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Picard-Fuchs Equations and Shimura Subvarieties

We explain, both abstractly and through concrete examples, how the problem of detecting families of lattice-polarized K3 surfaces with higher-than-normal Picard rank can be recast in differential algebraic terms. Starting from the uniformizing differential equation for a moduli space, we provide a complete differential algebraic characterization of the totally geodesic divisors. Rational solutions to these differential equations then correspond to rational divisors on which the Picard rank increases by one. This is joint work with Andrew Harder, building on special cases previously studied with Adrian Clingher, Jacob Lewis, Hossein Movosati, and Ursula Whitcher.