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Nonlinear diffusion from a delocalized source: affine self-similarity, spacetime asymptotics, and focusing geometry

A family of explicit solutions to the porous medium equation and its fourth order generalizations is described, in the full range of nonlinearities, in which the pressure is given by a quadratic function of space at each instant in time. These include spreading solutions whose source is concentrated on any conic region of dimension lower than the ambient space, and solutions which focus at conic regions. The singular limiting distributions are affine projections of Barenblatt type profiles with arbitrary signature. A time-reversal symmetry is revealed which transforms spreading solutions to focusing solutions, and vice versa. This yields new information about the long and short time asymptotics of finite-mass solutions, about the instability of focusing, and about singularity geometry.

This work is joint with Jochen Denzler (University of Tennessee at Knoxville). Preprints are found at `www.math.toronto.edu/mccann`.