UNIVERSITÄT BIELEFELD

Faculty of Physics
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THE UNIVERSITY OF MELBOURNE

Seminar

Bielefeld - Melbourne Random Matrices

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Moments and *SU(N)* algebra for Embedded Unitary Ensemble

Embedded random matrix ensembles with *k*-body interactions, usually called EE(*k*), introduced 50 years back in the context of nuclear shell model, are now well established to be appropriate for understanding statistical properties of many quantum systems [1]. Say *m* fermions (or bosons) are in *N* degenerate single particle states and interacting with *k*-body interactions. Then, with direct product representation of the many-particle states, the *k* and *m* fermion space dimensions are $\binom{N}{k}$ and $\binom{N}{m}$ respectively. Now, with a GUE representation for the Hamiltonian (*H*) matrix in the *k* particle space, the *m*-particle *H* matrix will be EGUE(*k*) - embedded GUE with *k*-body interactions. Similarly, we have EGOE(*k*) and EGSE(*k*). Note that for *k*=*m* we have the classical GOE, GUE and GSE. Recently, using the formulas for the moments up to order 8, it is established that the one-point function, ensemble averaged density of eigenvalues, follows the so called *q*-normal distribution for EGUE(*k*) [also for EGOE(*k*)] with *q* defined by the fourth moment [2]. The *q*-normal generates Gaussian density for *k* << *m* and semi-circle for *k*=*m*. Unlike the one-point function, till today there is no success in deriving the two-point correlation function for EGUE(*k*) or EGOE(*k*) even in the limit of *k* <<*m*. However, recently formulas are obtained for the bivariate moments of the two-point function up to order 8. These moments results, largely obtained by using the underlying *SU(N)* algebra and the binary correlation approximation [3], will be described in this talk besides first giving a overview of embedded random matrix ensembles in quantum physics.

[1] V.K.B. Kota, Embedded Random Matrix Ensembles in Quantum Physics (Springer, Heidelberg, 2014); V.K.B. Kota and N.D. Chavda, Int. J. Mod. Phys. E **27**, 1830001 (2018).
[2] Manan Vyas and V.K.B. Kota, J. Stat. Mech.: Theory and Experiment **2019**, 103103 (2019).
[3] K. K. Mon and J.B. French, Ann. Phys. (N.Y.) **95**, 90 (1975); L. Benet, T. Rupp, and H.A. Weidenmüller, Ann. Phys. (N.Y.) **292**, 67 (2001); V.K.B. Kota, J. Math. Phys. **46**, 033514 (2005); R.A. Small and S. Müller, Ann. Phys. (N.Y.) **356**, 269 (2015); V.K.B. Kota, arXiv:2208.11312 (2022).

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Zoom Konferenzschaltung— Please contact Leslie Molag (lmolag@math.uni-bielefeld.de) for details regarding access

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