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Hilbert modular double octic Calabi-Yau 3-fold

I will discuss modularity of a Calabi-Yau threefold X with $h^{1,2} = 1$, i.e. the Hodge numbers of $H^3(X)$ equal $(1, 1, 1, 1)$. The restriction of the Galois representation on $H^3(X)$ to $\mathrm{Gal}(\bar{\mathbb{Q}}/\mathbb{Q}[\sqrt{2}])$ decomposes into the direct sum of the Galois representation for a Hilbert modular form for $\mathbb{Q}[\sqrt{2}]$ of weight [4,2] and level $6\sqrt{2}\mathcal{O}$.

The Calabi-Yau X is a resolution of singularities of the double covering of $\mathbb{P}^3$ branched along an arrangement of eight planes (arrangement No. 250 in Meyer's list).

The proof is based on a careful study of geometric properties of X, which allows us to find a birational map to a Kummer fibration associated to two rational elliptic surfaces. As a consequence we find a birational map on X which acts as multiplication by $\sqrt{2}$ on $H^{0,3} \oplus H^{3,0}$ and by $-\sqrt{2}$ on $H^{1,2} \oplus H^{2,1}$.

Joint work with M. Schütt and D. van Straten