Secteur des Sciences et Technologies

Invitation à la soutenance publique de thèse de

Monsieur Alexander GALSTYAN

Specialist in Physics

Pour l'obtention du grade de Docteur en sciences

« Mathematical modelling of laser matter interaction within the single active electron approximation»

qui se déroulera

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Auditoire SUD 17

Place Croix du Sud

1348 Louvain-la-Neuve

Membres du jury :

Prof. Bernard Piraux (UCL), supervisor
Prof. Yuri Popov (Lomonosov Moscow State University, Russia), supervisor
Prof. Bernard Nysten (UCL), chairperson
Prof. Clément Lauzin (UCL), secretary
Prof. Patrick O'Mahony (Royal Holloway, UK)
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Due to the difficulties in treating the electron-electron correlations and the interaction of these electrons with the Coulomb and the laser fields, the theoretical description of the interaction of multi-electron atoms and molecules with a strong laser field is currently limited to simple models. The most popular modelling framework in this field is the strong field approximation (SFA). The main assumption behind it is that the electron does not feel the laser field while it is bound, and does not feel the Coulomb field after it has been ejected. However, SFA has several drawbacks: SFA wave packets are not gauge invariant, SFA perturbation series are not always convergent, and we can extract only a very limited amount of quantitative information from the wave packet since it cannot be normalised. In this thesis, we consider a few models, based on the philosophy of the SFA, but improving it in several aspects. The reformulated SFA resolves the gauge and normalisation problems and allows one to study the full wave packet of the quantum system. Perturbation series based on a Faddeev-like formalism coincide with the reformulated SFA in the first order, but converge much better for a range of field frequencies. Finally, the separate potentials for atoms and molecules (SPAM) model allows one to study, in a systematic way, the contribution of the different single active electron states to the overall dynamics of the system. For the sake of illustration, we have applied the SPAM model to the treatment of the interaction of atomic and molecular hydrogen, the hydrogen anion, and the water molecule with an ultrashort intense electromagnetic pulse.