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The Frank–Lieb approach to sharp Sobolev inequalities

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Abstract

Frank and Lieb gave a new, rearrangement-free, proof of the sharp Hardy–Littlewood–Sobolev inequalities by exploiting their conformal covariance. By duality, they obtain new proofs of sharp Sobolev inequalities for the embeddings $W^{k,2}(\mathbb{R}^n) \hookrightarrow L^{\frac{2n}{n-2k}}(\mathbb{R}^n)$. We show that their argument gives a direct proof of the latter inequalities without passing through Hardy–Littlewood–Sobolev inequalities. Moreover, their argument can also be used to systematically understand sharp fully nonlinear Sobolev inequalities and their trace analogues.