

Continuations of the nonlinear Schrodinger equation beyond the singularity

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The nonlinear Schrodinger equation (NLS) is one of the canonical nonlinear equations in physics. In 1965, Kelley showed that the NLS admits solutions that collapse (become singular) at a finite time (distance). Since physical quantities do not become singular, a question which has been open since 1965 is whether and how singular NLS solutions can be continued beyond the singularity.

A similar situation occurs in hyperbolic conservation laws, where in the absence of viscosity, the solution can become singular (develop shocks). In that case, there is a huge body of literature on how to continue the inviscid solution beyond the singularity. In contrast, very few studies addressed this question in the NLS.

In this talk I will present several potential continuations of the NLS beyond the singularity. These continuations share the universal feature that after the singularity, the solution is only determined up to multiplication by a constant phase term. As a result, the interaction between two post-collapse components (beams) is chaotic, as indeed has been observed recently in experiments with high-power laser beams.