O P-S F N E T - Volume 30, Number 5 - September 15, 2023

The Electronic News Net of the
SIAM Activity Group on Orthogonal Polynomials and Special Functions

http://math.nist.gov/opsf

OP-SF Net is distributed to OPSF Activity Group members and non-members alike through the OP-SF Talk listserv.

If you are interested in subscribing to the Newsletter and/or OP-SF Talk, or if you would like to submit a topic to the Newsletter or a contribution to OP-SF Talk, please send an email to the OP-SF Net Editors.

Editors:
Howard S. Cohl howard.cohl@nist.gov
Sarah Post spost@hawaii.edu

Topics:

Calendar of Events:

December 14-15, 2023

4th Workshop "Two Days of Orthogonal Polynomials"
University of Almería, Almería, Spain
Dedicated to Guillermo López Lagomasino for his 75th birthday and to
Andrei Martínez Finkelshtein for his 60th birthday.
https://w3.ual.es/GruposInv/Tapo/D2PO-2023/D2PO2023.html

January 3-6, 2024

2024 Joint Mathematics Meetings, American Mathematical Society,
Moscone Center, San Francisco, California, USA
https://www.jointmathematicsmeetings.org/meetings/national/jmm2024/2300_program.html

AWM-AMS Noether Lecture: Anne Schilling: The Ubiquity of Crystal Bases

AMS Special Session on Numerical Analysis, Spectral Graph Theory, Orthogonal Polynomials, and Quantum Algorithms,
Organized by Anastasiia Minenkova, Gamal Mograby, and Anastasiia Minenkova (SS 92A)

AMS Special Session on Partition Theory and q-Series,
Organized by William Jonathan Keith, Brandt Kronholm, and Dennis Eichhorn (SS 30A)

May 27–31, 2024
Asymptotics, Randomness, Nonlinearity, and Orthogonality (ARNO 2024)
ARNO 2024 will also be the 2024 Annual Meeting of the PIICQ network,
Leuven, Belgium
https://gsilva.pages.math.cnrs.fr/arno2024/index.html

June 24–28, 2024
17th International Symposium on Orthogonal Polynomials, Special Functions and Applications (OPSFA–17),
Universidad de Granada, Granada, Spain.
https://opsfa17.com/

July 8–12, 2024
Operator Theory and Approximation 2024
TU Wien, Vienna, Austria
https://haraldworacek.github.io/OTA2024/

Topic #1 ——— OP – SF Net 30.5 ——— September 15, 2023

From: Benjamin Eichinger (benjamin.eichinger@tuwien.ac.at)
Subject: Announcement: Operator Theory and Approximation (OTA 2024)

Dear colleagues and friends,

We are pleased to announce the conference "Operator Theory and Approximation". The conference aims to bring together mathematicians working on spectral theory, complex analysis, approximation theory and related areas, and provide a framework for scientific exchange.

The topics of the conference include:

- Spectral theory of difference and differential operators
- Orthogonal polynomials
- Complex analysis
- Extremal problems of Chebyshev type
- Random matrices
- Integrable systems

When: July 8–12, 2024

Where: TU Wien, Vienna, Austria

Website: https://haraldworacek.github.io/OTA2024/

Registration: Registration and submission of abstracts will open December 1, 2023, and should be done through the website. The registration fee is €200, which includes the conference dinner. Participants who plan to not attend the dinner, should pay a reduced fee of €130.

The conference program consists of invited and contributed talks.
The confirmed plenary speakers are:

- Sergey Denisov
- Pavel Exner
- Arno Kuijlaars
- Matthias Langer
- Ari Laptev

- Marius Lemm
- Mikhail Sodin
- Christiane Tretter
- Peter Yuditskii

More information can be found on the conference website.
If you have special inquiries which are not answered by the information on the website, please use the conference email address: ota2024@tuwien.ac.at

Topic #2 ——— OP - SF Net 30.5 ——— September 15, 2023

From: Guilherme Silva (silvag@usp.br)
Subject: Announcement: Asymptotics, Randomness, Nonlinearity, and Orthogonality (ARNO 2024)

Dear colleagues,

This is the first announcement of the conference Asymptotics, Randomness, Nonlinearity, and Orthogonality 2024 Leuven, Belgium which will occur on May 27–31, 2024.

The synergy of classical analysis and modern mathematical physics has fostered profound developments in asymptotics, randomness, nonlinearity, and orthogonality. This conference aims to explore these and other related topics. Moreover, it will be the occasion to celebrate the deep and influential contributions to these and numerous other topics of Professor Arno Kuijlaars on the occasion of his 60th birthday.

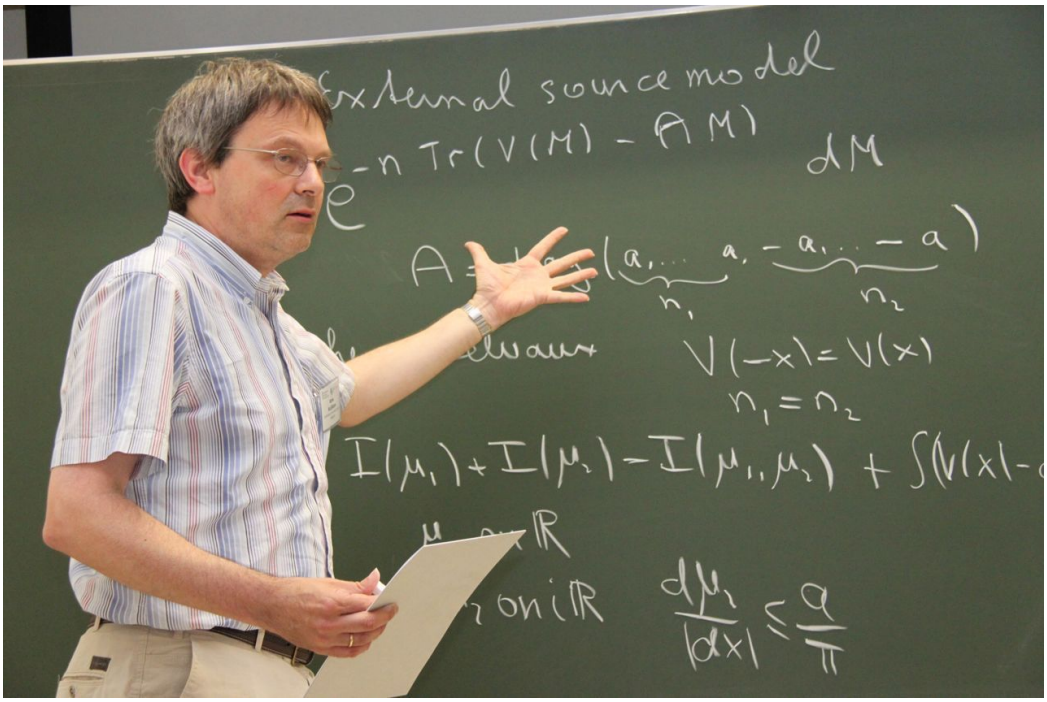

Figure 1: Conference to celebrate Arno Kuijlaars on his 60th birthday.

The conference will also be the 2024 Annual Meeting of the PIICQ network.

The list of speakers (available on the event website) are:

- Gernot Akemann (Bielefeld University, Germany)

- Fanny Augeri (Weizmann Institute of Science, Israel)
- Marco Bertola (Concordia University, Canada)
- Pavel Bleher (IUPUI, USA)
- Thomas Bothner (University of Bristol, UK)
- Alexey Bufetov (Leipzig University, Germany)
- Sunil Chhita (Durham University, UK)
- Vadim Gorin* (UC Berkeley, USA)
- Tamara Grava (University of Bristol, UK; Sissa, Italy)
- Alice Guionnet (ENS Lyon, France)
- Kurt Johansson (KTH Stockholm)
- Mylène Maïda (Université de Lille, France)
- Andrei Martínez-Finkelshtein (Baylor University, USA)
- Marta Mazzocco (University of Birmingham, UK)
- Ken McLaughlin (Tulane University, USA)
- Peter Miller (University of Michigan, USA)
- Lun Zhang (Fudan University, China)

*To be confirmed

Registration will open in early 2024, and we anticipate there will be room in the program for contributed talks. The contribution by people from underrepresented groups, including also young career scientists, is encouraged.

We greatly appreciate it if you share this announcement with researchers that may be interested in the conference.

With our best wishes, Guilherme Silva, in the name of the organizing committee:

Tom Claeys (UC Louvain, Belgium)
Maurice Duits (KTH Stockholm, Sweden)
Manuela Girotti (Emory University, USA)
Leslie Molag (Carlos III University of Madrid, Spain)
Guilherme Silva (Universidade de São Paulo, Brazil)
Walter Van Assche (KU Leuven, Belgium)

Topic #3 ——— OP - SF Net 30.5 ——— September 15, 2023

From: Henrik Pedersen (henrikp@math.ku.dk)
and Jacob Stordal Christiansen (jacob_stordal.christiansen@math.lth.se)
Subject: Report by **Pedersen** and **Christiansen**: ICSTA in Lund, Sweden

The International Conference on Spectral Theory and Approximation (ICSTA) was held in Lund, Sweden on August 14^{th} -18^{th} , 2023.

The main topics were Periodic and Almost Periodic Operators, Extremal Problems, Jacobi and CMV matrices, Orthogonal Polynomials, Schrödinger Operators, Random Matrices and Toeplitz Operators.

The program consisted of eight 50 minute invited lectures by Alexander Pushnitski, Benjamin Eichinger, María Ángeles García-Ferrero, Maxim Zinchenko, Aron Wennman, Wafaa Assaad, Søren Fournais and Arno Kuijlaars, and 18 contributed talks. Around 35 participants attended the conference, including many early career mathematicians. Ample time in the program made room for fruitful discussions.

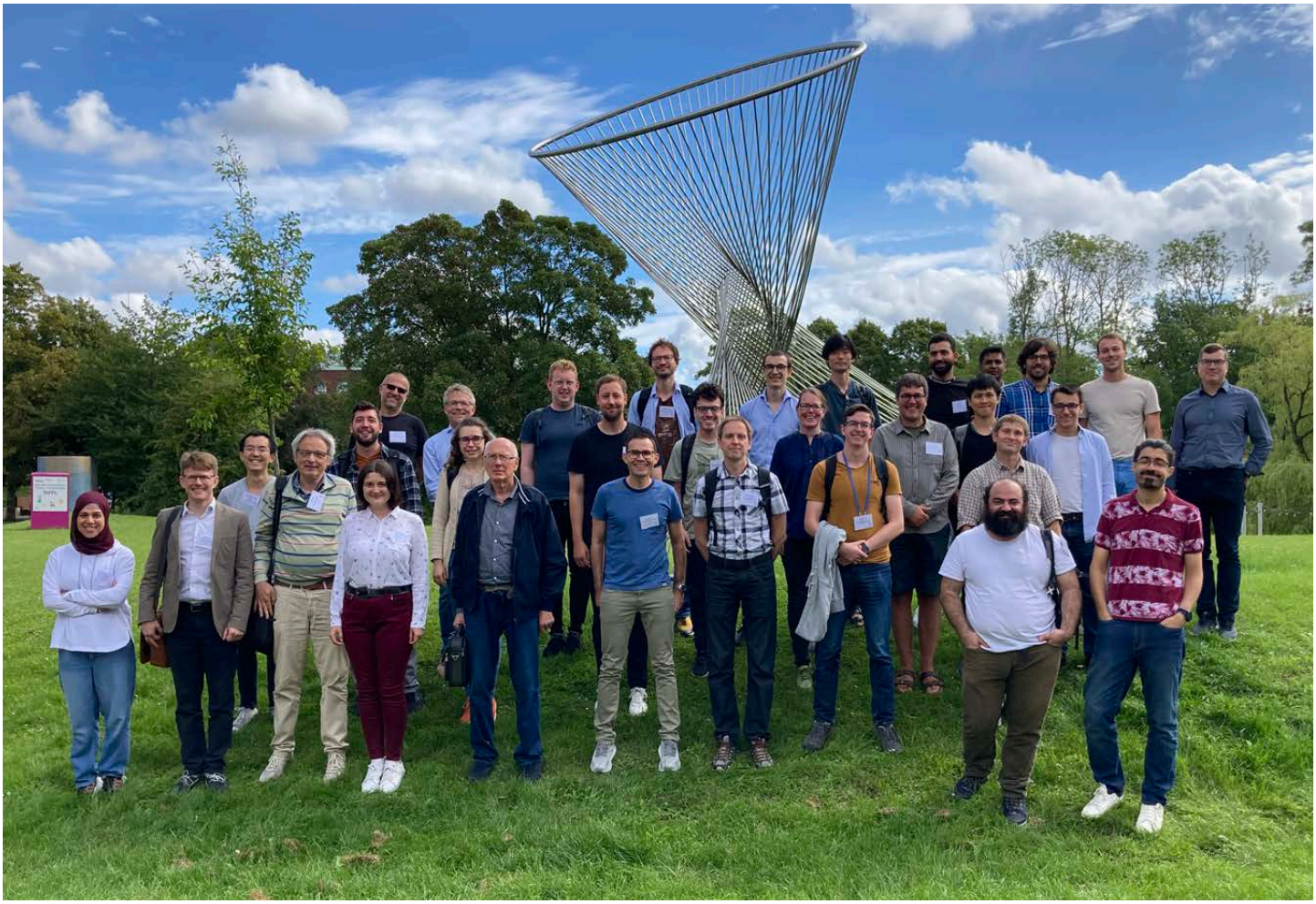

Figure 2: ICSTA group photo.

The conference took place at Lund University. The city of Lund and its key role in history was focus of the excursion to the open air museum "Kulturen" on Tuesday afternoon.

The conference was funded by Vetenskabsrådet and the Crafood Foundation, which gave support and made possible the attendance of a number of young scientists. The scientific committee consisted of Jacob Stordal Christiansen (main organizer, Lund University), Henrik Laurberg Pedersen (University of Copenhagen), Mikael Persson Sundqvist (Lund University), and Frank Wikström (Lund University).

Topic #4 ——— OP - SF Net 30.5 ——— September 15, 2023

From: Sergei Suslov (sergei@asu.edu)
Subject: Report by **Suslov**: Workshop on Quantum Nonstationary Systems in Brasília, Brazil

Dear colleagues,

The Second International Workshop on Quantum Nonstationary Systems took place in Brasília, Brazil from 28th August to 1st September 2023 on occasion of the 75th birthday of Prof. Viktor V. Dodonov.

Topics included are: Cavity and circuit QED, Dynamical Casimir effect, Adiabatic/nonadiabatic evolution, Scattering dynamics, Quantum back reaction, Quantum tomography, Bose-Einstein condensates,

Many-body systems, Open quantum systems, Non-Hermitian systems, Entropy production, Quantum metrology, Phase transition dynamics, Spin dynamics and spintronics, Quantum control, and other time-dependent phenomena.

Figure 3: The conference poster.

The International Center of Physics (ICP) is an academic center linked to the Physics Institute of the University of Brasília, located at the Darcy Ribeiro Campus in Brasília. Its main purpose is to develop research activities, scientific dissemination and exchange and training of personnel, at a high level, both nationally and internationally. One can watch all the videos of the talks from the distinguished invited speakers at the Youtube channel of the ICP: https://www.youtube.com/@cifunb/streams

This includes my talk on "The Kepler Problems and Sommerfeld Puzzle":

https://www.youtube.com/watch?v=s4p6bCADyvU&t=40s

Respectfully, Sergei Suslov

From: Sergei Suslov (sergei@asu.edu)
Subject: Essay: "On Fermi's Oversight" by **Suslov**

On Fermi's Oversight:
On a Seldom Oversight in Fermi's Calculations Almost Seventy Years After

Sergei K. Suslov, School of Mathematical and Statistical Sciences,
Arizona State University, P. O. Box 871804, Tempe, AZ 85287-1804, U.S.A.

We discuss an unfortunate error in the last Fermi lecture notes on quantum mechanics, in a course given at the University of Chicago.

— *To Dr. Miranda Materi*

Enrico Fermi - A Biographical Sketch

Several Fermi's biographies [5], [28][1], [29], [30], recollections [15], [23], [24], [25], historical investigations [17], [18], and the collected works in two volumes [13], [14] had been published after his untimely death in November of 1954 (see also references therein). As is well-known, at the very beginning of his distinguished career, Fermi held a temporary job for the academic year 1923-1924 at the University of Rome, where he taught a mathematics course for chemists and biologists. From 1924 to 1926, Fermi lectured on mathematical physics and mechanics at the University of Florence. During this time, he thoroughly studied Schrödinger's theory through the original publications and privately explained it to his students in seminars. A bit later, he reworked some of Dirac's papers into a more accessible format, partly for didactic purposes [12]. Subsequently, Fermi became a professor of theoretical physics at the University of Rome, the first chair of this kind in Italy, where he taught for 12 years, starting in 1926 [5], [28], [29].

During this period of time, Fermi laid a sound foundation for education in modern physics in Italy (and abroad). He delivered many popular lectures and seminars and wrote a textbook and some articles for *Enciclopedia Italiana Treccani* [13]. His teaching style and personality attracted many talented students to the physics department. The whole generation of physicists worldwide had studied the quantum theory of radiation from his review article [10], which was based on the lectures delivered in the summer of 1930 at the University of Michigan when Fermi visited the United States for the first time. The students recalled a remarkable atmosphere of immense enthusiasm and total dedication to physics and formed lifelong friendships. From as early as 1928, Fermi made little use of books; a collection of mathematical formulas and the tables of physical constants were almost the only reference books he had in his office. If a complicated equation was required in his research or teaching, Fermi could derive it by himself, usually faster than his students could find this result in the library books [29]. An example of research notes is presented in [1].

At the end of the year 1933, Fermi wrote his famous article on the explanation of beta decay. He sent a letter to *Nature* advancing his theory, but it was rejected[2], and, instead, the article Tentative theory of beta rays was published in *Nuovo Cimento* in Italian and in *Zeischrift für Physik* in German [13], [15], [29]. The novel neutron bombardment experiments, systematically reported in *Ricerca Scientifica* letters in the summer of 1934, were equally "... successful escape from the sphere of theoretical physics" (in

[1] The most complete one at the moment.

[2] The editors felt that "it contained abstract speculations too remote from physical reality to be of interest to the reader [30]".

Rutherford's own words [29]). The neutron work, accomplished by that summer, was summarized in an article that was communicated by Lord Rutherford to the Royal Society of London. The subsequent discovery of slow neutron effects is now a part of the nuclear physics history... [5], [11], [14], [15], [17], [18], [23], [28], [29], [30].

The visit to Ann Arbor was a great scientific success, and Fermi returned there in the summers of 1933 and 1935. In the year 1934, he went to Brazil [7]. In 1936, Fermi visited Colombia University for the summer session. Next year, he spent the summer in California [28], lecturing at Berkeley and Stanford, and driving back to New York across the entire country. Through these visits, he grew to appreciate America and the new opportunities it offered. He ultimately relocated to the United States soon after being awarded the Nobel Prize in Physics on December 10, 1938. The subsequent major Fermi contributions to the Manhattan Project [26] and his work for the Atomic Energy Commission [6] are well-documented [28], [29], [30].

Throughout his life, Fermi maintained a strong passion for teaching. He conducted numerous courses and seminars at the University of Rome, Columbia University, Los Alamos Lab, and the University of Chicago. In the winter and spring semesters of his final year, before his untimely death in November, Fermi gave his last quantum mechanics course at the University of Chicago [12]. Subsequently, during the summer of 1954, he traveled to Europe. During his visit, Fermi presented a course on pions and nucleons at the Villa Monastero, located in Varenna on Lake Como. This course was part of the summer school organized by the Italian Physical Society, which now bears his name. Fermi also attended the French summer school at Les Houches near Chamonix, where he delivered lectures [28], [29], [30].[3]

Fermi's Last Lecture Notes

As is well-known, Enrico Fermi's scientific mistakes had a "monumental character" — it is worth noting, for instance, his Nobel Prize controversy and the xenon nuclear reactor poisoning [28] — as it was supposed to be due to the novelty and originality of his research at that new epoch in nuclear physics. At a "personal level" the initial calculation of the "double window effect" in his family Chicago winter house also wasn't that successful [15]. But this list is rather short! On the contrary, Fermi freely shared his deep scientific ideas with colleagues and later was not involved in their publications, some at the Nobel Prize level [28].

We are dealing here with Fermi's original lecture notes for a course Physics 341/342: Quantum Mechanics given at the University of Chicago [12] in the winter and spring of 1954 – two quarters and approximately sixty lectures. At the end of each lecture, Fermi would always make up a problem, which was usually closely related to what he had just discussed that day (this list of problems is available in the Second Edition). For further details on some subjects, Fermi occasionally referred to Leonard Schiff's book, *Quantum Mechanics*, First Edition [27] and also to Enrico Persico's book *Fundamentals of Quantum Mechanics*, First Edition [21] (Fermi's dear friend from his childhood in Italy [29], [30]). These lecture notes, originally written by the past Master and distributed only among his own students as a course material, nowadays already have two English editions and an extended Russian translation [4] [12], which made it available for the entire physics community.

We only discuss his lecture 34 on the free relativistic electron. Our concern is the following — there

[3] From Britannica: Enrico Fermi (born Sept. 29, 1901, Rome, Italy – died Nov. 28, 1954, Chicago, Illinois, U. S. A.), Italian-born American scientist who was one of the chief architects of the nuclear age. He developed the mathematical statistics required to clarify a large class of subatomic phenomena, explored nuclear transformations caused by neutrons, and directed the first controlled chain reaction involving nuclear fission. He was awarded the 1938 Nobel Prize for Physics, and the Enrico Fermi Award of the U.S. Department of Energy is given in his honor. Fermilab, the National Accelerator Laboratory, in Illinois, is named for him, as is fermium, element number 100. https://www.britannica.com/biography/Enrico-Fermi

[4] with some typos corrected; see, for example, the definition of matrix multiplication on pp. 14–15, equation (24), in the handwritten notes

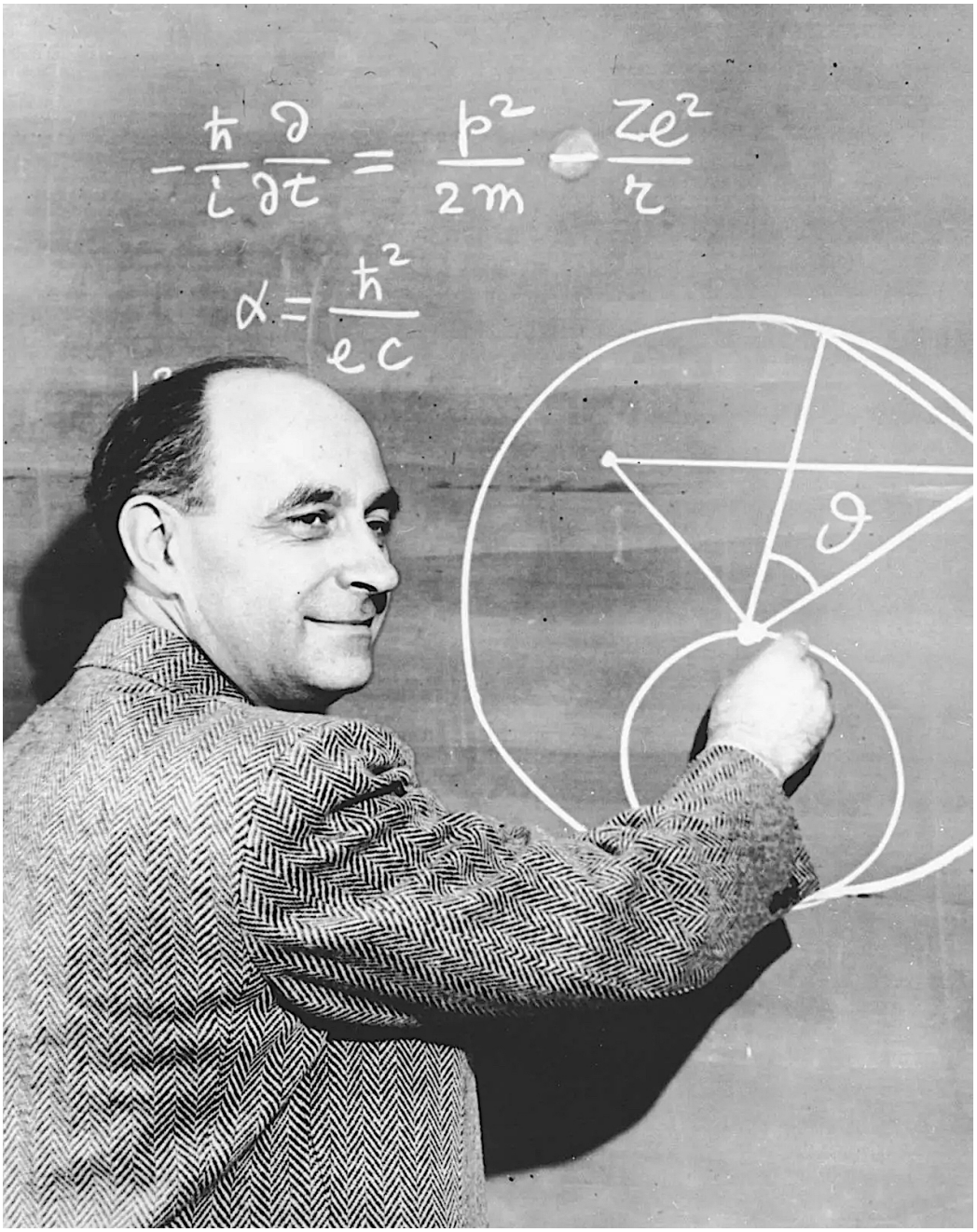

Figure 4: Enrico Fermi teaching quantum mechanics. *Courtesy of Argonne National Lab.* (The second formula is, most likely, his idea of a joke [28]).) https://science.osti.gov/fermi/The-Life-of-Enrico-Fermi/formula

is an unfortunate mistake over there, namely, as it will be shown below (see also [16]), all four bi-spinors (26)-(27) on pp. 34-36 for free spin $1/2$ particle in [12] (see Figures 6-7 for Fermi's handwritten notes below and Appendix B in [16]) correspond to the positive energy eigenvalues $E = E_+ = +R = \sqrt{c^2p^2 + m^2c^4}$. This fact can be verified by a direct substitution into equation (24) on pp. 34-35. For example, in the case of the third bi-spinor $u^{(3)}$ given by equation (27) in Fermi's notes (Figure 7), one

Figure 5: Enrico Fermi hiking with students in New Mexico. *Courtesy of Peter Lax.*

gets, up to a constant, that

$$\begin{pmatrix} mc^2 & 0 & cp_3 & c\,(p_1-\mathrm{i}p_2) \\ 0 & mc^2 & c\,(p_1+\mathrm{i}p_2) & -cp_3 \\ cp_3 & c\,(p_1-\mathrm{i}p_2) & -mc^2 & 0 \\ c\,(p_1+\mathrm{i}p_2) & -cp_3 & 0 & -mc^2 \end{pmatrix} \begin{pmatrix} \dfrac{cp_3}{R-mc^2} \\ \dfrac{c\,(p_1+\mathrm{i}p_2)}{R-mc^2} \\ 1 \\ 0 \end{pmatrix}$$

$$= \begin{pmatrix} cp_3\left(\dfrac{mc^2}{R-mc^2}+1\right) = R\dfrac{cp_3}{R-mc^2} \\ c\,(p_1+\mathrm{i}p_2)\left(\dfrac{mc^2}{R-mc^2}+1\right) = R\dfrac{c\,(p_1+\mathrm{i}p_2)}{R-mc^2} \\ \dfrac{c^2p^2}{R-mc^2} - mc^2 = \dfrac{R^2-m^2c^4}{R-mc^2} - mc^2 = R \\ c\,(p_1+\mathrm{i}p_2)\,\dfrac{cp_3}{R-mc^2} - cp_3\dfrac{c\,(p_1+\mathrm{i}p_2)}{R-mc^2} = 0 \end{pmatrix} = R \begin{pmatrix} \dfrac{cp_3}{R-mc^2} \\ \dfrac{c\,(p_1+\mathrm{i}p_2)}{R-mc^2} \\ 1 \\ 0 \end{pmatrix}.$$

Although Fermi's bi-spinors are normalized, they are not mutually orthogonal. For example,

$$\left(u^{(1)}\right)^\dagger u^{(3)} = \frac{p_3}{|p|}, \qquad \left(u^{(2)}\right)^\dagger u^{(3)} = \frac{p_1+\mathrm{i}p_2}{|p|}$$

("nobody's perfect"!?). As a result,

$$u^{(3)} = \frac{p_3}{|p|}\; u^{(1)} + \frac{p_1+\mathrm{i}p_2}{|p|}\; u^{(2)}$$

and

$$u^{(4)} = \frac{p_1 - \mathrm{i}p_2}{|p|}\, u^{(1)} - \frac{p_3}{|p|}\, u^{(2)},$$

as one can easily verify in a similar fashion. In terms of the helicity operator,

$$\left(u^{(3)}, u^{(4)}\right) = \left(u^{(1)}, u^{(2)}\right)(\sigma \cdot n), \quad n = \frac{p}{|p|}$$

(we have used the standard Pauli matrices [2], [4], [19], [22]).

The correct answer can be obtained by replacing $R \to -R$ in the last two original Fermi bi-spinors, with a proper change of the normalization, of course. This result is presented, for instance, in [21], [27] (with $H \to -H$), and verified in the Mathematica file posted at https://community.wolfram.com/groups/-/m/t/2933767. Once again, the original Fermi's bi-spinors are linearly dependent because the corresponding 4×4 determinant equals zero (see also our complementary Mathematica notebook for the detailed calculations; available from the author by request).

In his lecture notes (see Figure 7 below), Fermi also states that "for $|p| \ll mc$, the third and fourth components of the positive energy solutions $u^{(1)}$ and $u^{(2)}$ are very small; and the first and second components of the negative energy[5] solutions $u^{(3)}$ and $u^{(4)}$ are also very small (on the order of p/mc)". This is true only for the first two bi-spinors. On the contrary, one can easily verify that, in Fermi's normalization,

$$\left(u^{(3)},\ u^{(4)}\right) \to \begin{pmatrix} \dfrac{\sigma \cdot p}{|p|} \\ \mathbf{0} \end{pmatrix} = \begin{pmatrix} \dfrac{p_3}{|p|} & \dfrac{p_1 - ip_2}{|p|} \\ \dfrac{p_1 + ip_2}{|p|} & -\dfrac{p_3}{|p|} \\ 0 & 0 \\ 0 & 0 \end{pmatrix}, \quad c \to \infty.$$

It's unclear how those mistakes were made by Fermi himself and why his students never corrected them, although, there is a similarity with Persico's book [21]. It appears that a more general concept of the helicity states for electrons and positrons and the corresponding polarization density matrices were never discussed in Fermi's introductory quantum mechanics course.

The bottom line is that those formulas, unfortunately, were copied without proper verification into the second English edition of the lecture notes and also appeared in the Russian translation, which has extensive comments on Fermi's original handwritings. Some physicists believe that the second formula, for α, in the Figure 4 is, most likely, Fermi's idea of a joke. But it does not seem to be the case here?! Dick Askey used to like to say that, "if there is a formula in a book (or lecture notes — SKS), something like that should be true", meaning that one has to derive this result on her or his own.

In the last three lectures 35–36–37, Fermi discussed introduction of the electromagnetic field into the theory of relativistic Dirac particles, motion in central field and the ground state of hydrogen atom, as well as the nonrelativistic limit, magnetic moment, and Thomas correction. Lorentz invariance and charge conjugation are also studied, although these topics are usually discussed in the quantum field theory courses [2], [4], [19], [22].

Relativistic helicity states of Dirac's free particles and the polarization density matrices are discussed in detail in [2], [4], [16], [19], [22]. Relativistic Coulomb problems are considered in [2], [3], [4], [8], [9], [12], [20], [27], [31] (see also the references therein). Computer algebra methods are utilized in [9], [16], and elsewhere (see also our complementary Mathematica notebook for the detailed calculations of all formulas derived in this note).

Acknowledgments. The author is grateful to Ruben Abagyan, Maria Aksenteva, Kamal Barley, Howard Cohl, Viktor Dodonov, Ben Goren, Sergey Kryuchkov, Aryadev Padhi, Oleg Poluektov, Eugene Stepanov, and Alexei Zhedanov for valuable comments, discussions, and help.

[5] As observed in [16], all four Fermi's bi-spinors correspond to the positive energy eigenvalues.

(13) is written also

(20) $E\psi = H\psi$

(21) H = hamiltonian

$$H = mc^2\beta + c\,\vec{\alpha}\cdot\vec{p}$$

Time indep. equation for $\psi = \begin{vmatrix} \psi_1 \\ \psi_2 \\ \psi_3 \\ \psi_4 \end{vmatrix}$

(22)
$$\begin{cases} E\psi_1 = mc^2\psi_1 + \frac{c\hbar}{i}\left\{\frac{\partial\psi_4}{\partial x} - i\frac{\partial\psi_4}{\partial y} + \frac{\partial\psi_3}{\partial z}\right\} \\ E\psi_2 = mc^2\psi_2 + \frac{c\hbar}{i}\left\{\frac{\partial\psi_3}{\partial x} + i\frac{\partial\psi_3}{\partial y} - \frac{\partial\psi_4}{\partial z}\right\} \\ E\psi_3 = -mc^2\psi_3 + \frac{c\hbar}{i}\left\{\frac{\partial\psi_2}{\partial x} - i\frac{\partial\psi_2}{\partial y} + \frac{\partial\psi_1}{\partial z}\right\} \\ E\psi_4 = -mc^2\psi_4 + \frac{c\hbar}{i}\left\{\frac{\partial\psi_1}{\partial x} + i\frac{\partial\psi_1}{\partial y} - \frac{\partial\psi_2}{\partial z}\right\} \end{cases}$$

Also time dep. Schr. eq by $E \to i\hbar\frac{\partial}{\partial t}$

Plane wave solution. Take

(23) $$\psi = \begin{vmatrix} u_1 \\ u_2 \\ u_3 \\ u_4 \end{vmatrix} e^{\frac{i}{\hbar}\vec{p}\cdot\vec{x}}$$

$\vec{p}$ now a numerical vector

$u_1\ u_2\ u_3\ u_4$ are constants.

Substitute in (22) (Divide by common exp. factor)

(24)
$$\begin{cases} Eu_1 = mc^2u_1 + c(p_x - ip_y)u_4 + cp_z u_3 \\ Eu_2 = mc^2u_2 + c(p_x + ip_y)u_3 - cp_z u_4 \\ Eu_3 = -mc^2u_3 + c(p_x - ip_y)u_2 + cp_z u_1 \\ Eu_4 = -mc^2u_4 + c(p_x + ip_y)u_1 - cp_z u_2 \end{cases}$$

Four homog. linear eq. for $u_1\ u_2\ u_3\ u_4$.

Require det = 0. One finds e.v's of E

(25) $E = +\sqrt{m^2c^4 + c^2p^2}$ twice and $E = -\sqrt{m^2c^4 + c^2p^2}$ twice

Figure 6: Pages 34–35 of Fermi's lecture notes [12]: Dirac's equation and the eigenvalue problem.

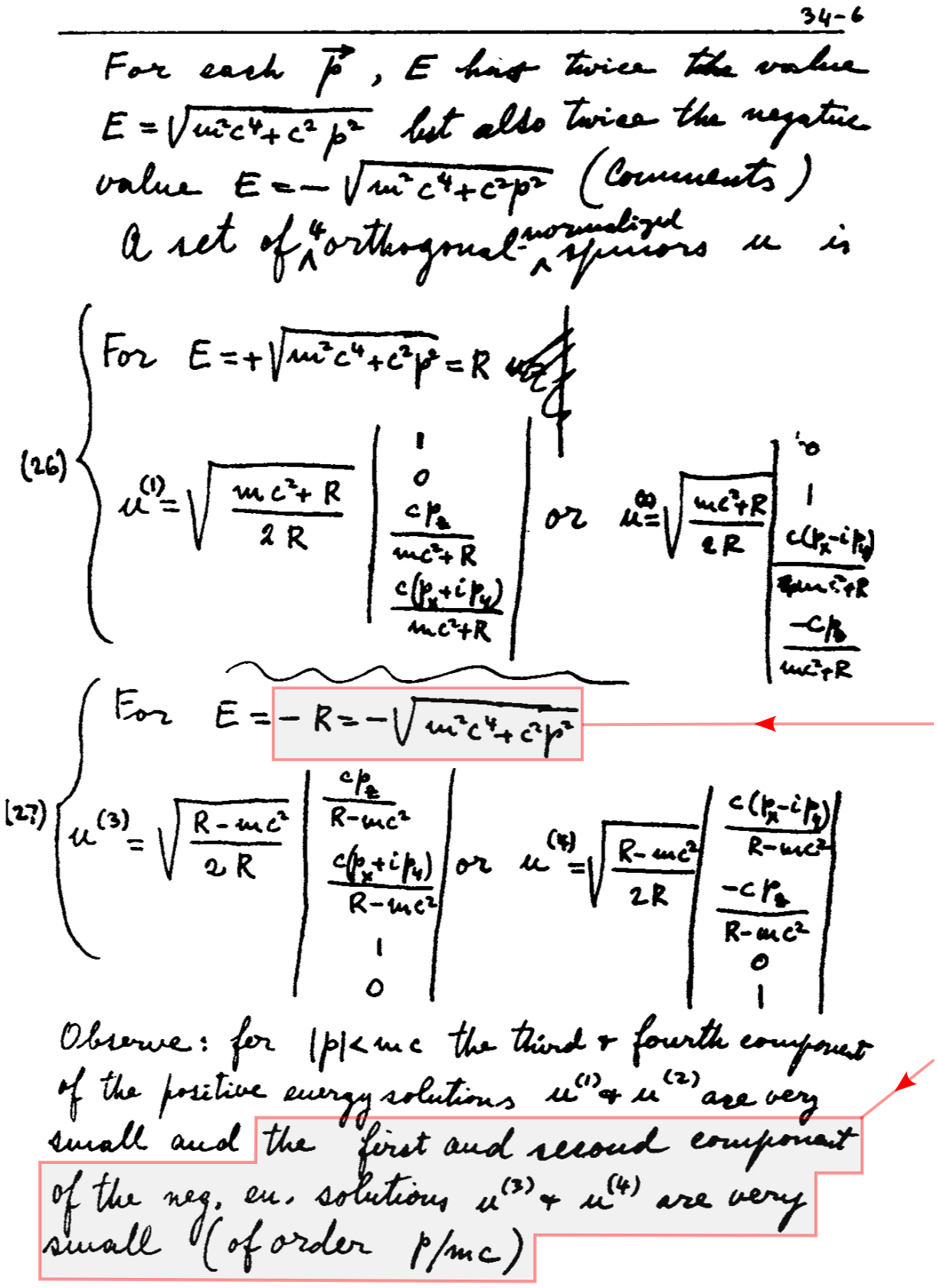

Figure 7: Pages 34–36 of Fermi's lecture notes [12]: observe that both bi-spinors (27) also correspond to $E = +R$.

Bibliography

[1] H. L. Anderson and S. K. Allison, From professor's Fermi notebooks, Rev. Mod. Phys. **27** (3), 273–275 (1955). (A memorial issue of the journal.) https://journals.aps.org/rmp/abstract/10.1103/RevModPhys.27.273

[2] A. I. Akhiezer and V. B. Berestetskii, *Quantum Electrodynamics*, Interscience, New York, 1965.

[3] K. Barley, J. Vega-Guzmán, A. Ruffing, and S. K. Suslov, Discovery of the relativistic Schrödinger equation, Physics-Uspekhi, **65**(1), 90–103, 2022 [in English]; **192**(1), 100–114, 2022 [in Russian]. https://iopscience.iop.org/article/10.3367/UFNe.2021.06.039000

[4] V. B. Berestetskii, E. M. Lifshitz, and L. P. Pitaevskii, *Relativistic Quantum Theory*, Pergamon Press, Oxford, 1971.

[5] G. Bruzzaniti, *Enrico Fermi: The Obedient Genius*, Springer, New York, Heidelberg, Dordrecht, London, 2016.

[6] A. Buck, The Atomic Energy Commission, The U.S. Department of Energy, The Office of Management, July 1983. https://www.energy.gov/management/articles/history-atomic-energy-commission

[7] I. de Castro Moreira, A viagem de Fermi ao Brasil em 1934 e suas entrevistas e conferôncias, Revista Brasileira de Ensino de Física, **44**, e20220204 (2022) [in Portuguese]. https://www.scielo.br/j/rbef/a/HWWXfqTppL3RG7TJ9GcYzyB/?lang=pt

[8] A. S. Davydov, *Quantum Mechanics*, Pergamon Press, Oxford and New York, 1965.

[9] L. Ellis, I. Ellis, C. Koutschan, and S. K. Suslov, On Potentials Integrated by the Nikiforv-Uvarov Method, to appear in: *Hypergeometric functions, q-series and generalizations*, Contemporary Mathematics, (H. S. Cohl, R. S. Costas-Santos, and R. S. Maier, eds.), American Mathematical Society, Providence, arXiv:2303.02560. https://arxiv.org/abs/2303.02560

[10] E. Fermi, The quantum theory of radiation, Rev. Mod. Phys. **4** (1), 87–132 (1932). https://journals.aps.org/rmp/abstract/10.1103/RevModPhys.4.87

[11] E. Fermi, *Conferenze Di Fisica Atomica*, Roma, Accademia dei Lincei 1950 [in Italian]; *Lectures on Atomic Physics*, Foreign Languages Publishing House, Moscow, 1950 (First Edition), R&C Dynamics, Izhevsk, 2001 (Second Edition) [in Russian].

[12] E. Fermi, *Notes on Quantum Mechanics*, Second Edition, with Problems Compiled by R. A. Schuter, University of Chicago Press, Chicago and London, 1961 (First edition), 1995 (Second edition); Mir, Moscow, 1965 (First Edition), R&C Dynamics, Izhevsk, 2000 (Second Edition) [in Russian]; see also review of 2nd English edition by David Griffiths, Am. J. Phys. **64** (4), 510–511 (1996). https://doi.org/10.1119/1.18461

[13] E. Fermi, *Note E Memoire (Collected Papers)*, Vol. I, Italia 1921–1938, Academia Nazionale Dei Lingei – Roma, University of Chicago Press, Chicago, E Londra, 1962.

[14] E. Fermi, *Note E Memoire (Collected Papers)*, Vol. II, United States 1939–1954, Academia Nazionale Dei Lingei – Roma, University of Chicago Press, Chicago, E Londra, 1965.

[15] L. Fermi, *Atoms in the Family. My Fife with Enrico Fermi*, University of Chicago Press, Chicago and London, 1954 (First edition), 1961 (Paperback edition) [in Russian]. https://coollib.com/b/323110/read

[16] B. Goren, K. K. Barley, and S. K. Suslov, Matrix approach to helicity states of Dirac free particles, arXiv:2212.11994. https://arxiv.org/abs/2212.11994

[17] F. Guerra and N. Robotti, *The Lost Notebook of Enrico Fermi. The True Story of the Discovery of Neutro-Induced Radioactivity*, Springer Nature, Berlin, Cham, Switzerland, 2018.

[18] F. Guerra, M. Leone, and N. Robotti, Enrico Fermi's discovery of neutron-induced artificial adioactivity: a case of "emanation" from "divine providence", Phys. Perspect. **22** (July 6), 129–161 (2020). https://link.springer.com/article/10.1007/s00016-020-00258-w

[19] A. N. Moskalev, *Relativistic Field Theory*, PIYaF RAN = Peterburgskiy Institut Yadernoy Fiziki, St. Petersburg, 2006 [in Russian].

[20] A. F. Nikiforov and V. B. Uvarov, *Special Functions of Mathematical Physics: A Unified Introduction with Applications*, Birkhäuser, Boston, MA, 1988.

[21] E. Persico, *Fundamentals of Quantum Mechanics*, Prentice-Hall, Englewood Cliff, N. J., 1950. https://archive.org/details/dli.ernet.15015/page/n5/mode/2up

[22] M. E. Peskin and D. V. Schroeder, *An Introduction to Quantum Field Theory*, Westview Press, 1995.

[23] B. M. Pontecorvo, Enrico Fermi (1901–1954), Physics-Uspekhi, **57** (3), 349–359, 1955 [in Russian]. https://ufn.ru/ru/articles/1955/11/a/

[24] B. M. Pontecorvo, Enrico Fermi: Ricordi d'allievi e amici, Pordenone, Edizione Studio Tei, 1993 [in Italian].

[25] B. M. Pontecorvo, Fermi e la fisica moderna, Naples, La Citta del Sole, 2004 [in Italian].

[26] B. C. Reed, Resource letter MP-4: The Manhattan project and related nuclear research, Am. J. Phys. **91** (7), 495–509 (2023). https://doi.org/10.1119/5.0149901

[27] L. I. Schiff, *Quantum Mechanics*, 3rd edn. International series in pure and applied physics. McGraw-Hill, Inc., New York, 1968.

[28] D. N. Schwartz, *The Last Man Who Knew Everything. The Life and Times of Enrico Fermi, Father of the Nuclear Age*, Basic Books, Hachette Book Group, New York, 2017.

[29] E. Segrè, *Enrico Fermi, Physicist*, The University of Chicago Press, Chicago and London, 1970.

[30] G. Segrè and B. Hoerlin, *The Pope of Physics: Enrico Fermi and the Birth of the Atomic Age*, Henry Holt and Co., New York, 2016.

[31] S. K. Suslov, J. M. Vega-Guzmán, and K. Barley, An Introduction to Special Functions with Some Applications to Quantum Mechanics, in: *Orthogonal Polynomials* (M. Foupouagnigni and W. Koepf, eds.), AIMSVSW 2018. Tutorials, Schools, and Workshops in the Mathematical Sciences, Birkhäuser, Cham, 2020. https://doi.org/10.1007/978-3-030-36744-2_21

From: OP-SF Net Editors
Subject: Preprints in arXiv.org

The following preprints related to the fields of orthogonal polynomials and special functions were posted or cross-listed to one of the subcategories of arXiv.org during July and August 2023. This list has been separated into two categories.

OP-SF Net Subscriber E-Prints

http://arxiv.org/abs/2307.00566
Proof of an explicit formula for a series from Ramanujan's Notebooks via tree functions
Ming-Jian Ding, Jiang Zeng

http://arxiv.org/abs/2307.00570
Some identities involving q-Stirling numbers of the second kind in type B
Ming-Jian Ding, Jiang Zeng

http://arxiv.org/abs/2307.01839
Sharp Bernstein inequalities on simplex
Yan Ge, Yuan Xu

http://arxiv.org/abs/2307.01912
Yay for Determinants!
Tewodros Amdeberhan, Christoph Koutschan, Doron Zeilberger

http://arxiv.org/abs/2307.01921
On the cumulative distribution function of the variance-gamma distribution
Robert E. Gaunt

http://arxiv.org/abs/2307.02385
Symmetry and Pieri rules for the bisymmetric Macdonald polynomials
Manuel Concha, Luc Lapointe

http://arxiv.org/abs/2307.03140
Greedy Matching in Optimal Transport with concave cost
Andrea Ottolini, Stefan Steinerberger

http://arxiv.org/abs/2307.03345
Absence of logarithmic enhancement in the entanglement scaling of free fermions on folded cubes
Pierre-Antoine Bernard, Zachary Mann, Gilles Parez, Luc Vinet

http://arxiv.org/abs/2307.03350
Generalizations (in the spirit of Koshliakov) of some formulas from Ramanujan's Lost Notebook
Pedro Ribeiro, Semyon Yakubovich

http://arxiv.org/abs/2307.03418
Rank deviations for overpartitions
Jeremy Lovejoy, Robert Osburn

http://arxiv.org/abs/2307.03857
Intermediate Jacobi polynomials for the root system of type BC1
Max van Horssen, Maarten van Pruijssen

http://arxiv.org/abs/2307.04373
A determinant approach for generalized q-Bernoulli polynomials and asymptotic results
S. Z. H. Eweis, Z. S. I. Mansour

http://arxiv.org/abs/2307.04464
Inequalities for trigonometric sums
Horst Alzer, Man Kam Kwong

http://arxiv.org/abs/2307.04884
A q-Chaundy representation for the product of two nonterminating basic hypergeometric series and its symmetric generating functions
Howard S. Cohl, Roberto S. Costas-Santos

http://arxiv.org/abs/2307.05120
Log-concavity for unimodal sequences
Walter Bridges, Kathrin Bringmann

http://arxiv.org/abs/2307.05160
Characters of classical groups, Schur-type functions, and discrete splines
Grigori Olshanski

http://arxiv.org/abs/2307.06517
A raising operator formula for Macdonald polynomials
Jonah Blasiak, Mark Haiman, Jennifer Morse, Anna Pun, George Seelinger

http://arxiv.org/abs/2307.06574
Askey-Wilson signed measures and open ASEP in the shock region
Yizao Wang, Jacek Wesolowski, Zongrui Yang

http://arxiv.org/abs/2307.06668
Charting the q-Askey scheme. III. Verde-Star scheme for $q = 1$
Tom H. Koornwinder

http://arxiv.org/abs/2307.06786
Notes for Neighborly Partitions
Kathleen O'Hara, Dennis Stanton

http://arxiv.org/abs/2307.07833
A Q-polynomial structure for the Attenuated Space poset $\mathcal{A}_q(N, M)$
Paul Terwilliger

http://arxiv.org/abs/2307.07968
General q-series transformations based on Abel's lemma on summation by parts and their applications
Jianan Xu, Xinrong Ma

http://arxiv.org/abs/2307.08002
Infinite elliptic hypergeometric series: convergence and difference equations
D. I. Krotkov, V. P. Spiridonov

http://arxiv.org/abs/2307.08075
Toda and Laguerre-Freud equations and tau functions for hypergeometric discrete multiple orthogonal polynomials
Itsaso Fernández-Irisarri, Manuel Mañas

http://arxiv.org/abs/2307.08081
Banded matrices and their orthogonality
Amílcar Branquinho, Ana Foulquié-Moreno, Manuel Mañas

http://arxiv.org/abs/2307.09277
Recurrence coefficients for orthogonal polynomials with a logarithmic weight function
Percy Deift, Mateusz Piorkowski

http://arxiv.org/abs/2307.09581
Symmetrization process and truncated orthogonal polynomials
Diego Dominici, Juan C. García-Ardila, Francisco Marcellán

http://arxiv.org/abs/2307.09919
Criticality transition for positive powers of the discrete Laplacian on the half line
Borbala Gerhat, David Krejcirik, Frantisek Stampach

http://arxiv.org/abs/2307.10331
Epilegomena to the study of semiclassical orthogonal polynomials
K. Castillo, D. Mbouna

http://arxiv.org/abs/2307.10668
A Generalized Pell's equation for a class of multivariate orthogonal polynomials
Jean-Bernard Lasserre, Yuan Xu

http://arxiv.org/abs/2307.10821
Expansions of averaged truncations of basic hypergeometric series
Michael J. Schlosser, Nian Hong Zhou

http://arxiv.org/abs/2307.11217
Painlevé-III Monodromy Maps Under the $D_6 \to D_8$ Confluence and Applications to the Large-Parameter Asymptotics of Rational Solutions
Ahmad Barhoumi, Oleg Lisovyy, Peter D. Miller, Andrei Prokhorov

http://arxiv.org/abs/2307.12164
The Jacobi operator on $(-1,1)$ and its various m-functions
Fritz Gesztesy, Lance L. Littlejohn, Mateusz Piorkowski, Jonathan Stanfill

http://arxiv.org/abs/2307.12921
An elliptic extension of the multinomial theorem
Michael J. Schlosser

http://arxiv.org/abs/2307.13119
Integrable operators, $\overline{\partial}$-Problems, KP and NLS hierarchy
Marco Bertola, Tamara Grava, Giuseppe Orsatti

http://arxiv.org/abs/2307.15415
On a moment generalization of some classical second-order differential equations generating classical orthogonal polynomials
Edmundo J. Huertas, Alberto Lastra, Víctor Soto-Larrosa

http://arxiv.org/abs/2307.16069
Lots and Lots of Perrin-Type Primality Tests and Their Pseudo-Primes
Robert Dougherty-Bliss, Doron Zeilberger

http://arxiv.org/abs/2308.00182
Finite Markov chains and multiple orthogonal polynomials
Amílcar Branquinho, Juan E. F. Díaz, Ana Foulquié-Moreno, Manuel Mañas

http://arxiv.org/abs/2308.00694
Single radius spherical cap discrepancy via gegenbadly approximable numbers
Dmitriy Bilyk, Michelle Mastrianni, Stefan Steinerberger

http://arxiv.org/abs/2308.00713
A Guide to the Risk-Averse Gambler and Resolving the St. Petersburg Paradox Once and For All
Lucy Martinez, Doron Zeilberger

http://arxiv.org/abs/2308.00901
Higher-order degenerate harmonic numbers related to degenerate Riemann zeta function
Taekyun Kim, Dae San Kim

http://arxiv.org/abs/2308.01288
Bidiagonal factorization of the recurrence matrix for the Hahn multiple orthogonal polynomials
Amílcar Branquinho, Juan E. F. Díaz, Ana Foulquié-Moreno, Manuel Mañas

http://arxiv.org/abs/2308.01388
A formula and sharp estimates for the Dunkl kernel for the root system A_2
P. Graczyk, P. Sawyer

http://arxiv.org/abs/2308.01522
The number of $\mathbb{F}_q$-points on diagonal hypersurfaces with monomial deformation
Dermot McCarthy

http://arxiv.org/abs/2308.01955
Triple-Spherical Bessel Function Integrals with Exponential and Gaussian Damping: Towards an Analytic N-Point Correlation Function Covariance Model
Jessica Chellino, Zachary Slepian

http://arxiv.org/abs/2308.02863
On some hypergeometric Sobolev orthogonal polynomials with several continuous parameters
Sergey M. Zagorodnyuk

http://arxiv.org/abs/2308.03246
Asymptotics of Hankel Determinants for Some Freud Weights
Chao Min, Liwei Wang, Yang Chen

http://arxiv.org/abs/2308.03452
Complex-plane singularity dynamics for blow up in a nonlinear heat equation: analysis and computation
M. Fasondini, J. R. King, J. A. C. Weideman

http://arxiv.org/abs/2308.03561
Bidiagonal matrix factorisations associated with symmetric multiple orthogonal polynomials and lattice paths
Hélder Lima

http://arxiv.org/abs/2308.04362
New closed forms for a class of digamma series and integrals
Abdulhafeez A. Abdulsalam

http://arxiv.org/abs/2308.05766
Hypergeometric integrals, hook formulas and Whittaker vectors
G. Felder, A. Smirnov, V. Tarasov, A. Varchenko

http://arxiv.org/abs/2308.06135
A note on differential equations of logistic type
G. Dattoli, R. Garra

http://arxiv.org/abs/2308.06363
Particles and $p-$adic integrals of Spin$(\frac{1}{2})$: spin Lie group, $\mathcal{R}(\rho,q)-$gamma and $\mathcal{R}(\rho,q)-$ beta functions, ghost and applications
Mahouton Norbert Hounkonnou, Francis Atta Howard, Kinvi Kangni

http://arxiv.org/abs/2308.06800
Some q-Identities derived by the ordinary derivative operator
Jin Wang, Ruiqi Ruan, Xinrong Ma

http://arxiv.org/abs/2308.06863
Boundary dents, the arctic circle and the arctic ellipse
Mihai Ciucu, Christian Krattenthaler

http://arxiv.org/abs/2308.07011
Unique special solution for discrete Painlevé II
Walter Van Assche

http://arxiv.org/abs/2308.07642
Some experimental observations about Hankel determinants of convolution powers of Catalan numbers
Johann Cigler

http://arxiv.org/abs/2308.08266
A recurrence relation for generalised connection coefficients
Jing Gao, Arieh Iserles

http://arxiv.org/abs/2308.10332
Boson Operator Ordering Identities from Generalized Stirling and Eulerian Numbers
Robert S. Maier

http://arxiv.org/abs/2308.11061
Spin models and distance-regular graphs of q-Racah type
Kazumasa Nomura, Paul Terwilliger

http://arxiv.org/abs/2308.11556
Odd unimodal sequeneces
Kathrin Bringmann, Jeremy Lovejoy

http://arxiv.org/abs/2308.11637
Classical values of Zeta, as simple as possible but not simpler
Olga V. Holtz

http://arxiv.org/abs/2308.12809
Matrix elements of $SO(3)$ in sl_3 representations as bispectral multivariate functions
Nicolas Crampe, Julien Gaboriaud, Loïc Poulain d'Andecy, Luc Vinet

http://arxiv.org/abs/2308.13583
Orthogonality of the big -1 Jacobi polynomials for non-standard parameters
Howard S. Cohl, Roberto S. Costas-Santos

http://arxiv.org/abs/2308.13652
Multi-integral representations for Jacobi functions of the first and second kind
Howard S. Cohl, Roberto S. Costas-Santos

http://arxiv.org/abs/2308.14183
Combinatorial Identities for Vacillating Tableaux
Zhanar Berikkyzy, Pamela E. Harris, Anna Pun, Catherine Yan, Chenchen Zhao

http://arxiv.org/abs/2308.14490
Efficient least squares approximation and collocation methods using radial basis functions
Yiqing Zhou, Daan Huybrechs

http://arxiv.org/abs/2308.14728
Proofs of Mizuno's Conjectures on Generalized Rank Two Nahm Sums
Boxue Wang, Liuquan Wang

http://arxiv.org/abs/2308.15013
Some identities on degenerate harmonic and degenerate higher-order harmonic numbers
Taekyun Kim, Dae San Kim

http://arxiv.org/abs/2308.16014
Lubinsky inequality associated with certain measures in the Marcellán class
Vikash Kumar, A. Swaminathan

http://arxiv.org/abs/2308.16051
Differential equations for approximate solutions of Painlevé equations: Application to the algebraic solutions of the Painlevé-III (D_7) equation
Robert J. Buckingham, Peter D. Miller

http://arxiv.org/abs/2308.16144
Short proofs of Ramanujan-like identities for the eighth order mock theta function $V_0(q)$
Eric T. Mortenson

http://arxiv.org/abs/2308.16366
The double dihedral Dunkl total angular momentum algebra
Marcelo De Martino, Alexis Langlois-Rémillard, Roy Oste

http://arxiv.org/abs/2308.16782
Some new results on Minuscule polynomial of type A
Ming-Jian Ding, Jiang Zeng

Other Relevant OP-SF E-Prints

http://arxiv.org/abs/2307.00346
A Menon-type Identity derived using Cohen-Ramanujan sum
Arya Chandran, K. Vishnu Namboothiri

http://arxiv.org/abs/2307.00502
Lipschitz and Triebel-Lizorkin spaces, commutators in Dunkl setting
Yongsheng Han, Ming-Yi Lee, Ji Li, Brett D. Wick

http://arxiv.org/abs/2307.01239
One functional property of the ς-function of Riemann
Azimbay Sadullaev

http://arxiv.org/abs/2307.01254
Riemann zeros as quantized energies of scattering with impurities
Andre LeClair, Giuseppe Mussardo

http://arxiv.org/abs/2307.01424
Two error bounds of the elliptic asymptotics for the fifth Painlevé transcendents
Shun Shimomura

http://arxiv.org/abs/2307.01625
Joint moments of higher order derivatives of CUE characteristic polynomials I: asymptotic formulae
Jonathan P. Keating, Fei Wei

http://arxiv.org/abs/2307.01631
The River Model of Gravitational Collapse
Soumya Chakrabarti

http://arxiv.org/abs/2307.01749
A numerical method for wave-structure interactions in the Boussinesq regime
Geoffrey Beck, David Lannes, Lisl Weynans

http://arxiv.org/abs/2307.02027
A probabilistic interpretation for central zeros of L-functions in the Selberg class
Takashi Nakamura, Masatoshi Suzuki

http://arxiv.org/abs/2307.02080
Resurgent Structure of the Topological String and the First Painlevé Equation
Kohei Iwaki, Marcos Marino

http://arxiv.org/abs/2307.02124
Peter-Weyl theorem for Iwahori groups and highest weight categories
Evgeny Feigin, Anton Khoroshkin, Ievgen Makedonskyi, Daniel Orr

http://arxiv.org/abs/2307.02307
The refined solution to the Capelli eigenvalue problem for $\mathfrak{gl}(m|n) \oplus \mathfrak{gl}(m|n)$ and $\mathfrak{gl}(m|2n)$
Mengyuan Cao, Monica Nevins, Hadi Salmasian

http://arxiv.org/abs/2307.02344
Applying the Resonance Method to Re $\left(e^{-i\theta} \log \zeta(\sigma + it)\right)$
Mikko Jaskari

http://arxiv.org/abs/2307.02370
A generalization of formal multiple zeta values related to multiple Eisenstein series and multiple q-zeta values
Annika Burmester

http://arxiv.org/abs/2307.03065
Quantum Complexity for Discrete Logarithms and Related Problems
Minki Hhan, Takashi Yamakawa, Aaram Yun

http://arxiv.org/abs/2307.03076
Arctic curves of the four-vertex model
I. N. Burenev, F. Colomo, A. Maroncelli, A. G. Pronko

http://arxiv.org/abs/2307.03100
Note on a numerical equality regarding the eta invariant on Berger spheres
J. S. Dowker

http://arxiv.org/abs/2307.03720
Biorthogonal polynomials related to quantum transport theory of disordered wires
Dong Wang

http://arxiv.org/abs/2307.04323
Optimal $(2, \delta)$ Locally Repairable Codes via Punctured Simplex Codes
Dong Wang, Weijun Fang, Sihuang Hu

http://arxiv.org/abs/2307.04852
`AlgRel.wl`: Algebraic Relations for the Product of Propagators in Feynman integrals
B. Ananthanarayan, Souvik Bera, Tanay Pathak

http://arxiv.org/abs/2307.05303
Multicritical Schur measures and higher-order analogues of the Tracy-Widom distribution
Dan Betea, Jérémie Bouttier, Harriet Walsh

http://arxiv.org/abs/2307.05323
Existence of quantum states for Klein-Gordon particles based on exact and approximate scenarios with pseudo-dot spherical confinement
Sami Ortakaya

http://arxiv.org/abs/2307.05864
Stable-Limit Non-symmetric Macdonald Functions
Milo James Bechtloff Weising

http://arxiv.org/abs/2307.05925
A Tractable Statistical Representation of IFTR Fading with Applications
Maryam Olyaee, Hadi Hashemi, Juan M. Romero-Jerez

http://arxiv.org/abs/2307.05958
Chebyshev's bias for Fermat curves of prime degree
Yoshiaki Okumura

http://arxiv.org/abs/2307.06002
On off-critical zeros of lattice energies in the neighborhood of the Riemann zeta function
Laurent Bétermin, Ladislav Šamaj, Igor Travěnec

http://arxiv.org/abs/2307.06221
Fast and stable rational approximation of generalized hypergeometric functions
Richard Mikael Slevinsky

http://arxiv.org/abs/2307.06493
Bounded Bessel Processes and Ferrari-Spohn Diffusions
Matthew Lerner-Brecher

http://arxiv.org/abs/2307.06734
The cubic Szegő equation on the real line: explicit formula and well-posedness on the Hardy class
Patrick Gérard, Alexander Pushnitski

http://arxiv.org/abs/2307.07106
Absolute zeta functions for zeta functions of quantum cellular automata
Jirô Akahori, Norio Konno, Iwao Sato

http://arxiv.org/abs/2307.07261
Numerical evaluation of oscillatory integrals via automated steepest descent contour deformation
A. Gibbs, D. P. Hewett, D. Huybrechs

http://arxiv.org/abs/2307.07272
Extreme values of the Dedekind zeta function on the critical line
Patrick Nyadjo Fonga

http://arxiv.org/abs/2307.07363
Computational progress on the unfair 0-1 polynomial Conjecture
Kevin G. Hare

http://arxiv.org/abs/2307.07491
Two string theory flavours of generalised Eisenstein series
Daniele Dorigoni, Rudolfs Treilis

http://arxiv.org/abs/2307.07621
The fundamental solution of the fractional p-laplacian
Leandro M. Del Pezzo, Alexander Quaas

http://arxiv.org/abs/2307.07825
Why is my rational Painlevé V solution not unique?
H. Aratyn, J. F. Gomes, G. V. Lobo, A. H. Zimerman

http://arxiv.org/abs/2307.08063
The computation of $\zeta(2k)$, $\beta(2k+1)$ and beyond by using telescoping series
Óscar Ciaurri, Luis M. Navas, Francisco J. Ruiz, Juan L. Varona

http://arxiv.org/abs/2307.08091
Mean values of ratios of the Riemann zeta function
Daodao Yang

http://arxiv.org/abs/2307.08127
Negative flows and non-autonomous reductions of the Volterra lattice
V. E. Adler

http://arxiv.org/abs/2307.08458
A simple proof of monotonicity for remainder of Stirling's formula
Yuling Xue, Songbai Guo

http://arxiv.org/abs/2307.08940
Frobenius structure on hypergeometric equations and p-adic polygamma functions
Masanori Asakura, Kei Hagihara

http://arxiv.org/abs/2307.09028
Simple and high-order N-solitons of the nonlocal generalized Sasa-Satsuma equation via an improved Riemann-Hilbert method
Guixian Wang, Xiu-Bin Wang, Haie Long, Bo Han

http://arxiv.org/abs/2307.09034
The minimal quasi-stationary distribution of the absorbed M/M/∞ queue
Elie Cerf

http://arxiv.org/abs/2307.09242
Hankel operators with band spectra and elliptic functions
Alexander Pushnitski, Alexander Sobolev

http://arxiv.org/abs/2307.09276
On some Operator Filtering Strategies Based on Suitably Modified Green's Functions
Matteo E. Masciocchi, Ermanno Citraro, Alexandre Dély, Lyes Rahmouni, Adrien Merlini, Francesco P. Andriulli

http://arxiv.org/abs/2307.09403
Duality-reflection formulas of multiple polylogarithms and their ℓ-adic Galois analogues
Densuke Shiraishi

http://arxiv.org/abs/2307.09419
On the Approximate Solution of Integral Equations with Logarithmic Kernels Using the Third Kind of Chebyshev Polynomials
M. R. A. Sakran

http://arxiv.org/abs/2307.09471
Estimating the kth coefficient of $(f(z))^n$ when k is not too large
Valerio De Angelis

http://arxiv.org/abs/2307.09518
Efficient Inverse-designed Structural Infill for Complex Engineering Structures
Peter Dørffler Ladegaard Jensen, Tim Felle Olsen, J. Andreas Bærentzen, Niels Aage, Ole Sigmund

http://arxiv.org/abs/2307.09867
An algebraic proof of the duality of multiple zeta-star values of height one
Nita Tamang, Pitu Sarkar

http://arxiv.org/abs/2307.09894
Schur-Positivity of Short Chords in Matchings
Avichai Marmor

http://arxiv.org/abs/2307.10000
Two supercongruences involving truncated hypergeometric series
Wei Xia, Chen Wang

http://arxiv.org/abs/2307.10141
Black hole perturbation theory and multiple polylogarithms
Gleb Aminov, Paolo Arnaudo, Giulio Bonelli, Alba Grassi, Alessandro Tanzini

http://arxiv.org/abs/2307.10748
An upper bound for the Nevanlinna matrix of an indeterminate moment sequence
Raphael Pruckner, Jakob Reiffenstein, Harald Woracek

http://arxiv.org/abs/2307.10962
Questions about the dynamics on a natural family of affine cubic surfaces
Julio Rebelo, Roland Roeder

http://arxiv.org/abs/2307.11006
A new proof of the expansion of iterated Ito stochastic integrals with respect to the components of a multidimensional Wiener process based on generalized multiple Fourier series and Hermite polynomials
Dmitriy F. Kuznetsov

http://arxiv.org/abs/2307.11384
Boundary dynamics in unbounded Fatou components
Anna Jové, Núria Fagella

http://arxiv.org/abs/2307.11982
Diagonal hypersurfaces and elliptic curves over finite fields and hypergeometric functions
Sulakashna, Rupam Barman

http://arxiv.org/abs/2307.12001
Characterizing the Fourier transform by its properties
Mateusz Krukowski

http://arxiv.org/abs/2307.12007
Meromorphic Continuation Of Global Zeta Function For Number Fields
Subham De

http://arxiv.org/abs/2307.12043
Euler and the Duplication Formula for the Gamma-Function
Alexander Aycock

http://arxiv.org/abs/2307.13194
The eighth moment of Dirichlet L-functions II
Vorrapan Chandee, Xiannan Li, Kaisa Matomäki, Maksym Radziwiłł

http://arxiv.org/abs/2307.13577
Approximating the stationary distribution of the ASEP with open boundaries
Evita Nestoridi, Dominik Schmid

http://arxiv.org/abs/2307.13587
Differential approximation of the Gaussian by short cosine sums with exponential error decay
Nadiia Derevianko, Gerlind Plonka

http://arxiv.org/abs/2307.13956
Quantum Painlevé II Lax Pair and Quantum (Matrix) Analogues of Classical Painlevé II equation
Muhammad Waseem, Irfan Mahmood, Hira Sohail

http://arxiv.org/abs/2307.14251
Harmonic Oscillator with a Step and its Isospectral Properties
Yuta Nasuda, Nobuyuki Sawado

http://arxiv.org/abs/2307.14639
Explicit error bound of the elliptic asymptotics for the first Painlevé transcendents
Shun Shimomura

http://arxiv.org/abs/2307.14904
Recursions and ODEs for correlations in integrable systems and random matrices
Bertrand Eynard, Dimitrios Mitsios, Soufiane Oukassi

http://arxiv.org/abs/2307.15206
Ramanujan–Shen's differential equations for Eisenstein series of level 2
Masato Kobayashi

http://arxiv.org/abs/2307.15608
Kashiwara conjugation and the enhanced Riemann–Hilbert correspondence
Andreas Hohl

http://arxiv.org/abs/2307.15722
Long time and Painlevé-type asymptotics for the defocusing Hirota equation with finite density initial data
Wei-Qi Peng, Yong Chen

http://arxiv.org/abs/2307.15948
Supersymmetric Quantum Mechanics of Hypergeometric-like Differential Operators
Tianchun Zhou

http://arxiv.org/abs/2307.16197
The Cauchy problem associated to the logarithmic Laplacian with an application to the fundamental solution
Huyuan Chen, Laurent Véron

http://arxiv.org/abs/2308.01282
On positivity of Roger–Yang skein algebras
Hiroaki Karuo

http://arxiv.org/abs/2308.01289
On representations of the Helmholtz Green's function
Gregory Beylkin

http://arxiv.org/abs/2308.02740
The Painlevé-type asymptotics of defocusing complex mKdV equation with finite density initial data
Lili Wen, Engui Fan

http://arxiv.org/abs/2308.02912
Multiplicity formula for induced representations: Bessel and Fourier-Jacobi models over Archimedean local fields
Cheng Chen

http://arxiv.org/abs/2308.03039
Automorphic Integrals with Rational Period Functions and Arithmetical Identities
Tewlede G. Egziabher, Hunduma Legesse Geleta, Abdul Hassen

http://arxiv.org/abs/2308.03232
Absolute zeta functions and ceiling and floor Puiseux polynomials
Yoshinosuke Hirakawa, Takuki Tomita

http://arxiv.org/abs/2308.03304
Some Approximation Properties by Szász-Păltănea type Operators involving the Appell Polynomials of class A^2
Naokant Deo, Chandra Prakash, D. K. Verma

http://arxiv.org/abs/2308.03337
Solving Falkner-Skan type equations via Legendre and Chebyshev Neural Blocks
Alireza Afzal Aghaei, Kourosh Parand, Ali Nikkhah, Shakila Jaberi

http://arxiv.org/abs/2308.03744
Lie reductions and exact solutions of dispersionless Nizhnik equation
Oleksandra O. Vinnichenko, Vyacheslav M. Boyko, Roman O. Popovych

http://arxiv.org/abs/2308.03974
Sharp gradient estimate, rigidity and almost rigidity of Green functions on non-parabolic $\mathrm{RCD}(0,N)$ spaces
Shouhei Honda, Yuanlin Peng

http://arxiv.org/abs/2308.04165
Univalent Functions involving Generalized Hypergeometric Series
K. Chandrasekran, D. J. Prabhakaran

http://arxiv.org/abs/2308.04310
On germs of constriction curves in model of overdamped Josephson junction, dynamical isomonodromic foliation and Painlevé 3 equation
Alexey Glutsyuk

http://arxiv.org/abs/2308.04432
A Comprehensive Study of Complete Generalized New Mock Theta Functions
Swayamprabha Tiwari, Sameena Saba

http://arxiv.org/abs/2308.04434
A Table of Generating Functions
Robert Reynolds

http://arxiv.org/abs/2308.04567
Binomial Fibonacci sums from Chebyshev polynomials
Kunle Adegoke, Robert Frontczak, Taras Goy

http://arxiv.org/abs/2308.04684
The Number of Overlapping Customers in Erlang-A Queues: An Asymptotic Approach
Young Myoung Ko, Jamol Pender, Jin Xu

http://arxiv.org/abs/2308.04977
An explicit construction of Kaleidocycles
Shizuo Kaji, Kenji Kajiwara, Shota Shigetomi

http://arxiv.org/abs/2308.05002
Deficiency bounds for the multivariate inverse hypergeometric distribution
Frédéric Ouimet

http://arxiv.org/abs/2308.05044
Cyclic products of higher-genus Szegő kernels, modular tensors and polylogarithms
Eric D'Hoker, Martijn Hidding, Oliver Schlotterer

http://arxiv.org/abs/2308.05138
Irregular Hodge filtration of hypergeometric differential equations
Yichen Qin, Daxin Xu

http://arxiv.org/abs/2308.05167
Total positivity from a kind of lattice paths
Yu-Jie Cui, Bao-Xuan Zhu

http://arxiv.org/abs/2308.05435
Another look at binomial and related distributions exceeding values close to their centre
Tilo Wiklund

http://arxiv.org/abs/2308.05469
Weighted Sobolev orthogonal polynomials and approximation in the ball
Leonardo E. Figueroa

http://arxiv.org/abs/2308.06052
Doubling the rate – improved error bounds for orthogonal projection in Hilbert spaces
Ian H. Sloan, Vesa Kaarnioja

http://arxiv.org/abs/2308.06166
Sequentially-ordered Sobolev inner product and Laguerre-Sobolev polynomials
Abel Díaz-González, Juan Hernández, Héctor Pijeira-Cabrera

http://arxiv.org/abs/2308.06171
Differential properties of Jacobi-Sobolev polynomials and electrostatic interpretation
Héctor Pijeira-Cabrera, Javier Quintero-Roba, Juan Toribio-Milane

http://arxiv.org/abs/2308.06304
Electrostatic models for zeros of Laguerre-Sobolev polynomials
Abel Díaz-González, Héctor Pijeira-Cabrera, Javier Quintero-Roba

http://arxiv.org/abs/2308.06440
On some conjectural series containing harmonic numbers of 3-order
Chuanan Wei, Ce Xu

http://arxiv.org/abs/2308.06902
KP solitons and the Riemann theta functions
Yuji Kodama

http://arxiv.org/abs/2308.06950
Transient asymptotics of the modified Camassa-Holm equation
Taiyang Xu, Yiling Yang, Lun Zhang

http://arxiv.org/abs/2308.07021
Weighted Szegő Kernels on Planar Domains
Aakanksha Jain, Kaushal Verma

http://arxiv.org/abs/2308.07073
Representation zeta functions of arithmetic groups of type A_2 in positive characteristic
Uri Onn, Amritanshu Prasad, Pooja Singla

http://arxiv.org/abs/2308.07217
Rigidity of J-rotational rational maps and critical quasicircle maps
Willie Rush Lim

http://arxiv.org/abs/2308.07245
On the proof of the Prime Number Theorem using Order Estimates for the Chebyshev Theta Function
Subham De

http://arxiv.org/abs/2308.08228
Expected Euler characteristic method for the largest eigenvalue: (Skew-)orthogonal polynomial approach
Satoshi Kuriki

http://arxiv.org/abs/2308.08988
A Dirichlet character analogue of Ramanujan's formula for odd zeta values
Anushree Gupta, Md Kashif Jamal, Nilmoni Karak, Bibekananda Maji

http://arxiv.org/abs/2308.09100
Exceptional Siegel-Weil theorems for compact Spin_8
Aaron Pollack

http://arxiv.org/abs/2308.09283
Starlikeness Using Special Functions and Subordination
Meghna Sharma, Naveen Kumar Jain, Sushil Kumar

http://arxiv.org/abs/2308.09338
Asymptotic Analysis for the Eigenvalues of Peridynamic Operators
Bacim Alali, Nathan Albin, Thinh Dang

http://arxiv.org/abs/2308.09365
The dissolving limit and large volume limit of Einstein-Bogomol'nyi metrics
Chengjian Yao

http://arxiv.org/abs/2308.10323
Boltzmann weights and fusion procedure for the rational seven-vertex SOS model
Pavel V. Antonenko, Pavel A. Valinevich

http://arxiv.org/abs/2308.10404
Sumset Fractal Properties
Derong Kong, Zhiqiang Wang

http://arxiv.org/abs/2308.10518
Heun-type solutions for the Dirac particle on the curved background of Minkowski space-times
Saman Rahmani, Hossein Panahi, Amerne Najafizade

http://arxiv.org/abs/2308.10813
On L-derivatives and biextensions of Calabi-Yau motives
V. Golyshev

http://arxiv.org/abs/2308.10844
Affine Hecke algebras and symmetric quasi-polynomial duality
Vidya Venkateswaran

http://arxiv.org/abs/2308.11332
Uncovering a generalised gamma distribution: from shape to interpretation
Matthias Wagener, Andriette Bekker, Mohammad Arashi, Antonio Punzo

http://arxiv.org/abs/2308.11363
Bivariate Bernstein-gamma functions, potential measures, and asymptotics of exponential functionals of Lévy processes
Martin Minchev, Mladen Savov

http://arxiv.org/abs/2308.11398
Interior solution of azimuthally symmetric case of Laplace equation in orthogonal similar oblate spheroidal coordinates
Pavel Strunz

http://arxiv.org/abs/2308.11964
On the Computation of the Logarithm of the Modified Bessel Function of the Second Kind
Remi Cuingnet

http://arxiv.org/abs/2308.12166
Wreath Macdonald polynomials, a survey
Daniel Orr, Mark Shimozono

http://arxiv.org/abs/2308.12184
Estimates of approximations by interpolation trigonometric polynomials on the classes of convolutions of high smoothness
A. S. Serdyuk, T. A. Stepaniuk

http://arxiv.org/abs/2308.12187
Quasi-periodic solutions of the universal hierarchy
I. Krichever, A. Zabrodin

http://arxiv.org/abs/2308.12521
The generalized Bernoulli numbers and its relation with the Riemann zeta function at odd-integer arguments
Yayun Wu

http://arxiv.org/abs/2308.12855
Algebraicity of hypergeometric functions with arbitrary parameters
Florian Fürnsinn, Sergey Yurkevich

http://arxiv.org/abs/2308.13521
Cantorvals as sets of subsums for a series connected with trigonometric functions
Mykola Pratsiovytyi, Dmytro Karvatskyi

http://arxiv.org/abs/2308.13698
On the fractional integrals and derivatives of Bateman's matrix polynomials
Ghazi S. Khammsh, Shimaa I. Moustafa, Shahid Mubeen, Ayman Shehata

http://arxiv.org/abs/2308.14154
Integrals Associated with the Digamma Integral Representation
Richard J. Mathar

http://arxiv.org/abs/2308.14382
Catalogue of modular relations for double zeta values
Koji Tasaka

http://arxiv.org/abs/2308.14707
On the hard edge limit of the zero temperature Laguerre beta corners process
Matthew Lerner-Brecher

http://arxiv.org/abs/2308.14736
The Artin-Hasse series and Laguerre polynomials modulo a prime
Marina Avitabile, Sandro Mattarei

http://arxiv.org/abs/2308.15743
Nontrivial zeros of the Riemann zeta function on the celestial circle
Wei Fan

http://arxiv.org/abs/2308.16209
A New Generating Function for Hermite Polynomials
Manouchehr Amiri

http://arxiv.org/abs/2308.16249
A random free-fermion quantum spin chain with multi-spin interactions
Francisco C. Alcaraz, José A. Hoyos, Rodrigo A. Pimenta

http://arxiv.org/abs/2308.16302
Low lying zeros of Rankin-Selberg L-functions
Alexander Shashkov

http://arxiv.org/abs/2308.16303
On the Order Estimates for Specific Functions of $\zeta(s)$ and its Contribution towards the Analytic Proof of The Prime Number Theorem
Subham De

http://arxiv.org/abs/2308.16305
Sequences related to Lehmer's problem
Björn Johannesson

http://arxiv.org/abs/2308.16318
Euler and the Legendre Polynomials
Alexander Aycock

http://arxiv.org/abs/2308.16396
Discrete universality for Matsumoto zeta-functions and the nontrivial zeros of the Riemann zeta-function
Keita Nakai

http://arxiv.org/abs/2308.16815
Strichartz estimates for the (k, a)-generalized Laguerre operators
Kouichi Taira, Hiroyoshi Tamori

Topic #7 ——— OP - SF Net 30.5 ——— September 15, 2023

From: OP-SF Net Editors
Subject: Submitting contributions to OP-SF NET and SIAM-OPSF (OP-SF Talk)

To contribute a news item to OP-SF NET, send e-mail to one of the OP-SF Editors
howard.cohl@nist.gov, or spost@hawaii.edu.

Contributions to OP-SF NET 30.6 should be sent by November 1, 2023.

OP-SF NET is the electronic newsletter of the SIAM Activity Group on Special Functions and Orthogonal Polynomials (SIAG/OPSF). We disseminate your contributions on anything of interest to the special functions and orthogonal polynomials community. This includes announcements of conferences, forthcoming books, new software, electronic archives, research questions, and job openings as well as news about new appointments, promotions, research visitors, awards and prizes. OP-SF Net is transmitted periodically through a post to OP-SF Talk which is currently managed and moderated by Howard Cohl (howard.cohl@nist.gov). Anyone wishing to be included in the mailing list (SIAG/OPSF members and non-members alike) should send an email expressing interest to him. Bonita Saunders also posts the Newsletter through SIAM Engage (SIAG/OPSF) which is received by all SIAG/OPSF members.

OP-SF Talk is a listserv associated with SIAG/OPSF which facilitates communication among members, non-members and friends of the Activity Group. To post an item to the listserv,
send e-mail to howard.cohl@nist.gov.

WWW home page of this Activity Group:
http://math.nist.gov/opsf
Information on joining SIAM and this activity group: service@siam.org

The elected Officers of the Activity Group (2020-2022*) are:
Peter Alan Clarkson, Chair
Luc Vinet, Vice Chair
Andrei Martínez-Finkelshtein, Program Director
Teresa E. Pérez, Secretary and SIAM Engage (SIAG/OPSF) moderator

The appointed officers are:
Howard Cohl, OP-SF NET co-editor
Sarah Post, OP-SF NET co-editor
Bonita Saunders, Webmaster and SIAM Engage (SIAG/OPSF) moderator

*As of the date of the publication of OP-SF NET 30.5, the SIAG/OPSF elections have not occurred.

Topic #8 ——— OP - SF Net 30.5 ——— September 15, 2023

From: OP-SF Net Editors
Subject: Thought of the Month by **George Pólya**

"If there is a problem you can't solve, then there is an easier problem you can solve: find it."

George Pólya, taken from *How to Solve It. A New Aspect of Mathematical Method*, Second Edition, *Princeton University Press*, Princeton, NJ, 1948.