

## MY MAIN RESEARCH INTERESTS

The following two areas, both of which lie on the border line between algebraic geometry and representation theory, I can define as my main fields of interest. **Geometrization of automorphic forms.** Let  $G$  be a reductive group and  $X$

a (complete smooth) curve. Let us consider the moduli stack  $\text{Bun}_G$  of principal  $G$ -bundles on  $X$ . The category  $D^b(\text{Bun}_G)$  (i.e. the appropriate derived category of constructible  $\ell$ -adic sheaves) may be thought of as a geometric analog of the space of automorphic functions for the group  $G$  with values in adèles. Various questions that can be asked about the above category, among which probably the most gripping one is the following (the so-called geometric Langlands conjecture): Given a local system  $E_G$  on  $X$  with respect to the Langlands dual group, can one construct the corresponding Hecke eigen-object in  $D^b(\text{Bun}_G)$ ? Since 1996, I have been trying to prove the above conjecture when  $G = GL_n$ , cf. references 1,2, 10 below. Other questions that I addressed were: what is the “correct” geometric analog of the Eisenstein series operator and what replaces the Whittaker model in our set-up (cf. ref. 4,5,7, 9)? In another direction, it would be very interesting to understand the geometric picture behind the representation theory of groups over local fields. The paper ref. 6 can be regarded as a step in this direction. **The**

**theory of chiral algebras.** The notion of a chiral algebra was introduced by A.Beilinson and V.Drinfeld as an algebro-geometric object, equivalent, roughly speaking, to the notion of a vertex operator algebra. I think that this subject is very interesting for two reasons: First, because it has a chance to capture the various mathematical structures that arise in 2-dimensional quantum field theory (cf. ref. 3). Secondly, I think that chiral algebras have a (potentially) very rich representation theory, which can be used to address problems of infinite-dimensional algebraic geometry (cf. ref. 8). **Some related publications.**

1. *Geometric realization of Whittaker functions and the Langlands conjecture*, joint with E. Frenkel, D. Kazhdan, K. Vilonen, JAMS **11** (1998), 451-484.
2. *Automorphic sheaves and Eisenstein series for  $GL(n)$* , PhD Thesis (1997).
3. *Notes on 2D conformal field theory and string theory*, in “Quantum Fields and Strings”, P. Deligne, P. Etingof, D. Freed, L. Jeffrey, D. Kazhdan, J. Morgan, D. Morrison, E. Witten, eds., AMS (1999), 1017-1088.

4. *Whittaker patterns in the geometry of moduli spaces of bundles on curves*, joint with E. Frenkel and K. Vilonen, alg-geom/9907133, accepted to Annals of Mathematics.
5. *Crystals via the affine Grassmannian*, joint with A. Braverman, alg-geom/9909077, accepted to the Duke Mathematical Journal.
6. *Construction of central elements in the affine Hecke algebra via nearby cycles*, alg-geom/9912074, accepted to Inventiones Mathematicae.
7. *Geometric Eisenstein series*, joint with A. Braverman, preprint alg-geom/9912097, submitted for publication.
8. *Differential operators on the loop group via chiral algebras*, joint with S. Arkhipov, preprint math.AG/0009007, submitted for publication.
9. *Intersection cohomology of Drinfeld's compactifications*, joint with A. Braverman, M. Finkelberg and I. Mirkovic, math.AG/0012129, submitted for publication.
10. *On the geometric Langlands conjecture*, joint with E. Frenkel and K. Vilonen, math.AG/0012255, submitted for publication.