

BREAKING MECHANISM FROM A VACUUM POINT IN THE
DEFOCUSING NONLINEAR SCHRÖDINGER EQUATION

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We study the wave breaking mechanism for the weakly dispersive defocusing nonlinear Schrödinger (NLS) equation with a constant phase dark initial datum that contains a vacuum point at the origin. We prove by means of the exact solution of the initial value problem that, in the dispersionless limit, the vacuum point is preserved by the dynamics until breaking occurs at a finite critical time. In particular, both Riemann invariants experience a simultaneous breaking at the origin. Although the initial vacuum point is no longer preserved in the presence of a finite dispersion, the critical behavior manifests itself through an abrupt transition occurring around the breaking time.