DSM - DAPNIA
DIRECTION DES SCIENCES DE LA MATIÈRE
SPP
Service de Physique des Particules

SÉMINAIRE

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Ultra-Cold Neutrons and Searches for an Electric Dipole Moment

Due to their outstanding property to be storable and hence observable for long periods of time (several hundreds of seconds) in suitable material or magnetic traps, ultra-cold neutrons (UCN) with energies around 100 neV are an unique tool to study fundamental properties of the free neutron.

A brief introduction to the Institute Laue-Langevin (ILL) in Grenoble, which is a world leader in academic research with neutrons will be given. The scope of fundamental physics studies with neutrons is outlined. The main instruments provided for such studies are described and some past and current flagship experiments with ultra-cold neutrons (UCN) in this field (lifetime and quantum states) are highlighted. The properties and the production of UCN are described in detail.

For particles to have electric dipole moments, the forces concerned in their structure must be asymmetric with regard to space-parity (P) and time reversal (T). P violation is a well-known intrinsic feature of the weak interaction which is responsible for the beta-decay of the free neutron. T violation turns out to be necessary to explain the survival of matter at the expense of antimatter after the Big Bang. By searching for an EDM of the free neutron hypothetical new channels of T-violation can be investigated.

In this talk two EDM projects will be presented in detail, an experiment at room temperature that has recently been completed and a cryogenic experiment that is currently being constructed. The experiments are based on a precision measurement of the Larmor precession frequency of polarised ultracold neutrons stored in a cell in a magnetic field. An EDM would reveal itself by a response of the Larmor precession frequency of the neutron to an electric field applied over the storage volume.

The room temperature experiment has been carefully analysed. An upper limit on the absolute value of the neutron EDM of $|d_n| < 3.0 \times 10^{-26}$ e·cm (90% CL) has been found.

The two experiments at the ILL will be compared to competing EDM projects worldwide.

Salle André Berthelot, bât. 141

Le café sera servi 15 minutes avant

NB : La présentation d'une carte d'identité ou d'un passeport est exigée à l'entrée du centre. Tous les auditeurs extérieurs sont priés de prévenir à l'avance de leur visite Émilie Chancrin, tél. 01 69 08 23 50 (U.E. : délai de 24h, hors U.E. : délai de 4 jours).