1018-60-215 **Dimitris Achlioptas*** (optas@cs.ucsc.edu), Department of Computer Science, University of California Santa Cruz, 1156 High Street MS: SOE3, Santa Cruz, CA 95060, and **Federico Ricci-Tersenghi**, Italy. *On the Solution-space Geometry of Random Constraint Satisfaction Problems.*

For many random constraint satisfaction problems, such as random k-SAT and coloring random graphs, all known polynomial-time algorithms stop finding solutions much below the satisfiability threshold of the problem (the largest constraint density for which solutions exist with high probability). To understand the origin of this phenomenon we study how the structure of the space of solutions evolves in such problems as constraints, e.g., clauses and edges, are added.

We prove that much before solutions disappear, they organize into an exponential number of clusters that are relatively small and far apart from each other. Moreover, inside each cluster the vast majority of variables are frozen, i.e., take only one value. The existence of exponentially many clusters, each with many frozen variables, gives a satisfying intuitive explanation for the failure of the kinds of algorithms considered so far. At the same time, our results establish rigorously one of the two main hypotheses underlying Survey Propagation, a heuristic introduced by physicists in recent years that appears to perform extraordinarily well on random constraint satisfaction problems. (Received March 07, 2006)