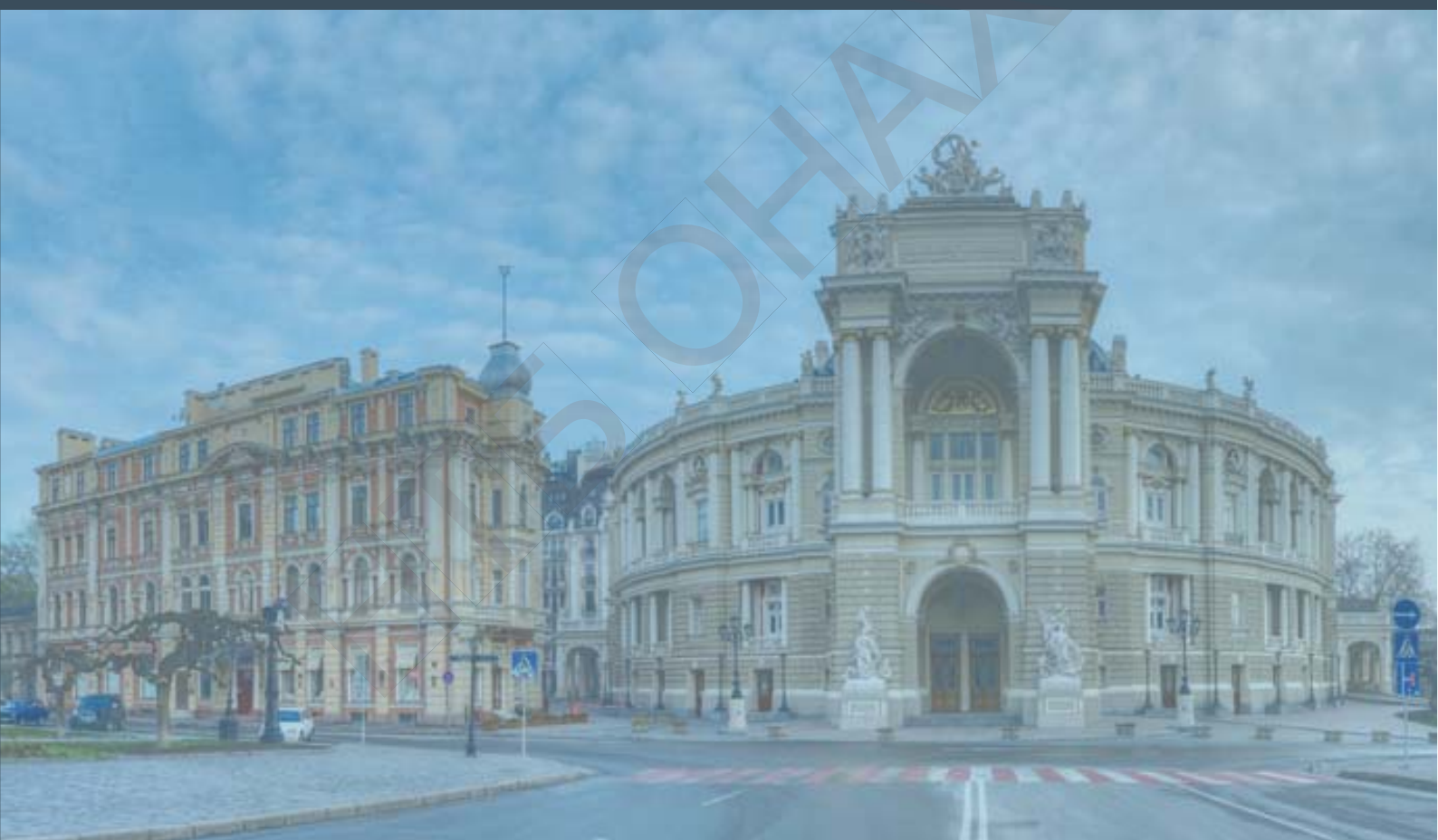


International scientific conference

**“Algebraic and Geometric
Methods of Analysis”**

Book of abstracts



May 28 - June 3, 2019

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ФІТБ ОНАФТ

Algebraic-geometric aspects of function field analogues to abelian varieties

Nikolaj Glazunov
(NAU, Kiev, Ukraine)
E-mail: glanm@yahoo.com

This communication is a continuation of [6, 7, 8, 9].

Let p be a prime number, $q = p^n$, \mathbb{F}_q be the field with q elements and characteristic p , \mathbb{F} be a finite field extension of a finite field \mathbb{F}_q .

We extend the case of algebraic number fields [6, 7] to the case of function fields in characteristic $p > 0$ and construct function field analogues to abelian varieties of elliptic and hyperelliptic curves appeared in [8, 9]. In the last case we investigate function field analogues to abelian varieties which are Jacobian varieties of hyperelliptic curves in characteristic $p > 0$. Recall that for hyperelliptic curves the function field analogues to abelian varieties are function field analogues to Jacobian varieties of the curves. For Jacobians it is possible to define corresponding p -divisible groups. We plan to present results on function field analogues to p -divisible groups of the Jacobian varieties.

Moduli and estimates for hyperelliptic curves of genus $g \geq 2$ over \mathbb{F}_p .

Let

$$C : y^2 = f(x)$$

be an algebraic curve and let $Disk(C)$ be the discriminant of $f(x)$. Consider hyperelliptic curve of genus $g \geq 2$ over prime finite field \mathbb{F}_p

$$C_g : y^2 = f(x), D(f) \neq 0.$$

For projective closure of C_g the quasiprojective variety

$$S_{g,p} = \{\mathbf{P}^{2g+2}(\mathbb{F}_p) \setminus (Disk(C_g) = 0)\}$$

parametrizes all hyperelliptic curves of genus g over \mathbb{F}_p . By well known Weil bound (affine case)

$$|\#C_g(\mathbb{F}_p) - p| \leq 2g\sqrt{p}.$$

where $\#C$ is the number of points on the curve C over ground field. As we can see from Weil (and some more strong) bounds, for $p \geq 17$ any hyperelliptic curve of genus $g = 2$ has points in \mathbb{F}_p for these prime p . Also for $g = 3$ every hyperelliptic (h) curve of genus 3 has points in \mathbb{F}_p for $p \geq 37$. For $p = 2, 3, 5, 7, 11$ there are examples of h-curves of genus 2 that have not points in \mathbb{F}_p . By author's computations any h-curve of genus 2 over \mathbb{F}_{13} has points in the field. Similarly, for $p = 2, 3, 5, 7, 11, 13, 17$ there are examples of h-curves of genus 3 that have not points in \mathbb{F}_p .

Theorem 1. [8]. *Let $p \equiv 3 \pmod{4}$. Under $p \geq 11$ there is such $a \in \mathbb{F}_p$ that the equation*

$$y^2 = x^{\frac{p-1}{2}} + a$$

has no solutions in \mathbb{F}_p .

Global \mathfrak{G} -shtukas and local \mathbb{P} -shtukas [1, 2, 3, 4].

Definition 2. (Hartl, Rad [1, 2]) Let C be a smooth projective geometrically irreducible curve over \mathbb{F}_q . A global \mathfrak{G} -shtuka $\overline{\mathcal{G}}$ over an \mathbb{F}_q -scheme S is a tuple $(\mathcal{G}, s_1, \dots, s_n, \tau)$ consisting of a \mathfrak{G} -torsor \mathcal{G} over $C_S := C \times_{\mathbb{F}_q} S$, an n -tuple of (characteristic) sections $(s_1, \dots, s_n) \in C^n(S)$ and a Frobenius connection τ defined outside the graphs of the sections s_i .

For Jacobian varieties it is possible to define corresponding p -divisible groups and their function field analogues.

Definition 3. (Hartl, Rad [1]) Let \mathbb{P} be a flat affine group scheme of finite type over $\text{Spec } \mathbb{F}[[z]]$ and \mathfrak{G} is a flat affine group scheme of finite type over a smooth projective geometrically irreducible curve over \mathbb{F}_q

Recall that local \mathbb{P} -shtukas are the functional field analogs of p -divisible groups with additional structure and moduli stacks of global \mathfrak{G} -shtukas are the functional field analogs for Shimura varieties. In some cases \mathbb{P} is a paraholic Bruhat-Tits group scheme by Pappas, Rapoport [5] and \mathfrak{G} is a parahoric Bruhat-Tits group scheme over a smooth projective curve over finite field \mathbb{F}_q with q elements of characteristic p . Investigations by U. Hartl [3], by Hartl, Arasteh Rad [1, 2], by U. Hartl, E. Viehmann [4] continue works of V. G. Drinfeld, L. Lafforgue, G. Faltings.

If will sufficient time we plan to give a short review of history of these research.

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