

Whitehead Prize 2019
Citation for Dr Alexandr Buryak

Dr Alexandr Buryak of the University of Leeds is awarded a Whitehead Prize in recognition of his outstanding contributions to the study of moduli of curves and integrable systems.

Alexandr Buryak's research lies at the intersection of algebraic geometry, algebraic topology, and mathematical physics. The link between moduli spaces of curves and nonlinear integrable hierarchies goes back to Witten, who conjectured a relationship between the intersection theory on the moduli space of stable curves and the KdV hierarchy. This celebrated conjecture was proved by Kontsevich. There has since been a huge explosion of work involving enumerative curve-counting invariants generalizing aspects of Witten's work, in string theory, algebraic geometry, and symplectic geometry. Frequently, generating functions for these invariants satisfy certain systems of PDEs of KdV-type. Such theories also give rise to cohomological field theories, and for any (semisimple) cohomological field theory, Dubrovin and Zhang suggested a construction of a hamiltonian system of PDEs controlling the correlators of the theory.

Among Buryak's main contributions to this subject are:

1. A proof of the polynomiality of the Dubrovin—Zhang system.
2. Construction of the double ramification (DR) hierarchy, a Hamiltonian hierarchy associated to a cohomological field theory.
3. Description of the top tautological group of the moduli space of smooth genus g curves with n marked points. This work generalizes Faber's three conjectures about the structure of the tautological ring to the case with marked points.
4. Proof of the open analog of Witten's conjecture. The open analog deals with bordered Riemann surfaces; it had been proposed by Pandharipande, Solomon, and Tessler (2014).
5. Establishing a link between DR/DZ equivalence conjecture and tautological relations. Buryak proposed a new set of conjectural relations in the tautological ring of the moduli spaces of stable curves and showed that (the strong form of) the equivalence between the Dubrovin-Zhang and DR hierarchies follows from these conjectural relations.