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Acceptance speech

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Anne L'Huillier, awardee in the Basic Sciences category (15th edition)

Paul Corkum, Ferenc Krausz, and I are deeply honored to accept the BBVA Foundation award for Basic Sciences. This prize rewards not only us but also many scientists who have pushed our field forward, step by step, for more than 30 years.

The motivation from the committee is "for enabling subatomic particles to be observed in motion over the shortest time scale captured by science." That time scale is attoseconds. Atto comes from the Danish language, atten, which means eighteen. One attosecond is 10 to the power -18 seconds, or one billionth of a billionth of a second. Let me simply say that it is an incredibly short time!

This field of research started about 35 years ago when physicists studied the light emitted by a gas of atoms exposed to an intense laser field, an experiment in which I had the privilege to participate. The emitted light was found to be composed of a series of high-order harmonics of the laser field, similar to a violin, whose sound is never a pure note but is accompanied by harmonics that contribute to the richness of the sound. These harmonics are almost synchronous and add together for a very short time, of the order of 100 attoseconds. The physical reason for this short duration was explained a few years later, with a clever intuitive model proposed by Paul Corkum. Just at the turn of the millennium, individual attosecond pulses were experimentally studied and characterized in the group of Ferenc Krausz.

What can we observe with these ultrashort light pulses? The smaller the particles the faster the motion. Femtosecond pulses allow us to study the motion of atoms in molecules. Attosecond pulses allow us to follow the movement of electrons in atoms. The idea is to use attosecond light pulses like an ultra-short flash from a camera, making it possible to capture fast phenomena. However, as we know from quantum mechanics, an electron is both a particle and a wave. In our research, an electron behaves much more like a wave than a particle. Attosecond physics is about measuring the properties of this wave-like particle. This research is pursued today in many places around the world, with applications in many different areas, from atomic physics to chemistry and condensed matter physics!

Journalists often ask me: What is your research good for? Will attosecond science be useful to society? My honest answer is: I don't know, but I believe so. Can attosecond pulses help us understand and possibly control chemical processes useful for the green transformation that we so badly need? Possibly, I hope so. Can attosecond pulses help build tomorrow's computers that will be based on very small components? I think that this will happen, it has started.

Research in attosecond science has been and is still driven by curiosity, the wish to learn new things and push forward the frontiers of knowledge. Lasers were not invented to solve a problem. In fact, Theodore Maiman, who built the first laser, called it "a solution seeking a problem." No need to describe here the huge impact that lasers have in our society, for example in medicine or for communication. Attosecond pulses were not invented or developed to solve a specific problem, they were discovered out of curiosity. The future will tell us what impact on society they will have.

My last remark is to the women listening to this speech. Standing here as a woman and accepting this wonderful award, I hope to contribute to inspiring other women to pursue their dream to do research in science. Research is truly fascinating!