XL. Dynamics Days 2020

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Title: Super-Random States of Random Matrix Gases and One Curious Application

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Abstract:

It is well known from classical chapters of Random Matrix Theory that joint probability density function for energy levels of various classes of random matrices shows exactly the same form as that calculated for the Dyson gas of identical repelling particles exposed to a heat bath driven by a specific value of the inverse temperature. Statistical rigidity (number variance) of the Dyson gas is located in the region of the Poissonian or sub-Poissonian states, for which the compressibility (i.e. slope of the linear asymptote of the rigidity) is equal to 1 (Poissonian systems) or less than 1 (sub-Poissonian systems). Furthermore, in the earlier works of the speaker it has been discussed a surprising theoretical link between the above-mentioned Dyson gases and various transport systems (public transport in Cuernavaca, Mexico [1], vehicular traffic [2], pedestrian dynamics [3]). Indeed, modified versions of Dyson gas are effective when explaining statistical properties of traffic microstructure. However, some states of vehicular traffic show significant aberrations from sub-Poissonian behavior. Associated rigidities are located in the region of super-Poissonian systems, where the compressibility significantly exceeds the unit value.

In this presentation we explain an origin of these super-Poissonian states and formulate conditions for generating these states in particle systems. The theoretical results obtained are then discussed in the context of vehicular theory. Moreover, we show that ascertained facts explain several open problems in the Vehicular Headway Modelling.

References

[1] M. Krbálek and P. Šeba, Statistical properties of the city transport in Cuernavaca (Mexico) and random matrix ensembles, J. Phys. A: Math. Gen. 33 (2000) L229 - L233
[2] L. Li and X.M. Chen, Headway Modelling Survey, Transportation Research Part C 76 (2017) 170 - 188
[3] M. Krbálek, P. Hrabák, and M. Bukáček, Pedestrian headways — Reflection of territorial social forces, Physica A 490 (2018) 38 - 49