Laudatio für Daniel Smertnig aus Anlass der Verleihung des Förderungspreises 2023

Dear Colleagues, dear Daniel,

It is a great pleasure for me to give this laudatory speech for Daniel Smertnig, on the occasion of receiving the Förderungspreis of the Austrian Mathematical Society in 2023. I will start with some information on his vita and then I discuss some of his scientific achievements.

Daniel was born on May 23rd, 1986, in Bad Eisenkappel. He attended HTL Mössingerstraße in Klagenfurt. In 2006, he started to study mathematics at the University of Graz. During the master program he spent one year at Utrecht University (Netherlands). In his Bachelor thesis, he disproved a conjecture by Weidong Gao and Yuanlin Li on group algebras.

In spring 2011, he started his PhD under my supervision, within the Doctoral Program Discrete Mathematics. As a side remark, this program is now continued in the frame of the Graz School of Discrete Mathematics and Daniel is already the second prize winner who graduated in this program. The first one was Christopher Frei. During his PhD program, Daniel spent half a year at the University of Padova, where he worked with Alberto Facchini. He received a Best Paper award of the Doctoral School *Mathematics and Scientific Computing* at the University of Graz and Graz University of Technology and graduated in summer 2014.

After a few PostDoc years at the University of Graz, he won an FWF-Erwin-Schrödinger Grant and went to the US and Canada, where he worked with John Voight and Jason P. Bell. After that he accepted an offer for a professorship at our department, where he has served as the group leader of the algebra and number theory group. This year, he won an FWF standalone project, entitled *Modules, Monoids, and Factorizations* and he accepted an attractive offer from the University of Ljubljana. The Faculty of Mathematics and Physics at the University of Ljubljana is a center of non-commutative ring theory, and Daniel will start there on October 1st, 2023.

Daniel's main research area is non-commutative ring theory, with a focus on their ideal, module, and factorization theory. Moreover, his work on noncommutative power series has substantial overlap with automata theory and theoretical computer science. Quite a lot of his papers appeared in first class journals, such as the Transactions of the AMS, Trans. of the London Math. Soc., Advances in Mathematics, Journal für Reine und Angewandte Mathematik, Journal of the European Mathematical Society, and others.
Let us have a short glance at four of his papers.

(i) Noncommutative rational Polya series (with J. Bell, Selecta Math., 2021).
This paper is in the overlap of algebra, number theory, and applications in computer science. The authors show that rational Polya series are unambiguous rational series, and this settles a forty year old conjecture by Reutenauer. Also several of his most recent papers deal with applications to automata theory and theoretical computer science.

(ii) Every abelian group is the class group of a simple Dedekind domain (Trans. AMS, 2017). Realizing abelian groups as class groups of certain types of rings, is a classic, but still highly active topic in ring theory (indeed, it dates back to the 1960s when Claborn proved that every abelian group is isomorphic to the class group of a commutative Dedekind domain). Daniel settles an open problem stated in the monograph by Levy and Robson. Indeed, in Section 57, the authors list eight key problems. Problem 7 runs as follows:

> What abelian groups can occur as the ideal class group $\mathcal{G}$ of a simple Dedekind prime ring?

Daniel showed that every abelian group can be realized as the class group of a simple Dedekind prime ring (this is a non-commutative ring).

(iii) Factoriality and class groups of cluster algebras (with A. Garcia Elsener and P. Lampe, Advances in Math., 2019). A commutative integral domain is factorial if and only if it is a Krull domain with trivial class group. Locally acyclic cluster algebras are Krull and research so far was restricted to studying when such domains are factorial. In this paper, the authors study (for the first time) the class group of such cluster algebras and the distribution of height-one prime ideals in the classes. As a corollary, they obtain that every finite nonempty subset of $\mathbb{N}_{\ge 2}$ occurs as a set of lengths in such a cluster algebra (apart from exceptional cases).

(iv) Factorizations in bounded hereditary Noetherian prime rings (Proc. Edinburgh Math. Soc., 2019). A key method in factorization theory runs as follows. In order to study the arithmetic of a ring R and in order to understand how badly the ring R fails to be factorial, one constructs (a much simpler) semigroup B and a transfer homomorphism $\theta\colon R \to B$, which allows to pull back arithmetic properties from B to R. There is a well-developed transfer machinery for commutative integral domains. The best understood class of rings are Krull domains. They allow a transfer homomorphism to monoids of zero-sum sequences over their class group, whence the arithmetic can be studied with methods from additive combinatorics. Daniel is one of the pioneers extending this transfer machinery to noncommutative rings. In this paper, he constructs a transfer homomorphism from bounded HNP rings to commutative Krull monoids (and hence to monoids of zero-sum sequences). This implies that lots of arithmetic properties in HNP rings coincide with those of commutative Krull monoids (which was quite a bit of surprise to all people in this community). The approach is based on the structure theory of finitely generated projective modules over HNP rings, as developed by Levy and Robson.

This short discussion demonstrates that Daniel has built himself a well-deserved international reputation, which is documented not only by his papers in first-class journals but also by the list of invited conference and seminar talks. To conclude, I would like to congratulate Daniel for winning the ÖMG Förderungspreis 2023. I wish him all the best for his new start in Ljubljana and I am sure that he will in the future, as he did in the past, surprise the ring theory community with exciting new results.

(Alfred Geroldinger)