



Mathematical Physics

A Family of Exact, Analytic Time Dependent Wave Packet Solutions to a Nonlinear Schroedinger Equation

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We obtain time dependent q -Gaussian wave-packet solutions to a non linear Schrödinger equation recently advanced by Nobre, Rego-Montero and Tsallis (NRT) [Phys. Rev. Lett. 106 (2011) 10601]. The NRT non-linear equation admits plane wave-like solutions (q -plane waves) compatible with the celebrated de Broglie relations connecting wave number and frequency, respectively, with energy and momentum. The NRT equation, inspired in the q -generalized thermostatistical formalism, is characterized by a parameter q , and in the limit $q \rightarrow 1$ reduces to the standard, linear Schrödinger equation. The q -Gaussian solutions to the NRT equation investigated here admit as a particular instance the previously known q -plane wave solutions. The present work thus extends the range of possible processes yielded by the NRT dynamics that admit an analytical, exact treatment. In the $q \rightarrow 1$ limit the q -Gaussian solutions correspond to the Gaussian wave packet solutions to the free particle linear Schrödinger equation. In the present work we also show that there are other families of nonlinear Schrödinger-like equations, besides the NRT one, exhibiting a dynamics compatible with the de Broglie relations. Remarkably, however, the existence of time dependent Gaussian-like wave packet solutions is a unique feature of the NRT equation not shared by the aforementioned, more general, families of nonlinear evolution equations.

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