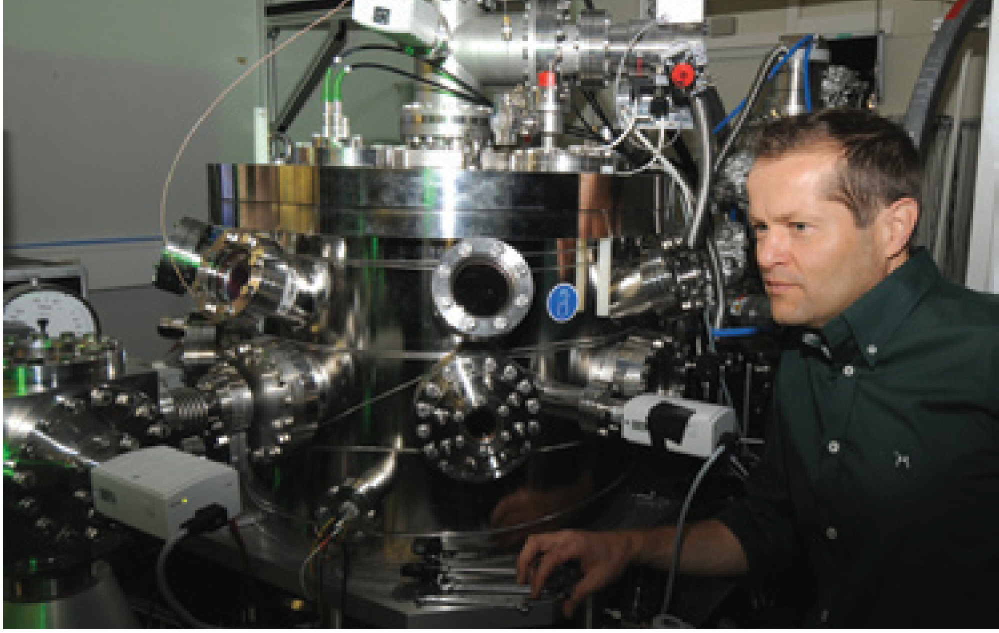

Thorsten Naeser, Max-Planck Institute of Quantum Optics

OPN Talks with …

Ferenc Krausz

Attosecond Aficionado and FiO Plenary Speaker

"The second decade of attosecond science has begun," says Ferenc Krausz, a professor at the Max-Planck Institute of Quantum Optics (MPQ) and the Ludwig-Maximilian's University (LMU) in Germany. Krausz, whose research team generated the world's first attosecond light pulse and founded the field of attosecond physics, will discuss this relatively new area of study in his plenary session keynote address at OSA's Annual Meeting, Frontiers in Optics, 16-20 Oct. in San Jose, Calif., U.S.A.

He will cover the major milestones of the first decade of attosecond science and discuss the future of the field, addressing first steps toward the synthesis of ultra-broadband infrared-visible-ultraviolet light transients, along with their first applications to sub-femtosecond electron control. Here, Krausz reflects on his career and why he loves this area of research. To delve deeper into the world of attosecond physics, visit the MPQ/LMU website: www.attoworld.de.

This year is the 10-year anniversary of attosecond physics. How has the field changed since 2001, and where will it go next?

The first 10 years were mainly devoted to developing the technology for triggering, controlling and measuring events on the attosecond time scale. Other research efforts focused on proof-of-principle experiments with novel attosecond tools to demonstrate the feasibility of attosecond spectroscopy. Early investigations served mainly to validate the novel techniques and demonstrate their power, rather than to explore new physics.

The next 10 years will bring a paradigm shift. The tools and techniques are now mature enough to tackle studies of ever more complex systems, such as molecules (from diatomics to biological ones), mesoscopic particles (e.g., clusters), and condensed-matter systems (e.g., semiconductor nanostructures, molecular assemblies on surfaces).

You and your collaborators recently observed valence electron motion. What impact do you expect this to have?

Our investigations, performed in an international collaboration with researchers from Berkeley, Argonne and Riad, have demonstrated the feasibility of tracking the dynamics of valence electrons with attosecond probe pulses. This new capability is likely to affect research into all kinds of molecular processes, given that all of them are triggered, mediated and/or accompanied by the motion of valence electrons in molecular orbitals.

Throughout your career, you've conducted research on diverse topics, including light-matter interactions, laser pulse generation and attosecond physics. Do you have a favorite area?

I have to be cautious because—thanks to the substantial resources provided by MPQ, LMU and German and European funding agencies—I have the privilege of leading a large group and pursuing with them a number of exciting projects simultaneously. Some of my coworkers might therefore feel upset if I do not give a politically correct answer. So the answer is: NO!

Joking aside, I feel equally excited about pushing the frontiers of laser technology and using novel laser or laser-based tools and techniques for exploring and controlling hyperfast phenomena of the microcosm.

Electrons, their motion at the microscopic scale, and their interaction with light affect and control pretty much everything relevant to our life, from converting sunlight into life on Earth to enabling critical chemical and biological pathways to the processing and transmitting of information in our brains and nerves, just as in modern electronics and telecommunications.

Ultrashort pulses also allow us to subject matter to extreme forces that are not achievable in a small laboratory by any other means. The study of the response of matter to these extreme forces has perhaps less direct consequences to our everyday life than exploring electron motion, but it is certainly the most intriguing from a fundamental point of view.

Last but not least, back to technology: I still feel the happiness of a child when I see a technological development start to work. I will never forget the moment, when—together with Andreas Stingl and Christian Spielmann—I saw femtosecond pulses lighting up for the first time from a Ti:sapphire laser operated with chirped mirrors. Today, several hundred of such sources are serving as workhorses for researchers around the world.

What has been the most challenging moment of your career?

There is not one single moment that stands out, but the challenge that I have been most frequently confronted with is resisting the temptation to explore new areas when technological advances lead to unexpected opportunities. Since many of them would distract us, it is ultimately better to focus on the original, longer-term goal.

One prominent example was the first demonstration of isolated attosecond pulses in 2001. We had—most probably—already generated them back in 1997, shortly after intense few-cycle laser pulses became available in our Vienna laboratory. However, we could not provide compelling evidence for their existence in the absence of an attosecond temporal characterization technique. It took us four years to develop such a technique.

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Had we succumbed to our temptation to explore all the aspects of the novel intense few-cycle pulses, it might have taken significantly longer.

Where do you see your research going in the next five years?

We will pursue two major directions: First, we will use our existing attosecond tools for research into non-trivial electron dynamics in atoms, molecules and condensed-matter systems. Second, we seek to further advance the technology by improving the sources and extending the repertoire of attosecond spectroscopic and control techniques.

What one piece of advice do you give to your students?

Set ambitious goals and pursue them with great persistence and single-mindedness. This is particularly important in science and academic research, which offer an unparalleled number of possibilities for distraction. Only those who can focus their attention, dedication and energy on well-defined goals have the chance to achieve breakthrough discoveries.

Angela Stark is OSA’s director of communications (astark@osa.org).

ONLINE EXTRA: Visit www.osa-opn.org for a profile of Jorge Rocca, Schawlow Prize recipient.
