

# Constantino

by Hans Herrmann

Dept. de Física, Univ. Fed. do Ceará  
Fortaleza  
&  
PMMH, ESPCI, Paris



Statistical Mechanics for  
Complexity – A Celebration of the  
80th Birthday of C. Tsallis

CBPF, Rio de Janeiro

Nov. 6 – 10, 2023

# the origin of life

## from the primordial soup

Physica A 153 (1988) 202-216  
North-Holland, Amsterdam

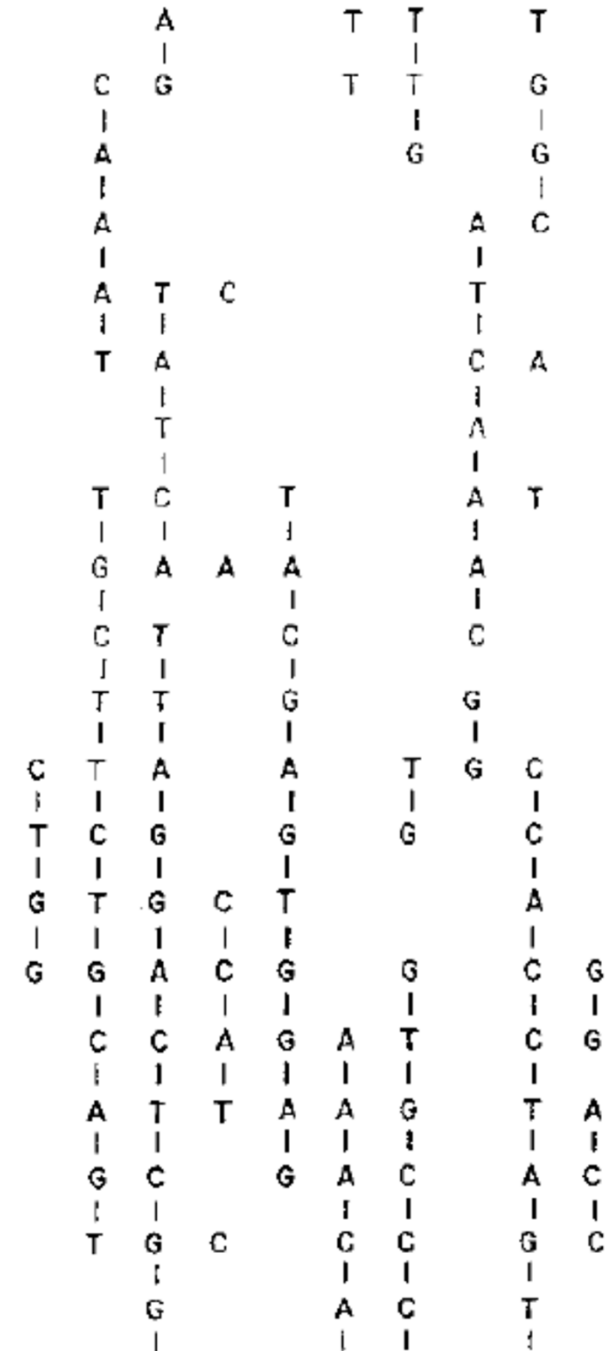
### BIOGENESIS AND THE GROWTH OF DNA-LIKE POLYMER CHAINS: A COMPUTER SIMULATION

Hans J. HERRMANN\* and Constantino TSALLIS

*Centro Brasileiro de Pesquisas Físicas/CNPq, Rua Dr. Xavier Sigaud 150,  
22290 Rio de Janeiro, Brazil*

Received 8 July 1988

We study, through computer simulation, a crucial step of biogenesis, namely the growth of self-replicating codified DNA-like polymers starting from a mixture of oligomers. We have adopted the growth scheme that has been recently proposed by [Ferreira and Tsallis](#) which incorporates usual ideas of autocatalysis through complementary pairs and within which a central role is played by the hydrogen-like links (characterized by the probabilities  $p_{AT}$  and  $p_{CG}$  of chemical bonding of the A-T and C-G pairs respectively) between the two chains of the growing polymer. We find that the average equilibrium polymeric length  $\xi$  diverges, for any fixed ratio  $(1 - p_{AT}) / (1 - p_{CG})$ , as  $\xi \propto 1 / \sqrt{1 - p_{AT}}$ . Selection of patterns may happen at all stages and in particular at chemical equilibrium. Selection occurs via two different mechanisms: (i) away from the critical point  $p_{AT} = p_{CG} = 1$  if  $p_{AT} \neq p_{CG}$ ; (ii) both on and



# the thermal transmissivity and the break-collapse method

VOLUME 47, NUMBER 13

PHYSICAL REVIEW LETTERS

28 SEPTEMBER 1981

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## Simple Method to Calculate Percolation, Ising, and Potts Clusters: Renormalization-Group Applications

Constantino Tsallis

*Centro Brasileiro de Pesquisas Físicas, Conselho Nacional de Desenvolvimento Científico e Tecnológico,  
22290 Rio de Janeiro, Brazil*

and

Silvio V. F. Levy<sup>(a)</sup>

*Instituto de Matemática Pura e Aplicada, Conselho Nacional de Desenvolvimento Científico e Tecnológico,  
20060 Rio de Janeiro, Brazil*

(Received 26 May 1981)

We introduce a procedure which considerably simplifies the calculation of clusters like those commonly appearing in real-space renormalization-group treatments of bond-percolation and pure and random Ising and Potts problems. The method is illustrated through two applications for the  $q$ -state Potts ferromagnet.



# chaos

PHYSICAL REVIEW A

VOLUME 35, NUMBER 2

JANUARY 15, 1987

## New road to chaos

M. C. de Sousa Vieira, E. Lazo,\* and C. Tsallis

*Centro Brasileiro de Pesquisas Físicas, Conselho Nacional de Desenvolvimento Científico e Tecnológico,  
Rua Xavier Sigaud 150, Urca, 22290 Rio de Janeiro, Brazil*

(Received 19 May 1986)

We numerically discuss the asymmetric map  $x' = 1 - \varepsilon_i - a_i |x|^{z_i}$  ( $i=1,2$ , respectively, correspond to  $x > 0$  and  $x < 0$ ). Severe differences appear with respect to the Feigenbaum scenario ( $\varepsilon_1 = \varepsilon_2 = 0$ ,  $a_1 = a_2$ ,  $z_1 = z_2$ ), the strongest corresponding to simple discontinuity ( $\varepsilon_1 \neq \varepsilon_2$ ,  $a_1 = a_2$ ,  $z_1 = z_2$ ) in which case many inverse cascades are observed. The whole set of these cascades can be seen as a new road to chaos.

# fractals

VOLUME 53, NUMBER 12

PHYSICAL REVIEW LETTERS

17 SEPTEMBER 1984

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## Fractons and the Fractal Structure of Proteins

J. S. Helman,<sup>(a)</sup> Antonio Coniglio,<sup>(b)</sup> and Constantino Tsallis

*Centro Brasileiro de Pesquisas Físicas, Conselho Nacional de Pesquisas,  
22290 Rio de Janeiro, Rio de Janeiro, Brazil*

(Received 29 May 1984)

We show that a proper description of the temperature dependence of the spin-lattice relaxation rate of low-spin hemoproteins and ferredoxin requires that both the fractal structure of the protein backbone (polypeptide chain) and the cross connections (H bridges) between segments of the folded chain be taken into account. Within this picture the *fracton* dimensionality  $d_{fr}$  (recently introduced by Alexander and Orbach), the *fractal* dimensionality  $d_f$ , and the experimental noninteger exponent  $n$  of Stapleton *et al.* (spin-lattice relaxation rate  $1/T_1 \propto T^n$ ) become satisfactorily consistent.

# neural networks

International Journal of Neural Systems, Vol. 5, No. 2 (June, 1994) 123-129  
© World Scientific Publishing Company

## OPTIMAL HEBBIAN LEARNING RULES AND THE ROLE OF ASYMMETRY

D. A. STARIOLO\* and C. TSALLIS  
*Centro Brasileiro de Pesquisas Físicas*  
*Rua Xavier Sigaud 150, 22290-Rio de Janeiro-RJ, Brazil*

Received 21 January 1994

Revised 23 March 1994

Accepted 1 May 1994

We study the storage properties associated with generalized Hebbian learning rules which present four free parameters that allow for asymmetry. We also introduce two extra parameters in the post-synaptic potentials in order to further improve the critical capacity. Using signal-to-noise analysis, as well as computer simulations on an analog network, we discuss the performance of the rules for arbitrarily biased patterns and find that the critical storage capacity  $\alpha_c$  becomes maximal for a particular symmetric rule ( $\alpha_c$  diverges in the sparse coding limit). Departures from symmetry decrease  $\alpha_c$  but can increase the robustness of the model.

# population dynamics

Physica A 194 (1993) 502–518  
North-Holland



## Exactly solvable model for a genetically induced geographical distribution of a population

Constantino Tsallis

*Centro Brasileiro de Pesquisas Físicas/CNPq, Rua Dr. Xavier Sigaud 150,  
22290 Rio de Janeiro, RJ, Brazil*

We consider a population with biparental procreation which genetically transmits, through a specific blending-like mechanism, a combination of two characters, namely a *nomadic* and a *sedentary* one. Consequently, as time goes on, the population spreads out geographically, space distribution thus reflecting genetic distribution. The model is exactly tractable, and we calculate the relevant quantities. We finally present and calculate a generalized version of the model.

# economy



Pergamon

*Chaos, Solitons & Fractals* Vol. 6, pp. 561–567, 1995  
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0960-0779/95 \$9.50 + .00

0960-0779(94)00305-X

## Stock Exchange: A Statistical Model

C. TSALLIS, A.M.C. de SOUZA\* and E.M.F. CURADO

Centro Brasileiro de Pesquisas Físicas

Rua Dr. Xavier Sigaud, 150 - 22290-180 - Rio de Janeiro - RJ, Brazil

**Abstract-** In the spirit of microfoundations of macroeconomic theory, we introduce a coupled map lattice model to describe time evolution of relevant quantities associated with stock exchange. In particular, computer simulations exhibit the stabilizing effect, on stock exchange, of dispersion of the external parameters which control the coupled map.



# the Generalizator



PHYSICAL REVIEW B

VOLUME 46, NUMBER 10

1 SEPTEMBER 1992-II

## Phase diagram of a generalized $t$ - $J$ model: Renormalization-group approach

Sergio A. Cannas\*

*Facultad de Matemática, Astronomía y Física, Universidad Nacional de Córdoba,  
Laprida 854, 5000 Córdoba, Argentina*

Constantino Tsallis

*Centro Brasileiro de Pesquisas Físicas, Conselho Nacional de Desenvolvimento Científico e Tecnológico,  
Rua Xavier Sigaud 150, 22290 Rio de Janeiro, Rio de Janeiro, Brazil  
(Received 15 October 1991)*

Physica A 191 (1992) 277-283  
North-Holland



PHYSICAL REVIEW B

VOLUME 49, NUMBER 5

1 FEBRUARY 1994-I

## Generalized single-spin-flip dynamics for the Ising model and thermodynamic properties

A. M. Mariz and F. D. Nobre

*Departamento de Física Teórica e Experimental, Universidade Federal do Rio Grande do Norte,  
Campus Universitário, Caixa Postal 1641, 59072-970 Natal-RN, Brazil*

C. Tsallis

*Departamento de Física Teórica e Experimental, Universidade Federal do Rio Grande do Norte,  
Campus Universitário, Caixa Postal 1641, 59072-970 Natal-RN, Brazil*

## Generalized Archie law – application to petroleum reservoirs

Constantino Tsallis<sup>a</sup>, Evaldo M.F. Curado<sup>a</sup>,  
Maria do Socorro de Souza<sup>b</sup>, Vera L. Elias<sup>b</sup>, Claudio Bettini<sup>b</sup>,  
Maximiano S. Scuta<sup>c</sup> and Rodolfo Beer<sup>c</sup>

<sup>a</sup>Centro Brasileiro de Pesquisas Físicas, Rua Xavier Sigaud 150, 22290 Rio de Janeiro, RJ,  
Brazil



Solid State Communications, Vol. 78, No. 8, pp. 685-690, 1991.  
Printed in Great Britain.

0038-1098/91\$3.00+.00  
Pergamon Press plc

J. Phys. A: Math. Gen. **15** (1982) 587-598. Printed in Great Britain

## Pure and dilute $Z(N)$ spin and generalised gauge lattice systems: duality and criticality

F C Alcaraz† and C Tsallis‡

† Departamento de Física, Universidade Federal de São Carlos, Via Washington Luiz, Km

A GENERALISED HUBBARD HAMILTONIAN : INFLUENCE OF TEMPERATURE AND FRACTALITY

Sergio A. CANNAS<sup>++</sup>, Francisco A. TAMARIT<sup>++</sup>  
and Constantino TSALLIS<sup>\*</sup>

<sup>\*</sup> Centro Brasileiro de Pesquisas Físicas/CNPq,  
Rua Xavier Sigaud 150, 22290-Rio de Janeiro-RJ, Brazil

## THE INFINITE NUMBER OF **GENERALIZED** DIMENSIONS OF FRACTALS AND STRANGE ATTRACTORS

H.G.E. HENTSCHEL and Itamar PROCACCIA

*Department of Chemical Physics, Weizmann Institute of Science, Rehovot 76100, Israel*

Received 23 December 1982

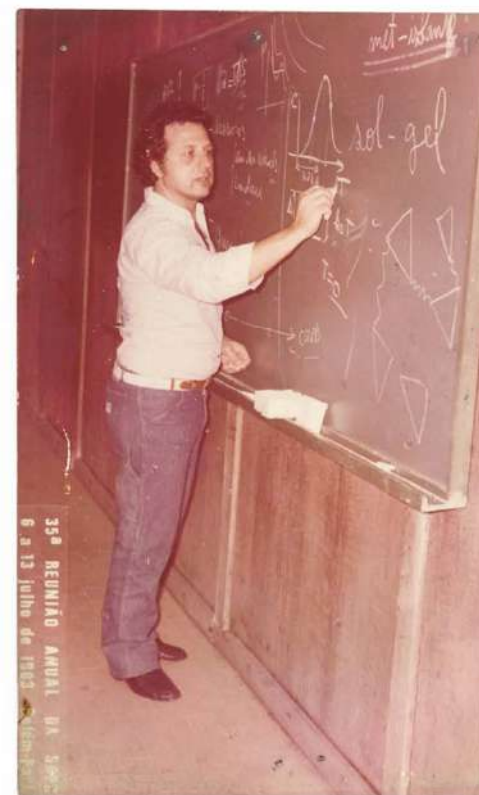
Revised 30 March 1983

For  $q \rightarrow 1$  one finds

$$\begin{aligned}
 d_1 &= \lim_{q \rightarrow 1} \frac{1}{q-1} \lim_{\ell \rightarrow \infty} \lim_{N \rightarrow \infty} \frac{\ln \sum_i P_i e^{(q-1) \ln P_i}}{\ln (L/\ell)} \\
 &\approx \lim_{q \rightarrow 1} \frac{1}{q-1} \lim_{\ell \rightarrow \infty} \lim_{N \rightarrow \infty} \frac{\ln \sum_i P_i (1 + (q-1) \ln P_i)}{\ln (L/\ell)} \\
 &= \lim_{\ell \rightarrow \infty} \lim_{N \rightarrow \infty} \frac{\sum_i P_i \ln P_i}{\ln (L/\ell)}
 \end{aligned}$$

which is formally like an entropy and is called the

$$D_q = \frac{1}{(q-1)} \lim_{l \rightarrow 0} \frac{\log \sum_{i \in l} p_i^q}{\log l},$$



11000 citations

## **Possible Generalization of Boltzmann–Gibbs Statistics**

**Constantino Tsallis<sup>1</sup>**

*Received November 12, 1987; revision received March 8, 1988*

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With the use of a quantity normally scaled in multifractals, a generalized form is postulated for entropy, namely  $S_q \equiv k[1 - \sum_{i=1}^W p_i^q]/(q-1)$ , where  $q \in \mathbb{R}$  characterizes the generalization and  $\{p_i\}$  are the probabilities associated with  $W$  (microscopic) configurations ( $W \in \mathbb{N}$ ). The main properties associated with this entropy are established, particularly those corresponding to the microcanonical and canonical ensembles. The Boltzmann–Gibbs statistics is recovered as the  $q \rightarrow 1$  limit.

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1 POSSIBLE GENERALIZATION OF BOLTZMANN-GIBBS STATISTICS

6,874

Citations

TSALLIS, C

Jul 1988 | JOURNAL OF STATISTICAL PHYSICS 52 (1-2), pp.479-487

4

References

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Publication Years

2023 162

2022 157

2021 162

2020 235

2019 263

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2 QUANTITATIVE UNIVERSALITY FOR A CLASS OF NON-LINEAR TRANSFORMATIONS

2,559

Citations

EEIGENBAUM, M J

1978 | JOURNAL OF STATISTICAL PHYSICS 19 (1), pp.25-52

7

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3 EMBEDOLOGY

1,773

Citations

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Nov 1991 | JOURNAL OF STATISTICAL PHYSICS 65 (3-4), pp.579-616

30

References

Mathematical formulations of the embedding methods commonly used for the reconstruction of attractors from data series are discussed. Embedding theorems, based on previous work by H. Whitney and F. Takens, are established for compact subsets A of Euclidean space  $R^k$ . If n is an integer larger than twice the box-counting dimension of A, then almost every map from  $R^k$  to  $R^n$ , in the sense of  $f...$  Show more

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Ernst, M.H. 45

Cohen, E. G. D. 43

4 FLUIDS WITH HIGHLY DIRECTIONAL ATTRACTIVE FORCES .1. STATISTICAL THERMODYNAMICS

1,598

Citations

WERTHEIM, M S

1984 | JOURNAL OF STATISTICAL PHYSICS 35 (1-2), pp.19-34

16

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$$S = k_B \ln W$$



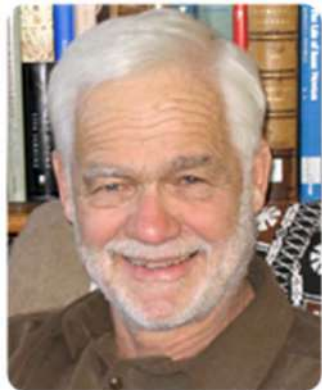
# the Greek warrior



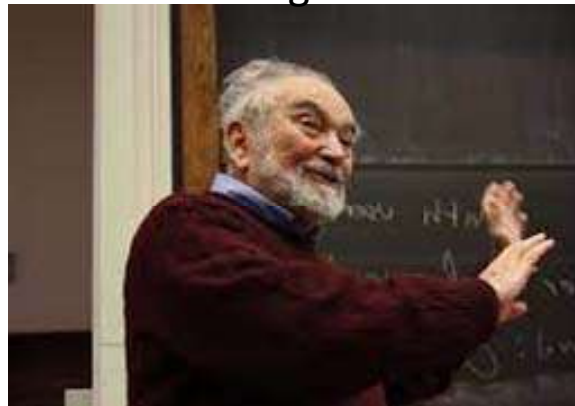
Grassberger



Hawking



Nauenberg



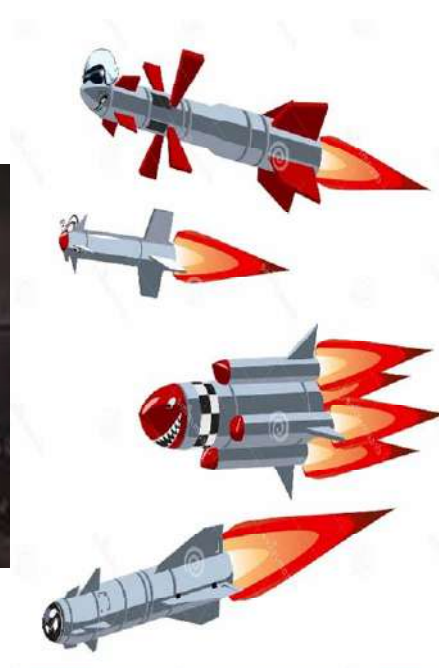
Lebowitz



Derrida



Procaccia



# Introduction to Nonextensive Statistical Mechanics

APPROACHING A COMPLEX WORLD

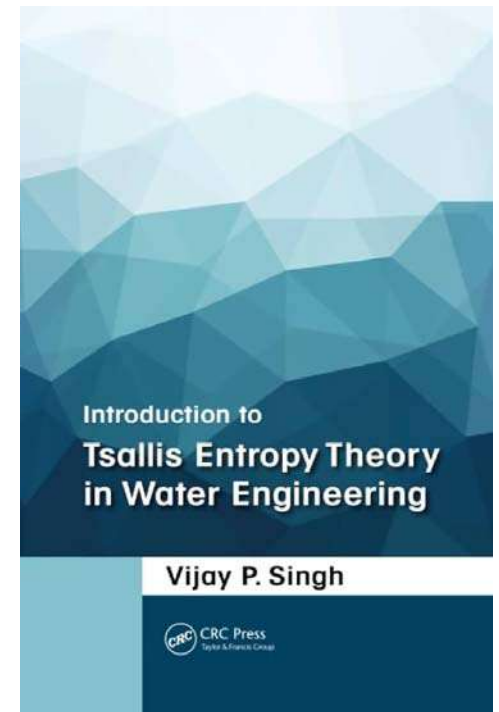
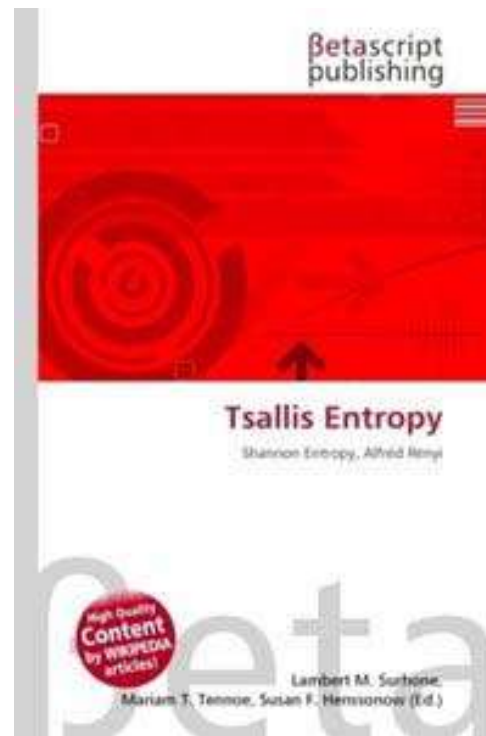
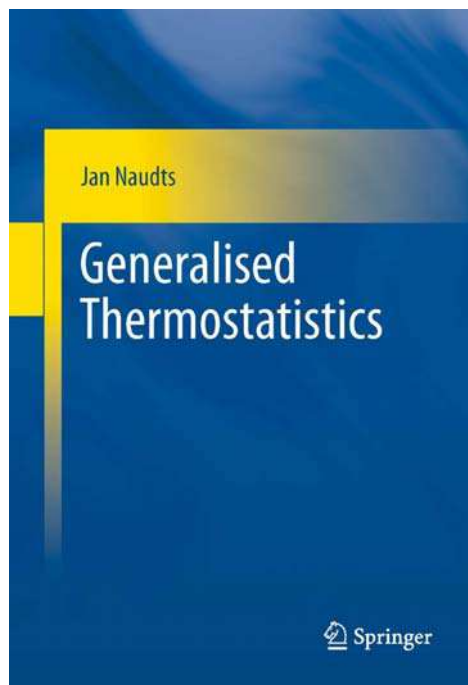
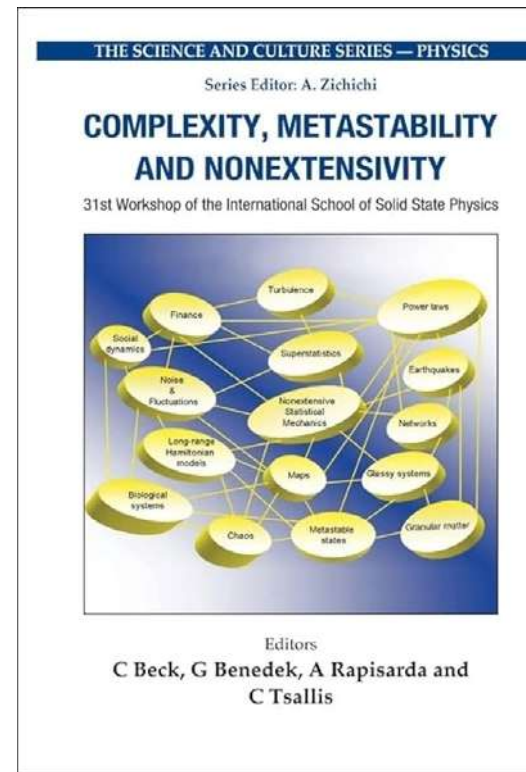
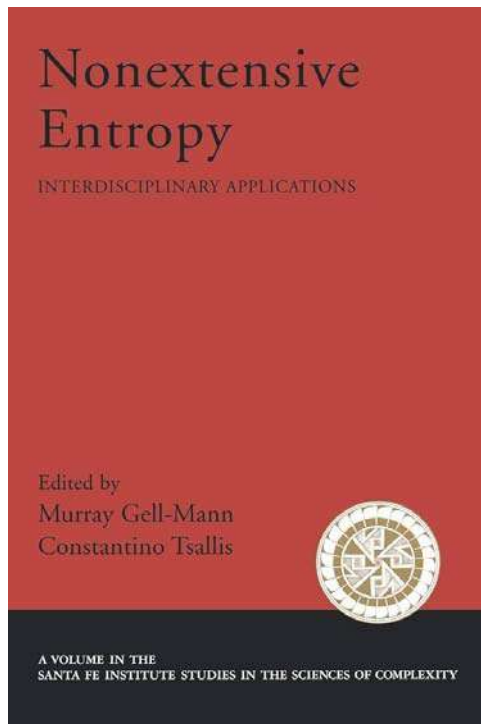
Constantino Tsallis

 Springer

# Mathematical Foundations of Nonextensive Statistical Mechanics

Sabir Umarov  
Constantino Tsallis

 World Scientific





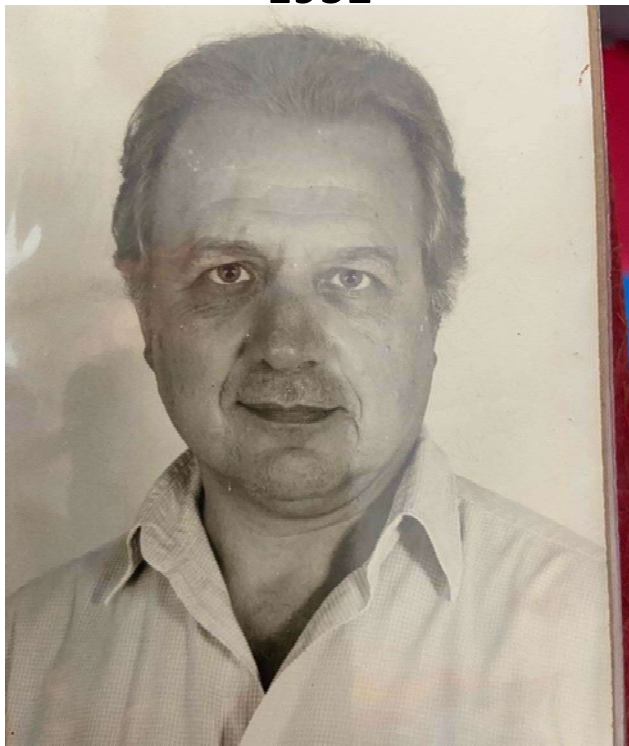
# the history of a great man



1952



1959



2008



# a Greek family goes to Argentina



1946, 3 years old, with his father Emmanuel



ca 1951, with mother Cleopatra, sister Thalia and brother Demetrio



ca 1959 in Mendoza

# Bariloche 1963





Guido Beck

1965, Diploma do  
Instituto de Física de  
Bariloche



André Guinier

Doctorat d' État (1974)

“M. Tsallis a du flair, il devine la réponse!”



Pierre-Gilles de Gennes

Classification  
*Physics Abstracts*  
17.29

## DYNAMICS OF $\text{KH}_2\text{PO}_4$ TYPE FERROELECTRIC PHASE TRANSITIONS

C. TSALLIS

Service de Physique du Solide et de Résonance Magnétique  
Centre d'Etudes Nucléaires de Saclay, BP n° 2, 91, Gif-sur-Yvette, France

(Reçu le 14 avril 1972, révisé le 28 juillet 1972)

phys. stat. sol. (b) **79**, 451 (1977)

Subject classification: 13.4 and 14.2

*Departamento de Física, Universidade de Brasília<sup>1)</sup>*

## Conduction Electron Spin Resonance Due to Exchange and Spin-Orbit Scatterings by Dilute Impurities in Superconductors

By

C. TSALLIS<sup>2)</sup>

## Diagonalization methods for the general bilinear Hamiltonian of an assembly of bosons

Constantino Tsallis

Centro Brasileiro de Pesquisas Físicas/CNPq, Rio de Janeiro, Brazil  
(Received 27 June 1977)

1972-1975  
Ecole Supérieure de Physique  
et Chimie Industrielles (ESPCI)



1975-1977  
Instituto de Física  
Universidade de Brasília (UnB)

1977 ate hoje  
Centro Brasileiro de Pesquisas Físicas (CBPF)





2009: Celebrating the 60 years of CBPF, Rio de Janeiro. From left to right: Adalberto Fazzio, Moysés Nussenzveig, Walter Baltensperger, Sergio Mascarenhas, Spero Morato, Ricardo Galvao, Amóos Troper, Constantino Tsallis, Sergio Rezende in front of Alberto Passos Guimaraes, Alfredo Ozório de Almeida, Elisa Frota Pessoa, Erasmo Ferreira, Jayme Tiomno and Affonso Guidao Gomes.



2008, Constantino with some of the founders of modern statistical mechanics in Brazil. From left to right: Silvio R. A. Salinas, Maurício D. Coutinho-Filho and Francisco C. Sá Barreto





2000, During the IUPAP International Conference on New Trends in the Fractal Aspects of Complex Systems (FACS2000) at Federal University of Alagoas, Maceió



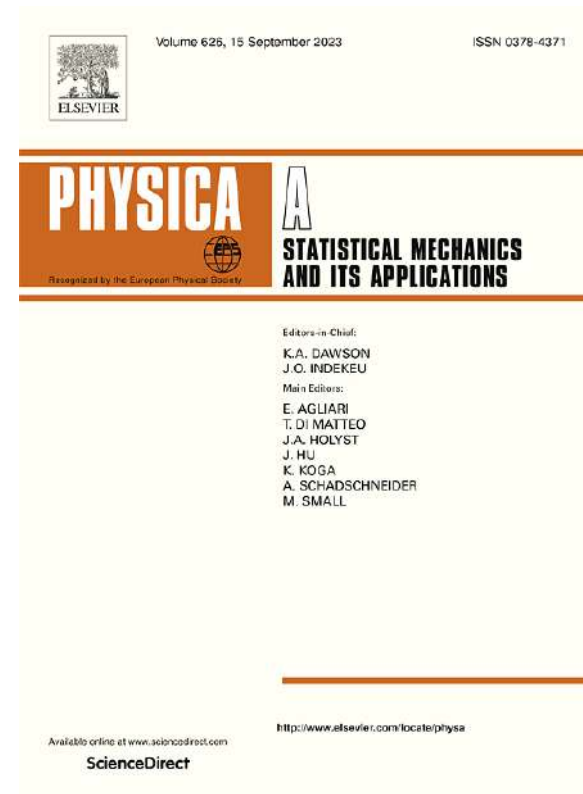
# friend of Nobel prize winners

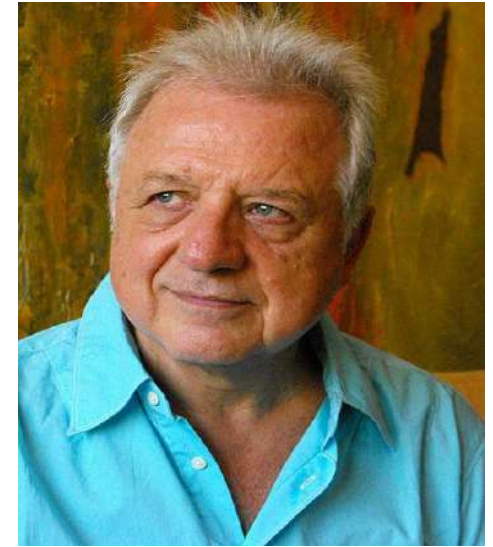


2006, with Murray Gell-Mann in Santa Fe



2007, with Gerard t'Hooft at Cristo Redentor





Guggenheim Foundation Award

organization of STAPHYS17 in Rio de Janeiro

former head of the Department of Theoretical Physics of CBPF

External Faculty Fellow of the Santa Fe Institute

External Faculty of the Complexity Science Hub Vienna

Professor at the University of Catania

member of the Academy of Sciences of Brazil,  
the Academy of Economic, Political and Social Sciences of Brazil,  
the Academy of Sciences of Latin America.

# popularizing physics



2012: Constantino lecturing to teenagers at a high school in Itacoatiara, Amazonas, Brazil. Itacoatiara is 270 Kms away from Manaus

# Maria Cristina



1984, reveillón in Buzios



1985, in Mendoza

# Maria Aparecida



2008, carnaval in Rio



2005, with Emmanuel in Santa Fé



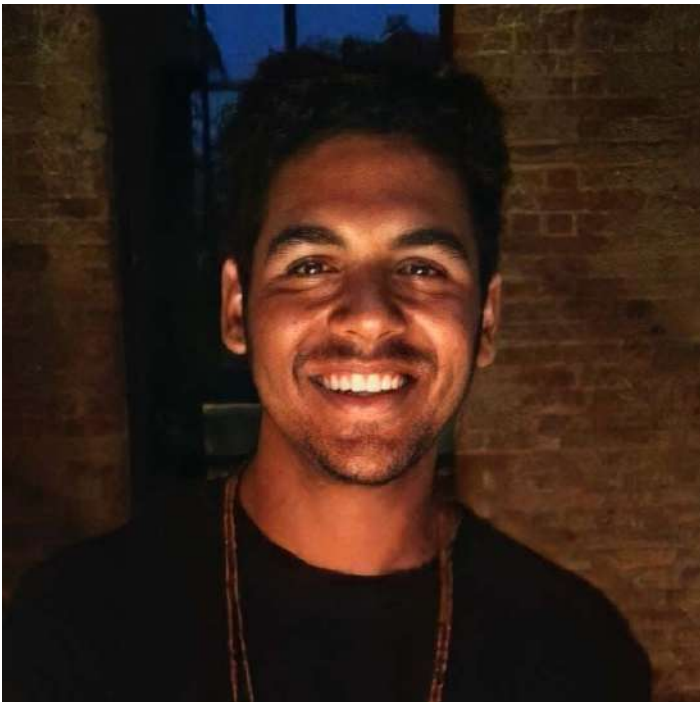
**Marisa**



# children



2004, Brasilia



# grandchildren



2006, Father's Day



2012, Rio de Janeiro



**2004:** Receiving the award *Comendador da Ordem Nacional do Mérito Científico* from the Minister of Science and Technology, Eduardo Campos. President Lula in the background. Brasília, Brazil



**2004:** Constantino Tsallis receiving the *Mexico Prize for Science and Technology* from the President Vicente Fox, Mexico City, Mexico.



**2012:** Constantino Tsallis discoursing after being awarded the *Aristio* (Excellence) by the Academy of Athens, Greece. The modern Academy of Athens has its origin in the Academy founded by Plato in the Vth century B.C.

2007 receiving the Elsevier Price  
for the importance of his scientific production.







2005, Constantino receiving the Disney award for the best show from Mickey Mouse (Mickey is on the left), Orlando, Florida



**2009:** Constantino Tsallis receiving the title of Doctor Honoris Causa by the Aristotelian University of Thessaloniki, Greece. The title of his talk was: *Aristotelian Metaphor, Caratheodory Thermodynamics, and Nonextensive Statistical Mechanics - An Epistemological Promenade.*

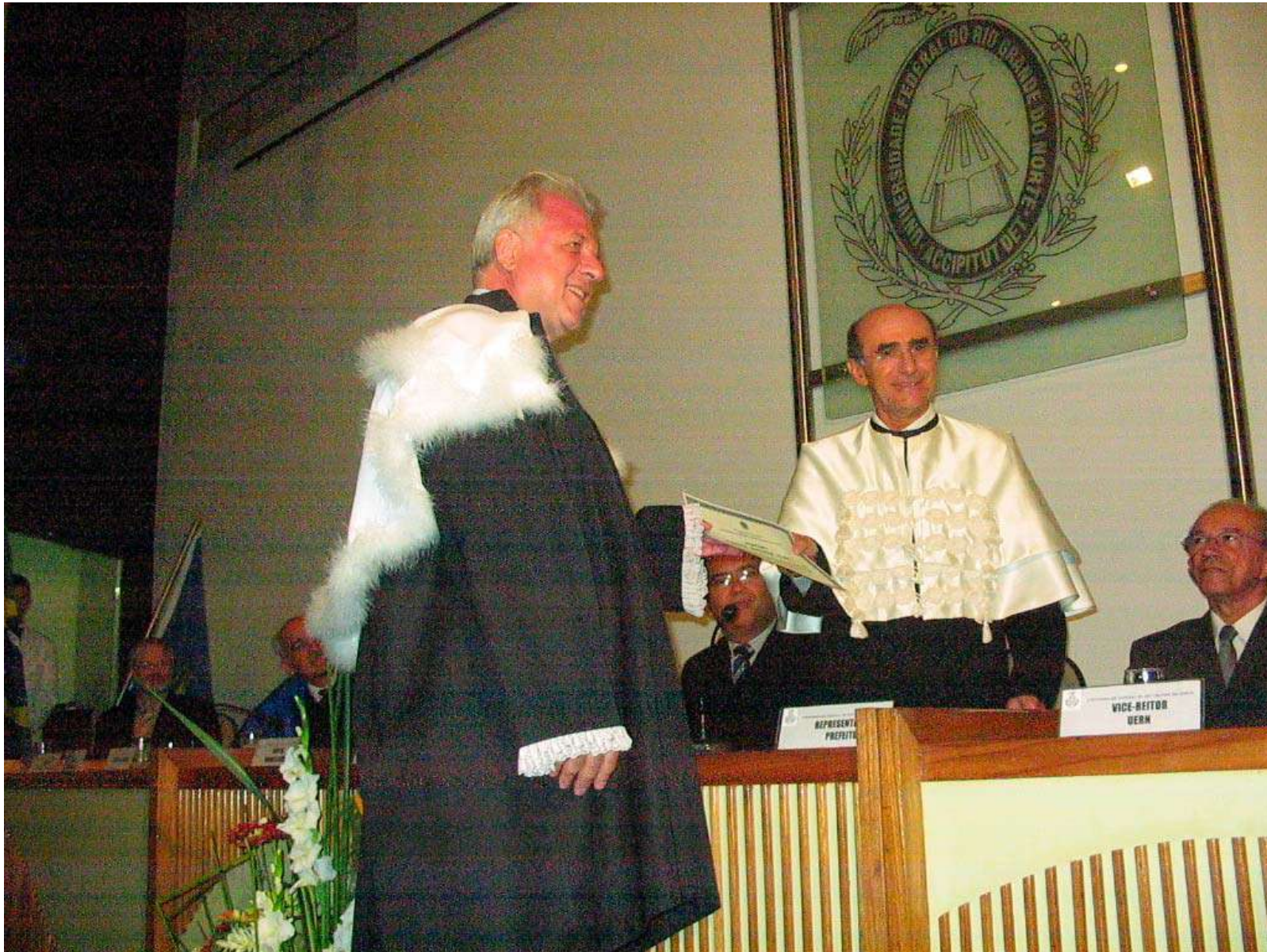
2005, Doctor Honoris Causa Córdoba Argentina



Doctor Honoris ,Universidade Estadual de Maringa', Paraná Brasil 2007



## Doctor Honoris Causa – Natal 2008



# Teopoztlán, 2005



Happy birthday  
Constantino



wishing you many more happy years

