

# Inverse Scattering with Rational Scattering Coefficients

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The initial value problem for hyperbolic integrable systems are frequently given on a finite or semi-infinite interval. In these cases, simplifications to the solution of the Marchenko equations can be given. Examples of such systems will be described [1]. The common features of all these problems is that the initial value problem is a Goursat problem and the asymptotic form of the effective reflection coefficients is stationary. One feature of the latter is that all contributions of the continuous spectra (radiation) becomes equivalent to countable set of pure solitons and/or virtual solitons [2]. In this case, the Marchenko equations can be solved by pure  $N$ -soliton solutions, upon taking the limit of  $N \rightarrow \infty$ . As has been shown [1], this can be done by numerically constructing the  $N$ -soliton solution for some finite value of  $N$ , and then repeating the calculations for  $N$  taken to be successively larger and larger. We will demonstrate that in these situations, the reflection coefficients become equivalent to rational coefficients and will also discuss some of the subtle features of these scattering problems.

## References

- [1] D. J. Kaup and H. Steudel, *Recent Results on Second Harmonic Generation*, Contemporary Mathematics **326**, 33-48 (2003).
- [2] D.J. Kaup and H. Steudel, *Virtual Solitons and the Asymptotics of the Second Harmonic Generation*, Inverse Problems **17**, 959-970 (2001).