

# 千葉大学解析セミナー

2023年12月15日 10時45分～17時30分

千葉大学理学部2号館105室(午前)、4号館マルチメディア講義室2(午後)

## プログラム

### Morning session

10:45–11:30 田原 秀敏 (上智大)

Asymptotic existence theorem for formal power series solutions of singularly perturbed linear  $q$ -difference equations

### Afternoon session

13:00–13:30 澁澤 健 (千葉大)

On an extension of the confluent hypergeometric system of Kummer type

13:45–14:30 安達 駿弥 (千葉大)

On the Laplace transform for KZ type equations

14:45–15:30 Alberto Lastra (Univ. Alcalà)

Meromorphic solutions of linear  $q$ -difference equations

15:45–16:30 Stéphane Malek (Univ. Lille)

Asymptotics and confluence for a singular nonlinear  $q$ -difference-differential Cauchy problem

16:45–17:30 Javier Sanz (Univ. Valladolid)

Generalized extension theorems in ultraholomorphic classes in sectors

問い合わせ先: 岡田 靖則 (千葉大)

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## Abstracts

HIDETOSHI TAHARA, Sophia University

### **Asymptotic existence theorem for formal power series solutions of singularly perturbed linear $q$ -difference equations**

In this talk, I will treat singularly perturbed linear  $q$ -difference equations in the complex domain. The purpose is to show the existence of a true solution that has an asymptotic expansion which is just the formal solution obtained by Carrillo-Lastra.

KEN SHIBUSAWA, Chiba University

### **On an extension of the confluent hypergeometric system of Kummer type**

Kimura, Haraoka, and Takano gave the confluent hypergeometric system. They used simultaneous eigenvectors of the adjoint representation of maximal abelian Lie subalgebra associated with the system to define the relevant linear differential operators giving the contiguity relations for the system. In the talk, in the Kummer type, we give an extension of the system and new contiguity relations for this extended system coming from generalized simultaneous eigenvectors. This is a joint work with Kazuki Hiroe and Yasunori Okada in Chiba University.

SHUNYA ADACHI, Chiba University

### **On the Laplace transform for KZ type equations**

In this talk, I will discuss the Laplace transform for KZ (Knizhnik-Zamolodchikov) type equations, which is a class of regular holonomic systems. It will be explained how the Laplace transform changes the equation and the irreducibility. If time permits, I would like to mention the inverse transform.

ALBERTO LASTRA, Universidad de Alcalá (Spain)

### **Meromorphic solutions of linear $q$ -difference equations**

In the talk, we construct explicit meromorphic solutions of first order linear  $q$ -difference equations in the complex domain and we describe the location of all their zeros and poles. The homogeneous case leans on the study of four fundamental equations, providing the previous information in the framework of entire or meromorphic coefficients. The inhomogeneous situation is also considered.

We also address the case of higher-order linear  $q$ -difference equations, using a classical factorization argument.

This is a joint work with P. Remy.

STEPHANE MALEK, University of Lille, FRANCE

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### **Asymptotics and confluence for a singular nonlinear $q$ -difference-differential Cauchy problem**

We examine a family of nonlinear  $q$ -difference-differential Cauchy problems obtained as a coupling of linear Cauchy problems containing dilation  $q$ -difference operators, recently investigated by the author, and quasi-linear Kowalevski type problems that involve contraction  $q$ -difference operators. We build up local holomorphic solutions to these problems. Two aspects of these solutions are explored. One facet deals with asymptotic expansions in the complex time variable for which a mixed type Gevrey and  $q$ -Gevrey structure is exhibited. The other feature concerns the problem of confluence of these solutions as the parameter  $q$  tends to 1.

JAVIER SANZ (joint work with J. JIMÉNEZ-GARRIDO and G. SCHINDL),

University of Valladolid, SPAIN

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### **Generalized extension theorems in ultraholomorphic classes in sectors**

In our framework, an extension theorem provides linear and continuous right inverses for the Borel map, considered from an ultraholomorphic class and into a class of formal power series with prescribed growth for their coefficients. Our first aim is to generalize the extension theorem for Carleman-Roumieu ultraholomorphic classes (i.e. in the weight sequence setting) by V. Thilliez to the context of new Roumieu ultraholomorphic classes defined (in a similar way as Braun-Meise-Taylor ultradifferentiable classes) by means of a weight function.

Secondly, we will show how to treat the mixed setting in both the classical and the new situations, consisting of determining conditions under which the Borel map acts between structures given by different weights (sequences or functions). In order to have control on the opening of the sectors in the Riemann surface of the logarithm for which the extension theorems are valid, we introduce new mixed growth indices, generalizing the known ones for weight sequences and functions and already appearing in the theory of  $O$ -regular variation.