

Matrix factorizations and birational geometry

David Morrison, Duke

The theory of matrix factorizations gives an important tool that has been used extensively in commutative algebra and singularity theory, but less so in the more global aspects of algebraic geometry. The basic idea is simple: even if a polynomial f is irreducible, there may exist square matrices A and B with polynomial entries such that AB is f times the identity matrix. Such an expression is called a matrix factorization.

The explicit form of the McKay correspondence worked out by Gonzalez-Sprinberg and Verdier in the mid-1980's can be interpreted as providing matrix factorizations for the equations defining rational double points, and interpreting those matrix factorization geometrically. Curto and the speaker have extended these ideas to provide a construction and explanation in terms of matrix factorizations for the basic new birational operation in dimension three: the flop. (The construction is still conjectural in general, but has been proved in an important case.) We will discuss this result, and related issues in birational geometry. If time permits, we'll give an application to the study of D-branes in string theory on Calabi-Yau manifolds.