Texas Tech University. Pure Mathematics Colloquium.
Current Advances in Mathematics.

Mysterious Duality

Alexander Voronov

University of Minnesota

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ABSTRACT. "Mysterious Duality" was suggested by mathematical physicists Iqbal, Neitzke, and Vafa in 2001. They noticed that (already mysterious for a mathematician) toroidal compactifications of M-theory lead to the same series of combinatorial objects as the del Pezzo surfaces (equally mysterious for all but algebraic geometers) do, along with numerous mysterious coincidences: both toroidal compactifications and del Pezzo surfaces give rise to the exceptional series E_k; a collection of various M- and D-branes corresponds to a set of divisors on a del Pezzo surface; the brane tension is related to the ?area? of the corresponding divisor, etc. The mystery is that it is not at all clear where this duality comes from. In the talk, I will present another series of mathematical objects: certain versions of multiple loop spaces of the four-sphere S^4, which are, on the one hand, directly connected to M-theory and its compactifications, and, on the other hand, possess the same combinatorics as the del Pezzo surfaces. This solves the physics-mathematics mystery and transfers it to the geometry-topology plane: what is the relation between the del Pezzo surfaces and loop spaces of the four-sphere? This is a preliminary report on a work with Hisham Sati.