

# Daniel Smertnig

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[http://arxiv.org/a/smertnig\\_d\\_1](http://arxiv.org/a/smertnig_d_1)

## Research Interests

Noncommutative algebra and ring theory, factorization theory, multiplicative ideal theory, quaternion algebras, noncommutative rational series and connections to automata theory,  $D$ -finite power series, monoids of modules.

## Positions

- 2023 **Associate Professor**, Faculty of Mathematics and Physics, University of Ljubljana, Slovenia.
- 2020–2023 **Professor of algebra**, University of Graz, Austria (interim appointment).  
Head of the research group [Algebra and Number Theory](#).
- 2017–2020 **Post-doctoral Fellow**, Austrian Science Fund (FWF) Erwin Schrödinger Fellowship J4079-N32 (2 years abroad, 1 year in Austria):
- University of Graz, Austria (October 2019–April 2020).
  - University of Waterloo, ON, Canada (February 2018–September 2019) working with [Jason P. Bell](#).
  - Dartmouth College, NH, USA (October 2017–January 2018) working with [John Voight](#).
- 2014–2017 **Post-doctoral Fellow**, University of Graz, Austria.  
In the Austrian Science Fund (FWF) project [P26036-N26](#), *Non-Unique Factorizations, Ideal Theory, and Additive Theory*.

## Education

- 2014 **PhD in Mathematics** (with distinction), University of Graz, Austria.  
Within the [Doctoral Program Discrete Mathematics](#) (TU Graz, Uni Graz, MU Leoben).  
Thesis: *Factorization Theory in Maximal Orders*. Advisor: Alfred Geroldinger.  
Research stay with [Alberto Facchini](#) at University of Padua, Italy (September 2012–February 2013).
- 2011 **MSc in Mathematics**, University of Graz, Austria.  
Exchange at Utrecht University, Netherlands (August 2009–June 2010).
- 2009 **BSc in Mathematics**, University of Graz, Austria.

**Publications**

1. J. P. Bell, D. Smertnig, and H. Tamm. Duality of lattices associated to left and right quotients. *Proceedings of the 16th International Conference on Automata and Formal Languages (AFL 2023)*. Ed. by S. I. Zsolt Gazdag and G. Kovászai. Vol. 386. Electronic Proceedings in Theoretical Computer Science. *To appear*. 2023, 35–50. DOI: [10.4204/EPTCS.386.5](https://doi.org/10.4204/EPTCS.386.5). arXiv: [2306.02491](https://arxiv.org/abs/2306.02491).
2. J. P. Bell and D. Smertnig. Computing the linear hull: Deciding Deterministic? and Unambiguous? for weighted automata over fields. *LICS '23—38th Annual ACM/IEEE Symposium on Logic in Computer Science*. 2023, 1–13. DOI: [10.1109/LICS56636.2023.10175691](https://doi.org/10.1109/LICS56636.2023.10175691). arXiv: [2209.02260](https://arxiv.org/abs/2209.02260).
3. J. P. Bell, K. Brown, Z. Nazemian, and D. Smertnig. On noncommutative bounded factorization domains and prime rings. *J. Algebra* 622 (2023), 404–449. DOI: [10.1016/j.jalgebra.2023.01.023](https://doi.org/10.1016/j.jalgebra.2023.01.023). arXiv: [2206.10115](https://arxiv.org/abs/2206.10115).
4. J. Bell and D. Smertnig.  $D$ -finite multivariate series with arithmetic restrictions on their coefficients. *Canad. J. Math* (2022). *Online First*. DOI: [10.4153/S0008414X22000517](https://doi.org/10.4153/S0008414X22000517). arXiv: [2202.00415](https://arxiv.org/abs/2202.00415).
5. B. Adamczewski, J. Bell, and D. Smertnig. A height gap theorem for coefficients of Mahler functions. *J. Eur. Math. Soc. (JEMS)* 25.7 (2023), 2525–2571. DOI: [10.4171/JEMS/1244](https://doi.org/10.4171/JEMS/1244). arXiv: [2003.03429](https://arxiv.org/abs/2003.03429).
6. J. Bell and D. Smertnig. Noncommutative rational Pólya series. *Selecta Math. (N.S.)* 27.3 (2021), Paper No. 34, 34. DOI: [10.1007/s00029-021-00629-2](https://doi.org/10.1007/s00029-021-00629-2). arXiv: [1906.07271](https://arxiv.org/abs/1906.07271).
7. N. R. Baeth and D. Smertnig. Lattices over Bass rings and graph agglomerations. *Algebr. Represent. Theory* 25 (2022), 669–704. DOI: [10.1007/s10468-021-10040-2](https://doi.org/10.1007/s10468-021-10040-2). arXiv: [2006.10002](https://arxiv.org/abs/2006.10002).
8. S. Chari, D. Smertnig, and J. Voight. On basic and Bass quaternion orders. *Proc. Amer. Math. Soc. Ser. B* 8 (2021), 11–26. DOI: [10.1090/bproc/68](https://doi.org/10.1090/bproc/68). arXiv: [1903.00560](https://arxiv.org/abs/1903.00560).
9. A. Garcia Elsener, P. Lampe, and D. Smertnig. Factoriality and class groups of cluster algebras. *Adv. Math.* 358 (2019), 106858. DOI: [10.1016/j.aim.2019.106858](https://doi.org/10.1016/j.aim.2019.106858). arXiv: [1712.06512](https://arxiv.org/abs/1712.06512).
10. D. Smertnig and J. Voight. Definite orders with locally free cancellation. *Trans. London Math. Soc.* 6 (1 2019), 53–86. DOI: [10.1112/tlm3.12019](https://doi.org/10.1112/tlm3.12019). arXiv: [1903.10662](https://arxiv.org/abs/1903.10662).
11. N. R. Baeth and D. Smertnig. Arithmetical invariants of local quaternion orders. *Acta Arith.* 186.2 (2018), 143–177. DOI: [10.4064/aa170601-13-8](https://doi.org/10.4064/aa170601-13-8). arXiv: [1706.00572](https://arxiv.org/abs/1706.00572).
12. D. Smertnig. Factorizations in bounded hereditary Noetherian prime rings. *Proc. Edinburgh Math. Soc.* (2) 62 (2 2019), 395–442. DOI: [10.1017/S0013091518000305](https://doi.org/10.1017/S0013091518000305). arXiv: [1605.09274](https://arxiv.org/abs/1605.09274).
13. D. Smertnig. Every abelian group is the class group of a simple Dedekind domain. *Trans. Amer. Math. Soc.* 369.4 (2017), 2477–2491. DOI: [10.1090/tran/6868](https://doi.org/10.1090/tran/6868). arXiv: [1505.00608](https://arxiv.org/abs/1505.00608).
14. D. Smertnig. Factorizations of Elements in Noncommutative Rings: A survey. *Multiplicative Ideal Theory and Factorization Theory*. Springer, 2016, 353–402. arXiv: [1507.07487](https://arxiv.org/abs/1507.07487).
15. N. R. Baeth and D. Smertnig. Factorization theory: From commutative to noncommutative settings. *J. Algebra* 441 (2015), 475–551. DOI: [10.1016/j.jalgebra.2015.06.007](https://doi.org/10.1016/j.jalgebra.2015.06.007). arXiv: [1402.4397](https://arxiv.org/abs/1402.4397).
16. N. R. Baeth, A. Geroldinger, D. J. Gryniewicz, and D. Smertnig. A semigroup-theoretical view of direct-sum decompositions and associated combinatorial problems. *J. Algebra Appl.* 14.2 (2015), 1550016, 60. DOI: [10.1142/S0219498815500164](https://doi.org/10.1142/S0219498815500164). arXiv: [1404.7264](https://arxiv.org/abs/1404.7264).
17. D. Smertnig. A note on cancellation in totally definite quaternion algebras. *J. Reine Angew. Math.* 707 (2015), 209–216. DOI: [10.1515/crelle-2013-0069](https://doi.org/10.1515/crelle-2013-0069).

18. A. Facchini, D. Smertnig, and N. Khanh Tung. Cyclically presented modules, projective covers and factorizations. *Ring theory and its applications*. Vol. 609. Contemp. Math. Amer. Math. Soc., Providence, RI, 2014, 89–106. DOI: [10.1090/conm/609/12082](https://doi.org/10.1090/conm/609/12082). arXiv: [1306.5710](https://arxiv.org/abs/1306.5710).
19. D. Smertnig. Sets of lengths in maximal orders in central simple algebras. *J. Algebra* 390 (2013), 1–43. DOI: [10.1016/j.jalgebra.2013.05.016](https://doi.org/10.1016/j.jalgebra.2013.05.016). arXiv: [1306.0834](https://arxiv.org/abs/1306.0834).
20. G. W. Chang and D. Smertnig. Factorization in the self-idealization of a PID. *Boll. Unione Mat. Ital. (9)* 6.2 (2013), 363–377. arXiv: [1311.5107](https://arxiv.org/abs/1311.5107).
21. D. Smertnig. On the Davenport constant and group algebras. *Colloq. Math.* 121.2 (2010), 179–193. DOI: [10.4064/cm121-2-2](https://doi.org/10.4064/cm121-2-2). arXiv: [0907.4913](https://arxiv.org/abs/0907.4913).

## Awards & Grants

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| 2023      | ÖMG Förderungspreis 2023 (prize of the Austrian Mathematical Society).   |
| 2023      | Austrian Science Fund (FWF) project P36742, <i>Modules, Monoids, and Factorizations</i> (€ 406,240).   |
| 2017–2020 | Austrian Science Fund (FWF) <a href="#">Erwin Schrödinger Fellowship</a> J4079-N32 (€ 152,023).  |
| 2013      | One of two Doctoral School Awards in 2013 of the Doctoral School “Mathematics and Scientific Computing” at University of Graz and Graz University of Technology. |

## Conference Talks (invited)

- *On factorizations in noncommutative rings*, ÖMG Tagung 2023 (Meeting of the Austrian Mathematical Society), Graz (Austria), 2023-09-22.
- *On some factorization questions in noncommutative noetherian domains*, International Conference on Noncommutative Algebra and its Applications, Teheran (Iran)/Online, 2022-05-10.
- *Monoids of graph agglomerations*, Special Session on Commutative rings: ideals, modules and factorizations, AMS/MAA Joint Mathematics Meeting 2021, Washington DC/Online, 2021-01-08.
- *Locally free cancellation for definite quaternion algebras*, Special Session on Rings, Monoids and Module Theory in the 3rd International Conference on Mathematics and Statistics, AUS-ICMS, Sharjah, United Arab Emirates, 2020-02-08.
- *Class groups of cluster algebras*, Special Session on Factorization and Arithmetic Properties of Integral Domains and Monoids, AMS Spring Central and Western Joint Sectional Meeting 2019, Honolulu, Hawaii (USA), 2019-03-23.
- *Non-unique factorizations in bounded hereditary noetherian prime rings*, Conference on Rings and Factorizations, Graz (Austria), 2018-02-21.
- *A semigroup-theoretical view of direct-sum decompositions over HNP rings*, Special Session on Factorization Theory and Its Applications, AMS/MAA Joint Mathematics Meeting 2015, San Antonio, Texas (USA), 2015-01-10.

## Conference Talks (contributed)

- *On noncommutative bounded factorization domains and prime rings*, 9th China-Japan-Korea International Conference on Ring and Module Theory, Incheon (Korea), 2023-08-15.
- *Computing the linear hull: Deciding Deterministic? and Unambiguous? for weighted automata over fields*, Thirty-Eighth Annual ACM/IEEE Symposium on Logic in Computer Science (LICS), Boston (USA), 2023-06-28.
- *Noncommutative rational Pólya series*, Algebra, algebraic geometry and number theory section, DMV-ÖMG Annual Conference 2021, Passau Germany/Online, 2021-09-28.
- *On noncommutative bounded factorization domains*, Conference on Rings and Polynomials, Graz, Austria/Hybrid, 2021-07-21.

- *Noncommutative rational Pólya series*, Noncommutative Rings and their Applications, VII, Lens, France/Online, 2021-07-06.
- *Arithmetical invariants of local quaternion orders*, Maine–Québec Number Theory Conference, Orono, Maine (USA), 2017-10-14.
- *A transfer homomorphism for factorizations in bounded hereditary Noetherian prime rings*, Conference on Rings and Polynomials, Graz (Austria), 2016-07-06.
- *Every abelian group is the class group of a simple Dedekind domain*, Noncommutative rings and their Applications, IV, Lens (France), 2015-06-11.
- *Factorization theory in maximal orders in central simple algebras*, Brock International Conference on Groups, Rings and Group Rings, St. Catharines, Ontario (Canada), 2014-08-01.
- *A semigroup-theoretical view of direct-sum decompositions and associated combinatorial problems*, Algebraic Structures and Their Applications, Abbazia di Spineto, Sarteano (Italy), 2014-06-20.
- *Non-unique factorizations in maximal orders in central simple algebras*, 18th ÖMG Congress and Annual DMV Meeting, Innsbruck (Austria), 2013-09-26.
- *Sets of lengths in maximal orders in central simple algebras*, Classical Aspects of Ring Theory and Module Theory, Będlewo (Poland), 2013-07-17.
- *Sets of lengths in maximal orders in central simple algebras*, Noncommutative rings and their Applications, III, Lens (France), 2013-07-02.
- *Factorization in a commutative subring of the  $2 \times 2$  matrices over a PID*, Conference on Commutative Rings, Integer-valued Polynomials and Polynomial Functions, Graz (Austria), 2012-12-21.
- *The set of distances in maximal orders of central simple algebras over number fields*, Commutative Rings and their Modules, Bressanone (Italy), 2012-06-05.
- *On the Davenport constant of a finite abelian group*, Paul Turán Memorial Conference, Budapest (Hungary), 2011-08-23.

## Invited Colloquia

- *From Bass Rings to Monoids of Graph Agglomerations*, Mathematical Colloquium on the occasion of the 60th birthday of Sophie Frisch, Graz University of Technology, Austria, 2023-06-16.
- *Algebraic structures and arithmetical properties*, Colloquium of the Mathematics Department, University of Ljubljana, Slovenia, 2023-05-19.
- *On rational Pólya series and unambiguous weighted finite automata*, Café Matemático, Universidad Nacional de Mar del Plata, Argentina, 2023-02-23.
- *Factorizations of elements in cluster algebras*, Mathematics Colloquium, University of Nebraska–Lincoln, Lincoln, Nebraska, USA, 2019-03-15.
- *Factorization theory of cluster algebras*, Math Colloquium, Franklin & Marshall College, Lancaster, Pennsylvania, USA, 2018-11-29.

## Invited Seminar Talks

- *Computing the linear hull: Deciding Sequential? and Unambiguous? over fields*, Automata Seminar, Institut de Recherche en Informatique Fondamentale (IRIF), Paris, France, 2023-06-09.
- *On the linear Zariski closure of a finitely generated matrix semigroup and its connection to weighted automata*, Algebra Seminar, University of Warsaw, Poland (online), 2022-11-03.
- *A height gap theorem for coefficients of Mahler functions*, Kolchin Seminar in Differential Algebra, City University of New York, NY, USA (online), 2022-10-28.
- *Monoids of graph agglomerations and lattices over Bass rings*, The Open Webinar, Hebei Normal University, China (online), 2022-05-20.
- *On noncommutative bounded factorization domains*, Algebra Seminar, University of Warsaw, Poland (online), 2021-01-14.

- *Noncommutative rational Pólya series*, Automata Seminar, Institut de Recherche en Informatique Fondamentale (IRIF), Paris, France, 2019-11-08.
- *Noncommutative rational Pólya series*, Séminaire de Combinatoire et d'Informatique Mathématique du LaCIM, Université du Québec à Montréal, Montréal, Québec, Canada, 2019-09-13.
- *Locally free cancellation for definite quaternion orders*, Commutative Algebra Seminar, University of Nebraska–Lincoln, Lincoln, Nebraska, USA, 2019-03-14.
- *The role of transfer Krull monoids in studying non-unique factorizations*, Commutative Algebra Seminar, University of Nebraska–Lincoln, Lincoln, Nebraska, USA, 2019-03-13.
- *On noncommutative rational Pólya series*, Algebra and Number Theory Seminar, Dartmouth College, Hanover, New Hampshire, USA, 2019-02-18.
- *On basic and Bass quaternion orders*, Number Theory Seminar, University of Waterloo, Waterloo, Ontario, Canada, 2019-01-22.
- *Factoriality and class groups of cluster algebras*, Cluster Algebra Seminar, University of Connecticut, Storrs, Connecticut, USA, 2018-01-26.
- *Non-unique factorizations and transfer homomorphisms*, Seminar, Bowdoin College, Maine, USA, 2017-12-11.
- *Non-unique factorizations via transfer principles*, Number Theory Seminar, Dartmouth College, New Hampshire, USA, 2017-10-19.
- *Non-unique factorizations and transfer homomorphisms*, Algebra Seminar, University of California at Santa Barbara, California, USA, 2017-02-27.
- *Non-unique factorizations in maximal orders and beyond*, Algebra Seminar, University of Waterloo, Ontario, Canada, 2016-10-19.
- *A transfer result for factorizations in bounded Dedekind prime rings*, Algebra Seminar, University of Warsaw, Poland, 2015-04-12.

## Teaching

- S 2023      \* Number theory (lecture, 3h, Master students).
- W 2023/24    Topics in algebra: Modules over hereditary noetherian prime rings (lecture, 2h, PhD students).
- S 2023      Special Topics in Algebra: Ring Theory (lecture, 3h, graduate students),  
Seminar: Diskrete Mathematik und Algorithmentheorie (seminar, 2h, 6th semester),  
Mathematisches Seminar (seminar, 2h, 9th semester  $\text{\textcircled{T}}$ ).
- W 2022/23    Discrete and Algebraic Structures (lecture & exercise class, 3+1h, graduate students),  
Lineare Algebra 1 Übungen (exercise class, 2h, 1st semester).
- S 2022      Elementare Zahlentheorie (lecture & exercise class, 1+1h, 6th semester  $\text{\textcircled{T}}$ ),  
Ausgewählte Kapitel der Mathematik (lecture & exercise class, 2+1h, 10th semester  $\text{\textcircled{T}}$ ).
- W 2021/22    Diskrete Mathematik (lecture & exercise class, 2+1h, 1st semester),  
Lineare Algebra 1 Übungen (exercise class, 2h, 1st semester),  
Seminar Discrete Mathematics (1h, seminar for graduate students),  
Mathematics Seminar (1h, seminar  $\text{\textcircled{T}}$ ).
- S 2021      Lineare Algebra und Analytische Geometrie (lecture, 3h, 4th semester  $\text{\textcircled{T}}$ ),  
Elementare Zahlentheorie (lecture & exercise class, 1+1h, 6th semester  $\text{\textcircled{T}}$ ).
- W 2020/21    Discrete and Algebraic Structures (lecture & exercise class, 3+1h, graduate students),  
Lineare Algebra 1 Übungen (exercise class, 2h, 1st semester).
- W 2019/20    Elementare Diskrete Mathematik (lecture & exercise class, 2h, 1st semester  $\text{\textcircled{T}}$ ).
- S 2017      Elective subject mathematics: Noncommutative Noetherian rings  
(lecture, 2h, graduate students).

- W 2016/17    Elementare Zahlentheorie für LAK (lecture & exercise class, 1+1h, 6th semester  $\textcircled{T}$ ).
- W 2015/16    Analysis 1 Übungen (exercise class, 2h, 1st semester).
- W 2014/15    Algebra Übungen (exercise class, 1h, 5th semester).
- W 2014/15    Lineare Algebra 1 Übungen (exercise class, 2h, 1st semester).
- W 2013        Einführung in die Algebra Proseminar (exercise class, 1h, 4th semester).
- W 2011/12    Höhere Mathematik I Proseminar (exercise class, 2h, 1st semester).

Courses marked with  $\textcircled{T}$  are for students studying towards a teaching degree. Courses from W2020/21 through W2021/22 were taught in various forms of online or hybrid formats.

Language of course title (German/English) corresponds to language of instruction.

## Service, Professional Activities, and Memberships

- Reviews and quick-opinions for *Algebra and Number Theory*, *Advances in Applied Clifford Algebras*, *American Mathematical Monthly*, *Canadian Journal of Mathematics*, *Colloquium Mathematicum*, *Communications in Algebra*, *Communications of the Korean Mathematical Society*, *Discrete Applied Mathematics*, *Forum Mathematicum*, *International Electronic Journal of Algebra*, *Israel Journal of Mathematics*, *Journal of Algebra*, *Journal of Algebra and Its Applications*, *Journal of Combinatorial Theory, Series A*, *Journal of the London Mathematical Society*, *Journal of Number Theory*, *Journal of the Korean Mathematical Society*, *Journal of Pure and Applied Algebra*, *Mathematica Bohemica*, *Monatshefte für Mathematik*, and *Rendiconti del Circolo Matematico di Palermo Series 2*.
- Member of
  - Österreichische Mathematische Gesellschaft (ÖMG, Austrian Mathematical Society) since 2014,
  - American Mathematical Society (AMS) since 2014.
- Co-organisation of conferences:
  - Rings and Factorizations 2023, Graz, Austria, July 2023,
  - Combinatorial and Additive Number Theory, Graz, Austria, 2016,
  - Arithmetic and Ideal Theory of Rings and Semigroups, Graz, Austria, 2014.
- Co-organisation of the event *Celebrating Women in Mathematics, in Graz*, 2022-05-19.
- Co-organisation of the event *Celebrating Women in Mathematics, in Graz*, 2023-05-26.
- Vice-Treasurer for Österreichische Mathematische Gesellschaft (ÖMG, Austrian Mathematical Society) since 2022.
- Representative for the Institute of Mathematics in the “Fakultätsgremium” at the faculty of natural sciences (2021–2023).
- Committee service (various).

## Other

- Languages: German (native), English (fluent), a few words of French (A1).
- Programming skills (C, C++, Python, basic Haskell) and familiarity with computer algebra systems (Sage, Magma).
- Magma code for the classification of Hermite quaternion orders and enumeration of suborders of quaternion orders: <https://github.com/dansme/hermite>.

- Personal details: born 1986-05-23 in Eisenkappel, Austria. Austrian citizenship.