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Tropical geometry of the Hodge bundle

The Hodge bundle is a vector bundle over the moduli space of smooth curves (of genus g) whose fiber over a smooth curve is the space of abelian differentials on this curve. We may define a tropical analogue of its projectivization as the moduli space of pairs (Γ, D) consisting of a stable tropical curve Γ and an effective divisor D in the canonical linear system on Γ. This tropical Hodge bundle turns out to be of dimension $5g-5$, while it is a classical fact that the projective Hodge bundle has dimension $4g-4$. This means that not every pair (Γ, D) in the tropical Hodge bundle arises as the tropicalization of a suitable element in the algebraic Hodge bundle.

In this talk I am going to outline a comprehensive (and completely combinatorial) solution to the realizability problem, which asks us to determine the locus of points in the tropical Hodge bundle that arise as tropicalizations. Our approach is based on recent work of Bainbridge-Chen-Gendron-Grushevsky-Möller on compactifcations of strata of abelian differentials. Along the way, I will also develop a moduli-theoretic framework to understand the specialization of divisors to tropical curves as a natural tropicalization map in the sense of Abramovich-Caporaso-Payne.

This talk is based on joint work with Bo Lin, as well as on an ongoing project with Martin Möller and Annette Werner.