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Cyclic $(v; k_1, k_2, k_3; \lambda)$ difference families with $v = 3 \pmod{4}$ a prime

We construct several new cyclic difference families $(v; k_1, k_2, k_3; \lambda)$ with $v = 3 \pmod{4}$ a prime and $\lambda = k_1 + k_2 + k_3 - (3v - 1)/4$. The construction is based on the method of orbits, together with an efficient algorithm to solve a corresponding 3-way matching problem. Such families can be used in conjunction with the well-known Paley-Todd difference sets to construct Hadamard and skew Hadamard matrices of order $4v$. In particular, we construct the first example of a skew Hadamard matrix of order $4 \cdot 239$.

Joint work with D. Z. Djokovic.