

OIST workshop:

MCM2016 (Moduli space, conformal field theory and matrix models)

Organized by Nariya Kawazumi(U. Tokyo) and Shinobu Hikami(OIST)

Oct. 24 – Oct. 27, 2016

Venue: OIST, Central build. C209

Contact: shiho.saito@oist.jp, workshop@oist.jp

Oct. 24 (Mon.)

Registration: 9:30 – 10:00

10:00 – 11:00 Rinat Kashaev

“Lattice integrable models with gauge symmetry.”

coffee break

11:30 – 12:30 Vladimir Fock

“Moduli of local systems and matroids.”

lunch 12:30 – 14:00

14:00 – 15:00 Takuya Sakasai

“Topological approaches to Mumford-Morita-Miller classes”

coffee break

15:30 – 17:00 (Participants talks)

Motoko Kato

“Embedding free products into higher-dimensional Thompson groups”

Moeka Nobuta

“The Poisson structure on the moduli space of flat bundles over a surface”

Tsukasa Ishibashi

“Nielsen-Thurston type classification on cluster modular groups”

Shogo Matsuba

“ Some properties of the Universal Teichmüller space”

Banquet: 18:00 – 20:00 at OIST Restaurant

Oct. 25 (Tue.)

10:00 – 11:00 Boris Pioline

"A string theorist viewpoint on the Kawazumi-Zhang invariant for genus-two Riemann surfaces"

coffee break

11:30 – 12:30 Nariya Kawazumi

“Some tensor field on the Teichmuller space”

lunch 12:30 – 14:00

14:00 – 15:00 Paul Norbury

“Primary invariants of Frobenius manifolds and periods on Riemann surfaces.”

coffee break

15:30 – 16:30 Yuuki Tadokoro

“ Harmonic volume and its applications”

Dinner 18:00- 20:00 OIST Restaurant

Oct. 26 (Wed.)

10:00 – 11:00 Alexandr Buryak

“Intersection theory on the moduli space of Riemann surfaces with boundary and integrable hierarchies.”

coffee break

11:30 – 12:30 Sergey Natanzon

“Moduli space of $N=2$ Riemann super surfaces”.

Excursion

(lunch box in OIST bus, Shuri-castle and fisher market 泊ゆいまち)

18:00 – 20:00 Dinner at restaurant (il Gastro Sala, 皿の上の自然)

Oct.27 (Thu.)

10:00 – 11:00 Ferdinando Gliozzi

“The Wilson-Fisher fixed points in CFT”

coffee break

11:30 – 12:30 (Participants talk)

Ferdinando Gliozzi,

“The Conformal Bootstrap Program”

Hirohiko Shimada,

“Hierarchies of Conformal Amplitudes”

Yasuhiko Asao

“On string topology”

Takeru Asaka

“Introduction to Teichmüller space “

lunch 12:40 – 14:00

free discussions

18:00 – 20:00 Dinner at Restaurant (Seven Fortune 七福) in RIZZAN Hotel

Invited speakers:

Vladimir Fock (U. Strasbourg)
Rinat Kashaev (U. Geneve)
Sergey Natanzon (Higher School of Economics)
Paul Norbury (U. Melbourne)
Boris Pioline (CERN)
Ferdinando Gliozzi (U. Torino)
Alexandr Buryak (ETH Zurich)
Takuya Sakasai (U. Tokyo)
Yuuki Tadokoro (KisarazuNIT)
Nariya Kawazumi (U. Tokyo, organizer)

Participants:

Adrian David (OIST, PhD Student)
Hirohiko Shimada (OIST, postdoc scholar)
Tomoki Tokuda (OIST, postdoc scholar)
Ayumi Kikkawa (OIST, researcher)
Takayuki Oda (OIST, staff scientist)
Megumi Oya (OIST, PhD student)
Momoka Higa (OIST, technician)
Takuro Tamashiro (OIST, technician)
Shinobu Hikami (OIST, organizer)
Motoko Kato (U. Tokyo, PhD student)
Tsukasa Ishibashi (U. Tokyo, PhD student)
Takashi Ueda (U. Tokyo, PhD student)
Yasuhiko Asao (U. Tokyo, PhD student)
Moeka Nobuta (U. Tokyo, PhD student)
Takeru Asaka (U. Tokyo, PhD student)
Shogo Matsuba (U. Tokyo, PhD student)

Title and Abstract of talks

Rinat Kashaev

“Lattice integrable models with gauge symmetry.”

To each quantum dilogarithm over a self-dual locally compact abelian group, we associate a solution of the Yang-Baxter equation which is a direct analog of the solution associated with the Faddeev-Volkov model. I will discuss a method of writing those solutions in the form of an Interaction Round a Face model with Boltzmann weight functions being quasi-periodic functions of states variables with respect to local “gauge transformations”.

Vladimir Fock

“Moduli of local systems and matroids.”

The aim of the talk is to introduce cluster coordinates on the moduli of local systems on Riemann surfaces as a monodromies of an Abelian local systems on its covering. As an application of this approach we will suggest an explicit formula parameterizing local systems by a Prym variety of the covering. Combined with Hitchin construction it gives an isomorphism between Higgs bundles and local systems.

Boris Pioline

“BPS amplitudes, theta lifts and the Kawazumi-Zhang invariant”

Protected couplings in the low energy effective action of toroidal compactifications of string theory are typically expressed as regularized theta lifts, i.e. modular integrals of a Siegel-Narain theta series times a real-analytic Siegel modular form. In this talk I will focus on four-graviton couplings in type II strings compactified on a torus. By analyzing the constraints from supersymmetry and duality, I will motivate and establish a new theta lift representation for the Kawazumi-Zhang invariant for genus-two Riemann surfaces, which enters in the integrand of the two-loop $D^6 R^4$ coupling.

Nariya Kawazami

“Some tensor field on the Teichmuller space”

In my old unpublished preprints <http://arxiv.org/abs/math/0603158> and <http://arxiv.org/abs/0801.4218> , I constructed some differential forms and a real-valued modular function on the Teichmuller space. They seem to be related to some tensor field on the Teichmuller space. But its meaning is still far from clear. In this talk, I would like to review these constructions and discuss this tensor field.

Sergey Natanzon

“Moduli space of $N=2$ Riemann super surfaces”.

In the talk I describe connected components of a moduli space of $N=2$ Riemann super surfaces. For each component I built a Fricke-Klein-Teichmuller space.

Takuya Sakasai

“ Topological approaches to Mumford-Morita-Miller classes”

By a seminal work by Madsen and Weiss, it is now known that the Mumford-Morita-Miller classes (MMM classes, for short) generate the stable rational cohomology algebra of the moduli spaces of Riemann surfaces (the mapping class groups).

We discuss two topological approaches to understand certain deeper structures related to the MMM classes through mapping class groups: one uses Johnson homomorphisms and representation theory of symplectic groups, the other uses relationships to the automorphism groups of free groups and free abelian groups. The latter approach is based on Igusa's theory of higher Franz-Reidemeister torsions. This is a joint work with Shigeyuki Morita and Masaaki Suzuki.

Alexandra Buryak

“Intersection theory on the moduli space of Riemann surfaces with boundary and integrable hierarchies.”

A study of the intersection theory on the moduli space of Riemann surfaces with boundary was recently initiated in a work of R. Pandharipande, J. Solomon and R. Tessler. They defined open intersection numbers and proposed an open

analog of Witten's conjecture. In a joint work with R. Tessler we proved this conjecture. More recently we observed that the generating series of the open intersection numbers admits a refinement that distinguishes contributions from surfaces with different numbers of boundary components. We construct a matrix model for the refined generating series and conjecture that it is equivalent to the Kontsevich-Penner model that was recently intensively studied by A. Alexandrov.

Motoko Kato, (participant talk)

“ Embedding free products into higher-dimensional Thompson groups”

The Thompson group V is an infinite simple finitely presented group, which is described as a subgroup of the homeomorphism group of the Cantor set.

Deciding which groups can be subgroups of V is a difficult question. For example, it is known that V does not contain the free product $Z^2 * Z$ as a subgroup, while V contains many groups such as Z^n or $Z * Z$.

In this talk, we consider the subgroup structure of higher-dimensional Thompson groups, which are generalizations of V . Especially, we construct an embedding of $Z^2 * Z$ into 2-dimensional Thompson group.

Ferdinando Gliozzi

“The Wilson-Fisher fixed points in CFT”

The epsilon expansion is normally studied using standard diagrammatic perturbation of quantum field theory and renormalization group. An open question is whether conformal bootstrap can reproduce this expansion. Here I report some progress in this direction.

Ferdinando Gliozzi (participant talk)

“The Conformal Bootstrap Program”

Conformal group invariance combined with crossing symmetry constrains the dynamics of various physically interesting theories.

Yuuki Tadokoro

“ Harmonic volume and its applications”

The period is a classical complex analytic invariant for a compact Riemann surface defined by integration of differential 1-forms.

It has a strong relationship with the complex structure of the surface.

In this talk, we treat another complex analytic invariant called the harmonic volume. It is a natural extension of the period defined using Chen's iterated integrals and captures more detailed information of the complex structure. It is also one of a few explicitly computable examples of complex analytic invariants. We introduce its two applications. First, we give an algorithm in proving nontriviality for a class of homologically trivial algebraic cycles obtained from special compact Riemann surfaces. Second, we explain a relation between the harmonic volume and first extended Johnson homomorphism on the mapping class group of a pointed oriented closed surface.

Paul Norbury

“Primary invariants of Frobenius manifolds and periods on Riemann surfaces.”

I will begin by describing a classical construction of so-called Darboux-Egoroff metrics used in various enumerative problems such as Gromov-Witten theory. They are flat diagonal metrics meaning that there exists coordinates with respect to which the metric is constant. A natural construction of such metrics is obtained using families of Riemann surfaces and gives rise to a Frobenius manifold structure on a Hurwitz space of covers of the sphere by Riemann surfaces. Flat coordinates for the metric conveniently appear as periods of differentials along cycles on the Riemann surfaces. In joint work with Dunin-Barkowski, Orantin, Popolitov and Shadrin we show that the primary invariants defined by the Frobenius manifold structure on the Hurwitz space can also be obtained as periods along cycles. In this case, we use periods of multidifferentials obtained by applying topological recursion to a point of Hurwitz space.

Tsukasa Ishibashi(participant talk)

“Nielsen-Thurston type classification on cluster modular groups”

A cluster ensemble, defined by V.Fock and A.Goncharov, is a pair of positive spaces which are related by a monomial morphism.

The cluster algebraic nature of (higher) Teichmüller spaces are encoded in this framework, and the mapping class groups of surfaces are generalized to cluster modular groups of cluster ensembles.

My research is an attempt to generalize Nielsen-Thurston's classification theory on the mapping class groups to the cluster modular groups, using Thurston-type compactifications.

Hirohiko Shimada (participant talk)

"Hierarchies of Conformal Amplitudes"

Conformal field theories in $d > 2$ have untruncated OPE spectrum in general. In the recent breakthrough in the 3D Ising model, a central role is played by the bootstrap of the 4-point function which does not truncate, corresponding to the non-degenerate case in the Virasoro representation. Lacking the BPZ null vector equation, however, this 4-point function remains elusive even for physicists.

Here we use our conjectural integral formula for the monodromy invariant pairing of the BC-type hypergeometric functions to derive an exact infinite hierarchies in the singlet spectrum of this 4-point function. This approach applies to the critical $O(n)$ model for $-2 < n < 2$, in particular, for which each torus operator multiplicity is given explicitly as a certain Dirichlet convolution of the Ramanujan sum. This give us important insights on the ubiquitous unitarity-violation, which is inevitable for instance in our previous determination of the fractal dimension of the 3D self-avoiding walk, the model of the polymer chain in a good solvent.

Yasuhiko Asao (participant talk)

In 1990's, Moira Chas and Dennis Sullivan discovered a "Lie algebra" structure, which is called a Batalin-Vilkoviski structure, on the homology of the free loop space of a manifold. This structure is a generalization of the Goldman Lie algebra structure of the loops on a closed surface. Furthermore, Kate Gruher and Paolo Salvatore discovered a generalized string operations which makes the homology of free loop space a 2 dimensional TQFT. We will talk on the recent study of this structure.

Takeru Asaka (participant talk)

“Introduction to Teichmüller space “

I will talk about quite basic things of Teichmüller space. I will show some topological spaces homeomorphic to Teichmüller space and introduce a complex structure into it.

Moeka Nobuta(participant talk)

“The Poisson structure on the moduli space of flat bundles over a surface”

The moduli space of flat connections on principal bundles over a compact oriented surface with boundary carries a Poisson structure. This structure decides a Poisson algebra, which is related to the Goldman Lie algebra. The Goldman Lie algebra is a Lie algebra generated by free homotopy classes of loops in a surface. I will talk about the relation between the Poisson algebra and the Goldman Lie algebra and some generalization of this relation by using spin networks.

Shogo Matsuba(participant talk)

“ Some properties of the Universal Teichmüller space”

The Universal Teichmüller space $T(1)$ was introduced by L.Bers in 60's, and it plays an important role in Teichmüller theory because all (classical) Teichmüller spaces $T(G)$ of Fuchsian groups G can be embedded into it as complex manifolds. I will describe some topological properties of $T(1)$ and its metric.