physics:Spatio-temporal correlations quantum mechanics

January 8, 2024

1 On "agential realism" and ontology of quantum mechanics

Francois-Igor Pris

Metadata

ID: http://arxiv.org/abs/2307.12993v1
UPDATED: 2023-07-21T10:26:14Z
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physics.hist-ph :: 5 pages

Summary

K. Barad proposes "agential realism" as a unified approach to natural and social phenomena. The position is inspired by quantum mechanics and in particular the phenomenon of quantum entanglement. Barad also sees similarities between her approach, N. Bohr's view and C. Rovelli's relational quantum mechanics. In our view, agential realism is a kind of ontological correlationism, not a realism. The analogy with the Bohr and Rovelli approaches is only partial. Agential realism is a wrong interpretation of quantum mechanics. It is also unsuitable for social theorizing, for which taking into account the sensitivity of ontology to the context is fundamental. As an alternative, we propose a contextual quantum realism that rejects substantive dualisms (as does Barad), but at the same time accepts the categorical dualism of the real and the ideal. Our approach also allows one to better understand Bohr's position and to correct Rovelli's relational quantum mechanics.

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2 k-Forrelation Optimally Separates Quantum and Classical Query Complexity

Nikhil Bansal, Makrand Sinha

Metadata

ID: http://arxiv.org/abs/2008.07003v3
UPDATED: 2020-11-17T14:51:56Z
PUBLISHED: 2020-08-16T21:26:46Z
quant-ph :: 40 pages, 2 figures. Change from v1 to v2: Updated figures to fix an Adobe Acrobat specific issue. Change from v0 to v1: Improved the advantage δ to $2^{-O(k)}$ strengthening the main conclusions. Added a reference to the independent work of Sherstov, Storozhenko and Wu (arxiv:2008.10223) who obtained a similar lower bound for the randomized query complexity of k-Rorrelation

Summary

Aaronson and Ambainis (SICOMP '18) showed that any partial function on N bits that can be computed with an advantage δ over a random guess by making q quantum queries, can also be computed classically with an advantage $\delta/2$ by a randomized decision tree making $O_q(N^{1-\frac{1}{2q}}\delta^{-2})$ queries. Moreover, they conjectured the k-Forrelation problem – a partial function that can be computed with $q = \lceil k/2 \rceil$ quantum queries – to be a suitable candidate for exhibiting such an extremal separation. We prove their conjecture by showing a tight lower bound of $\widetilde{\Omega}(N^{1-1/k})$ for the randomized query complexity of k-Forrelation, where the advantage $\delta = 2^{-O(k)}$. By standard amplification arguments, this gives an explicit partial function that exhibits an $O_\epsilon(1)$ vs $\Omega(N^{1-\epsilon})$ separation between bounded-error quantum and randomized query complexities, where $\epsilon > 0$ can be made arbitrarily small. Our proof also gives the same bound for the closely related but non-explicit k-Rorrelation function

introduced by Tal (FOCS '20). Our techniques rely on classical Gaussian tools, in particular, Gaussian interpolation and Gaussian integration by parts, and in fact, give a more general statement. We show that to prove lower bounds for k-Forrelation against a family of functions, it suffices to bound the ℓ_1-weight of the Fourier coefficients between levels k and $(k-1)k$. We also prove new interpolation and integration by parts identities that might be of independent interest in the context of rounding high-dimensional Gaussian vectors.

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3 A $(D_{,D_x})$-manifold with N-correlators of N_t-objects

Pierros Ntelis

Metadata

ID: http://arxiv.org/abs/2209.07472v1
UPDATED: 2022-08-05T22:57:34Z
PUBLISHED: 2022-08-05T22:57:34Z
physics.gen-ph :: 25 pages, 2 Figure, paper prepared for submission, comments are most welcome

Summary

In this paper, we describe a mathematical formalism for a (D_τ, D_x)-dimensional manifold with N-correlators of N_t types of objects, with cross correlations and contaminants. In particular, we build this formalism using simple notions of mathematical physics, field theory, topology, algebra, statistics n-correlators and Fourier transform. We discuss the applicability of this formalism in the context of cosmological scales, i.e. from astronomical scales to quantum scales, for which we give some intuitive examples.

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4 Characterising two-sided quantum correlations beyond entanglement via metric-adjusted f-correlations

Marco Cianciaruso, Irénée Frérot, Tommaso Tufarelli, Gerardo Adesso

Metadata

ID: http://arxiv.org/abs/1707.07723v2
UPDATED: 2019-01-26T07:10:37Z
PUBLISHED: 2017-07-24T19:44:01Z
quant-ph :: 20 pages, 1 figure. Published version

Summary

We introduce an infinite family of quantifiers of quantum correlations beyond entanglement which vanish on both classical-quantum and quantum-classical states and are in one-to-one correspondence with the metric-adjusted skew informations. The 'quantum $f-$correlations' are defined as the maximum metric-adjusted $f-$correlations between pairs of local observables with the same fixed equispaced spectrum. We show that these quantifiers are entanglement monotones when restricted to pure states of qubit-qudit systems. We also evaluate the quantum $f-$correlations in closed form for two-qubit systems and discuss their behaviour under local commutativity preserving channels. We finally provide a physical interpretation for the quantifier corresponding to the average of the Wigner-Yanase-Dyson skew informations.

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5 The essence of nonclassicality: non-vanishing signal deficit

S. Aravinda, R. Srikanth

Metadata

ID: http://arxiv.org/abs/1502.05390v2
UPDATED: 2015-07-01T12:10:15Z
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quant-ph :: Accepted in Int. J. Theor. Phys.; based on talk delivered by S. Aravinda at Quantum Structures 2014, Olomouc; title changed

Summary

Nonclassical properties of correlations– like unpredictability, no-cloning and uncertainty– are known to follow from two assumptions: nonlocality and no-signaling. For two-input-two-output correlations, we derive these properties from a single, unified assumption: namely, the excess of the communication cost over the signaling in the correlation. This is relevant to quantum temporal correlations, resources to simulate quantum correlations and extensions of quantum mechanics. We generalize in the context of such correlations the nonclassicality result for nonlocal-nonsignaling correlations (Masanes, Acin and Gisin, 2006) and the uncertainty bound on nonlocality (Oppenheim and Wehner, 2010), when the no-signaling condition is relaxed.

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6 Non-Markovian response of complex quantum systems

S. V. Radionov

Metadata

ID: http://arxiv.org/abs/1911.01820v2
UPDATED: 2019-12-13T17:08:27Z
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cond-mat.stat-mech ::

Summary

We study the perturbative response of a complex quantum system on time changes of an external parameter X. The driven dynamics is treated in adiabatic basis of the system's Hamiltonian $\hat{H}[X]$. Within a random matrix approach we obtained non–Markovian Fokker–Planck equation for the occupancy of given adiabatic state. We observed normal diffusion regime of the driven quantum dynamics at quite small values of the memory time defined by the time scales of the X–correlations and energy–distribution of the coupling matrix elements $(\partial\hat{H}/\partial X)_{nm}$. Here the normal energy diffusion was found to drop out with the width of the matrix elements' energy–distribution and the diffusion may be significantly suppressed with the decrease of the correlations between the matrix elements. In the opposite limit of relatively large memory times we obtained ballistic regime of the dynamics.

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7 Stability of quantum eigenstates and kinetics of wave function collapse in a fluctuating environment

Simone Chiarelli, Piero Chiarelli

Metadata

ID: http://arxiv.org/abs/2011.13997v1
UPDATED: 2020-11-25T10:41:53Z
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quant-ph :: Sumitted to Quantu Reports

Summary

The work analyzes the stability of the quantum eigenstates when they are submitted to fluctuations by using the stochastic generalization of the Madelung quantum hydrodynamic approach. In the limit of sufficiently slow kinetics, the quantum eigenstates show to remain stationary configurations with a very small perturbation of their mass density distribution. The work shows that the stochastic quantum hydrodynamic model allows to obtain the definition of the quantum eigenstates without recurring to the measurement process or any reference to the classical mechanics, by identifying them from their intrinsic properties of stationarity and stability. By using the discrete approach, the path integral solution of the stochastic quantum-hydrodynamic equation has been derived in order to investigate how the final stationary configurations depend by the the initial condition of the quatum superposition of states. The stochastic quantum hydrodynamics shows that the

superposition of states can relax to different stationary states that, in the small noise limit, are the slightly perturbed quantum eigenstates. The work shows that the final stationary eigenstate depends by the initial configuration of the superposition of states and that possibly the probability transition to each eigenstates can satisfy the Born rule, allowing the decoherence process to be compatible with the Copenhagen interpretation of quantum mechanics.

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8 Hidden correlations entailed by q-non additivity render the q-monoatomic gas highly non trivial

A. Plastino, M. C. Rocca

Metadata

ID: http://arxiv.org/abs/1702.03535v2
UPDATED: 2017-08-09T00:53:50Z
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cond-mat.stat-mech :: Text has changed. Accepted for publication in Physica A, August 2, 2017

Summary

It ts known that Tsallis' q-non-additivity entails hidden correlations. It has also been shown that even for a monoatomic gas, both the q-partition function Z and the mean energy $<U>$ diverge and, in particular, exhibit poles for certain values of the Tsallis non additivity parameter q. This happens because Z and $<U>$ both depend on a Γ-function. This Γ, in turn, depends upon the spatial dimension ν. We encounter three different regimes according to the argument A of the Γ-function. (1) $A > 0$, (2) $A < 0$ and $\Gamma > 0$ outside the poles. (3) A displays poles and the physics is obtained via dimensional regularization. In cases (2) and (3) one discovers gravitational effects and quartets of particles. Moreover, bound states and gravitational effects emerge as a consequence of the hidden q-correlations.

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9 Derivation of Conservation Laws in 2nd order Quantum-Correlation Theory

Sobhan Sounda, Dibyendu jana

Metadata

ID: http://arxiv.org/abs/2308.11772v2
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quant-ph ::

Summary

This paper extends the foundational concept to second-order quantum correlation tensors, representing intensity-intensity correlations.As their application in diverse optical field experiments gaining importance, we investigate conserved quantities such as energy, linear and angular momentum and illuminate the dynamic nature of quantum correlations.

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10 Phase Diagram and Storage Capacity of Sequence Processing Neural Networks

A. During, A. C. C. Coolen, D. Sherrington

Metadata

ID: http://arxiv.org/abs/cond-mat/9805073v1
UPDATED: 1998-05-06T15:26:10Z
PUBLISHED: 1998-05-06T15:26:10Z
cond-mat.dis-nn :: 17 pages Latex2e, 2 postscript figures

Summary

We solve the dynamics of Hopfield-type neural networks which store sequences of patterns, close to saturation. The asymmetry of the interaction matrix in such models leads to violation of detailed balance, ruling out an equilibrium statistical mechanical analysis. Using generating functional methods we derive exact closed equations for dynamical order parameters, viz. the sequence overlap and correlation- and response functions, in the thermodynamic limit. We calculate the time translation invariant solutions of these equations, describing stationary limit-cycles, which leads to a phase diagram. The effective retarded self-interaction usually appearing in symmetric models is here found to vanish, which causes a significantly enlarged storage capacity of $\alpha_c \sim 0.269$, compared to α