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Stable I-surfaces of index 2 and generalized spin curves of genus 2

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An I-surface (also called a (1,2)-surface) is a complex projective surface with $K^2 = 1$, $h^2(O) = 2$ and ample canonical class. Gorenstein stable I-surfaces are hypersurfaces of degree 10 in $\mathbb{P}(1, 1, 2, 5)$. In order to study stable I-surfaces of index 2 we introduce generalized Gorenstein spin curves, namely pairs (C, L) where C is a Gorenstein curve with ample canonical class and L is a torsion-free rank 1 sheaf on C with $\chi(L) = 0$ admitting a generically injective map $L \otimes L \to \omega_C$. We obtain a complete classification of such pairs with C reduced of genus 2 and derive from it the classification of stable I-surfaces of index 2 with a reduced canonical curve.

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