EXPERIÊNCIAS INTERNACIONAIS NO DESENVOLVIMENTO DA CIÊNCIA E DA TECNOLOGIA

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Nicolas Léonard Sadi Carnot
(1796-1832)

The principle of energy conservation was fairly new and quite controversial among scientists at the time.

American Physical Society News **18** (6) 2, (June 2009)

Helen Quinn

The key values of honesty and openness are essential for science to progress.

Physics Today (July 2009)

1807 Jean-Baptiste Joseph Fourier's manuscript *Théorie de la propagation de la chaleur dans les solides* was never published by the French Academy of Sciences because two of the four referees recommended rejection. These two referees were ... Lagrange and Laplace! Fourier was essentially introducing the *Fourier transform*!

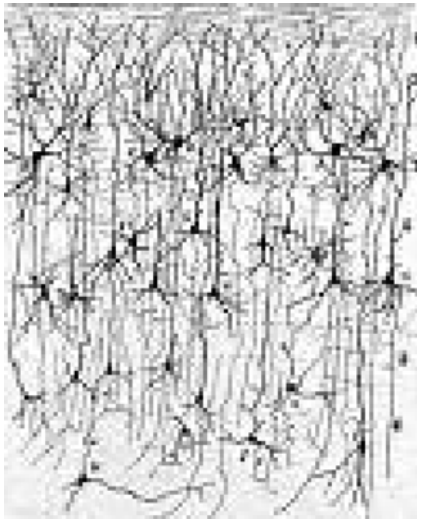
1822 → *Théorie analytique de la chaleur* !

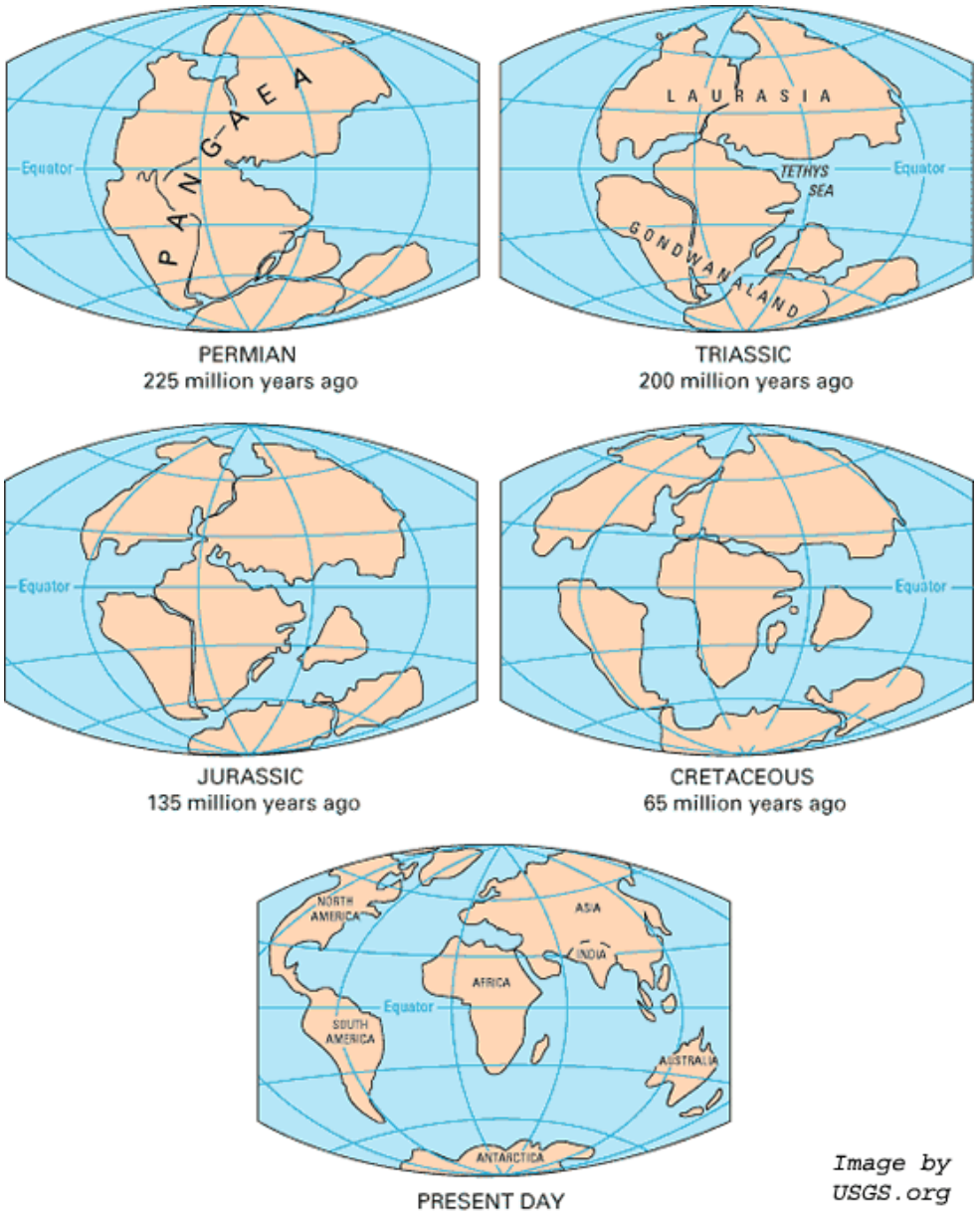
Antoine-Laurent Lavoisier (1743-1794):

I do not expect my ideas to be adopted all at once. [...] *It is the passage of time, therefore, which must confirm or destroy the opinions I have presented. Meanwhile, I observe with great satisfaction that the young people are beginning to study the science without prejudice ...*
[*Reflexions sur le Phlogistique* (1783)]

Santiago Ramon y Cajal

(1852 – 1934)



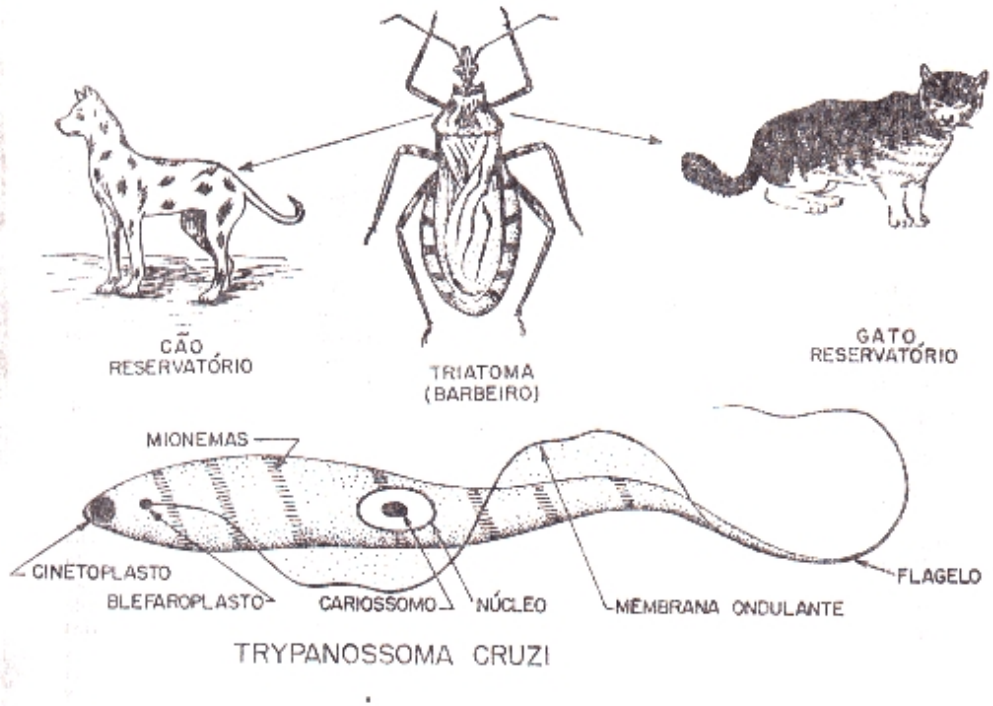


Alfred Lothar Wegener (1880-1930)

CONTINENTAL DRIFT

Carlos Ribeiro Justiniano das Chagas

(1879-1934)



Descobriu e descreveu a doenca em 1909. Indicado para o Premio Nobel de Medicina em 1913 e 1921. Foi duramente contestado por Afrânio Peixoto, Figueiredo de Vasconcellos e alguns outros acadêmicos, uma disputa histórica que durou de 1920 a 22, terminando com a plena vitória de Chagas. Entretanto, colocou a doença de Chagas, à época, sob suspeita e com isto foram sensivelmente reduzidos o seu estudo e o seu ensino nas universidades brasileiras. Aliás, é da maior importância ressaltar a tenacidade de Chagas (muito mais que sua tristeza) mantendo-se ativo e trabalhador apesar dos lamentáveis fatos da Academia.

Salvador Maza (Argentina) comecou o tratamento da doenca em 1937.

24 / 08 / 2007: 5.413 citacoes nominais ISI

Il [Freeman Dyson] *est convaincu que les vérités scientifiques sont si profondement enfouies que la seule certitude que nous puissions avoir, c'est que la plupart de choses que nous pensons se révéleront fausses.*

Courrier International 974, 36 (2 Juillet 2009)

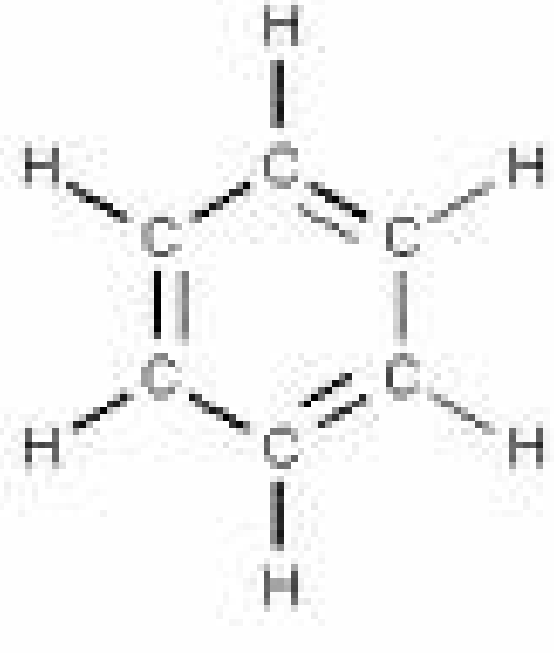
[Extraits du *New York Times*]

Sólo sé que no sé nada

Sócrates

“Any really new idea in science always emerges through a metaphor.”
Chemistry Nobel laureate Roald Hoffmann,
[May 1995, in a Italian restaurant in Ithaca, New York]

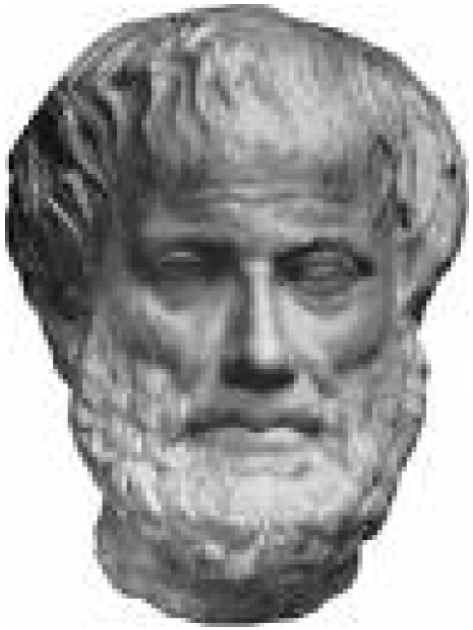
Uroboros



benzene

Friedrich August Kekulé von Stradonitz

(1829 – 1896)



[384-322 BC]

ARISTOTLE

Poetry is more elevated and more philosophical than history; for poetry expresses the universal, and history only the particular. History tells us the events as they happened, whereas poetry tells them as they could or should have happened.

[384-322 BC]

[Αριστοτέλη, Περί Ποιητικής, 1459^{α}]

Ἔστιν δὲ μέγα μὲν τὸ ἑκάστωι τῶν εἰρημένων πρεπόντως χρῆσθαι, καὶ διπλοῖς ὀνόμασι καὶ γλώτταις, πολὺ δὲ μέγιστον τὸ μεταφορικὸν εἶναι. Μόνον γὰρ τοῦτο οὔτε παρ᾽ ἄλλου ἔστι λαβεῖν εὐφυίας τε σημεῖόν ἐστι· τὸ γὰρ εὖ μεταφέρειν τὸ τὸ ὅμοιον θεωρεῖν ἐστιν.

Το πιο σημαντικό από όλα τα παραπάνω είναι η δεξιοτεχνική χρήση της μεταφοράς. Διότι μόνο αυτό δεν μπορεί να διδαχθεί, ενώ είναι δείγμα ευφυΐας καθώς μια σωστή μεταφορά υποδηλώνει την ικανότητα να διακρίνει κανείς ομοιότητες ανάμεσα σε ανόμοια πράγματα.

[Aristotle, Ars Poetica, 322 BC]

"By far the greatest thing is to be a master of metaphor. It is the one thing that cannot be learned from others. It is a sign of genius, for a good metaphor implies an intuitive perception of similarity among dissimilars."

“Nothing is a sign until it is interpreted as a sign”

EPISTEMOLOGICAL INFERENCES

SEMIOTICS [Charles Sanders Peirce (1839 - 1914)]

Abduction:

All stones in box A are black.
Stone Sj is black.

Stone Sj is from box A.

Induction:

Stone S1 is from box A and it is black.
Stone S2 is from box A and it is black.
Stone S3 is from box A and it is black.
...

All stones in box A are black.

Deduction:

All stones in box A are black.
Stone Si is from box A.

Stone Si is black.

Le savant n'étudie pas la nature parce que cela est utile; il l'étudie parce qu'il y prend plaisir et il y prend plaisir parce qu'elle est belle. Si la nature n'était pas belle, elle ne vaudrait pas la peine d'être connue, la vie ne vaudrait pas la peine d'être vécue.

Jules Henri Poincaré (1854 -1912)
Science et méthode

The scientist does not study nature because it is useful; he studies it because he delights in it, and he delights in it because it is beautiful. If nature were not beautiful, it would not be worth knowing, and if nature were not worth knowing, life would not be worth living.

E debbasi considerare come non è cosa più difficile a trattare, né più dubia a riuscire, né più pericolosa a maneggiare, che farsi capo ad introdurre nuovi ordini. Perché lo introduttore ha per nimici tutti quelli che delli ordini vecchi fanno bene, et ha tepidi defensori tutti quelli che delli ordini nuovi farebbono bene. La quale tepidezza nasce, parte per paura delli avversarii, che hanno le leggi dal canto loro, parte dalla incredulità delli uomini; li quali non credano in verità le cose nuove, se non ne veggono nata una ferma esperienza.

Il Príncipe (Capitolo VI) **Niccolò Machiavelli** (1469-1527)

We must consider that nothing is harder to implement, of more uncertain success, nor more dangerous to deal with, than to initiate a new order of things. Because the one who introduces the novelties finds enemies in all those who profit from the old order and tepid defenders in all those who would profit from the new order. This tepidity comes in part from their fear of their adversaries, who have the laws on their side, and in part from the incredulity of people, who do not really believe in new things until they have solid experience of them.

(Translation: C. Tsallis and M. Gell-Mann)

The reasonable man adapts himself to the world: the unreasonable one persists in trying to adapt the world to himself. Therefore all progress depends on the unreasonable man.

George Bernard Shaw (1856-1950)

Maxims for Revolutionists

Si l’action n’a quelque splendeur de liberté, elle n’a point de grâce ni d’honneur.

Montaigne,
“Essais”, L.III, Chap. 9

Je ne suis pas d'accord avec ce que vous dites, mais je me battrai jusqu'à la mort pour que vous ayez le droit de le dire.

Voltaire (François-Marie Arouet, 1694-1778)

If you have an apple and I have an apple,
and we exchange apples,
we both still only have one apple.
But if you have an idea and I have an idea,
and we exchange ideas,
we each now have two ideas.

George Bernard Shaw (1856-1950)

Tout le monde savait que c’ était impossible.

Il y avait un qui ne le savait pas.

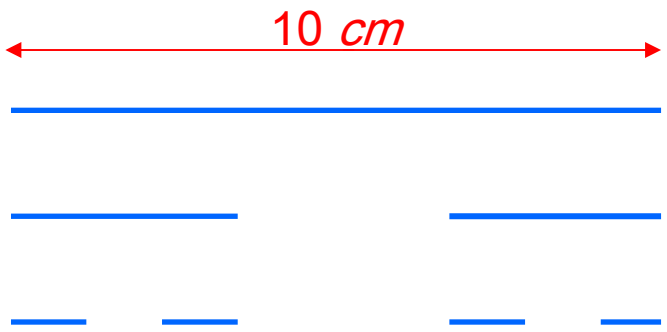
Alors il est allé et il l’a fait.

Jean Cocteau, Marcel Pagnol, Winston Churchill, Mark Twain ...

In the preface to his book, *I Wish I'd Made You Angry Earlier,* Chemist and Nobelist Max Perutz writes:

> *Creativity in science, as in the arts, cannot be organized. It arises spontaneously from individual talent. Well-run laboratories can foster it, but hierarchical organization, inflexible, bureaucratic rules, and mounds of futile paperwork can kill it. Discoveries cannot be planned; they pop up, like Puck, in unexpected corners.* (Perutz 1998, p. ix)

TRIADIC CANTOR SET:



$$d_F = \frac{\ln 2}{\ln 3} = 0.6309...$$

Hence the interesting measure is

$$(10\ cm)^{0.6309...} \cong 4.275\ cm^{0.6309}$$

It is the natural (or artificial or social) system itself which, through its geometrical-dynamical properties, indicates the specific informational tool --- entropy --- to be meaningfully used for the study of its thermostatistical and thermodynamical properties.

LAS 10 FORMULAS MATEMATICAS QUE CAMBIARON LA FAZ DE LA TIERRA (*Nicaragua, 1971*)

$1 + 1 = 2$

$f = \frac{G m_1 m_2}{r^2}$

Newton

$E = mc^2$

Einstein

$V = V_e \ln \frac{m_0}{m_1}$

Tsiolkovski

$\nabla^2 E = \frac{K\mu}{c^2} \frac{\partial^2 E}{\partial t^2}$

Maxwell

$e^{\ln N} = N$

Napier

$A^2 + B^2 = C^2$

Pythagoras

$S = k \log W$

Boltzmann

$\lambda = h / m v$

de Broglie

$F_1 x_1 = F_2 x_2$

Archimedes

Ludwig Boltzmann
1844-1906

Las ecuaciones de Boltzmann reveló como el comportamiento de gases dependía del movimiento constante de átomos y moléculas. Su gran importancia reside en su aplicación donde los gases juegan un papel importante: en todas las máquinas impulsadas por vapor ó combustión interno; en las incontables reacciones entre gases usados por químicos para hacer drogas modernas, plásticos ú otras sustancias; en comprender el tiempo; y aún en explicar los procesos violentos del sol, estrellas y galaxias distantes.

$$S = k \log W \qquad \text{(Boltzmann)}$$

NONADDITIVE ENTROPY and NONEXTENSIVE STATISTICAL MECHANICS

1985: Mexico City, then Rio de Janeiro

1987: Maceio, then Rio de Janeiro

1988: Journal of Statistical Physics (C. T.)

1991: Journal of Physics A (E.M.F. Curado and C. T.)

1998: Physica A (C. T., R.S. Mendes and A.R. Plastino)

$$p^q > p \quad \text{if} \quad q < 1$$

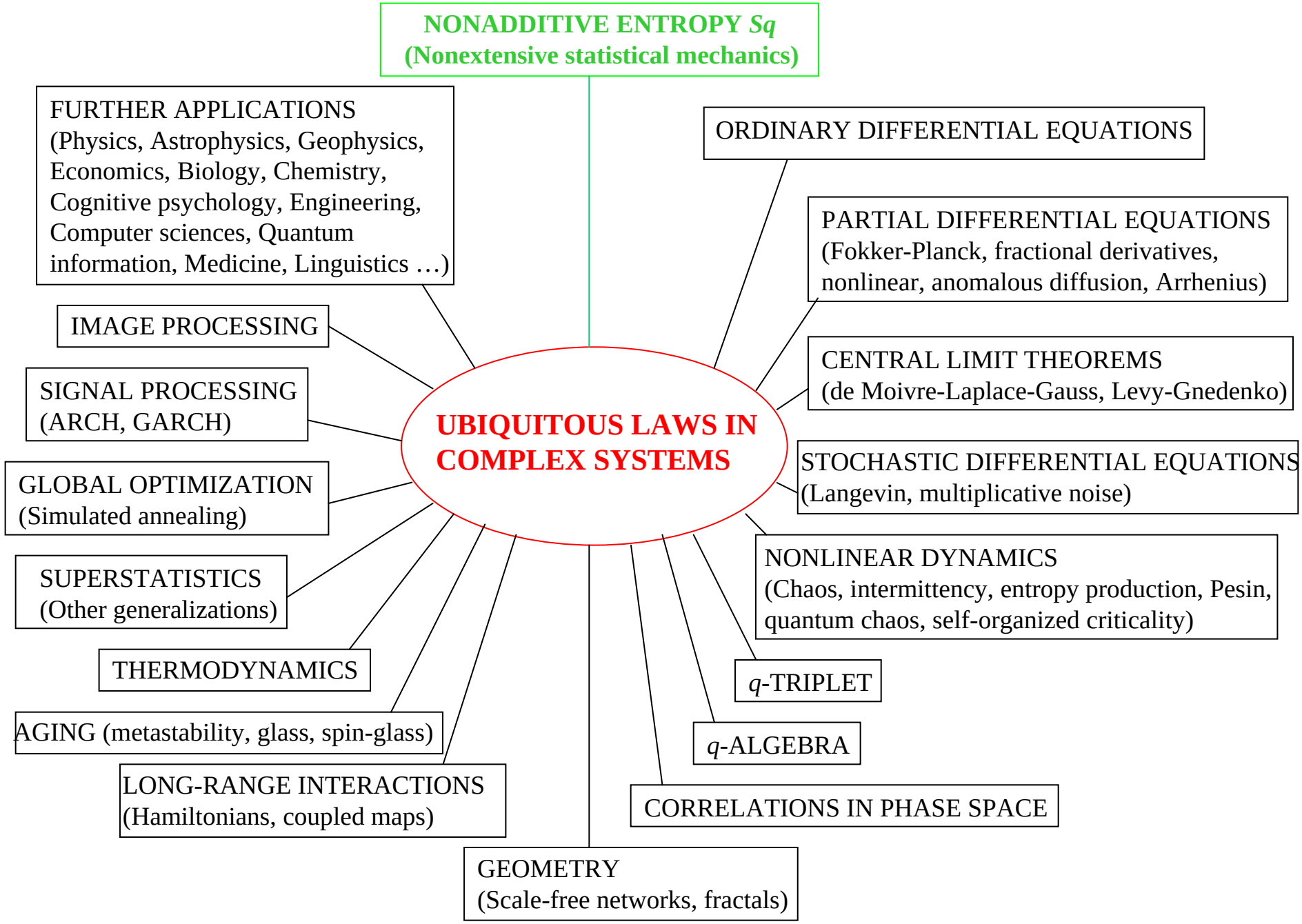
$$p^q < p \quad \text{if} \quad q > 1$$

$$p^q = p \quad \text{if} \quad q = 1 \qquad (Boltzmann - Gibbs)$$

$$S_q = k \frac{1 - \sum_{i=1}^{W} p_i^q}{q-1} \qquad (q \in \mathbb{R} \; ; \; S_1 \equiv S_{BG} = -k \sum_{i=1}^{W} p_i \ln p_i)$$

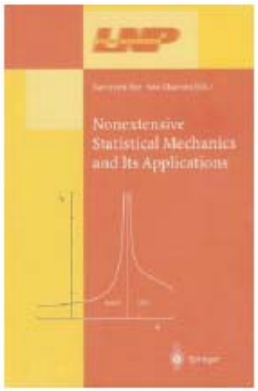
A and B independent $\Rightarrow$

$$\frac{S_q(A+B)}{k} = \frac{S_q(A)}{k} + \frac{S_q(B)}{k} + (1-q)\frac{S_q(A)}{k}\frac{S_q(B)}{k} \qquad \text{(nonadditivity)}$$


NONADDITIVE ENTROPY Sq
(Nonextensive statistical mechanics)
FURTHER APPLICATIONS
(Physics, Astrophysics, Geophysics, Economics, Biology, Chemistry, Cognitive psychology, Engineering, Computer sciences, Quantum information, Medicine, Linguistics …)
ORDINARY DIFFERENTIAL EQUATIONS
PARTIAL DIFFERENTIAL EQUATIONS
(Fokker-Planck, fractional derivatives, nonlinear, anomalous diffusion, Arrhenius)
IMAGE PROCESSING
CENTRAL LIMIT THEOREMS
(de Moivre-Laplace-Gauss, Levy-Gnedenko)
SIGNAL PROCESSING
(ARCH, GARCH)
UBIQUITOUS LAWS IN COMPLEX SYSTEMS
STOCHASTIC DIFFERENTIAL EQUATIONS
(Langevin, multiplicative noise)
GLOBAL OPTIMIZATION
(Simulated annealing)
NONLINEAR DYNAMICS
(Chaos, intermittency, entropy production, Pesin, quantum chaos, self-organized criticality)
SUPERSTATISTICS
(Other generalizations)
q-TRIPLET
THERMODYNAMICS
q-ALGEBRA
AGING (metastability, glass, spin-glass)
LONG-RANGE INTERACTIONS
(Hamiltonians, coupled maps)
CORRELATIONS IN PHASE SPACE
GEOMETRY
(Scale-free networks, fractals)

BOOKS ON NONEXTENSIVE STATISTICAL MECHANICS AND THERMODYNAMICS

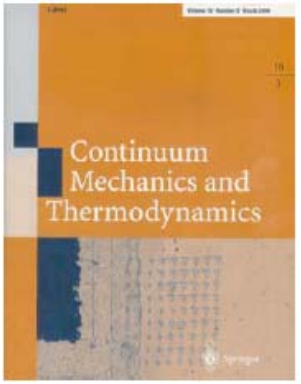
1999



2001

2002

2002



2004

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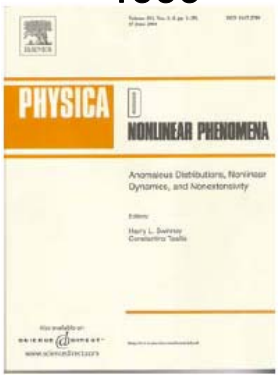

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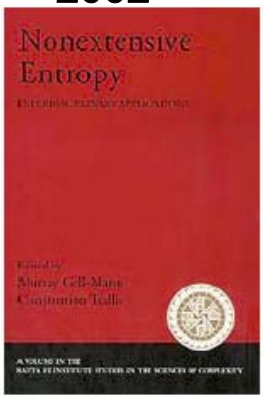

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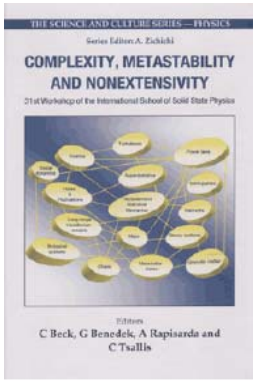
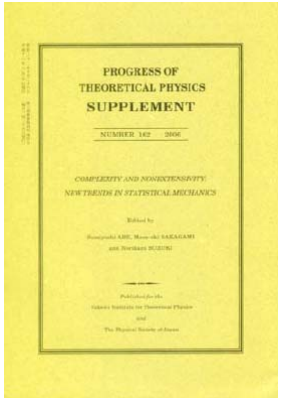


2005

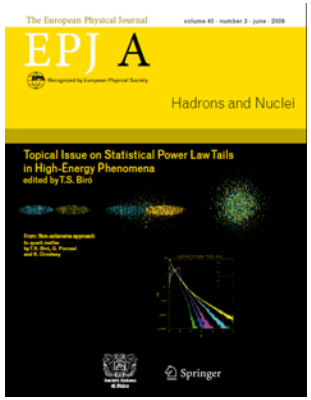
2005

2006



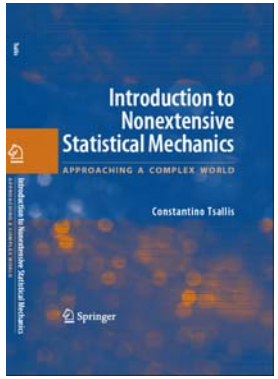
2006

2007



2009

2009



2009

Full bibliography (regularly updated):

http://tsallis.cat.cbpf.br/biblio.htm

2855 articles by 2201 scientists from 64 countries

[17 September 2009]

CONTRIBUTORS (2855 MANUSCRIPTS)

[Updated 17 September 2009]

BRAZIL	389	BELGIUM	15	BULGARIA	3
USA	312	SOUTH KOREA	15	LITHUANIA	3
CHINA	179	ISRAEL	14	SLOVENIA	3
JAPAN	160	HUNGARY	13	PUERTO RICO	3
ITALY	131	NETHERLANDS	13	CZECK	2
FRANCE	122	IRAN	12	FINLAND	2
SPAIN	91	CUBA	11	KAZAKSTAN	2
ARGENTINA	86	DENMARK	11	MOLDOVA	2
UNIT. KINGDOM	79	SOUTH AFRICA	11	PHILIPINES	2
GERMANY	68	CHILE	7	COLOMBIA	2
POLAND	49	VENEZUELA	7	ARMENIA	1
INDIA	48	ROMENIA	7	CYPRUS	1
RUSSIA	46	NORWAY	5	INDONESIA	1
CANADA	45	SINGAPORE	5	JORDAN	1
GREECE	36	CROATIA	4	MALAYSIA	1
TURKEY	35	EGYPT	4	SAUDI ARABIA	1
UKRAINE	27	IRELAND	4	SERBIA	1
AUSTRIA	24	SLOVENIA	4	SRI LANKA	1
MEXICO	22	SWEDEN	4	THAILAND	1
PORTUGAL	19	TAIWAN	4	UZBEKISTAN	1
SWITZERLAND	17	URUGUAY	4		
AUSTRALIA	15	BOLIVIA	4	64 COUNTRIES	2201 SCIENTISTS

MEPHISTOPHELES:

Denn eben wo Begriffe fehlen,

Da stellt ein Wort zur rechten Zeit sich ein.

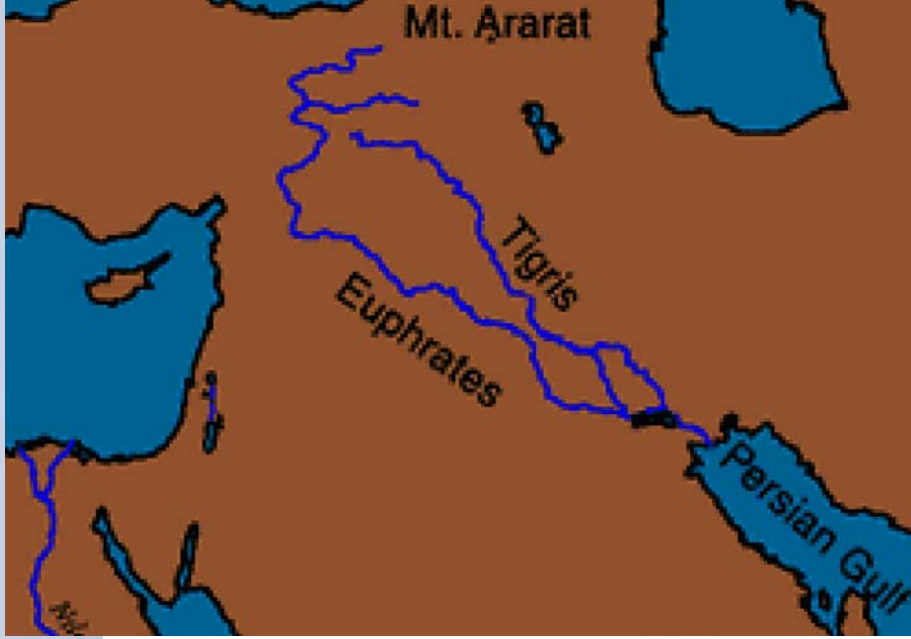
Wolfgang von Goethe

[*Faust I, Vers 1995, Schuelerszene (1808)*]

For at the point where concepts fail,

At the right time a word is thrust in there.

SYSTEMS	ENTROPY S_{BG} (additive)	ENTROPY S_q ($q<1$) (nonadditive)
Short-range interactions, weakly entangled blocks, etc	**EXTENSIVE**	**NONEXTENSIVE**
Long-range interactions (QSS), strongly entangled blocks, etc	**NONEXTENSIVE**	**EXTENSIVE**



King Thutmosis III
18th Dynasty
c. 1460 B. C.

Prediction of the q - triplet: C. T., Physica A 340,1 (2004)

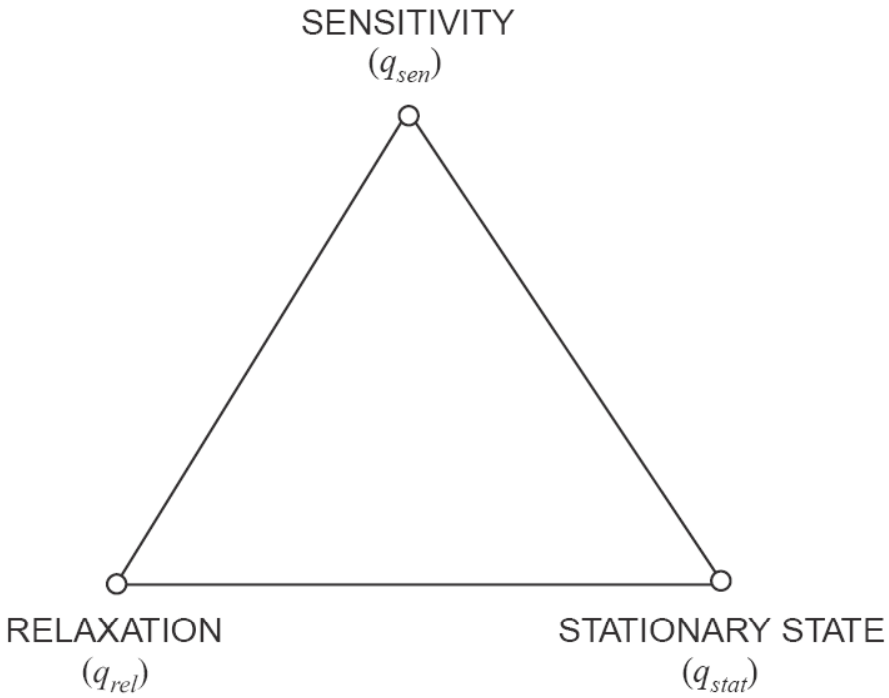


Fig. 2. The triangle of the basic values of q, namely those associated with sensitivity to the initial conditions, relaxation and stationary state. For the most relevant situations we expect $q_{sen} \leqslant 1$, $q_{rel} \geqslant 1$ and $q_{stat} \geqslant 1$. These indices are presumably inter-related since they all descend from the particular dynamical exploration that the system does of its full phase space. For example, for long-range Hamiltonian systems characterized by the decay exponent α and the dimension d, it could be that q_{stat} decreases from a value above unity (e.g., 2 or $\frac{3}{2}$) to unity when α/d increases from zero to unity. For such systems one expects relations like the (particularly simple) $q_{stat} = q_{rel} = 2 - q_{sen}$ or similar ones. In any case, it is clear that, for $\alpha/d > 1$ (i.e., when BG statistics is known to be the correct one), one has $q_{stat} = q_{rel} = q_{sen} = 1$. All the weakly chaotic systems focused on here are expected to have well defined values for q_{sen} and q_{rel}, but only those associated with a Hamiltonian are expected to *also* have a well defined value for q_{stat}.

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Triangle for the entropic index q of non-extensive statistical mechanics observed by Voyager 1 in the distant heliosphere

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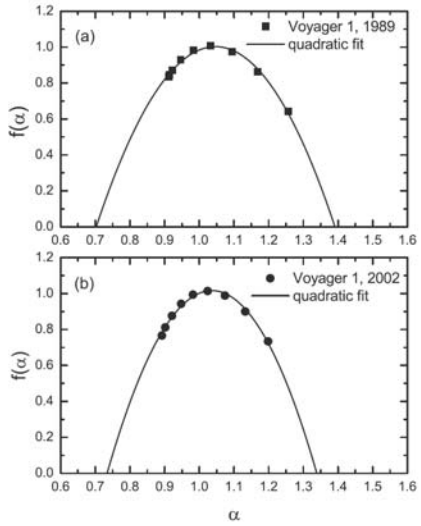
Received 10 June 2005
Available online 11 July 2005

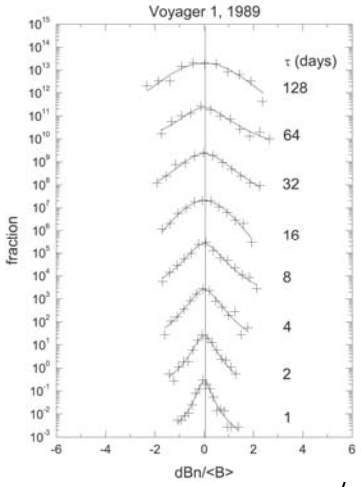
SOLAR WIND: Magnetic Field Strength

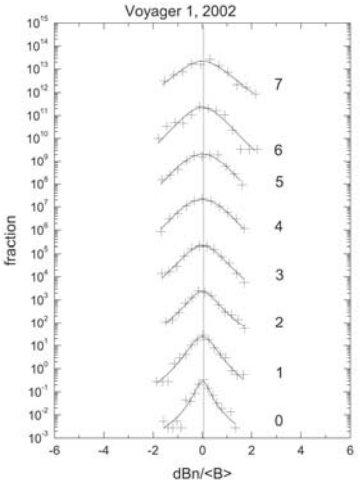
L.F. Burlaga and A. F.-Vinas (2005) / NASA Goddard Space Flight Center; Physica A **356**, 375 (2005)

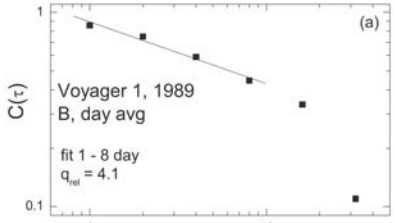
[Data: Voyager 1 spacecraft (1989 and 2002); 40 and 85 AU; daily averages]

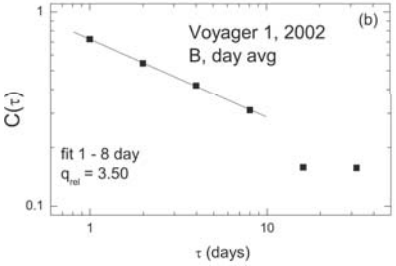


$q_{sen} = -0.6 \pm 0.2$







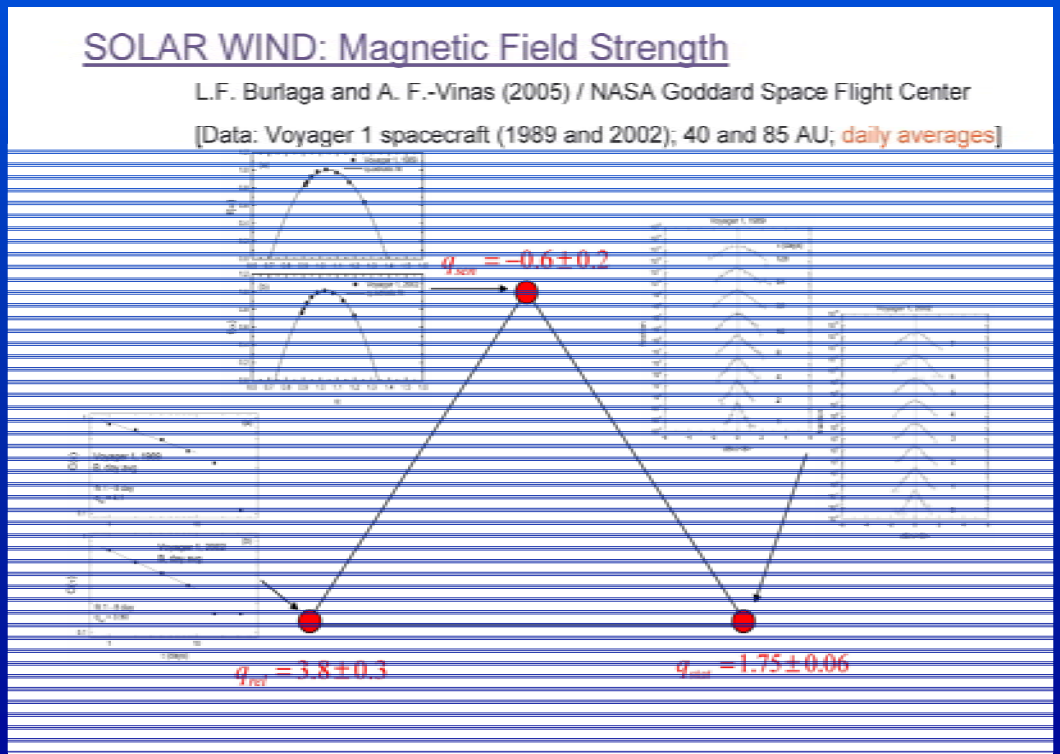


$q_{rel} = 3.8 \pm 0.3$

$q_{stat} = 1.75 \pm 0.06$

IHY 2007: VOYAGER 1: Fundamental Physics

The atmosphere of the Sun beyond a few solar radii, known as HELIOSPHERE, is fully ionized plasma expanding at supersonic speeds, carrying solar magnetic fields with it. This solar wind is a driven non-linear non-equilibrium system. The Sun injects matter, momentum, energy, and magnetic fields into the heliosphere in a highly variable way. Voyager 1 observed magnetic field strength variations in the solar wind near 40 AU during 1989 and near 85 AU during 2002. Tsallis' non-extensive statistical mechanics, a generalization of Boltzmann-Gibbs statistical mechanics, allows a physical explanation of these magnetic field strength variations in terms of departure from thermodynamic equilibrium in an unique way:



Playing with additive duality $(q \to 2-q)$

and with multiplicative duality $(q \to 1/q)$

(*and using numerical results related to the* $q-$*generalized central limit theorem*)

we conjecture

$$q_{rel} + \frac{1}{q_{sen}} = 2 \qquad \textit{and} \qquad q_{stat} + \frac{1}{q_{rel}} = 2$$

hence $$1 - q_{sen} = \frac{1 - q_{stat}}{3 - 2\, q_{stat}}$$

hence only one independent!

Burlaga and Vinas (*NASA*) *most precise value of the* $q-$*triplet is*

$$q_{stat} = 1.75 = 7/4$$

hence $q_{sen} = -\,0.5 = -\,1/2$ (*consistent with* $q_{sen} = -0.6 \pm 0.2$!)

and $q_{rel} = 4$ (*consistent with* $q_{rel} = 3.8 \pm 0.3$!)

C.T., M. Gell-Mann and Y. Sato, Proc Natl Acad Sc USA **102**, 15377 (2005)

$$\varepsilon_{sen} \equiv 1 - q_{sen} = 1 - (-1/2) = 3/2$$

$$\varepsilon_{rel} \equiv 1 - q_{rel} = 1 - 4 = -3$$

$$\varepsilon_{stat} \equiv 1 - q_{stat} = 1 - 7/4 = -3/4$$

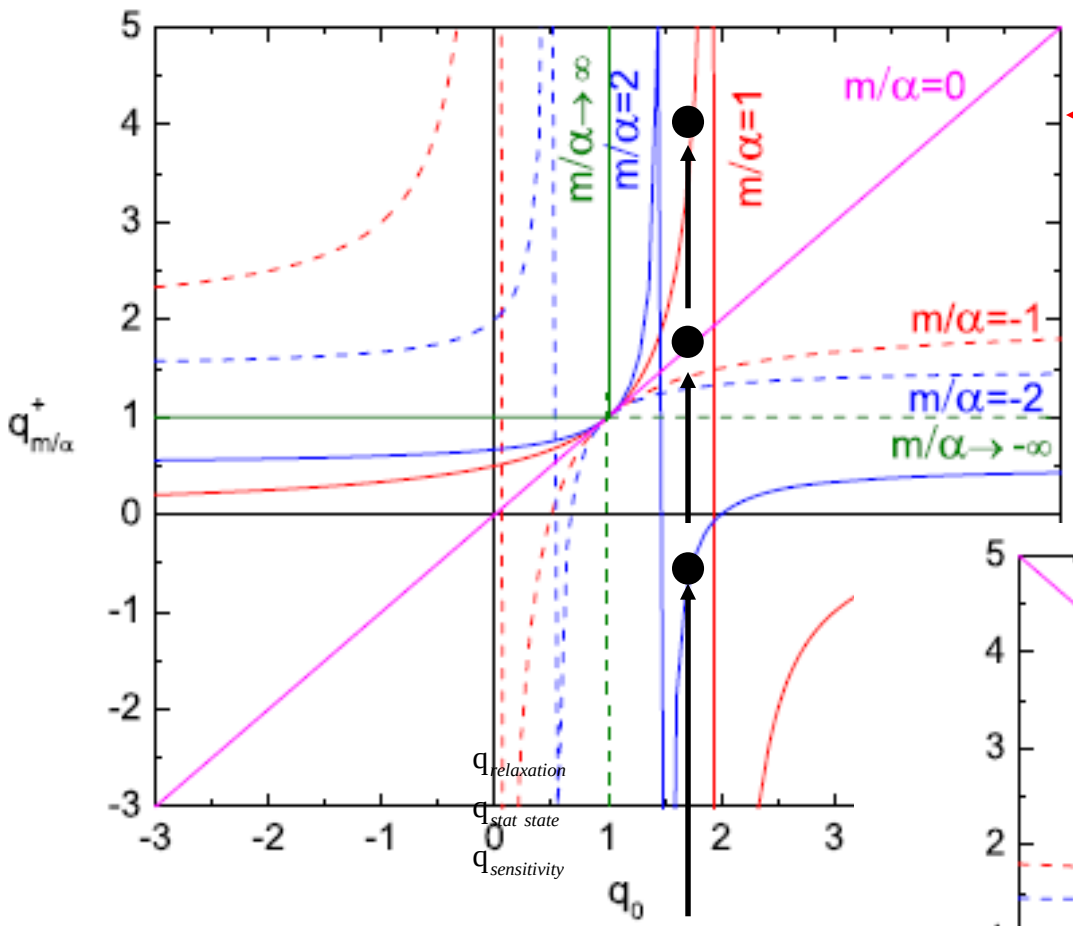
We verify

$$\varepsilon_{stat} = \frac{\varepsilon_{sen} + \varepsilon_{rel}}{2} \quad \text{(arithmetic mean!)}$$

$$\varepsilon_{sen} = \sqrt{\varepsilon_{stat}\ \varepsilon_{rel}} \quad \text{(geometric mean!)}$$

$$\varepsilon_{rel}^{-1} = \frac{\varepsilon_{sen}^{-1} + \varepsilon_{stat}^{-1}}{2} \quad \text{(harmonic mean!)}$$

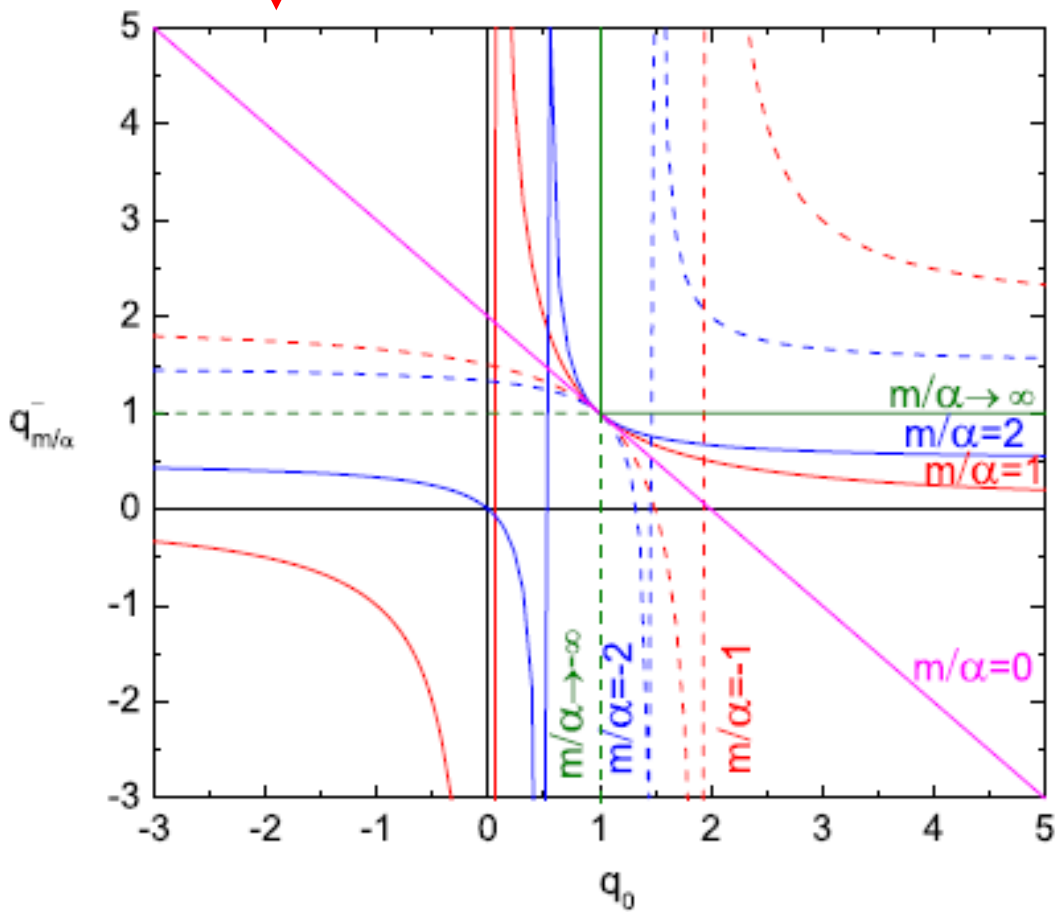
N.O. Baella (2008)



$$\frac{1}{1-q^{+}_{m/\alpha}} = \frac{1}{1-q_0} + \frac{m}{\alpha}$$

$$\frac{1}{1-q^{-}_{m/\alpha}} = \frac{1}{q_0-1} + \frac{m}{\alpha}$$

$$(0 < \alpha \le 2;\ m = 0, \pm 1, \pm 2, \ldots)$$



solar wind q-triplet

$q_{relaxation}$

$q_{stat\ state}$

$q_{sensitivity}$

C. T., Braz J Phys **39**, 337(2009)

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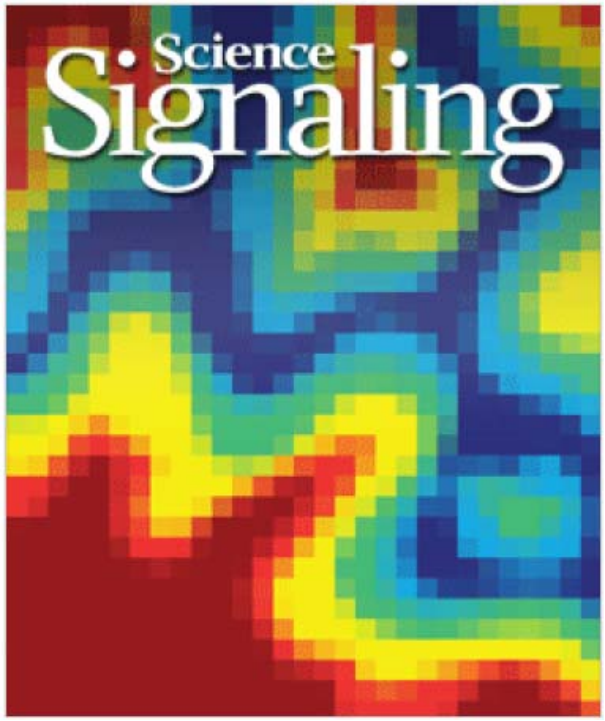
Science Signaling The signal transduction knowledge environment



[1]Department of Chemistry and Biochemistry, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093–0505, USA. [2]San Diego Supercomputer Center, University of California, San Diego, La Jolla, CA 92093–0505, USA. [3]Department of Medicine, School of Medicine, University of California, San Diego, La Jolla, CA 92093–0693, USA. [4]Department of Pediatrics, School of Medicine, University of California, San Diego, La Jolla, CA 92093–0693, USA. [5]Department of Cellular and Molecular Medicine, University of California, San Diego, La Jolla, CA 92093–0693, USA. [6]John and Rebecca Moores UCSD Cancer Center, School of Medicine, University of California, San Diego, La Jolla, CA 92093–0693, USA.

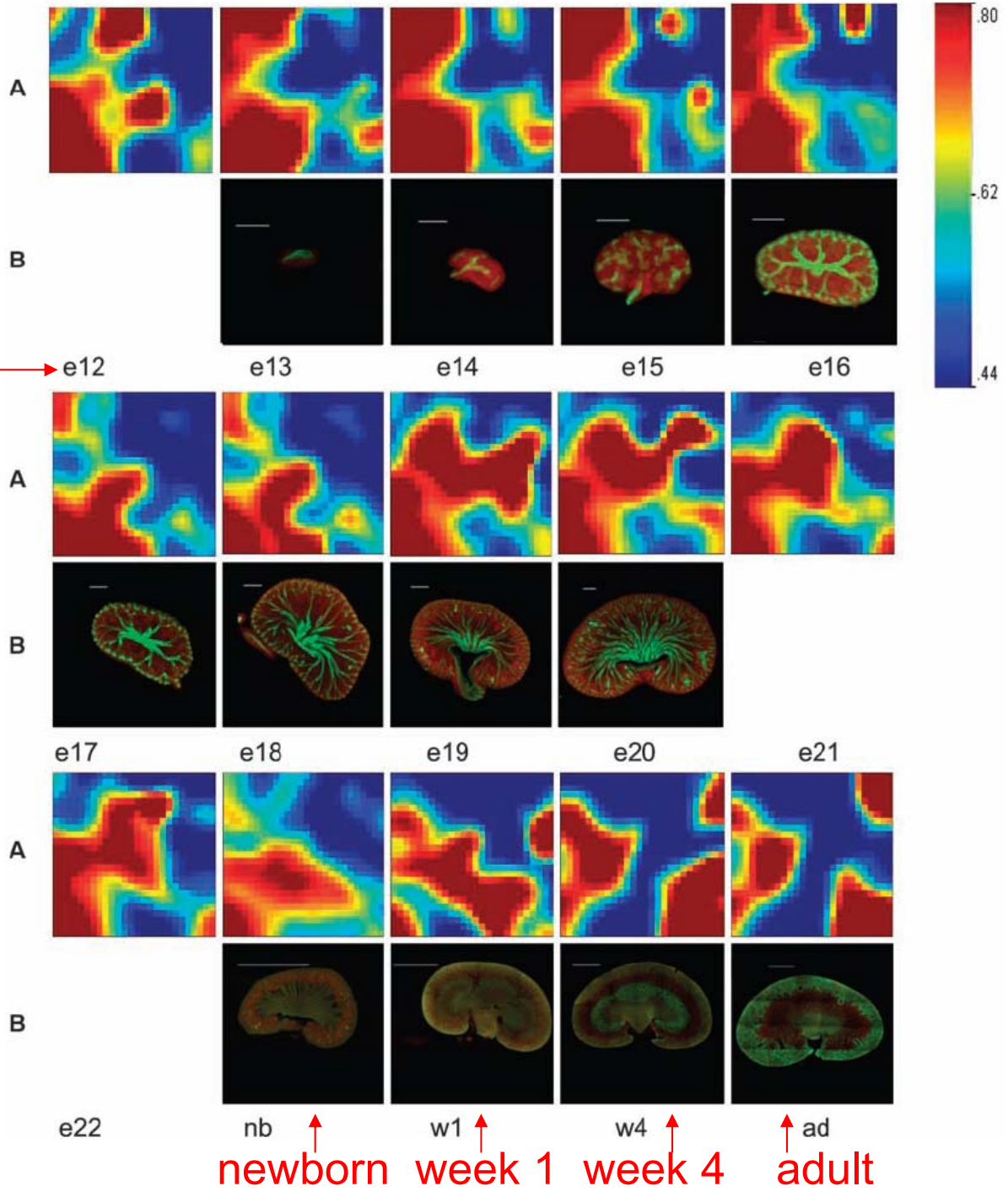
Analysis of Metagene Portraits Reveals Distinct Transitions During Kidney Organogenesis

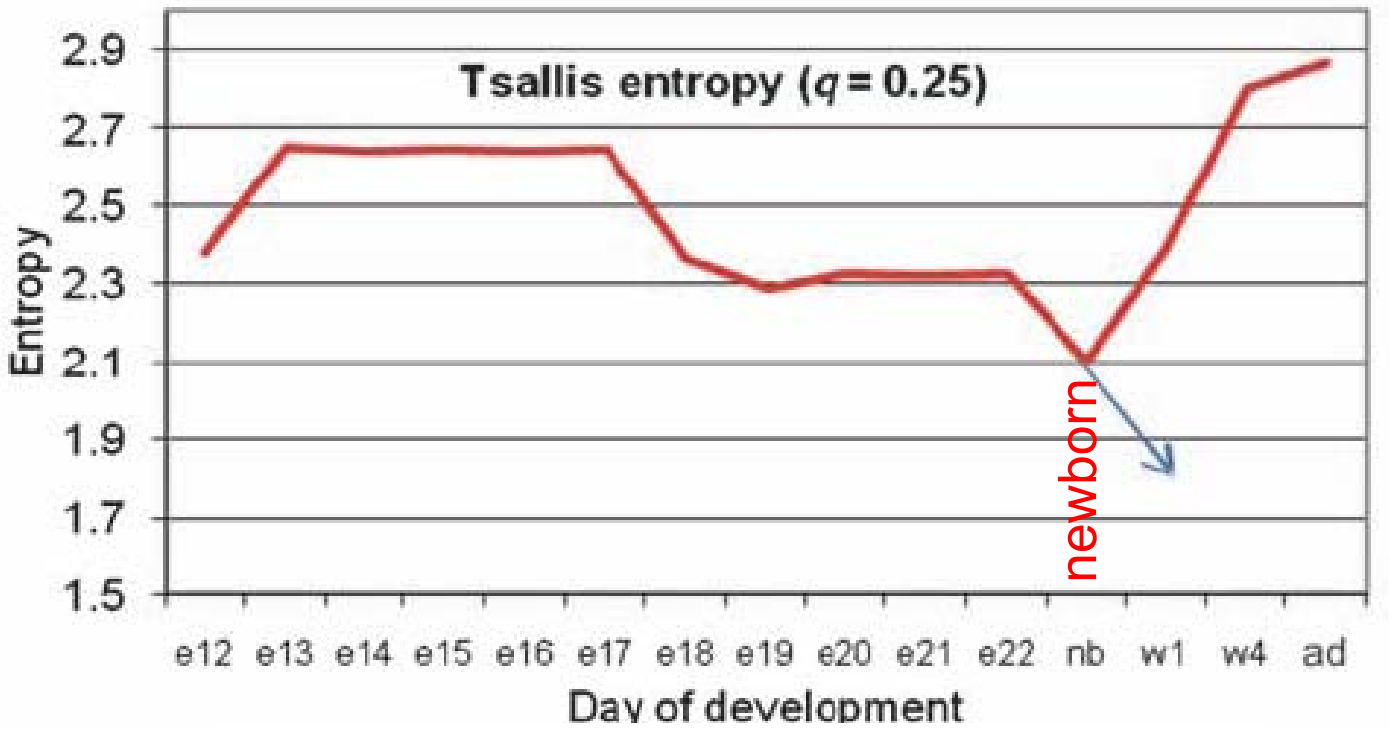
Igor F. Tsigelny,[1,2*†] Valentina L. Kouznetsova,[3†] Derina E. Sweeney,[3] Wei Wu,[3] Kevin T. Bush,[3] Sanjay K. Nigam[3,4,5,6*]

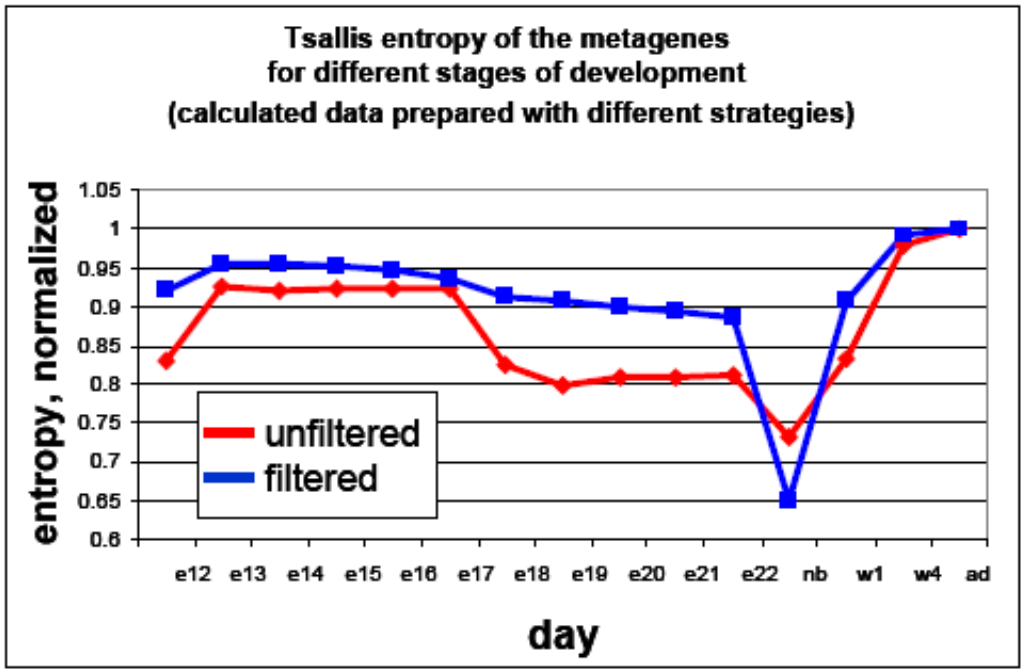
(Published 9 December 2008; Volume 1 Issue 49 ra16)

METAGENE MOSAICS (self-organizing maps)

MORPHOGENETIC STAGES




Tsallis entropy (q = 0.25)
Entropy
2.9
2.7
2.5
2.3
2.1
1.9
1.7
1.5
newborn
e12 e13 e14 e15 e16 e17 e18 e19 e20 e21 e22 nb w1 w4 ad
Day of development


Tsallis entropy of the metagenes
for different stages of development
(calculated data prepared with different strategies)
entropy, normalized
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
unfiltered
filtered
e12 e13 e14 e15 e16 e17 e18 e19 e20 e21 e22 nb w1 w4 ad
day

FACIAL EXPRESSION RECOGNITION USING ADVANCED LOCAL BINARY PATTERNS, TSALLIS ENTROPIES AND GLOBAL APPEARANCE FEATURES

Shu Liao[1,2], *Wei Fan*[2], *Albert C. S. Chung*[1,2] *and Dit-Yan Yeung*[2]

[1]Lo Kwee-Seong Medical Image Analysis Laboratory
and [2]Department of Computer Science and Engineering,
The Hong Kong University of Science and Technology, Hong Kong.

Fig. 4. *Some sample images from the JAFFE database*

[2006 IEEE International Conference on Image Processing, pages 665 – 668]

Features	Classification Accuracy %
AMGFR [15]	82.46
LBP [6]	85.57
ALBP	88.26
Tsallis	85.36
ALBP + Tsallis	91.89
ALBP + Tsallis + NLDAI	94.59

Table 2. *Performance comparison of different approaches with resolution level 64×64 for the images from the JAFFE database*

Features	Classification accuracy (%)		
	48×48	32×32	16×16
AMGFR [15]	78.13	67.83	56.35
LBP [6]	81.44	77.28	68.02
ALBP	84.27	82.74	75.39
Tsallis	79.25	71.04	63.81
ALBP + Tsallis	87.31	85.73	80.40
ALBP + Tsallis + NLDAI	90.54	88.82	84.62

Table 3. *Performance comparison of different approaches with resolution levels 48×48, 32×32 and 16×16 for the images from the JAFFE database*

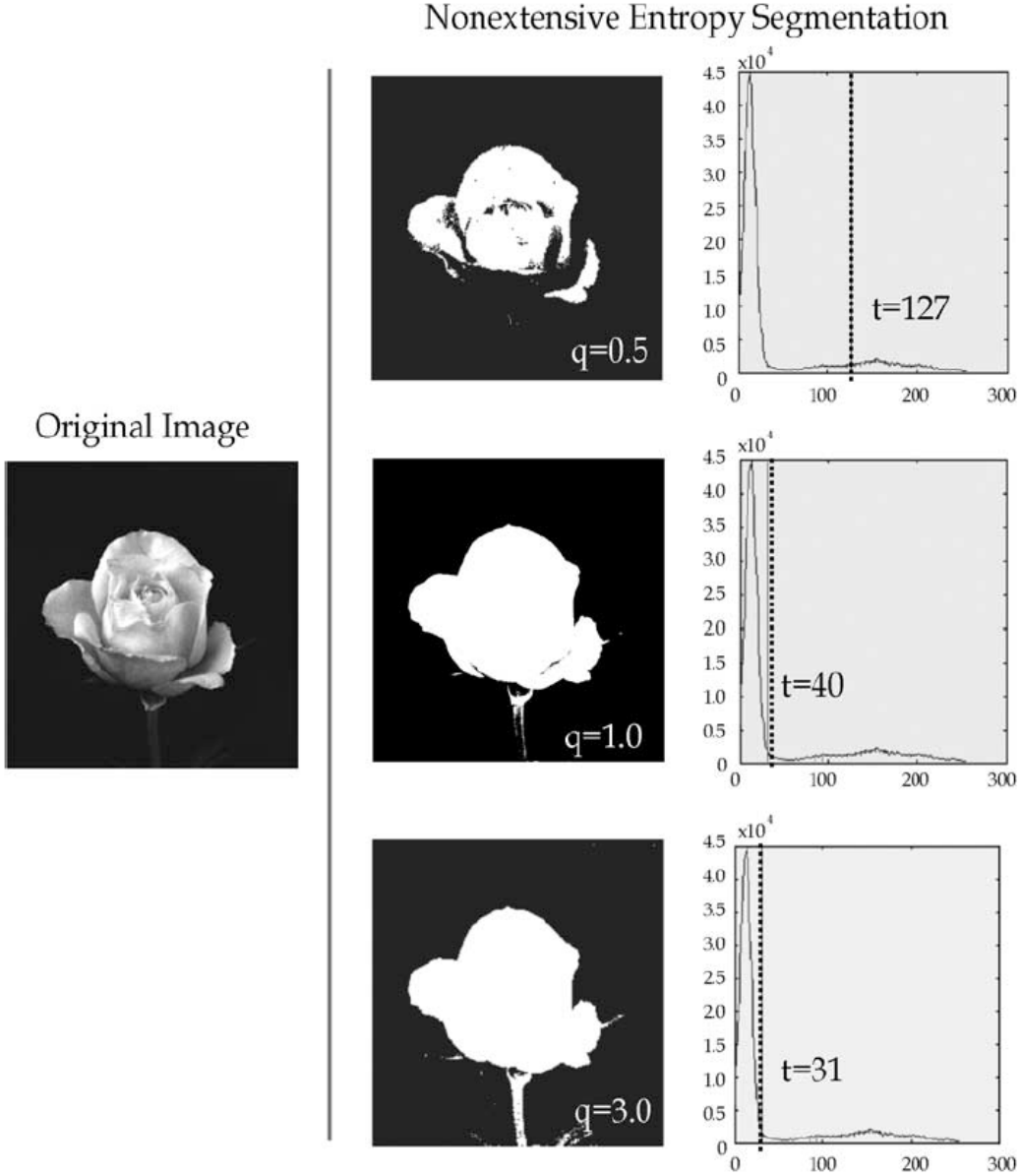
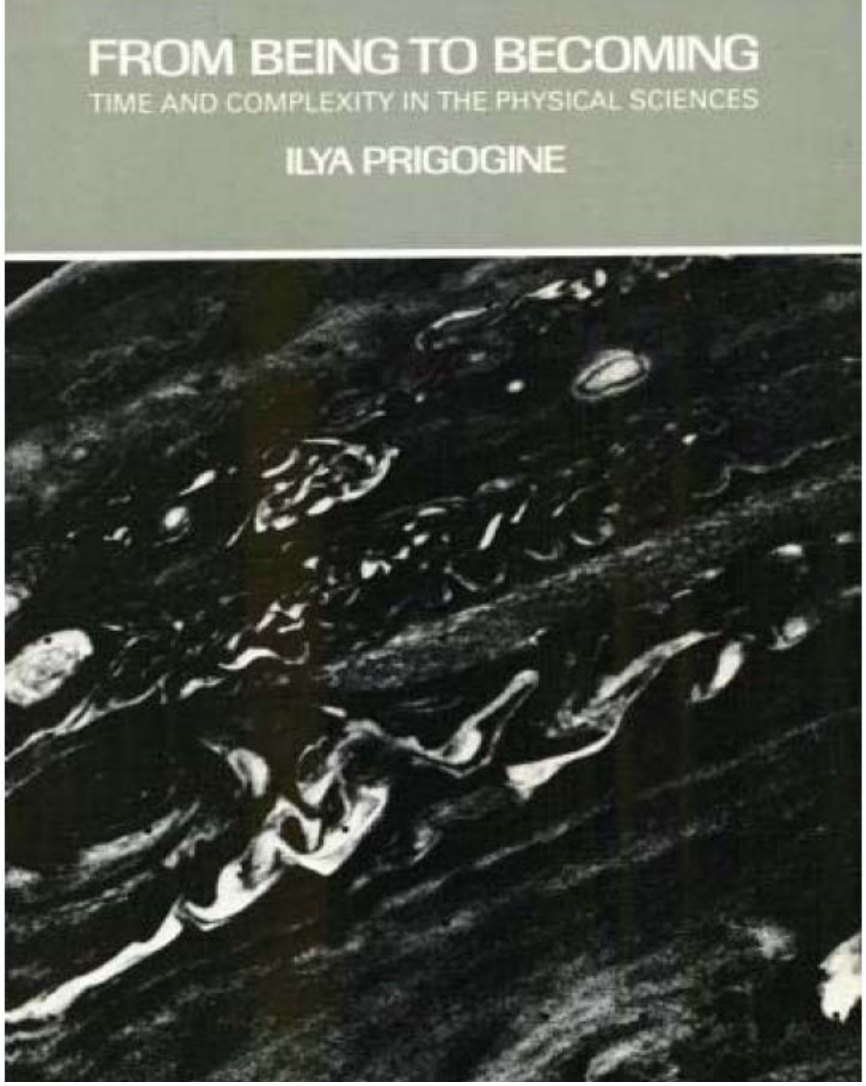


Fig. 4. Influence of parameter q in natural images: $q = 0.5$, $q = 1.0$ (classical entropic segmentation) and $q = 3.0$.

M.P. de Albuquerque, I.A. Esquef, A.R.G. Mello and M.P. de Albuquerque
Pattern Recognition Letters **25**, 1059 (2004)



Statistical mechanics of *BEING*

→ Boltzmann-Gibbs statistical mechanics $(q = 1)$

Statistical mechanics of *BECOMING*

→ Nonextensive statistical mechanics $(q \neq 1)$

$q = 1$ statistical mechanics :

Non, je ne regrette rien…
balayé, oublié, je me fous du passé…

Edith Piaf

$q \neq 1$ statistical mechanics :

Je me souviens

Québec

Sofia e la scoperta delle fragole (Marco Bersanelli)

A Gutenberg, tra le verdissime colline austriache, una mattina saliamo per il sentiero che attraversa il bosco scuro e profumato alle spalle del paese. Dopo mezz'ora di cammino troviamo sulla destra una sorgente presso una radura e ci fermiamo a bere. Con una grande espressione di felicità ad un tratto Sofia, la piccola di tre anni, esclama: «Mamma, mamma!! una fragola!!». Gli altri due accorrono e, constatato che la sorellina ha prontamente raccolto e inghiottito il frutto della sua scoperta, si mettono a cercare, presto seguiti dai genitori. «Un'altra!» e dopo un po': «Guarda qui, ce ne sono altre tre, quattro...». La caccia è aperta. Cercando in quel prato abbiamo presto riempito un bicchiere di fragole di bosco. Poi al ritorno, con mia sincera sorpresa, ripercorrendo lo stesso sentiero dalla sorgente in giù ne abbiamo trovate altrettante! Zero fragole all'andata, forse un centinaio al ritorno: un effetto statisticamente schiacciante. Cos'era cambiato?

Sofia e la scoperta delle fragole (Marco Bersanelli)

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Eravamo cambiati noi.

Introduction to Nonextensive Statistical Mechanics

APPROACHING A COMPLEX WORLD

Constantino Tsallis

Springer

1. Title: POSSIBLE GENERALIZATION OF BOLTZMANN-GIBBS STATISTICS
Author(s): TSALLIS C
Source: **JOURNAL OF STATISTICAL PHYSICS** Volume: **52** Issue: **1-2** Pages: **479-487** Published: **JUL 1988**
Times Cited: **2,035**
Full Text

12 Julho 2009