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Discrepancy in Modular Arithmetic Progressions

Celebrated theorems of Roth and Matousek-Spencer show that the discrepancy of arithmetic progressions in the first n positive integers is $\Theta(n^{1/4})$. We study the analogous problem in \mathbb{Z}_n . We asymptotically determine the logarithm of the discrepancy of arithmetic progressions in \mathbb{Z}_n for all n . We further determine up to a constant factor the discrepancy for many n . For example, if $n = p^k$ is a prime power, then the discrepancy is $\Theta(n^{1/3+r_k/(6k)})$, where $r_k \in \{0, 1, 2\}$ is the remainder when k is divided by 3. This solves a problem posed by Hebbinghaus-Srivastav. This work is joint with Jacob Fox and Yunkun Zhou.