

PREFACE

These lecture notes arose from the program “*Braids*” which was held from 14 May to 13 July 2007 at the National University of Singapore’s Institute for Mathematical Sciences (IMS). The program’s highlights included an international conference on braids, from 25 to 29 June 2007, and a summer school for three weeks (4 to 22 June) leading up to the conference. In addition, there were numerous informal seminars and a public lecture by Robert Ghrist.

The main theme of the program was the mathematical structure of the braid group, together with applications arising from this structure both within mathematics, and outside mathematics such as magnetohydrodynamics, robotics, cryptography and molecular biology. These diverse aspects of braids were reflected in the wide range of talks at the conference. At the same time, we were also delighted to have the opportunity to celebrate the 80th birthday of one of the great pioneers of the subject, Joan Birman.

The purpose of the summer school (the first of PRIMA, the Pacific Rim Institutes of Mathematics Association) was to introduce graduate students and others not necessarily familiar with braids to the topic, as preparation for more technical material in the conference itself. More than 30 students from Canada, China, Germany, Japan, Korea, Malaysia, Mexico, UK, USA and Singapore attended the PRIMA summer school. We were very fortunate to have some gifted expositors to provide a relatively gentle introduction to the topic. Their lectures form the basis of this book. Their work was complemented by talks from a number of graduate students, among whom we should mention those of E-Jay Ng, who gave a review of the algebraic topology needed for later lectures.

Dale Rolfsen’s introduction set up notational conventions and showed how braids interweave geometry, topology and algebra, leading to group theory associated with the question of ordering the elements of the braid

group. From there, there were two strands to the theoretical discussion. Jie Wu introduced the simplicial approach to algebraic topology, and showed how fruitful it can be in studying the topology of braid groups. On the other hand, Fred Cohen focused on braids as paths in configuration spaces, an idea that is rich in applications. One source of such applications is robotics, which was explored by Robert Ghrist in a way that showed that questions arising from applications can lead to interesting theoretical research. Mitch Berger's lectures covered a lot of territory — literally, as they demonstrated remarkable braiding phenomena in astrophysics. In a completely different vein, David Garber explored to what extent difficult problems in the group theory of braids can be harnessed to create new techniques in cryptography.

These were generally agreed to be excellent courses, as we are sure will be apparent from a reading of the chapters within. We thank them most warmly for the effort that they have put into the preparation of the chapters, and the patience with which they have dealt with all our editorial queries.

As well as the summer school lecturers, we would like to thank Joan Birman and Toshitake Kohno for help with the program's organization, and their part in ensuring such a high quality of participation. The conference organizers also thank IMS and its staff for providing such an idyllic setting for mathematical discussions and collaborations. Funding support from IMS and its director, Louis Chen, and from NUS Research Grant R-146-000-097-112, was vital to the success of the program. The cooperation of the NUS Department of Mathematics and the Singapore Mathematical Society is also gratefully acknowledged.

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