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On the Hamilton-Waterloo problem with cycle lengths of distinct parities

The Hamilton-Waterloo problem asks for a decomposition of the complete graph into r copies of a 2-factor F_1 and s copies of a 2-factor F_2 such that $r+s=\left\lfloor \frac{v-1}{2} \right\rfloor$. If F_1 consists of m-cycles and F_2 consists of n cycles, then we call such a decomposition a $(m,n)-HWP(v;r,s)$. The goal is to find a decomposition for every possible pair (r,s). This problem has been studied in great depth in the cases when m and n have the same parity and $1 \notin \{r,s\}$. In this work, we use dihedral groups to obtain decompositions of the form $(m,n)-HWP(v;r,s)$ when both m and n have different parities. We also obtain decompositions when m and n have the same parity and $1 \in \{r,s\}$. This talk is based on joint work with Andrea Burgess, Peter Danziger and Tommaso Traetta.