Crystal Bases for Quantum Generalized Kac-Moody Algebras

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In this paper, we develop the crystal basis theory for quantum generalized Kac-Moody algebras. For a quantum generalized Kac-Moody algebra $U_q(g)$, we first introduce the category $\mathcal{O}$ of $U_q(g)$-modules and prove its semisimplicity. Next, we define the notion of crystal bases for $U_q(g)$-modules in the category $\mathcal{O}$ and for the subalgebra $U_q^-(g)$. We then prove the tensor product rule and the existence theorem for crystal bases. Finally, we construct the global bases for $U_q(g)$-modules in the category $\mathcal{O}$ and for the subalgebra $U_q^-(g)$.

Optimal Bounds on the Gradient of Solutions to the Conductivity Problem

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We establish upper and lower bounds on the gradient of solutions to the conductivity problem in the case where two circular conductivity inclusions are very close but not touching. We also obtain such bounds when a circular inclusion is very close to the boundary of a circular domain which contains the inclusion. The novelty of these estimates is that they give very specific information about the blow up of the gradient as the conductivities of the inclusions degenerate.

New a priori estimate for the Boltzmann-Enskog equation

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We present new a priori estimate to the Boltzmann-Enskog equation when initial datum has small mass and finite energy. For this, we devise a new multi-dimensional

Bony type interaction potential measuring future collisions between mass and momentum. We obtain a new Strichartz type estimate using the time-decay property of this functional. This is a jointwork with Seung-Yeal Ha.

On spanners in a wedge

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We show that every spanner in a wedge is part of a sphere.

Parabolic elliptic systems in Reifenberg Domains

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We obtain the global $W^{1,p}$, $1 < p < \infty$, estimate for the weak solution of inhomogeneous parabolic elliptic system in divergence from a bounded cylinder $\Omega_* = \Omega \times (0,T]$. Our results are based on the assumptions that the boundary of the domain is only assumed to be nontangentially accessible and that the coefficients are allowed to be discontinuous.

A decomposition of representations of quadratic forms over local fields

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Let V be a quadratic space over Q_p, L and M be lattices and $L \subset M$, and let $O(L,M)$ be the set of all isometries φ on V such that $\varphi(L) \subset M$. We prove that $O(L,M) = \bigcup_{\substack{L \subset K_1 \subset \cdots \subset K_t \subset M \\ K_i : lattices}} O(K_1) \cdots O(K_t)$ where $O(K_i) = O(K_i, K_i)$. From this

result, given vectors $v \in L$ and $w \in M$, we find necessary and sufficient conditions for the existence of φ in $O(L, M)$ such that $\varphi(v) = w$.

2-Universal Hermitian Forms

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A positive definite hermitian lattice is said to be 2-universal if it represents all positive definite binary hermitian lattices. We find all ternary and quaternary 2-universal hermitian lattices over imaginary quadratic fields $Q(\sqrt{-m})$ and provide the 15-theorem type of criteria for 2-universality of hermitian lattices. We also investigate asymptotic behavior of minimal ranks of 2-universal hermitian lattices over $Q(\sqrt{-m})$ as m varies. As an application we discuss the solvability of certain types of Diophantine equations.

On Almost 2-Universal Diagonal Senary Lattices

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Quantum algorithms without initializing the auxiliary qubits

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This letter is about quantum computation, especially about some efficient quantum computational algorithms for the problems which are known to be hard classically, and its initialization. We develop the quantum algorithms for the Simon problem and the period-finding problem, which do not require initializing the qubits

of some parts while the efficiency of the algorithms is as good as that of the original algorithms. Since all known 'exponentially fast' applications of the quantum Fourier transform (QFT) can be considered as a generalization of the task of finding unknown period of a periodic function, the existence of these quantum algorithms implies that any initialization of the auxiliary qubits may be unnecessary in quantum computing.

Nonlinear ω-Poisson equation on network

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A network represents a way of interconnecting any pair of users or nodes by means of some meaningful links. Thus, it is quite natural that its structure can be represented, at least in a simplified form, by a connected graph whose vertices represent nodes and whose edges represent their links.

For example, the brain is a network of neurons, organizations are people networks, electric circuits, the global economy, food webs, molecules, and the internet can all be represented as networks.

First, we discuss the solvability of nonlinear ω-Poisson equation on network. To do this we deal with the weighted Laplacian Δ_ω and an ω-harmonic function on the graph, with its physical interpretation as a diffusion equation on the graph, which models an electric network. After deriving some properties of ω-Laplacian operator, we prove the existence of solution for nonlinear ω-Poisson equation on network.

Second, we deal with some inverse problems on network. This is a jointwork with Soon-Yeong Chung.

Poster Participants of Kyoto University

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