0. Introduction to lectures 1–4

Please read this introduction before the start of the summer school.

It would also be very helpful if you would read through and familiarize yourself with the contents of section 1.1 (Lecture 1) before the start of the lectures.

0.1 General outline

These written notes which accompany the lectures are quite detailed and comprehensive. In the lectures, there will not be time to go over all the topics which are described in the notes. Rather, we will go slowly through the key ideas and the most important points. Later, after the summer school, you may wish to study the notes in greater detail and look at those parts we will not have time to go through.

The lectures will follow the notes closely and I recommend most strongly that during the lectures you do not take any notes, but listen and follow the presentation. The lecture notes provided here are so comprehensive that you will not really miss anything by not taking notes.

There will be exercise classes following the lectures, and I hope that by working through the problems you will deepen your understanding. Again, there may not be time to work through all the exercises.

0.2 Scheme of the lectures

Lecture 2 Product Operators will be given first. It sets out a straightforward theory which is well suited to analysing multiple-pulse NMR experiments, and which will be used in the other lectures. Although this theory has a sound base in quantum mechanics, it is quite easy to use as much of it can be interpreted geometrically.

Lecture 3 Basic concepts for two-dimensional NMR will be given next. In this lecture, the key ideas behind two-dimensional NMR will be introduced, and several important experiments will be analysed using the product operator approach introduced in lecture 1.

Lecture 1 Introduction to quantum mechanics introduces the theory which is used to describe NMR experiments and from which the product operator approach is developed. All of the basic ideas in quantum mechanics are introduced, but these are developed in relation to NMR rather than using the examples most commonly found in books about elementary quantum mechanics.

Finally, Lecture 4 Coherence selection: phase cycling and gradient pulses describes a very practical part of multiple-pulse NMR, which is how to select the signals we want and reject those we do not. Two methods – phase cycling and gradient pulses – are described in theory and many examples will be given of how to devise and analyse coherence selection schemes.

0.3 General matters

Lectures 1 and 2 have been prepared specially for this summer school. The first half of Lecture 3 is based in part of a third-year undergraduate course NMR Spectroscopy which I gave in Cambridge in association with Dr Melinda Duer; I thank her for invaluable advice and assistance . Lecture 4 was prepared for the EMBO sponsored course held in Turin, Italy, in 1995. The section on phase cycling was based in part on a lecture given at a NATO ASI Workshop in Italy in 1990. The section on field gradient pulses is based on an article published in Methods in Enzymology volume 239C (1994) which I co-authored with Robin Clowes, Adrian Davis and Ernest Laue. I thank the organisers of this and other meetings for the opportunity to prepare and present this material.

You are welcome to make copies of these lecture notes for your own use, and to supply copies to colleagues, provided that due acknowledgement of their origin is given. If you wish to make large numbers of copies, I would appreciate being consulted first.

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