Unbiased complex Hadamard matrices

A complex Hadamard matrix is a very simple matrix of order $n$ whose entries are all in \{-1, 1, i, -i\} and its rows are pairwise orthogonal. Two complex Hadamard matrices $H$ and $K$ of order $n$ are called unbiased if $HK^* = L$, where $K^*$ denotes the conjugate transpose of the matrix $K$, and $L$ is a matrix whose entries have the same absolute values. For example, the two matrices

$$H = \begin{pmatrix} 1 & 1 \\ 1 & -i \end{pmatrix}, \quad K = \begin{pmatrix} 1 & i \\ i & 1 \end{pmatrix}$$

form a pair of unbiased complex Hadamard matrices of order 2. Pairs of unbiased complex Hadamard matrices exist only in orders which are the sum of two squares. For example, there are none of order 6, as 6 is not a sum of two squares, but there are many pairs of unbiased complex Hadamard matrices of orders 10 and 18. There is no theoretical method known yet to show the existence of (or lack of) these matrices.

Unbiased complex Hadamard matrices have applications in quantum information theory including quantum coding and quantum cryptography.

The talk is a mixture of theory and computer programming and will be easy to follow.

There will be refreshments and pizza.
Everyone is welcome!