Preface

Model theory is a lively branch of mathematical logic which studies first-order structures and has always had close links with algebra. Traditionally, model theory studies the interplay between first-order properties of algebraic objects, such as groups and fields, and the abstract combinatorial behaviour of formulas (or definable sets) in first-order theories.

For a long time, the core of the subject has been stability theory, as introduced by Shelah in the seventies. A large number of people, mainly in the eighties, have contributed to the in-depth understanding of stability that we have today. Since then numerous techniques and tools inherent to stable theories have been developed in larger frameworks, such as simple and NIP theories, as well as in the applications of model theory to algebra and combinatorics. A particularly noteworthy example is Hrushovski's proof of the Mordell–Lang conjecture for function fields.

In recent years, two of the most important areas of model theoretic research have been NIP theories and valued fields. NIP theories are a common generalization of stable and o-minimal theories, and provide a suitable setting to understand the shared aspects of these. NIP groups have proven to be a particularly fruitful area. A prototypical example of an NIP theory is the theory of algebraically closed valued fields (ACVF), which roughly speaking is controlled by a stable and an o-minimal part. In addition to the study of ACVF, the model theory of valued fields has been an active area since the ground-breaking theorems of Ax–Kochen and Ershov. The interaction between henselian valued fields and NIP is a current theme in research linking pure and applied model theory.

The Model Theory Month in Münster (MMM) consisted of a spring school (four weeks of lectures) plus a one-week conference. The aim of this spring school was to provide training in different areas of model theory at graduate level, including not only the aforementioned traditional subjects but also introductions to motivic integration and additive combinatorics. Moreover, it gave current PhD students and postdocs working around model theory the opportunity to interact with each other and with local researchers. The final conference gave a platform for the participants of the MMM and other young researchers to present and discuss their work in a friendly environment. The entire programme was financed by the special emphasis area "Groups, Geometry & Actions" (SFB 878).

The topics treated in the spring school were split into two main themes, namely NIP theories with a special emphasis on groups, and valued fields. Furthermore, there was a course on approximate subgroups. All these

courses were too specialized to be part of a regular curriculum at the home universities of the participants. Two courses were taught in each week of the spring school. In the first week, there were two introductory courses: *Introduction to stability theory* taught by Daniel Palacín and *Introduction to valued fields* lectured by Franziska Jahnke. In the second week, Pierre Simon gave a course on *NIP and definably amenable groups* and Martin Hils taught *Model theory of valued fields*. In week three, Katrin Tent and Martin Bays taught courses on *Profinite and pseudofinite groups* and *Geometric stability theory*, respectively. Finally, to close the spring school, Emmanuel Breuillard gave a course on *Approximate subgroups* and Immanuel Halupczok lectured on *Motivic integration*. The lecture notes of all courses, apart from the one of Emmanuel Breuillard, are published in this volume. In fact, Breuillard based the lectures he gave during the MMM on notes he had previously published[1].

The idea to organize such a programme was suggested by Zoé Chatzidakis when she visited Münster, and both she and Katrin Tent immediately encouraged us to initiate this project. From this point on, we received immense support from Katrin Tent. We are deeply grateful to both of them. In fact, one of the reasons why we so readily agreed to take on this task was that we both attended and profited from a similar programme in Lyon 2011. We hope that the MMM participants have had a similarly productive and enjoyable time as we had back then. We thank all participants and speakers for making the MMM a successful event. None of this would have been possible without the financial support of the SFB 878 and the enormous help of Gabi Dierkes and Martina Pfeifer, who provided a multitude of advice and administrative support. We would also like to thank everybody from the Department of Mathematics and Computer Science of the Universität Münster who was involved at the various stages of the organization.

The MMM is a project that we personally enjoyed very much and we sincerely hope that future generations of students will profit from similar events and these lecture notes.

Franziska Jahnke and *Daniel Palacín*
Będlewo, Poland, July 2017

---

[1]E. Breuillard, A brief introduction to approximate groups, in: *Thin Groups and Superstrong Approximations*, Math. Sci. Res. Inst. Publ. 61, Cambridge University Press, Cambridge (2014), 23–50.

Hosting the Model Theory Month in Münster was a great pleasure for several reasons: it was particularly rewarding to see that the area is such an active part of mathematics with lots of young promising doctoral students and postdocs from all over the world. But it was also great seeing Franziska Jahnke and Daniel Palacín plan this event, to which I contributed only as a senior advisor (apart from being one of the lecturers). I was particularly happy and proud for Münster to be able to host such a program and recruit the lecturers for the courses almost entirely from among our group with the notable exception of P. Simon (Berkeley), including former and future members, like E. Breuillard (formerly Orsay), I. Halupczok (now Düsseldorf) and M. Hils (formerly Paris VII).

We are extremely grateful for the financial support of the SFB 878 without which the whole idea could not have been realized.

I hope that this spring school will have a lasting impact on the participants and through them on the future development of our field.

Katrin Tent
Münster, Germany, July 2017