Société de l'électricité, de l'électronique et des technologies de l'information et de la communication

Geometric Science of Information

SEE Conference

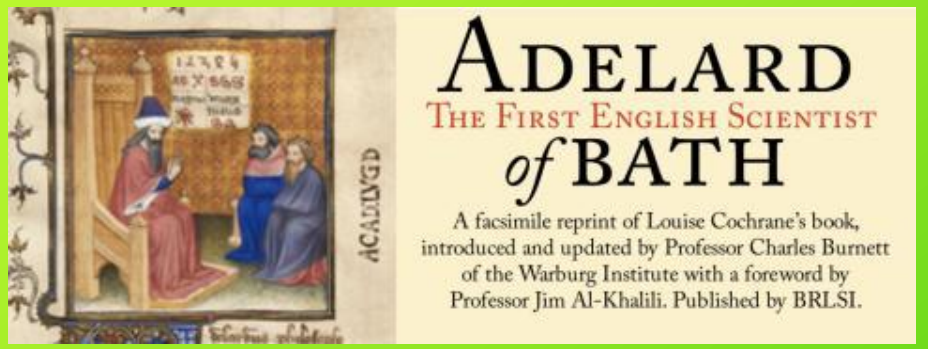
GSI'21 in Paris

GSI General Chairmen: Frédéric BARBARESCO*, Frank NIELSEN**

(*) President of SEE ISIC Club (Ingéniérie des Systèmes d'Information de Communications) & THALES Land & Air Systems, (**) Ecole Polytechnique/LIX & LIX & Sony CSL Tokyo

GSI Logo: Adelard of Bath

The frontispiece of an Adelard of Bath Latin translation of Euclid's Elements, c. 1309–1316; the oldest surviving Latin translation of the Elements is a 12th-century translation by Adelard from an Arabic version



- He left England toward the end of the 11th century for Tours in France
- Adelard taught for a time at Laon, leaving Laon for travel no later than 1109.
- After Laon, he travelled to Southern Italy and Sicily no later than 1116.
- Adelard also travelled extensively throughout the "lands of the Crusades": Greece, West Asia, Sicily, Spain, and potentially Palestine.

Adelard of Bath was the first to translate **Euclid's Elements in Latin**

Adelard of Bath has introduced the word « **Algorismus** » in Latin after his translation of Al Khuwarizmi

SEE at a glance

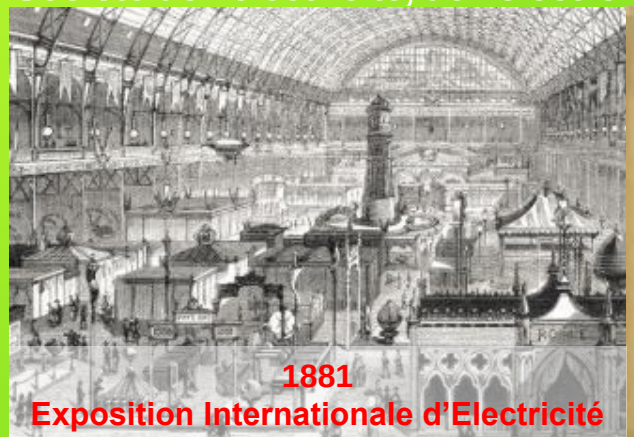
- Meeting place for science, industry and society
- An officialy recognised non-profit organisation
- About 2000 members and 5000 individuals involved
- Large participation from industry (~50%)
- 19 «Clubs techniques» and 12 «Groupes régionaux»
- Organizes conferences and seminars
- Initiates/attracts International Conferences in France
- Institutional French member of IFAC and IFIP
- Awards (Glavieux/Brillouin Prize, Général Ferrié Prize, Néel Prize, Jerphagnon Prize, Blanc-Lapierre Prize,Thévenin Prize), grades and medals (Blondel, Ampère)
- Publishes 3 periodical publications (REE, …) & 3 monographs each year
- Web: **http://www.see.asso.fr** and LinkedIn SEE group
- SEE Presidents: Louis de Broglie, Paul Langevin, …


Paul Langevin


Louis de Broglie

1883-2019: From SIE & SFE to SEE: 136 years of Sciences

Société de l'électricité, de l'électronique et des technologies de l'information et de la communication


1881
Exposition Internationale d'Electricité

1883: SIE
Société
Internationale
des Electriciens

1886: SFE
Société
Française
des Electriciens


2013: SEE
17 rue de l'Amiral Hamelin
75783 Paris Cedex 16

GSI conferences ancestors

Séminaire Léon Brillouin

Sciences géométriques de l'information

2009-2014

http://repmus.ircam.fr/brillouin/home
http://repmus.ircam.fr/brillouin/past-events

Leon Brillouin Seminar on Geometric Science of Information

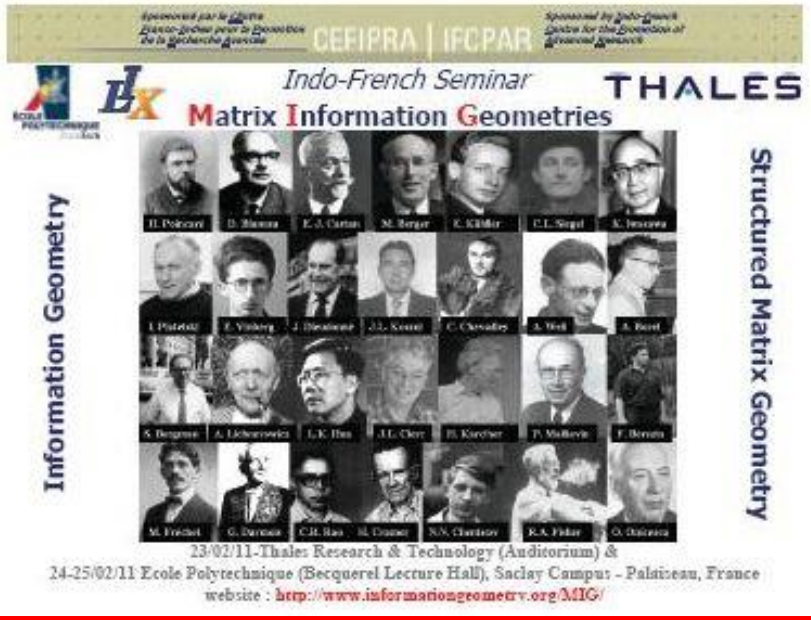
(Hosted by IRCAM, Stravinsky Room)

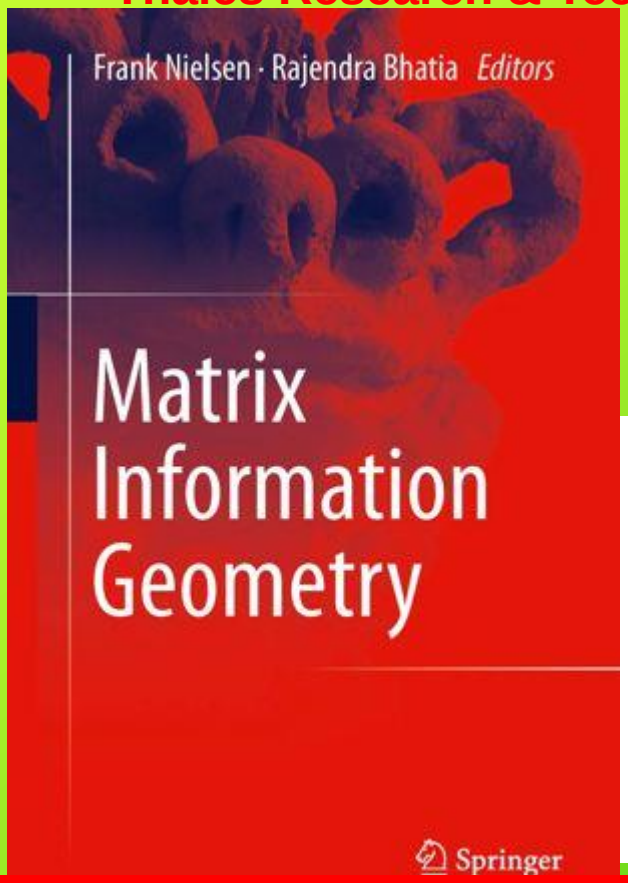
Videos & slides available online

GSI conferences ancestors

INDO-FRENCH MIG'11 Matrix Information Geometry Workshop

(Ecole Polytechnique & Thales Research & Technology, 2011)





https://www.lix.polytechnique.fr/~nielsen/MIG/
https://www.lix.polytechnique.fr/~nielsen/MIG/FLYERS-MIG-Final-V2.pdf
https://www.lix.polytechnique.fr/~nielsen/MIG/MIG-proceedings.pdf

THALES

ÉCOLE POLYTECHNIQUE

https://link.springer.com/book/10.1007/978-3-642-30232-9

GSI'13 Mines ParisTech

Slides :
https://www.see.asso.fr/gsi2013

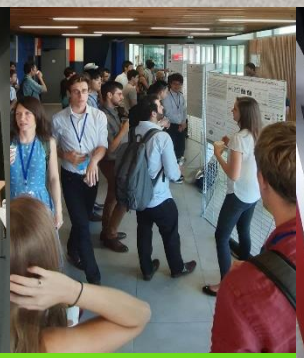
GSI'15 Ecole Polytechnique

Videos:
https://www.youtube.com/channel/UC5HHo1jbQXusNQzU1iekaGA
UNITWIN website (slides & videos):
http://forum.cs-dc.org/category/90/gsi2015

GSI'17 Mines ParisTech

Videos: https://www.youtube.com/channel/UCnE9-LbfFRqtaes49cN2DVg/videos
UNITWIN website (slides & videos):
http://forum.cs-dc.org/category/135/gsi2017

GSI'19 ENAC in Toulouse



website :
https://www.see.asso.fr/en/GSI2019

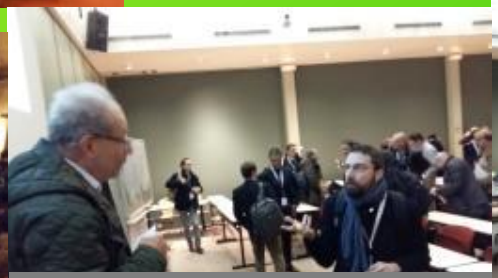
Hirohiko Shima
Jean-Louis Koszul

Roger Balian

GSI'13 Mines ParisTech

GSI'15 Polytechnique

Charles-Michel
Marle

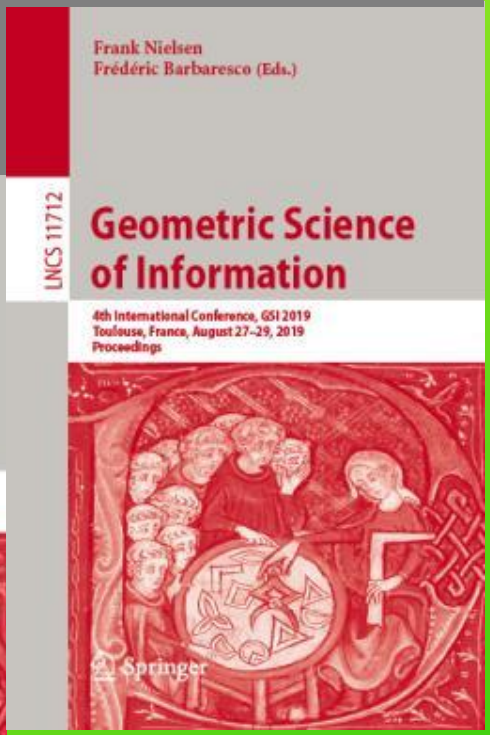


Jean-Michel Bismut &
Yann Ollivier

GSI'17 Mines ParisTech

GSI SPRINGER PROCEEDINGS Collection

GSI'19 Springer Proceedings:
https://www.springer.com/gp/book/9783030269791



GSI'17 Springer Proceedings:
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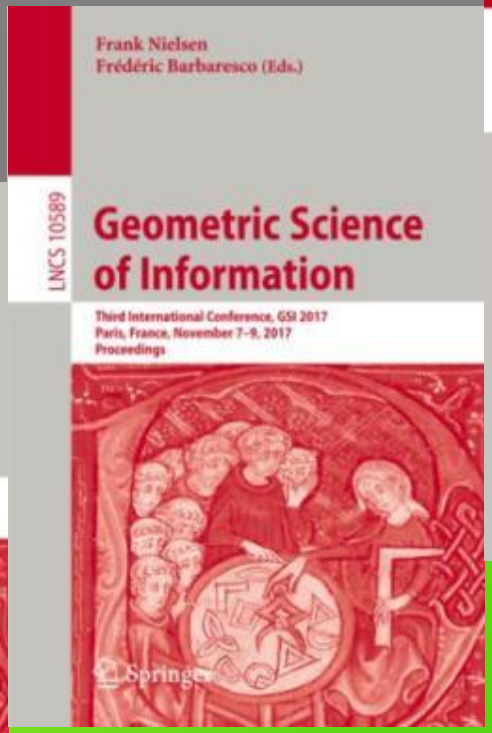
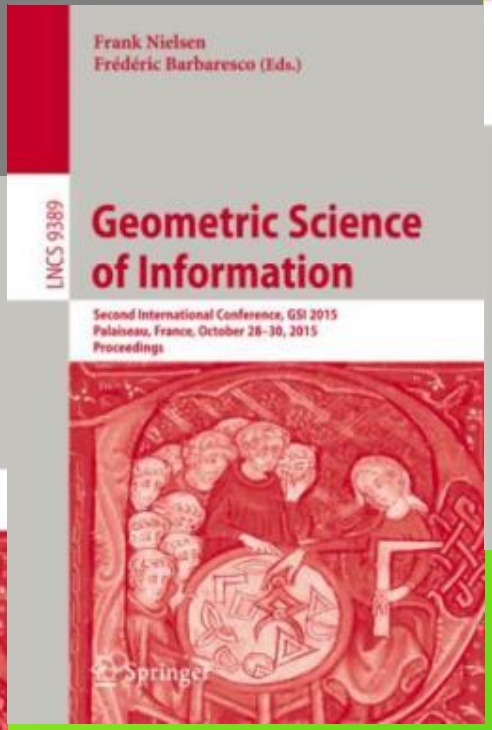
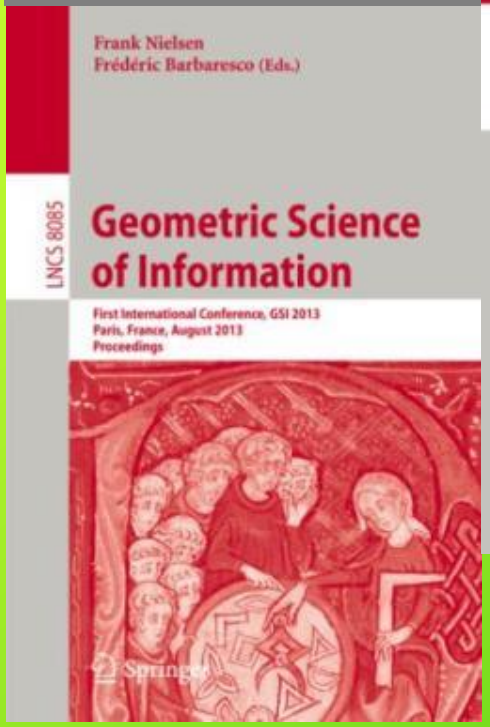


GSI'15 Springer Proceedings:
http://www.springer.com/la/book/9783319250397

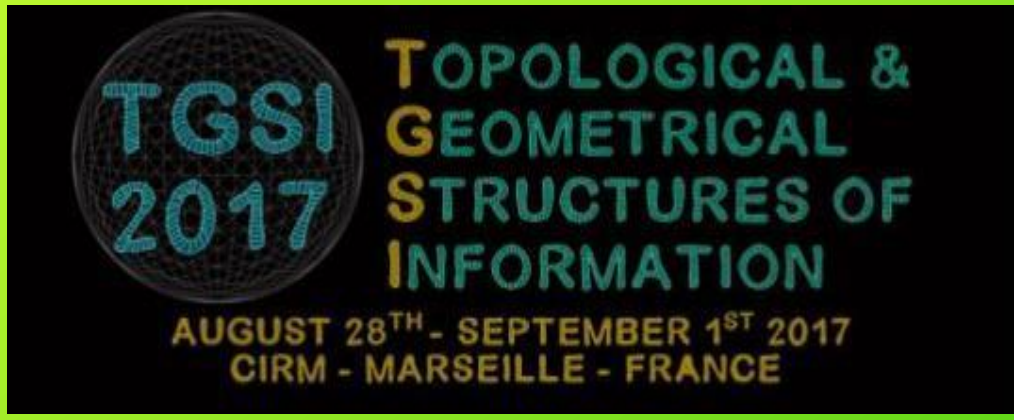


GSI'13 Springer Proceedings:
http://www.springer.com/us/book/9783642400193



Free SPRINGER GSI'19 Proceedings:
https://link.springer.com/book/10.1007/978-3-030-26980-7

CIRM Seminar, August 2017
TGSI'17 « Topological & Geometrical Structures of Information »



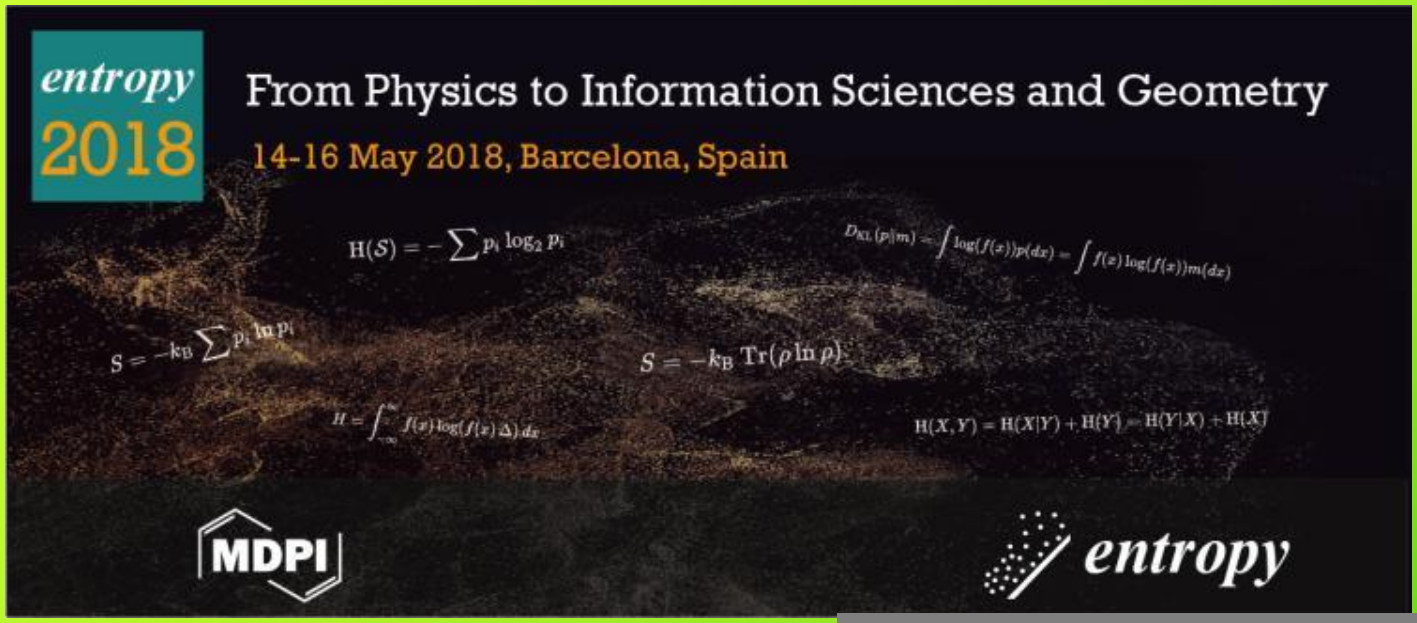
TGSI'17 videos & slides
http://forum.cs-dc.org/category/94/tgsi2017

Special Issue "**Topological and Geometrical Structure of Information**", Selected Papers from CIRM conferences 2017"

http://www.mdpi.com/journal/entropy/special_issues/topological_geometrical_info

entropy
an open access journal by MDPI

Talk on Koszul-Souriau Characteristic Function:
https://www.youtube.com/watch?v=VXxiMCn-tsE&feature=youtu.be



https://sciforum.net/conference/Entropy2018-1

14–16 May 2018

From Physics to Information Sciences and Geometry

Barcelona, Spain

The main topics and sessions of the conference cover:

- Physics: classical Thermodynamics and Quantum
- Statistical physics and Bayesian computation
- Geometrical science of information, topology and metrics
- Maximum entropy principle and inference
- Kullback and Bayes or information theory and Bayesian inference
- Entropy in action (applications)

The inter-disciplinary nature of contributions from both theoretical and applied perspectives are very welcome, including papers addressing conceptual and methodological developments, as well as new applications of entropy and information theory.

FGSI'19 Cartan-Koszul-Souriau

Foundations of Geometric Structures of Information

Foundations of Geometric Structures of Information

4-6 Feb 2019 Montpellier (France)

Login

MAIN MENU

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- Speakers
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- Documents of the conference
- Practical information
- Sponsors

HELP

PRESENTATION

A seminar on Topological and Geometrical Structures of Information has been organized at CIRM in 2017, to gather engineers, applied and pure mathematicians interested in the geometry of information. This year FGSI'19 conference will be focused on the foundations of geometric structures of information. It is dedicated to the triumvirat Cartan - Koszul - Souriau and their influence on the field.

Poster

https://fgsi2019.sciencesconf.org/

La Région Occitanie Pyrénées · Méditerranée

MUSE MONTPELLIER UNIVERSITY OF EXCELLENCE

IMAG

cnrs

Anton ALEKSEEV (Geneva Univ.)

Dmitri ALEKSEEVSKY (Moscow IITP)

John BAEZ (Riverside UC)

Michel BRION (Grenoble Univ.)

Misha GROMOV (Paris IHES)

Patrick IGLESIAS-ZEMMOUR (Aix-Marseille Univ.)

Yann OLLIVIER (Paris Facebook)

Vasily PESTUN (Paris IHES)

Aissa WADE (Penn State Univ.)

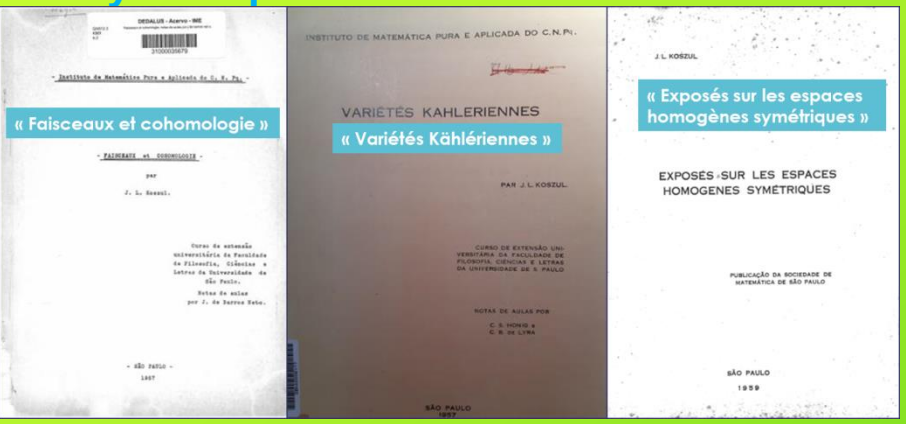
Panel sessions: SYMPLECTIC GEOMETRY IN PHYSICS

TRIBUTE TO J-L KOSZUL & J-M SOURIAU

Jean-Louis Koszul was foreign member of **São Paulo Academia of Sciences**

Jean Louis Koszul Lectures at Sao Paulo:

- **Faisceaux et Cohomologie**
- **Variétés Kählériennes**
- **Exposés sur les espaces homogènes symétriques**



Sao Paulo Journal of Mathematical Sciences
SPRINGER
Editor-in-Chief: **Claudio Gorodski**

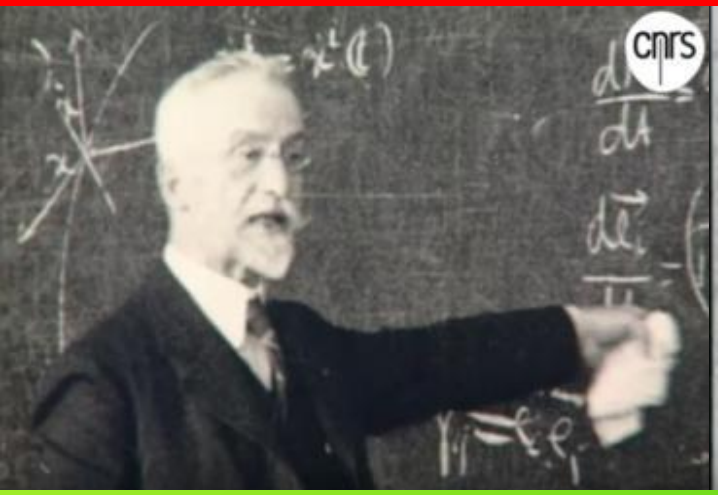
https://www.springer.com/mathematics/journal/40863

GSI'19 Program

- More than 180 attendees from 21 different countries (France, Japan, Germany, USA, UK, Danemark, Brazil, Canada, Norway,…)
- 88 talks on 3 days (selection rate: 76% based on 356 reviews) and 16 posters
- 1 Invited Honorary Speaker
  – Gérard LETAC (Université Paul Sabatier, Toulouse) – "Classifying the exponential families by moving a convex function"
- 1 Guest Honorary Speaker
  – Karl Friston (Wellcome Trust Centre for Neuroimaging), "Markov Blankets and Bayesian Mechanics"
- 3 Keynote Speakers
  — Elena Celledoni (Norwegian University of Science and Technology), "Structure preserving algorithms for geometric numerical integration"
  — Gabriel Peyré (CNRS, Ecole Normale Supérieure), "Optimal Transport for Machine Learning"
  — Jean-Baptiste Hiriart-Urruty (Université de Toulouse), "Pierre de FERMAT (ca. 1605-1665): lawyer, philologist and illustrious mathematician ... but enigmatic"

Elie Cartan 150th Birthday
1869-2019

150 years ago, April 9th 1869, was born a spirit, raised to the heat of the forge and the sound of the anvil and the hammer of his father Joseph, blacksmith of little Dolomieu village.



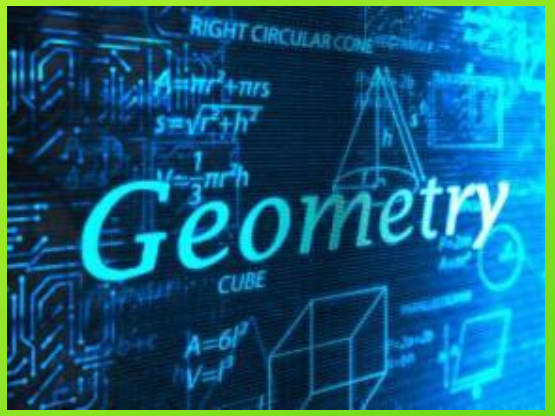
Elie Cartan with his wife and his 4 children

"des paysans sans prétention qui, au cours de leur longue vie, ont montré à leurs enfants un exemple de travail accompli avec joie et d'acceptation courageuse des fardeaux" - Elie Cartan

Joseph Cartan & Anne Cartan (Dolomieu, 1890)

Henri Cartan Testimony on his father Elie Cartan:
https://www.youtube.com/watch?v=GJ9NwEwUcyY

GSI'19: 18 sessions



Probability on Riemannian Manifolds
Optimization on Manifold
Shape Space
Statistics on Non-linear Data
Lie Group Machine Learning
Statistical Manifold and Hessian Information Geometry
Monotone Embedding and Affine Immersion of Probability Models
Non-parametric Information Geometry
Divergence Geometry
Computational Information Geometry
Wasserstein Information Geometry/Optimal Transport
Geometric Structures in Thermodynamics and Statistical Physics
Geometric and Structure-Preserving Discretizations
Geometry of Quantum States
Geometry of Tensor-Valued Data
Geometric Mechanics
Geometric Science of Information Libraries
Poster Session

Guest Honorary speaker
Gérard Letac

Classifying the exponential families by moving a convex function

Gérard Letac Emeritus at the Université Paul Sabatier in mathematics.
Birth in 1940. Undergraduate and graduate studies Université de Caen, Agrégation in mathématiques in 1962. Doctorat d'Etat Clermont in 1972 (Thesis advisor Paul Malliavin). Professor at the Université Paul Sabatier from 1973 to 2003. Other positions as maitre- assistant in Orsay from 1962 to 1966; associated professor, University of Montréal from 1966 to 1969; chairman of the computer science department at IUT de Clermont from 1969 to 1973. Supervision of 26 doctorate thesis, and publications of 130 papers.
Scientific interests:

- Harmonic analysis and probabilities: Markov chains on permutations ('Libraries'); Gelfand pairs and group actions on Markov chains, homogeneous trees; Dirichlet processes.
- Random matrices: Random walks on SL(2;R) and random continuous fractions. Wishart and non central Wishart laws on symmetric cones.
- Theoretical statistics: Fisher information; exponential families and their variance functions; Gaussian and discrete graphical models.

Invited Honorary speaker
Karl Friston

Markov blankets and Bayesian mechanics

Karl Friston (MB, BS, MA, MRCPsych, FMedSci, FRSB, FRS, Wellcome Principal Fellow, Scientific Director: Wellcome Trust Centre for Neuroimaging, Institute of Neurology, UCL). Karl Friston is a theoretical neuroscientist and authority on brain imaging. He invented statistical parametric mapping (SPM), voxel-based morphometry (VBM) and dynamic causal modelling (DCM). These contributions were motivated by schizophrenia research and theoretical studies of value-learning, formulated as the dysconnection hypothesis of schizophrenia. Mathematical contributions include variational Laplacian procedures and generalized filtering for hierarchical Bayesian model inversion. Friston currently works on models of functional integration in the human brain and the principles that underlie neuronal interactions. His main contribution to theoretical neurobiology is a free-energy principle for action and perception (active inference). Friston received the first Young Investigators Award in Human Brain Mapping (1996) and was elected a Fellow of the Academy of Medical Sciences (1999). In 2000 he was President of the international Organization of Human Brain Mapping. In 2003 he was awarded the Minerva Golden Brain Award and was elected a Fellow of the Royal Society in 2006. In 2008 he received a Medal, College de France and an Honorary Doctorate from the University of York in 2011. He became of Fellow of the Royal Society of Biology in 2012, received the Weldon Memorial prize and Medal in 2013 for contributions to mathematical biology and was elected as a member of EMBO (excellence in the life sciences) in 2014 and the Academia Europaea in (2015). He was the 2016 recipient of the Charles Branch Award for unparalleled breakthroughs in Brain Research and the Glass Brain Award, a lifetime achievement award in the field of human brain mapping. He holds Honorary Doctorates from the University of Zurich and Radboud University.

Keynote speaker
Elena Celledoni

Structure preserving algorithms for geometric numerical integration

Elena Celledoni (Professor at Department of Mathematical Sciences, Norwegian University of Science and Technology (NTNU), Trondheim, Norway). Elena Celledoni received her Master degree in mathematics from the University of Trieste in 1993, and her Ph.D in computational mathematics from the University of Padua, Italy, 1997. She held post doc positions at the University of Cambridge, UK, at the Mathematical Sciences Research Institute, Berkeley, California and at NTNU.

Her research field is in numerical analysis and in particular structure preserving algorithms for differential equations and geometric numerical integration.

Keynote speaker
Gabriel Peyré

Optimal Transport for Machine Learning

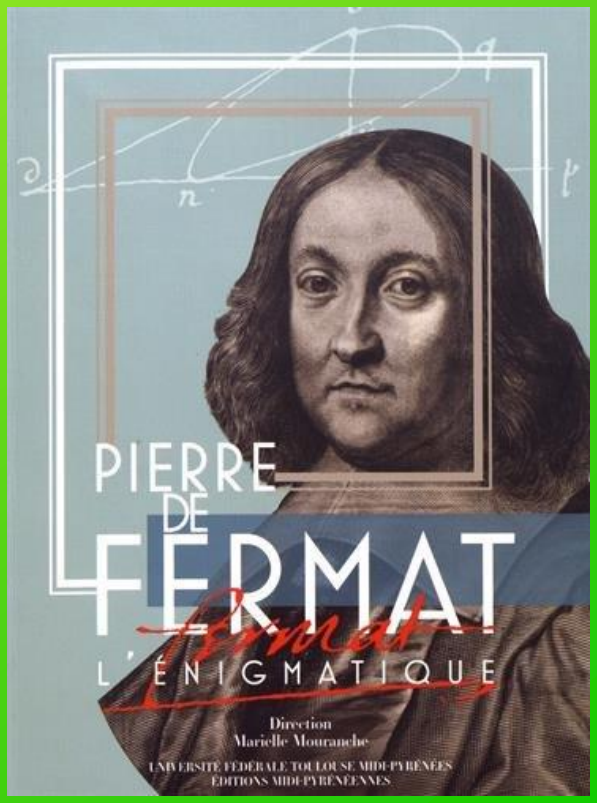
Gabriel Peyré (CNRS and Ecole Normale Supérieure).
Gabriel Peyré is senior researcher at the Centre Nationale de Recherche Scientifique (CNRS) and professor at the Ecole Normale Supérieure, Paris. His research is focused on developing mathematical and numerical tools for imaging sciences and machine learning. He is the creator of the "Numerical tour of data sciences" (www.numerical-tours.com), a popular online repository of Python/Matlab/Julia/R resources to teach mathematical data sciences. His research was supported by a ERC starting grant (SIGMA-Vision, 2010-2015) and is now supported by a ERC consolidator grant (NORIA 2017-2021). He is the 2017 recipient of the Blaise-Pascal prize from the French Academy of sciences, awarded each year to a young applied mathematician.o.

Keynote speaker
Jean-Baptiste Hiriart-Urruty

Pierre de FERMAT (ca. 1605-1665): lawyer, philologist and illustrious mathematician ... but enigmatic

Jean-Baptiste Hiriart-Urruty
(Toulouse University)

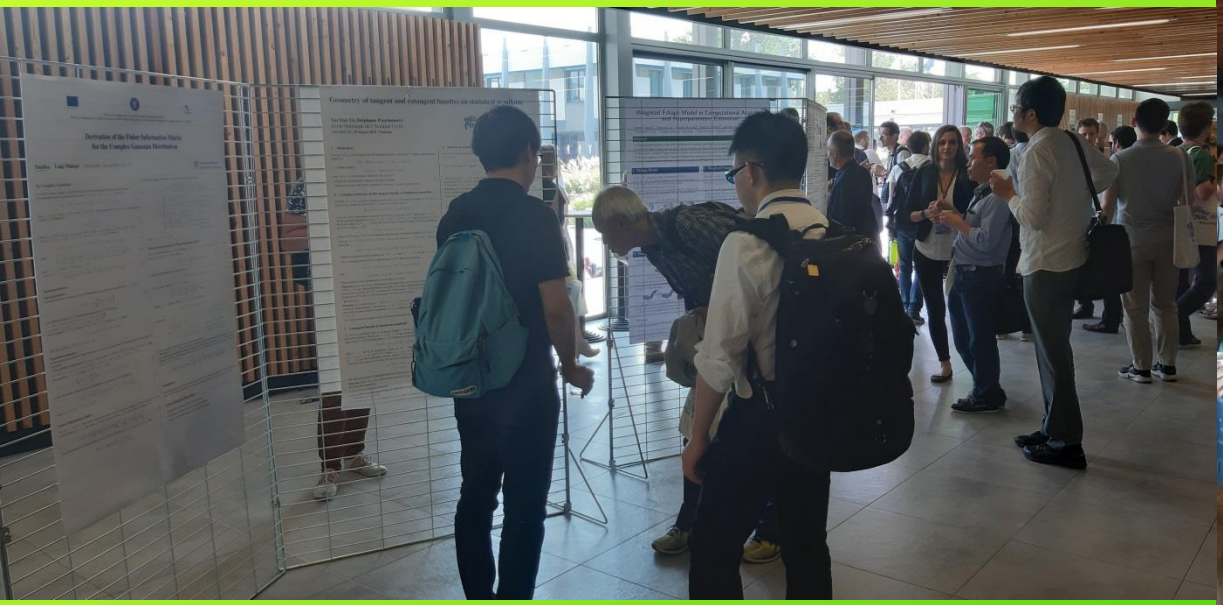
Jean-Baptiste Hiriart-Urruty is professor emeritus at the Université Paul Sabatier in Toulouse since 2015. It holds a PhD in mathematics from the Université Blaise Pascal in Clermon-Ferrand and an habilitation. He was fulle time professor in mathematics at University Paul Sabatier from 1981 to 2015. His research topics are variational calculus (convex, non smooth and applications) and optimization (global optimization, non smooth, non convex). He has also many contributions in the history of mathematics and mathematicians and in dissemination of mathematical science towards general public..



Thanks to ENAC administration & Local Organizing Team

Thanks to 180 GSI'19 Attendees

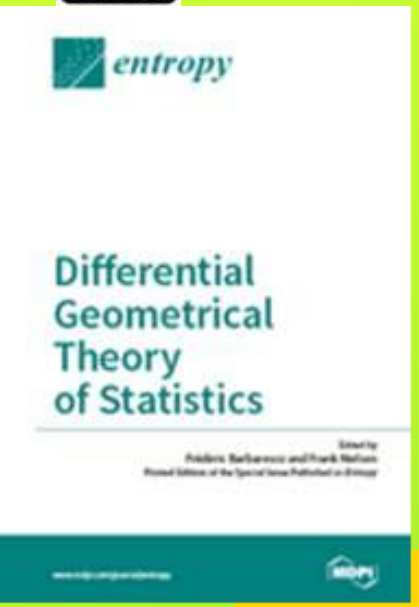
Thanks to GSI'19 Attendees (Posters)

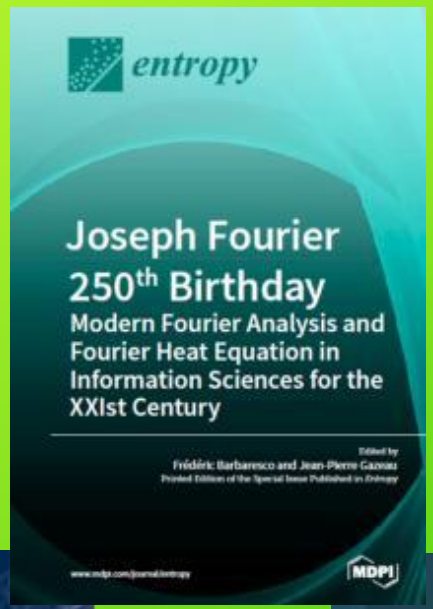


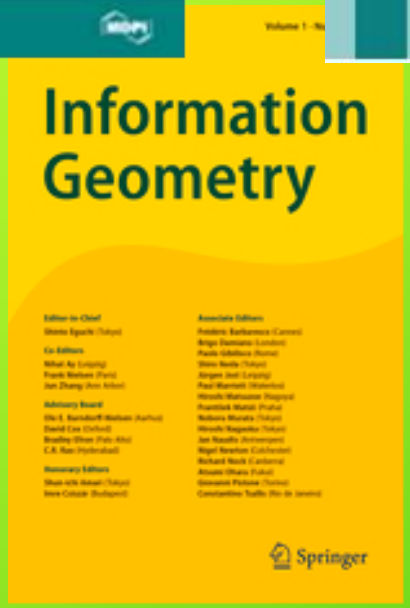
Thanks ENAC for cocktail with Wine Master & Cheese Master of G7 & GSI'19

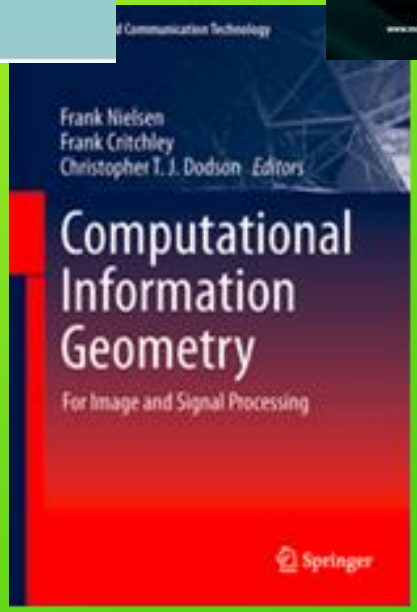
Thanks to ENAC for Gala Diner

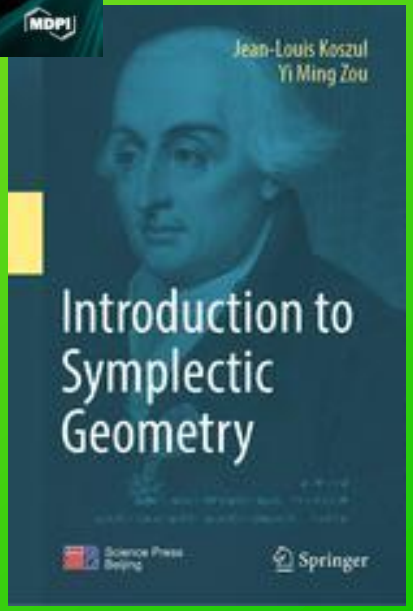
Last Publications on Geometric Science of Information











GSI'21 in …

Paris

Candidates of local host:

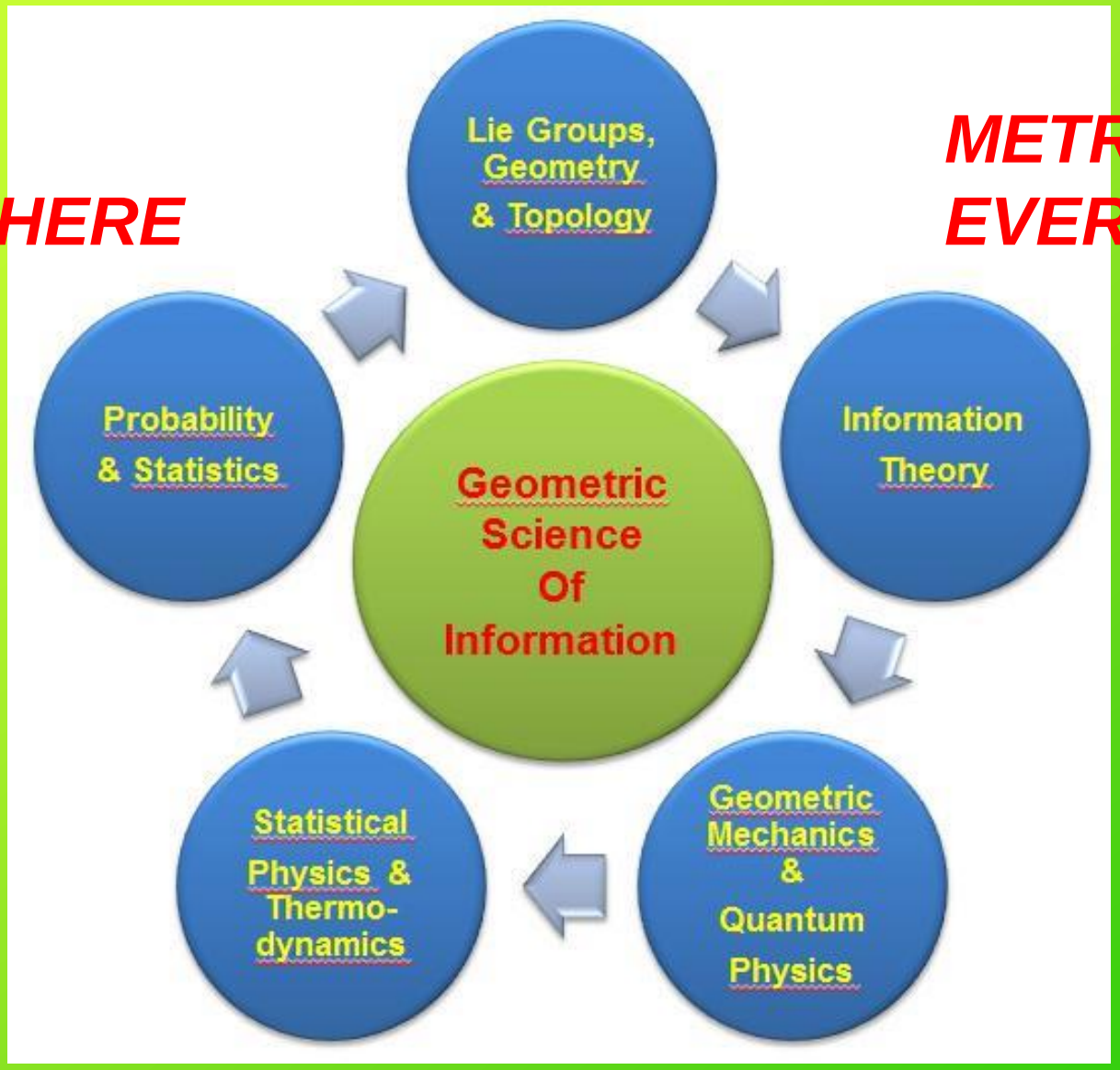
- IPP (Institut Polytechnique de Paris)
- Mine ParisTech
- Sorbonne University (SCAI lab)
- Institut Henri Poincaré
- … ?

A new Grammar of Information

GROUP EVERYWHERE

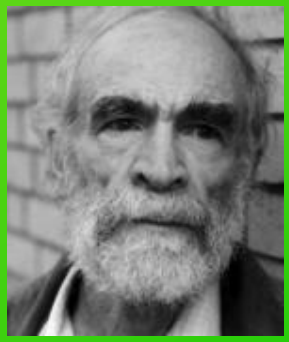
Elie Cartan

Henri Poincaré



METRIC EVERYWHERE

Maurice Fréchet



Misha Gromov

"*Mathematics is the art of giving the same name to different things*" – Henri Poincaré

Elie Cartan: Group Everywhere
(Henri Poincaré review of Cartan's Works)

RAPPORT SUR LES TRAVAUX DE M. CARTAN

fait à la Faculté des Sciences de l'Université de Paris.

PAR

H. POINCARÉ.

Si alors on dépouille la théorie mathématique de ce qui n'y apparaît que comme un accident, c'est-à-dire de sa matière, il ne restera que l'essentiel, c'est-à-dire la forme; et cette forme, qui constitue pour ainsi dire le squelette solide de la théorie, ce sera la structure du groupe.

M. CARTAN a fait faire des progrès importants à nos connaissances sur trois de ces catégories, la 1ère la 3e et la 4e. Il s'est principalement placé au point de vue le plus abstrait de la structure, de la forme pure, indépendamment de la matière, c'est-à-dire, dans l'espèce, du nombre et du choix des variables indépendantes.

Conclusions.

On voit que les problèmes traités par M. CARTAN sont parmi les plus importants, les plus abstraits et les plus généraux dont s'occupent les Mathématiques; ainsi que nous l'avons dit, la théorie des groupes est, pour ainsi dire, la Mathématique entière, dépouillée de sa matière et réduite à une forme pure. Cet extrême degré d'abstraction a sans doute rendu mon exposé un peu aride; pour faire apprécier chacun des résultats, il m'aurait fallu pour ainsi dire lui restituer la matière dont il avait été dépouillé; mais cette restitution peut se faire de mille façons différentes; et c'est cette forme unique que l'on retrouve ainsi sous une foule de vêtements divers, qui constitue le lien commun entre des théories mathématiques qu'on s'étonne souvent de trouver si voisines.

"the problems addressed by Elie Cartan are among the most important, most abstract and most general dealing with mathematics; group theory is, so to speak, the whole mathematics, stripped of its material and reduced to pure form. This extreme level of abstraction has probably made my presentation a little dry; to assess each of the results, I would have had virtually render him the material which he had been stripped; but this refund can be made in a thousand different ways; and this is the only form that can be found as well as a host of various garments, which is the common link between mathematical theories that are often surprised to find so near"

H. Poincaré

Maurice Fréchet: Metric Everywhere

LES ESPACES ABSTRAITS TOPOLOGIQUEMENT AFFINES.

PAR

MAURICE FRÉCHET

à STRASBOURG.

Un grand nombre des propriétés topologiques de l'espace euclidien s'étendent immédiatement à tous les espaces où une définition de la limite étant donnée (qui est en général imposée par la nature des éléments ou points de l'espace et les applications qu'on a en vue), cette définition peut s'exprimer par l'intermédiaire d'une *distance*.[1] Nous entendons par là qu'à tout couple A, B d'éléments ou points de l'espace considéré correspond un nombre $(A, B)=(B, A)\geq 0$, qui n'est nul que si A et B ne sont pas distincts et qui satisfait aux deux conditions suivantes:

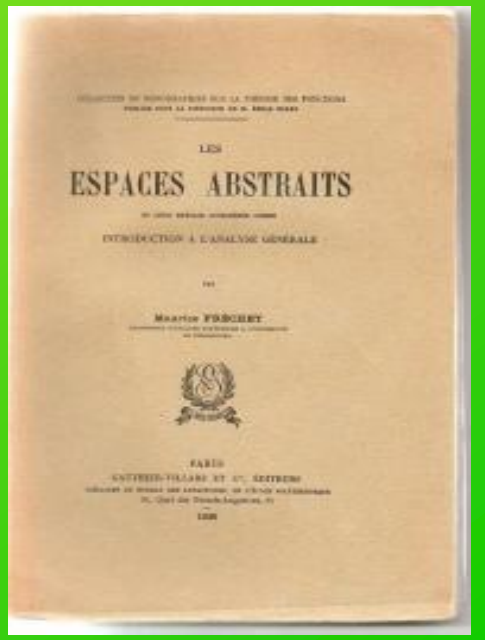
I. Pour trois points A, B, C arbitraires, on a toujours

$$(A, B)\leq(A, C)+(C, B).$$

II. La condition nécessaire et suffisante pour qu'une suite de points $A_1, A_2, \ldots$ de cet espace tende vers le point A de cet espace est que la distance (A, A_n) tende vers zéro.

Un tel espace sera appelé un espace (D) (initiale de distance).[1] Dans le cas où l'on n'impose pas la condition I, (A, B) sera un écart[1] et l'espace sera un espace (E)[1].

- Maurice Fréchet made major contributions to the topology of point sets and introduced the entire concept of metric spaces.
- His dissertation opened the entire field of functionals on metric spaces and introduced the notion of compactness.
- He has extended Probability in Metric space



1948 (Annales de l'IHP)

Les éléments aléatoires de nature quelconque dans un espace distancié

Extension of Probability/Statistic in abstract/Metric space