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Soliton Propagation through a Disordered System: Statistics of the Transmission Delay

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We have studied the soliton propagation through a segment containing random point-like scatterers. In the limit of small concentration of scatterers when the mean distance between the scatterers is larger than the soliton width, a method has been developed for obtaining the statistical characteristics of the soliton transmission through the segment. The method is applicable for any classical particle transferring through a disordered segment with the given velocity transformation after each act of scattering. In the case of weak scattering and relatively short disordered segment, the transmission time delay of a fast soliton is mostly determined by the shifts of the soliton center after each act of scattering. For sufficiently long segments the main contribution to the delay is due to the shifts of the amplitude and velocity of a fast soliton after each scatterer. Corresponding crossover lengths for both cases of light and heavy solitons have been obtained. We have also calculated the exact probability density function of the soliton transmission time delay for a sufficiently long segment. In the case of weak identical scatterers it is a universal function which depends on a sole parameter - mean number of scatterers in a segment.

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