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Membership of academic societies:
MSJ（The Mathematical Society of Japan）

Research Interest:

- p-adic representations of a complete discrete valuation field
- p-adic differential equation

Research Summary:

I study p-adic aspects of algebraic number theory. In modern number theory, as in the proof of Fermat's last theorem due to Taylor and Wiles, it is important to study algebraic varieties and its p-adic étale cohomology V. The absolute Galois group $G_{\mathbb{Q}}$ of $\mathbb{Q}$ acts naturally on V and we study the Galois action by restricting $G_{\mathbb{Q}}$ to its decomposition groups D. The most critical case is $D = G_{\mathbb{Q}_p}$, that is, the absolute Galois group of the p-adic number field $\mathbb{Q}_p$. Fontaine established a fundamental theory of p-adic representations of $G_{\mathbb{Q}_p}$ arising in the above situation: He classified p-adic representations V by using rings of p-adic periods, then he associated linear algebraic objects (p-adic Hodge structure) to V. Berger related a p-adic Hodge structure of V to the solution space of a certain p-adic differential equation, and he proved Fontaine's p-adic monodromy conjecture. Brinon generalized Fontaine's theory where $G_{\mathbb{Q}_p}$ is replaced by the absolute Galois group of a complete discrete valuation field with imperfect residue field. In my early study ([1,2]), I proved a partial generalization of Berger's theory in Brinon's setup.

I am also studying the asymptotic behavior of solutions of p-adic differential equations. On the p-adic number field $\mathbb{Q}_p$, a naïve analogue of analytic continuation fails because of its totally discontinuity. So, when we study p-adic differential equations, beside the existence of solutions, it is important to study the asymptotic behavior of the solutions around the boundary, that is, the edge of its convergent disc. Around the 1970s, Dwork established the fundamental theory on the asymptotic behavior of solutions of p-adic differential equations. He also (vaguely) stated some basic conjectures, but there had been little progress until recently. In late 2000s, André and Chiarellotto-Tsuzuki re-considered Dwork's theory, and they obtained some important results on Dwork's conjecture. In [3], I gave a negative answer to a problem of André on the logarithmic growth Newton polygon of p-adic differential equations by constructing a certain p-adic differential equation of rank 2.

Major Publications:

[1] S. Ohkubo, The p-adic monodromy theorem in the imperfect residue field case, Algebra and Number Theory 7 (2013), No. 8, 1977–2037.

[2] S. Ohkubo, On differential modules associated to de Rham representations in the imperfect residue field case, arXiv:1307.8110.

[3] S. Ohkubo, A note on logarithmic growth Newton polygons of p-adic differential equations, to appear in International Mathematics Research Notices 2014; doi: 10.1093/imrn/rnu017.

Awards and Prizes:

- MSJ Takebe Katahiro Prize for Encouragement of Young Researchers (2014)

Education and Appointments:

2012-2015 JSPS post-doc at The University of Tokyo

Message to Prospective Students:

- Background knowledge

When I was an undergraduate student, I learned basics of algebraic number theory by reading

J.-P. Serre, "A Course in Arithmetic"

J. W. S. Cassels, A. Frohlich, "Algebraic number theory".

To study number theory, I think that it is better to have some knowledge about elliptic curves. I learned it by reading

J. H. Silverman, "The arithmetic of elliptic curves".

(A) Basic texts on Fontaine's theory on p-adic representations

1. J.-M. Fontaine, Y. Ouyang, "Theory of p-adic Galois representations"
2. O. Brinon, B. Conrad, "Notes on p-adic Hodge theory"
3. L Berger, "An introduction to the theory of p-adic representations"
4. J. Tate, "p-divisible groups"

(B) Basic texts on p-adic differential equations

5. K S. Kedlaya, "p-adic differential equations"
6. B. Dwork, "On p-Adic Differential Equations II: The p-Adic Asymptotic Behavior of Solutions of Ordinary Linear Differential Equations with Rational Function Coefficients"

Potential students who want to study Fontaine's theory on p-adic representations or p-adic differential equations under my supervision should look at [3] or § 0 of [5] respectively.