A Structure Theorem for Sets with Doubling $4 + \delta$

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Abstract: A question of Green asks whether every finite set of integers A with doubling constant K must contain a subset A' of comparable size whose small doubling is explained by some explicit algebraic structure. This was previously understood in the regime $K < 4 - \delta$, by work of Eberhard, Green, and Manners, who showed that one can find such a subset A' with density at least $1/2 + \epsilon$ inside a long arithmetic progression. In this talk, I will discuss our extension of this picture to the range $4 + \delta$. We prove that A contains a large subset A' such that either A' has density at least $1/2 - \epsilon$ in a long arithmetic progression, or A' has density at least $1 - \epsilon$ in a two-dimensional arithmetic progression. The proof combines the arithmetic regularity lemma, geometry of numbers, Brunn–Minkowski-type inequalities, and the structure theory behind the Gowers U^2-norm. This is joint work with Akshat Mudgal.