BIOGRAPHIC FILE

Date	January 26, 2025
Department	Physics and Astronomy
Name	Jacobus Johannes Maria Verbaarschot
Present Rank	Full Professor of Physics
Date of Last Promotion	Summer 2000
Civil Status	Married and no children

Education

Institution	*Dates Attended*	*Degree*	*Date of Degree*	*Field*
University of Utrecht	1972-1977	M.Sc.	January 1977	Physics
University of Utrecht	1977-1982	Ph.D.	April 1982	Physics

Dissertation Topics

Master: Quark Confinement by Exactly Soluble Two Dimensional Gauge Theories
(Adviser: Martinus Veltman, Noble Prize 1999)

Doctoral: On Spectral Averages in Nuclear Spectroscopy
(Advisor: Piet Brussaard)

Summary

PhD. 1982 (University of Utrecht). Joined Stony Brook Nuclear Theory Group in 1987 as Visiting Assistant Professor; Distinguished Professor since 2024; Full Professor since 2000; James Simons Fellow, 2001-2002; Villum Kann Rassmussen Visiting Professor, 2006-2007; Danish National Bank Award, 2006-2007; Humboldt Research Award 2006 . Author of over 200 publications, 28 since 2013. According to Google Scholar they have 15455 citations, 2625 since 2020. His h-index is 70. Most cited papers ((citations (year)): 1045 (1985), 904 (1998), 656 (1993), 615 (1994), 491 (1993), 461 (2000). Derived the VWZ-formula (Verbaarschot-Weidenmueller-Zirnbauer) for cross-section fluctuations in the statistical theory of nuclear reactions (1985) and introduced chiral random matrix theory to describe fluctuations of Dirac spectra (1993). From 2009-2019 he has also been Graduate Program Director and from 2008 to 2011 he has served as the Chair of the Graduate Council.

1. Professional Experience

Institution	*Rank and Field*	*From-To*
University of Utrecht	Teaching Assistant	1975-1981
University of Utrecht	Research Assistant	1977-1982
MPI Heidelberg	Research Associate	1982-1985
University of Illinois	Research Associate	1985-1987
SUNY at Stony Brook	Visiting Assistant Professor	1987-1991
CERN Geneva (on leave from Stony Brook)	Paid Associate	1988-1989
SUNY at Stony Brook	Assistant Professor	1991-1996
SUNY at Stony Brook	Associate Professor	1996-2000
University of Washingon	Visiting Faculty	March-June 2000
SUNY at Stony Brook	Full Professor	2000-present
SUNY at Stony Brook	James H. Simons Fellow	Spring 2001
Niels Bohr Institute	Niels Bohr International Academy Visiting Professor	2006-2007
SUNY Stony Brook	Graduate Program Director	2009-2019
SUNY at Stony Brook	Distinguished Professor	2024-present

2. Honors

Max-Planck Fellowship at the Max Planck Institute for Nuclear Physics at Heidelberg (1982-1983).

James H. Simons Fellowship (2001-2002).

Guest editor of Special issue on Random Matrix Theory for J. Phys. A.

Villum Kann Rassmussen Visiting Professor, (2006-2007).

Humboldt Research Award (April 2006)

Danish National Bank Award (2006-2007)

Moshinsky Lecture, July 2019, Honorary Lecture at the CIC Cuernavaca

Chancellor's Award of the State University of New York for Excellence in Scholarship and Creative Activities, July 2020

Fellow of the American Physicals Society, October 2021

SUNY Distinguished Professor, April 2024

3. Grants

In our field it is customary that research groups share so-called umbrella grants. Each of us contributes a section to the proposal which then will be be combined into a single proposal.

Our research proposal "Research in Theoretical Nuclear Physics" is presently funded at US $ 800,000 per annum. The investigators on this grant are D. Kharzeev (PI), E. Shuryak, D. Teaney, I. Zahed and myself.

Summary of Accomplishments

The main theme of the research activities of Jacobus Verbaarschot has been the study of nonperturbative effects in Quantum Mechanics, Nuclear Physics and Field Theory. One important question he has addressed is the effect of complexity and chaotic behavior in quantum systems and to what extent this gives rise to universal phenomena. After having worked on two-dimensional QCD for his Master thesis, Verbaarschot started his research career with a doctoral thesis on statistical spectroscopy in nuclear physics. In the context of the nuclear shell model he was working on the two-body random ensemble, a model that is now known as the complex Sachdev-Ye-Kitaev model. The main idea of this approach was that because of the complexity of the nuclear interactions, it makes much more sense to analyze the average behavior of spectra and wave functions with the goal to uncover universal properties of the many-body system. He was one of the early pioneers of Quantum Chaos and established in 1984 (together with Seligman and Zirnbauer) that the reverse of the Bohigas-Gionnoni Schmidt conjecture is also correct, namely that if quantum mechanical system is not fully chaotic the eigenvalues are not correlated according to Random Matrix Theory. In this paper he studied a quantum system with two degrees of freedom where the fraction of phase space that is chaotic depends on the strength of the quartic potential, ranging from integrable to fully chaotic. Only in the latter case did the correlations agree with the universal random matrix correlations. His work on compound nucleus cross section fluctuations is also well known. Using a Random Matrix Theory for the nuclear Hamiltonian he (together with Weidenmüller and Zirnbauer) obtained an analytical result for the compound nucleus cross section in terms of the average S matrix which is determined by an energy average over many level spacings or, in the time domain, by fast processes which can be obtained from simple models such as the optical model. The analytical result is a three dimensional integral which is now known as the VWZ integral, and which has been widely used for study of disordered systems in general and quantum dots in particular. The universality of this result was also established by Verbaarschot who showed that it minimizes the information entropy. The VWZ formula was derived using the supersymmetric method for disordered systems which was invented two years prior by Efetov, and an important contribution of this paper is that it established the mathematical foundations of this method. Verbaarschot's understanding of the universality of eigenvalue correlation led him to hypothesis that the eigenvalues of the QCD Dirac operator correlated according random matrices with chiral symmetry. Depending on the representation of the gauge group, he found three new universality classes which are now known as the chiral ensembles. Together with the superconducting ensembles which where discovered a few years later by Altland and Zirnbauer and the original Wigner-Dyson ensembles, they form the so called ten-fold classification of random matrix theories which is in one- to-one correspondence with Cartan's classification of large symmetric spaces. One reason that his work on chiral random matrix theory had a great deal of impact was that it showed that it was possible to obtain analytical results for a complicated numerical calculation.

For example the work of Verbaarschot has been used to obtain a more accurate extrapolation of the chiral condensate, and for the observation of the restoration of U(1) in the spectra of the lattice QCD Dirac operator. His ideas on chiral random matrix theory have become so well-known is the lattice community, that more often than not, his work is no longer cited in this context. Some of his important results in this area are the derivation of the spectral density of the QCD Dirac operator from chiral perturbation theory which also proved the correctnes of the random matrix hypothesis, the phase diagram of QCD based on random matrix models, and the application to random matrix theory to QCD at nonzero chemical potential. Throughout his career, Verbaarschot has been fascinated by manifestations of topology in physics. He worked on the Skyrme model of the nucleon and the $B = 2$ solution has the shape of a torus. Also his work on nuclear matter in this model is well-known. He analyzed the chiral properties of QCD at low energy in terms of field configurations given by a superposition of instantons and anti-instantons. The first tests of chiral random matrix theory, including the effects of topology, were performed for this model. Another well-know paper of Verbaarschot with connections to topology is the solution of the three anyon problem using the Faddeev equations. Verbaarschot's work on QCD at nonzero chemical potential has received a great deal of attention. He (together with Splittorff) was able to get explicit analytical results for the severity of the sign problem using chiral perturbation theory. He showed that the critical chemical potential beyond which lattice simulations become impossible is given by the pion mass. His work on QCD at nonzero chemical potential is intertwined with his work on random matrix theory. Among other he was able to get a detailed understanding of the "Silver Blaze" problem in terms of Dirac spectra, and using a random matrix model he showed that the complex Langevin method converges incorrectly to the quenched limit. His most recent work is on chaotic behavior in many-body theory, in particular on the Sachdev- Ye-Kitaev model. He (mostly together with Garcia-Garcia), building on result he (with Zirnbauer) obtained 35 years prior, showed that the spectra of this Hamiltonian are correlated according to random matrix theory and correspond to a chaotic system which has important implications for the application of this model to Black Hole physics. He obtained an analytical formula for the spectral density of this model and discovered a Z4 for a coupled version of this model. Recently he has been working on a non-Hermitian version of the SYK model which has the so-called worm-hole solutions in the absence of an explicit coupling between two SYK Hamiltonians. The solutions of this model could be understood in terms of replica symmetry breaking of non-hermitian random matrix theories in the same spirit as the effect of quenching for QCD at nonzero chemical potential. He also showed that the properties of the SYK model do not change after nullifying a large fraction of the matrix elements of the Hamiltonian. This result was essential for porting a rarefied version this model to a quantum computer by Jafferis et al..

Representative Publications

1. Antonio M. García-García, Chang Liu and Jacobus J .M. Verbaarschot , *Sparsity independent Lyapunov exponent in the Sachdev-Ye-Kitaev model*, Phys .Rev. Lett. 133 (2024) 9, 091602 [arXiv: 2311.00639 [hep-th]].
2. Antonio M. García-García, Lucas Sá, Jacobus J .M. Verbaarschot and Can Yin, *Sixfold way of traversable wormholes in the Sachdev-Ye-Kitaev model*, Phys. Rev. Lett. **132** (2024) 6, 061603 (2024) [arXiv: 2305.09663 [hep-th]].
3. A. M. García-García, L. Sá and J. J. M. Verbaarschot, *Symmetry classification and universality in non-Hermitian many-body quantum chaos by the Sachdev-Ye-Kitaev model* Phys. Rev. X 12 (2022), 021040 [arXiv:2110.03444 [hep-th]].
4. A. M. García-García, Y. Jia, D. Rosa and J. J. M. Verbaarschot, *Replica Symmetry Breaking and Phase Transitions in a PT Symmetric Sachdev-Ye-Kitaev Model*, Phys. Rev. Lett. **128** (2022) 8, 081601 [arXiv:2102.06630 [hep-th]].
5. A. M. Garcia-Garcia and J. J. M. Verbaarschot, *Spectral and thermodynamic properties of the Sachdev-Ye-Kitaev model*, Phys. Rev. D94, 126019 (2016) [arXiv:1610.03816 [hep-th]].
6. J. J. M. Verbaarschot,*Handbook Article on Applications of Random Matrix Theory to QCD* [arXiv:0910.4134] (in press).
7. K. Splittorff and J.J.M. Verbaarschot, *Phase of the Fermion Determinant at Nonzero Chemical Potential,* Phys. Rev. Lett.**98**, 031601 (2007), [arXiv:hep-lat/0609076].
8. K. Splittorff and J. J. Verbaarschot, *Replica limit of the Toda lattice equation,* Phys. Rev. Lett. **90**, 041601 (2003) [arXiv:cond-mat/0209594].
9. T. Schafer, D. T. Son, M. A. Stephanov, D. Toublan and J. J. Verbaarschot, *Kaon condensation and Goldstone's theorem*, Phys. Lett. **B522**, 67 (2001).
10. J. B. Kogut, M. A. Stephanov, D. Toublan, J. J. Verbaarschot and A. Zhitnitsky, *QCD-like theories at finite baryon density*, Nucl. Phys. **B582** (2000) 477 .
11. J.C. Osborn, D. Toublan and J.J.M. Verbaarschot, *From chiral Random Matrix Theory to chiral Perturbation Theory*, Nucl. Phys. **B540** (1999) 317 .
12. M.E. Berbenni-Bitsch, S. Meyer, A. Schafer, J.J.M. Verbaarschot and T. Wettig, *Microscopic universality in the spectrum of the lattice Dirac operator*, Phys. Rev. Lett. **80** (1998) 1146.
13. M.A. Halasz and J.J.M. Verbaarschot, *Universal fluctuations in spectra of the lattice Dirac operator*, Phys. Rev. Lett. **74** (1995) 3920 .
14. J.J.M. Verbaarschot, *The spectrum of the QCD Dirac operator and chiral random matrix theory*, Phys. Rev. Lett. **72** (1994) 2531 .
15. E.V. Shuryak and J.J.M. Verbaarschot, *Random matrix theory and spectral sum rules for the Dirac operator in QCD*, Nucl. Phys. **A560** (1993) 306 .
16. J.J.M. Verbaarschot and I. Zahed, *On the spectrum of the Dirac operator in QCD near zero virtuality*, Phys. Rev. Lett. **70** (1993) 3852.
17. M. Sporre, J.J.M. Verbaarschot and I. Zahed, *Numerical solution of the three anyon problem*, Phys. Rev. Lett. **67** (1991) 1817 .
18. J.J.M. Verbaarschot, *Axial symmetry of bound baryon number two solution of the skyrme model*, Phys. Lett. **B195** (1987) 235 .
19. J.J.M. Verbaarschot, H.A. Weidenmüller and M.R. Zirnbauer, *Grassmann integration in stochastic quantum physics: the case of compound nucleus scattering*, Phys. Rep. **129** (1985) 367,
20. T.H. Seligman, J.J.M. Verbaarschot and M.R. Zirnbauer, *Quantum spectra and the transition from regular to chaotic classical motion*, Phys. Rev. Lett. **53** (1984) 215 .

Selected Presentations (after 1991)

1. Three Invited Lectures at the Manstam School of the University of Witwatersrand, *Random Matrix Theory, Quantum Chaos and the Sachdev-Ye-Kitaev Model*, January 2025
2. Invited Colloquium at Jiaotong University, *Random Matrix Theory, Chaos, and Many-Body Quantum Systems*, December 2024.
3. Invited Joint Israel High Energy Theory Seminar, Chaos and Wormholes in the Sachdev-Ye-Kitaev Model, January 2023.
4. Invited Talk at Princeton Workshop on Mathematical Challenges of Quan-tum Mechanics, *Mathematical Challenges of Many-Body Quantum Chaos*, March 2023
5. Invited seminar at Princeton University, *Chaotic and Thermodynamic Properties of two Coupled Sachdev-Ye-Kitaev Model*, November 2019.
6. Moshinky Lecture (Honorary Lecture) at CIC Cuernavaca, *Black Holes and Compound Nuclei*, Jyly 2019.
7. Invited talk at APS Physics Next Workshop, *Spectra and Chaos in the SYK Model*, August 2017.
8. Invited Colloquium at UNAM Cuernavaca, *Random Matrix Theory and Universal Spectral Behavior*, September 2015.
9. Invited Colloquium at Ben Gurion University, *Chiral Symmetry and Strong Interaction*, October 2014.
10. Invited Colloquium at the University of Cologne, *Dirac Spectra, Tail States and Spontaneous Symmetry Breaking*, January 2014.
11. Invited Colloquium at the University of Bielefeld, *Random Matrix Theory and Universal Spectral Fluctuation*, January 2014.
12. Invited Colloquium at the University Regensburg, *Random Matrix Theory and Quantum Spectra*, June 2007.
13. Invited Colloquium at Niels Bohr Institute, *Applications and Foundations of Random Matrix Theory*, April 2007
14. Invited Colloquium at the University of Cologne, *Facing the Phases of QCD*, January 2006.
15. Invited Colloquium at Lund University, *Applications and Foundations of Random Matrix Theory*, October 2006.
16. Invited Colloquium at the University of Chapel Hill, *Foundations and Applications of Random Matrix Theory*, April 2006.
17. Invited Lectures at the Les Houches Summer School, *QCD, Chiral Random Matrix Theory and Integrability*, June 2004.
18. Invited Seminar at MIT, *Reality Checks for QCD at finite Density*, April 2002.
19. Invited Colloquium at UIC Chicago, *The Ubiquity of Random Matrix Theory in Physics*
20. Invited Colloquium University of Iowa, *Order in Chaos and Unity in Physics*, November 1999
21. Planery Talk at Lattice 1996 in St, Louis, *Random Matrix Model Approach to Chiral Symmetry*, June 1996.
22. Invited Seminar at MIT, *Universal Conductance Fluctuations in QCD*, May 1994
23. Plenery talk at APS meeting in Washingtonb DC, *Chiral Symmetry Breaking and Instantons*

4. Publications

4a. Refereed articles

1. J.J.M. Verbaarschot and P.J. Brussaard, *A statistical study of shell-model eigenvectors*, Phys. Lett. **87B** (1979) 155 .
2. J.J.M. Verbaarschot and P.J. Brussaard, *A new method to evaluate operator moments for fixed angular momentum*, Phys. Lett. **102B** (1981) 201 .
3. J.J.M. Verbaarschot and P.J. Brussaard, *Fixed-JT averages of electromagnetic operators*, Nucl. Phys. **A423** (1984) 77 .
4. J.J.M. Verbaarschot, P.J. Brussaard and G.A. Timmer, *On the systematic energy difference between states of positive and negative parity*, Nucl. Phys. **A378** (1984) 77.
5. J.J.M. Verbaarschot and P.J. Brussaard, *Distribution of electromagnetic amplitudes*, Z. Phys. **A321** (1985) 125 .
6. M.R. Zirnbauer, J.J.M. Verbaarschot and H.A. Weidenmüller, *Destruction of order in nuclear spectra by a residual GOE interaction,* Nucl. Phys. **A411** (1984) 161 .
7. J.J.M. Verbaarschot, H.A. Weidenmüller and M.R. Zirnbauer, *Evaluation of ensemble averages for simple Hamiltonians perturbed by a GOE interaction*, Ann. Phys. **153** (1984) 367 .
8. J.J.M. Verbaarschot, H.A. Weidenmüller and M.R. Zirnbauer, *Statistical nuclear physics as a zero-dimensional Anderson model*, Phys. Rev. Lett. **52** (1984) 1597 .
9. J.J.M. Verbaarschot and M.R. Zirnbauer, *Replica fields, loop expansion and spectral rigidity of random matrix ensembles*, Ann. of Phys. **158** (1984) 78 .
10. T.H. Seligman, J.J.M. Verbaarschot and M.R. Zirnbauer, *Quantum spectra and the transition from regular to chaotic classical motion*, Phys. Rev. Lett. **53** (1984) 215 .
11. T.H. Seligman, J.J.M. Verbaarschot and M.R. Zirnbauer, *Scale invariant Lyapunov exponents for Hamiltonian systems*, Phys. Lett. **110A** (1985) 1093 .
12. J.J.M. Verbaarschot and M.R. Zirnbauer, *Critique of the replica trick*, J. Phys. **A17** (1985) 1093 .
13. J.J.M. Verbaarschot, H.A. Weidenmüller and M.R. Zirnbauer, *Grassmann integration and the theory of compound nucleus reactions*, Phys. Lett. **149B** (1985) 263.
14. T.H. Seligman, J.J.M. Verbaarschot and M.R. Zirnbauer, *The transition from order to chaos in quantum systems*, J. Phys. **A18** (1985) 2751 .
15. T.H. Seligman and J.J.M. Verbaarschot, *Fluctuations of quantum spectra and their semiclassical limit at the transition between order and chaos*, J. Phys. **A18** (1985) 2227 .
16. T.H. Seligman and J.J.M. Verbaarschot, *Quantum spectra of classically chaotic systems without time reversal invariance*, Phys. Lett. **108A** (1985) 183 .
17. J.J.M. Verbaarschot, H.A. Weidenmüller and M.R. Zirnbauer, *Grassmann integration in stochastic quantum physics: the case of compound nucleus scattering*, Phys. Rep. **129** (1985) 367, `(385 citations, ISIS)`.
18. J.J.M. Verbaarschot and S. Yoshida, *Comparison of exact and approximate time developing functions in the statistical theory of nuclear reactions*, Z. Phys. **A322** (1985) 621 .
19. T.H. Seligman, J.J.M. Verbaarschot and H.A. Weidenmüller, *Chaotic motion and collective nuclear rotation*, Phys. Lett. **167B** (1986) 365 .
20. J.J.M. Verbaarschot, *Investigation of the formula for the average of two S-matrix elements in compound nucleus reactions*, Ann. Phys. **168** (1986) 368 .

21. H. Nishioka, J.J.M. Verbaarschot, S. Yoshida and H.A. Weidenmüller, *Statistical theory of precompound reactions: The multistep compound process*, Ann. Phys. (N.Y.) **172** (1986) 67 .
22. T.H. Seligman and J.J.M. Verbaarschot, *Long range stiffness of spectral fluctuations in integrable scale invariant systems*, J. Phys. **A20** (1987) 1433 .
23. T.H. Seligman and J.J.M Verbaarschot, *Level statistics of integrable quantum systems*, Phys. Rev. Lett. **56** (1986) 2767 .
24. J.J.M. Verbaarschot, T.S. Walhout, J. Wambach and H.W. Wyld, *Scattering of skyrmions in an axially symmetric system*, Nucl. Phys. **A461** (1986) 603 .
25. M. Altenbokum, U. Kaulfuss and J.J.M. Verbaarschot, *The mass of the Sine-Gordon soliton in the Hartree approximation*, Phys. Rev. **D34** (1986) 1840 .
26. J.J.M. Verbaarschot, T.S. Walhout, J. Wambach and H.W. Wyld, *Symmetry and quantization of the two-skyrmion system: The case of the deuteron*, Nucl. Phys. **A468** (1987) 520 .
27. J.J.M. Verbaarschot, *Higher order correlation level correlation functions in integrable quantum systems*, J. Phys.**A20** (1987) 5589 .
28. J.J.M. Verbaarschot, *Axial symmetry of bound baryon number two solution of the skyrme model*, Phys. Lett. **B195** (1987) 235 .
29. J.J.M. Verbaarschot, *Graded symmetry and Anderson localization on the Bethe lattice for time reversal invariant systems*, Nucl. Phys. **B300**[**FS22**] (1988) .
30. A.D. Jackson and J.J.M. Verbaarschot, *Phase structure of the Skyrme model*, Nucl. Phys. **A484** (1988) 419 .
31. M.A. Nowak, J.J.M. Verbaarschot and I. Zahed, *Flavor mixing in the instanton vacuum*, Nucl. Phys. **B324** (1989) 1 .
32. M.A. Nowak, J.J.M. Verbaarschot and I. Zahed, *Is the nucleon strange?*, Phys. Lett. **B217** (1989) 157 .
33. L. Castillejo, P.S.J. Jones, A.D. Jackson, A. Jackson and J.J.M. Verbaarschot, *Dense skyrmion systems*, Nucl. Phys. **A501** (1989) 801 .
34. M.A. Nowak, J.J.M. Verbaarschot and I. Zahed, *Chiral fermions in the instanton vacuum at finite temperature*, Nucl. Phys. **B325** (1989) 581 .
35. M.A. Nowak, J.J.M. Verbaarschot and I. Zahed, *Instantons and chiral dynamics*, Phys. Lett. **B228** (1989) 251 .
36. M.A. Nowak, J.J.M. Verbaarschot and I. Zahed, *OZI rule and instantons*, Phys. Lett. **B226** (1989) 382 .
37. E.V. Shuryak and J.J.M. Verbaarschot, *Chiral symmetry breaking and correlations in the instanton liquid*, Nucl. Phys. **B341** (1990) 1 .
38. J.J.M. Verbaarschot, P. West and T.T. Wu, $N = 4$ *Supersymmetric quantum mechanics and its large order behavior*, Phys. Lett. **B240** (1990) 401 .
39. J.J.M. Verbaarschot, P. West and T.T. Wu, *Large order behavior of the supersymmetric anharmonic oscillator*, Phys. Rev. **D42** (1990) 1276 .
40. R. Alkofer, M.A. Nowak, J.J.M. Verbaarschot and I. Zahed, *Pseudoscalars in the instanton liquid model*, Phys. Lett. **B233** (1990) 205 .
41. J.J.M. Verbaarschot and P. West, *Instantons and Borel resummability of the perturbed supersymmetric anharmonic oscillator*, Phys. Rev. **D43** (1991) 2718 .
42. J.J.M. Verbaarschot and P. West, *Renormalons in supersymmetric theories*, Int. J. Mod. Phys. **A6** (1991) 2361 .

43. E.V. Shuryak and J.J.M. Verbaarschot, *QCD instantons at finite temperature. (I) Gluonic interactions and the fermion determinant*, Nucl. Phys. **B364** (1991) 255 .

44. J.J.M. Verbaarschot, *Streamlines and conformal invariance in Yang-Mills theories*, Nucl. Phys. **B362** (1991) 33 .

45. M. Sporre, J.J.M. Verbaarschot and I. Zahed, *Numerical solution of the three anyon problem*, Phys. Rev. Lett. **67** (1991) 1817 .

46. M. Sporre, J.J.M. Verbaarschot and I. Zahed, *Four anyons in a harmonic well*, Phys. Rev. **B46** (1992) 5738 .

47. E.V. Shuryak and J.J.M. Verbaarschot, *On baryon number violation and non-perturbative weak processes at SSC energies*, Phys. Rev. Lett. **68** (1992) 2576.

48. M. Sporre, J.J.M. Verbaarschot and I. Zahed, *Anyon spectra and the third virial coefficient*, Nucl. Phys. **B389** [**FS**] (1993) 645 .

49. E.V. Shuryak and J.J.M. Verbaarschot, *Quark propagation in the random instanton vacuum*, Nucl. Phys. **B410** (1993) 37 .

50. E.V. Shuryak and J.J.M. Verbaarschot, *Mesonic correlation functions in the random instanton vacuum*, Nucl. Phys. **B410** (1993) 55 .

51. T. Schäfer, E.V. Shuryak and J.J.M. Verbaarschot, *Baryonic correlation functions in the random instanton vacuum*, Nucl. Phys. **B412** (1994) 143 .

52. E.V. Shuryak and J.J.M. Verbaarschot, *Random matrix theory and spectral sum rules for the Dirac operator in QCD*, Nucl. Phys. **A560** (1993) 306 .

53. J.J.M. Verbaarschot and I. Zahed, *On the spectrum of the Dirac operator in QCD near zero virtuality*, Phys. Rev. Lett. **70** (1993) 3852.

54. J.J.M. Verbaarschot, *Chiral random matrix theory and the spectrum of the Dirac operator near zero virtuality*, Acta Phys. Pol. **B25** (1994) 133 .

55. J.J.M. Verbaarschot, *The spectrum of the QCD Dirac operator and chiral random matrix theory*, Phys. Rev. Lett. **72** (1994) 2531 .

56. J.J.M. Verbaarschot, *Spectral sum rules and Selberg's integral formula*, Phys. Lett. **B329** (1994) 351 .

57. J.J.M. Verbaarschot, *The spectrum of the Dirac operator near zero virtuality for* $N_c = 2$, Nucl. Phys. **B 426** [**FS**] (1994) 559 .

58. A. Fayyazuddin, T.H. Hansson, M.A. Nowak, J.J.M. Verbaarschot and I. Zahed, *Finite temperature correlators in the Schwinger model*, Nucl. Phys. **B425** (1994) 553 .

59. J.J.M. Verbaarschot, *Spectrum of the Dirac operator in a QCD instanton liquid: two versus three colors*, Nucl. Phys. **B427** (1994) 534 .

60. A. Smilga and J.J.M. Verbaarschot, *Spectral sum rules and finite volume partition function in gauge theories with real and pseudoreal fermions*, Phys. Rev. **D51** (1995) 829 .

61. J.J.M. Verbaarschot and I. Zahed, *Random matrix theory and* QCD_3, Phys. Rev. Lett. **73** (1994) 2288 .

62. T. Schäfer, E.V. Shuryak and J.J.M. Verbaarschot, *The Chiral phase transition and instanton−anti-instanton molecules*, Phys. Rev. **D51** (1995) 1267 .

63. E.V. Shuryak and J.J.M. Verbaarschot, *Screening of the topological charge in a correlated instanton vacuum*, Phys. Rev. **D52** (1995) 295 .

64. J. Steele, J.J.M. Verbaarschot and I. Zahed. *The Invariant Fermion Correlator in the Schwinger Model on the Torus*, Phys. Rev. **D51** (1995) (5915) .

65. M.A. Halasz and J.J.M. Verbaarschot, *Universal fluctuations in spectra of the lattice Dirac operator*, Phys. Rev. Lett. **74** (1995) 3920 .
66. M.A. Halasz and J.J.M. Verbaarschot, *Effective Lagrangians and chiral random matrix theory*, Phys. Rev. **D52** (1995) (2563) .
67. J.J.M. Verbaarschot, *Universal scaling of the valence quark mass dependence of the chiral condensate*, Phys. Lett. **B368** (1996) 137 .
68. A.D. Jackson and J.J.M. Verbaarschot, *A random matrix model for chiral symmetry breaking*, Phys. Rev. **D53** (1996) 7223 .
69. A. Smilga and J.J.M. Verbaarschot, *Scalar susceptibility in QCD and the multiflavor Schwinger model*, Phys. Rev. **D54** (1996) 1087 .
70. A.D. Jackson, M.K. Sener and J.J.M. Verbaarschot, *Universality near zero virtuality*, Nucl. Phys. **B479** (1996) 707 .
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4b. Invited articles

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4c. Abstracts and book reviews

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2. J.J.M. Verbaarschot, Review of *Finite Temperature QCD* by J. Kapusta, J. Phys. **G21** (1995) 149.
3. M.A. Halasz, A.D. Jackson, M.K. Sener, J.J.M. Verbaarschot, *Random Matrix Model for Chiral Phase Transition at Finite T and μ*, DNP Fall Meeting, Cambridge, 1996.
4. J.J.M. Verbaarschot, *Universal Fluctuations of QCD Dirac Spectra*, DNP Fall Meeting, Whistler 1997.
5. J.J.M. Verbaarschot, *Chiral symmetry breaking and the spectrum of the QCD Dirac Operator*, in Abstract of the XVth Particles and Nuclei International Conference, June 1999, invited talk at the 1999 PANIC conference.

4d. Unpublished Material

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2. J.J.M. Verbaarschot, *On spectral averages in nuclear spectroscopy*, thesis of the University of Utrecht (1982).
3. A.D. Jackson, J.J.M. Verbaarschot, I. Zahed and L. Castillejo, *Superconductivity in a two-dimensional soliton crystal* (1987).

5. Invited Lectures (Since September 1991)

Month	*Year*	*Institution*	*Title*
September	1991	MIT	Chiral Symmetry Breaking and Instantons
January	1992	ITP Minneapolis	Streamlines and Baryon Number Violation
March	1992	NIKHEF Amsterdam	Chiral Symmetry Breaking and Instantons
March	1992	University of Utrecht	Quantum Mechanics of Few Anyon Systems
April	1992	APS meeting Washington DC	Chiral Symmetry Breaking and Instantons
June	1993	Zakopane Summer School	Random Matrix Theory Universality of the Spectrum of the Dirac Operator near Zero Virtuality
August	1993	Workshop at ITP Santa Barbara	Finite Temperature Effects and Instantons
December	1993	BNL Brookhaven	Instantons and Correlations in QCD
January	1994	Minneapolis QCD Workshop	Chiral Random Matrix Theory and QCD
March	1994	Ohio State University	Correlations in QCD and Instantons
May	1994	MIT	Universal Conductance Fluctuations in QCD
July	1994	Aspen QCD Workshop	Universality and the Spectrum of the Dirac Operator
April	1995	University of Maryland	Universal Correlations in the Spectrum of the Dirac Operator
May	1995	Columbia University	Small Dirac Eigenvalues
July	1995	Trento QCD Workshop	Universal Scaling of the Chiral Condensate
September	1995	University of Nijmegen	Chiral Symmetry in QCD
September	1995	University of Leiden	The Spectrum of the Dirac operator in the Mesoscopic Limit of QCD
March	1996	Minneapolis QCD Workshop	On the Spectrum of the QCD Dirac Operator
April	1996	MIT	Chiral Symmetry and the Spectrum of the QCD Dirac Operator
June	1996	St. Louis, Lattice 1996	Random Matrix Model Approach to Chiral Symmetry
June	1996	St. Louis, Lattice 1996	Universal Correlations in Spectra of the Lattice QCD Dirac Operator
August	1996	Argonne Theory Institute	Chiral Symmetry Breaking and Random Matrix Theory

Invited Lectures (Continued)

Month	*Year*	*Institution*	*Title*
August	1996	Frankfurt University	Chiral Symmetry and the Spectrum of QCD Dirac Operator
November	1996	University of Pennsylvania	Chiral Symmetry and Universal Correlations in the Spectrum of the QCD Dirac Operator
January	1997	Hirschegg Workshop	Chiral Symmetry and the Spectrum of the QCD Dirac Operator
February	1997	Les Houches Workshop	Spectral Fluctuations of the QCD Dirac Operator
March	1997	Duke University	Chiral Symmetry and the Spectrum of the QCD Dirac Operator
June	1997	Zakopane Workshop	Spectral Fluctuations of the QCD Dirac Operator
July	1997	Cambridge Summer School	Universal Behavior in Dirac Spectra
September	1997	Whistler APS meeting	Universal Fluctuations of QCD Dirac Spectra
November	1997	University of Maryland	Universal Behavior in Dirac Spectra
January	1998	Niels Bohr Institute	Universal Behavior in QCD Dirac Spectra
April	1998	Minneapolis QCD Workshop	Universal Behavior in QCD Dirac Spectra
April	1998	Bielefeld QCD Workshop	Random Matrix Theory and QCD at Nonzero Chemical Potential
May	1998	Trento chRMT workshop	The First Five Years of RMT in QCD
July	1998	Rio de Janeiro Chaos Winterschool	Chiral Random Matrix Theory and QCD
August	1998	Trieste workshop on mesoscopic systems	QCD as a Disordered Mesoscopic Sample
September	1998	Strong Interaction Study Days	Applications of Random Matrix Theory to QCD
October	1998	APCTP-RNCP school on QCD	The Infrared Limit of the QCD Dirac Spectrum and Applications of Chiral Random Matrix Theory to QCD
October	1998	YITP workshop on QCD and hadrons	The Infrared Limit of the QCD Dirac Spectrum
November	1998	BNL workshop on QCD Phase Transitions	Quenching, Localization and the Chiral Phase Transition in QCD
January	1999	Aspen Conference on Nonperturbative Particle Dynamics	The Infrared Limit of the QCD Dirac Spectrum
March	1999	Trento deconfinement workshop	The Infrared Limit of the QCD Dirac Spectrum

Invited Lectures (Continued)

Month	*Year*	*Institution*	*Title*
May	1999	CERN heavy ion theory workshop	The Infrared Limit of the QCD Dirac Spectrum
May	1999	Orsay, Statistical Mechanics Group	QCD as a Disordered Mesoscopic Sample
June	1999	Aspen workshop on the QCD Dirac Spectrum	The Infrared Limit of the QCD Dirac Spectrum and chiral Random Matrix Theory
June	1999	PANIC conference, Uppsala	Chiral Symmetry and the Spectrum of the QCD Dirac Operator
June	1999	NBI Copenhagen	What does Chiral Symmetry tell us about the QCD Dirac Spectrum?
August	1999	ICTP Conference on Nonhermitian Random Matrix Theory	Effective Low Energy Theories and QCD Dirac Spectra
September	1999	Many Body Conference Seattle	Low Energy Effective Theories, Random Matrix Theory and QCD Dirac Spectra
November	1999	Colloquium University of Iowa	Order in Chaos and Unity in Physics
November	1999	Seminar University of Iowa	Effective Low Energy Theories and QCD Dirac Spectra
January	2000	Mexico Workshop on Quantum Chaos	Chiral Symmetry, Universal Behavior and Random Matrix Theory
February	2000	Seminar Brookhaven	Exact Results for QCD Dirac Spectra at Zero and at Finite Baryon Density
April	2000	Colloquium at UIC Chicago	The Ubiquity of Random Matrix Theory in Physics
May	2000	Minneapolis QCD Workshop	Chiral Symmetry, Sigma-Models and Exact Results for QCD Dirac Spectra
June	2000	Copenhagen Field Theory Workshop	Dirac Spectra and Random Matrix Theory
June	2000	Light Cone QCD Workshop at Heidelberg	Randomness on the Lattice
September	2000	Brittany Workshop	Reality Checks for QCD at Finite Density
September	2000	Colloquium at Stony Brook	The Ubiquity of Random Matrix Theory
February	2001	Summer School in Campos de Jordanos	Random Matrix Theory and QCD
June	2001	Matrix Models 2001, Paris	Chiral Random Matrix Theory and Unitary Matrix Integras
August	2001	Paris Workshop on QCD	Real Dense QCD at Low Energy

Invited Lectures (Continued)

Month	*Year*	*Institution*	*Title*
April	2002	Seminar at MIT	Reality Checks for QCD at finite Density
May	2002	QCD 2002, Minneapolis	Real QCD at nonzero density
July	2002	Seminar at Dijon	Random Matrix Theory
July	2002	Trento Workshop	The QCD Dirac Spectrum
August	2002	QCD 2002, Minneapolis	Real QCD at nonzero density
November	2002	Mathclub, Stony Brook	Random Matrix Theory in Mathematics and Physics
May	2003	Yale Workshop	QCD at finite Goldstone Boson Density
May	2003	KIAS Workshop, Seoul	Random Matrix Theory in QCD
May	2003	Trento Workshop	Random Matrix Theory in QCD
June	2003	MPI Dresden	Chiral Random Matrix Theory and the Low Energy Limit of QCD
July	2003	Lyon France	The Sign Problem in Random Matrix Theory
May	2004	INT Seattle	Dirac Spectra at Nonzero Chemical Potential
May	2004	University of Minnesota	Spectra and the Toda Lattice
June	2004	Les Houches Summer School	QCD, Chiral Random Matrix Theory and Integrability
June	2004	Trieste Workshop	Replicas do the Trick
July	2004	Latin American Summer School	The Supersymmetric Method in Random Matrix Theory
August	2004	Cuernavaca Workshop	Replicas do the trick
October	2004	Michigan Workshop	Nuclei and Mesoscopic Physics
December	2004	Seminar at Maryland	The QCD Dirac Spectrum at Nonzero Chemical Potential
January	2005	Santa Barbara Workshop	RMT and lattice QCD
March	2005	Dresden Workshop	Non-Hermitian Random Matrix Theory and the Toda Lattice Equation
June	2005	Beijing Conference	Chiral Symmetry Breaking at Nonzero Chemical Potential
November	2005	Seminar at IAS Dublin	Random Matrix Theory and the Toda Lattice
November	2005	Stellenbosch (South-Africa) Workshop	Non-Hermitian Random Matrix Theory and the Toda Lattice
March	2006	ECT Trento	Random Matrix Theory and QCD

Invited Lectures (Continued)

Month	*Year*	*Institution*	*Title*
April	2006	Colloquium Chapel Hill	Foundations and Applications of Random Matrix Theory
May	2006	Minneapolis Workshop	Surprises for QCD at Nonzero Chemical Potential
October	2006	Colloquium at Lund	Applications and Foundations of Random Matrix Theory
November	2006	Invited Talk at Graz University	Random Signs
November	2006	Invited Talk at Kyoto Workshop	Random Matrix Theory at Nonzero μ and T
December	2006	Invited talk at Brunel Workshop	Random Signs, Complex Eigenvalues and QCD
January	2006	Colloquium at Cologne	Facing the Phases of QCD
February	2007	Invited talk at Benasque Workshop	Beating the Sign Problem at Small Chemical Potentials
April	2007	Invited talk at Leiden Workshop	Challenges of QCD at Nonzero Chemical Potential
April	2007	Colloquium at Niels Bohr Institute	Applications and Foundations of Random Matrix Theory
May	2007	Invited talk at NBI Workshop	Phasing in QCD
May	2007	Invited talk at Krakow Workshop	Triage of the Sign Problem
May	2007	Invited talk at GSI Darmstadt	Challenges of QCD at Nonzero Chemical Potential
June	2007	Theory Colloquium at CERN	Applications and Foundations of Random Matrix Theory
June	2007	Colloquium at Regensburg	Random Matrix Theory and Quantum Spectra
July	2007	Invited talk at the Newton Institute	Phases of QCD, Dirac Spectrum and Random Matrix Theory
August	2007	Invited Talk at a Newton Institute Workshop	Phases of QCD, Perspectives, Challenges and Opportunities
January	2008	Seminar at Graz	Phases and Dirac Eigenvalues
May	2008	Invited talk at Minneapolis Conference	Lessen From Random Matrix Theory for QCD at Finite Density
June	2008	Invited talk at INT Seattle	Adventures with Dirac Eigenvalues
July	2008	Lattice 2008 Conference	Phase of the Fermion Determinant for QCD at Finite Chemical Potential
July	2008	XQCD 2008 Conference	Phase of the Fermion Determinant for QCD at Nonzero Chemical Potential
August	2008	Invited Talks at INT Seattle	Phase of the Fermion Determinant and the Phase Diagram of QCD

Invited Lectures (Continued)

Month	*Year*	*Institution*	*Title*
July	2009	Invited Talk at the KITPC Beijing workshop on Lattice QCD	The Phase of the Fermion Determinant at Nonzero Chemical Potential
July	2009	Invited Talk at the KITPC Beijing workshop on Lattice QCD	Random Matrix Theory in Lattice QCD
November	2009	Seminar at the Niels Bohr International Academy	Spontaneous Symmetry Breaking and Random Matrix Theory
January	2010	Seminar at the University of Regensburg	Random Matrix Theory for the Wilson Dirac Operator
June	2010	Talk at Lattice 2010, Sardinia	Wilson Fermions, Random Matrix Theory and the Aoki Phase
July	2010	Workshop on Future Directions in Lattice Gauge Theory, CERN	Phase the Fermion Determinant and QCD at Nonzero Chemical Potential
October	2010	Invited Talk in Random Matrix Workshop at the Niels Bohr Institute	Random Matrix Theory and Wilson Fermions
November	2010	Invited Talk EMMI Workshop on Strongly Coupled Systems	QCD at Finite Density and the Sign Problem
November	2010	Seminar at the University of Regensburg	QCD at Finite Density and the Sign Problem
November	2010	Seminar at the University of Duisburg	Random Matrix Theory in QCD
May	2011	Workshop on Continuous Advances in QCD	Continuous Insights in Wilson Fermions
July	2011	Talk at Lattice 2011, Lake Tahoe	Progress on the Wilson Dirac Spectrum
September	2011	Invited Talk at the Workshop "Strings, Gauge Theory and the LHC", NBIA Copenhagen	The Wilson Dirac Spectrum
October	2011	Invited talk at Workshop Chiral Dynamics of Wilson Fermions, ECT* Trento	Wilson Fermions, Topology and the Sign
January	2012	Invited Seminar at the University of Regensburg	First Order Scenario versus Aoki Phase in Wilson Dirac Spectra
January	2012	Invited Seminar at the University of Bielefeld	First Order Scenario versus Aoki Phase in Wilson Dirac Spectra
March	2012	Invited talk at INT Workshop on Gauge Field Dynamics	QCD at Finite Density and the Sign Problem
July	2012	Invited talk at the workshop "Critical Behavior of Lattice Models", KITPC Beijing	Spectra and Phases
September	2012	Invited talk at the workshop "Sign 2012", Regensburg	The Sign Problem and Dirac Eigenvalues
October	2012	Invited Seminar at the University of Lisbon	Spectra and Phases

Invited Lectures (Since July 1995)

Month	*Year*	*Institution*	*Title*
November	2013	Invited Graduate Lectures for the Graduierten Kolleg of Graz University	Dirac Spectra in QCD
December	2013	Invited talk at the conference Miami 2013	Dirac Spectra in QCD
January	2014	Invited Colloquium at the University of Bielefeld	Random Matrix Theory and Universal Spectral Fluctuations
January	2014	Invited Colloquium at the University of Cologne	Dirac Spectra, Tail States and Spontaneous Symmetry Breaking
February	2014	Invited talk at Darmstadt Workshop Sign 2014	QCD with one Flavor and the Sign Problem at Fixed θ Angle
June	2014	Invited talk at Moen Workshop Facing Strong Dynamics	One Flavor QCD
July	2014	Invited talk at the Krakow Workshop Matrix 2014	Random Matrix Theory, Dirac Spectra and the Dimensionality of Space-Time
July	2014	Invited talk at Cuernavaca Gathering a Random (Matrix Theory) Event	Non-Hertian Random Matrix Theory in QCD
July	2014	Invited talk at Cuernavaca Conference at Quantum Chaos in the 21st Century	Random Matrix Theory and Spontaneous Symmetry Breaking
October	2014	Invited talk at Non-Hermitian Random Matrices, Yad Hoshmona	Non-Hermitian Random Matrix Theories in QCD
October	2014	Invited Colloquium at Ben Gurion University	Chiral Symmetry and Strong Interaction
June	2015	Invited Seminar at BNL	One Flavor QCD and the Dirac Spectrum at $\theta = 0$
July	2015	Talk at Lattice 2015	Chiral Symmetry Braeking in Bosonic Partition Functions
September	2015	Invited talk at the workshop Billiards and RMT, Cuernavaca	Bosonic Partition Functions
September	2015	Invited Colloquium at UNAM Cuernavaca	Random Matrix Theory and Universal Spectral Behavior
January	2016	Invited talk at Hirschegg Workshop on QCD Matter	Wilson Fermions and QCD at Nonzero Isospin Chemical Potential
May	2016	Invited talk in the Workshop Continuous Advances in QCD, Minneapolis	Topology and the Dirac Spectrum for One-Flavor QCD
June	2016	Invited talk in the Frascati program Mathematics and Physics at the Crossroads	Random Matrix Models for Finite Density QCD
June	2016	Invited talk at the Rome Workshop Gauge Fields, Strings and Holography ,	Random Matrix Theories in Strongly Interacting Gauge Theories – a Review

Invited Lectures (Since July 1995)

Month	*Year*	*Institution*	*Title*
July	2016	Invited talk at the Macao Eurasia Random Matrix Workshop	Random Matrix Theories in Strongly Interacting Gauge Theories
December	2016	Invited seminar at Bielefeld	Spectral and Thermodynamical Properties of the SYK Model
December	2016	Invited seminar at Regensburg	The SYK Model, Nuclear Physics and Quantum Chaos
January	2017	Invited talk at KEK Workshop on Hadron and Nuclear Physics	Random Matrix Theory and Strong Interactions
February	2017	Invited Seminar at Brown University	Chaos, Random Matrix Theory and Spectral Properties of the SYK Model
March	2017	Invited talk at MSU workshop on Nuclei and Mesoscopic Physics	Chaos, Random Matrix Theory and Spectral Properties of the SYK Model
March	2017	Invited talk at the INT workshop SIGN 2017	Chiral Condensate and Dirac Spectrum for QCD at Nonzero θ
March	2017	Invited seminar at University of Washington	Thermodynamical and Spectral Properties of the Sachdev-Ye-Kitaev Model
June	2017	Talk at Lattice 2017 Conference in Granada	Chiral Condensate and Dirac Spectrum at Nonzero θ Angle
June	2017	Cuernavaca Symposion on RMT, Time Series and Many-Body Systems	Chaos, Random Matrix Theory and Spectral Properties of the SYK Model
July	2017	Invited talk at Cuernavaca Gathering on Correlations in Time Series and Manuy-Body Systems	Chaos, Random Matrix Theory and Spectral Properties of the SYK Model
July	2017	Invited talk at Shanghai Eurasia-2017 RMT workshop	Chaos, Random Matrix Theory and Spectral Properties of the SYK Model
August	2017	Invited talk at APS Physics Next Workshop	Spectra and Chaos in the SYK Model
April	2018	Invited Seminar at CUNY	Spectra, Chaos and Thermodynamics of the SYK Model
May	2018	Invited talk at Trento Conference on Gauge Topology	Topology and Chiral Symmetry Breaking at Nonzero θ Angle
May	2018	Invited talk at Minnepolis Workshop on Holographic Quantum Matter	Spectral Properties of the SYK Model
September	2018	Invited talk at Oberwöltz workshop on Quantum Chromodynamics and Its Symmetries	Random Matrix Theory in QCD
October	2018	Invited talk at Yad Hashmona Workshop on Random Matrices, Integrability and Complex Systems	Spectral Properties of the SYK Model
October	2018	Invited talk at Delhi conference on Nonlinear Systems and Dynamics	Spectral Properties of the Sachdev-Ye-Kitaev Model

Invited Lectures (Since July 1995)

Month	*Year*	*Institution*	*Title*
December	2018	Invited talk at Santa Barbara conference on Order from Chaos	Spectral Properties of the SYK Model
March	2019	Invited Seminar at Brookhaven National Laboratory	Worm-Holes, Quantum Chaos and the Sachdev-Ye-Kitaev Model
April	2019	Invited Seminar at the University of Massachusetts at Amherst	The Sachdev-Ye-Kitaev Model and Quantum Chaos in Many-Body Systems
June	2019	Invited talk at the Third French-Russian Conference on Random Geometry and Physics: Sachdev-Ye-Kitaev Model and Related Topics at the Stekhlov Institute in Moscow	Quantum Chaos in the (Coupled) SYK Model
June	2019	Invited talk at the Euler Symposion on Theoretical and Mathematical Physics at the Euler Institute in St. Petersburg	Spectral Properties of the Sachdev-Ye-Kitaev Model
July	2019	Moshinky Lecture (Honorary Lecture) at CIC Cuernavaca	Black Holes and Compound Nuclei
July	2019	Invited Lecture at the program on Analytical and Numerical Method ob Open Quantum Systems, CIC Cuernavaca	Replica Trick with Application to the Gaussian Unitary Ensemble
August	2019	Invited talk at the conference RMT in Subatomic Physics and Beyond, ECT* Trento	Quantum Chaos in Strongly Interacting Systems
November	2019	Invited seminar at Princeton University	Chaotic and Thermodynamic Properties of two Coupled Sachdev-Ye-Kitaev Models
November	2019	Invited talk at the Dreiburg Meeting on Many-Body Quantum Chaos, University of Duisburg (Germany),	Chaotic and Thermodynamic Properties of two Coupled Sachdev-Ye-Kitaev Models.
December	2019	Invited talk at Workshop on JT Gravity and Condensed Matter, University of Cologne	JT-Gravity and Many-Body Physics.
May	2020	Invited talk at the Steklov Workshop Frontiers of Holographic Duality 2,	Chaos of the Hypercube
. May	2020	Invited Seminar at the University of Melbourne,	Chaos on the Hypercube.
December	2020	Stony Brook, Group Seminar	Compound Nuclei and the Sachdev-Ye-Kitaev Model.
February	2021	Stony Brook, Group Seminar	Replica Wormholes in a PT Symmeric SYK Model.
August	2021	Invited talk Melbourne random matrix theory workshop,	The (non-)Hermitian Sachdev-Ye-Kitaev Model

Invited Lectures (Since July 1995)

Month	*Year*	*Institution*	*Title*
October	2021	Max Planck Institute Dresden, invited talk,	Replica Wormhole in a PT symmetric SYK Model.
December	2021	Umass Amherst, invited seminar,	Replica Wormhole in a PT symmetric SYK Model.
May	2022	Invited talk at NTU Singapore Eurasia Conference	The Integrable Sachdev-Ye-Kitaev Model.
May	2022	Stony Brook Group Seminar	Lindblad Equation and Keldysh Wormholes.
July	2022	Trondheim workshop on Extreme QCD	Phases of QCD in Three Dimensions.
December	2022	Invited talk at Brunel Random Matrix Theory Workshop	Chaos in the Sachdev-Ye-Kitaev Model.
January	2023	Invited Joint Israel High Energy Theory Seminar	Chaos and Wormholes in the Sachdev-Ye-Kitaev Model.
March	2023	Invited Talk at Princeton Workshop on Mathematical Challenges of Quantum Mechanics	Mathematical Challenges of Many-Body Quantum Chaos.
July	2023	Invited talk at Pohang APCTP Workshop on Numerical Methods in Theoretical Physics	Advances through Computation in Chaotic Open Quantum Systems.
July	2023	Invited Seminar at IBS Daejeon	Chaos and Relaxation in a Dissipative Sachdev-Ye-Kitaev Model.
June	2024	Invited Talk at Yad Hashmona Random Matrix Theory Conference	Conference Postponed
July	2024	Invited Talk at the Guadalajara Conference on Complex Systems	Random Matrix Theory, Chaos, and Many-Body Quantum Systems
December	2024	Invited Colloquium at Jiaotong University	Random Matrix Theory, Chaos, and Many-Body Quantum Systems
December	2024	Invited talk at Shanghai University Conference on Ensemble Average Theories in High Energy Theory	Ensemble Averages in the Sachdev-Ye-Kitaev Model
January	2025	Invited Lecture at the Mandelstam School of the University of Witwatersrand	Random Matrix Theory
January	2025	Invited Lecture at the Mandelstam School of the University of Witwatersrand	Quantum Chaos
January	2025	Invited Talk at the Mandelstam School of the University of Witwatersrand	Chaos, Anomalous Relaxation and Emergent Topology in Many-Body Dissipative Quantum Systems

Invited Lectures (Since July 1995)

Month	*Year*	*Institution*	*Title*
June	2025	Invited Colloquium at Anhui Univeristy	Random Matrices
August	2025	Invited talk at the Conference "Log-Gases in Caeli Australi"	Non-Hermitian Random Matrix Theories, Integrability and Topology
August	2025	Invited Seminar at the School of Mathematics of Melbourne University	Chaos and Green's functions in Many-Body Quantum Systems
October	2025	Invited Seminar at Syracuse University	Many-Body Quantum Chaos
March	2026	Invited talk at the Conference "Random Matrices and Random Graphs in Quantum Systems", Yad Hashmona, Israel	TBA
June	2026	Invited talk at the Workshop "Gathering Advances in Random Matrices and Beyond", Institut Henri Poincaré, Paris	TBA
October	2026	Invited talk at the Workshop "Unifying Aspects of Topology in Quantum and Classical Systems", Bad Honnef, Germany	TBA

6. Summary of Research Interests

The main theme in my research activities since my Ph.D. has been the study of nonperturbative effects in Quantum Mechanics and Field Theory. One important question that has been addressed is the effect of complexity and chaotic behavior in quantum systems. We showed that answer to this question is in the correlations of the eigenvalues. If the system is chaotic the spectral correlations do not depend on its dynamics and are given by Random Matrix Theory. This has been observed in complex systems as varied as atomic nuclei, resonance cavities and the zeros of the Riemann ζ-function. Analytical results can be obtained, for example, with the supersymmetric formalism. More recently, we have applied these ideas to strongly interacting Quantum Field Theories, in particular to QCD, the theory of the Nuclear Forces. Typically, nonperturbative effects in QCD are studied in 4 Euclidean dimensions in which there is no difference between space and time. The motion of a quark can then be interpreted as motion in 4 spatial dimensions and 1 artificial time dimension. One expects that its classical trajectories in the quantum disordered Yang-Mills background field configurations are chaotic. For example, this has been confirmed by microcanonical simulations of lattice QCD. From our experience with simple chaotic systems we thus expect that the correlations of the QCD Dirac eigenvalues are given by Random Matrix Theory. The appropriate Random Matrix Theories have been formulated and classified according to the global symmetries of the QCD partition function. Analytical results have been derived and the universality of these results has been understood. These ideas have been verified by explicit Monte-Carlo simulations of the QCD partition function. Of course, the QCD partition function is much richer than chiral Random Matrix Theory. This implies that there exists a scale above which Random Matrix Theory is not applicable. We have identified this scale as the equivalent of the Thouless energy in mesoscopic physics. Other non-perturbative effects in Field Theory I have been interested in are the study of instanton field configurations in QCD, the study of nucleon as a topological Skyrmion in the Skyrme model, and the study of particles with fractional statistics (anyons). Specifically, I wish to mention the discovery of the axially symmetric solution with baryon number two in the Skyrme model. During the past few years my main research interest have been focused on QCD at nonzero chemical potential and on discretization effects for Wilson Wilson. Using random matrix theory and chiral perturbation theory, we made substantial progress in understanding the temperature and chemical potential dependence of the phase of the the fermion determinant. We also made major progress on explaining the relation between the phase of the fermion determinant on observables in QCD. Among others we solved the so called "Silver Blaze Problem". More recently we have analyzed the sign problem and the overlap problem for QCD at nonzero chemical potential. For Wilson fermions we have obtained the lattice spacing dependence of the spectrum of the Dirac operator and have obtained fundamental constraints on the low energy constants of Wilson chiral perturbation theory. Since the middle of 2016, I have been working on many-body physics and it relation to chaos and random matrix theory using the Sachdev-Ye-Kitaev model. Using moments we have obtained an analytical formula for the spectral density of this model as well as the corresponding free energy.

7. Teaching Activity Since 1996

Semester	*Course*	*Title*	*Population*	*Enrollment*
Spring 1996	PHY 506	Classical Electrodynamics II	Graduate Requirement	9
	PHY 121	Undergraduate Recitation	Lower Division Service Course	
Fall 1996	PHY 505	Classical Electrodynamics I	Graduate Requirement	18
	PHY 132	Undergraduate Recitation	Lower Division Service Course	
Spring 1997	PHY 506	Classical Electrodynamics II	Graduate Requirement	15
	PHY 122	Undergraduate Recitation	Lower Division Service Course	
Fall 1997	PHY 541	Statistical Mechanics II	Graduate Course	14
	PHY 132	Undergraduate Recitation	Lower Division Service Course	
Spring 1998	PHY 620	Relativity	Graduate Course	9
	PHY 125(2)	Undergraduate Recitation	Lower Division Service Course	
Fall 1998	PHY 541	Statistical Mechanics II	Graduate Course	18
Spring 1999	PHY 684	Topics: Random Matrix Theory	Graduate Course	12
	PHY 126	Undergraduate Recitation	Lower Division Service Course	
Fall 1999	PHY 501	Classical Mechanics	Graduate Requirement	21
Spring 2000	PHY 121	Undergraduate Recitation	Lower Division Service Course	
Fall 2000	PHY 501	Classical Mechanics	Graduate Requirement	21
	PHY 131	Undergraduate Recitation	Lower Division Service Course	
Spring 2001	PHY 407	Physics of Continuous Media	Graduate Course	3
	PHY 132	Undergraduate Recitation	Lower Division Service Course	
Fall 2001	PHY 501	Classical Mechanics	Graduate Requirement	25
Spring 2002		No Teaching (Simons Fellow)		
	PHY 132	Undergraduate Recitation	Lower Division Service Course	
Fall 2002	PHY 501	Classical Mechanics	Graduate Requirement	25

7. Teaching Activity Since 1996

Semester	*Course*	*Title*	*Population*	*Enrollment*
Spring 2003	PHY 407	Physics of Continuous Media	Graduate Course	3
	PHY 132	Undergraduate Recitation	Lower Division Service Course	
Fall 2003	PHY 511	Quantum Mechanics	Graduate Requirement	20
	PHY 122	2 Undergraduate Recitations	Lower Division Service Course	50
Spring 2004	PHY 512	Quantum Mechanics	Graduate Course	21
	PHY 127	Undergraduate Recitation	Lower Division Service Course	20
Fall 2004	PHY 541	Advanced Statistical Mechanics	Graduate Course	2
	PHY122	Physics Recitation	Undergraduate Recitation	44
Spring 2005	PHY 306	Thermal Physics	Undergraduate Course	40
	PHY122	Physics Recitation	Undergraduate Recitation	46
	PHY 132	Undergraduate Recitation	Lower Division Service Course	
Fall 2005	PHY 131	4 Physics Recitations	Undergraduate Recitation	80
Spring 2006	PHY 306	Thermal Physics	Undergraduate Course	40
	Phy 131	Physics Recitation	Undergraduate Recitation	15
Fall 2007	PHY 501	Classical Mechanics	Graduate Course	25
	Phy 131	Physics Recitation	Undergraduate Recitation	15
Spring 2008	PHY 551	Nuclear Physics	Graduate Course	10
	Phy 131	Physics Recitation	Undergraduate Recitation	15
Fall 2008	PHY 501	Classical Mechanics	Graduate Course	34
	Phy 121	Physics Recitation	Undergraduate Recitation	25
	PHY447	Tutorial in advanced Topics		2
	PHY699	Dissertation Research	Tutorial	1
Spring 2009	PHY 551	Nuclear Physics	Graduate Course	11
	Phy 121	Physics Recitation (2 sections)	Undergraduate Recitation	52
	PHY447	Tutorial in advanced Topics		2
	PHY580	Special Research Projects	Tutorial	1
	PHY699	Dissertation Research	Tutorial	1

7. Teaching Activity Since 1996

Semester	*Course*	*Title*	*Population*	*Enrollment*
Fall 2009	Phy 121	Physics Recitation (1 section)	Undergraduate Recitation	52
	PHY447	Tutorial in advanced Topics		2
	PHY580	Special Research Projects	Tutorial	3
	PHY600	Practicum in Teaching	Graduate Students	42
	PHY699	Dissertation Research	Tutorial	1
Spring 2010	PHY447	Tutorial in advanced Topics		2
	PHY580	Special Research Projects	Tutorial	2
	PHY600	Practicum in Teaching	Graduate Students	31
	PHY699	Dissertation Research	Tutorial	1
Fall 2011	Phy 121	Physics Recitation (1 section)	Undergraduate Recitation	52
	PHY447	Tutorial in advanced Topics		1
	PHY580	Special Research Projects	Tutorial	2
	PHY600	Practicum in Teaching	Graduate Students	38
	PHY699	Dissertation Research	Tutorial	1
Spring 2011	PHY580	Special Research Projects	Tutorial	3
	PHY600	Practicum in Teaching	Graduate Students	28
	PHY674	Nuclear Physics Seminar	Graduate Students	1
	PHY699	Dissertation Research	Tutorial	7
Fall 2011	PHY580	Special Research Projects	Tutorial	2
	PHY600	Practicum in Teaching	Graduate Students	25
	PHY699	Dissertation Research	Tutorial	1
Spring 2012	Phy 125	Physics Recitation (1 section)	Undergraduate Recitation	28
	PHY580	Special Research Projects	Tutorial	3
	PHY600	Practicum in Teaching	Graduate Students	25
	PHY674	Nuclear Physics Seminar	Graduate Students	22
	PHY699	Dissertation Research	Tutorial	6
	PHY700	Dissertation Research	Tutorial	1
Fall 2012	PHY 505	Electrodynamics	Graduate Students	30
	PHY600	Practicum in Teaching	Graduate Students	33
	PHY 487	Special Research Projects	Undergraduate	1
	PHY580	Special Research Projects	Tutorial	2
	PHY585	Special Study	Tutorial	2
	PHY600	Practicum in Teaching	Graduate Students	25
	PHY674	Nuclear Physics Seminar	Graduate Students	NA
	PHY699	Dissertation Research	Tutorial	7
	PHY701	Dissertation Research	Tutorial	1

7. Teaching Activity Since 1996

Semester	*Course*	*Title*	*Population*	*Enrollment*
Spring 2013	PHY580	Special Research Projects	Tutorial	3
	PHY600	Practicum in Teaching	Graduate Students	32
	PHY674	Nuclear Physics Seminar	Graduate Students	0
	PHY699	Dissertation Research	Tutorial	8
Fall 2013	PHY595	Master Degree Thesis Research	Tutorial	1
	PHY600	Practicum in Teaching	Graduate Students	22
	PHY674	Nuclear Physics Seminar	Graduate Students	1
	PHY699	Dissertation Research	Tutorial	4
	PHY700	Dissertation Research	Tutorial	2
Spring 2014	PHY580	Special Research Projects	Tutorial	1
	PHY585	Special Study	Tutorial	2
	PHY595	Master Degree Thesis Research	Tutorial	1
	PHY600	Practicum in Teaching	Graduate Students	23
	PHY699	Dissertation Research	Tutorial	4
	PHY700	Dissertation Research	Tutorial	2
Fall 2014	PHY487	Special Research Projects	Tutorial	1
	PHY580	Special Research Projects	Tutorial	4
	PHY600	Practicum in Teaching	Graduate Students	26
	PHY674	Nuclear Physics Seminar	Graduate Students	2
	PHY699	Dissertation Research	Tutorial	4
Spring 2015	PHY580	Special Research Projects	Tutorial	7
	PHY600	Practicum in Teaching	Graduate Students	21
	PHY674	Nuclear Physics Seminar	Graduate Students	4
	PHY699	Dissertation Research	Tutorial	3
	PHY700	Dissertation Research	Tutorial	1
Fall 2015	PHY580	Special Research Projects	Tutorial	4
	PHY585	Special Study	Tutorial	2
	PHY600	Practicum in Teaching	Graduate Students	30
	PHY674	Nuclear Physics Seminar	Graduate Students	2
	PHY699	Dissertation Research	Tutorial	3
	PHY700	Dissertation Research	Tutorial	1

7. Teaching Activity Since 1996

Semester	*Course*	*Title*	*Population*	*Enrollment*
Spring 2016	PHY580	Special Research Projects	Tutorial	1
	PHY585	Special Study	Tutorial	1
	PHY595	Master Thesis Research	Tutorial	1
	PHY600	Practicum in Teaching	Graduate Students	20
	PHY674	Nuclear Physics Seminar	Graduate Students	0
	PHY699	Dissertation Research	Tutorial	3
	PHY700	Dissertation Research	Tutorial	1
Fall 2016	PHY580	Special Research Projects	Tutorial	5
	PHY600	Practicum in Teaching	Graduate Students	13
	PHY674	Nuclear Physics Seminar	Graduate Students	0
	PHY699	Dissertation Research	Tutorial	3
	PHY700	Dissertation Research	Tutorial	1
Spring 2017	PHY580	Special Research Projects	Tutorial	1
	PHY585	Special Study	Tutorial	2
	PHY595	Master Thesis Research	Tutorial	2
	PHY600	Practicum in Teaching	Graduate Students	22
	PHY674	Nuclear Physics Seminar	Graduate Students	0
	PHY699	Dissertation Research	Tutorial	1
	PHY700	Dissertation Research	Tutorial	1
Fall 2017	PHY580	Special Research Projects	Tutorial	4
	PHY585	Special Study	Tutorial	2
	PHY600	Practicum in Teaching	Graduate Students	34
	PHY699	Dissertation Research	Tutorial	2
	PHY700	Dissertation Research	Tutorial	1
Spring 2018	PHY580	Special Research Projects	Tutorial	5
	PHY585	Special Study	Tutorial	5
	PHY600	Practicum in Teaching	Graduate Students	22
	PHY699	Dissertation Research	Tutorial	2
	PHY700	Dissertation Research	Tutorial	1
Fall 2018	PHY580	Special Research Projects	Tutorial	6
	PHY585	Special Study	Tutorial	2
	PHY595	Master Thesis Research	Tutorial	1
	PHY600	Practicum in Teaching	Graduate Students	50
	PHY674	Seminar in Nuclear Physics	Seminar	2
	PHY699	Dissertation Research	Tutorial	2
	PHY700	Dissertation Research	Tutorial	1

7. Teaching Activity Since 1996

Semester	*Course*	*Title*	*Population*	*Enrollment*
Spring 2019	PHY580	Special Research Projects	Tutorial	8
	PHY585	Special Study	Tutorial	2
	PHY600	Practicum in Teaching	Graduate Students	54
	PHY674	Seminar in Nuclear Physics	Seminar	0
	PHY699	Dissertation Research	Tutorial	2
	PHY700	Dissertation Research	Tutorial	1
Fall 2019	PHY131	Classical Physics I	Recitation	31
	PHY585	Special Study	Tutorial	1
	PHY 674	Seminar in Nuclear Physics	Seminar	1
	PHY684	Special Topics in Nuclear Physics	Lecture	4
	PHY699	Dissertation Research on Campus	Tutorial	2
Spring 2020	PHY541	Advanced Statistical Mechanics	Lecture	2
	PHY585	Special Study	Tutorial	1
	PHY 574	Seminar in Nuclear Physics	Seminar	2
	PHY699	Dissertation Research on Campus	Tutorial	2
Fall 2020	PHY503	Methods of Mathematical Physics	Lecture	2
	PHY699	Dissertation Research on Campus	Tutorial	2
Spring 2021	PHY505	Classical Electrodynamics	Lecture	19
	PHY580	Special Research	Tutorial	1
	PHY 674	Seminar in Nuclear Physics	Seminar	1
	PHY699	Dissertation Research on Campus	Tutorial	2
Fall 2021	PHY503	Methods of Mathematical Physics	Lecture	11
	PHY580	Special Research	Tutorial	1
	PHY 674	Seminar in Nuclear Physics	Seminar	1
	PHY699	Dissertation Research on Campus	Tutorial	2
Spring 2022	PHY505	Classical Electrodynamics	Lecture	42
	PHY505	Classical Electrodynamics	Recitation	42
	PHY580	Special Research	Tutorial	1
	PHY699	Dissertation Research on Campus	Tutorial	2
Fall 2022	PHY503	Methods of Mathematical Physics	Lecture	2
	PHY580	Special Research	Tutorial	1
	PHY 674	Seminar in Nuclear Physics	Seminar	1
	PHY699	Dissertation Research on Campus	Tutorial	2
Spring 2023	PHY408	Relativity	Lecture	16
	PHY699	Dissertation Research on Campus	Tutorial	1

7. Teaching Activity Since 1996

Semester	*Course*	*Title*	*Population*	*Enrollment*
Fall 2023	PHY126-R01	Classical Physics B (Recitation)	Recitation	36
	PHY126-R02	Classical Physics B (Recitation)	Recitation	28
	PHY126-R04	Classical Physics B (Recitation)	Recitation	32
	PHY699	Dissertation Research on Campus	Tutorial	2
Spring 2024	PHY131-R07	Classical Physics I (Recitation)	Recitation	36
	PHY408	Relativity	Lecture	5
	PHY699	Dissertation Research on Campus	Tutorial	1
Fall 2024	PHY131	Classical Physics I (Recitation)	Recitation	36
	PHY408	Relativity	Lecture	5
	PHY699	Dissertation Research on Campus	Tutorial	1
Spring 2025	PHY131	Classical Physics I (Recitation)	Recitation	35
	PHY408	Relativity	Lecture	18
	PHY447	Tutorial in Advanded Topics	Tutorial	2
	PHY699	Dissertation Research on Campus	Tutorial	1
Fall 2025	PHY408	Relativity	Lecture	2
	PHY447	Tutorial in Advanded Topics	Tutorial	2
	PHY487	Research	Tutorial	1
	PHY699	Dissertation Research on Campus	Tutorial	1

8. Teaching Goals

The education of a physicist requires a well established core knowledge. That is why many courses are taught in very much the same way all over the world. For example, most of the textbooks used at Stony Brook for the introductory graduate course are still the same as I was taught from, 35 years ago at a University in Europe (Utrecht) . Nevertheless, I am continuously looking for approaches from a more modern perspective with discussions of recent developments in the field. What I hope to achieve with my teaching activities is to motivate the students and to get them excited about the material. For example, I try to connect to related topics that stimulate their interest and make reference to recent developments and my own research experience when appropriate. However, one should keep in mind that most of the material is in standard texts, and my main role is to explain the subject to the students as well as I possibly can. I consider the student-teacher relationship very important. Students should have the feeling that I am there to help them, that I provide a service to the students. Each student deserves personal attention, and I make a special effort to monitor the progress of all of them individually in order to create a welcoming atmosphere in which I care about their work and their progress on a personal basis. I ask for and try to remember some personal information of each student as for example: who is their advisor, which other courses are they following, where did they graduate from, etc.. I am always open to questions and students are welcome in my office both inside and outside office hours. Another teaching goal is to get students interested in studying physics. One way to achieve this is to work with high-school students. From my experience of working with high-school students I have learned that such research experience may change their thinking forever. I believe that if we can get high school students excited about physics, this will ultimately change the perception of our field among incoming undergraduate students in particular among underrepresented minorities. In the future I hope to teach a variety of courses, both undergraduate courses and standard as well as specialized graduate courses. All students will feel welcome and I will present the material such that they all will learn it to their fullest potential.

9. Graduate Dissertation and Honors Projects

Name	*Project*	*Title*
Matts Sporre	Dissertation (1991-1992)	Few Anyon Systems
Rich Corrado	Senior Honors Project (1992-1993)	Instantons and Eigenvalues of the Dirac Operator
Adam Halasz	Dissertation (1994-1998)	Universal Properties of the Chiral Phase Transition
Lenore Horner	Dissertation (1994-1995)	Universality in Chiral Random Matrix Theories
Melih Sener	Dissertation (1995-1999)	Universality in Chiral Random Matrix Theories
Jon Kelner	High School Student (1997-1998)	Universality in Chiral Random Matrix Theories
James Osborn	Dissertation (1995-1999)	Thouless Energy in QCD
Bertram Klein	Dissertation (1998-2003)	Universality for $\beta = 1$ and $\beta = 4$
Antonio Garcia-Garcia	Dissertation (1999-2002)	Boundary Conditions in QCD Dirac Spectra
Tim Gerasimov	High School Student (2000-2001)	Wavefuntions and Nonhermiticity
Leonid Shifrin	Dissertation (2002-2006)	Investigations of Low-Dimensional Field Theories
Christoph Lehner	Dissertation (2008)	Topology in Random Matrix Theory
Savvas Zafeiropoulos	Dissertation (2008-2013)	Dirac Eigenvalues and the the Sign of the Fermion Determinant
Robert Regan	Undergradute Research (2012)	Wilson Dirac spectra

9. Graduate Dissertation and Honors Projects

Name	*Project*	*Title*
Oliver Jansen	Undergraduate Research (2012)	The Phase Diagram of Wilson Fermion at Nonzero Chemical Potential
Deriam Chirinos	High School Student (2012)	Spectral Correlations of the Overlap Dirac Operator
Moshe Kellerstein	Thesis Reserach (2014-2018)	Random Matrix Theory
Yiyang Jia	Thesis Research (2017-2021)	SYK Model
Joshua Leeman	Thesis Research (2021-2024)	SYK Model

Rich Corrado has worked on his thesis at the University of Texas at Austin. Lenore Horner has completed her Ph.D. in the summer of 1999 at the YITP of Stony Brook (advisor A. Goldhaber). Matts Sporre got a permanent position at Eriksson (in Sweden) after completing a postdoc at NORDITA in Copenhagen. Adam Halasz is Associate Professor at the University of West-Virginia. Melih Sener has a senior post-doctoral position at the University of Illinois at Champaign-Urbana. James Osborn found a permanent position at Argonne National Laboratory. John Kelner joined me as a high school student. With his project he became winner (8th place) in the prestigious Westinghouse competition and he got the first prize in the Intel Science Contest. Now he is Professor in the Math Department of MIT. Tim Gerasimov also graduated from Harvard University and is now working in Finance. Leonid Shifrin accepted a postdoctoral position at Brunel University (London) and now is a software developer for Mathematica. Antonio Garcia-Garcia is a tenured professor at Jiaotong University in Shanghai. Oliver Janssen is postdoc at ICTP Trieste. Bertram Klein is postdoc at the Munich Technical University. High School student Deriam Chirinos got a BA in economics from Harvard University and is now working in finance. Since Fall 2019, Savvas Zarfeiropoulos has a tenured position at the CNRS National Laboratory in Marseille (France). Yiyang Jia is now postdoc at the Weizmann Institutee.

10 Departmental and University Service Since 1994

Semester	*Committee*
Fall 1994	Comprehensive Exam Committee
Spring 1995	Comprehensive Exam Committee
Fall 1995	Comprehensive Exam Committee
Spring 1996	Comprehensive Exam Committee
Fall 1996	Graduate Committee
Spring 1997	Graduate Committee
Fall 1997	Self-Study Committee Graduate Committee
Spring 1998	Self-Study Committee Graduate Committee
Fall 1998	Long Range Planning Committee Graduate Committee
Spring 1999	Long Range Planning Committee Condensed Matter Search Committee
Fall 1999	Condensed Matter Search Committee Graduate Committee Computational Physics Committee
Spring 2000	Graduate Committee Solid State Theory Search Committee
Fall 2000	Graduate Committee Promotion Committee of Igor Aleiner (Chairman)
Spring 2001	Graduate Committee
Fall 2001	Graduate Committee
Spring 2002	Graduate Committee

Departmental and University Service (Continued)

Fall 2002	Experimental Nuclear Physics Search (Chair)
	Graduate Admissions Committee
	Graduate Council
	Faculty Adviser of the Outdoor Club
Spring 2003	Graduate Committee
	Graduate Admissions Committee (Chair)
	Graduate Committee
	Experimental Nuclear Physics Search (Chair)
	Graduate Council
	Faculty Adviser of the Outdoor Club
Fall 2003	Graduate Committee
	Graduate Admissions Committee (Chair)
	Faculty Adviser of the Outdoor Club
	Adjunct Professor Committee
	Graduate Council
Spring 2004	Graduate Committee
	Graduate Admissions Committee (Chair)
	Faculty Adviser of the Outdoor Club
	Adjunct Professor Committee
	Graduate Council
Fall 2004	Graduate Committee
	Graduate Admissions Committee (Chair)
	Faculty Adviser of the Outdoor Club
	Theoretical Nuclear Physics Search
	Graduate Council Appeals Committee
	Graduate Council
Spring 2005	Graduate Committee
	Graduate Admissions Committee (Chair)
	Faculty Adviser of the Outdoor Club
	Theoretical Nuclear Physics Search
	Graduate Council Appeals Committee
	Graduate Council

10. Departmental and University Service (Continued)

Fall 2005	Graduate Committee
	Graduate Admissions Committee (Chair)
	Graduate Exam Committee
	Physics and Astronomy Department Review Committee
	Graduate Council Appeals Committee (Chair)
	Graduate Council
Spring 2006	Graduate Committee
	Graduate Admissions Committee (Chair)
	Graduate Council Appeals Committee (Chair)
	Graduate Council Fellow Committee
	Graduate School China Committee
	Graduate Council
Spring 2007	Graduate School China-Korea Committee
Fall 2007	Graduate Council
	Advising Committee
	Exam Committee
Spring 2008	Graduate Council
	Graduate School China-Korea Committee
	Exam Committee
Fall 2008	Graduate Council (Chair)
	Coordinating Committee
	Graduate Advising Committee
	Exam Committee
Spring 2009	Graduate Council (Chair)
	Coordinating Council
	Graduate School China-Korea Committee
	Graduate Admissions Committee
	Exam Committee
Fall 2009	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Council (Chair)
	Coordinating Committee
	Graduate Advising Committee (Chair)

10. Departmental and University Service (Continued)

Spring 2010	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Council (Chair)
	Graduate Advising Committee (Chair)
	Coordinating Council
	Graduate School China Interview Committee
	Graduate Admissions Committee
	Course Evaluation Process Committee
	Graduate School Strategic Steering Committee
Fall 2010	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Council (Chair)
	Graduate Advising Committee (Chair)
	Coordinating Council
	Graduate Admissions Committee
	Course Evaluation Process Committee
	Graduate School Strategic Steering Committee
Spring 2011	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Council (Chair)
	Graduate Advising Committee (Chair)
	Coordinating Council
	Graduate Admissions Committee
	Course Evaluation Process Committee
Fall 2011	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Advising Committee (Chair)
	Provost Graduate Student Lecture Committee (Chair)
	Graduate Admissions Committee
	Strategic Advisory Committee
	Course Evaluation Process Committee

10. Departmental and University Service (Continued)

Spring 2012	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Advising Committee (Chair)
	Provost Graduate Student Lecture Committee (Chair)
	Graduate Admissions Committee
	Strategic Advisory Committee
	Course Evaluation Committee
Fall 2012	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Advising Committee (Chair)
	Provost Graduate Student Lecture Committee (Chair)
	Graduate Admissions Committee
	Strategic Advisory Committee
	Course Evaluation Process Committee
	Promotion Committee of Derek Teaney
Spring 2013	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Advising Committee (Chair)
	Provost Graduate Student Lecture Committee (Chair)
	Graduate Admissions Committee
	Strategic Advisory Committee
	Course Evaluation Process Committee
Fall 2013	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Advising Committee (Chair)
	Provost Graduate Student Lecture Committee (Chair)
	Graduate Admissions Committee
	Assessment Coordinator for the Graduate Programs
	Strategic Advisory Committee
Spring 2014	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Advising Committee (Chair)
	Provost Graduate Student Lecture Committee (Chair)
	Graduate Admissions Committee
	Strategic and Long Range Planning Committee
	Course Evaluation Process Committee

10. Departmental and University Service (Continued)

Fall 2014	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Advising Committee (Chair)
	Provost Graduate Student Lecture Committee
	Graduate Admissions Committee
	Assessment Coordinator for the Graduate Programs
	Strategic and Long Range Planning Committee
Spring 2015	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Advising Committee (Chair)
	Provost Graduate Student Lecture Committee
	Graduate Admissions Committee (Chair)
	Strategic and Long Range Planning Committee
Fall 2015	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Advising Committee (Chair)
	Provost Graduate Student Lecture Committee
	Graduate Admissions Committee (Chair)
	Executive Committee
	Strategic and Long Range Planning Committee
Spring 2016	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Advising Committee (Chair)
	Provost Graduate Student Lecture Committee
	Graduate Admissions Committee (Chair)
	Executive Committee
	Strategic and Long Range Planning Committee
Fall 2016	Graduate Program Director
	Graduate Committee (Chair)
	Graduate Advising Committee (Chair)
	Provost Graduate Student Lecture Committee
	Graduate Admissions Committee (Chair)
	Examine the Exam Committee
	Executive Committee
	Strategic and Long Range Planning Committee
Spring 2017	Graduate Program Director
	Graduate Committee (Chair)
	Provost Graduate Student Lecture Committee
	Graduate Admissions Committee (Chair)
	Executive Committee

10. Departmental and University Service (Continued)

Fall 2017	Graduate Program Director Graduate Committee (Chair) Graduate Admissions Committee (Chair) Executive Committee
Spring 2018	Graduate Program Director Graduate Committee (Chair) Graduate Advising Committee (Chair) Graduate Admissions Committee (Chair) Executive Committee
Fall 2018	Graduate Program Director Graduate Committee (Chair) Executive Committee Graduate Advising Committee (Chair) Graduate Admissions Committee
Spring 2019	Graduate Program Director Graduate Committee (Chair) Executive Committee Graduate Advising Committee (Chair) Graduate Admissions Committee
Spring 2020	Online Teaching Committee
Spring 2021	Appointment Committee of Paul Goldbart (Chair)
Fall 2021	Chancellor's Award Nomination
Spring 2022	Promotion Committee of Dmitry Tsybychev (Chair) Library Committee
Fall 2022	Worlds of Physics (Chair)
Spring 2023	Provost Council on Assessment Worlds of Physics (Chair)
Fall 2023	Provost Council on Assessment Library Committee Worlds of Physics (Chair)
Spring 2024	Provost Council on Assessment Library Committee Worlds of Physics (Chair)

10. Departmental and University Service (Continued)

Fall 2024	Provost Council on Assessment
	Library Committee
	Worlds of Physics (Chair)
Spring 2025	Provost Council on Assessment
	Library Committee
	Worlds of Physics (Chair)
Fall 2025	Library Committee
	Worlds of Physics (Chair)

Annually I serve on about 3 Oral Exam Committees and about 3 Ph.D. Exam Committees

12. Professional Service Outside the University

Conferences Organized

Date	*Place*	*Title*	*Comments*
August, 1999	ICTP Trieste	Non-Hermiticity and Disorder	with F. Haake and Y. Fyodorov, budget: 30,000 DM
March-June, 2000	INT Seattle	QCD at Finite Density	lead organizer, co-organizers: with F. Karsch, K. Rajagopal and U. Wiese, budget 125,000 US$.
July, 2000	ECT Trento	Light Quarks in QCD	co-organizers: P. Damgaard and U. Heller.
February, 2002	SUNY Stony Brook	James H. Simons Workshop on RMT.	
August 1 - 31, 2004	Cuernavaca	Perspectives in Random Matrix Theory	co-organizers: Luis Benet and Thomas Guhr.
August 16 - 21, 2004	Cuernavaca	Quantum Chaos in the 21st Century	co-organizers: Luis Benet and Thomas Guhr.
March 27 - 31, 2006	ECT Trento	New Directions in Non-perturbative QCD	co-organizers: Gernot Akemann and Poul Damgaard .
October 2-3,2008	Stony Brook	The Extra Strong Quark Gluon Plasma	co-organizers: Larry McLerran, Thomas Schaefer and Arkady Vainshtein.
May 15-18, 2008	Minneapolis	Continuous Advances in QCD	convener of a section on finite temperature and density

Conferences Organized (continued)

Date	*Place*	*Title*	*Comments*
March 9-13, 2009	Cuernavaca Mexico	Penetrating Physics by Random Matrices	co-organizers: Thomas Seligman, Jorge Flores, Carolina Nemes, Thomas Papenbroeck and Martin Zirnbauer
March 25-30, 2009	Yad Hashmona, Israel	Random Matrices and Integrability: From Theory to Applications	co-organizers: Eugene Kanzieper, Oded Agam, Sasha Finkelstein, Alex Kamenev Paul Wiegmann
October 24-28, 2011	ECT Trento	Chiral Dynamics with Wilson Fermions	co-organizers: K. Splittorff and P. Damgaard
June 19-24, 2014	Stony Brook	Extreme QCD 2014	lead organizer, co-organizers: F. Karsch and D. Kharzeev
July 24-August 1, 2014	CICC Cuernavaca	A Celebation with Chaos:from RMT to Quantum INformation	co-organizers: L. Benet, J. Flores, T. Gorin, F, Leyvraz and C. Pineda
October 22-27, 2014	Yad Hashmona	Non-Hermitian Random Matrices	co-organizers: P. Forrester, Y. Fyodorov, A. Golberg, E. Kanzieper, E. Strahov and P. Wiegmann
August 24 - December 18, 2015	Simons Center Stony Brook	Foundations and Applications of Random Matrix Theory in Mathematics and Physics	lead organizer, co-organizers: A. Borodin, Y.. Fyodorov, A. Guionnet, J. Keating and M. Kieburg
November 2-6, 2015	Simons Center Stony Brook	Random Matrix Theory, Integrable Systems, and Topology in Physics	lead organizer, co-organizers: Y. Fyodorov and M. Kieburg
July 2017	CICC Cuernavaca	Random Matrix Theory, Time Series and Many Body Theory	co-organizers: Mario Kieburg, Thomas Seligman, Manan Vyas

Conferences Organized (continued)

Date	*Place*	*Title*	*Comments*
October 2018	Yad Hashmona	Random Matrices, Integrability and Complex Systems	co-organizers: Eugene Kanzieper, Joshua Feinberg, Jonathan Breuer, Yan Fyodorov, Anatoly Goldberg, Maciek Nowak
August 2019	Simons Center Stony Brook	Program on Universality and Ergodicity in Qauntum Many-Body Systems	co-organizers: Boris Altshuler, Anatoly Dymarsky and Lea Santos
September 2019	Simons Center Stony Brook	Applications of Random Matrix Theory to Many-Body Physics	co-organizers: Boris Altshuler, Anatoly Dymarsky and Lea Santos
March 2026	Yad Hashmona Israel	Random Matrices and Integrability in Complex and Quantum Systems	co-organizers: : Eugene Kanzieper, Joshua Feinberg, Jonathan Breuer, Yan Fyodorov, Anatoly Goldberg, Maciek Nowak
May 2026	Simons Center Stony Brook	Double Scaled Sachdev-Ye-Kitaev Model: From Gravity to Many-Body Quantum Chaos	co-organizers: Micha Berkooz, Barbara Dietz, Yiyan Jia, Henry Lin

External Committees

Date	*Place*	*Title*	*Comments*
Spring 2007	Copenhagen	NBI Adjunct Professor Committee of Gordon Baym	External Member
Spring5 2007	Copenhagen	NBI Adjunct Professor Committee of Ben Mottelson	External Member
December 4, 2008	Chicago	Thesis Committee of Ji-Long Han	External Member
August 2010	IIE New York	Fulbright Science and Technology Award Selection Committee	
2016	Wuhan	International Advisory Committee of XQCD Wuhan	
2017	Pisa	International Advisory Committee of XQCD Pisa	
2019	Tokyo	International Advisory Committee of XQCD Tokyo	
2020	Stavanger	International Advisory Committee of XQCD Stavanger	
2020	Moscow	International Advisory Commitee of the program"Holographty:from High Energy Physics to Quantum Information", Steklov Institute Moscow	
2021	Amherst	Dissertaion Commiittee of Chenan Wei	External Member
2023	Shanghai	Jiaotong University PhD Committee of Jieping Zheng	External Member

Refereeing and Reviewing of articles

For the following journals I referee articles on a regular basis. The annually number of reviewed articles is given between brackets.

Nuclear Physics B	(1-2)
Entropy	(2)
Physical Review Letters	(3-6)
Physical Review B	(0-1)
Physical Review C	(0-1)
Physical Review D	(1-3)
Journal of Physics A	(1-3)
Journal of Physics G	(1-2)
New Journal of Physics	(0-1)
Annals of Physics	(0-1)
Few Body Physics	(0-1)
New Journal of Physics	(0-1)
Journal of High Energy Physics	(2-4)
Journal of Mathematical Physics	(1-2)

In addition I serve as reviewer for grant proposals to the Department of energy and as external reviewer of Ph.D. Thesis and Habillitations Thesis.

The information on the preceding pages represents a satisfactory compilation of professional biographic information.

Jacobus Verbaarschot