Preface

This volume grew out of several courses given in the framework of the special programme on "Local representation theory and simple groups" held at the Centre Interfacultaire Bernoulli of the EPF Lausanne, Switzerland in the second half of 2016.

The programme focused on the representation theory of finite groups and algebraic groups, the interplay between these two and more specifically on the long-standing local–global conjectures for representations of finite groups.

The special programme started off in July with a three-week summer school with lectures by the experts Marc Cabanes, Olivier Dudas, Meinolf Geck, Burkhard Külshammer, Markus Linckelmann, and Britta Späth on various current topics in the representation theory of finite groups. A second summer school was held in September, with courses by Tim Burness, Martin Liebeck, and Eamonn O'Brien on modern aspects of permutation group theory, applications of character values and on computational group theory. These courses started off by assuming only a rather basic knowledge of group and representation theory, to lead the participants up to the most recent exciting developments in these areas.

This volume contains extended versions of seven out of the nine courses given during the programme. The content indicates the collaborative nature of the workshops: the different lectures were inter-related, each building on the work of others to make a coherent whole, which can be seen by the numerous cross-references within the volume. These will form a good basis for any graduate student or researcher interested in learning about the foundations, as well as in obtaining an overview of the newest developments in these fields.

We have made an attempt to order the contributions in a way that makes them most accessible to the reader.

The first part concerns the representation theory of finite groups. It starts out with a description of basic concepts and major open questions by Burkhard Külshammer. The article by Britta Späth introduces the techniques that led to the recent reduction of the major counting conjectures to questions about finite simple groups.

The next three chapters are devoted to the representation theory of finite reductive groups. Meinolf Geck's contribution describes the character theory of finite reductive groups as developed by George Lusztig. The article by Olivier Dudas focuses on the cohomology of Deligne–Lusztig varieties and the fundamental role played by these in representation theory. Finally, the contribution of Marc Cabanes gives an account of the fruitful interplay between Brauer's theory of p-blocks and the representation theory of finite reductive groups.

The third part focuses on applications of character theory to the study of finite simple groups. The chapter by Tim Burness describes the new far-reaching results on fixed point ratios for simple groups and their various applications, for example to base sizes for primitive permutation groups, while the contribution of Martin Liebeck studies applications of character theory of simple groups to random generation, to random walks, and to width questions.

We wish to express our thanks to the staff of the Bernoulli Center for all their hard work, which led to a successful and smoothly run programme. We also thank the participants of the programme, and in particular the workshop and conference speakers. Finally, our special thanks go to the contributors to this volume.

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