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A limiting case for the divergence equation and related problems

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Let $d \geq 2$, $\Omega \subset \mathbb{R}^d$ be a smooth bounded domain and $f \in L^d(\Omega)$
with $\int_{\mathbb{R}^d} f(x) dx = 0$. Bourgain
and Brezis proved that there exists a vector field $X \in W^{1,d}(\Omega) \cap L^\infty(\Omega)$
such that $\operatorname{div} X = f$ and
 $\|X\|_{W^{1,d}} + \|X\|_{L^\infty} \leq C \|f\|_{L^d}$.

We will discuss various extensions of this result to more general functions
spaces, and present some related inequalities. This talk is based on results obtained in collaboration
with P. Bousquet, P. Mironescu, Y. Wang and P. L. Yung.

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