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Normal form approach to well-posedness of nonlinear dispersive PDEs

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Harmonic analysis has played a crucial role in the well-posedness theory of nonlinear dispersive PDEs such as the nonlinear Schrödinger equations (NLS). In this talk, we present an alternative method to prove well-posedness of nonlinear dispersive PDEs which avoids a heavy machinery from harmonic analysis. As a primary example, we study the Cauchy problem for the one-dimensional NLS on the real line. We implement an infinite iteration of normal form reductions (namely, integration by parts in time) and reformulate the equation in terms of an infinite series of multilinear terms of arbitrarily large degrees. By establishing a simple trilinear estimate and applying it in an iterative manner, we establish enhanced uniqueness of NLS in almost critical spaces.

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