



PONTIFICIA UNIVERSITAS LATERANENSIS

# Teorie dell'informazione semantica

---

## Significato, essere verità

**Gianfranco Basti**

[basti@pul.it](mailto:basti@pul.it)

Facoltà di Filosofia

[www.stoqatpul.org](http://www.stoqatpul.org)



Introduzione

# TRE PREMESSE: ONTOLOGICA, FISICA, MATEMATICA,



Ontologica

# DA UNA VISIONE ATOMISTA AD UNA DINAMICISTA

# Carattere “duale” della realtà fisica (QFT)

- Fine del paradigma newtoniano del corpo fisico come particella che si muove nel vuoto meccanico:
  1. Nozione di “vuoto quantistico” (Terzo Principio della Termodinamica)
  2. Distinzione energia-informazione (bosoni di gauge *versus* bosoni di Goldman)
- Prigogine: Dal paradigma meccanicista (Democrito) al paradigma ilemorfico (Aristotele): enti come composizione di forma-materia (coerentizzazioni locali dell materia prima come **δυναμις** (“essere finito eppure sempre diverso”) e non come la statica **κωφα** platonica (“sabbia”).





Fisica

# DALLA QM ALLA QFT

# Principio di Heisenberg: Versione “nobile”

$$\Delta n \Delta \varphi \geq h$$

dove  $n$  è il numero di quanti del campo, e  $\varphi$  è la fase del campo. Possiamo considerare due casi estremi di grande interesse:

a)  $\Delta n=0$  e  $\varphi$  totalmente indefinita: questo corrisponde al caso in cui non è possibile definire una fase precisa con un numero di quanti ben definito, ed è dunque legittimo trascurare gli aspetti ondulatori in favore di quelli particellari;

b)  $\Delta \varphi=0$  ed  $n$  indefinito: è il caso in cui un numero estremamente alto di quanti oscillano assieme secondo una ben definita fase di oscillazione. Sono questi i fondamentali *domini di coerenza*, sui quali ritorneremo più avanti, e gli aspetti ondulatori hanno la prevalenza su quelli particellari.



# Accelerazioni nel vuoto: effetto Fulling–Davies–Unruh

INSTITUTE OF PHYSICS PUBLISHING

JOURNAL OF OPTICS B

J. Opt. B: Quantum Semiclass. Opt. 7 (2005) S40–S46

## Quantum vacuum friction

P C W Davies

Australian Centre for Astrobiology, Macquarie University, New South Wales, 2109, Australia

Received 25 October 2004, accepted for publication 7 December 2004

Published 1 March 2005

Online at [stacks.iop.org/JOptB/7/S40](http://stacks.iop.org/JOptB/7/S40)

### Abstract

The quantum vacuum may in certain circumstances be regarded as a type of fluid medium, or aether, exhibiting energy density, pressure, stress and friction. Vacuum friction may be thought of as being responsible for the spontaneous creation of particles from the vacuum state when the system is non-stationary. Examples include the expanding universe, rotating black holes, moving mirrors, atoms passing close to surfaces, and the activities of sub-cellular biosystems. The concept of vacuum friction will be reviewed and illustrated, and some suggestions for future experiments made.

$$T = \frac{\hbar a}{2\pi c k}$$



**La funzione d'onda della MQ non è altro che un sottile  
“ricoprimento statistico” dei processi “fini” descritti  
dalla QFT!**

---



?

Ma il punto sul quale vogliamo soffermarci riguarda il **concetto di “collettività”**. Nell'esempio fatto lo stato **coerente e cooperativo** va inteso in senso molto forte, come una **perdita dell'individualità particellare** (cosa sperimentalmente ben nota in fenomeni come la superconduttività, la superfluidità, e che non c'è dunque alcun motivo di negare all'onda elettronica del classico esperimento di diffrazione in MQ), a favore di un comportamento di campo. In questo senso, ***l'approccio della QFT è profondamente sistemico e non riduzionistico***, perché il comportamento ondulatorio e quello particellare smettono di l'essere caratteristiche fondamentali, ma dipendono dal bilancio energetico globale del sistema, e si ha una **transizione da una cadenza temporale ( l'oscillazione di fase) ad una scansione spaziale ( formazione del dominio)**.





Available online at [www.sciencedirect.com](http://www.sciencedirect.com)



Annals of Physics 305 (2003) 83–95

---

---

*ANNALS*  
*of*  
*PHYSICS*

---

---

[www.elsevier.com/locate/aop](http://www.elsevier.com/locate/aop)

# Field quantization and wave particle duality

M. Cini

*Dipartimento di Fisica, Roma Istituto Nazionale di Struttura della Materia,  
Università La Sapienza, Rome, Italy*

Received 6 November 2002



ality is no longer a puzzling phenomenon. The wave particle duality is instead, in this new perspective, only the manifestation of two complementary aspects (continuity vs. discontinuity) of an intrinsically nonlocal physical entity (the field) which objectively exists in ordinary three-dimensional space. This theory, in which the field's statistical properties are represented by Wigner pseudoprobabilities deduced without any reference to Schrödinger wave functions, is based on two postulates. The first one is the requirement of invariance under canonical transformations of the probability distributions of a classical statistical description of the field's state. This invariance leads to an uncertainty relation for the conjugated variables of the field's oscillators. The second postulate is quantization. This means to assume that the intensity of each monochromatic wave should only have discrete values instead of the continuous range allowed by the classical theory. These two postulates can be satisfied only if the system's physical variables are represented by noncommuting numbers. In this way what is generally assumed as a basic mathematical postulate in the standard formulation of quantum mechanics, follows from the physical postulates of the theory.

© 2003 Elsevier Science (USA). All rights reserved.



This deduction from first principles of the Wigner–Feynman pseudoprobabilities may help in increasing the consensus currently acquired in some domains of physics such as quantum optics [7] (leading even to a proposal for their experimental determination [8]) on their use as the most adequate representation of the random character of quantum phenomena. Finally, the direct deduction of Wigner functions from first principles solves a puzzling unanswered question which has been worrying all the beginners approaching the study of our fundamental theory of matter, all along its 75 years of life, namely “Why should one take the modulus square of a wave amplitude in order to obtain the corresponding probability?” We can now say that there is no longer need of an answer, because there is no longer need to ask the question.

## DOMAINS IN AQUEOUS SOLUTIONS: THEORY AND EXPERIMENTAL EVIDENCE

CARMI A. YINNON

*The Fritz Haber Center for Molecular Dynamics,  
The Hebrew University of Jerusalem, Jerusalem 91904, Israel*

TAMAR A. YINNON

*L. Water Center, K. Kalia, D.N. Kikar Jordan 90666, Israel  
lwcdsrc@kalia.org.il*

Received 22 September 2008

Revised 2 January 2009

Experimentally observed aggregates in under-saturated aqueous solutions are analyzed. Aggregates studied include: 0.5 to 6 micrometer-sized domains composed of solvated strong electrolyte ions, organic- or bio-molecules; clusters of up to 280 water molecules.

Hitherto, the customary electrostatic (ES) theories could not explain the formation of these large aggregates. Recently, it was shown that quantum electrodynamic (QED) interactions might affect the structure of solutions. Our analysis indicates that these interactions cause the observed aggregations.

We found the observed aggregate characteristics conform to those of QED coherent domains. For example, QED predicts that dilution, e.g. from 2 M to 1 M, causes an increase of several hundred percent in the size of domains composed of solvated coherently oscillating molecules or ions. For solutions of DNA or NaCl, the measured cluster size as a function of concentration is available in the literature. We found it to be in agreement with the QED predictions.

*Keywords:* Coherent domains; quantum electro-dynamics; aggregates; clusters; aqueous solutions.





Matematica

# PROBABILITÀ E QUASI- PROBABILITÀ

# Assiomi della Teoria della Probabilità

## First axiom

The probability of an event is a non-negative real number:

$$P(E) \in \mathbb{R}, P(E) \geq 0 \quad \forall E \in \mathcal{F}$$

where  $\mathcal{F}$  is the event space and  $E$  is any event in  $\mathcal{F}$ . In particular,  $P(E)$  is always finite, in contrast with more general [measure theory](#). Theories which assign [negative probability](#) relax the first axiom.

## Second axiom

*See also: Unitarity (physics)*

This is the assumption of **unit measure**: that the probability that some [elementary event](#) in the entire sample space will occur is 1. More specifically, there are no elementary events outside the sample space.

$$P(\Omega) = 1.$$

This is often overlooked in some mistaken probability calculations; if you cannot precisely define the whole sample space, then the probability of any subset cannot be defined either.

## Third axiom

This is the assumption of  $\sigma$ -[additivity](#):

Any [countable](#) sequence of [pairwise disjoint](#) (synonymous with *mutually exclusive*) events  $E_1, E_2, \dots$  satisfies

$$P(E_1 \cup E_2 \cup \dots) = \sum_{i=1}^{\infty} P(E_i).$$

Some authors consider merely [finitely additive](#) probability spaces, in which case one just needs an [algebra of sets](#), rather than a  $\sigma$ -algebra. [Quasiprobability distributions](#) in general relax the third axiom.

# Assiomi della Teoria della Quasi-Probabilità

- A **quasiprobability distribution** is a mathematical object similar to a probability distribution but relaxing some of the axioms of probability theory. Although quasiprobabilities share many of the same general features of ordinary probabilities such as the ability to take expectation values with respect to the weights of the distribution, they all violate the third probability axiom because regions integrated under them do not represent probabilities of mutually exclusive states. To compensate, some quasiprobability distributions also counterintuitively have regions of negative probability density, contradicting the first axiom.





Informazione sintattica, semantica, pragmatica

# **DUE PARADIGMI DI INFORMAZIONE SEMANTICA**

# Analisi logica: tripartizione dell'analisi logica delle teorie

## ■ Tripartizione dell'analisi logica

1. **Analisi sintattica:** senso  $\leftarrow$  relazione con le altre parti del linguaggio (grammatica, logica formale)  $\rightarrow$  *coerenza*
2. **Analisi semantica:** senso  $\leftarrow$  relazione con il contenuto delle espressioni linguistiche (teoria dei modelli, logica materiale)  $\rightarrow$  *verità*
3. **Analisi pragmatica:** senso  $\leftarrow$  relazione con gli agenti della comunicazione e all'interazione col mondo esterno (dialettica)  $\rightarrow$  *efficacia*

## ■ $\rightarrow$ Tripartizione nozione di informazione



# Nozione multivoca di informazione

---

- The word 'information' has been given different meanings by various writers in the general field of information theory. It is likely that at least a number of these will prove to be useful in certain applications to deserve further study and permanent recognition. It is hardly to be expected that a single concept of information would satisfactorily account for the numerous possible applications of the general field (Shannon 1950, p.80).



# Tripartizione Teoria dell'Informazione

---

- (1) technical problems concerning the quantification of information and dealt with by Shannon's theory
- (2) semantic problems relating to meaning and truth; and
- (3) what he called “influential” problems concerning the impact and effectiveness of information on human behaviour, which he thought had to play an equally important role (Shannon Weaver, 1949).



# Bipartizione della teoria semantica informazione (TSI: Floridi)

---

- 1) Fattuale o rappresentazionale: nozione di verità semantica
- 2) Istruzionale o computazionale: nozione di verità prammatica (logica dinamica come logica della programmazione in *computer science*)
  - Informazione biologica (genetica e neurale)



# CSI e Paradosso di Bar-Hillel & Carnap (BHC)

---

- **CSI** (Bar-Hillel and Carnap, *op. cit.*) is *semantic information* precisely because it is concerned with the information contained in the content of a sentence, as opposed to the surprise value of receiving a message (which is the subject matter of Shannon and Weaver's (1948) *mathematical theory of communication* (**MTC**)).

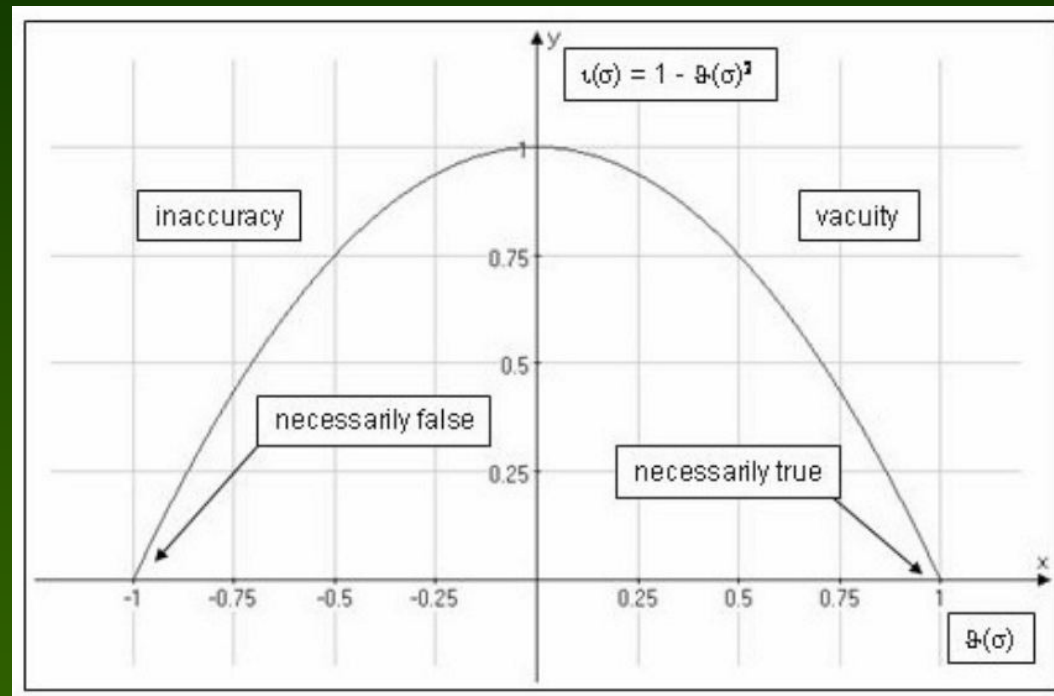


# Teoria intensionale di BHC

- Bar-Hillel and Carnap built **CSI** around a monadic predicate language. The number of possible worlds is calculated accordingly. Where there are  $n$  individual constants (standing for  $n$  individuals) and  $m$  primitive monadic predicates, the number of atomic sentences will be  $nm$ , the number of possible worlds  $2^{nm}$ , and the number of “Q-predicators”  $2^m$  (Q-predicators are individuations of possible types of objects given a conjunction of predicates whereby each primitive predicate occurs either negated or un-negated (but not both)). A full sentence of a Q-predicator is a Q-sentence where a predicate is attached to a term. Hence a possible world is a conjunction of  $n$  Q sentences as each Q sentence describes a possibly existing individual.



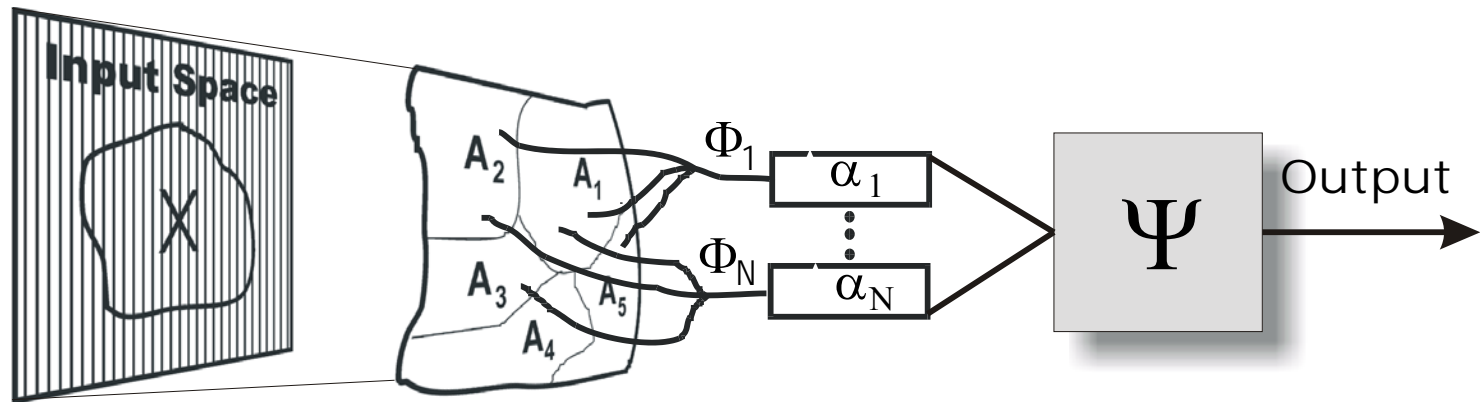
# Distribuzione di Floridi



- (T) there may or may not be some guests for dinner tonight; or
- (V) there will be some guests tonight; or
- (P) there will be three guests tonight.

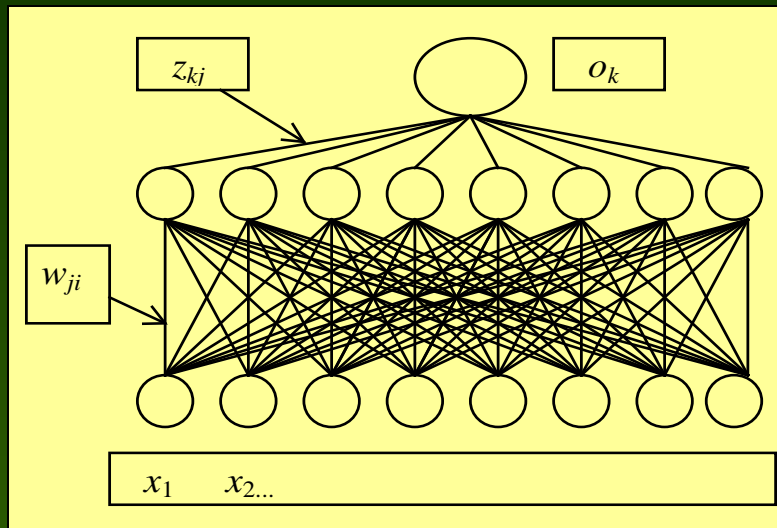
# Implementazione dinamica via QFT del Perceptrone Dinamico

## 1) Il Perceptrone Geometrico di Rosenblatt

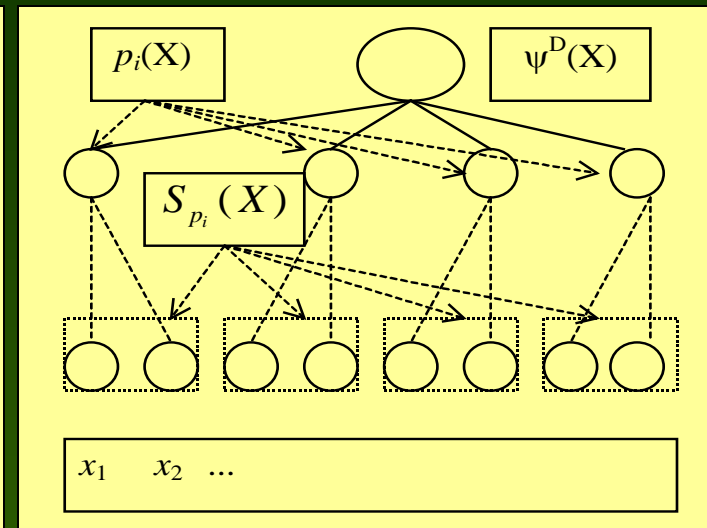


Impossibility of parallel calculus in this architecture  
(Minsky & Papert (1988))

# Scheme of Dynamic Perceptron (DP)



2)a. Back Propagation



b. Perceptrone Dinamico

Neurophysiological evidence: retina (Tsukada 1998), auditory cortex (Eggermont *et al.* 1981; Kilgard e Merzenich 1998) primary visual cortex (Dinse 1990; 1994) speech control (recycling neurons: Dehaene 2005; 2009).