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On the singularities of extremal periodic strings

Fraenkel and Simpson conjectured in 1998 that the number of distinct squares in a string is at most its length. Kolpakov and Kucherov conjectured the same in 1999 for the number of runs. We consider the role of the size of the string's alphabet in both problems and investigate the functions $\sigma_d(n)$ and $\rho_d(n)$, i.e. the maximum number of distinct primitively rooted squares, respectively runs, over all strings of length n containing exactly d distinct symbols. We discuss singularities of the two functions, i.e. pairs (d, n) such that $\sigma_d(n) - \sigma_{d-1}(n-2) \geq 2$, or $\rho_d(n) - \rho_{d-1}(n-2) \geq 2$ respectively. Joint work with A. Deza.