

**Noam Elkies.** *K3 surfaces of high Picard number and their moduli.* (5 hours).

A K3 surface  $S$  in characteristic zero has Picard number  $\rho(S)$  (= Neron-Severi rank) at most  $20 - \rho$ . Surfaces  $S$  that attain or come close to this upper bound, and the moduli varieties of dimension  $20 - \rho$  that parametrize such  $S$ , have a rich geometric and arithmetic structure and various Diophantine applications. We review some of the theory of K3 surfaces and of their Jacobian fibrations that realize them as elliptic surfaces. We then develop computational techniques to construct, parametrize, and exploit these surfaces using explicit equations. Among the applications, we emphasize those that are related to modular curves and forms, such as the computation of curves of genus 2 whose Jacobians have real multiplication (such curves over  $\mathbb{Q}$  correspond to newforms whose coefficients generate a real quadratic field) and of Shimura modular curve