

# 华东师范大学 2017 特殊函数论研讨会日程安排

## 2017 East China Normal University workshop on special functions

地点：华东师大数学系办公楼 401 室

9 月 26 日上午

8:35-8:40	开幕式	
主持人：张瑞明		
8:40-9:30	M. E. H. Ismail	University of Central Florida
题目	Combinatorics of Orthogonal Polynomials	
9:30-10:00	孙智宏	淮阴师范学院
题目	A kind of orthogonal polynomials and related identities	
10:00-10:15	茶歇	
主持人：孙智宏		
10:15-10:45	周海港	同济大学
题目	特殊函数与调和 Maass 形式	
10:45-11:15	王六权	南洋理工大学
题目	Hecke-Rogers Type Identities and False Theta Functions	
11:15-11:30	合影	
11:30-14:00	午餐、午休	

9 月 26 日下午

主持人：马欣荣		
14:00-14:30	汪明瑾	常州大学
题目	A new discrete probability space with applications	
14:30-15:00	张仑	复旦大学
题目	Mixed type multiple orthogonal polynomials associated with the modified Bessel functions	
15:00-15:30	曹健	杭州师范大学
题目	Solutions of $q$ -difference equations and some applications	
15:30-15:50	茶歇	
主持人：郭军伟		
15:50-16:20	夏先伟	江苏大学
题目	Some congruences for Appell-Lerch sums	
16:20-16:50	王瑾	苏州大学
题目	On Andrews-Warnaar's identities of partial theta functions	
17:30	晚宴	

## 9月27日上午

主持人：张之正		
8:30-9:00	张瑞明	西北农林科技大学
题目	On Some 2d Orthogonal $q$ -Polynomials	
9:00-9:30	郭军伟	淮阴师范学院
题目	Some generalizations of a supercongruence of van Hamme	
9:30-10:00	陈士超	河南大学
题目	Periodicity of a Partition Function	
10:00-10:20	茶歇	
主持人：汪明瑾		
10:20-10:50	张之正	洛阳师范学院
题目	Multiple Basic Hypergeometric Series and Their Applications	
10:50-11:20	刘治国	华东师范大学
题目	Elliptic theta functions and Ramanujan series for $1/\pi$	
11:30	午餐	

9月27日下午：自由交流。

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## Abstract

### Combinatorics of Orthogonal Polynomials

Mourad E. H. Ismail

**Abstract:** We discuss some recent combinatorial interpretations of integrals of products of orthogonal polynomials in one and several variables.

### A kind of orthogonal polynomials and related identities

Zhi-Hong Sun

**Abstract:** In this talk we introduce the polynomials  $\{d_n^{(r)}(x)\}$  and  $\{D_n^{(r)}(x)\}$  given by  $d_n^{(r)}(x) = \sum_{k=0}^n \binom{x+r+k}{k} \binom{x-k}{n-k}$  ( $n \geq 0$ ),  $D_0^{(r)}(x) = 1$ ,  $D_1^{(r)}(x) = x$  and

$$D_{n+1}^{(r)}(x) = xD_n^{(r)}(x) - n(n+2r)D_{n-1}^{(r)}(x) \quad (n \geq 1)$$

We show that  $D_n^{(r)}(x)$  are orthogonal polynomials for  $r > -\frac{1}{2}$ , and establish many identities for  $\{d_n^{(r)}(x)\}$  and  $\{D_n^{(r)}(x)\}$ , especially obtain a formula for  $d_n^{(r)}(x)^2$ , and the linearization formulas for  $d_m^{(r)}(x)$  and  $d_n^{(r)}(x)$  and  $D_m^{(r)}(x)$ ,  $D_n^{(r)}(x)$ . As an application we extend recent work of Sun and Guo.

### 特殊函数与调和Maass形式

Hai-Gang Zhou  
(Not available)

### Hecke-Rogers Type Identities and False Theta Functions

Liu-Quan Wang

**Abstract:** In this talk, we present three new identities of the Hecke-Rogers type. The first identity is associated with a definite quadratic form and the other two identities are associated with indefinite quadratic forms. The proofs are based on some amazing formulas of Liu. We will also discuss some new proofs of Ramanujan's identities on false theta functions.

## **A new discrete probability space with applications**

Ming-Jin Wang

Abstract: We first construct a new discrete probability space  $(\Omega; \mathcal{F}; \mathcal{P})$  and then denote a random variable with probability distribution  $W(x; y; q)$  in this space. As applications, we give a probabilistic form of Al-Salam and Verma  $q$ -integral, a new  $q$ -identity of  ${}_3\phi_2$  and the two terms  ${}_3\phi_2$  transformation formula of Sears.

## **Mixed type multiple orthogonal polynomials associated with the modified Bessel functions**

Lun Zhang

Abstract: We consider mixed type multiple orthogonal polynomials associated with a system of weight functions consisted of two vectors. One vector is defined in terms of scaled modified Bessel function of the first kind  $I_\mu$  and  $I_{\mu+1}$ , the other vector is defined in terms of scaled modified Bessel function of the second kind  $K_\nu$  and  $K_{\nu+1}$ . We show that the corresponding mixed type multiple orthogonal polynomials exist. For the special case that each multi-index is on or close to the diagonal, basic properties of the polynomials and their linear forms are investigated, which include explicit formulas, integral representations, differential properties, limiting forms and recurrence relations. It comes out that, for specified parameters, the linear forms of these mixed type multiple orthogonal polynomials can be interpreted as biorthogonal functions encountering in recent studies of products of two coupled random matrices. This particularly implies a Riemann-Hilbert characterization of the correlation kernel, which provides an alternative way for further asymptotic analysis.

## **Solutions of $q$ -difference equations and some applications**

Jian Cao

Abstract: In this talk, we show how to prove identities and evaluate integrals by expanding functions in terms of products of the  $q$ -hypergeometric polynomials by  $q$ -difference equations, we also generalize some results of Liu. In addition, we generalize multilinear and multiple generating functions for the  $q$ -hypergeometric polynomials as applications. Moreover, we deduce some recurring formulas for Ramanujan's integrals, Askey-Roy integrals, Andrews-Askey integrals and moment integrals by the method of homogeneous  $q$ -partial difference equations. Finally, we build the relation of Ismail-Zhang type generating functions for the  $q$ -hypergeometric polynomials by the method of Ismail and Zhang.

## Some congruences for Appell-Lerch sums

Ernest X. W. Xia

Abstract: Recently, Chan proved some congruences and gave several conjectures for Appell-Lerch sums. Wang and Yao proved congruences modulo 2 which generalize some conjectures given by Chan. In this paper, we prove new congruences modulo 4 and 5 for Appell-Lerch sums.

## On Andrews–Warnaar's identities of partial theta functions

Jin Wang

Abstract: In this talk we will give a short survey on recent development of partial theta functions, and then report our latest results on this aspect. Among our new results the most important one is a surprising bivariate representation of partial theta functions, which in turn unifies some famous identities for partial theta functions due to Andrews and Warnaar, et al. but also unveils a new characteristic of such identities. As further applications, we establish a general  $q$ -series transformation associated with Bailey pairs.

## On Some 2d Orthogonal $q$ -Polynomials

Rui-Ming Zhang

Abstract: This talk is based on a joint work with Professor Mourad E. H. Ismail published on AMS Transactions. In this talk I introduce two  $q$ -analogues of the 2d-Hermite polynomials that are polynomials in two complex variables. For both families, I present explicit formulas, raising and lowering operator relations, generating functions, Rodrigues formulas.

## Some generalizations of a supercongruence of van Hamme

Victor J. W. Guo

Abstract: van Hamme conjectured that, for any odd prime  $p$ ,

$$\sum_{k=0}^{(p-1)/2} \frac{4k+1}{(-64)^k} \binom{2k}{k}^3 \equiv p(-1)^{\frac{p-1}{2}} \pmod{p^3}$$

This result was proved by Mortenson using a  ${}_6F_5$  transformation, and was reproved by Zudilin via the Wilf-Zeilberger method. In this paper, we propose a conjectural generalization of van Hamme's supercongruence and prove some special cases, such as

$$\sum_{k=0}^{(p-1)/2} \frac{(4k+1)^3}{(-64)^k} \binom{2k}{k}^3 \equiv -3p(-1)^{\frac{p-1}{2}} \pmod{p^3}$$

where  $p$  is a prime with  $p \equiv 3 \pmod{8}$ . We also state some related conjectures.

## Periodicity of a Partition Function

Shi-Chao Chen

Abstract: Let  $p_c(n)$  be the number of ways to make change for  $n$  cents using pennies, nickels, dimes, and quarters. We will prove that the sequence  $p_c(n) \pmod{1^j}$  is periodic for every prime power  $1^j$ .

## Multiple Basic Hypergeometric Series and Their Applications

Zhi-Zheng Zhang

Abstrac: The theory of basic hypergeometric series consists of many known summation and transformation formulas. These basic hypergeometric series identities frequently appear in combinatorics and in related area such as number theory, physics, and representation theory of Lie algebras. Multiple basic hypergeometric series associated to the unitary group  $A_n$ (or  $U(n + 1)$ ),  $C_n$  and  $D_n$  have been investigated by various authors. Many different types of such series exist in the literature. In this talk, we give that: 1.two new WP-Bailey lattices.2.  $U(n + 1)$  analogue of AAB Bailey lattice (Agarwal, Andrews and Bressoud)and its applications, The  $U(n + 1)$ ,  $C_n$  and elliptic generalizations of WP-Bailey pairs.

## Elliptic theta functions and Ramanujan series for $1/\pi$

Zhi-Guo Liu

Abstrac: In his 1914 paper "Modular Equations and Approximations to  $\pi$ ", Ramanujan listed a total of 17 series for  $1/\pi$ . Ramanujan did not indicate how he arrived at these series but instead hinted that some of these series belonged to the theories of elliptic functions to alternative bases. In 1987, Jonathan and Peter Borwein provided rigorous proofs of Ramanujan for all 17 of Ramanujan series for  $1/\pi$ . The proofs of these series require a sophisticated knowledge of number theory such as modular forms and class invariants. In this talk, I will illustrate with an example that one can derive Ramanujan series only using elliptic theta functions.

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