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On the determinant formula in the inverse scattering procedure with a partially known steplike potential

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(Submitted on 17 Jul 2011)

We are concerned with the inverse scattering problem for the full line Schr\"odinger operator \$-\partial_x^2+q(x)\$ with a steplike potential \$q\$ a priori known on \$\Reals_+=(0,\infty)\$. Assuming \$q|_ {\Reals_+}\$ is known and short range, we show that the unknown part \$q|_{\Reals_-}\$ of \$q\$ can be recovered by {equation*} q|_{\Reals_-}(x)=-2\partial_x^2\log\det(1+(1+\mathbd{M}_x^+)^{-1}\\mathbd{G}_x), {equation*} where \$\mathbd{M}_x^+\$ is the classical Marchenko operator associated to \$q|_ {\Reals_+}\$ and \$\mathbd{G}_x\$ is a trace class integral Hankel operator. The kernel of \$\mathbd{M}_k^+\$ {G}_x\$ is explicitly constructed in term of the difference of two suitably defined reflection coefficients. Since \$q|_{\Reals_-}\$ is not assumed to have any pattern of behavior at \$-\infty\$, defining and analyzing scattering quantities becomes a serious issue. Our analysis is based upon some subtle properties of the Titchmarsh-Weyl \$m\$-function associated with \$\Reals_-\$.

Subjects: Mathematical Physics (math-ph)

MSC classes: 34L25, 34B20, 47B35 Cite as: arXiv:1107.3274 [math-ph] (or arXiv:1107.3274v1 [math-ph] for this version)

Submission history

From: Odile Bastille [view email] [v1] Sun, 17 Jul 2011 04:28:42 GMT (19kb)

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