

Master of Science  
in Mathematical and Theoretical Physics

String Theory I Mini-Project

**Topic: Light-cone quantization in string theory**

Write a report on the light-cone quantization of the bosonic string. Your report must include an explanation of gauge fixing, a description of the quantized spectrum for both closed and open strings, and a derivation of criticality, i.e., why  $a = 1, D = 26$  is needed. Give also a qualitative assessment of the similarities and differences between light-cone and old covariant quantization. Additionally, discuss at least one further aspect for which you can establish a reasonable connection to light-cone quantization. For example, you can try to include a discussion of the normal ordering constant as the worldsheet Casimir energy, and its connection to the sum over all integers.

Light-cone quantization is covered in many textbooks, e.g.,

- M. Green, J. Schwarz, and E. Witten, “Superstring Theory Vol 1”, Section 2.3. This reference is a good starting point and contains material you can try to cover;
- B. Zwiebach, “A First Course in String Theory”, Sections 12 and 13;
- R. Blumenhagen, D. Lüst and, S. Theisen, “Basic Concepts in String Theory”, Sections 3.2 and 3.3.

For your report, you may assume and make use of results and techniques in quantum field theory, general relativity, group theory etc., that are covered in Master’s level courses, such as those of the MTP program. You should make reasonable choices, as consistently as possible, about the level of details of lengthy computations whose results are relevant. The report should be 10–15 pages, using an 11 point font, and the pages should have one-inch margins. In your report, indicate explicitly which ideas come from existing sources, and, if appropriate, which are original. You should also make appropriate attribution for all of your sources. Your report need not contain original research done by yourself.