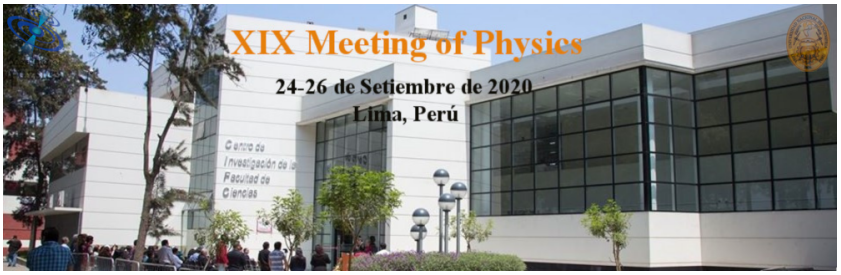

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Modified non-linear Schr\"odinger models,

cal C

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cal T_d symmetric $N-$bright solitons and towers of anomalous charges

Saturday, 26 September 2020 14:40 (20)

Modifications of the non-linear Schr\"odinger model (MNLS) $i\partial_t\psi(x,t) + \partial_x^2\psi(x,t) - [\frac{\delta V}{\delta|\psi|^2}]\psi(x,t) = 0$, where $\psi \in C$ and $V : R_+ \to R$, are considered. We show that the quasi-integrable MNLS models possess infinite towers of quasi-conservation laws for soliton-type configurations with a special complex conjugation, shifted parity and delayed time reversion ($calCcalP_scalT_d$) symmetry. Infinite towers of anomalous charges appear even in the standard NLS model for $calCcalP_scalT_d$ invariant $N-$bright solitons. The true conserved charges emerge through some kind of anomaly cancellation mechanism, since a convenient linear combination of the relevant anomalies vanishes.

A Riccati-type pseudo-potential is introduced for a modified AKNS system (MAKNS), which reproduces the MNLS quantities upon a reduction process. Two infinite towers of exact non-local conservation laws are uncovered in this framework.

Our analytical results are supported by numerical simulations of $2-$bright-soliton scatterings with potential $V = -\frac{2\eta}{2+\epsilon}(|\psi|^2)^{2+\epsilon}, \epsilon \in R, \eta > 0$. Our numerical simulations show the elastic scattering of bright solitons for a wide range of values of the set $\{\eta, \epsilon\}$ and a variety of amplitudes and relative velocities. The AKNS-type system is quite ubiquitous, and so, our results may find potential applications in several areas of non-linear physics, such as Bose-Einstein condensation, superconductivity, soliton turbulence and the triality among gauge theories, integrable models and gravity theories.

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