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Dynamical and quenched random matrices and homolumo gap

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We consider a rather general type of matrix model, which is partly given by some "fundamental randomness" and partly dynamical even quantum mechanically. We then study the homolumo-gap effect, which means that we study how the level density gets attenuated near the Fermi surface, while considering the matrix as the Hamiltonian matrix for a type of fermion interacting with this matrix. In the case of the quenched randomness (the "fundamental" one) dominating the quantum mechanical one and the coupling to the fermions is not too small we calculate a homolumo gap that in first approximation consists of there being essentially no levels for the a single fermion between two steep limits (box-shape). The filled and empty state densities are in this first approximation just pushed each to its side. In next approximation these steep falls in the spectral density are smeared out to have an error function shape. The studied model could be considered as a first step towards the more general case of considering a whole field of matrices - defined say on some phase space - rather than a single matrix.

Biography

H B Nielsen is a Danish theoretical physicist, Professor emeritus at the Niels Bohr Institute, at the University of Copenhagen, where he started studying physics in 1961. He has made original contributions to theoretical particle physics specifically in the field of string theory. He was the first to propose that the Veneziano model was actually a theory of strings and is considered among the fathers of string theory. He was awarded the highly esteemed Humboldt Prize in 2001 for his scientific research. Several physics concepts are named after him, e.g. Nielsen-Olesen Vortex and the Nielsen-Ninomiya no-go theorem for representing chiral fermions on the lattice. He is known in Denmark for his enthusiastic public lectures on physics and string theory, and he is often interviewed in daily news, especially on matters regarding particle physics.

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Hydrogen-functionalized graphene (nanomesh) spintronics and magnetism

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Graphene, a carbon mono-atomic layer, is still attracting significant attention even after awarding Nobel Prize at 2010. In particular, strong spin coherence has been highly expected in graphene because of the weak spin-orbit interaction (SOI) and weak hyperfine interaction, which are unique to carbon atoms. In the talk, I will show the following some of our latest experimental results about hydrogen(H)-functionalized graphene spintronics and magnetism; (1) Observation of spin Hall Effect (SHE) arising from SOI introduced by slight H-functionalization and its strong correlation with induced spin coherence, (2) Significant improvement of spontaneous spin polarization and flat band ferromagnetism (mostly 100-times greater) arising from nano-pore edge spins in graphene nanomesh (GNM) magnets realized by effective pore-edge-H termination using HSQ resist, and (3) Tunnel magneto resistance structure using the ferromagnetic GNM (FGNM) as an electrode for future rare-metal free spintronics. These results must open doors to rare-metal free (all-carbon) spintronics and magnetism.

Biography

Junji Haruyama is professor of materials science at the Faculty of Science and Technology, Aoyama Gakuin University, Japan. He graduated from Waseda University, Tokyo, Japan, in 1985, after which he joined NEC Corporation, Japan. He received his PhD in physics from Waseda University in 1996. During 1995–1997, he worked with the University of Toronto, Canada, and Ontario Laser and Lightwave Research Center, Canada, as a visiting scientist. Then he was a visiting professor at NTT Basic Research Laboratories, Japan, and the Institute for Solid State Physics, the University of Tokyo, Japan. Currently, he is also a principal researcher for a grant by the Air-Force Office of Scientific Research, USA, for a project on carbon-based high-Tc superconductivity. He has authored over 30 books and over 100 peer-reviewed articles in international journals, including *Physical Review Letters and Nature Nanotechnology.* He has been honored with many grants by the Japan Science and Technology agency, the Japan Society for the Promotion of Science, and the Ministry of Education, Culture, Sports, Science and Technology of Japan.

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