

WHITEHEAD PRIZE: citation for Holly Krieger

Short citation:

Dr Holly Krieger, of the University of Cambridge, is awarded a Whitehead Prize for her deep contributions to arithmetic dynamics, to equidistribution, to bifurcation loci in families of rational maps, and her recent proof (with DeMarco and Ye) of uniform boundedness results for numbers of torsion points on families of bielliptic genus two curves in their Jacobians.

Long citation:

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Arithmetic dynamics lies at the intersection of number theory and dynamical systems, and has close connections to classical Diophantine geometry. Many of its foundational questions are motivated by the study of preperiodic points for multiplication on abelian varieties, and revolve around the idea that ‘unlikely intersections’ in geometry are tied to the presence of additional arithmetic structure. Krieger’s PhD thesis studied patterns of divisibility of primes appearing along the orbit of a point in an arithmetic dynamical system, via a novel combination of ideas from Diophantine approximation and complex dynamics. Krieger, with Ghioca and Nguyen, studied the dynamical André–Oort conjecture, which constrains the subvarieties of moduli spaces of rational maps in which the post-critically finite maps are Zariski dense, and is an instance of a deep analogy between the dynamics of (postcritically finite) rational maps on the projective line and the arithmetic of elliptic curves (with complex multiplication).

More recently, with DeMarco and Ye, Krieger studied uniform boundedness results of Manin–Mumford type. If a Riemann surface of genus at least two is embedded in its Jacobian, its image meets the dense set of torsion points in only a finite set. It is a major open problem to bound the size of this finite set uniformly in families. The DeMarco–Krieger–Ye theorem achieves this for a complex family of bielliptic genus two curves. This in particular gives a dynamical proof of a conjecture of Bogomolov and Tschinkel concerning common torsion points for pairs of Legendre elliptic curves. The proofs use a wide array of techniques from arithmetic and Diophantine geometry: non-Archimedean analysis of local equilibrium measures on the Berkovich line, quantitative equidistribution results for height functions, and the degeneration of complex dynamical systems to systems on Berkovich or hybrid space. It is widely regarded as a breakthrough result in the field.

Krieger is also renowned for her exposition of mathematics and her influential and visible work in outreach, for instance via her YouTube videos for Numberphile which have attracted many millions of views.