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Semiclassical Non-self-adjoint WKB and Focusing NLS: a Fundamental Integrable Model of Unstable Phenomena

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Since the discovery of the so-called modulational instability in the 1960s it has been clear that the focusing NLS (as opposed to the similar but simpler defocusing NLS and real KdV equations) is an important model for unstable phenomena. The discovery by Zakharov and Shabat that the spectral analysis of a non-self-adjoint Dirac operator enables the solution of the focusing NLS equation via inverse scattering theory led to the spectral study of such Dirac operators. Motivated by the observation that instability phenomena become more pronounced in the semiclassical limit, we have recently undertaken a careful rigorous of the semiclassical analysis of the scattering data of a non-self-adjoint Dirac operator arising in the most general case that corresponds to the semiclassical limit of focusing NLS under rapidly oscillating initial data. We here present some results and a final conjecture.