1059-60-239 **Igor Rumanov*** (igorrumanov@math.ucdavis.edu), UC Davis, Department of Mathematics, 1 Shields Avenue, Davis, CA 95616. *PDE for spectral gap probabilities of random single and coupled matrices and Toda lattice.* Preliminary report.

Direct connection is exposed between the equations in random matrix (RM) theory, derived by different - Tracy-Widom and Adler-Shiota-van Moerbeke - methods. Simple relations hold between the gap probabilities considered as ratios of 1-dim. Toda lattice τ-functions and functions in the resolvent kernel of Fredholm operator approach to the probabilities. A unified description of RM unitary ensembles (UE) is found in terms of universal, i.e. independent of the specific ensemble, PDE for gap probabilities. At the core of our study was the tie of orthogonal polynomials (OP) with 1-Toda lattice. Toda-AKNS system provides a common structure of PDE for UE, appearing in different guises: one arises from OP-Toda lattice relations, while the other comes from Schlesinger equations. Similar relations for coupled matrices, based on 2-dim. Toda lattice, exist and help the harder treatment of the case. The joint probability for largest eigenvalues of two coupled Gaussian matrices satisfies a number of different PDE, besides the previously known Adler-van Moerbeke equation (AvM). Some of the new equations have Painlevé IV equation as 1-matrix limit, in contrast to the AvM equation, trivial in this limit. The situation resembles the case of several endpoints for the 1-matrix ensemble. (Received February 23, 2010)