frobenius Structures. This theory includes variants of String Topology as I will explain and has relations to topological field theories.

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The topology of spaces of morphisms between complex projective spaces and toric varieties

A morphism from $\mathbf{CP^m}$ to a fixed smooth toric variety X is given by a collection of complex homogeneous polynomials with certain properties. The aim of the talk is to show that the inclusion of the space of all morphisms from $\mathbf{CP}^m$ to X given by polynomials of fixed degrees $d_1, ..., d_r$ into the space of all continuous maps from $\mathbf{CP}^m$ to X, induces isomorphisms in homotopy groups up to some dimension $n(d_i)$. This generalizes Segal's theorem on the spaces of rational maps from $\mathbf{CP}^1$ to $\mathbf{CP}^m$. We will use the Stone-Weiersrass theorem and Vassiliev's simplicial resolutions.

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Finiteness conditions for classifying spaces for the family of virtually cyclic subgroups

Let $\mathfrak{X}$ be a family of subgroups of a group G. We say a G-CW-complex X is a model for the classifying space for the family $\mathfrak{X}$, if X^H is contractible whenever $H \in \mathfrak{X}$ and $X^H = \emptyset$ otherwise. When $\mathfrak{X}$ is the family of finite groups, the classifying space for proper actions $\underline{E}G$ has been widely researched and models satisfying a range of finiteness conditions are known for large classes of groups.

In contrast, not much is known for $\underline{\underline{E}}G$, the classifying space for the family of virtually cyclic subgroups. Very few classes of groups, including virtually polycyclic groups and hyperbolic groups are known to have finite dimensional models. In this talk we shall consider certain elementary amenable groups.

Juan-Pineda and Leary conjectured that a group admitting a finite model for the classifying space for the family of virtually cyclic subgroups has to be virtually cyclic. We show that a stronger version of this conjecture holds for elementary amenable groups.

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Hopf invariants and a conjecture by Ganea on the LS category of spaces

Let X be a topological space and denote by $cat\, X$ the Lusternik–Schnirelmann category of X. Ganea conjectured that $cat\,(X \times S^n) = cat\, X + 1$ for any finite CW–complex X and $n \geq 1$. Although this conjecture was proved in some particular cases, it has been disproved in general by Iwase, with the lowest dimensional counterexample having dimension 10. Ganea established that an upper bound to the category of a space is equivalent to the existence of sections of some fibrations associated to it. In this work, using Ganea's characterisation and a divisibility phenomenon for the Hopf invariants of its attaching maps, a 7–dimensional CW–complex X such that $cat\, X = 2$ is constructed. In addition, an alternative cell decomposition of X is presented and by another divisibility phenomenon of its attaching maps, it is proved that $cat\,(X \times S^n) = 2$ for $n \geq 2$ it is constructed by the use of a divisibility phenomenon for Hopf invariants. Such space hence constitutes the minimum dimensional known counterexample to Ganea's conjecture on the Lusternik–Schnirelmann category of spaces. This talk presents joint work with Don Stanley.

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String Topology

String topology is the study of the free loop space of a manifold LM. Under some hypothesis, the homology $H_*(LM)$ satisfies the axioms of a positive boundary Topological Field Theory. In this talk I will extend the string topology to a G-equivariant analog. Finally, I will make some comments about how to give a noncommutative version of the string topology.

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A homotopy colimit spectral sequence for Hochschild and Baues-Wirsching cohomologies

In this talk, we introduce several variations of bicategories by using bimodules over enriched categories. One of the purposes is to find an appropriate framework working with the Grothendieck construction and its right adjoint. The other is to set up a framework to work with the nerve of categories enriched over a symmetric monoidal category $\mathbf{V}$.

As an application, in the case $\mathbf{V} = k$-Mod, we construct a spectral sequence converging to the Hochschild (co)homology of the Grothendieck construction of a digram X of k-linear categories, which can be regarded as a generalization of the construction by Cibils and Redondo. When X takes values in coalgebra categories, we also construct a generalization of the spectral sequence for the Baues-Wirsching cohomology constructed by Pirashvili and Redondo.

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Equivariant Connective K-homology and configuration spaces

We generalize a theorem of Segal relating the equivariant homotopy groups of the configuration space of points in a topological space X labelled with elements of the equivariant infinite grassmanian with the Atiyah-Segal connective equivariant K-homology of X.

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On mapping class groups of non-orientable surfaces and function spaces

The purpose of this work is to study the relationship between mapping class groups of non-orientable surfaces and certain function spaces, via a combinatorial construction analogous to the classical labelled configuration spaces. In the case of the groups for the projective plane and the Klein bottle the mod 2 cohomology is determined. We also analyze the periodicity of the Farrel cohomology of mapping class groups of non-orientable surfaces with marked points.

Continuum Theory

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Small Whitney Blocks

Given a metric continuum X, let $C(X)$ be its hyperspace of subcontinua. Given a Whitney map $\mu : C(X) \to [0,1]$ and a number $t \in (0,1)$, $\mu^{-1}([0,t])$ is called a Whitney block, which is a subcontinuum of $C(X)$. In this talk we give some partial answers to the next questions:

a. Let P a topological property. If a continuum X has property P, then their Whitney blocks have property P?

b. If the Whitney blocks have a topological property, is it true that the space X has the same property?

Among others, we have considered the following properties: aposyndesis, contractibility, being absolute neighborhood, having trivial fundamental group, unicoherence, the property of Kelley and the fix point property.

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Homogeneous arcwise connected continua

This talk will summarize what is known about homogeneous arcwise connected continua. There will be special emphasis on unsolved problems. The material presented is largely expository, although there will be some new material.

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Large Order Arcs

Given a metric continuum X, let $C(X)$ be the hyperspace of subcontinua of X. A Large Order Arc (LOA) in $C(X)$ is a subcontinuum of $C(X)$ such that A is an arc joining an element of the form $\{x\}$ ($x \in X$) to X and satisfying that if B, C are elements of A, then B is a subset of C or C is a subset of B. Let $LOA(X)$ be the space of all LOA in $C(X)$, considered as a subspace of $C(C(X))$. For a given $x \in X$, let $LOA(x, X)$ be the subspace of $LOA(X)$ consisting of all LOA in $C(X)$ that contain $\{x\}$. In this talk we present some results on $LOA(X)$ and $LOA(x, X)$, for example, $LOA(x, X)$ always is either a singleton or a Hilbert cube. We study some properties of X that $AOL(X)$ inherits.

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Dynamical properties on symmetric products

Let X be a continuum. Let $F_n(X)$ denote the hyperspace of subsets of X with at most n points with the Hausdorff metric. We will show some results about the next question, if the dynamical system (X, f) has the P property, is it true that hyperspace $F_n(X)$ has the same property?

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Aposyndesis in hyperspaces

On a given a metric continuum X it is possible to define several notions related to aposyndesis. For example, X is mutually aposyndetic provided that for each pair of different points p and q in X, there exist disjoint subcontinua M and N in X such that p is in the interior of M and q is in the interior of N. All these concepts generalize local connectedness. In this talk we present a general overview of the results of aposyndesis in hyperspaces. We consider the following hyperspaces of X: $2X$ the hyperspace of all nonempty closed subsets of X; $C(X)$ the hyperspace of all subcontinua of X; $C_n(X)$ the hyperspace of elements of 2X with at most n components and $F_n(X)$ the hyperspace of nonempty subsets of X with at most n points.

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Appications of normal sequences of finite open covers of separable metric spaces to fractal dimension theory and topological dynamics

Topological dimension $\dim X$ is originally defined in terms of local cardinality, order of cover. Recently, fractal dimensions has been studied by many scientists and mathematicians. Fractal dimensions depend on the metrics of spaces and hence the analysis of metrics of the spaces is important. In this talk, we study some properties of topological dimension $\dim X$, metrics d and lower and upper box-counting dimensions $\underline{\dim}_B(X, d)$, $\overline{\dim}_B(X, d)$ of separable metric spaces X from a point of view of general topology. The key word of this talk is "normal sequences" of open covers.

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On the idempotency of the set function T

A *contiuum* is a compact connected Hausdorff space. A continuum X is indecomposable provided that if A and B are subcontinua of X such that $X = A \cup B$, then either $A = X$ or $B = X$.

Given a continuum X, we define the set function T as follows: if $A \subset X$ then

$$T(A) = X \setminus \left\{ \begin{array}{l} x \in X \mid \text{there exists a subcontinuum } W \text{ of} \\ X \text{ such that } \ x \in \operatorname{Int}(W) \subset W \subset X \setminus A \end{array} \right\}.$$

We say that the set function T is *idempotent* if $T(T(A)) = T(A)$ for each subset A of X.

Professor David P. Bellamy asked the following question: If X and Y are indecomposable continua, is T idempotent on $X \times Y$?

We provide a negative answer to this question.

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Making Holes in the Second Symmetric Product of Fruit-trees

Let X be a finite graph. Denote $\mathcal{S}(X) = \{S \in C(X) : S$ is a simple closed curve$\}$, where $C(X)$ is the set of all subcontinua of X. We said that X is a *fruit-tree* if

a) the closure of $X \setminus \bigcup \mathcal{S}(X)$, denoted by $\mathcal{T}(\mathrm{X})$, is a tree,

b) the set $\mathcal{S}(X)$ is nonempty,

c) $S \cap \mathcal{T}(X)$ is only a point, for all $S \in \mathcal{S}(X)$; and

d) if $S_1, S_2 \in \mathcal{S}(X)$ with $S_1 \neq S_2$, such that $S_1 \cap S_2 \neq \emptyset$ then $S_1 \cap S_2$ is only a point and $S_1 \cap S_2 \subseteq \mathcal{T}(X)$.

Let X be a metric continuum and $F_n(X)$ the hyperspace of all subset of X that have at most n elements. Let $A \in F_2(X)$, A is said to make a hole in $F_2(X)$, if the multicoherence degree of $F_2(X) \setminus \{A\}$ is more than the multicoherence degree of $F_2(X)$. In this talk, we give a clasification of elements A of $F_2(X)$, such that A make a hole in $F_2(X)$, for X a fruit-tree.

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k-Mutual aposyndesis in symmetric products and n-fold hyperespaces

Joint work with Alejandro Illanes and Mauricio Chacón

A continuum is a compact connected metric space with more than one point. Let $k \geq 2$. We say that a continuum X is k-mutually aposyndetic if for each k different points $x_1, \ldots, x_k$ in X there are k disjoint subcontinua $M_1, \ldots, M_k$ of X such that x_i is in the interior of M_i for each $i = 1, \ldots, k$. Answering questions of Prof. Illanes, we prove that if X is a continuum, $n \geq 3$ and $k \geq 2$, then $F_n(X)$, the n-fold symmetric product of X, is k-mutually aposyndetic. Also, we show that if X is a Kelley continuum, $n \geq 2$ and $k \geq 2$, then $C_n(X)$, the n-fold hyperspace is k-mutually aposyndetic.

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The classification of circle-like continua that admit expansive homeomorphisms

A homeomorphism $h : X \longrightarrow X$ of a compactum X is *expansive* provided that for some fixed $c > 0$ and every $x, y \in X (x \neq y)$ there exists an integer n, dependent only on x and y, such that $\mathrm{d}(h^n(x), h^n(y)) > c$. It is shown that if X is a solenoid that admits an expansive homeomorphism, then X is homeomorphic to a regular solenoid. It then can be concluded that *a circle-like continuum admits an expansive homeomorphism if and only if it is homeomorphic to a regular solenoid.*

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On the structure of topologically mixing maps in dimension one

Co-authors: Dominik Kwietniak and Grzegorz Harańczyk

In 1986 S. Blokh proved that topological weak mixing, mixing, and specification property are equivalent for maps on topological graphs. In this talk we will present steps which can lead to a proof of this important result. We will present how the proof of Blokh's theorem can be divided, highlighting when exactly the assumptions about the special structure of the underlying space play a role (in some steps these assumptions can be weakened which leads to natural questions in the setting of dendrites). Particular emphasis we will put on pure mixing maps on topological graphs (i.e. topologically mixing but not exact) and infimum of topological entropy in this class. Finally, we will show why common interpretation connecting the numerical value of the entropy directly to the degree of chaos present in the system can be somehow misleading.

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The Hyperspace of Regular and Meager Subcontinua

Given a continuum X, we define the following hyperspaces:

$$C(X) = \{A \subset X : A \text{ is connected, closed and nonempty}\}$$

(the hyperspace of subcontinua of X)

$$D(X) = \{A \in C(X) : \text{cl}(\text{int}\, A) = A\}$$

(the hyperspace of regular subcontinua) and

$$M(X) = \{A \in C(X) : \text{int}(A) \text{ is empty}\}.$$

(the hyperspace of meager subcontinua)

In this talk, we discuss some topological properties of the hyperspaces $M(X)$ and $D(X)$. We relate properties of $M(X)$ and $D(X)$ with properties of the continuum X. Also we characterize some special families of continua by using the structure of their hyperspaces $M(X)$ and $D(X)$.

Finally we show some relations between these hyperspaces and others.

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Induced maps between quotien spaces of symmetric products of continua

A *continuum* means a compact, connected, metric space not degenerated. Given a continuum X and $n \in \mathbb{N}$, $F_n(X)$ denote the hyperspace of subsets of X with at most n points, this hyperspace is considered with the Hausdorff metric ($F_n(X)$ is also known as the *n-th symmetric product of* X). If $n, m \in \mathbb{N}$ and $m < n$, $F_n(X)/F_m(X)$ is the quotient space obtained by shrinking $F_m(X)$ to a point in $F_n(X)$, topologized with the quotient topology.

Let $f : X \to Y$ be a mapping between continua. In this talk we consider the induced map $h^n_m(f) : F_n(X)/F_m(X) \to F_n(Y)/F_m(Y)$ given by $h^n_m(f)\left([A]_{F_m(X)}\right) = [f(A)]_{F_m(Y)}$ and study some properties as openess, monotone and confluence.

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$\frac{1}{2}$-Homogeneous suspensions

A space is said to be $\frac{1}{2}$-homogeneous provided there are exactly two orbits for the action of the group of homeomorphisms of the space onto itself.

In this talk we will see necessary and sufficient conditions under which the suspension of a continuum X is $\frac{1}{2}$-homogeneous, among certain classes of continua. For example, we classify the local dendrites and we classify those continua that contain free arcs and have $\frac{1}{2}$-homogeneous suspension (regardless of the dimension of continuum).

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New families of continua for which their cone can be embedded into their hyperspace of subcontinua

Given a metric continuum X, let $C(X)$ be the hyperspace of subcontinua of X and $Cone(X)$ the topological cone of X. We say that a continuum X is cone-embeddable in $C(X)$ provided that there is an embedding h from $Cone(X)$ into $C(X)$ such that $h(x, 0) = x$ for each x in X.

In this talk, we present new families of continua for which their cone can be embedded into their hyperspace of subcontinua.

Geometric Topology

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Equivariant extension properties of coset spaces of locally compact groups

Let G be a locally compact Hausdorff group. A G-space X is called proper (in the sense of Palais) if each point of X has a, so called, *small* neighborhood, i.e., a neighborhood V such that for every point of X there is a neighborhood U with the property that the set $\langle U, V\rangle = \{g \in G \mid gU \cap V \neq \emptyset\}$ has a compact closure in G.

Denote by $\mathcal{P}$ the class of all paracompact spaces. G-$\mathcal{P}$ is the class of all paracompact proper G-spaces X having a paracompact orbit space X/G.

For a G-space Y we write $Y \in G$-ANE($\mathcal{P}$) if each G-map $f : A \to Y$ defined on a closed invariant subset A of a G-space $X \in G$-$\mathcal{P}$ extends to a G-map $F : U \to Y$ over some invariant neighborhood U of A in X. If one always can take $U = X$, then we write $Y \in G$-AE($\mathcal{P}$).

We prove that for a compact subgroup $H \subset G$ the following properties are mutually equivalent:

1.- G/H is finite-dimensional and locally connected;

2.- G/H is locally contractible;

3.- G/H is a manifold;

4.- G/H is an ANE for the class $\mathcal{P}$;

5.- G/H is metrizable and $G/H \in G$-ANE($\mathcal{P}$).

Furthermore, the property $G/H \in G\text{-AE}(\mathcal{P})$ characterizes the maximal compact subgroups $H \subset G$.

We shall discuss also the relationship of these properties with the approximate slice theorem.

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Orbit projections as approximate G-fibrations

In the homotopy theory of G-spaces the following result is well known: if G is a *compact Lie* group and E is a paracompact G-space with orbits only of one type, then the orbit projection $q_E : E \to E/G$ is a G-fibration. The natural question: what can one say about the orbit projection when G is *not* necessarily a *Lie* group? We show that q_E admits a G-ANR-resolution consisting of G-fibrations if G is a compact metrizable group. This fact helps us to prove that E/G is a fibrant space (in the sense of F. Cathey) if E is a G-fibrant space.

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Colorings of homeomorphisms on connected spaces

Let $f : X \to X$ be a fixed-point free map, i.e., $f(x) \neq x$ for all $x \in X$. A closed subset A of X is called a *color* of (X, f) if $f(A) \cap A = \emptyset$. A *coloring* of (X, f) is a cover of X consisting of colors. The minimal cardinality of a coloring is called the *color number* of (X, f). We will report a recent study of the color number of fixed point free homeomorphisms on connected spaces. In particular, we focus on connected graphs.

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Computing hyperspaces of compact convex bodies

This is a joint work with Sergey Antonyan.

Let $cb(\mathbb{R}^n)$, $n \geq 1$, denote the hyperspace of all nonempty compact convex bodies of $\mathbb{R}^n$ equipped with the Hausdorff metric topology.

It is well-known that $cb(\mathbb{R}^1)$ is homeomorphic to the Euclidean plane $\mathbb{R}^2$. In this talk we will use the theory of group actions to prove that for every $n \geq 2$, $cb(\mathbb{R}^n)$ is homeomorphic to $Q \times \mathbb{R}^p$, where Q denotes the Hilbert cube, and $p = n(n+3)/2$. We will consider also the H-orbit spaces $cb(\mathbb{R}^n)/H$, where H is a closed subgroup of the orthogonal group $O(n)$ acting nontransitively on the sphere $\mathbb{S}^{n-1}$.

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On G-fibrations of G-ANR spaces

The concept of a G-fibration represents an equivariant version of a Hurewicz fibration, in this sense, a G-function is called G-fibration if it has the G-homotopy lifting property for the class of all G-spaces.

Similarly, many concepts of the classical homotopy theory belong to the G-TOP_B category of G-spaces over a given G-space B. In this talk we will pay special attention to notions of G-AR and G-ANR over B.

We will show that given a G-fibration $p : E \to B$, where E and B are G-ANR spaces, then the equivariant path space E^I is G-AR over $coCyl(p)$.

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Approximation theorems for compactifications

In this talk, we shall consider several approximation theorems for the Hausdorff compactifications of metrizable spaces or locally compact Hausdorff spaces. For instance, every compactification of the Euclidean n-space $\mathbb{R}^n$ is the supremum of some compactifications homeomorphic to a subspace of $\mathbb{R}^{n+1}$. Moreover, the following are equivalent for any connected locally compact Hausdorff spaces X: (i) X has no two-point compactifications, (ii) every compactification of X is the supremum of some compactifications whose remainder is homeomorphic to the unit closed interval or a singleton, (iii) every compactification of X is the supremum of some singular compactifications. We shall also present a necessary and sufficient condition of compactifications to approximate by metrizable (or Smirnov) compactifications.

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Linearization of group actions

Given a locally compact group G and a proper G-space X, we construct an equivariant embedding $X \hookrightarrow L$ into a linear G-space such that the complement $L\setminus\{0\}$ is a proper G-space. If X has an invariant metric, L may be choosen to be an infinite dimensional

Banach G-space such that $L \setminus \{o\}$ is an H-AE for every closed subgroup $H \subset G$. This imples that the notions of G-A(N)E and G-A(N)R coincide in the class of all proper metrizable G-spaces which admit an invariant metric.

This is a joint work with Sergey Antonyan

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Approximate fixed points of non expansive maps and the fractals space

Joint work with Liz Ramiro-Fernández

In this work we define a "metric space with the convex property", and we prove an approximate fixed point theorem for non expansive maps of such spaces. The convex subsets of Banach spaces and the "fractals space" $H(P)$ are examples of metric spaces with the convex property, if P is a compact and convex subset of $\mathbb{R}^n$. Therefore our theorem extends a known result about the existence of approximate fixed point of maps of sets in Banach spaces and the Collage Theorem of Barnsley.

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Einstein & Entropy

This is joint work with Masashi Ishida & Michael Brunnbauer.

We will show that the minimal volume entropy of closed manifolds remains unaffected when nonessential manifolds are added in a connected sum. We combine this result with the stable cohomotopy invariant of Bauer–Furuta in order to present an infinite family of four–manifolds with the following properties:

1. They have positive minimal volume entropy.
2. They satisfy a strict version of the Gromov–Hitchin–Thorpe inequality, with a minimal volume entropy term.
3. They nevertheless admit infinitely many distinct smooth structures for which no compatible Einstein metric exists.

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Dimensions of Smirnov remainders controlled by uniform local connectedness

Joint work with Yuji Akaike and Naotsugu Chinen.

We investigate relations between uniform local connectedness and the dimension of the Smirnov remainder. In particular, we concentrate on calculating the dimension of the Smirnov remainder $u_d\mathbb{R}^n \setminus \mathbb{R}^n$ of the n-dimensional Euclidean space $(\mathbb{R}^n, d)$ with uniform local connectedness.

We show that $\dim u_d\mathbb{R} \setminus \mathbb{R} = \operatorname{ind} u_d\mathbb{R} \setminus \mathbb{R} = \operatorname{lnd} u_d\mathbb{R} \setminus \mathbb{R} = 1$ if $(\mathbb{R}, d)$ is uniformly locally connected. Moreover, we introduce a new concept of "thin" covering spaces, and we have the following: If an infinite covering space $(\mathbb{R}^2, \rho)$ of a compact 2-manifold is "thin", then $\dim u_\rho\mathbb{R}^2 \setminus \mathbb{R}^2 = \operatorname{ind} u_\rho\mathbb{R}^2 \setminus \mathbb{R}^2 = \operatorname{lnd} u_\rho\mathbb{R}^2 \setminus \mathbb{R}^2 = 2$.

In this talk, we are going to present the results above and several results concerning relations between uniform local connectedness and the dimension of the Smirnov remainder.

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Polygonal billiards and the Loch Ness monster

We prove that the natural invariant surface associated with the billiard game on an irrational polygonal table is homeomorphic to the Loch Ness monster, that is, the only orientable infinite genus topological real surface with exactly one end.

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Bing and Krasinkiewicz maps

We present general methods for proving some parametric results. This method is applied to show that both parametric Bing and parametric Krasinkiewicz maps form residual subsets of the corresponding function spaces.

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Universal proper G-spaces

This is a joint work with Prof. Sergey A. Antonyan.

We prove that every locally compact group G of weight $w(G) \leq \tau$, an infinite cardinal number, can act properly (in the sense of R. Palais) on $\mathbb{R}^\tau \setminus \{0\}$ such that $\mathbb{R}^\tau \setminus \{0\}$ becomes a universal proper G-space in the class of all Tychonoff proper G-spaces of weight $\leq \tau$. The metric cones $\mathrm{cone}(G/H)$ over coset spaces G/H that are manifolds constitute the main building blocks in our approach.

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Homeomorphism and diffeomorphism groups of non-compact manifolds with the Whitney topology

In this talk we discuss topological properties of the homeomorphism group $\mathcal{H}(M)$ and diffeomorphism group $\mathcal{D}(M)$ of a non-compact n-manifold M endowed with the Whitney (C^∞) topology. Let $\mathcal{H}(M)$ and $\mathcal{D}(M)$ denote the subgroups consisting of homeomorphisms and diffeomorphisms of M with compact support. It is shown that both the pair $(A;DD(M), A;DD_c(M))$ for any n and the pair $(A;HH(M), A;HH_c(M))$ for $n = 2$ are locally homeomorphic at id_M to the pair of box and small box powers $(A;\Box^A;wl_2, A;cbox^A;wl_2)$. It is also shown that the group $A;HH_c(M)$ is locally contractible for any n. We also discuss some related topics.

Knot Theory

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Lee's homology and Rasmussen invariant

The Rasmussen invariant is a concordance invariant which is defined by cycles of Lee's complex. We introduce the notion of state cycles for Lee's complex. We describe "good" state cycles whose homology classes form a basis of Lee's homology of a knot. As a corollary, we give a new proof of the sharper slice-Bennequin inequality for the Rasmussen invariant, which was first proved by Kawamura. We also consider Kawamura-Lobb's inequality for the Rasmussen invariant which is stronger than the sharper slice-Bennequin inequality and show that the equality holds for the homogeneous knots.

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Artin presentations of trivial groups

In this talk we will define what we mean by an Artin presentation of a group. We calculate Artin presentations for the fundamental group of a closed orientable 3-manifold obtained by integral Dehn surgery on a link which is the closure of a pure 3-braid. For a particular family of such links we can say when the groups obtained are trivial, or equivalently, when we obtain the 3-sphere by surgery on these links.

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Closures of oriented 3-tangles and its Conway polynomial

Given a 3-tangle s with certain orientation on its strands there are several closures of it from where we obtain knots or links. In this talk we will show how to assign a matrix invariant $M_\nabla(s)$ to s, whose entries are the Conway polynomial of some closures of s. Moreover, given two 3-tangles s_1, s_2, this matrix allow us to compute the Conway polynomials associated to the closure of the product $s_1 \cdot s_2$, since it is a homomorphism: $M_\nabla(s_1 \cdot s_2) = M_\nabla(s_1)M_\nabla(s_2)$.

In particular we will deal with certain subgroup of the 3-braid group which agrees with the previously assigned orientation.

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Hex Structures on Spheres

A surface is called *singular Euclidean* if it can be obtained from a finite disjoint collection of Euclidean triangles by identifying pairs of edges by Euclidean isometries. The surface is locally isometric to the Euclidean plane except at finitely many points, at which it is locally modeled on Euclidean cones. These singular points are called the *cone points*. For each cone point there is a *cone angle*, which is the sum of the angles of the triangles that are incident to the cone point.

A *hex sphere* is a singular Euclidean sphere with 4 cones whose cone angles are (integer) multiples of $\frac{2\pi}{3}$ but less than 2π.

Given a hex sphere, we consider its Voronoi decomposition centered at the two cone points with greatest cone angles. This decomposes the hex sphere into two cells, the Voronoi cells, which intersect along a graph. By cutting a Voronoi cell along a special shortest geodesic, the Voronoi cell becomes a polygon on the Euclidean plane. This polygon will be referred to as a *Voronoi polygon*. We prove that the Moduli space of hex spheres of unit area is homeomorphic to the space of similarity classes of Voronoi polygons in the Euclidean plane.

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On knots with icon surfaces

A well known conjecture in combinatorial group theory is the so called *Kervaire conjecture*, which says that if G is a group, $G \neq 1$, then $\mathbb{Z} * G$ cannot be normally generated by one element. F. González-Acuña and A. Ramírez proved that Kervaire conjecture is equivalent to what they called the $\mathbb{Z}$-conjecture [1], that is, if F is a compact orientable nonseparating surface properly embedded in a knot exterior E, then $\pi_1(E/F) \cong \mathbb{Z}$.

Following Gónzalez-Acuña, we define an ICON surface to be an Incompressible Compact Orientable Nonseparating surface properly embedded in a knot exterior. A Seifert surface for a knot is then an example of an ICON surface, but it is not clear whether or not there exist ICON surfaces with disconnected boundary.

In this talk I will show a general construction that produces explicit examples of knots whose exteriors contain ICON surfaces of genus m having n boundary components, n odd, $m \geq n$. It is also shown that these examples satisfy the $\mathbb{Z}$-conjecture.

[1] F. González-Acuña and A. Ramírez. *A knot-theoretic equivalent of the Kervaire conjecture.* J. Knot Theory Ramifications 15 (2006), no. 4, 471–478.

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Manifolds with P^2-category 2

Joint work with J. C. Gómez-Larrañaga and W. Heil.

Let K be a CW-complex. A space X has K-category $\leq n$ if it can be covered with n open subsets $U_1, \ldots, U_n$ such that, for every i, there are maps $U_i \xrightarrow{f_i} K$, $K \xrightarrow{\alpha_i} X$ such that $\alpha_i f_i$ is homotopic to the inclusion $U_i \longrightarrow X$.

We determine all closed 3-manifolds with P^2-category 2, where P^2 is the real projective plane.

Higher dimensions will also be discussed.

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3-bridges combinatorial knots

The 3-bridges knots can be codified using six natural numbers. This codification allows a combinatorial treatment of this class of knots through certain groups of permutations defined in a natural way from the sextet; this is, one can recover some topological invariants of the knot from the combinatorial information.

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Any smooth knot of dimension n can be cubulated

In this talk we will consider smooth higher dimensional knots, that is, spheres $\mathbb{S}^n$ smoothly embedded in $\mathbb{R}^{n+2}$. In $\mathbb{R}^{n+2}$ we have the canonical cubulation $\mathcal{C}$ by translates of the unit $(n+2)$-dimensional cube. We will call the n-skeleton $\mathcal{S}$ of this cubulation the *canonical scaffolding* of $\mathbb{R}^{n+2}$. We consider the question of whether it is possible to continuously deform a smooth knot by an ambient isotopy so that the deformed knot is contained in the scaffolding. In particular, a positive answer to this question implies that knots can be embedded as cubic sub-complexes of $\mathbb{R}^{n+2}$, which in turn implies the well-known fact that smooth knots can be triangulated by a PL triangulation.

We will prove that any smooth, compact, closed, n-dimensional submanifold of $\mathbb{R}^{n+2}$ with trivial normal bundle can be continuously isotoped by an ambient isotopy of $\mathbb{R}^{n+2}$ onto a cubic submanifold contained in $\mathcal{S}$. In particular, any knot can be isotoped onto a cubic knot contained in $\mathcal{S}$.

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The smallest hyperbolic braid

The smallest pseudo-Anosov braid monodromy is represented by $\sigma_1\sigma_2^{-1}$ with respect to the standard braid generators, and has monodromy equal to the square of the golden ratio. McMullen's theory of Teichmüller polynomials gives a way of computing dilatations for other fibrations of the complement of the encircled braid closure in S^3. We will show that Lehmer's number and other conjectural minimal dilatations occur in this family.

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On exceptional surgeries on Montesinos knots

Joint works with In Dae Jong and Shigeru Mizushima.

I will report recent progresses of the study on exceptional surgeries on Montesinos knots. Actually we will determine all cyclic surgeries, finite surgeries, and toroidal Seifert surgeries on Montesinos knots, and also give a complete classification of exceptional surgeries on alternating Montesinos knots.

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On Reeb graph and Hempel distance of Heegaard splittings

Let P, Q be Heegaard surfaces of an irreducible 3-manifold. J. Johnson and T. Li introduced a method for giving an estimation of the (Hempel) distance of P via genus of Q (which was originally proved by Scharlemann-Tomova) by using a horizontal arc in the Rubinstein-Scharlemann graphic derived from P and Q. In this talk, we give a new method for giving an upper bound of the distance by using the Reeb graph derived from the horizontal arc, which possibly gives a better estimation. Furthermore, we give another application of the Reeb graph, that is, we make use of it for analyzing genus g Heegaard splittings with distance $2g$.

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Spectral sequences for the colored Jones polynomial

We consider three spectral sequences which give some expressions of the colored Jones polynomial. Each spectral sequence contains Khovanov-type homology groups. One of them is a generalization of the spectral sequence that appears in the construction of Rasmussen's invariant of knots. The others are derived from a bicomplex which is a Khovanov-type complex of the colored Jones polynomial.

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Surface-links represented by 4-charts and quandle cocycle invariants II

In this talk, we study surface braids represented by 4-charts and quandle cocycle invariants associated with Mochizuki's 3-cocycle of order 3. As a consequence, we characterize 4-charts representing some surface-links including a 2-twist spun trefoil. We also prove that the braid index of a connected sum of a 2-twist spun trefoil and a spun trefoil is five, which is the answer to a special case of Tanaka's Problem.

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Characterization of 3-bridge links with infinitely many 3-bridge spheres

It is known by [1] that there exists a family of 3-bridge links each of which admits infinitely many 3-bridge spheres up to isotopy. In this talk, we show that they are the only links which admit infinitely many 3-bridge spheres up to isotopy. (Reference: [1] Yeonhee Jang, Three-bridge links with infinitely many 3-bridge spheres, Topology Appl. 157 (2010), 165-172.)

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Relationships between Khovanov homology and the categorification of graph polynomials

The similarities between the bracket state sum for the Jones polynomial and a state sum for graphs when computing the chromatic and the Tutte polynomial provide connections between the categorification of these polynomials. In this talk we discuss these connections, as well as a relation with the Potts model given by L. Kauffman

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On a characterization of the Alexander polynomials of alternating knots

The author gave linear inequalities on the coefficients of the Alexander polynomials of alternating knots of genus two, which are best possible as linear inequalities on the coefficients of them. In this talk, we give an infinite family of Alexander polynomials which satisfy the linear inequalities, but they are not realized by alternating knots. This implies that a characterization of the Alexander polynomials of alternating knots cannot be achieved by linear inequalities on the coefficients of them.

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Polynomial invariants and quandles of twisted links

Bourgoin defined a twisted virtual link, which is also called a twisted link, that is a generalization of a virtual link. He also introduced invariants of them by extending from virtual links. In this talk, we discuss the quandles and a multivariable polynomial invariant of twisted links. We give some applications of these invariants.

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Finite type invariants for a spatial handcuff graph

We consider a finite type invariant, or a Vassiliev invariant, for an embedded handcuff graph in a 3-sphere: We express a basis for the vector space of finite type invariants of order less than or equal to three for a spatial handcuff graph in terms of the linking number, the Conway polynomial, and the Jones polynomial of the sublinks of the handcuff graph.

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On the Alexander polynomials of Gordian distance one

We consider a condition on a pair of the Alexander polynomials of knots which are realizable by a pair of knots with Gordian distance one. We show that there are infinitely many mutually disjoint infinite subsets in the set of the Alexander polynomials of knots such that every pair of distinct elements in each subset is not realizable by any pair of knots with Gordian distance one. As one of the subsets, we have an infinite set containing the Alexander polynomials of the trefoil knot and the figure-eight knot. We also show that every pair of distinct Alexander polynomials such that one is the Alexander polynomial of a slice knot is realizable by a pair of knots of Gordian distance one, so that every pair of distinct elements in the infinite subset consisting of the Alexander polynomials of slice knots is realizable by a pair of knots with Gordian distance one. These results solve problems given by Y. Nakanishi and by I. Jong.

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Finite type invariants of a spatial theta-curve

Joint work with Atsushi Ishii.

Koike gave a basis of the finite type invariants of a spatial theta-curve of order 4 by using chord diagrams. We represent the finite type invariants by using the coefficients of the HOMFLYPT polynomial. By using this description, we study the finite type invariants of a handlebody-knot.

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Circular thin position for knots

A circle valued Morse function on a knot in S^3 induces a circular handle decomposition on it. This gives rise to the definition of "circular width" and "circular thin position" for the knot. A knot in circular thin position is provided with a nice sequence of Seifert surfaces with the property of being incompressible and weakly incompressible. In this talk I will discuss this concept and some other properties.

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A distance for diagrams of a knot

Any two diagrams of a knot are related by a finite sequence of Reidemeister moves. In this talk, by using this fact, we introduce a distance for diagrams of an oriented knot, and we give an evaluation of the distance. Furthermore, we apply the distance to the construction of a knot invariant.

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On upper bounds of stable commutator lengths in mapping class groups

We give a new upper bound of the stable commutator length of a Dehn twist in the mapping class group of a surface. Moreover, we consider the stable commutator length of a certain reducible map.

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Neighbors of Seifert surgeries on a trefoil knot in the Seifert Surgery Network

Joint with Arnaud Deruelle and Katura Miyazaki.

Seifert surgeries on a trefoil knot are well understood and the most basic ones among those on nontrivial knots.

We revisit Seifert surgeries on a trefoil knot K and investigate their "seiferters", i.e. trivial knots in the exterior of K which become fibers after surgeries on K. Twisting K along its seiferter or an annulus cobounded by a pair of seiferters, we obtain an infinite family of Seifert surgeries on hyperbolic knots. In this talk, we will describe such Seifert surgeries. In particular, we show that a non-primitive/Seifert-fibered Seifert surgery found by H. J. Song arises in this manner and extend his example using a seiferter.

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On minimal elements for a partial order of prime knots

It is well-known that a partial order on the set of prime knots can be defined by surjective homomorphisms between knot groups. We will show by using Chebyshev polynomials and the character varieties that some types of twist knots (infinitely many) are minimal elements with respect to the partial order.

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The differences of Alexander polynomials caused by a single crossing change

This is a joint work with Yuki Okada. In this talk, we will characterize the Alexander polynomials of knots obtained from a knot with a monic Alexander polynomial by a single crossing change. The proof is given by a surgical description of Alexander matrices.

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On semi-alternating knots

We consider knots which are the union of two alternating n-tangles ($n = 2, 3, 4$) and look for meridionally incompressible surfaces in their complements.

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On pallets for Fox colorings of spatial graphs

A Fox n-coloring for a diagram of a spatial graph is an assignment of an element of $X = \{0, 1, \cdots, n-1\}$ to each arc. At each crossing, the well-known coloring condition is satisfied. A k-pallet of X is a subset of X^k satisfying some conditions. It gives a coloring condition at a k-valent vertex. In this talk, we consider what kind of k-pallets of $\{0, 1, \cdots, n\}$ can be obtained for some integers $k \geq 2$ and $n \geq 3$.

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Bridge position and the representativity of spatial graphs

First, we extend Otal's result for the trivial knot to trivial spatial graphs, namely, we show that for any bridge tangle decomposing sphere S^2 for a trivial spatial graph Γ, there exists a 2-sphere F such that F contains Γ and F intersects S^2 in a single loop. This characterizes the bridge position of a trivial spatial graph.

Next, we introduce two invariants for spatial graphs. As a generalization of the bridge number for knots, we define the *bridge string number* $bs(\Gamma)$ of a spatial graph Γ as the minimal number of $|\Gamma \cap S^2|$ for all bridge tangle decomposing sphere S^2. As a spatial version of the representativity for a graph embedded in a surface, we define the *representativity* of a non-trivial spatial graph Γ as

$$r(\Gamma) = \max_{F \in \mathcal{F}} \min_{D \in \mathcal{D}_F} |\partial D \cap \Gamma|,$$

where $\mathcal{F}$ is the set of all closed surfaces containing Γ and $\mathcal{D}_F$ is the set of all compressing disks for F in S^3. Then we show that the representativity $r(\Gamma)$ does not exceed the half of the bridge string number $bs(\Gamma)$. In particular, if Γ is a knot, then $r(\Gamma) \leq b(\Gamma)$, where $b(\Gamma)$ denotes the bridge number. This generalizes the Schubert's result on torus knots.

Next, we show that for any 2-connected graph G, any positive genus closed surface F embedded in S^3 ($g(F) \geq g(G)$) and any integer n, there exists a spatial graph Γ of G contained in F such that $r(F, \Gamma) \geq n$, where $r(F, \Gamma) = \min_{D \in \mathcal{D}_F} |\partial D \cap \Gamma|$.

Finally, we show that if $r(\Gamma) > \beta_1(G)$, then Γ contains a non-free connected subgraph, where $\beta_1(G)$ denotes the first Betti number of G.

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The Z conjecture for some pretzel knots

I will show that some pretzel knots satisfy the $\mathbb{Z}$ conjecture. In order to do that, I will describe the list of ICON surfaces in the knot exterior of these pretzels.

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Meridional destabilizing number of knots

From the viewpoint of Heegaard theory, we have two types of natural positions of knots in closed orientable 3-manifolds: a bridge position with respect to a Heegaard surface, and a core position of a handlebody bounded by a Heegaard surface. The latter has a close connection to Heegaard genus (or tunnel number) of knots. Meridional destabilizing number, which is defined by considering such two positions, will be introduced in this talk. We could say this together with tunnel number gives a binary complexity of knots. We will then discuss its behavior for composite knots.

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On tunnel number one knots and meridional tori

Joint work with M. Eudave-Muñoz.

A knot k in S^3 has tunnel number one if there exists an arc τ embedded in S^3 with $k \cap \tau = \partial\tau$, such that $S^3 - \operatorname{int} N(k \cup \tau)$ is a genus 2 handlebody. Such an arc is called an unknotting tunnel for k. The arc τ can be slided over itself and expressed as $\tau = \tau_1 \cup \tau_2$, where τ_1 is a simple closed curve in the complement of k, and τ_2 is an arc connecting k and τ_1.

We study knots with tunnel number one that admit an essential meridional torus S, which intersects the knot in two points. We show that if an unknotting tunnel for such a knot can be isotoped to be disjoint from the essential torus, then after expressing τ as $\tau = \tau_1 \cup \tau_2$, the following happens:

1. S is knotted as a nontrivial torus knot,
2. the knot τ_1 is a satellite tunnel number one knot,
3. k is an iterate of τ_1 and of an unknotting tunnel for τ_1.

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The complete splitting number of a lassoed link

We define a lassoing on a link, a local addition of a trivial knot to a link. Let K be an s-component link with the Conway polynomial non-zero. Let L be a link which is obtained from K by r-iterated lassoings. We show that the complete splitting number $\mathrm{split}(L)$ is greater than or equal to $r+s-1$, and less than or equal to $r+\mathrm{split}(K)$. In particular, we show that every $(r+1)$-component link L obtained from any given knot by r-iterated component-lassoings is an algebraically completely splittable link with $\mathrm{split}(L)=r$. Moreover, we shall construct a link L whose unlinking number is greater than $\mathrm{split}(L)$.

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Khovanov homology for virtual links with two types of maps for Möbius cobordisms

Joint work with Atsushi Ishii (University of Tsukuba).

Khovanov homology is a homology theory for classical links which is a categorification of the Jones polynomial. In this talk, we construct an extension of Khovanov homology to virtual links by taking suitable grading shifts derived from the Miyazawa polynomial, which is known as a multi-variable generalization of the Jones-Kauffman polynomial. (We note that V. O. Manturov constructed another extension of Khovanov homology to virtual links.) We will also mention relations between our homology and Kauffman's self-linking invariant.

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Reducible and torus handle additions

A compact, orientable 3-manifold M is said to be simple if it is irreducible, ∂-irreducible, anannular and atoroidal. By Thurston's theorem, a Haken 3-manifold M is hyperbolic if and only if M is simple. Suppose M is a simple manifolds and $M[a]$ and $M[b]$ are two manifolds obtained by doing 2-handle additions on M along two separating slopes α and β on ∂M respectively. Let $\Delta(\alpha, \beta)$ denoted the geometric intersection number of α and β. M. Scharlemann and Y. Wu proved that if both $M[a]$ and $M[b]$ are non-hyperbolic, then the $\Delta(\alpha, \beta) \leq 14$. In some concrete cases, some smaller bounds can be found. In this talk, I will talk about label graphs which is a very useful tool in studying handle additions and give some results about reducible and torus handle additions.

Set Theory and Set-Theoretic Topology

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Countably compact group topologies on non-torsion abelian groups from selective ultrafilters

We will talk about the problem of constructing countably compact group topologies on non-torsion abelian groups assuming a condition weaker than Martin's axiom (MA) — namely, the existence of selective ultrafilters.

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An Algebraic Version of Tamano's Paracompactness Criterion

One part of the well-known Tamano's paracompactness criterion states that if X is not paracompact then one can find a compactum K such that the product of X and K is not normal. We will consider a version of this statement in the context of topological groups. If A and B are subspaces of a topological group G, then AB is a continuous image (sometimes, not very distorted) of the topological product of A and B, that is, G may contain a noticeable trace of the topological product of A and B. This fact together with the mentioned Tamano's theorem suggest that given a non-paracompact space X there might exist a compact space K such that no normal topological group contains a closed copy of the free sum of X and K. In this talk we will show that for some non-paracompact spaces this version of Tamano's theorem holds. The author does not know however whether 'some' can be replaced by 'every'.

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Cardinal invariants of F_σ quotients

I plan to discuss a number of results on cardinal invariants of quotients of the form $\mathcal{P}(\omega)/\mathcal{I}$ where $\mathcal{I}$ is a F_σ ideal on the integers. Such quotients are σ-closed and thus look rather similar to the classical structure $\mathcal{P}(\omega)/\mathrm{Fin}$. Many inequalities between cardinal invariants which hold in the classical case can be generalized to the context of arbitrary F_σ ideals, and similarly for consistency results. In fact, cardinal invariants of $\mathcal{P}(\omega)/\mathcal{I}$ are rather hard to distinguish from their classical counterparts, but there are a few consistency results.

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Wijsman Convergence, its Topology Properties and Embedding

In 1966, when R. A. Wijsman studied some optimum properties of sequential probability ratio test, he considered a mode of convergence for sequences of closed convex sets in $\mathbb{R}^n$. Since then, this type of convergence has attracted the attention of both analysts and topologists, and its applications in convex analysis and Banach space geometry have been explored.

Despite of 40 year investigation on Wijsman convergence, some fundamental questions concerning its topology remain unsolved. For example, when does the Wijsman topology have the Baire property? When is the Wijsman topology normal? To attach these questions, the techniques of splitting and embedding have been employed. In this talk, I shall highlight recent progress towards these questions. In particular, some partial solutions and my recent joint work with H. J. K. Junnila, A. H. Tomita et al will be presented.

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Set theoretic reflection principles and topological reflection

There are a number of assertions in general topology which are known to be independent from the axioms of set theory (ZFC). Among such independent assertions, there are many stating the reflection of some topological property $\mathcal{B}$ of the form:

> For a topological space X with the property $\mathcal{A}$, if all subspaces of X of cardinality $\leq \aleph_1$ have the property $\mathcal{B}$ then X itself also has the property $\mathcal{B}$

or some variation of this.

Following are examples of such reflection "theorems". Surprisingly, we could prove that all of the theorems below are equivalent to each other over ZFC (the citations in the parenthesis show the paper(s) where the equivalence is established).

- $\mathcal{A} \equiv$ separable and countably tight; $\mathcal{B} \equiv$ meta-Lindelöf ([3, 5]).

- $\mathcal{A} \equiv$ locally countably compact; $\mathcal{B} \equiv$ metrizable ([3, 5]).
- $\mathcal{A} \equiv T_1$ and with a point countable base; $\mathcal{B} \equiv$ left-separated ([2]).
- $\mathcal{A} \equiv$ of local density $\aleph_1$ and countably tight; $\mathcal{B} \equiv$ collectionwise Hausdorff. ([5]).

The equivalence of these assertions solves some of the open problems Fleissner listed in [1].

Actually, the equivalence is established by showing that each of the assertions above is equivalent to the following set theoretic reflection principle which we introduced and named as *Fodor-type Reflection Principle* (FRP) in [3]:

FRP: For any uncountable regular cardinal λ, any stationary $E \subseteq E^\lambda_\omega$ and any mapping $g : E \to [\lambda]^{\leq\aleph_0}$ there is an $I \in [\lambda]^{\aleph_1}$ satisfying:

(a) $\mathrm{cf}(I) = \omega_1$;

(b) $g(\alpha) \subseteq I$ holds for all $\alpha \in I \cap E$;

(c) For any regressive $f : E \cap I \to \lambda$ with $f(\alpha) \in g(\alpha)$ for all $\alpha \in E \cap I$, there is a $\xi^* < \lambda$ such that $f^{-1}{}''\{\xi^*\}$ is stationary in $\sup(I)$.

In other words, FRP is characterized by each of the topological reflection properties listed above.

Among other topological characterizations of set theoretic principles are a characterization of Martin's Axiom in terms of an extension of Baire category theorem to c.c.c. compact Hausdorff spaces ([7]) and a more recent topological characterization of Shelah's Strong Hypothesis (SSH) ([6]).

In spite of its name, Shelah's Strong Hypothesis is a very weak principle equivalent to the assertion that $cf([\kappa]^{\aleph_0}, \subseteq) = \kappa^+$ for all singular cardinals κ of countable cofinality and hence this principle is merely slightly stronger than Singular Cardinal Hypothesis. The name comes from [8] where Shelah compares this principle with even weaker principles for which it is (was?) open if ZFC alone implies them.

S. Fuchino and A. Rinot showed in [4] that FRP implies SSH and also obtained the following new characterization of SSH:

Theorem 1. *SSH is equivalent to the following topological assertion:*
Any countably tight topological space X is thin if it is $< \aleph_1$-thin.

Here a topological space X is said to be *thin* if $|\overline{D}| \leq |D|^+$ holds for all $D \subseteq X$. X is $< \kappa$-*thin* if $|\overline{D}| \leq |D|^+$ holds for all $D \in [X]^{<\kappa}$.

The theorem above indicates that SSH may also be regarded as a sort of topological reflection principle.

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When has one $e(X) \leqslant d(X)$?

Joint work with Charles Morgan, UCL, London and CMAF, Lisbon, charles.morgan@ucl.ac.uk

Our research program is focused on the general question posed in the title: for what classes of topological spaces and under what set-theoretical hypotheses one has extent constraining density, i.e., the size of the closed discrete subsets constrained by the minimal cardinality of dense sets. So far, topological properties on which we have concentrated include normality and covering properties such as metacompactness, countable paracompactness and property (a). In the separable case, set-theoretical statements such as " CH ", " $2^\omega < 2^{\omega_1}$ ", " There are no small dominating families in the family of functions of ω_1 into ω " (and even " There is no inner model with a measurable cardinal ") play significant roles. In this talk we give a short survey on this subject and present several recent results of the authors, obtained by applying certain weak parametrized diamond principles – namely, the principle $\Phi(\omega, <)$ and its Borel version $\diamondsuit(\omega, <)$. A number of questions are posed.

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On Hausdorff closed extensions

Joint work with Rubén Mancio T.

We consider two types of Hausdorff closed extensions of a Hausdorff space X: the *Katetov type*, where the remainder is closed and discrete and the *completion type*, where the extension is the completion of the pre-uniformity basis of X consisting of all densely finite covers of X. We prove that, in many cases, the remainder of the completion type extensions is dense in itself. We exhibit, however, a completion type extension which is also of the Katetov type.

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Disconnectedness Properties in Hyperspaces

For a Hausdorff space X, let $\mathcal{K}(X)$ represent the hyperspace of compact subsets of X. In his famous paper about hyperspaces, E. Michael gave characterizations of disconnectedness properties of $\mathcal{K}(X)$ in terms of that of X (zero-dimensionality, total disconnectedness). In this talk we consider, first, high disconnectedness properties such as extremal disconnectedness or being a P-space and on the other hand the concept of hereditary disconnectedness, and analyse when $K(X)$ possesses each of these properties.

This is a joint work with Professor Angel Tamariz Mascarúa and part of the author's doctoral dissertation.

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Cardinal invariants of monotone and porous sets

Joint work with Ondrej Zindulka

A metric space (X, d) is *monotone* if there is a linear order $<$ on X and a constant c such that $d(x, y) \leq c\,d(x, z)$ for all $x < y < z$ in X. We investigate cardinal invariants of the σ-ideal **Mon** generated by monotone subsets of the plane. Since there is a strong connection between monotone sets in the plane and porous subsets of the line, plane and the Cantor set, cardinal invariants of these ideals are also investigated.

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Preserving topological covering properties under forcing extensions

We will discuss the following general question: When does a forcing extension preserve a topological covering property such as Lindelofness? The results presented in this lecture will include the following:

(1) Adjoining any cardinality of Cohen or random reals preserves Lindelofness, the Menger property, the Rothberger property and more covering properties.

(2) We say a Lindelof space is indestructible if it is preserved under any countably closed poset. We show that the indestructible Lindelofness is preserved under forcing with posets in an even wider class, which is nicely described using cut-and-choose games on posets.

(3) Again using cut-and-choose games, we will show that the Rothberger property is preserved under forcing with posets in a natural subclass of ω^ω-bounding forcing notions.

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Topogical properties of hyperspaces: a set theoretical approach

This is a joint work with Y. Hirata. For a regular space X, 2^X denotes the collection of all non-empty closed sets of X with the Vietoris topology and $\mathcal{K}(X)$ denotes the collection of all non-empty compact sets of X with the subspace topology of 2^X. I talk about the following results with related topics:

1. For every non-zero ordinal γ, $\mathcal{K}(\gamma)$ is orthocompact iff either $\mathrm{cf}\gamma \leq \omega$ or γ is a regular uncountable cardinal, as a corollary, normality and orthocompactness of $\mathcal{K}(\gamma)$ are equivalent.

2. 2^ω is orthocompact iff it is countably metacompact.

3. The hyperspace $\mathcal{K}(\mathbb{S})$ of the Sorgenfrey line $\mathbb{S}$ *is* orthocompact therefore so is the Sorgenfrey plane $\mathbb{S}^2$.

(1) is proved by using elementary submodels. For (2), remark that the problem whether 2^ω is countably metacompact still remains open.

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About Baire category methods in operator theory

Is Baire category a useful tool for the study of Banach space operators? This problem is worrisome because there is no close analogue of the Lebesgue measure in infinite dimensional Banach spaces, so meagerness may be the only natural notion of smallness which can come to the help of the analyst.

Unfortunately, our answer is negative. In collaboration with Tanja Eisner, we investigated the typical behavior of Hilbert space operators in various topologies, where a property Φ of operators is *typical* if the operators satisfying Φ form a co-meager set. We obtained that in the four most used separable topologies, from the point of view of Baire category, the theory of Hilbert space operators reduces to the theories of very particular classes of operators, e.g. unitary operators, positive self-adjoint operators or even one single operator.

The only usual topology in which the theory of Hilbert space operators does not trivialize is the norm topology. However, this topology is too fine from many aspects, e.g. it is non-separable. Our results give a mathematical content to the common observation that Hilbert space operators in general are hard to study.

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Katětov order and combinatorics of ideals and filters

M. Katětov used a (pre)order on ideals on ω which was not so much studied by himself. It is defined as follows: $\mathcal{I} \leq_K \mathcal{J}$ if there is $f \in \omega^\omega$ such that $f^{-1}(I) \in \mathcal{J}$ for all $I \in \mathcal{I}$. This is evidently a generalization of the more popular Rudin-Keisler order, and it has several interesting properties among the whole ideals and even when we restrict it to definable (analytic) ideals. We will review some connections of the Katětov order with Ramsey properties and other combinatorial properties like p and q-pointness. Finally we will enumerate the main open problems in the area.

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Butterfly Sets, $\Sigma_\Gamma(F)$-products, normality and compactnes

In this talk we define the Butterfly Sets and give some results about normality in subspaces of product of compact spaces. Also, we define the $\Sigma_\Gamma(F)$-products and give conditions under which these spaces are normal and satisfy some compact type properties.

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Well-Quasi-Ordering Aronszajn Lines

We show that assuming PFA, the class of Aroszajn lines is well-quasi ordering by embedability.

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Topological Mappings via $\widetilde{g}_\alpha$-closed sets

Join work with M. Lellis Thivagar.

Topology plays an important role in many branches of modern mathematics. It has gone through a wide range of progress from the classical topological concepts. Levine offered a new and useful notion in General topology, that is the notion of a generalised closed set. This notion has been studied extensively in recent years by many topologists. The investigation of generalised closed sets has led to several new and interesting concepts like new covering properties, new separation axioms, continuity of functions etc. Some of these axioms have found to be useful in Computer science and digital topology. After the introduction of generalised closed sets several closed sets have been introduced. $\widetilde{g}_\alpha$-closed sets is a new class of closed set which turned out to be a topology. In this paper we introduce $\widetilde{g}_\alpha$-closed and $\widetilde{g}_\alpha$-open functions. Using this new type of functions we derive several characterizations and its properties. Also we derive the relationship between other existing closed functions. Although these concepts are classified as pure mathematics they become application oriented when converted into fuzzy and digital topology.

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Filter Convergence On Banach Spaces

Given a free filter $\mathcal{F}$ on $\mathbb{N}$ and a topological space X, we recall that a sequence $(x_n)_{n\in\mathbb{N}}$ in X is $\mathcal{F}$-convergent to $x \in X$ if for every neighborhood U of x, $\{n \in \mathbb{N} : x_n \in U\} \in \mathcal{F}$. Using $\mathcal{F}$-convergent sequences in Banach spaces with Schauder basis we characterize P-filters$^+$, Q-filters$^+$ and selective$^+$ filters. By using $\mathcal{F}$-convergent sequences in ℓ_1, A. Aviles-Lopez, B. Cascales-Salinas, V. Kadets and A. Leonov characterized the P-filters$^+$ and the Q-filters$^+$.

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On weakly tight families

We modify Shelah's recent construction of a completely separable MAD family from $c < \aleph_\omega$, to prove the existence of weakly tight almost disjoint families under various hypotheses about cardinal invariants. The notion of a weakly tight a.d. family was introduced by Hrušák, and García Ferreira, and is closely related to the notion of a Cohen indestructible MAD family. This is joint work with Juris Steprans.

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The metrization problem for Fréchet groups (precompact Abelian case)

Is there a countable (separable) Fréchet topological group which is non-metrizable? This question also known in literature as the metrization problem for Fréchet groups, was made by V. I. Malykhin in 1978 and has been of great interest in all this time.

In this talk we will present the results of study of this question in the precompact Abelian case. For example, we give a characterization of Fréchet property among precompact topologies on countable Abelian groups in terms of a γ-set type property. Using this characterization we present the results of a systematic study of these topologies.

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Compactifying a ring

The prime spectrum of a ring is the set of its prime ideals endowed with Zariski topology. It is well known that if the ring has unity then the prime spectrum is compact and if the ring has not unity, the spectrum could be non compact. There are two standard methods to adjoin unity to a commutative ring of characteristic n, different from zero. Through these methods we obtain two unitary rings: one of characteristic n and the other of characteristic zero. We observe that, if the original ring is not compact, then each prime spectrum of the new rings contains a compactification by finite points of the original prime spectrum. Although the prime spectra are different, the two compactifications are homeomorphic.

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Approximation theorems for group-valued functions

Constructive groups were introduced by Sternfeld as a class of metrizable groups G for which a suitable version of the Stone-Weierstrass theorem on the group of G-valued functions $C(X, G)$ remains valid. In this framework we study criteria for a subgroup of the group of continuous functions $C(X, G)$ (X compact, G a topological group) to be uniformly dense. First, we characterize when a locally compact group with more than two points is constructive. Secondly, we provide approximation theorems for functions with arbitrary (compact) domain and discrete range.

These criteria are based on the existence of so-called condensing functions, where a continuous function $\phi\colon G \to G$ is said to be condensing if it does not operate on any proper, point separating, closed subgroup of $C(K,G)$, with K compact, that contains the constant functions. Among other things, the set of condensing functions $D(G)$ of a discrete Abelian group G is characterized. Answering an old question of Sternfeld, the description of $D(\mathbb{Z})$ that follows is particularly simple: given $\phi\colon \mathbb{Z} \to \mathbb{Z}$, $\phi \in D(\mathbb{Z})$ if and only if for every $k \in \mathbb{Z}$, with $k \in \mathbb{N}$, $k \geq 2$, there are $n_1, n_2 \in \mathbb{Z}$ such that $n_1 - n_2$ is a multiple of k, while $\phi(n_1) - \phi(n_2)$ is not. Several open questions are commented.

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Distributivity number of analytic ideals

The distributivity number $\mathfrak{h}$ is equal to the minimal size of a family of tall ideals whose intersection is not tall. In the same way, one can define $\mathfrak{h}_{\text{analytic}}, \mathfrak{h}_{\text{borel}}, \ldots, \mathfrak{h}_{F_\sigma}$. Then $\mathfrak{h} \leq \mathfrak{h}_{\text{analytic}} \leq \cdots \leq \mathfrak{h}_{F_\sigma} \leq \min\{\mathfrak{b}, \mathfrak{s}\}$. We will show that the first inequality is consistently strict.

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A new class of generalised quotient mapping

Topological ideas are present in almost all areas of today's Mathematics. General Topology in particular lays the foundations for several areas of research in Topology such as Bitopology, Fuzzy topology and Digital topology. In 1970, Levine introduced generalized closed sets in a topological space in order to extend many of the important properties of closed sets to a larger family. In the recent past, many modern Topologists have introduced various types of closed sets such as closed sets, $^{\#}$g-semi closed sets. Recently $\widetilde{g}$-closed set was introduced by us. Interestingly this class of closed set is found to lie between the class of closed sets and the class of $^{\#}$g-semi closed sets and forms a topology. This paper introduces and develops a new mapping known as $\widetilde{g}$-quotient mapping associated with $\widetilde{g}$-closed sets. Quotient mapping as being stronger than continuous mapping gains its significance instantaneously. Consequently, $\widetilde{g}$-quotient mapping finds its application in the study of relations between various spaces.

Although it is classified as pure mathematics, when converted into Bitopology, Fuzzy topology and Digital topology, it becomes application oriented around. Hence this paper will serve as the basis which leads to many applications in Science and Technology.

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The class of groups in which all countable subgroups are closed

The motivation of our study is the *Bohr topology* on an abstract Abelian group G, i.e., the maximal precompact topological group topology on G, say τ_G. Following van Douwen's article [2], we denote the topological group (G, τ_G) by $G^\#$. It is well known that for every Abelian group G, the corresponding precompact topological group $G^\#$ does not contain infinite compact subsets and *all* subgroups of $G^\#$ are closed [1]. It is also known that the group $G^\#$ is pseudocompact iff G is finite.

We show that if all *countable* subgroups of a topological Abelian bounded torsion group G are closed, then every countably compact subset of G is finite. This result cannot be extended to torsion groups, even adding the precompactness condition—it suffices to take the quasicyclic group $\mathbb{Q}_p$, for a prime p, considered as a topological subgroup of the circle group $\mathbb{T}$. Clearly, the precompact Abelian group $\mathbb{Q}_p$ is torsion and all proper subgroups of $\mathbb{Q}_p$ are finite and closed. However, the group $\mathbb{Q}_p$ is non-discrete and metrizable, so it contains non-trivial convergent sequences.

Denote by $\mathcal{CC}$ the class of topological Abelian groups G such that all countable subgroups of G are closed. It turns out that all countably compact subsets of any group in $\mathcal{CC}$ are countable and compact.

The case of pseudocompact Abelian groups is even more interesting. It is known that for every infinite cardinal κ, there exists a pseudocompact Boolean group G of cardinality 2^κ such that every subgroup H of G with $|H| \leq \kappa$ is closed in G.

Since G is Boolean, our first result implies that such a group G does not contain infinite compact subsets. It is natural to ask, therefore, whether a pseudocompact group $G \in \mathcal{CC}$ can contain non-trivial convergent sequences. We answer this question in the affirmative and show that there exist arbitrarily big pseudocompact Abelian groups $G \in \mathcal{CC}$ that contain non-trivial convergent sequences. As we already know, none of these groups can be torsion.

Finally, we show that if a group $G \in \mathcal{CC}$ is either *countably pseudocompact* or *countably pracompact*, then G is finite. It should be noted that each of the two conditions is stronger than pseudocompactness.

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Some new countably compact groups

In this talk we will mention some questions and some new examples concerning countably compact groups.

In 1976, Hajnal and Juhasz (Gen. Topology Appl.) constructed under CH the first countably compact group without non-trivial convergent sequences. In 1980, van Douwen (Trans. Amer. Math. Soc.) constructed one from MA. In 2000, Koszmider, Tomita and Watson (Top. Proc.), constructed one from $MA_{countable}$. In 2005, Garcia-Ferreira, Tomita and Watson (Proc. Amer. Math. Soc.) showed that there exists one from the existence of a single selective ultrafilter. CH implies MA and MA implies $MA_{\text{countable}}$ and $MA_{\text{countable}}$ implies the existence of selective ultrafilters.

Recently, Szeptycki and Tomita (Top. Appl., 2010) showed that there exists a model in which there exists a countably compact group without non-trivial convergent sequences and there are no selective ultrafilters.

In 1991, Hart and van Mill (Trans. Amer. Math. Soc.) showed that there exists a countably compact group whose square is not countably compact from $MA_{countable}$. Comfort (Open Problems in Topology, 1990) asked for which cardinals $\kappa \leq 2^{\mathfrak{c}}$ there exists a topological group G such that G^α is countably compact for every $\alpha < \kappa$ and G^κ is not countably compact. In 2005, Tomita (Fund. Math.) answered this question obtaining groups for each cardinal $\kappa \leq 2^{\mathfrak{c}}$ using some cardinal arithmetic and the existence of $2^{\mathfrak{c}}$ selective ultrafilters. In the case of finite cardinals, $\mathfrak{c}$ selective ultrafilters sufficed to obtain this example.

Recently, Sanchis and Tomita obtained examples for $\kappa \leq \omega_1$ using a single selective ultrafilter.

We will also give a brief overview of the joint work with Boero who will also give a talk at this conference.

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Compactness, reflection and cardinal arithmetic

Joint work with Stevo Todorcevic.

We prove that the Weak Reflection Principle and the saturation of the ideal NS imply $\diamondsuit_{[\lambda]^{\omega_1}}$ for all regular $\lambda \geq \omega_2$.

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Dynamical Subbases and Two-Dimensional Analogues of the Tent Map

The dynamical system of the tent map derives a subbase of the unit interval, which can be used for computation over the reals [Tsuiki, TCS 02]. That is, (1) by defining $S_{n,i} = t^{-n}(X_i)$ for $X_0 = [0, 1/2)$, $X_1 = (1/2, 1]$, and t the tent map, $\{S_{n,i} : n < \omega, i < 2\}$ forms a subbase of X, (2) the itinerary of t on $x \in \mathbb{I}$ can be considered as the unique $\{0, 1, \perp\}^\omega$-code of x, and (3) this code can be used for computation over the reals.

We generalize this notion and define the notion of a dynamical subbase $\{S_{n,i} : n < \omega, i < 2\}$ of a space X. That is, X is devided into $X_0 \cup X_1 \cup B$, where X_0 and X_1 are regular open sets which are exteriors of each other and B is their common boundary, and $f : X \to X$ is a continuous map such that f restricted to $X_i \cup B$ is a homeomorphism onto X $(i = 0, 1)$, and for $S_{n,i} = f^{-n}(X_i)$, $\{S_{n,i} : n < \omega, i < 2\}$ forms a subbase of X.

Up to conjugacy, the subbase derived from the tent map is the unique dynamical subbase of $\mathbb{I}$. We investigate dynamical systems which induce dynamical subbases on $\mathbb{I}^2$. In particular, we study its relations to the dynamical system of an unimodal map on $\mathbb{I}$ which is defined through its restriction to the boundary of $\mathbb{I}^2$.

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Combinatorial properties on definible ideals and topologies

We will review some results about combinatorial properties on definible ideals and topologies over a countable set. We will focus on properties like selectivity, p-point, q-point, Ramsey, diagonal sequence property and others. We will state some open problems.

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Lonely points in ω^*

Motivated by a paper of van Mill we have introduced the notion of a lonely point. A point $x \in X$ is $l$onely provided it is ω-discretely untouchable, it is in the closure of a countable set and the countable sets accumulating to it form a filter. We have proved the existence of lonely points in large subspaces of ω^* and have asked whether they exist in ω^*. We have hypothesized the question to be rather hard. In this talk we shall give a positive answer based on a construction of Dow and some techniques of van Douwen.

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Normality of products and topological games

All spaces are assumed to be *regular* T_1.

The topological game $G(\mathbf{K}, X)$ is in the sense of Telgársky in 1975, where $\mathbf{K}$ is a class of spaces. For a space X, 2^X denotes the family of all closed subsets in X.

A function $s : 2^X \to 2^X$ is a *winning strategy for Player I* in $G(\mathbf{K}, X)$ if it satisfies

(i) $s(F) \in \mathbf{K}$ with $s(F) \subset F$ for each $F \in 2^X$,

(ii) if $\{F_n\}$ is a decreasing sequence of 2^X such that $s(F_n) \cap F_{n+1} = \emptyset$ for each $n \in \omega$, then $\bigcap_{n\in\omega} F_n = \emptyset$.

Let $\mathbf{DC}$ denote the class of all spaces which have a discrete cover by compact sets.

Proposition 1 (Potoczny 1973, Telgársky 1975) *If a space X has a σ-closure-preserving cover by compact sets, then X is a P-space (in the sense of Morita) with a winning strategy for Player I in $G(\mathbf{DC}, X)$.*

A space X is *orthocompact* if every open cover $\mathcal{U}$ of X has an open refinement $\mathcal{V}$ such that $\bigcap \mathcal{W}$ is open in X for any $\mathcal{W} \subset \mathcal{V}$.

A product space $X \times Y$ is *rectangular* if every finite cozero cover of $X \times Y$ has a σ-locally finite refinement by cozero rectangles.

Theorem 2 *Let X be a paracompact space with a winning strategy for Player I in $G(\mathbf{DC}, X)$. Let Y be a monotonically normal space. If $X \times Y$ is orthocompact, then it is normal and rectangular.*

Theorem 3 *Let X be a paracompact space with a winning strategy for Player I in $G(\mathbf{DC}, X)$. Let Y be a monotonically normal space. If $X \times Y$ is rectangular, the following are equivalent.*

(a) $X \times Y$ is normal.

(b) $X \times Y$ is collectionwise normal.

(c) $X \times Y$ has the shrinking property.

A space X is *weakly suborthocompact* if every open cover $\mathcal{U}$ of X has an open refinement $\bigcup_{n\in\omega} \mathcal{V}_n$, satisfying that for each $x \in X$ there is $n_x \in \omega$ such that $\bigcap\{V \in \mathcal{V}_{n_x} : x \in V\}$ is open in X.

Theorem 4 *Let X be a metacompact P-space (in the sense of Morita) with a winning strategy for Player I in $G(\mathbf{DC}, X)$. Let Y be a monotonically normal space. Then $X \times Y$ is orthocompact if and only if it is weakly suborthocompact.*

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Continuous selections for set-valued mappings with finite-dimensional convex values

As a natural extension of the insertion theorem due to C. H. Dowker and M. Katětov, S. Barov (2008) proved that a T_1-space X is countably paracompact and normal if and only if for every separable Banach space Y, every lower semicontinuous set-valued mapping from X to Y with (not necessarily closed) convex values of the same finite dimension admits a continuous selection. In this talk, we discuss the existence of continuous selections for convex-and-finite-dimensional-valued mappings into arbitrary Banach spaces.

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The rectangle refining property, uniformizing ladder system colorings, and a forcing extension of a coherent Suslin tree

We introduce a property for forcing notions, which is called the rectangle refining property. This property is stronger than the countable chain condition. In this talk, a forcing notion which uniformize a ladder system coloring is given as its example. It is proved that the coherent Suslin tree may force that every forcing notion with the rectangle refining property has precaliber $\aleph_1$. Since the uniformizing ladder system coloring fails in the Suslin tree extension (which is due to Larson–Todorčević), $\mathsf{MA}_{\aleph_1}$ for forcing notions with the rectangle refining property fails in that extension. This result contrasts the following result due to Todorčević–Veličković: $\mathsf{MA}_{\aleph_1}$ is equivalent to the statement that every ccc forcing notions has precaliber $\aleph_1$.

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Set Theory and Operator Algebras

Let $\mathcal{B}(H)$ be the algebra of bounded operators on a separable infinite dimensional Hilbert space H and let $\mathcal{C}(H)$ denote the poset of projections of the Calkin algebra. These structures can be seen as non-commutative analogues of $\mathcal{P}(\omega)$ and $\mathcal{P}(\omega)/Fin$ respectively. We describe some differences and similarities of these classical objects with respect to their non-commutative analogues.

Symplectic Topology

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On the Bounded Symplectic Diffeomorphism Conjecture

We prove the bounded isometry conjecture proposed by F. Lalonde and L. Polterovich for a special type of closed symplectic manifolds. Namely for manifolds whose de Rham cohomology of degree one is generated by embedded punctured torus. As a byproduct, we prove that the flux group of a product of these special symplectic manifolds is isomorphic to the direct sum of the flux groups.

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Wall crossing formulae for Gauge-Gromov Witten invariants and applications

We will give a short introduction to gauged Gromov-Witten invariants and wall crossing formulas in different contexts. We then use the wall crossing formula of Cieliebak and Salamon to prove certain invariance of the invariants under wall crossing for the toric case.

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Floer homology and holomorphic stability for Toric Varieties

In this talk I will describe work in progress with Martin Guest on the relation between holomorphic stability and the Floer homology of Toric Varieties.

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Volume flux & minimal volume

We will show that every closed nonpositively curved manifold with non-trivial volume flux group has zero minimal volume, and admits a finite covering with circle actions whose orbits are homologically essential.

We also see that if a compact complex surface has non-trivial volume flux group then it also has zero minimal volume (this last part is joint work with J. Petean).

This proves a conjecture of Kedra-Kotschick-Morita for this class of manifolds.

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Groups of volume-preserving diffeomorphisms of noncompact manifolds and mass flow toward ends

Suppose M is a non-compact connected oriented C^∞ n-manifold and ω is a volume form on M. In this talk we discuss some problems of realizing data of volume transfer on M toward ends by diffeomorphisms of M. Our arguments yield two selection theorems on volume forms of M. The first one is a (parametrized) extension of Moser's theorem for volume forms to the non-compact case. The second one means that the end charge homomorphism c_ω introduced by Alpern - Prasad admits a continuous section. These theorems have the following consequences for the diffeomorphism groups of M endowed with the compact-open C^∞ topology: the group $\mathcal{D}(M)_0$ strong deformation retracts onto the subgroup $\mathcal{D}(M;\omega)_0$ and the latter strong deformation retracts onto the kernel $\ker c_\omega$.

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Leafwise Fixed Points, Exotic Symplectic Structures, and Relative Hofer Diameters

Leafwise fixed points of a self-map ϕ of a symplectic manifold (M,ω) with respect to a coisotropic submanifold $N \subset M$ generalize Lagrangian intersection points and true fixed points. I will discuss lower bounds on the number of such points, assuming that N is regular and ϕ is Hofer close to the identity or that N is regular and monotone.

As an application, one obtains exotic symplectic structures and a lower bound on the relative Hofer diameter of certain product symplectic manifolds.

This project is partly joint with Jan Swoboda.

List of Speakers