

Master of Science
in Mathematical and Theoretical Physics

String Theory I Mini-project

Topic: Light-cone quantisation of the bosonic string

Write a report on the light cone quantisation the bosonic string. Explain how space-time Lorentz invariance requires the normal ordering constant to take the value $a = 1$ and why the space time dimension is $D = 26$. You should then try to focus on an aspect of the light cone quantisation where you can show a detailed calculation and understanding of the aspect you are discussing. An example would be to compute the low level spectrum at least to level 2. Your report must include a comparison with the old covariant quantisation covered in the lectures where you should also choose a concrete aspect to discuss and elaborate on.

These topics are described in many textbooks and original research papers cited therein. Good examples are:

- Green, Schwarz and Witten, *Superstring theory Vol 1*.
- J Polchinski, *String theory Vol 1*.
- Blumenhagen, Lüst and Theisen, *Basic concepts in string theory*.

Original references are, for example:

- Goddard, Goldstone, Rebbi and Thorn, “Quantum dynamics of a mass- less relativistic string”, Nucl Phys B56, 109 (1973).
- Del Giudice, Di Vecchia and Fubini, “General properties of the dual resonance model”, Ann. Phys. 70, 378, (1972).

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. The report should be 10–13 pages (excluding a cover page and the references) using an 11 point font, and the pages should have one-inch margins. Include a cover page with the title and a short abstract of your work. If you wish you can include in this page a table of contents. 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. The report should not be merely a repetition of the lectures or follow a single textbook’s treatment. You should try to consult several sources and, ideally, original references or research literature. Your report need not contain original research done by yourself.