Institut de physique théorique

Unité de recherche du CEA, associée au CNRS

Cours de physique théorique

agréé par l'École doctorale de physique de la région parisienne - ED 107

Non-perturbative aspects of supersymmetric gauge theories

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Les vendredis 7, 14, 21, 28 mars et 4 avril 2014 à 10h

We will start with a brief introduction to supersymmetry (SUSY). This will include the N=1 (conformal) SUSY algebra, its representations, R-symmetry, superspace, and superfields. This will allow us to build basic supersymmetric Lagrangians, starting with the free Wess-Zumino model and ending with supersymmetric Yang-Mills (SYM) theory. We will see how supersymmetric vacua in these models are characterized by the so-called F- and D-term equations. Basic aspects of the minimal SUSY standard model (MSSM) and SUSY breaking will be then very shortly mentioned.

Then we will introduce a few necessary aspects of non-perturbatiive QFT: instantons, monopoles and gauge anomalies. In particular, we will focus on 't Hooft anomaly matching, which provides an efficient way of studying strongly coupled gauge theories. Another tool we will use is holomorphy, a particular SUSY version of the background field method. Using these tools, we will derive our first non-perturbative result, the Affleck-Dine-Seiberg superpotential.

We will then consider the Novikov-Shifman-Vainshtein-Zakharov (NSVZ) beta-function, which plays a crucial role in understanding the quantum phase diagram of supersymmetric QCD. This very rich diagram depends (among other things) on the numbers of flavours (F) and colours (N). According to Seiberg, certain theories with different gauge groups are related by an electric-magnetic duality. We will see how this duality works for SQCD with various F and N. If time permits we will also consider more complicated strongly couple gauge theories, in particular "cascading" ones.

Finally we will focus on extended supersymmetry and Seiberg-Witten theory. Amazingly, supersymmetry constraints allow to determine the metric of the moduli space of vacua of this N=2 SUSY gauge theory.

Lieu: *IPhT, CEA Saclay, Orme des Merisiers, Bât. 774, porte 1A Salle C. Itzykson*
Accès: *Navettes CEA du RER B Le Guichet vers CEA Ormes, toutes les 15 minutes de 8h à 9h45 ou bus publics Mobicaps 9 et 10, Albatrans 91.06 et 91.10*
Renseignements: `http://ipht.cea.fr` *ou* `ipht-lectures@cea.fr`

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