

FONDAZIONE C.I.M.E.
CENTRO INTERNAZIONALE MATEMATICO ESTIVO
INTERNATIONAL MATHEMATICAL SUMMER CENTER

“Probability and Analysis”

is the subject of the First 1985 C.I.M.E. Session.

The Session, sponsored by the Consiglio Nazionale delle Ricerche and the Ministero della Pubblica Istruzione, will take place under the scientific direction of Prof. GIORGIO LETTA and Prof. MAURIZIO PRATELLI (Università di Pisa, Italy) at «Villa Monastero», Varenna (Como), Italy, *from May 31 to June 8, 1985.*

C o u r s e s

- a) ***Some Applications of Probability to Geometry*** (6 lectures in English).
Prof. Jean-Michel BISMUT (Université Paris-Sud).
- Large deviations and the asymptotics of the heat kernel.
 - The index theorem of Atiyah-Singer for Dirac operators.
 - Some geometrical properties of the loop space of a Riemannian manifold.
 - The Witten complex and its applications.

References

- M.F. Atiyah: Classical groups and classical operators on manifolds. In «Differential operators on manifolds». CIME, Cremonese, Roma 1975.
- M.F. Atiyah, I.M. Singer: The index of elliptic operators III. Ann. of Math. 87 (1968), 546-604.
- J.M. Bismut: Large deviations and the Malliavin calculus. Progress in Math. n. 45, Birkhauser, 1984.
- B. Dubrovin, S. Novikov, A. Fomenko: Géométrie contemporaine I and II. Editions MIR (also English edition by Springer) (see the basics on connections in these two books).
- WITTEN E.: Supersymmetry and Morse theory. J. of Diff. Geom. 17 (1982), 661-692.

- b) ***Martingales and Fourier Analysis in Banach Spaces.*** (6 lectures in English).
Prof. Donald L. BURKHOLDER (University of Illinois, Urbana).
- Martingale transforms and the geometry of Banach spaces.
 - A geometrical condition implying the boundedness of singular integral operators.
 - Bourgain's converse.
 - Optimal control of martingales.
 - Boundary value problems and sharp inequalities for martingale transforms and stochastic integrals.
 - Some other problems and recent progress in probability, geometry, and Fourier Analysis.

References

- J. BOURGAIN, Some remarks on Banach spaces in which martingale difference sequences are unconditional. Ark. Mat. 21 (1983), 163-168.
- D.L. BURKHOLDER, A Geometrical characterization of Banach spaces in which martingale difference sequences are unconditional. Ann. Probab. 9 (1981), 997-1011.
- D.L. BURKHOLDER, A geometric condition that implies the existence of certain singular integrals of Banach-space-valued functions. in «Conference on Harmonic Analysis in Honor of Antoni Zygmund» (W. Beckner, A.P. Calderon, R.F. Fefferman, and P.W. Jones, editors). Wadsworth, Belmont, California, 1983.
- D.L. BURKHOLDER, Boundary value problems and sharp inequalities for martingale transforms. Ann. Probab. 12 (1984), 647-702.

- c) ***Martingale Theory: an Analytical Formulation with some Applications in Analysis.*** (6 lecture in English).
Prof. S. D. CHATTERJI (EPF Lausanne).
- A basic convergence theorem: its statement and discussion. Its relation to martingale, semimartingale et amart convergence theory.
 - Proof of the convergence theorem.
 - Applications:
 - (a) Lebesgue differentiation theorem
 - (b) Product measures
 - (c) Ryll-Nardzewski's fixed point theorem
 - (d) Miscellaneous.

References

- S.D. CHATTERJI, Les martingales et leurs applications analytiques. Lecture Notes in Mathematics, vol. 307, Springer Verlag, Berlin, 1973.
- d) ***Probabilistic Methods in the Geometry of Banach Spaces.*** (6 lectures in English).
Prof. Gilles PISIER (Université Paris VI).

Summary

The course will present the notions of type and cotype of a Banach space together with their geometric interpretations. The duality problem between type and cotype will be discussed and the main results related to the notion of k -convexity will be presented. Moreover, the relations of these notions with the famous theorem of Dvoretzky on the spherical sections of convex bodies will be discussed, using some recent inequalities concerning vector valued Gaussian random variables. The latter inequalities can be advantageously used instead of the isoperimetric inequality on the sphere.

References

- B. MAUREY, G. PISIER, Séries de variables aléatoires vectorielles indépendantes et propriétés géométriques des espaces de Banach. *Studia Math.* 58 (1976), 45-90.
- G. PISIER, Holomorphic semi-groups and the geometry of Banach spaces. *Annals of Math.* 115 (1982), 375-392.
- T. FIGIEL, J. LINDENSTRAUSS, V. MILMAN, The dimension of the spherical sections of convex bodies. *Acta Math.* 139 (1977), 53-94.
- Y. BENYAMINI, Y. GORDON, Random factorization of operators between Banach spaces. *Journal Analyse, Jerusalem.* 39 (1981), 45-74.

Seminars

A number of seminars and special lectures will be offered during the Session.

FONDAZIONE C.I.M.E. CENTRO INTERNAZIONALE MATEMATICO ESTIVO INTERNATIONAL MATHEMATICAL SUMMER CENTER

“Some Problems in Nonlinear Diffusion”

is the subject of the Second 1985 C.I.M.E. Session.

The Session, sponsored by the Consiglio Nazionale delle Ricerche and the Ministero della Pubblica Istruzione, will take place under the scientific direction of Prof. ANTONIO FASANO and Prof. MARIO PRIMICERIO (Università di Firenze, Italy) at Villa «La Querceta», Montecatini Terme (Pistoia), Italy, *from June 10 to June 18, 1985.*

Courses

- a) ***The Porous Medium Equation.*** (8 lectures in English).
Prof. D. G. ARONSON (University of Minnesota, USA).
- Physical background, elementary properties, basic existence and uniqueness theory.
 - Regularity in one space dimension.
 - Properties of the interface in one space dimension: smoothness, nonsmoothness, waiting time.
 - The relationship between the porous medium pressure equation and a Hamilton-Jacobi equation: limiting behavior as $m \rightarrow 1$.
 - Regularity in R^d for $d > 1$: Hölder continuity and quasi convexity.
 - Initial trace, existence and uniqueness in R^d : Harnack-type estimates and growth at infinity.
 - Asymptotic behavior of solutions of the initial-boundary value problem.
 - Stabilization results.

References

- D.G. ARONSON and P. BENILAN, Régularité des solutions de l'équation des milieux poreux dans R^n . C.R. Acad. Sci. Paris, Série A-B, 288 (1979), 103-105.
- D.G. ARONSON and L.A. CAFFARELLI, The initial trace of a solution of the porous medium equation. Trans. Amer. Math. Soc. 280 (1983), 351-366.
- D.G. ARONSON, L.A. CAFFARELLI and J.L. VAZQUEZ, Interfaces with a corner point in one-dimensional porous medium flow. Comm. Pure Appl. Math., to appear.
- D.G. ARONSON, M.G. CRANDALL and L.A. PELETIER, Stabilization of solutions of a degenerate nonlinear diffusion problem. Nonlinear Analysis 6 (1982), 1002-1022.
- D.G. ARONSON, S. KAMIN and L.A. CAFFARELLI, How an initially stationary interface begins to move in porous medium flow. SIAM J. Math. Anal. 14 (1983), 639-658.
- D.G. ARONSON and L.A. PELETIER, Large time behaviour of solutions of the porous medium equation. J. Diff. Eq. 39 (1981), 378-412.
- P. BENILAN, M.G. CRANDALL and M. PIERRE, Solutions of the porous medium equation in R^n under optimal conditions on initial values. Indiana Univ. Math. J. 33 (1984), 51-87.
- L.A. CAFFARELLI and A. FRIEDMAN, Continuity of the density of a gas flow in a porous medium. Trans. Amer. Math. Soc. 252 (1979), 99-113.
- L.A. CAFFARELLI and A. FRIEDMAN, Regularity of the free boundary of a gas flow in an n-dimensional porous medium. Indiana U. Math. J. 29 (1980), 361-391.
- B.E.J. DAHLBERG and C.E. KENIG, Nonnegative solutions of the porous medium equation. Comm. P.D.E., to appear.
- B.F. KNERR, The porous medium equation in one dimension. Trans. Amer. Math. Soc. 234 (1977), 381-415.
- O.A. OLEINIK, S.A. KALASHNIKOV and CHZOU YUI-LIN, The Cauchy problem and boundary problems for equations of the type of nonstationary filtration. Izv. Akad. Nauk SSSR Ser. Mat., 22 (1958), 667-704.

- b) ***Qualitative Methods in Reaction-Diffusion Equations.*** (8 lectures in English).
Prof. Joel SMOLLER (University of Michigan).

Outline.

Topological Methods, the Conley Index, Applications to Reaction-Diffusion Equations, the Fitz-Hugh Nagumo equations, Stability and Bifurcation of Stationary Solutions to Predator-Prey Equations, Symmetry-Breaking Solutions of Semilinear Elliptic equations.

References

- J. SMOLLER, Shock Waves and Reaction-Diffusion Equations. Springer Verlag. 1983.
- c) ***Reaction-Diffusion Problems in Chemistry.*** (8 lectures in English).
Prof. I. STAKGOLD (University of Delaware).
- The quasilinear parabolic system of equations for the concentration and temperature of a simple, irreversible reaction.
- The Frank-Kamenetskii, Semenov and Gelfand approximations, The notion of criticality.
- The method of upper and lower solutions.
- Existence, uniqueness and multiplicity of solutions.
- The case of nonlinearities that are not piecewise smooth. Extinction, dead cores and quenching.
- Free boundary problems and related estimates.
- Two-phase problems, particularly gas-solid interactions.
- The pseudo-steady-state approximation and estimates for the conversion.

S e m i n a r s

A number of seminars and special lectures will be offered during the Session.

FONDAZIONE C.I.M.E.
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“Theory of Moduli”

is the subject of the Third 1985 C.I.M.E. Session.

The Session, sponsored by the Consiglio Nazionale delle Ricerche and the Ministero della Pubblica Istruzione, will take place under the scientific direction of Prof. EDOARDO SERNESI (Università di Roma, Italy) at Villa «La Querceta», Montecatini Terme (Pistoia), Italy, *from June 21 to June 29, 1985.*

C o u r s e s

- a) ***Moduli of algebraic surfaces.*** (8 lectures in English).
Prof. Fabrizio CATANESE (Università di Pisa, Italy).
- Deformations of complex structures (theory of Kodaira-Spencer-Kuranishi).
 - Topological and complex analytic invariants of surfaces.
 - Outline of the Enriques-Kodaira classification of complex surfaces.
 - Existence of moduli spaces for algebraic varieties.
 - Surfaces of general type and their moduli spaces.
 - Moduli via periods.

References

- W. BARTH, C. PETERS, A. van de VEN, Compact complex surfaces. Springer Ergebnisse 4, (1984), Berlin-Heidelberg.
- A. BEAUVILLE, Surfaces algébriques complexes. Astérisque 54 (1978).
- E. BOMBIERI, Canonical models of surfaces of general type. Publ. Scient. I.H. E.S. 42 (1973), 447-495.
- F. CATANESE, On the moduli spaces of surfaces of general type. J. Diff. Geom. 19 (1984), 483-515.
- F. CATANESE, Commutative algebra methods and equations of regular surfaces, in «Algebraic Geometry», Proc. Bucharest 1982, Springer L.N.M. 1056 (1983), 68-111.
- D. GIESEKER, Global moduli for surfaces of general type. Inv. Math. 43 (1977), 233-282.
- K. KODAIRA, Collected papers, vol. II.
- K. KODAIRA, J. MORROW, Complex Manifolds, Holt Rinehart Winston (1971), New York.
- D. MUMFORD, Geometric invariant theory. (2nd edition 1982, with J. FOGARTHY as coauthor). Heidelberg, Springer, 1965.
- H. POPP, Moduli theory and classification theory of algebraic varieties. Springer L.N.M. 620 (1977).
- I. SHAFAREVITCH et al., Algebraic surfaces, Proc. Steklov Inst., A.M.S. Translation (1967), Providence.

- b) ***The Torelli and Schottky Problems.*** (8 lectures in English).
Prof. Ron DONAGI (Northeastern University, Boston).

Outline.

The theory of Prym varieties. Survey of works of Andreotti-Mayer, Beauville, R. Smith, Schottky-Young, van Geemen, Arbarello-De Concini and Shiota. Recent contributions to infinitesimal variations of Hodge structures.

- c) ***Cohomology of the Moduli Space of Curves.*** (8 lecture in English).
Prof. John HARER (University of Maryland).
- Cohomological dimension of the mapping class group.
 - Euler characteristic of the moduli space.
 - Stability theorem.
 - Survey of work of J. Harer, E. Miller, R. Lee, R. Charney, S. Wolpert.

LIST OF C.I.M.E. SEMINARS

Publisher

1954 -	1. Analisi funzionale	C.I.M.E.
	2. Quadratura delle superficie e questioni connesse	"
	3. Equazioni differenziali non lineari	"
1955 -	4. Teorema di Riemann-Roch e questioni connesse	"
	5. Teoria dei numeri	"
	6. Topologia	"
	7. Teorie non linearizzate in elasticità, idrodinamica, aerodinamica	"
	8. Geometria proiettivo-differenziale	"
1956 -	9. Equazioni alle derivate parziali a caratteristiche reali	"
	10. Propagazione delle onde elettromagnetiche	"
	11. Teoria della funzioni di più variabili complesse e delle funzioni automorfe	"
1957 -	12. Geometria aritmetica e algebrica (2 vol.)	"
	13. Integrali singolari e questioni connesse	"
	14. Teoria della turbolenza (2 vol.)	"
1958 -	15. Vedute e problemi attuali in relatività generale	"
	16. Problemi di geometria differenziale in grande	"
	17. Il principio di minimo e le sue applicazioni alle equazioni funzionali	"
1959 -	18. Induzione e statistica	"
	19. Teoria algebrica dei meccanismi automatici (2 vol.)	"
	20. Gruppi, anelli di Lie e teoria della coomologia	"
1960 -	21. Sistemi dinamici e teoremi ergodici	"
	22. Forme differenziali e loro integrali	"
1961 -	23. Geometria del calcolo delle variazioni (2 vol.)	"
	24. Teoria delle distribuzioni	"
	25. Onde superficiali	"
1962 -	26. Topologia differenziale	"
	27. Autovalori e autosoluzioni	"
	28. Magnetofluidodinamica	"
1963 -	29. Equazioni differenziali astratte	"
	30. Funzioni e varietà complesse	"
	31. Proprietà di media e teoremi di confronto in Fisica Matematica	"

1964 - 32. Relatività generale	C.I.M.E.
33. Dinamica dei gas rarefatti	"
34. Alcune questioni di analisi numerica	"
35. Equazioni differenziali non lineari	"
1965 - 36. Non-linear continuum theories	"
37. Some aspects of ring theory	"
38. Mathematical optimization in economics	"
1966 - 39. Calculus of variations	Ed. Cremonese, Firenze
40. Economia matematica	"
41. Classi caratteristiche e questioni connesse	"
42. Some aspects of diffusion theory	"
1967 - 43. Modern questions of celestial mechanics	"
44. Numerical analysis of partial differential equations	"
45. Geometry of homogeneous bounded domains	"
1968 - 46. Controllability and observability	"
47. Pseudo-differential operators	"
48. Aspects of mathematical logic	"
1969 - 49. Potential theory	"
50. Non-linear continuum theories in mechanics and physics and their applications	"
51. Questions of algebraic varieties	"
1970 - 52. Relativistic fluid dynamics	"
53. Theory of group representations and Fourier analysis	"
54. Functional equations and inequalities	"
55. Problems in non-linear analysis	"
1971 - 56. Stereodynamics	"
57. Constructive aspects of functional analysis (2 vol.)	"
58. Categories and commutative algebra	"
1972 - 59. Non-linear mechanics	"
60. Finite geometric structures and their applications	"
61. Geometric measure theory and minimal surfaces	"
1973 - 62. Complex analysis	"
63. New variational techniques in mathematical physics	"
64. Spectral analysis	"

1974 - 65. Stability problems	Ed. Cremonese, Firenze	
66. Singularities of analytic spaces	"	
67. Eigenvalues of non linear problems	"	
1975 - 68. Theoretical computer sciences	"	
69. Model theory and applications	"	
70. Differential operators and manifolds	"	
1976 - 71. Statistical Mechanics	Ed. Liguori, Napoli	
72. Hyperbolicity	"	
73. Differential topology	"	
1977 - 74. Materials with memory	"	
75. Pseudodifferential operators with applications	"	
76. Algebraic surfaces	"	
1978 - 77. Stochastic differential equations	"	
78. Dynamical systems	Ed. Liguori, Napoli and Birkhäuser Verlag	
1979 - 79. Recursion theory and computational complexity	Ed. Liguori, Napoli	
80. Mathematics of biology	"	
1980 - 81. Wave propagation	"	
82. Harmonic analysis and group representations	"	
83. Matroid theory and its applications	"	
1981 - 84. Kinetic Theories and the Boltzmann Equation	(LNM 1048)Springer-Verlag	
85. Algebraic Threefolds	(LNM 947)	"
86. Nonlinear Filtering and Stochastic Control	(LNM 972)	"
1982 - 87. Invariant Theory	(LNM 996)	"
88. Thermodynamics and Constitutive Equations	(LN Physics 228)	"
89. Fluid Dynamics	(LNM 1047)	"
1983 - 90. Complete Intersections	(LNM 1092)	"
91. Bifurcation Theory and Applications	(LNM 1057)	"
92. Numerical Methods in Fluid Dynamics	(LNM 1127)	"
1984 93. Harmonic Mappings and Minimal Immersions	to appear	"
94. Schrödinger Operators	(LNM 1159)	"
95. Buildings and the Geometry of Diagrams	to appear	"
1985 - 96. Probability and Analysis	to appear	"
97. Some Problems in Nonlinear Diffusion	to appear	"
98. Theory of Moduli	to appear	"

Note: Volumes 1 to 38 are out of print. A few copies of volumes 23,28,31,32,33,34,36,38 are available on request from C.I.M.E.

- Vol. 1008: Algebraic Geometry. Proceedings, 1981. Edited by J. Dolgachev. V, 138 pages. 1983.
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- Vol. 1010: J.-E. Dies, Chaînes de Markov sur les permutations. IX, 226 pages. 1983.
- Vol. 1011: J.M. Sigal. Scattering Theory for Many-Body Quantum Mechanical Systems. IV, 132 pages. 1983.
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- Vol. 1013: Complex Analysis – Fifth Romanian-Finnish Seminar. Part 1. Proceedings, 1981. Edited by C. Andreian Cazacu, N. Boboc, M. Jurchescu and I. Suciu. XX, 393 pages. 1983.
- Vol. 1014: Complex Analysis – Fifth Romanian-Finnish Seminar. Part 2. Proceedings, 1981. Edited by C. Andreian Cazacu, N. Boboc, M. Jurchescu and I. Suciu. XX, 334 pages. 1983.
- Vol. 1015: Equations différentielles et systèmes de Pfaff dans le champ complexe – II. Seminar. Edited by R. Gérard et J.P. Ramis. V, 411 pages. 1983.
- Vol. 1016: Algebraic Geometry. Proceedings, 1982. Edited by M. Raynaud and T. Shioda. VIII, 528 pages. 1983.
- Vol. 1017: Equadiff 82. Proceedings, 1982. Edited by H.W. Knobloch and K. Schmitt. XXIII, 666 pages. 1983.
- Vol. 1018: Graph Theory, Łagów 1981. Proceedings, 1981. Edited by M. Borowiecki, J.W. Kennedy and M.M. Sysło. X, 289 pages. 1983.
- Vol. 1019: Cabal Seminar 79–81. Proceedings, 1979–81. Edited by A.S. Kechris, D.A. Martin and Y.N. Moschovakis. V, 284 pages. 1983.
- Vol. 1020: Non Commutative Harmonic Analysis and Lie Groups. Proceedings, 1982. Edited by J. Carmona and M. Vergne. V, 187 pages. 1983.
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- Vol. 1023: S. McAdam, Asymptotic Prime Divisors. IX, 118 pages. 1983.
- Vol. 1024: Lie Group Representations I. Proceedings, 1982–1983. Edited by R. Herb, R. Lipsman and J. Rosenberg. IX, 369 pages. 1983.
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- Vol. 1029: Séminaire d'Algèbre Paul Dubreil et Marie-Paule Malliavin. Proceedings, 1982. Edité par M.-P. Malliavin. V, 339 pages. 1983.
- Vol. 1030: U. Christian, Selberg's Zeta-, L -, and Eisensteinseries. XII, 196 pages. 1983.
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