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Calabi-Yau Threefolds Fibered by High Rank Lattice Polarized K3 Surfaces

We study threefolds fibered by K3 surfaces admitting a lattice polarization by a certain class of rank 19 lattices. We begin by showing that any family of such K3 surfaces is completely determined by a map from the base of the family to the appropriate K3 moduli space, which we call the generalized functional invariant. Then we show that if the threefold total space is a smooth Calabi-Yau, there are only finitely many possibilities for the polarizing lattice and the form of the generalized functional invariant. Finally, we construct explicit examples of Calabi-Yau threefolds realizing each case and compute their Hodge numbers. The resulting geometric classification provides strong evidence in favor of the Doran-Harder-Thompson mirror symmetry conjecture in the threefold case.