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On complex Hadamard matrices with special properties

Two classes of complex Hadamard matrices with certain special properties found recently applications in quantum physics. Consider a four index tensor T_{ijkl} of size M . It can be reshaped into a square matrix $A_{\mu,\nu}$ of size M^2 with three different choices of composed indices e.g. $\mu = (i, j); \nu = (k, l)$ or $\mu = (i, k); \nu = (j, l)$, or $\mu = (i, l); \nu = (j, k)$. A tensor T is called *perfect* if all three matrices A, A' and A'' generated in this way are unitary. A matrix A is called *multiunitary* if it remains unitary after suitable reshuffling of their entries. Examples of multiunitary complex Hadamard matrices of size 9 are presented. We discuss also skew complex Hadamard matrices and address the question for which size they exist.