Singularity formation in Nonlinear Evolution Equations

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Abstract: Many central problems in geometry, mathematical physics and biology reduce to questions regarding the behavior of solutions of nonlinear evolution equations. The global dynamical behavior of bounded solutions for large times is of significant interest. However, in many real situations, solutions develop singularities in finite time. The singularities have to be analyzed in details before attempting to extend solutions beyond their singularities or to understand their geometry in conjunction with globally bounded solutions. In this context we have been particularly interested in qualitative descriptions of *blowup*. Particular examples include semilinear reaction-diffusion systems, harmonic map heat flows and wave maps, and the classical Keller-Segel system of modeling chemotaxis. I will present different techniques based on spectral analysis or/and energy-type methods to study the question of existence and stability of blowup solutions to these problems.