Preface

If you have good eyes, the smallest objects you can make out are about a tenth of a millimeter, roughly the width of a human hair. Add technology, and the smallest structures we have measured so far are approximately 10^{-19} m, that is, the wavelength of the protons collided at the LHC. It has taken us about 400 years from the invention of the microscope to the construction of the LHC—400 years to cross 15 orders of magnitude.

Quantum effects of gravity are estimated to become relevant on distance scales of approximately 10^{-35} m, known as the Planck length. That is another 16 orders of magnitude to go. It makes you wonder whether it is possible at all or whether all the effort to find a quantum theory of gravity is just idle speculation.

I am optimistic. The history of science is full with people who thought things to be impossible that have meanwhile been done: measuring the light deflection on the sun, heavier-than-airflying machines, detecting gravitational waves. Hence, I don't think it is impossible to experimentally test quantum gravity. Maybe it will take some decades, or maybe it will take some centuries—but if only we keep pushing, one day we will measure quantum gravitational effects. Not by directly crossing these 15 orders of magnitude, I believe, but instead by indirect detections at lower energies.

From nothing comes nothing though. If we do not think about how quantum gravitational effects can look like and where they might show up, we will certainly never find them. But fueling my optimism is the steadily increasing interest in the phenomenology of quantum gravity, the research area dedicated to studying how to best find evidence for quantum gravitational effects.

Since there is not any one agreed-upon theory for quantum gravity, existing efforts to find observable phenomena focus on finding ways to test general features of the theory, properties that have been found in several different approaches to quantum gravity. Quantum fluctuations of space-time, for example, or the presence of a "minimal length" would impose a fundamental resolution limit. Such effects can be quantified in mathematical models, which can then be used to estimate the strength of the effects and thus to find out which experiments are most promising.

This volume collects some recent developments in the field of phenomenological quantum gravity that were subject of the recent conference on "Experimental Search for Quantum Gravity." This meeting took place at the Frankfurt Institute of Advanced Studies (FIAS) in September 2016 as part of the first Giersch Symposion.

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June 2017

http://www.springer.com/978-3-319-64536-0

Experimental Search for Quantum Gravity
Hossenfelder, S. (Ed.)
2018, VIII, 120 p. 24 illus., 19 illus. in color., Hardcover
ISBN: 978-3-319-64536-0