

Dear Sir/Madam,

It is my pleasure to recommend Dr. Swiatoslaw Gal for the scientific degree of doktor habilitowany.

Dr. Gal's work concerns interactions of geometric group theory, dynamical systems, symplectic geometry and topology. Below is a review of the results by Dr. Gal, which are submitted for his habilitation thesis.

1. "A two-cocycle on the group of symplectic diffeomorphisms" and "A cocycle on the group of symplectic diffeomorphisms" (S. Gal and J. Kedra). In these papers Gal and Kedra study properties of a certain 1-cocycle on the group $Ham(M, \omega)$ of Hamiltonian symplectomorphisms of a symplectic manifold (M, ω) . The main application of this results is to the structure of subgroups of $Ham(M, \omega)$ for *closed symplectically hyperbolic manifolds* (M, ω) . It was proven by Leonid Polterovich in 2002 that in every subgroup of a *symplectically hyperbolic* manifold (M, ω) , every element is undistorted. This allowed Polterovich to rule out many groups as subgroups of $Ham(M, \omega)$, including nonuniform lattices of higher rank. The proof by Polterovich was quite hard and required development of a suitable Floer homology in this setting. Gal and Kedra came up with a much more direct and clearer, and, at the same time, more general, proof.

2. The authors continue their investigation of distortion in their joint paper "On distortion in groups of homeomorphisms". Using an extension of ideas from their earlier paper, Gal and Kedra prove nondistortion in the group of *homeomorphisms* of elements which preserve inequivalent measures. This proves nonexistence of measure-preserving actions in much greater generality than the one originally proven by Polterovich and providing a partial corroboration for Zimmer's Conjecture on measure-preserving actions of higher rank lattices.

3. The paper "On biinvariant word metrics" by Gal and Kedra establishes further restrictions on actions of various classes of finitely-generated groups. The main motivation comes from the deep theorem of Hofer, which implies that the Hofer metric on $Ham(M, \omega)$ (for many classes of symplectic manifolds) is unbounded. Since Hofer metric is biinvariant (this is one of the few instances of naturally occurring biinvariant unbounded metrics) Thus,

nonexistence of an unbounded biinvariant metrics on a group Γ forces each homomorphism $\Gamma \rightarrow Ham(M, \omega)$ to have bounded image. In their paper Gal and Kedra prove that some classes of nonuniform lattices in higher rank algebraic groups (more specifically, groups of integer points in irreducible algebraic groups split over integers) do not admit unbounded biinvariant metrics.

4. “Symplectic Configurations” by Gal and Kedra. In this paper they construct an interesting object, a *universal bundle* in the category of symplectic bundles with the fiber (M, ω) : The universal bundle in their paper has, as its base, the space of symplectic embeddings of (M, ω) into CP^∞ , equipped with its canonical symplectic structure, the Fubini–Study symplectic form. Gal and Kedra prove that the universal bundle classifies pairs (E, Ω) , which are symplectic (M, ω) -fibrations equipped with the closed connection form Ω , analogously to the classical theorem by Narasimhan and Ramanan in the context of unitary bundles. They further develop the theory of characteristic classes for (E, Ω) (analogously to the classical theory of characteristic classes for vector bundles). As one of the outcomes of this paper, coming from their analysis of the *holonomy group* of the universal bundle, Gal and Kedra answer a question of Dusa McDuff.

5. “On the algebraic independence of Hamiltonian characteristic classes”, by Gal, Kedra and Tralle. This paper deals with the theory of characteristic classes of symplectic fibrations $(M, \omega) \rightarrow E \rightarrow B$. The theory of characteristic classes is an important part of differential topology, they come from elements of cohomology rings of suitable infinite-dimensional Grassmannians. In their paper Gal, Kedra and Tralle prove algebraic independence of symplectic characteristic classes for symplectic fibrations associated with *generic coadjoint orbits* of compact Lie groups, conforming a conjecture made earlier by Alexander Reznikov (who proved it only in the case of CP^n -bundles).

To summarize: All the papers submitted by Dr. Gal for his habilitation establish new results improving upon work earlier work of other authors, solving conjectures by other authors and introducing new technique in their research areas; the papers appear in good and very good journals. For instance, Journal of Modern Dynamics and Journal of Symplectic Geometry, are the leading journals in the respective fields. All the paper are in collaboration, but, as the letters from Gal’s coauthors show, Gal’s contributions

were significant. The work of Dr. Gal makes important contributions in the areas of dynamical systems and symplectic geometry. Dr. Gal's achievements satisfy the requirements for awarding the doktor habilitowany degree and I support his application for this degree.

Sincerely yours,



Michael Kapovich

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