In this paper the authors carry out analytic studies of a (1+1)-dimensional matrix model. The model is the so-called IKKT matrix model [1] and the authors utilize the fuzzy 2-hyperboloid, a noncommutative version of two-dimensional hyperboloid, to calculate two-point correlation functions. The IKKT model does not have a priori notion of time but the authors argue that the resultant form of the propagators indicates emergence of causality and time evolution in (1+1)-dimensional IKKT-like matrix models, at least for free models. Note that for models with interactions one gets UV/IR mixing and it is not straightforward to discuss locality. The authors also consider propagators on a non-trivial (1+1)-dimensional FLRW (Friedmann–Lemaître–Robertson–Walker)-type metric and present possible applications of the results to (1+1)-dimensional cosmology.

For recent developments on this topic particularly in four-dimensional matrix models, see, *e.g.*, [2, 3], where higher-spin gauge theories are considered in the IKKT matrix model, utilizing the fuzzy 4-hyperboloid [4].

References

[1] N. Ishibashi, H. Kawai, Y. Kitazawa and A. Tsuchiya, "A Large N reduced model as superstring," Nucl. Phys. B **498**, 467-491 (1997) doi:10.1016/S0550-3213(97)00290-3 [arXiv:hep-th/9612115 [hep-th]].

[2] M. Sperling and H. C. Steinacker, "The fuzzy 4-hyperboloid H^4_n and higher-spin in Yang–Mills matrix models," Nucl. Phys. B **941**, 680-743 (2019) doi:10.1016/j.nuclphysb.2019.02.027 [arXiv:1806.05907 [hep-th]].

[3] H. Steinacker and T. Tran, "Spinorial higher-spin gauge theory from IKKT in Euclidean and Minkowski signatures," [arXiv:2305.19351 [hep-th]].

[4] K. Hasebe, "Non-Compact Hopf Maps and Fuzzy Ultra-Hyperboloids," Nucl. Phys. B **865**, 148-199 (2012) doi:10.1016/j.nuclphysb.2012.07.017 [arXiv:1207.1968 [hep-th]].