Do the freak waves exist in soliton gas?

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The possibility of short-lived anomalous large waves (rogue waves) in soliton gas in the frameworks of integrable models like the Korteweg – de Vries – type equations is studied. It is shown that the dynamics of heteropolar soliton gas differs sufficiently from the dynamics of unipolar soliton fields. In particular, in the wave fields consisting of solitons with different polarities the freak wave appearance is possible. It is shown numerically in [Shurgalina and Pelinovsky, 2015]. Freak waves in the framework of the modified Korteweg-de Vries equation have been studied previously in the case of narrowband initial conditions [Grimshaw et al, 2005, 2010; Talipova, 2011]. In this case, the mechanism of freak wave generation was modulation instability of modulated quasi-sinusoidal wave packets. At the same time the modulation instability of modulated cnoidal waves was studied in the mathematical work [Driscoll & O'Neil, 1976]. Since a sequence of solitary waves can be a special case of cnoidal wave, the modulation instability can be a possible mechanism of freak wave appearance in a soliton gas. Thus, we expect that rogue wave phenomenon in soliton gas appears in nonlinear integrable models admitting an existence of modulation instability of periodic waves (like cnoidal waves).

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