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**Two-Tuple-Balance of Non-Binary Sequences with
Ideal Two-Level Autocorrelation**

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Abstract Let p be a prime, $q = p^m$ and F_q be the finite field with q elements. In this paper, we will consider q -ary sequences of period $q^n - 1$ for $q > 2$ and study their various balance properties: symbol balance, difference-balance, and two-tuple-balance properties. The array structure of the sequences is introduced, and various implications between these balance properties and the array structure are proved. Specifically, we prove that if a q -ary sequence of period $q^n - 1$ is difference-balanced and has the “cyclic” array structure then it is two-tuple-balanced. We conjecture that a difference-balanced q -ary sequence of period $q^n - 1$ must have the cyclic array structure. The conjecture is confirmed with respect to all the known q -ary sequences which are difference-balanced, in particular, which have the ideal two-level autocorrelation function when $q = p$.

Keywords Non-binary PN Sequences, Array Structure, Balance Property, Difference-Balance Property, Two-Tuple-Balance Property, Ideal Two-Level Autocorrelation, Cyclic Difference Sets with Singer Type Parameters.