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Cross-wired lamplighter groups

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We give a necessary and sufficient condition for a locally compact group to be isomorphic to a closed cocompact subgroup in the isometry group of a Diestel-Leader graph. As a consequence of this condition, we see that every cocompact lattice in the isometry group of a Diestel-Leader graph admits a transitive, proper action on some other Diestel-Leader graph. We also give some examples of lattices that are not virtually lamplighters. This implies the class of discrete groups commensurable to lamplighter groups is not closed under quasi-isometries and, combined with work of Eskin, Fisher and Whyte, gives a characterization of their quasi-isometry class.

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