EURYI Awards 2004

Press Information

Dr. Andrius BALTUŠKA

– Physics –

Project:

Towards nonlinear time-resolved spectroscopy with attosecond X-ray pulses

The project aims at extending the techniques of time-resolved spectroscopy into the XUV and X-ray frequency range and providing the maximum enhancement of the temporal resolution for studying core excitation dynamics of atoms and small molecules. We would like to build sources of attosecond X-ray pulses tunable in the range of 50 eV—2 keV with the corresponding pulse durations of 200—30 as. We further suggest establishing a novel type of spectroscopy, X-ray-pump—X-ray-probe that would allow us to fully exploit the attosecond time resolution. The potential practical use of the proposed technique and its impact on both experimental and theoretical ultrafast science cannot be overestimated. Whereas the invention of femtosecond lasers has allowed time-domain measurement of nuclear motion in molecules (the science of Femtochemistry), the significantly shorter attosecond timescales of interatomic dynamics until recently have stood in the way of a direct temporal measurement of the relaxation processes in atoms. To realize the ambitious plans for efficient generation of isolated intense attosecond pulses, we would like to build a cost-effective multi-terawatt laser system for X-ray photon generation, using a novel concept of chirped pulse optical parametric amplification. In addition, we plan to implement an unprecedented degree of control over the parameters of the driving quasi-monocycle optical pulses, by maintaining their field exactly reproducible in every laser shot for arbitrarily long durations of the measurement. Upon setting up the described attosecond instrumentation, for the remaining duration of the project these pulses will be applied to time-resolve previously experimentally inaccessible ultrafast relaxation, and ionization in multi-electron systems such as noble atomic and simple molecular gasses, in which these processes are predicted on the timescales ranging from below 1 femtosecond to several femtoseconds. We believe that this research is in a unique position to draw multidisciplinary attention, as it unites the ideas from many areas of contemporary science, such as ultrafast laser optics, high-field physics, atomic physics, chemistry, frequency metrology, and conventional laser spectroscopy

Comments:

Achieving attosecond time resolution is at the forefront of spectroscopy. It will allow us to look at electron dynamics in atoms and molecules in real-time. The proposal contains the scientific and technical details showing that this is the leading effort world-wide in the field.

The candidate has already demonstrated excellent capacities in both, instrument building and related physics. Good outlook on perspectives.

The technical development will have impact on groups working in the field. The ideas put forward have ground-breaking character. The technical aims of the project are feasible and it is very likely that the ambitious science goals can be achieved.

The host institution is a place where he can lead his group optimally, as it is one of the very few in the world with the required (expensive) equipment and facility.

Nationality: Lithuanian
Address: Institut für Photonik, Technische Universität Wien,
Gußhaussraße 387/27, A-1040 Vienna, Austria

Current institution: Institut für Photonik,Technische Universität Wien
New institution: MAX-Planck Institute für Quantenoptik

Media Enquiries:

Jens Degett, ESF Communications Director
European Science Foundation, Strasbourg, France
Tel: +33 (0)3 88 76 71 32 – Fax: +33 (0)3 88 37 05 32 Email: jdegett@esf.org