

## Curriculum vitae

Søren Eilers

Hiort Lorenzens Gade 2, 4. th

DK-2200 Copenhagen N

**eilers@math.ku.dk**

### Career:

- Education
  - M.S., Mathematics, computer science, University of Copenhagen, **93**
  - PhD, Mathematics, University of Copenhagen, **95**.
- Positions:
  - Assistant professor **96–99**, University of Copenhagen.
  - Associate professor **99–08**, University of Copenhagen.
  - Professor **08–**, University of Copenhagen.
- International experience:
  - University of California at Santa Barbara **91–92** [10 months]
  - Universidade de São Paulo **94** [2 months]
  - The Fields Institute for Research in Mathematical Sciences **94–95** [11 months]
  - Purdue University **98** [5 months]
  - University of New Mexico **98** [5 months]
  - Mathematical Sciences Research Institute **00** [3 months]
  - Institut Mittag-Leffler **03–04** [2 months]
  - The Fields Institute for Research in Mathematical Sciences **07** [2 months]
  - Lund University **12–13** [2 months]
  - Institut Mittag-Leffler **16** [4 months]

### Scientific leadership:

- 41 M.S. theses (40 in mathematics, 1 in computer science, 2 current).
- Supervision [most advanced subsequent academic position in brackets]:
  - PhD students:
    - \* T.M. Carlsen **04** [Professor, University of Faroe Islands]
    - \* G. Restorff **08** [Professor, University of Faroe Islands]
    - \* R. Johansen **11** [Postdoc, University of Copenhagen]
    - \* S.E. Arklint, **12** [Postdoc, University of Copenhagen]
    - \* A.P.W. Sørensen, **12** [Associate professor, Oslo University]

- \* R. Bentmann **13** [Postdoc, Georg-August-Universität Göttingen]
- \* J. Gabe **15** [Associate professor, University of Southern Denmark]
- \* K. Brix **19** [Assistant professor, University of Southern Denmark]
- \* A. Frei **23** [Postdoc, University of Waterloo]
- Postdoctoral:
  - \* A. Toms, Canadian National Research Council postdoc fellow, **03–04**  
[Professor, Purdue University]
  - \* K. Medynets, INTAS fellow, **07**  
[Professor, United States Naval Academy]
  - \* T. Shulman, University of Copenhagen, **08–11**  
[Senior lecturer, University of Gothenburg]
  - \* T. Katsura, Japan Society for the Promotion of Science senior fellow, **10–11**  
[Professor, Keio University]
  - \* J. Öinert, Vetenskapsrådet fellow, **10–12**  
[Professor, Blekinge Institute of Technology]
  - \* S. Yamashita, Japan Society for the Promotion of Science junior fellow, **10–11**.
  - \* D. Enders, University of Copenhagen, **13–16**  
[Postdoc, Westfälische Wilhelms-Universität Münster]
  - \* A. Muñoz, NSF/DNRF GROW fellow, **15–16**  
[Research Scientist, Duke University]
  - \* A. Dor-On, ERC Marie Skłodowska-Curie individual fellow, **19–21**  
[Senior Lecturer, Haifa University]
  - \* I. Thompson, Canadian National Research Council postdoc fellow, **24–27**
- President, Danish Mathematical Society **06–08**.
- Associate chair for education, University of Copenhagen, **07–11**
- NordForsk Researcher Network: Operator algebras and dynamics, Principal Investigator, **09–12**.  
[Infrastructure for network of 8 nodes with 50 mathematicians]
- Principal investigator: *Experimental mathematics in number theory, operator algebras, and topology*. Villum Fonden **12–16**  
[9 postdoc years & infrastructure]
- Main organizer: *Classification of operator algebras: complexity, rigidity, and dynamics*. Mittag-Leffler Institute program **16**.
- Young Mathematicians in  $C^*$ -Algebras, senior committee **17–**

#### Editorial:

- Mathematica Scandinavica (Editor) **13–19**

- Journal of Mathematical Analysis and Applications (Associate editor) **17–**
- Pure and applied mathematics, Elsevier (Editorial board) **15–17**
- (with T.M. Carlsen, G. Restorff and S. Silvestrov) Operator Algebra and Dynamics, Springer Proceedings in Mathematics & Statistics **58** (2013)
- (with D. Olesen) Gert K. Pedersen,  $C^*$ -algebras and their Automorphism Groups, second edition. Elsevier 2018.

**Publications [Cited 834 times in 512 publications,  $h$ -index=15]**

- [1] A complete invariant for  $AD$  algebras with real rank zero and bounded torsion in  $K_1$ . *Journal of Functional Analysis* **139** (1996), 325–348.
- [2] Künneth splittings and classification of  $C^*$ -algebras with finitely many ideals. *Fields Institute Communications Series* **13**, “Operator Algebras and their Applications”, 81–90, American Mathematical Society, 1997.
- [3] Morita equivalence for crossed products by Hilbert  $C^*$ -bimodules (with B. Abadie and R. Exel). *Transactions of the American Mathematical Society* **350** (1998), 3043–3054.
- [4] Quasidiagonal extensions and  $AF$  algebras (with T.A. Loring and G.K. Pedersen). *Mathematische Annalen* **311** (1998), 233–249.
- [5] Stability of anticommutation relations. An application of noncommutative  $CW$  complexes (with T.A. Loring and G.K. Pedersen). *Journal für die reine und angewandte Mathematik* **499** (1998), 101–143.
- [6] Compressing coefficients while preserving ideals in the  $K$ -theory for  $C^*$ -algebras (with M. Dădărlat). *K-Theory* **14** (1998), 281–304.
- [7] Noncommutative end theory (with C. A. Akemann). *Pacific Journal of Mathematics* **185** (1998), 47–88
- [8] Approximate homogeneity is not a local property (with M. Dădărlat). *Journal für die reine und angewandte Mathematik* **507** (1999), 1–14.
- [9] Fragility for subhomogeneous  $C^*$ -algebras with one-dimensional spectrum (with T.A. Loring and G.K. Pedersen). *Bulletin of the London Mathematical Society* **31** (1999), 337–344.
- [10] Connectivity and components for  $C^*$ -algebras. *Mathematica Scandinavica* **84** (1999), 119–136.
- [11] Computing contingencies for stable relations (with T.A. Loring). *International Journal of Mathematics* **10** (1999), 301–326.
- [12] The Bockstein map is necessary (with M. Dădărlat). *Canadian Mathematical Bulletin* **42** (1999), 274–284.

- [13] Morphisms of extensions of  $C^*$ -algebras: Pushing forward the Busby invariant (with T.A. Loring and G.K. Pedersen). *Advances in Mathematics*, **147** (1999), 74–109.
- [14] Asymptotic unitary equivalence in  $KK$ -theory (with M. Dădărlat). *K-Theory* **23** (2001), 305–322.
- [15] Approximate homogeneity of  $C^*$ -algebras with finitely many ideals. *Proceedings of the Royal Irish Society* **101A** (2001), 149–162.
- [16] Finite dimensional representations of the soft torus (with R. Exel). *Proceedings of the American Mathematical Society* **130** (2002), 727–731.
- [17] On the classification of nuclear  $C^*$ -algebras (with M. Dădărlat). *Proceedings of the London Mathematical Society* **85** (2002), 168–210.
- [18] Regularity of projections revisited (with C.A. Akemann). *Journal of Operator Theory* **48** (2002), 515–534.
- [19] Riesz properties of  $K$ -groups associated to  $C^*$ -algebras of minimal ranks (with G.A. Elliott). *Comptes Rendus Mathématiques de l'Académie des Sciences (La Société Royale du Canada)* **25** (2003), 108–113.
- [20] Augmenting dimension group invariants for substitutional dynamical systems (with T.M. Carlsen). *Ergodic Theory & Dynamical Systems* **24** (2004), 1015–1039.
- [21] Matsumoto  $K$ -groups associated to certain shift spaces (with T.M. Carlsen). *Documenta Mathematica* **9** (2004), 639–671.
- [22]  $C^*$ -algebras associated to symbolic dynamics. *Discrete and Continuous Dynamical Systems* **15** (2006) 177–192.
- [23] Ordered  $K$ -groups associated to substitutional dynamics (with T.M. Carlsen). *Journal of Functional Analysis* **38** (2006), 99–117.
- [24] On Rørdam's classification of certain  $C^*$ -algebras with one nontrivial ideal (with G. Restorff) In "Operator algebras: The Abel symposium 2004", Abel Symposia **1** (2006), 87–96.
- [25] Dimension groups associated to  $\beta$ -expansions (with T. Bates and T.M. Carlsen). *Mathematica Scandinavica* **100** (2007), 198–208.
- [26] A graph approach to computing nondeterminacy in substitutional dynamical systems (with T.M. Carlsen). *RAIRO - Theoretical Informatics and Applications* **41** (2007), 285–306.
- [27] Inductive limits of  $K$ -theoretic complexes with torsion coefficients (with A. Toms). *Journal of K-theory* **1** (2008), 145–168.
- [28] Classification of extensions of classifiable  $C^*$ -algebras (with G. Restorff and E. Ruiz). *Advances in Mathematics* **222** (2009), 2153–2172.

- [29] On the classification of nonsimple graph  $C^*$ -algebras (with M. Tomforde). *Mathematische Annalen* **346** (2010), 393–418.
- [30] On graph  $C^*$ -algebras with a linear ideal lattice (with G. Restorff and E. Ruiz). *Bulletin of the Malaysian Mathematical Sciences Society* (2) **33** (2010), 233–241.
- [31] Enumeration of pyramids of one-dimensional pieces of arbitrary fixed integer length (with B. Durhuus). *Discrete Mathematics and Theoretical Computer Science* proc. **AM** (2010), 145–160.
- [32] Nonsplitting in Kirchberg’s ideal-related  $KK$ -theory. (with G. Restorff and E. Ruiz). *Canadian Mathematical Bulletin* **54** (2011), 68–81.
- [33] On the asymptotic enumeration of LEGO® structures (with M. Abrahamsen). *Journal of Experimental Mathematics*, **20** (2011), 145–152.
- [34] Reducibility of covers of AFT shifts (with T. Bates and D. Pask). *Israel Journal of Mathematics* **185** (2011), 207–234.
- [35] On some new invariants for strong shift equivalence for shifts of finite type (with I. Kiming). *Journal of Number Theory* **132** (2012), 502–510.
- [36] Index maps in the  $K$ -theory of graph algebras (with T.M. Carlsen and M. Tomforde). *Journal of  $K$ -theory* **9** (2012), 385–406.
- [37] Amplified graph  $C^*$ -algebras (with E. Ruiz and A. Sørensen). *Münster Journal of Mathematics* **5** (2012), 121–150.
- [38] Classifying  $C^*$ -algebras with both finite and infinite subquotients (with G. Restorff and E. Ruiz). *Journal of Functional Analysis* **265** (2013), 449–468.
- [39] Classification of graph  $C^*$ -algebras with no more than four primitive ideals (with G. Restorff and E. Ruiz). *Operator Algebra and Dynamics, Springer Proceedings in Mathematics & Statistics* **58** (2013) 89–129.
- [40] The ordered  $K$ -theory of a full extension (with G. Restorff and E. Ruiz). *Canadian Journal of Mathematics* **66** (2014), 596–624.
- [41] Identifying AF-algebras that are graph  $C^*$ -algebras (with T. Katsura, E. Ruiz, M. Tomforde). *Journal of Functional Analysis* **266** (2014), 3968–3996.
- [42] On the entropy of LEGO® (with B. Durhuus). *Journal of Applied Mathematics and Computing* **45** (2014) 433–448.
- [43] The ranges of  $K$ -theoretic invariants for nonsimple graph algebras (with T. Katsura, M. Tomforde and J. West). *Transactions of the American Mathematical Society* **368** (2016), 3811–3847.
- [44] Corrigendum to "Classifying  $C^*$ -algebras with both finite and infinite subquotients" [J. Funct. Anal. 265 (2013) 449–468] (with G. Restorff and E. Ruiz). *Journal of Functional Analysis* **270** (2016), 854–859.

- [45] The LEGO counting problem. *American Mathematical Monthly* **123** (2016), 415–426. **[Cover story]**
- [46] The isomorphism problem for semigroup  $C^*$ -algebras of right-angled Artin monoids (with X. Li and E. Ruiz). *Documenta Mathematica* **21** (2016), 309–343.
- [47] Ideal related  $K$ -theory with coefficients (with G. Restorff and E. Ruiz). *Houston Journal of Mathematics* **43** (2017), 403–458.
- [48] Semiprojectivity and properly infinite projections in graph  $C^*$ -algebras (with T. Katsura). *Advances in Mathematics* **317** (2017), 108–156.
- [49] Flow equivalence and isotopy for subshifts (with M.M. Boyle and T.M. Carlsen). *Dynamical Systems* **32** (2017), 305–325.
- [50] Invariance of the Cuntz splice (with G. Restorff, E. Ruiz and A.P.W. Sørensen). *Mathematische Annalen* **369** (2017) 1061–1080.
- [51] Flow equivalence of sofic shifts (with M.M. Boyle and T.M. Carlsen). *Israel Journal of Mathematics* **225** (2018), 111–146.
- [52] Filtered  $K$ -theory for graph algebras (with G. Restorff, E. Ruiz and A.P.W. Sørensen). In: Wood D., de Gier J., Praeger C., Tao T. (eds) 2016 MATRIX Annals, pp. 229–249. MATRIX Book Series, vol 1. Springer, 2018.
- [53] Geometric classification of graph  $C^*$ -algebras over finite graphs (with G. Restorff, E. Ruiz and A.P.W. Sørensen). *Canadian Journal of Mathematics* **70** (2018), 294–353.
- [54] Automorphisms of Cuntz-Krieger algebras (with G. Restorff and E. Ruiz). *Journal of Noncommutative Geometry* **12** (2018) 217–254.
- [55] A dynamical characterization of diagonal preserving  $*$ -isomorphisms of graph  $C^*$ -algebras (with S.E. Arklint and E. Ruiz). *Ergodic Theory and Dynamical Systems* **38** (2018), 2401–2421.
- [56] Flow equivalence and orbit equivalence for shifts of finite type and isomorphism of their groupoids (with T.M. Carlsen, E. Ortega and G. Restorff). *Journal of Mathematical Analysis and Applications* **469** (2019), 1088–1110.
- [57] Flow equivalence of  $G$ -SFTs (with M.M. Boyle and T.M. Carlsen). *Transactions of the American Mathematical Society* **373** (2020), 2591–2657.
- [58] The extension problem for graph  $C^*$ -algebras (with J. Gabe, T. Katsura, E. Ruiz and M. Tomforde). *Annals of  $K$ -theory* **5** (2020), 295–315.
- [59]  $C^*$ -stability of discrete groups (with T. Shulman and A.P.W. Sørensen). *Advances in Mathematics* **373** (2020), 107324.
- [60] Classification of irreversible and reversible Pimsner operator algebras (with A. Dor-On and S. Geffen). *Compositio Mathematica* **156** (2020), 2510–2535.

- [61] The complete classification of unital graph  $C^*$ -algebras: Geometric and strong (with G. Restorff, E. Ruiz and A.P.W. Sørensen). *Duke Mathematical Journal* **170** (2021), 2421–2517.
- [62] Strong classification of extensions of classifiable  $C^*$ -algebras (with G. Restorff and E. Ruiz). *Bulletin of the Korean Mathematical Society* **59** (2022), 567–608.
- [63] Amplified graph  $C^*$ -algebras II: Reconstruction (with E. Ruiz and A. Sims). *Proceedings of the American Mathematical Society, Series B*, **9** (2022), 297–310.
- [64] Geometric classification of isomorphism of unital graph  $C^*$ -algebras (with S.E. Arklint and E. Ruiz). *New York Journal of Mathematics* **28** (2022), 927–957.
- [65] Conjugacy of local homeomorphisms via groupoids and  $C^*$ -algebras (with B. Armstrong, K. Brix and T.M. Carlsen). *Ergodic Theory and Dynamical Systems* **43** (2023), 2516–2537.
- [66] Shift equivalences through the lens of Cuntz-Krieger algebras (with T.M. Carlsen and A. Dor-On). *Analysis & PDE* **17** (2024), 345–377.

Expository/instructional:

- Indledende matematisk analyse [Introductory analysis], with E. Hansen and T.G. Madsen, 1st-16th edition, 2010–2026.
- Analyse 1, with M. Christandl and H. Schlichtkrull, 4th-7th edition, 2022–2025.
- Introduction to experimental mathematics, with R. Johansen, Cambridge University Press, 2017.
- Symbolic Dynamics (with M.-P. Béal, J. Berstel, and D. Perrin). “Handbook of Automata Theory”, J.-É. Pin, editor, European Mathematical Society Publishing House, 2021, pp. 987–1030.

**Conference talks 2017– [of 92 since 1994, • = invited, ○ = contributed]**

- **6/17**: Barcelona conference on  $C^*$ -algebras: Structure, classification and dynamics. CRM, Barcelona, Spain.
- **6/17**: Special week on operator algebras, East China Normal University, Shanghai, China.
- **7/17**: Applications of Model Theory to Operator Algebras, University of Houston, USA.
- **10/17**: Applications of the UCT for  $C^*$ -algebras, University of Copenhagen.
- **1/18**: New Geometry of Quantum Dynamics, IMPAN, Poland.
- **5/18**: Workshop in operator algebras and dynamics on the Faroe Islands, Tórshavn, Faroe Islands.
- **7/18**: ICM Operator Algebras Satellite, Florianopolis, Brazil

- **6/21**: 8th Special week on operator algebras, East China Normal University, Shanghai, China. *[Online]*
- **7/21**: 8th European Congress of Mathematicians, Operator Algebras Minisymposium, Portorož, Slovenia. *[Online]*
- **6/22**: Quantum Geometry 2022, Tórshavn, Faroe Islands.
- **8/22**:  $C^*$ -algebras, Mathematisches Forschungsinstitut Oberwolfach, Germany.
- **8/22**: Glasgow Late August Symbolic Dynamics, Groups, and Operators Workshop, University of Glasgow, United Kingdom. *[Mini-course lecture series]*
- **8/22**: Baby Steps Beyond the Horizon 2022, The Banach Center, Białystok, Poland. *[Online]*
- **6/23**:  $C^*$ -Algebras: Tensor Products, Approximation & Classification, Münster, Germany.
- **7/23**: Graph Algebras, The Banach Center, Białystok, Poland. *[Online]*
- **9/23**: Quantum Groups and Noncommutative Geometry in Prague, Czech Republic. *[Online]*
- **6/24**: Non-commutativity in the North, Gothenburg, Sweden.
- **7/24**: 11th Special week on operator algebras, East China Normal University, Shanghai, China.

#### **Conference organization 2017– [of 39 since 2000]:**

- Organizer (with S.E. Arklint and K. Brix), “Rigidity of  $C^*$ -algebras associated to dynamics”, University of Copenhagen, **10/17**.
- Organizer (with J. Ramagge) “Computation and experiments in operator algebra and dynamics with Magma”, micro-workshop, University of Copenhagen, **10/19**.
- Organizer (with O. Becker and T. Shulman), “Stability in Group Theory and Operator Algebras”, workshop, University of Copenhagen, **12/19**.
- Organizer (with A. Dor-On, J. Gabe, J. Kaad, D. Kyed) “Automorphisms and invariants for operator algebras”, conference, University of Copenhagen, **10/21**.
- Organizer (with M. Musat, M. Rørdam, A. Törnquist) “Operator algebras, dynamics and groups”, conference, University of Copenhagen, **07/22**.
- Organizer (with L. Mančinská, S. Schmidt, J. Volčič), “The mathematics of quantum entanglement via nonlocal games”, master class, University of Copenhagen, **8/22**.
- Organizer (with A. Dor-On), “Irreversibility and non-commutative convexity in  $C^*$ -algebra theory”, master class, University of Copenhagen, **10/22**.



- Organizer (with P. M. Hajac, T. Maszczyk) “Graph Algebras”, Będlewo; Poland.
- Organizer (with G. Cortiñas, E. Gillaspy, R. Hazrat), “Combinatorial  $\ast$ -algebras”, Oberwolfach workshop (half-size), **03/24**

#### **Larger grants and stipends (as PI):**

- **94** Valdemar Andersens rejselegat for matematikere (279 kkr).
- **97** The Carlsberg Foundation (174 kkr)
- **99** Danish Centre for Science Education (127 kkr).
- **05** The Faroese Research Council (with G. Restorff) (519 kkr).
- **09** NordForsk: Researcher Network: Operator algebras and dynamics (800 kkr).
- **12** VILLUM Foundation: Experimental Mathematics in Number Theory, Topology and Operator Algebras (5743 kkr).
- **22** The Simons Foundation: Operator Algebras that One Can See (with P.M. Hajac and T. Maszczyk) (297 kkr).

#### **Other formalized research group memberships:**

- Operator algebras in Denmark, Independent Danish Research Foundation. Member **03–15**
- *AutoMathA*, European Science Foundation program “Automata from mathematics to applications”, steering committee member, **05–10**
- Marie Curie Research Training Network “Conformal Structure and Dynamics”, Denmark/Sweden team, associated researcher, **07–12**
- INTAS South Caucasian republics program “K-theory, non-commutative geometry, homology theories, homotopy theory, operator and normed algebras”, Copenhagen team, member **07–09**
- Symmetry and Deformation, University of Copenhagen Excellence and Danish Fundamental Science Foundation Center, permanent member **08–19**
- NordForsk Researcher Network: Operator algebras and dynamics, prime investigator, **09–12**.
- Experimental Mathematics in Number Theory, Topology and Operator Algebras. prime investigator, **12–16**.
- Quantum dynamics, Horizon 2020 RISE program. Member and work package coordinator. **15–20**.
- Automorphisms and invariants for operator algebras, Independent Danish Research Foundation. Member and node coordinator. **18–22**.

- Groups, Actions and  $C^*$ -algebras. Independent Danish Research Foundation. Member. **21-25**
- Graph Algebras, Horizon 2021 program. Node and work package coordinator. **23-26**.

### Evaluation:

- PhD evaluation committees: Copenhagen (chairman) **09,12,13,17,17,17,20,22,25**, Århus University **03,10**, Oslo University **06**, University of Lund **05,09,09**, University of Southern Denmark **09,11**, University of Glasgow **21**.
- **06**: Habilitation evaluation, Westfälische Wilhelms-Universität Münster.
- **10**: Hiring committee, university lecturer, University of Lund.
- **10**: Hiring committee, associate professor, Århus University.
- **15**: Advisory hiring committee, associate dean for education, Faculty of Science, University of Copenhagen.
- **19,21,25**: Hiring committee, editor-in-chief, Universitetsavisen (University of Copenhagen independent newspaper).
- **19,20,22,24**: Hiring committee, journalists, Universitetsavisen (University of Copenhagen independent newspaper).
- **19**: Advisory hiring committee, dean, Faculty of Science, University of Copenhagen.

### Various appointments and duties:

- **98–26**: Danish corps of external examiners.
- **06–07**: Chairman, "Den gode underviser" [Committee for furthering of teaching and teachers], The Faculty of Science, University of Copenhagen.
- **09**: International expert, The Danish Evaluation Institute  
"Mathematics A and B at upper-secondary level (STX and HTX) in an international perspective"
- **11–12,19–**: Member of the board of the University of Copenhagen newspaper Universitetsavisen. Chairman from 2019.
- **13–16,19–22**: Academic council, University of Copenhagen, member
- **17**: External expert, evaluation of Aarhus University mathematics programs.

### Honors:

- Faculty of Science, University of Copenhagen: Teaching prize **98 & 00**
- Faculty of Science, University of Copenhagen: Educator of the year **12**.
- Faculty of Science, University of Copenhagen: Communication prize **13**.
- University of Copenhagen: Nominated for Harald Bohr price (university-wide educator of the year) **16**.