A First Course in Loop Quantum Gravity

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Book review

A First Course in Loop Quantum Gravity
Rodolfo Gambini and Jorge Pullin
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Students who are interested in quantum gravity usually face the difficulty of working through a large amount of prerequisite material before being able to deal with actual quantum gravity. *A First Course in Loop Quantum Gravity* by Rodolfo Gambini and Jorge Pullin, aimed at undergraduate students, marvellously succeeds in starting from the basics of special relativity and covering basic topics in Hamiltonian dynamics, Yang Mills theory, general relativity and quantum field theory, ending with a tour on current (loop) quantum gravity research. This is all done in a short 173 pages!

As such the authors cannot cover any of the subjects in depth and indeed this book should be seen more as a motivation and orientation guide so that students can go on to follow the hints for further reading. Also, as there are many subjects to cover beforehand, slightly more than half of the book is concerned with more general subjects (special and general relativity, Hamiltonian dynamics, constrained systems, quantization) before the starting point for loop quantum gravity, the Ashtekar variables, are introduced.

The approach taken by the authors is heuristic and uses simplifying examples in many places. However they take care in motivating all the main steps and succeed in presenting the material pedagogically. Problem sets are provided throughout and references for further reading are given. Despite the shortness of space, alternative viewpoints are mentioned and the reader is also referred to experimental results and bounds.

In the second half of the book the reader gets a ride through loop quantum gravity; the material covers geometric operators and their spectra, the Hamiltonian constraints, loop quantum cosmology and, more broadly, black hole thermodynamics. A glimpse of recent developments and open problems is given, for instance a discussion on experimental predictions, where the authors carefully point out the very preliminary nature of the results. The authors close with an 'open issues and controversies' section, addressing some of the criticism of loop quantum gravity and pointing to weak points of the theory. Again, readers aiming at starting research in loop quantum gravity should take this as a guide and motivation for further study, as many technicalities are naturally left out.

In summary this book fully reaches the aim set by the authors – to introduce the topic in a way that is widely accessible to undergraduates – and as such is highly recommended.

Bianca Dittrich
Perimeter Institute for Theoretical Physics,
Ontario, Canada

