Abstract

Combinatorics and Quarks

Quite often, and quite unexpectedly, questions in Mathematics and the Mathematical Sciences have concealed within them connexions to discrete structures that are key to their solution, and it is important to understand them. For example, Feynman diagrams are an instance of such structures in Quantum Field Theory, and a combinatorial Legendre Transform based on these appears to circumvent some analytic awkwardnesses in the theory.

Since discrete structures may not be familiar to all members of the Audience, I shall begin with an unusual solution of the familiar Derangement Problem (How many permutations have no fixed points?), then touch upon the relation between Cayley's result for trees and the Lagrange-Bürmann Theorem from complex analysis as a concrete instance of an Unexpected Connexion alluded to above. The main topic of the Talk is a combinatorial study of the 1900's model of string theory for meson-meson interaction (associated with the quarks of the title), and what it suggests about combinatorial structures embedded in surfaces.

My intention is that this talk should be appealing to a general mathematical Audience. Where algebra that may be unfamiliar is used, I shall concentrate on the intuition behind it and what it signifies rather than on the details.

(In the sequel in the Algebra Seminar, tomorrow, I shall use techniques from algebraic combinatorics to study genus g ramified covers of the sphere, the impact of this material on the very short proof of Witten's Conjecture (Kontsevich's Theorem) by Alex Kazarian, and a very short proof of the λ_g-Conjecture/Theorem of Getzler and Pandharipande.)