Hurwitz spaces of torus covers: irreducibility conjectures and degree calculations

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Hurwitz spaces for covers of the projective line or with many branch points are connected and their degree in known by representation theory. Here, on the contrary, we consider Hurwitz spaces for branched covers of the torus branched over one point only. Interest in this particular case stems from the theory of Teichmüller curves.

Even for genus two covers, the components of these Hurwitz spaces are only conjecturally known. We present these conjectures, compute the degree of the Hurwitz spaces and their classes in the Picard groups of split Hilbert modular surfaces. The method relies on theta functions and intersection theory on the universal family of abelian surfaces.