

# OP-SF NET – Volume 29, Number 2 – March 15, 2022

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.

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**Calendar of Events:**

**April 21-23, 2022**

International Conference on Orthogonal Polynomials, Celebrating Francisco Marcellán's  
70<sup>th</sup> birthday

Cádiz, Spain

<https://www.marcellanfest.es/>

**May 23-27, 2022**

Baylor Analysis Fest: From Operator Theory to Orthogonal Polynomials, Combinatorics,  
and Number Theory

Baylor University, Waco, TX, USA

<https://tinyurl.com/BAFconference>

**May – November, 2022**

Symmetries: Algebras and Physics

Thematic Semester, includes the following workshops:

**May 23–June 10, 2022**

Non-commutative algebras, representation theory and special functions

**July 25–August 19, 2022**

Graph theory, algebraic combinatorics and mathematical physics

**September 12–October 7, 2022**

Integrable systems, exactly solvable models and algebras

Centre de Recherches Mathématiques, Montréal, Quebec, Canada

[http://www.crm.umontreal.ca/2022/Symmetries22/index\\_e.php](http://www.crm.umontreal.ca/2022/Symmetries22/index_e.php)

**June 13–17, 2022—now virtual due to coronavirus pandemic.**

OPSFA–16

Centre de Recherches Mathématiques, Montréal, Quebec, Canada

[http://www.crm.umontreal.ca/2022/OPSFA22/index\\_e.php](http://www.crm.umontreal.ca/2022/OPSFA22/index_e.php)

**July 5–8, 2022—new dates due to coronavirus pandemic.**

Functional Analysis, Approximation Theory and Numerical Analysis (FAATNA)

Matera, Italy

<http://web.unibas.it/faatna20/>

**August 8–12, 2022**

OPSF–S9: Radboud OPSFA Summer School

Nijmegen, The Netherlands

<https://www.ru.nl/radboudsummerschool/courses/2022/opsfa-summer-school/>

Topic #1 ——— OP – SF Net 29.2 ——— March 15, 2022

From: Josée Savard [josee.savard@umontreal.ca](mailto:josee.savard@umontreal.ca) and Luc Vinet ([luc.vinet@umontreal.ca](mailto:luc.vinet@umontreal.ca))

Subject: Announcement: OPSFA–16 to be held online June 13–17, 2022



The 16<sup>th</sup> International Symposium on Orthogonal polynomials, Special Functions and Applications (OPSFA16), organized by the Centre de Recherches Mathématiques (CRM) will be online from June 13–17, 2022. This conference will be dedicated to the memory of Richard Askey, who died at the age of 86 on October 9, 2019. A special day will be held to remember his legacy.

The registration period is now open until June 17<sup>th</sup>. The cost of registration is 20\$ CAN.

To register, navigate to the following link:

[https://www.crm.umontreal.ca/act/form/inscr\\_opsfa22\\_e.shtml](https://www.crm.umontreal.ca/act/form/inscr_opsfa22_e.shtml).

The event will host several internationally renowned plenary speakers as well as minisymposia. The themes of the minisymposia will be posted online shortly as well as the preliminary schedule.

Two contributed talks proposals are currently open. The [first is for calls open to all](#) and a second specific [to a minisymposium organized for doctoral students and postdoctoral fellows](#). The deadline to submit your proposal is May 1st .

The activity group also awards the Gábor Szegő Prize every two years to an early-career researcher for outstanding research contributions in the area of orthogonal polynomials and special functions. The Gabor Szegő prize 2021 is awarded to Dr. Atul Dixit for his impressive scientific work solving problems related to number theory using special functions, in particular related to the work of Ramanujan.

Finally, take note that OPSFA16 is part of a thematic semester, Symmetries: Algebras and Physics, organized by the CRM from May to December 2022. It will consist of six 1-month concentration periods devoted to ongoing research in cutting edge topics; each will involve 1- or 2-week workshops that will be preceded by several preparatory mini-courses.

You can find all the details [on this website](#).

We hope to see many of you!  
The organizing committee  
OPSFA16

Topic #2      ——— OP – SF Net 29.2      ——— March 15, 2022

From: Paul Martin ([pamartin@mines.edu](mailto:pamartin@mines.edu))  
Subject: **Paul A. Martin**: One Hundred Years of **Watson's** treatise on Bessel Functions

## One hundred years of Watson's "Bessel Functions" <sup>1</sup>

Paul A. Martin ([pamartin@mines.edu](mailto:pamartin@mines.edu))  
Department of Applied Mathematics and Statistics,  
Colorado School of Mines, Golden, Colorado, USA

George Neville Watson (1886–1965) was born in Westward Ho!, a seaside village in the west of England. He became a student at Trinity College, Cambridge, in 1904; Fellows there included E. T. Whittaker, G. H. Hardy and E. W. Barnes. Watson stayed in Cambridge for ten years. Then, after four years at University College London (UCL), he moved to the University of Birmingham, where he spent the rest of his career, from 1918 until he retired in 1951 as the Mason Professor of Pure Mathematics. The photograph of Watson in Figure 1 is reproduced in several places, including [7, 8, 14].

Watson is perhaps best known as one half of "Whittaker and Watson"; they co-authored what became a standard book on mathematical analysis and special functions [13]. Whittaker wrote the first edition alone in 1902 (378 pages) but Watson contributed much to later editions, including new material and much more rigour [9, p. 553], [14, p. 524]: the fourth edition [13] has 608 pages. After he retired, Watson envisaged a much expanded

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<sup>1</sup>This is a slightly edited version of an article published in the *London Mathematical Society Newsletter* in March 2022.



Figure 1: G. N. Watson, with winged collar

edition, but he did not complete it [9, p. 553], [11, p. 256]; after his death, numerous manuscript pages were deposited in the archives of the University of Birmingham.

Watson is well known to applied mathematicians for several contributions:

- The Watson transform, which is a method for replacing a slowly convergent infinite series by another that converges rapidly. He used this method in two papers on the propagation of electromagnetic waves around the Earth, including calculations showing that the postulated Heaviside layer was consistent with experimental results [14, p. 522].
- Watson's lemma, which gives the asymptotic expansion of Laplace-type integrals. He proved this useful result in the context of his study of parabolic cylinder functions [9, p. 554].
- Watson integrals, which are certain triple integrals of trigonometric functions [14, p. 527], [15].

These can be seen as examples of Watson's skill as a "problem solver": he was "most ready to help a colleague in difficulties and was willing to go to great trouble over problems of applied mathematics in which he was not basically interested" [14, p. 527].

However, it is Watson's *Treatise on the Theory of Bessel Functions* (WBF) that stands out as a singular scholarly achievement (Figure 2).

WBF was first published in 1922, with a second edition in 1944 [12]. From the Preface:

This book has been designed with two objects in view. The first is the development of applications of the fundamental processes of the theory of functions of complex variables. ...The second object is the compilation of a collection of results which would be of value to the increasing number of Mathematicians and Physicists who encounter Bessel functions in the course of their researches.

Both objects were achieved: WBF is still in print, and it has been cited about 20,000 times. (Some reviews of both editions have been collected in [8].) Nowadays, one might consult the *NIST Digital Library of Mathematical Functions* for a quick summary of relevant formulae, but WBF remains as the prime resource for serious study of Bessel functions and their many relatives.

Watson is clear that he is aiming for a complete survey of everything known about Bessel functions: there is an extensive bibliography. (For more on the history of Bessel functions, see [6].) However, in many cases, he supplies new proofs of known results. He fixes definitions and notations. For example, he uses  $J_\nu(z)$  and  $Y_\nu(z)$  for Bessel functions of the first and second kinds, where  $z$  and  $\nu$  are arbitrary complex variables. "The book contains not only formulae and theoretical investigations, but also extensive tables, some of which Watson had himself calculated. Throughout his life he found relaxation in numerical work, for which he used a Brunsviga calculating machine" [9, p. 555]. That may be true, but we also know that Watson declined a request to do ballistics calculations in Karl Pearson's laboratory at UCL during World War I; see the letter from A. V. Hill to Pearson quoted by Barrow-Green [4, p. 97], where some indication of Watson's character in 1917 may be gleaned: "I have known Watson these last 12 years [Hill and Watson were exact contemporaries at Trinity College], and am interested (and distressed) to hear he is exactly like he used to be. I didn't know that the War, and coming to London, had not made him more humble and human, but from what you say it obviously has not."

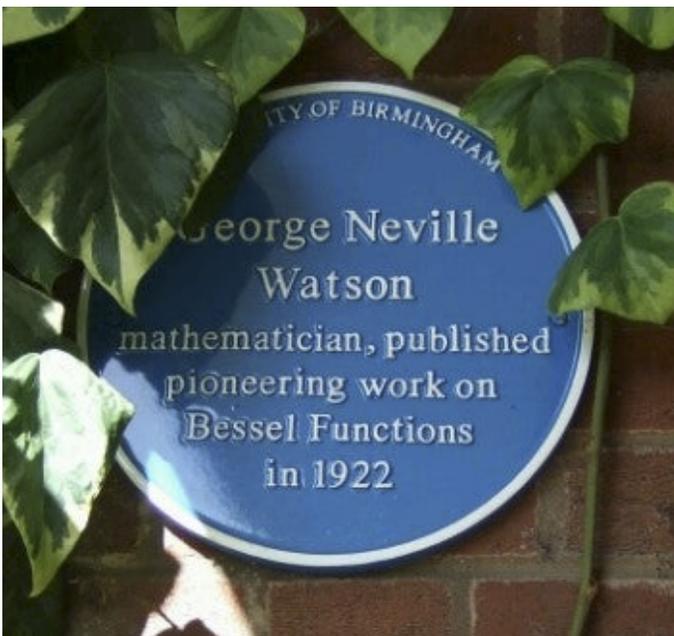


Figure 2: Blue plaque at the University of Birmingham

After publication of the first edition of WBF in 1922, Watson completed his work on the fourth edition of Whittaker and Watson in 1927 [13]. The following decade “might be described as Watson’s ‘Ramanujan period’” [14, p. 525]. “He had received from G. H. Hardy copies of Ramanujan’s famous note books” [9, p. 555] and he then endeavoured to supply proofs: this generated about 30 papers. (For a complete list of Watson’s papers, up to 1962, see [9]; he also co-authored a long paper 20 years after his death [2].) According to B. C. Berndt, “Watson invested at least ten years to the editing of Ramanujan’s notebooks. He never completed his task, but fortunately his efforts have been preserved” and many proofs in Berndt’s book are due to Watson [5, p. vi]. Rankin [10] has given

a detailed description of Watson’s involvement with Ramanujan’s notebooks.

A second edition of WBF was published in 1944: why? Rankin notes that, during World War II, WBF “was in great demand in government scientific establishments, both in [the UK] and abroad. It became difficult to acquire and unofficial copies were circulated in some quarters. It was no doubt largely for this reason that a second edition appeared in 1944” [9, p. 555]. R. A. Askey offers an American perspective, stating that he had “been told that when the work on the first successful atomic pile was being done at the University of Chicago, a copy of [WBF] was chained to a table and always open” [3]. Bessel functions arise in various problems of applied mathematics, and many of these had to be solved quickly. However, in the preface to the second edition, Watson famously admits that his “interest in Bessel functions has waned since 1922”, and so his revisions are confined to the “correction of minor errors and misprints and to the emendation of a few assertions”. He does not even cite his own occasional papers from the 1930s on Bessel functions.

In his lectures at the University of Manchester on asymptotic methods, Fritz Ursell [1] liked to remark that he knew of only two light-hearted remarks in WBF [12]. One concerns the Stokes phenomenon and its discovery: on p. 202, Watson notes that “it was apparently one of those which are made at three o’clock in the morning”. Ursell did not identify the second remark, but the author is fond of this one on p. 523: “The construction of the Neumann series when the Maclaurin series is given is consequently now merely a matter of analytical ingenuity”.

Concerning Watson the man, there are some evocative remarks in [9] and [11]; see also [8]. For example, in “manner and appearance (he always wore a wing collar) he recalled the professors of an earlier generation” (see Figure 1) and he “did not like telephones and regarded them as ‘an invention of the devil’” [11, p. 256]. He had similar strong aversions to motor-cars and fountain pens [8]. Although he “had a great admiration for his friend and co-author, Sir Edmund Whittaker [who was Professor in Edinburgh], he only

visited Scotland twice, once in June 1939 to receive his Honorary LL. D. from Edinburgh University, and in July 1914 to attend the Napier Tercentenary Congress. He used to say that he feared to make a third visit ...as each of his two previous visits had precipitated a major European catastrophe” [9, p. 552]. Evidently, Watson had a sense of humour!

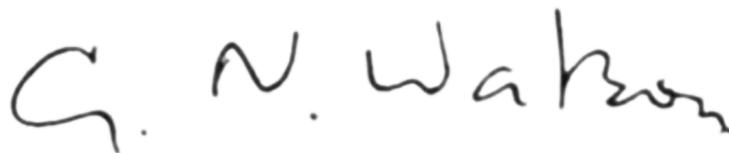
A handwritten signature in black ink that reads "G. N. Watson". The letters are cursive and somewhat slanted to the right.

Figure 3: George Neville Watson’s signature

**Acknowledgements.** I thank Tony Rawlins for permission to use his picture of the blue plaque in Figure 2 and June Barrow–Green for pointing out the letter about Watson in [4]. I thank them, David Abrahams and Stefan Llewellyn Smith for comments and encouragement.

### Bibliography.

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- [6] J. Dutka. On the early history of Bessel functions, *Arch. Hist. Exact Sci.* **49** (1995) 105–134.
- [7] S. Oakes, A. Pears, A. Rice. *The Book of Presidents, 1865–1965*, London Mathematical Society, 2005.
- [8] J. J. O’Connor, E. F. Robertson. [George Neville Watson](#), *MacTutor History of Mathematics*, University of St Andrews, Scotland, Sept. 2020. The book reviews are collected at “Additional Resources”.
- [9] R. A. Rankin. George Neville Watson, *J. London Math. Soc.* **41** (1966) 551–565.
- [10] R. A. Rankin. Ramanujan’s manuscripts and notebooks, *Bull. London Math. Soc.* **14** (1982) 81–97. Reprinted in: *Ramanujan: Essays and Surveys* (ed. B. C. Berndt, R. A. Rankin), American Mathematical Society, 2001, pp. 117–128.
- [11] K. L. Wardle, W. A. Cooke. Obituary: George Neville Watson. Honorary Member and Vice–President, President 1932–3, *Mathematical Gazette* **49** (1965) 253–258.

- [12] G. N. Watson. A Treatise on the theory of Bessel Functions, 2nd edition, Cambridge University Press, Cambridge, 1944.
- [13] E. T. Whittaker, G. N. Watson. A Course of Modern Analysis, 4th edition, Cambridge University Press, Cambridge, 1927.
- [14] J. M. Whittaker. George Neville Watson, 1886–1965, Biographical Memoirs of Fellows of the Royal Society **12** (1966) 520–530.
- [15] I. J. Zucker. 70+ years of the Watson integrals, J. Statistical Physics **145** (2011) 591–612.

Topic #3 ——— OP – SF Net 29.2 ——— March 15, 2022

From: Tom Koornwinder ([thkmath@xs4all.nl](mailto:thkmath@xs4all.nl))

Subject: A U.S.S.R. travel diary of **Liz and Dick Askey**, September 1987

On February 1, Howard Cohl posted the sad message that Liz Askey, the widow of Dick Askey, had passed away on January 29, 2022, at the age of 85. One can read about her life in the [Liz Askey Obituary](#), which was mostly written by her daughter Suzanne. She also took the accompanying photo of Liz, in May 2007.



Many of us who have been in touch with Dick Askey, will also have met Liz, since she often accompanied Dick during his travels and conference visits. I have met Liz for the first time in the academic year 1979–1980 during Dick’s sabbatical in Amsterdam. She was a cordial woman, made funny observations, and was very interested in art and handicraft. She was specialized in children’s literature.

Liz was also a good writer. She wrote travel diaries of the longer mathematical trips she made with Dick. During September 1987 – January 1988 they made a world trip to the U.S.S.R., Japan, Australia and India. I own a copy of a typewritten diary written by Liz. I will make scans of these, apply OCR to them, and make the corrected OCR output available on the web. I have done this already for the first part of the diary, about the trip to the U.S.S.R. in September 1987. See [https://staff.fnwi.uva.nl/t.h.koornwinder/specfun/AskeyDiary\\_USSR1987.pdf](https://staff.fnwi.uva.nl/t.h.koornwinder/specfun/AskeyDiary_USSR1987.pdf).

This was a three-week trip based in Moscow, but with a one-week intermezzo in Leningrad. Of course, Liz does not write about mathematics, but there is much about the museums visited, the walks made, the impression she got of the people and the communist system, the (sometimes delicious but often mean) quality of the food and the bad service, and the Academy Hotel in Moscow where they were terrorized by bedbugs. Some names of well-known mathematicians pass: Gelfand, Zelevinsky and Levitan. They brought a hearing aid for Gelfand, which caused problems at customs. On their first day in Moscow:

“Our guide found us a taxi and took us to the apartment building in which Gelfand and his family lived. We were only going to stay fifteen minutes since Gelfand’s wife was ill. He was delighted

to see Dick and the conversation went on much longer than 15 minutes. He was interrupted constantly to answer the telephone and we eventually learned that it was his 74<sup>th</sup> birthday.”

About the bed bugs: “Dick was up at 2:30 a.m. with six new bites and he wasn’t about to crawl back in there with the beasties who were making a meal out of him. Can’t blame him. However he just left to give his presentation at the Gelfand seminar and that’s a strenuous evening ahead for him with only three hours of sleep last night. Since talking mathematics is what he’s here for, that may be enough to keep him going.”

Is anyone reading this able to give a testimony about how Dick performed at the Gelfand seminar?

How could one have predicted in those days that visiting Moscow then during the cold war was easier than right now.

Topic #4 ——— OP – SF Net 29.2 ——— March 15, 2022

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 January and February 2022. This list has been separated into two categories.

### OP–SF Net Subscriber E-Prints

<http://arxiv.org/abs/2201.00215>

On the Parity of the Generalized Frobenius Partition Functions  $\varphi_k(n)$   
George E. Andrews, James A. Sellers, Fares Soufan

<http://arxiv.org/abs/2201.00474>

Asymptotics of  $k$ -nearest neighbor Riesz energies  
Douglas P. Hardin, Edward B. Saff, Oleksandr Vlasiuk

<http://arxiv.org/abs/2201.01352>

Turán inequalities for the plane partition function  
Ken Ono, Sudhir Pujahari, Larry Rolen

<http://arxiv.org/abs/2201.01451>

On the tau function of the hypergeometric equation  
Marco Bertola, Dmitry Korotkin

<http://arxiv.org/abs/2201.02267>

Schwarzian derivative, Painlevé XXV–Ermakov equation and Bäcklund transformations  
Sandra Carillo, Alexander Chichurin, Galina Filipuk, Federico Zullo

<http://arxiv.org/abs/2201.02337>

Classical and quantum walks on paths associated with exceptional Krawtchouk polynomials  
Hiroshi Miki, Satoshi Tsujimoto, Luc Vinet

<http://arxiv.org/abs/2201.02399>

An extension of an asymptotic result of Tricomi concerning a definite integral  
R. B. Paris

<http://arxiv.org/abs/2201.03047>

Weighted cylindrical partitions  
Walter Bridges, Ali Uncu

<http://arxiv.org/abs/2201.03086>

An elegant Multi-Integral that implies an even more elegant determinant identity of Dougherty and McCammond  
Tewodros Amdeberhan, Doron Zeilberger

<http://arxiv.org/abs/2201.03646>

An explanation of the commuting operator “miracle” in time and band limiting  
Pierre-Antoine Bernard, Nicolas Crampé, Luc Vinet

<http://arxiv.org/abs/2201.04589>

Time and band limiting operator and Bethe ansatz  
Pierre-Antoine Bernard, Nicolas Crampé, Luc Vinet

<http://arxiv.org/abs/2201.05422>

Rational spectral transformation of continued fractions associated to a perturbed  $R_I$  type recurrence relations  
Vinay Shukla, A. Swaminathan

<http://arxiv.org/abs/2201.05948>

Strict domain monotonicity of the principal eigenvalue and a characterization of lower boundedness for the Friedrichs extension of four-coefficient Sturm-Liouville operators  
Fritz Gesztesy, Roger Nichols

<http://arxiv.org/abs/2201.06630>

Distributions of Hook lengths in integer partitions  
Michael Griffin, Ken Ono, Wei-Lun Tsai

<http://arxiv.org/abs/2201.06746>

Combinatorial identities associated with a bivariate generating function for overpartition pairs  
Atul Dixit, Ankush Goswami

<http://arxiv.org/abs/2201.06942>

Further  $q$ -supercongruences from a transformation of Rahman  
Victor J. W. Guo

<http://arxiv.org/abs/2201.07049>

Gauss  $q$ -ed from Heine cubed  
P. L. Robinson

<http://arxiv.org/abs/2201.07326>

Automated Counting and Statistical Analysis of Labeled Trees with Degree Restrictions  
Shalosh B. Ekhad, Doron Zeilberger

<http://arxiv.org/abs/2201.09301>

$A_n$  extensions of some expansion formulas of Liu  
Bing He

<http://arxiv.org/abs/2201.09409>

Chain sequences and Zeros of a perturbed  $R_{II}$  type recurrence relation  
Vinay Shukla, A. Swaminathan

<http://arxiv.org/abs/2201.10117>

Generalized  $q$ -Bernoulli polynomials generated by Jackson  $q$ -Bessel functions  
S. Z. Eweis, Zeinab S. I. Mansour

<http://arxiv.org/abs/2201.11820>

On the number of  $p$ -hypergeometric solutions of KZ equations  
Alexander Varchenko

<http://arxiv.org/abs/2201.12359>

The single-indexed exceptional Krawtchouk polynomials  
Hiroshi Miki, Satoshi Tsujimoto, Luc Vinet

<http://arxiv.org/abs/2201.12415>

An asymptotic approach to Borwein-type sign pattern theorems  
Chen Wang, Christian Krattenthaler

<http://arxiv.org/abs/2201.12699>

The B-B-G Transfer Principle for signature four  
P. L. Robinson

<http://arxiv.org/abs/2201.12871>

Investigation of the two-cut phase region in the complex cubic ensemble of random matrices  
Ahmad Barhoumi, Pavel M. Bleher, Alfredo Deaño, Maxim L. Yattselev

<http://arxiv.org/abs/2201.12941>

Universality for multiplicative statistics of Hermitian random matrices and the integro-differential Painlevé II equation  
Promit Ghosal, Guilherme L. F. Silva

<http://arxiv.org/abs/2201.13315>

Some definite integrals involving Jacobi polynomials  
Enno Diekema

<http://arxiv.org/abs/2201.13337>

Higher regularity of homeomorphisms in the Hartman-Grobman theorem for semilinear evolution equations  
Weijie Lu, Manuel Pinto, Y. H Xia

<http://arxiv.org/abs/2202.00214>

The combinatorics of hopping particles and positivity in Markov chains  
Lauren K. Williams

<http://arxiv.org/abs/2202.00635>

A Simple Proof of Siegel's Theorem Using Mellin Transform  
Zihao Liu

<http://arxiv.org/abs/2202.00800>

On  $L^2_{\mathbb{R}}$ -best rational approximants to Markov functions on several intervals  
Maxim L. Yattselev

<http://arxiv.org/abs/2202.00943>

Laguerre Unitary Ensembles with Jump Discontinuities, PDEs and the Coupled Painlevé V System  
Shulin Lyu, Yang Chen, Shuai-Xia Xu

<http://arxiv.org/abs/2202.01278>

Determinantal Formulas for Exceptional Orthogonal Polynomials  
Brian Simanek

<http://arxiv.org/abs/2202.01392>

The Madelung Constant in  $N$  Dimensions  
Antony Burrows, Shaun Cooper, Peter Schwerdtfeger

<http://arxiv.org/abs/2202.02049>

The asymptotic expansion of the Humbert hyper-Bessel function  
R. B. Paris

<http://arxiv.org/abs/2202.02485>

Sharp regularity of the Hartman-Grobman theorem in  $C^0$  linearization  
Weijie Lu, Manuel Pinto, Y-H. Xia

<http://arxiv.org/abs/2202.02637>

Proof of two conjectures on Askey-Wilson polynomials  
K. Castillo, D. Mbouna

<http://arxiv.org/abs/2202.02678>

The Existence of Dyon Solutions for Generalized Weinberg-Salam Model  
Shouxin Chen, Yilu Xu

<http://arxiv.org/abs/2202.03139>

Free boson realization of the Dunkl intertwining operator in one dimension  
Luc Vinet, Alexei Zhedanov

<http://arxiv.org/abs/2202.03145>

Jensen-type inequalities for convex and  $m$ -convex functions via fractional calculus  
Yamilet Quintana, José M. Rodríguez, José M. Sigarreta Almira

<http://arxiv.org/abs/2202.03340>

The  $q$ -Lidstone series involving  $q$ -Bernoulli and  $q$ -Euler polynomials generated by the third Jackson  $q$ -Bessel function  
Z. S. I. Mansour, M. Al-Towailb

<http://arxiv.org/abs/2202.03827>

Universality for random matrices with equi-spaced external source: a case study of a biorthogonal ensemble  
Tom Claeys, Dong Wang

<http://arxiv.org/abs/2202.04116>

Asymptotic spectral properties of the Hilbert  $L$ -matrix  
František Štampach

<http://arxiv.org/abs/2202.04217>

On the algebraic solutions of the Painlevé–III (D7) equation  
Robert J. Buckingham, Peter D. Miller

<http://arxiv.org/abs/2202.04388>

Hypergeometric  ${}_4F_3(1)$  with integral parameter differences  
Dmitrii Karp, Elena Prilepkina

<http://arxiv.org/abs/2202.04819>

Some formulas for fully degenerate Bernoulli numbers and polynomials  
Taekyun Kim, Dae San Kim

<http://arxiv.org/abs/2202.04843>

A Stieltjes algorithm for generating multivariate orthogonal polynomials  
Zexin Liu, Akil Narayan

<http://arxiv.org/abs/2202.05925>

Bispectrality and biorthogonality of the rational functions of  $q$ -Hahn type  
Ismaël Bussière, Julien Gaboriaud, Luc Vinet, Alexei Zhedanov

<http://arxiv.org/abs/2202.06020>

Colored vertex models and  $k$ -tilings of the Aztec diamond  
Sylvie Corteel, Andrew Gitlin, David Keating

<http://arxiv.org/abs/2202.06456>

Discrete orthogonality of hypergeometric polynomial sequences on linear and quadratic lattices  
Luis Verde-Star

<http://arxiv.org/abs/2202.07298>

Some observations about Hankel determinants of the columns of Pascal triangle and related topics  
Johann Cigler

<http://arxiv.org/abs/2202.07763>

Combinatorial formula for arithmetic density  
Robert Schneider, Andrew V. Sills

<http://arxiv.org/abs/2202.07769>

Bohemian Matrix Geometry  
Robert M. Corless, George Labahn, Dan Piponi, Leili Rafiee Sevyeri

<http://arxiv.org/abs/2202.08911>

Symmetry of terminating series representations of the Askey–Wilson polynomials  
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Topic #5 ——— OP – SF Net 29.2 ——— March 15, 2022

From: OP–SF Net Editors

Subject: Submitting contributions to 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](mailto:howard.cohl@nist.gov), or [spost@hawaii.edu](mailto:spost@hawaii.edu).

Contributions to OP–SF NET 29.3 should be sent by May 1, 2022.

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From: OP–SF Net Editors

Subject: Thought of the Month by **Dick Askey**

“Part of the secret of success in studying and using special functions is to try to remember exactly what is necessary, and nothing more.”

**Dick Askey** (1933–2019), in p. 9, *Orthogonal Polynomials and Special Functions*, Society for Industrial and Applied Mathematics, Philadelphia, 1975.

*Contributed by Paul A. Martin*

Comment by **Charles Dunkl** (03/11/2022)

This quote by Dick Askey is amusing—but Dick had the reputation “Askey knows the literature” which was said at an analysis seminar at Wisconsin (by Walter Rudin (1921–2010), my Ph.D. advisor, when I was a grad student 63–65). Maybe he didn’t memorize every important formula but he evidently knew where to find stuff he needed.