Research Networking Programmes

Short Visit Grant ☒ or Exchange Visit Grant ☐

(please tick the relevant box)

Scientific Report

The scientific report (WORD or PDF file – maximum of eight A4 pages) should be submitted online <u>within one month of the event</u>. It will be published on the ESF website.

<u>Proposal Title</u>: Visit to Helsinki University

<u>Application Reference N°</u>: 7273

1) Purpose of the visit

The purpose of the visit was to carry out a work in collaboration with Niko Jokela. The initial idea was to study some particular holographic model in the AdS/CFT correspondence, the ABJM theory with unquenched massive flavor in an external magnetic field.

Besides, the visitant gave a talk in the physics department with title: ¨Flavored ABJM in an external magnetic field¨

2) Description of the work carried out during the visit

Starting from the ABJM model with unquenched flavor of http://arxiv.org/pdf/1309.4453.pdf, we have studied the embedding of a magnetic flavor probe brane, that is, a brane with a gauge field on its worldvolume turned on. We turn on the precise component which in the field theory correspond to an external magnetic field affecting the fundamental matter. We study numerically the fermionic condensate , and in particular the case of zero bare mass. In this last case a spontaneously symmetry breaking of parity symmetry takes place, and this phenomenom is know as magnetic catalysis.

In a second step, we obtain the linear fluctuations of the embedding, and study the normalizable modes, that holographically

correspond to the meson spectrum. We focus on see the effect of the magnetic field on the spectrum.

Besides, motivated by some works in the literature in which the backreaction of the external magnetic field is considered, we studied the non-commutative version of ABJM (It turns out that this non commutative version should correspond to some region of the fully backreacted solution). We add temperature and try to understand how to compute the meson spectrum.

Furthermore, some new ideas came out. For example, we understood how to consistently introduce a flavor massless probe brane in ABJM with internal flux and density. We studied the linear perturbations.

3) Description of the main results obtained

The main results obtaided were: In the case of ABJM under an external magnetic field, we obtained the decoupled equations for the meson spectrum, and solve analytically the exact corrections to the ground states when the magnetic field is small. We have explicitly checked that the EOMs are consistent. Regarding to the case of non-commutative ABJM, we have checked the second order equations of motion when a blackening factor is turned on, and this precisely correspond to a non-commutative background with temperature turned on. We also obtain the embedding of a probe brane, and check that the EOMs are exactly the same as the commutative case. Nevertheless, the linear fluctuations of this embedding are affected by the non-commutativity, and so the meson spectrum is affected. Regarding to the case of the massless flavor probe brane with internal flux in ABJM, we obtain the decoupled equations for the fluctuations at zero momentum, and this will allow us to study the meson spectrum. Besides, we obtained the EOMs for small omega and momentum, and this will allow us to study the zero sound.

4) Future collaboration with host institution (if applicable)

We have opened several directions in future works. For example, we have the idea of generalize the study of the effect of the external magnetic field on the fundamental matter in the ABJM model, doing the full backreaction, including the backreaction of the magnetic field.

5) **Projected publications / articles resulting or to result from the grant *(ESF must be acknowledged in publications resulting from the grantee's work in relation with the grant)***

We expect to publish an article of the ABJM model under the effet of an external magnetic field in a period of one or two months. Finishing the main points of this work was the purpose of the visit.

Besides, due to the new ideas that appeared during the stay, we will probably obtain new publications in the near future, for example for the case of the massless flavor probe brane with internal flux in ABJM.

6) Other comments (if any)