Short term visit grant : report

1 Purpose of the visit

The purpose of the visit was to collaborate with Prof. Dan Waldram. The research project aims at studying marginal deformations of four dimensional supersymmetric gauge theories in the context of the AdS/CFT correspondence. The idea is to apply the formalism of Extended Generalised Geometry to the analysis of the supergravity backgrounds dual to superconfornal gauge theories.

2 Description of the work carried out during the visit

In the formalism of Exceptional Generalised Geometry the conditions for supersymmetry can be recast as conditions on the moment map associated with the symmetries of the generalised tangent space. We had already worked out the moment map conditions for the case of $AdS_5 \times SE_5$ backgrounds (AdS_5 stands for five-dimensiional Anti de Sitter space while SE_5 denotes a five-dimensional Sasaki-Enstein space), which are dual to superconformal gauge theories in four-dimensions. During this visit we studied how such conditions are modified when considering marginal deformations of the gauge theory. The problem was to identify such deformations on the gravity side and to study what conditions the requirement of supersymmetry imposes on them.

3 Description of the main results obtained

The main result of this visit is the identifications of the elements $E_{6(6)}$ structure group corresponding to the marginal deformations on the gauge theory side and the derivation of the deformed moment maps. By imposing that the moment map conditions should be invariant under marginal deformations, we should be able to reproduce the constrained that supersymmetry sets on the allowed marginal deformations.

4 Future collaboration with host institution

The results obtained during this visit are only a fraction of a long term project which also involves other collaborators in Paris, M. Gabella and M. Grana, as well as two PhD students in London and Paris. A first step is to apply this general formalism to the construction of all marginal deformations of $\mathcal{N} = 4$ Super Yang Mills. The theory has a 3-dimensional complex manifold of marginal deformations. One line corresponds to the shifts in the coupling constant and the dual supergravity solution is simply $AdS_5 \times S^5$ with constant, dilaton and axion. The other two directions have $\mathcal{N} = 1$ supersymmetry. One is known as beta-deformation, and the dual supergravity background was found by Lunin and Maldacena using T-duality and non-commutative geometry. It is expected that

also the second deformation should be described by some supergravity dual, even though an explicit solution is not known. The hope is that exploiting the new techniques of GCG will help in understanding the geometry of such solution.

Then the same analysis can be extended to other specific Sasaki-Enstein manifolds dual to $\mathcal{N} = 1$ superconformal field theories. On an even longer term, we aim at using this formalism to study toric manifolds with fluxes.

5 Projected publications/articles resulting or to result from your grant

There will be two papers that should appear in fall : one about the general classification of marginal deformations and one about the construction of the explicit supergravity solution dual to the cubic deformation of $\mathcal{N} = 4$ Super Yang Mills.