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Explicit coverings of families of elliptic surfaces by squares of curves

We show that, for each $n > 0$, there is a family of elliptic surfaces which are covered by the square of a curve of genus $2n + 1$, and whose Hodge structures have an action by $\mathbb{Q}(\sqrt{-n})$. By considering the case n=3, we show that one particular family of K3 surfaces are covered by the square of genus 7. Using this, we construct a correspondence between the square of a curve of genus 7 and a general K3 surface in $\mathbb{P}^4$ with 15 ordinary double points up to isogeny. This gives an explicit proof of the Kuga-Satake-Deligne correspondence for these K3 surfaces and any K3 surfaces isogenous to them, and further, a proof of the Hodge conjecture for the squares of these surfaces. We conclude that the motives of these surfaces are Kimura-finite. Our analysis gives a birational equivalence between a moduli space of curves with additional data and the moduli space of these K3 surfaces with a specific elliptic fibration. This is joint work with Adam Logan and Owen Patashnick.