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

http://math.nist.gov/opsf

OP-SF Net was previously distributed through OP-SF Talk.
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Topics:

Calendar of Events:

April 21-23, 2022
International Conference on Orthogonal Polynomials, Celebrating Francisco Marcellán's 70th 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

June 13-17, 2022—**new dates due to coronavirus pandemic.**
OPSFA-16
Centre de Recherches Mathématiques, Montréal, Quebec, Canada
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 29.1 ——— January 15, 2022

From: Peter Clarkson (P.A.Clarkson@kent.ac.uk)
Subject: Message from the Chair

Happy New Year!

After the difficulties in the past couple of years due to the Covid-19 pandemic, we have to hope that the situation improves in 2022. Hopefully travel will be simpler, and without the risk of being stranded somewhere since a border has been closed at short notice. Personally I did no international travel in 2020 or 2020, the first years I've not done so for many, many years.

A highlight of this year is the 16th International Symposium on "Orthogonal Polynomials, Special Functions and Applications", due to be held in Montreal, Canada in June, which was postponed from last year. The conference is to be dedicated to the memory of Richard Askey, who made many significant contributions to our activity group and its research, as well as many other aspects of Mathematics. I'm sure that we all hope that this conference will take place as planned. Montreal is a city I have visited a number times and have always enjoyed my visits, in fact it's one of my favourite cities in North America. Another activity of our activity group taking place this year is the OPSFA Summer School due to be held in Nijmegen, The Netherlands in August.

In recent months I have been pressing SIAM to reduce the cost of a SIAM activity group membership for Outreach Members of SIAM, which is for residents of developing countries. SIAM Outreach members can join SIAM at a discounted rate, thought they don't get a discount for membership of a SIAM activity group. In comparison, student members of SIAM get free membership in two SIAM

activity groups. There is support from several SIAM officers for an activity group discount for Outreach members, there has been no change to do. During the coming year I will keep pressing that SIAM make the change which I believe will help our activity group.

I hope to be able to see many members of our activity group during the coming year

Peter Clarkson

Topic #2 ——— OP - SF Net 29.1 ——— January 15, 2022

From: Walter Van Assche (walter.vanassche@kuleuven.be),
David Gómez-Ullate (david.gomez-ullate@fis.ucm.es), Manuel Mañas (manuel.manas@ucm.es)
and Andrei Martínez-Finkelshtein (andrei@ual.es)
Subject: Announcement: **Marcellán** Fest, International Conference on Orthogonal Polynomials

We would like to announce the following conference to celebrate
Francisco Marcellán's 70th birthday.

International Conference on Orthogonal Polynomials
Celebrating **Francisco Marcellán**'s 70th birthday
Cádiz (Spain), April 21st -23rd 2022
Website: https://www.marcellanfest.es/

It is our hope to hold this conference as a regular conference with invited and contributed talks in a regular lecture room (not online or hybrid).

We will keep an eye on the evolution of the COVID situation and re-examine the situation as the date approaches, reaching a final decision on April 1st .

Registration for the conference opens on February 1, 2022.
For now please save the dates if you are interested in participating.

Topic #3 ——— OP - SF Net 29.1 ——— January 15, 2022

From: OP-SF Net Editors
Subject: Announcement: **Dick Askey** Memorial Tribute in the *Notices of the AMS*

We would like to draw your attention to a Memorial Tribute, *The Legacy of Dick Askey (1933–2019)* by **Howard S. Cohl, Mourad E. H. Ismail, and Hung-Hsi Wu** that appears in the January 2022 issue of Notices of the American Mathematics Society. The article brings together several remembrances of Dick including,

1. History, by Paul Terwilliger
2. Askey's Contribution to Mathematics Research
    - Askey and Ramanujan, by Krishnaswami Alladi
    - Askey and Ramanujan's notebooks, by Bruce C. Berndt
    - Askey and algebra, by Luc Vinet and Alexei Zhedanov
    - Askey and combinatorics, by Dennis Stanton

- Askey and beta integrals, by Mourad E. H. Ismail
- Askey, positivity, inequalities, and applications, by George Gasper
- Very positive memories about Dick Askey, by Tom H. Koornwinder

3. Askey's Contribution to Mathematics Education
    - Askey's contributions to school mathematics education, by Hung-Hsi Wu
    - Remembering Dick Askey, by Al Cuoco
    - Askey and mathematics education, by Roger Howe.

The full text is available here: https://www.ams.org/notices/202201/rnoti-p59.pdf.

Topic #4 ——— OP - SF Net 29.1 ——— January 15, 2022

From: Erik Koelink (e.koelink@math.ru.nl)
Subject: Announcement: Special session for Ph.D. students and postdocs at OPSFA-16 at CRM

If you are a Ph.D. student or a postdoc in the field of Orthogonal Polynomials and Special Functions and you have not been invited as a lecturer for one of the mini symposia at OPSFA-16, you might be eligible to give a presentation at the mini symposium for Ph.D. students and postdocs. This mini symposium will be organized for the first time at an OPSFA Conference. In this session we also plan to have time for networking and issues pertinent to young researchers. The OPSFA-16 symposium will take place from June 13-17, 2022 at the Centre de Recherches Mathématiques (CRM) in Montréal, Québec, Canada.

If you are interested in lecturing in this special session, please fill in this form by **May 1, 2022** with the following info:

- Proposed title and abstract (150 words) for a 20min lecture with 5 minutes question time;
- Name and email address of your (Ph.D. and/or postdoc) Supervisor ;
- (Expected) date of PhD;
- Brief CV (max 1 page).

Participants in this mini symposium will have to register for OPSFA-16.

Depending on the number of applicants and available time slots, a selection will be made by **Erik Koelink** (Radboud U, Nijmegen), **Francisco Marcellán** (U Carlos III, Madrid), **Sarah Post** (U Hawaii) and **Luc Vinet** (CRM, Montreal). If you have any questions, please send an email to Josée Savard at: josee.savard@umontreal.ca.

Topic #5 ——— OP - SF Net 29.1 ——— January 15, 2022

From: Gaurav Bhatnagar (bhatnagarg@gmail.com), Atul Dixit (adixit@iitgn.ac.in)
and Krishnan Rajkimar (krishnan.rjkmr@gmail.com)
Subject: Annual Report 2021: Topics in Special Functions and Number Theory Seminar Series

Seminar on "Topics in Special Functions and Number Theory": Annual Report 2021.

Organisers:
Gaurav Bhatnagar, Ashoka University;
Atul Dixit, Indian Institute of Technology Gandhinagar;
Krishnan Rajkumar, Jawaharlal Nehru University.

We meet approximately once every other week. The current timing is Thursdays, 4:00–5:00 PM (IST). In case you wish to be informed of future talks, please drop a line to the organizers at:
sfandnt@gmail.com.

The talks in the year 2021 (listed below) are all available on our website:
https://www.sfnt.org.

The first talk of the year will be on January 27, 2022, and it is the **Ramanujan Special 2022** talk. This year's speaker is **Alan Sokal**. In addition to talks every other week, we plan a mini-course: An introduction to probabilistic number theory, by **Kaneenka Sinha**, IISER, Pune, in the summer. We welcome suggestions for talks.

Talk Announcement: **Ramanujan Special 2022**

Title: **Coefficientwise Hankel-total Positivity**
Speaker: **Alan Sokal**, University College London and New York University
When: **January 27, 2022**, 4:00 PM – 5:00 PM IST (Note: IST=GMT-5:30)
Where: Virtual (Zoom): Please write to sdandnt@gmail.com for the Zoom link.

Talks from 2021

The talks are available on: https://www.sfnt.org.
The list of speakers, in reverse lexicographic order, is as follows.

1. **Ramanujan Special 2020.** Wadim Zudilin, Radboud University, Nijmegen: 10 years of q-rious positivity. More needed!
2. Meesue Yoo, Chungbuk National University, Korea: Elliptic rook and file numbers.
3. Liuquan Wang, Wuhan University, PRC: Parity of coefficients of mock theta functions.
4. Akshaa Vatwani, IIT, Gandhinagar: Limitations to equidistribution in arithmetic progressions.
5. Neelam Saikia, University of Virginia: Frobenius trace distributions for Gaussian hypergeometric function.
6. Siddhi Pathak, Penn State: Special values of L-functions.
7. Ritabrata Munshi, ISI, Kolkata: 100 years of sub-convexity.
8. Victor Moll, Tulane: Valuations of interesting sequences.
9. Jaban Meher, NISER, Bhubaneswar: Modular forms and certain congruences.
10. Bibekananda Maji, IIT, Indore: On Ramanujan's formula for $\zeta(\frac{1}{2})$ and $\zeta(2m+1)$.
11. Kamalakshya Mahatab, CMI, Chennai: Large oscillations of the argument of the Riemann zeta function.
12. Josef Küstner, University of Vienna: Elliptic and q-analogs of the Fibonomial numbers.
13. Christian Krattenthaler, University of Vienna, Austria: Determinant identities for moments of orthogonal polynomials.
14. Rajat Gupta, IIT, Gandhinagar: Koshliakov zeta functions and modular relations.
15. Ankush Goswami, IIT, Gandhinagar: Partial theta series with periodic coefficients and quantum modular forms.

16. Shishuo Fu, Chongqing University, PRC: Bijective recurrences for Schroeder triangles and Comtet statistics.
17. Anup Dixit, IMSc, Chennai: On Euler-Kronecker constants and the class number problem.
18. Howard Cohl, NIST: The utility of integral representations for the Askey-Wilson polynomials and their symmetric sub-families.
19. Peter A. Clarkson, University of Kent, UK: Special polynomials associated with the Painlevé equations.
20. Gaurav Bhatnagar, Ashoka University: The Partition-Frequency Enumeration Matrix.
21. Nayandeep Deka Baruah, Tezpur University: Matching coefficients in the series expansions of certain q-products and their inverses.
22. Koustav Banerjee, RISC, Johann Kepler University, Linz, Austria: Inequalities for the modified Bessel function of first kind and its consequences.
23. Debika Banerjee, Indraprastha Institute of Information Technology, IIIT, Delhi: Bessel functions and their application to classical number theory.
24. R. Balasubramanian, IMSc, Chennai: Hardy's approximation to the Riemann Zeta Function.

Topic #6 ——— OP - SF Net 29.1 ——— January 15, 2022

From: DLMF Editors
Subject: Annual Report: DLMF Summary Update for 2022

The 21st century successor to the National Bureau of Standards (NBS) Handbook [M. Abramowitz and I. Stegun, eds. *Handbook of Mathematical Functions with Formulas, Graphs and Mathematical Tables*. Applied Mathematics Series 55, National Bureau of Standards, Washington, DC 1964], the freely accessible online National Institute of Standards and Technology (NIST) Digital Library of Mathematical Functions (DLMF) together with the accompanying book, the *NIST Handbook of Mathematical Functions* [F. W. J. Olver, D. Lozier, R. Boisvert and C. Clark, eds. Cambridge University Press, Cambridge, 2010], are collectively referred to as the DLMF. The DLMF continues to serve as the gold standard reference for the properties of the special functions of applied mathematics.

The DLMF has considerably extended the scope of the original handbook as well as improving accessibility to the worldwide community of scientists and mathematicians. To cite a few examples, the new handbook contains more than twice as many formulas as the old one, coverage of more functions, in more detail, and an up-to-date list of references. The website covers everything in the handbook and much more: additional formulas and graphics, math-aware search, interactive zooming and rotation of 3D graphs, internal links to symbol definitions and cross-references, and external links to online references and sources of software.

While the original Handbook still receives an enormous number of citations, citations to the DLMF are steadily growing in relation to the original handbook. Google Scholar now reports more than 7,262 citations to the DLMF, a roughly 16% increase from 2020. The number of DLMF website pages served up and the number of unique visitors to the website each increased by 7% over calendar 2020.

Today's DLMF is the product of many years of effort by more than 50 contributors. Its initial release in 2010, however, was not the end of the project. Corrections to errors, clarifications, bibliographic updates, and addition of new material all need to be made on a continuing basis. And new chapters covering emerging subject areas need to be added to assure the continued

vitality of the DLMF deep into the 21st century. Since December of 2020, there were five DLMF releases, 1.1.0 (2020-12-15), 1.1.1 (2021-03-15), 1.1.2 (2021-06-15), 1.1.3 (2021-09-15), and 1.1.4 (2022-01-15) which kept us on our quarterly release schedule.

Release 1.1.0 was a significant revision from the previous year's release (1.0.28). Most notable in this release was the development and implementation for the possibility of new chapters, sections, subsections and equations being introduced with a decimal numbering scheme using "_" to delimit intermediate numbers for sections, equations, etc. Since that release, thirty-four new equations and two new sections have been introduced into the DLMF.

The updating of various DLMF chapters and the development of new ones continues. These include a new chapter on Several Variable Orthogonal Polynomials (SVOP) and substantial updates to the chapters on Orthogonal Polynomials (OP), Algebraic Methods (AM), Painlevé Transcendents (PT) and Zeta and Related Functions (ZE). Four authors and two validators were identified to carry out the work. Drafts are now available for three of the chapters and are being internally reviewed. External validation of the chapters is following in much the same manner as the original DLMF. The ZE chapter revision with full validation was completed in release 1.1.4. The OP validation is underway it is expected that the full revision of the OP and AM chapters, will be released in 2022.

One of the design goals for the DLMF was that each formula would be connected to a proof in the literature. This data, visible as annotations on the website, provides either a proof for the formula, a reference to the proof for the formula or, for definitions, a reference which gives that definition. Unfortunately, this information has not previously been provided in all cases. Our work to systematically verify the completeness and traceability to published proofs for DLMF formulae at the equation level is well underway. This audit has been completed for Chapter 9 (Airy and Related Functions) and Chapter 25 (Zeta and Related Functions, with validation provided by Gergő Nemes) and is actively continuing for Chapters 1-5 and 22-30. Furthermore, inherited metadata at the subsection and section levels has been fully deployed.

There have been notable additional advances during the last year.

- When the DLMF is viewed using a MathML accessible browser, one may now "hover" over particular objects and an English description of the object is revealed.
- A significant number of errata (all errata in the DLMF has been tracked since Version 1.0.0, May 7, 2010), mathematical formulas, and new mathematical information have been provided, many of which originated from the DLMF readership, validation staff, and contributors. Furthermore, mathematical constraints and symbols associated with equations and in the text, have been improved, clarified, fixed or disambiguated.
- Proof sketches in Chapters 9 (Airy and Related Functions), 25 (Zeta and Related Functions), and elsewhere are now carefully differentiated at the equation level providing useful metadata for the origination of formulas.
- Improved notations such as the Knuth notation for harmonic numbers

$$H_n = \sum_{k=1}^{n} k^{-1},$$

  and updated citations have been introduced.

Selected sections where explicit modifications have been made include:

- §3.2(vi). Linear Alg. Lanczos Tridiagonalization of a Symmetric Matrix
- §3.5(vi). Linear Alg. Eigenvalue/Eigenvector Characterization of Gauss Quadrature Formulas
- §19.25(vi). Symmetric Integrals. Relations to Other Functions. Weierstrass Elliptic Functions

Selected formula additions which include:
(see above DLMF update 1.1.0 for description of the decimal numbering scheme using the "_")

- (14.30.8_5). Herglotz generating function for spherical harmonics in §14.30. Spherical and Spheroidal Harmonics, $\mathbf{a} = \left(\frac{1}{2\lambda} - \frac{\lambda}{2}, -\frac{i}{2\lambda} - \frac{i\lambda}{2}, 1\right)$, $\mathbf{x} = (r\sin\theta\cos\phi, r\sin\theta\sin\phi, r\cos\theta)$:

$$\mathrm{e}^{t\mathbf{a}\cdot\mathbf{x}} = \sqrt{4\pi}\sum_{n=0}^{\infty}\sum_{m=-n}^{n}\frac{t^n r^n \lambda^m Y_{n,m}(\theta,\phi)}{\sqrt{(2n+1)(n+m)!(n-m)!}}.$$

- (16.4.2_5). Lerch Sum:

$${}_3F_2\left(\begin{matrix}-n, a, 1\\ -n, c\end{matrix}; 1\right) = \sum_{k=0}^{n}\frac{(a)_k}{(c)_k} = \frac{c-1}{c-a-1}\left(1 - \frac{(a)_{n+1}}{(c-1)_{n+1}}\right),$$

with limiting form $a(\psi(a+n+1)-\psi(a)) = \frac{a}{(a)_{n+1}}\frac{\mathrm{d}}{\mathrm{d}a}(a)_{n+1}$, in the case $c = a+1$.

- (15.5.16_5). Contiguous relation for Gauss hypergeometric function:

$$F(a,b;c;z) - F(a-1,b;c;z) - \frac{bz}{c}F(a,b+1;c+1;z) = 0.$$

- (17.6.4_5). Formula related to Andrews–Askey Sum ($|cq^3| < |b^2|$):

$${}_2\phi_1\left(\begin{matrix}b^2, b^2/c\\ cq^2\end{matrix}; q^2, cq^3/b^2\right) = \frac{1}{2b}\frac{(b^2,q;q^2)_\infty}{(cq^2, cq/b^2;q^2)_\infty}\left(\frac{(cq/b;q)_\infty}{(b;q)_\infty} - \frac{(-cq/b;q)_\infty}{(-b;q)_\infty}\right).$$

- (17.8.8). Sum related to Andrews–Askey Sum ($|cq^2| < |b^2|$):

$${}_2\psi_2\left(\begin{matrix}b^2, b^2/c\\ q, cq\end{matrix}; q^2, cq^2/b^2\right) = \frac{1}{2}\frac{(q^2, qb^2, q/b^2, cq/b^2;q^2)_\infty}{(cq, cq^2/b^2, q^2/b^2, c/b^2;q^2)_\infty}\left(\frac{(c\sqrt{q}/b;q)_\infty}{(b\sqrt{q};q)_\infty} + \frac{(-c\sqrt{q}/b;q)_\infty}{(-b\sqrt{q};q)_\infty}\right).$$

- (17.9.3_5). ${}_2\phi_1$ expressed as sum of two ${}_3\phi_2$'s with a vanishing denominator parameter:

$${}_2\phi_1\left(\begin{matrix}a, b\\ c\end{matrix}; q, z\right) = \frac{(c/a, c/b;q)_\infty}{(c, c/(ab);q)_\infty}{}_3\phi_2\left(\begin{matrix}a, b, abz/c\\ qab/c, 0\end{matrix}; q, q\right) + \frac{(a, b, abz/c;q)_\infty}{(c, ab/c, z;q)_\infty}{}_3\phi_2\left(\begin{matrix}c/a, c/b, z\\ qc/(ab), 0\end{matrix}; q, q\right).$$

- (19.2.11_5). Integral definition for a Bulirsch integral:

$$\mathrm{el1}(x, k_c) = \int_0^{\arctan x}\frac{1}{\sqrt{\cos^2\theta + k_c^2\sin^2\theta}}\mathrm{d}\theta.$$

- (15.4.34). Gauss hypergeometric sum:

$$F\left(3a, a; 2a; \mathrm{e}^{i\pi/3}\right) = \sqrt{\pi}\,\mathrm{e}^{i\pi a/2}\frac{2^{2a}\Gamma\left(\frac{1}{2}+a\right)}{3^{(3a+1)/2}}\left(\frac{1}{\Gamma\left(\frac{1}{3}+a\right)\Gamma\left(\frac{2}{3}\right)} + \frac{1}{\Gamma\left(\frac{2}{3}+a\right)\Gamma\left(\frac{1}{3}\right)}\right),$$

where the limit interpretation (15.2.6)

$$F\left(\begin{matrix}-m, b\\ -m-\ell\end{matrix}; z\right) = \lim_{a\to -m} F\left(\begin{matrix}a, b\\ a-\ell\end{matrix}; z\right),$$

needs to be taken when $a = 0, -1, -2, \ldots$.

- (19.5.4_1). Legendre's incomplete elliptic integral of the first kind given as an Appell function of the first kind:

$$F(\phi,k)=\sum_{m=0}^{\infty}\frac{\left(\frac{1}{2}\right)_m\sin^{2m+1}\phi}{(2m+1)m!}{}_2F_1\left(\begin{matrix}m+\frac{1}{2},\frac{1}{2}\\ m+\frac{3}{2}\end{matrix};\sin^2\phi\right)k^{2m}=\sin\phi\,F_1\left(\tfrac{1}{2};\tfrac{1}{2},\tfrac{1}{2};\tfrac{3}{2};\sin^2\phi,k^2\sin^2\phi\right).$$

- (19.5.4_2). Legendre's incomplete elliptic integral of the second kind given as an Appell function of the first kind:

$$E(\phi,k)=\sum_{m=0}^{\infty}\frac{\left(-\frac{1}{2}\right)_m\sin^{2m+1}\phi}{(2m+1)m!}{}_2F_1\left(\begin{matrix}m+\frac{1}{2},\frac{1}{2}\\ m+\frac{3}{2}\end{matrix};\sin^2\phi\right)k^{2m}=\sin\phi\,F_1\left(\tfrac{1}{2};\tfrac{1}{2},-\tfrac{1}{2};\tfrac{3}{2};\sin^2\phi,k^2\sin^2\phi\right).$$

- (19.5.4_3). Legendre's incomplete elliptic integral of the third kind given as a sum of Appell functions of the first kind:

$$\Pi(\phi,\alpha^2,k)=\sum_{m=0}^{\infty}\frac{\left(\frac{1}{2}\right)_m\sin^{2m+1}\phi}{(2m+1)m!}F_1\left(m+\tfrac{1}{2};\tfrac{1}{2},1;m+\tfrac{3}{2};\sin^2\phi,\alpha^2\sin^2\phi\right)k^{2m}.$$

- (5.15.9). Asymptotic expansion of the polygamma function

$$\psi^{(n)}(z)\sim(-1)^{n-1}\left(\frac{(n-1)!}{z^n}+\frac{n!}{2z^{n+1}}+\sum_{k=1}^{\infty}\frac{(2k+n-1)!}{(2k)!}\frac{B_{2k}}{z^{2k+n}}\right),$$

as $z\to\infty$ in $|\mathrm{ph}\,z|\le\pi-\delta$, and B_{2k} are the Bernoulli numbers.

Topic #7 ——— OP – SF Net 29.1 ——— January 15, 2022

From: OP–SF Net Editors
Subject: Two more remembrances of **Brian David Sleeman** (1939–2021)

Two more remembrances of Brian David Sleeman (August 4, 1939—July 19, 2021)

by Gridrod and Dassios

Below are two remembrances of Brian Sleeman from some of his colleagues:

Peter Grindrod and **George Dassios**.

For a link to Sleeman's obituary, see
https://www.leeds.ac.uk/secretariat/obituaries/2021/sleeman_brian.html.

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Peter Grindrod (CBE), Mathematical Institute, University of Oxford, Oxford, UK.

Brian D. Sleeman Memoriam

Figure 1: Brian thinking about a mathematical question asked by an attendee of the meeting. Ross Priory, Strathclyde University (1989)

Brian Sleeman was a very special, well liked, and well-known member of the UK and the International Mathematics Communities. He was held in very high regard by his peers as a wonderful and insightful contributor within a number of fields of maths.

Brian undertook post graduate research at the University of London supervised by Felix Arscott. He was awarded a Ph.D. in 1966 for his thesis, "Some Boundary Value Problems Associated with the Heun Equation". This type of mathematical endeavour seems almost archaic to some nowadays: but, in fact, the rigour and resourcefulness required laid a very strong foundation for Brian, being useful in both scattering theory and the spectral theory of differential operators. The boundary conditions were always critical since they specified the spectrum of such operators.

Brian would return to Heun matters, notably in Sleeman, B. D.; Kuznetzov, V. B. (2010), "Heun functions", in Olver, Frank W. J.; Lozier, Daniel M.; Boisvert, Ronald F.; Clark, Charles W. (eds.), NIST Handbook of Mathematical Functions, Cambridge University Press, ISBN 978-0-521-19225-5, MR 2723248

I remember meeting Felix (his Ph.D. supervisor) and Felix's wife at a dinner at the Sleeman home in 1985. I was Brian's Ph.D. student and then became his Post Doc researcher at Dundee: it was interesting to see him as a protegee rather than as my mentor. These were great times for us all.

In the 1980s I would observe him in the afternoon Applied Analysis research seminars. His eyes would often close, but at the end of the talk, when the chairman asked "Any questions?", he would

suddenly spring into action, and almost regardless of the subject of the seminar he would ask "What happens when you change the boundary conditions?"

After a couple of years, Douglas Jone told Brian that it would be a good idea if he spent a year at the Courant Institute of Mathematical Sciences at New York University in Joe Keller's group. There Brian rubbed shoulders with some of the really biggest names in the world of mathematics at that time. He had arrived.

Writing more recently in a paper with John Ockendon, Brian said, "I was influenced by Joe's enthusiasm and ideas which led to his investigations into the rigorous justification of the geometrical theory of diffraction, an interest in nerve impulse transmissions, as well as inverse problems."

Figure 2: Lunch time. Brian keeps thinking, a very familiar instance of Brian (with Gary Roach). Ross Priory, Strathclyde University (1989)

In the 1980s Brian became an early champion of mathematical Biology. Many of his Ph.D. students, like me, followed that discipline. He had a huge impact both first hand, and second hand, through all of us, on the initiation and growth of UK mathematical biology. He himself addressed a range of important applications, including heart physiology, nerve pulse transmission, chemical reactions, tumour growth, and epidemics.

Among other honours given to Brian was that he was elected President of the Edinburgh Mathematical Society, and a Fellow of the Royal Society of Edinburgh in 1976.

All of the professional recognitions and mathematical achievements do not really represent the mathematician and man that Brian truly was. He was much more than the sum of those elements. He could be intellectually brave and bold. I felt it. He could be cautious and rigorous. He would never shirk an analysis problem: "I'm not going to be afraid of that", he would say, before embarking on some reckless analysis which often would turn out so ridiculously well. He would smile the broad "Sleeman smile", and he would laugh!

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George Dassios, Professor of Applied Mathematics Division of Applied Mathematics Department of Chemical Engineering, University of Patras, Greece.

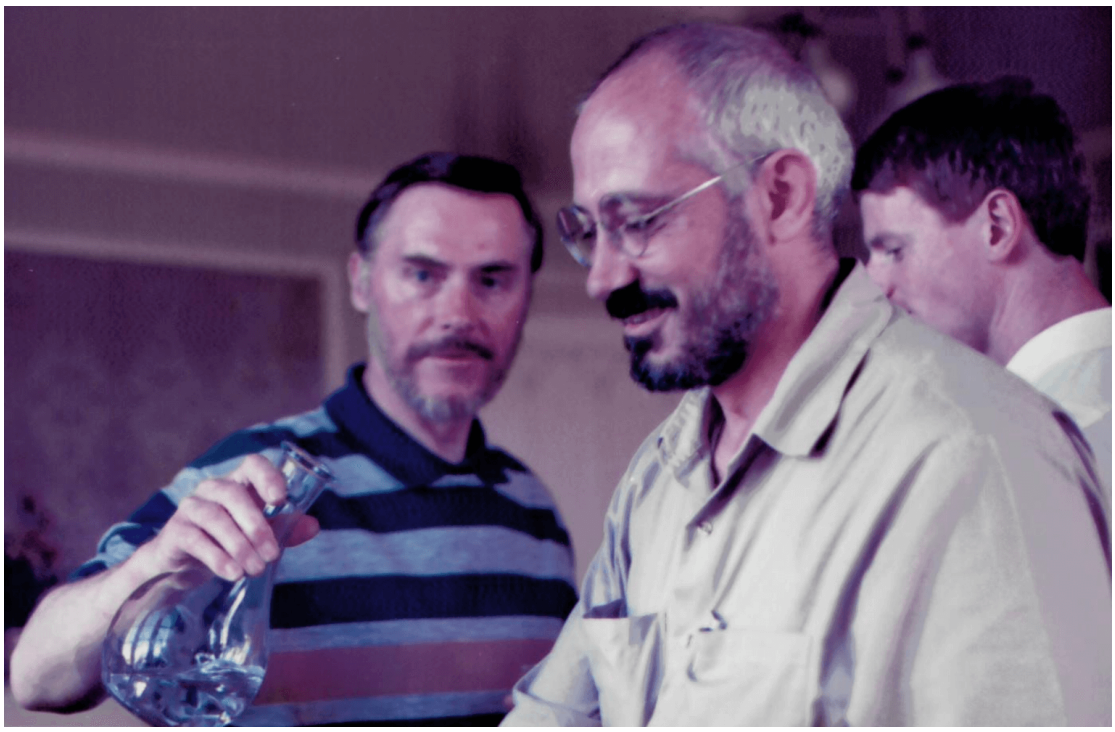

Figure 3: Brian Sleeman serving wine to George Dassios. Ross Priory, Strathclyde University (1989)

Obituary for the late Professor Brian Sleeman

The fundamental work of Brian Sleeman, on Mathematical Analysis, Functional Analysis, Numerical Analysis, Wave propagation and Scattering, Structural Stability, Nonlinear Analysis, Cancer Biology and of course, Modeling and General Problems in Applied Mathematics, is well known to everybody. His extensive scientific work is considered to be deep and innovative. All this work of his, as well as the honorary recognitions and prizes he won, is nowadays available to everybody. This is the reason why I decided to focus these lines on several not so well-known moments of my contacts with Brian.

It was the fall of 1973 when I started working on my Doctoral Dissertation in the University of Illinois at Chicago under the guidance of Victor Twersky. My problem was connected with low-frequency scattering by penetrable ellipsoids and I had to find bibliographical information on the subject. Since the Internet did not exist at the time, I had to spend an enormous amount of time in the library trying to find relative work in the existing literature. But I was lucky enough because Twersky guided me right away to look at two basic papers, one by A. F. Stevenson (1953) (*Solution of Electromagnetic Scattering Problems as Power Series in the Ratio (dimension of Scatterer)/wavelength*, Journal of Applied Physics. **24**, pp. 1134-1142) and one by B. D. Sleeman (1967) (*The Low-Frequency Scalar Dirichlet Scattering by a General Ellipsoid*, Journal of the Institute of Mathematics and its Applications. **3**, pp. 291-312). This was the first time that I ever heard about Brian Sleeman and this was the beginning of a continuous and fruitful collaboration with Brian and his work.

I met Brian in person a few years later in Dundee and after that we became good friends. Brian visited Greece a few times and I remember taking him to archaeological sites like Ancient Olympia, Ancient Delphi, and as well to some mountain places which Brian liked very much. In fact, he was very much impressed by the rudiments of the ancient Olympic Stadium and he did not miss the opportunity to walk a couple of times the whole length of 197 meters of this stadium. In this straight line track (almost 200 meters long), athletes from all over the ancient world would run forward and backward, every four years for almost eleven centuries. In fact, the legend says

Figure 4: Dinner and enjoying jokes and after dinner drinks with Gary Roach in Ross Priory, Strathclyde University (1989)

that this distance was the 200 steps of Hercules, who was invited to determine the length of the stadium (this is the origin of the word stadium). I remember that Brian was very moved with all this history. During these tours we had the opportunity to explore our mutual interests in wave propagation, scattering theory, and other applied mathematical problems, as well as to discuss social, political and cultural issues. He was interested in many different aspects and we both enjoyed our conversations.

Brian met my Greek colleagues and I can assure you that everyone was impressed with his politeness, quick mind and generosity in helping people with their mathematical problems. It is amazing that all these people here in Greece had the same reaction when they heard that Brian was not with us anymore: "We lost a wonderful person".

I had many times the opportunity to appreciate his quick and clear way of mathematical thinking in action during our discussions as we were walking, having coffee, or after dinner drinks in many places all over the world from Glasgow, Scotland to Oberwolfach, Germany; from the Greek mountains to the dream castle of Ross Priory to the (Abdus Salam) International Centre for Theoretical Physics in Trieste, Italy (ICTP). During our discussions Brian was literally radiating mathematical ideas. I remember once, sitting on a bench in a central square of Glasgow overlooking the James Watt statue, we were discussing the problem of identifying the size and orientation of a triaxial ellipsoid through high frequency measurements. We actually solved the problem through discussion without any writing and we only had to do a few calculations before we saw it published, Dassios & Sleeman (1991) (*A Note on the Reconstruction of Ellipsoids from the X-ray transform*, IMA Journal of Mathematics Applied in Medicine and Biology, **8**, pp. 141–147). In fact when we were exchanging ideas on ellipsoidal harmonics, we were communicating just with isolated symbols, we did not have to explain to each other what these symbols represent. This was quite obvious to us.

Brian' and Juliet's hospitality was mythical. I recollect the day that my wife and I were invited to their house in Dundee, Scotland for dinner, where they had tried to find in Dundee as much Greek food as possible. Although we had not missed Greek food, we were very much moved by their efforts to please us. Everybody knows that Brian Sleeman was an applied mathematician that had solved problems in a wide range of interesting real life applications. But in my eyes Brian was a pure classical analyst with a deep understanding of what was needed to be solved.

One of the major mathematical interests of Brian during the last years was the growth of tumors and in fact we have proved together that the growth of an ellipsoidal tumor has no stable states as the sphere does. It is a tragic irony that he was always telling me "George, we have to accept that no matter what we do, the tumor will eventually win".

Brian was a gifted mathematician, a sensitive human being and a British gentleman. A friend that we will remember, since he will always be present in our hearts.

Topic #8 ——— OP - SF Net 29.1 ——— January 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 November and December 2021. This list has been separated into two categories.

OP-SF Net Subscriber E-Prints

http://arxiv.org/abs/2111.00650
The Strong Gauss Lucas Theorem and Analyticity of Correlation Functions via the Lee-Yang Theorem
Barry Simon

http://arxiv.org/abs/2111.01279
Pattern-avoiding ascent sequences of length 3
Andrew R. Conway, Miles Conway, Andrew Elvey Price, Anthony J. Guttmann

http://arxiv.org/abs/2111.02105
Legendre pairs of lengths $\ell \equiv 0 \pmod 5$
Dursun Bulutoglu, Ilias Kotsireas, Christoph Koutschan, Jonathan Turner

http://arxiv.org/abs/2111.02832
Automating John P. D'Angelo's method to study Complete Polynomial Sequences
Shalosh B. Ekhad, Doron Zeilberger

http://arxiv.org/abs/2111.05103
Series solutions of linear ODEs by Newton-Raphson method on quotient D-modules
Yik Man Chiang, Avery Ching, Chiu Yin Tsang

http://arxiv.org/abs/2111.05104
Semi-classical Jacobi Polynomials, Hankel Determinants and Asymptotics
Chao Min, Yang Chen

http://arxiv.org/abs/2111.05661
Global and Local Scaling Limits for Linear Eigenvalue Statistics of Jacobi β-Ensembles
Chao Min, Yang Chen

http://arxiv.org/abs/2111.06478
A Short Course on Orthogonal Polynomials and Special Functions
J. Petronilho

http://arxiv.org/abs/2111.06873
The elliptic hypergeometric function and $6j$-symbols for SL(2,$\mathbb{C}$) group
S. E. Derkachov, G. A. Sarkissian, V. P. Spiridonov

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The A_2 Andrews-Gordon identities and cylindric partitions
S. Ole Warnaar

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Swaine L. Chen, Nico M. Temme

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Nalini Joshi, Tomas Lasic Latimer

http://arxiv.org/abs/2111.12226
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Robert P. Boyer, Daniel Parry

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Alexander Apelblat, Juan Luis González-Santander

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Wei-Qi Peng, Yong Chen

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Charles F. Dunkl

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Cameron's operator in terms of determinants, and hypergeometric numbers
Narakorn Rompurk Kanasri, Takao Komatsu, Vichian Laohakosol

http://arxiv.org/abs/2112.15349
On the evaluation of the alternating multiple t value $t(\{\overline{1}\}^a, 1, \{\overline{1}\}^b)$
Steven Charlton

Topic #9 ——— OP - SF Net 29.1 ——— January 15, 2022

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 29.2 should be sent by March 1, 2022.

OP-SF NET is an electronic newsletter of the SIAM Activity Group on Special Functions and Orthogonal Polynomials. 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 SIAM-OPSF (OP-SF Talk).

SIAM-OPSF (OP-SF Talk) is a listserv of the SIAM Activity Group on Special Functions and Orthogonal Polynomials, which facilitates communication among members, and friends of the Activity Group. See the previous Topic. To post an item to the listserv, send e-mail to siam-opsf@siam.org.

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 OP-SF Talk moderator

The appointed officers are:
Howard Cohl, OP-SF NET co-editor
Sarah Post, OP-SF NET co-editor
Diego Dominici, OP-SF Talk moderator
Bonita Saunders, Webmaster and OP-SF Talk moderator

From: OP-SF Net Editors
Subject: Thought of the Month by **Girish Karnad**

"I was not a very sincere student of mathematics though, given that my sole purpose in studying it was to obtain more marks. But as the examinations approached and I immersed myself day and night in the subject, I began to see in it patterns, arrangements, rhythm, elegance. In one of Aldous Huxley's stories, a character is moved to tears by the beauty of the Pythagorean theorem. Such a reaction was not surprising to me once I had begun to relish how mathematics — ripple upon ripple, branch growing from branch — led one to the uncanny and wonderful.

It was only later, when I was in Oxford and writing *Tughlaq*, that I realized how studying mathematics has shaped my working process. While proving a theorem, it is important at the outset to identify its constituent parts, the relationships between those parts, and how they are held in balance. It is mathematics that taught me that, while working out an individual part, I always had to be vigilant about the effect it had on other parts, and how it changed the overall structure as well as the interrelationships between various parts. This is essential technical training for a playwright."

Girish Karnad (1938-2019), in *This Life at Play, Memoirs*, 2021, translated by Girish Karnad and Srinath Perur. Aldous Huxley's story mentioned in the quote is Young Archimedes.

Contributed by Gaurav Bhatnagar and Tom H. Koornwinder