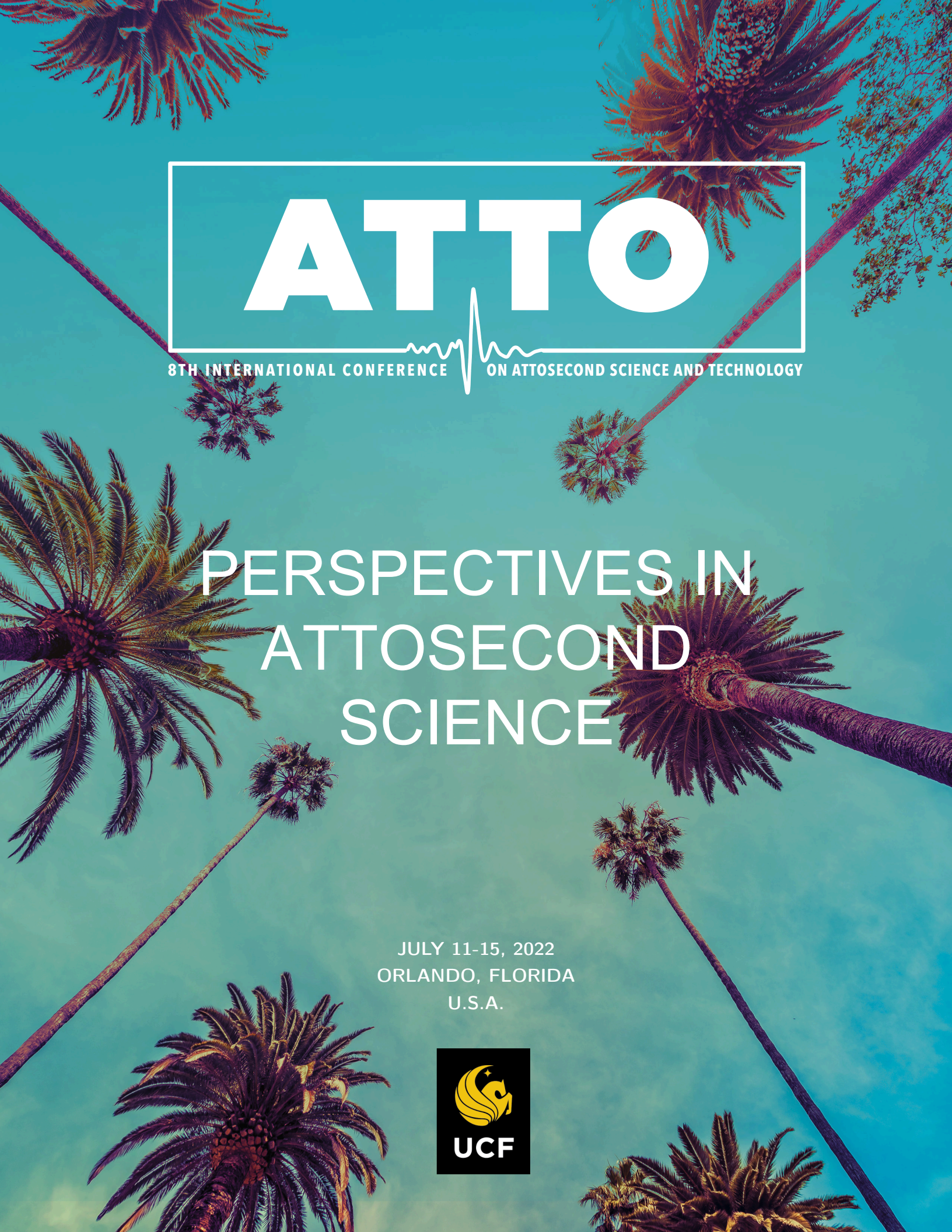
ATTO
8TH INTERNATIONAL CONFERENCE ON ATTOSECOND SCIENCE AND TECHNOLOGY
PERSPECTIVES IN ATTOSECOND SCIENCE
JULY 11-15, 2022
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Perspectives in Attosecond Science

Compiled and edited by:
Shima Gholam-Mirzaei
National Research Council of Canada and University of Ottawa
Luca Argenti
University of Central Florida
Michael Chini
University of Central Florida

ATTO VIII
July 11-15, 2022
Orlando, FL USA

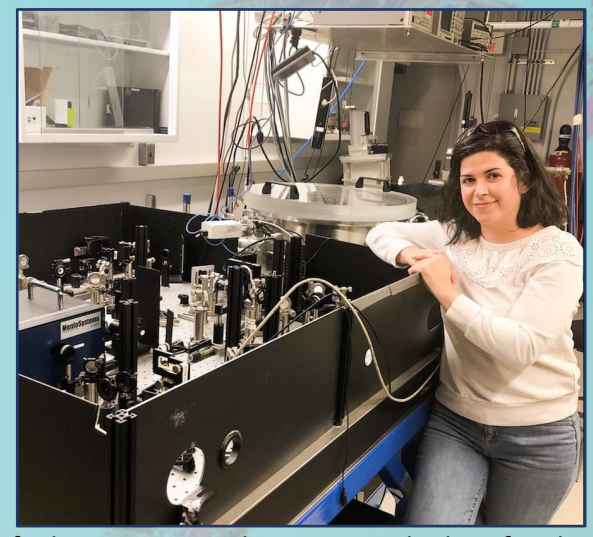
Shima Gholam Mirzaeimoghadar

National Research Council and University of Ottawa, Canada

Introduction

I am a postdoctoral fellow at the Joint Attosecond Science Laboratory of National Research Council of Canada and University of Ottawa. I was born and raised in Iran, where I obtained my master's degree in theoretical physics from Tehran Polytechnic. After two years in industry, I decided to pursue a Physics PhD at the University of Central Florida (UCF). I became interested in ultrafast laser science and joined Prof. Chini's Laboratory for Ultrafast Metrology and Attoscience in Solids (LUMAS). Now, I work to extend high-harmonic spectroscopy to solids, to study their excitation dynamics and symmetry properties, and to develop novel techniques to compress and characterize few-cycle near- to mid-infrared pulses.

Being part of a diverse and inclusive international community with distinct scientific perspectives has broadened my horizon. The mentorship and support I received has been essential to my personal and professional growth, and it has opened for me doors in prestigious laboratories, such as UCF's institute for the Frontier of Attosecond Science and Technology (iFAST). Presenting my research at several international conferences allowed me to enter exciting research projects, with the Pulse Institute at Stanford, Los Alamos National Laboratory, and Kansas State University. As an International female student in physics, I was motivated to lead Physics Women Society (PWS) and the Graduate Society of Physics Students (GSPS) at UCF. In this role, I promoted a gender-balanced atmosphere and provided guidance, mentoring, and counseling for female students. I hosted scientific and networking events, leading students in the STEM Summer Institute, and developing an educational program to foster students, funded by American Physical Society. These experiences have kindled in me a new passion for science and have been invaluable to



find my career path. As outreach chair for the International OSA Network of Students (IONS 2019) in Florida, I became involved in the student chapter for Optica, and organized laboratories tour and orientation workshops for graduate and undergraduate students.

Conferences are incredible opportunities to strengthen the inclusive outlook of our scientific community. This year, the participation to ATTO of female scientists, postdocs, and graduate students is remarkable, with more than 40% of female invited speakers. The Local Organizing Committee seized this opportunity to promote an atmosphere that welcomes all. An entirely female evening panel, with experience across the attosecond science spectrum, will explore the Future of Attosecond Science.

In this book we collect interviews of female attoscientists at various stages of their careers, in which they share their professional and personal experiences. Respondents were free to choose which and how many questions to answer. The book will be accessible on the conference website. I am thankful to all the scientists who agreed to contribute to this project, and to Michael Chini and Luca Argenti who willingly took this initiative, helped me refine the interview questions, and arranged for the printing and publication of this document. I would also like to give special thanks to Giulio Vampa and Andre Staudte for valuable discussion and helpful resources.

Prof. Agapi Emmanouilidou

University College London, UK

Tell us about yourself and your journey to attosecond science.

I was an undergraduate student in Physics at the University of Patras Greece and graduated first. I got a fellowship from the University of Texas at Austin in the US where I obtained my Ph.D in Physics. My work was on the mathematical side of weak, and strong interaction of laser fields with matter. During my postdoc years in Germany, I studied the interaction of a single photon with lithium and invented a collision scheme to identify a sequence of collisions underlying the escape of three electrons close to the ionization threshold. I then returned to the US and held positions and fellowships as an independent researcher where I developed and extended significantly state-of-the-art semi-classical techniques to study the multi-electron escape in strongly-driven atoms and molecules. These techniques led to a very prestigious EPSRC Career Acceleration Fellowship in 2009 at University College London (UCL) where I started my group. In 2013 I became Assistant Professor and in 2019 Full Professor of Physics at UCL. My trip has been a difficult one until 2013, with stereotypes about women physicists getting in the way of my career. Of the most difficult things to achieve was to network and create strong collaborations. Currently, my group is one of the few groups in the world that can study 3-electron ionization in atoms and molecules driven by intense infrared laser fields. Since 2011, we also develop state-of-the-art quantum techniques to study the interaction of atoms and molecules with VUV and XUV pulses.

What inspired your interest to attosecond science and what drives you the most about your research now?

What fascinates me in attosecond science is studying the correlated motion of many electrons, deciphering the pathways these electrons follow to ionize and developing simple models to unravel the mechanisms of multi-electron ionization. Learning new things, developing new models that have a great predictive power as well as providing the theory for experiments performed in attoscience is the main driving force behind my research. My research also gives me the opportunity to interact and collaborate with other scientists around the world.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

Perseverance, persistence, and a strong belief in my abilities and sense of what is important. Moreover, I wanted to create something unique in my field; this is why I continued to develop state-of-the-art semi-classical techniques to study strongly-driven systems, even though several well established colleagues told me it would be a mistake to do so. Moreover, I developed strong collaborations with people who believed in me when I did not have a permanent position and maintained and treasured these collaborations over the years.

What were the main challenges in establishing your own group in attosecond science, and what helped you stay motivated during difficult times? What are the lessons you would like to pass on to the researchers who are new to the field?

Main challenge is that most colleagues are used to physicists behaving in a certain way which is associated mostly with ways men behave, since they are the majority in our field. Many colleagues used to make (and I believe still make) the mistake of connecting the mannerisms of each individual with the quality of their science. Moreover, during job interviews for faculty positions not more than 15 years ago, I encountered stereotypes and sexist behavior. My first real chance was given to me by EPSRC in the UK where during the interview process for my fellowship there was an EPSRC representative that was monitoring the interview process and the appropriateness of the questions asked.

What helped me keep going is my love for science and physics and my family who strongly supported me throughout the years and believed in my abilities.

A lesson to pass on is to choose to work on something that you really believe in and enjoy so you can make a significant contribution.

What is your mentorship philosophy?

To give interesting and new problems to students, help them and work closely with them along the way. Also, to teach them to persist so that they can overcome obstacles in science and life no matter if they continue in academia or not.

At its inception, attosecond science was done by only few isolated groups. In the last two decades, however, it has expanded, with many projects including multiple PIs. How has this increase in teamwork and collaboration impacted your approach to research?

I work and collaborate with several groups; however, I also enjoy projects delivered solely by my own group. Both kinds of projects give a different kind of scientific satisfaction when successfully delivered.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

Not exactly, even though significant progress has been made over the years. I would like to see a change in the way our community thinks, for instance, a shift of focus on the quality of the research delivered and not on who delivers it or where it is published.

Prof. Alexandra Landsman

Ohio State University, OH USA

Tell us about yourself and your journey to attosecond science.

I graduated with a degree in Plasma Physics from Princeton University. As a postdoc in Washington DC, I modelled synchronization of lasers to achieve high intensity output. My journey to attosecond science started with my 10-year journey to Europe, which ended back in the US, where I am currently faculty at the Ohio State University. Shortly after arriving to Switzerland, I applied and received a Marie Curie Senior Scientist Fellowship to work on questions relating to strong field ionization of atoms in the Ultrafast Laser Physics group at ETH Zurich. This was my first exposure to attosecond science, and I loved the underlying physics and the direct connection to experiment.

What inspired your interest to attosecond science and what drives you the most about your research now?

I like how attosecond science combines both the practical and the fundamental. On the fundamental side, the field can contribute to ongoing theoretical debates, such as tunneling time or the duration of the photoelectric effect. On the practical side, attosecond science has a broad range of possible long-term applications from lightwave electronics to pharmaceuticals to cancer research. Hence, in my research, I am driven by both the desire to understand the fundamentals, as well as a wish to contribute to future technical developments. As one might guess, these two goals are not mutually exclusive.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

I think coming outside the field was an advantage, as it allowed me to have a "different set of tools in the toolbox", to quote Feynman. Perhaps because I came outside attosecond science, I was also more willing to challenge the prevailing consensus on certain topics, such as tunneling time. In addition, I like to take a broader view of the field and whenever possible link seemingly distinct phenomena by a common underlying physical mechanism. This has amplified the impact of my work and attracted broader interest from the community. Finally, whenever possible, I try to work with experimentalists, since this is really a field which allows for an almost immediate experimental test of many theoretical predictions, which is one of the things I really enjoy about working in attosecond physics.

What is your mentorship philosophy?

My mentorship philosophy is to let people reach their potential, while providing any support they might need. People have different sets of skills and inclinations, hence as a mentor, it is important to find a task that fits a particular person and give that person freedom in how to accomplish this task. I also give a fair amount of flexibility, since I expect that people who go into physics are already highly self-motivated and are doing it because they enjoy the work. Hence, I tend to let people work on their own schedule, and focus more on the results then on the details of when and where they work and how many hours are put in.

At its inception, attosecond science was done by only few isolated groups. In the last two decades, however, it has expanded, with many projects including multiple PIs. How has this increase in teamwork and collaboration impacted your approach to research?

By the time I came to attosecond science roughly a decade ago, it was already a very collaborative field. I was lucky to enjoy a number of very productive collaborations, both with theorists and experimentalists, which have greatly contributed to my research. This has certainly increased my appreciation for collaborative research, as well as appreciation for the interplay of theory and experiment, which I did not experience as directly before coming into the field.

Prof. Carla Faria

University College London, UK

Tell us about yourself and your journey to attosecond science.

I am originally from the Amazon Delta and did my undergraduate physics studies at the University of Sao Paulo, Brazil. My early research was in a totally different area, namely cold gases, trapping and cooling of atoms. However, in the mid-1990s I fell in love with a German scientist, got married and then moved to Berlin. The city was a great place to be for a twenty-something year old, as it was being unified, and one could see history being made. After looking for a PhD position, I got really interested in the work done at the Max Born Institute, Berlin. The MBI was a dedicated center to our field, and I had the opportunity to interact with world leading scientists in there. It was also a very unusual place at that time, with a lot of old hangars and bunkers, and it reminded me of spy movies. After that several postdocs followed, in Germany and Austria, and eventually we moved to the UK for longer-term academic positions. They included a University Research Fellowship at City, University of London in 2004, an EPSRC Advanced Fellowship in 2006 at University College London. In 2007 I have obtained a permanent academic position, in 2013 I was promoted to Reader in Physics and in 2018 I was made full professor. I have broken many barriers, such as being the first South American to win the Institute of Physics Thompson Medal and Prize in 2021, and I am the first female physics professor in the UK of mixed Black heritage. Since 2007, I have been the primary supervisor of research students at all levels and from a wide range of backgrounds and have hosted several post-doctoral fellows, some of them self-funded. In total, my PhD students have been awarded 20 prizes at local, national, and international levels.

What inspired your interest to attosecond science and what drives you the most about your research now?

The extreme conditions awakened my interest: typically, in optics lasers were used to excite/de-excite systems, and established theoretical methods did a good job. However, in our field perturbation theory just broke down and the times were so short that nothing used in the stationary regime seemed to work anymore. This was the ideal scenario for a theorist because one needs to test new methods and be creative. Novel theoretical methods have always interested me, and I continue to pursue them, or look for tools in other areas. At the moment, my group and I have been studying quantum effects in a wide range of strong-field phenomena, from nonsequential double ionization to ultrafast photoelectron holography. I guess curiosity and `making things up' have always driven me.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

Overall, I am a stubborn person, which depending on the circumstances and on the perspective can be a blessing or a curse. I am also quite curious about pretty much everything, which is a good quality for a scientist, and can appreciate the beauty of Math. As a good South American, I usually look for `out of the box' solutions, plan Bs and see the silver linings in the

most difficult situations. We also have a healthy disregard for authority, which sometimes helps us, sometimes harms us, but also means we will not be afraid of trying to break glass ceilings.

This can be convenient if you come from a minoritized group.

What were the main challenges in establishing your own group in attosecond science, and what helped you stay motivated during difficult times? What are the lessons you would like to pass on to the researchers who are new to the field?

I have faced huge challenges throughout all my life as a scientist, from being a mixed-race undergraduate from the North of Brazil in a predominantly white University in the South-East to funding problems in the early stages of my PhD in Europe, to the typical job insecurity that plagues a postdoctoral research associate. Once you obtain a permanent position, you have job security, but the challenges continue. Building and maintaining a research group is difficult, and there are struggles with lack of resources, internal and external enemies and managing people who are very different. The time you are able to spend on research also decreases substantially, which can be very frustrating. A key lesson I would like to pass on is that, while we should try to change society for the better, it is important to view every setback as an opportunity to grow and develop as a scientist, instead of dwelling on the suffering. Setbacks can be great learning tools to become a better person too.

What is your mentorship philosophy?

Over the years I have observed that every person is different, and one needs different strategies to help them achieve their full potential. What works for person B may not work for person A and vice versa. It is also important to understand a mentee's strengths and weaknesses, acknowledge their humanity and be crystal clear about their objectives, both in science and in life. Finally, you need to be aware not to pass your own traumas on to that person – they are not younger versions of yourself, and everyone's life experience is unique.

At its inception, attosecond science was done by only few isolated groups. In the last two decades, however, it has expanded, with many projects including multiple PIs. How has this increase in teamwork and collaboration impacted your approach to research?

I try to do both. Working only within my group has the advantage that fewer compromises are needed, and that there is more control over the topic and the working strategy, but it is important to learn from other people. Collaborations can be challenging, but quite enriching too, as you are able to interact and draw from a much larger poll of researchers.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

The scientific community reflects society in general, and it is an illusion to think scientists in any area are neutral. Obviously, this includes the attosecond science community. Although there has been a lot of progress, it is still too white, too Eurocentric and too male dominated. Moreover, most initiatives supporting women in science have benefitted mainly white women, and even the statement "women and minorities" suggests these categories do not intersect. I would like our community to promote people of color more actively and to include the Global South as much as possible. We are routinely overlooked for invited talks, for instance, and this needs to change. Acknowledging good work outside the US/Western Europe axis is also important. There are strong emerging attoscience communities in China and India, for instance, who are doing great work.

Dr. Caterina Vozzi

CNR-IFN, Italy

Tell us about yourself and your journey to attosecond science.

My name is Caterina Vozzi and I am a Research Director at the Istituto di Fotonica e Nanotecnologie (IFN) of the Consiglio Nazionale delle Ricerche in Italy. I got my PhD in Physics at Università degli Studi di Milano in 2005 with a project on high-order harmonic generation in atoms, molecules, and clusters. I did my Postdoc at the Istituto Nazionale di Fisica della Materia, developing optical parametric amplifier sources in the mid-IR for application in high-order harmonic spectroscopy. Currently, I lead the Ultrafast Dynamics in Matter research group at IFN, where we develop advanced spectroscopies for the investigation of materials and molecules, from the THz to the Soft-X.

What inspired your interest to attosecond science and what drives you the most about your research now?

I liked non-linear optics and lasers since my master thesis work on the production of fiber Bragg gratings at the EU Joint Research Center in Ispra. During my PhD, I got in contact with the group of Mauro Nisoli at Politecnico di Milano and I started working on high-order harmonic generation, joining my passion for lasers with my interest in atomic and molecular physics.

Since then, 20 years have passed (!!) and I faced different projects from harmonic spectroscopy of molecules to ultrafast XUV spectroscopy in solids and ultrafast THz spectroscopy.

The initial drive was the possibility to understand, thanks to the advanced spectroscopy techniques available in attosecond science, the very fast processes in the photophysics of materials.

Today I am impressed by the possible technological applications that our findings can have in materials science, for instance in fields like efficient light harvesting, hydrogen storage, or low consumption electronics…all starting with the understanding of chemical reactions at the atomic level and on the attosecond time scale.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

When I did my PhD and Post Doc, curiosity, focus on the long-term goals of my research and hard work were the attitudes that made me succeed in the projects I was pursuing.

With time, the ability to team working, motivate collaborators, and organize the research activities became more important.

Today, as a PI, I think the most important skill is the vision, the ability to identify long-term goals and develop a strategy to realize them.

What were the main challenges in establishing your own group in attosecond science, and what helped you stay motivated during difficult times? What are the lessons you would like to pass on to the researchers who are new to the field?

I'm an optimist and in general, I don't easily lose my motivation.

In difficult times, I try to find and focus on the bright side, always looking for new opportunities and trying to adapt my goals and expectations to the external situation, getting the best possible

outcome. Understanding what I can do for positively impact on the difficult situation is also very useful. As Sir. Winston Churchill said: “Success is not final; failure is not fatal. It is the courage to continue that counts”.

What is your mentorship philosophy?

As a PhD student and a Postdoc, I was given opportunities and pieces of advice from many people, including the most unexpected ones. It’s very good that many institutions are establishing official mentoring projects and if there is one, you should definitely take advantage of it. However, you can extract useful pieces of mentoring from many collaborators.

At its inception, attosecond science was done by only few isolated groups. In the last two decades, however, it has expanded, with many projects including multiple PIs. How has this increase in teamwork and collaboration impacted your approach to research?

Since the beginning of my career, I did many collaborative experiments and I actively looked for collaborations. I gained several competencies and many friends.

Also nowadays, I often rely on the experience of colleagues when doing multidisciplinary experiments.

I believe that teamwork, collaboration, and networking are an important part of our working activity and I’m glad this has been increasing over the past years.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

I found the people in attosecond science an inclusive community in general. But I believe there is still a long way to run to make the STEM community a safe place for all people. I’d like to see more women, non-binary people, people of color, and minorities in general in leading positions where they will be able to affect the policy-making process.

In my experience, scientists, and physicists in particular, are not fully aware of their unconscious biases and how these affect their decision-making…they often consider themselves rational and smart, but when it comes to biases, we should always be conscious that we have our own.

Prof. Eva Lindroth

Stockholm University, Sweden

Tell us about yourself and your journey to attosecond science.

My background is in atomic physics in general and many-body methods in particular. I had worked with photoionization before and then when the photoionization delay experiments came it was fascinating to try to understand how they should be treated.

What inspired your interest to attosecond science and what drives you the most about your research now?

I am interested in electron dynamics and what more we can understand from the electron wave-packet phase-information. Here I am especially interested in autoionizing resonances which I have always found fascinating.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

I am a stubborn person who does not give up very easily.

What is your mentorship philosophy?

I just try to be nice and supportive.

At its inception, attosecond science was done by only few isolated groups. In the last two decades, however, it has expanded, with many projects including multiple PIs. How has this increase in teamwork and collaboration impacted your approach to research?

I collaborate closely with very good experimental groups. That is fantastic.

Prof. Hanieh Fattahi

Max Planck Institute for the Science of Light, Germany

Tell us about yourself and your journey to attosecond science.

My journey started in 2008, when I moved to Germany to pursue my education and joined the group of Prof. Ferenc Krausz. There, I got involved in the development of novel attosecond pulse drivers with unprecedented peak and average power. Later on, I spanned my research towards novel field-resolved detection techniques of light in ambient air, which paved the path toward my current research at Max Planck Institute for the Science of Light. Here, we are focused on utilizing advanced laser technology and detection techniques for highly sensitive, high-resolution spectro-microscopy of soft matter.

What inspired your interest to attosecond science and what drives you the most about your research now?

In attosecond science, technological advancement, and basic science go hand in hand and that has been a very interesting aspect for me. Currently, I am very excited to implement these advancements in real-life applications in particular for a better understanding of soft matter.

What were the main challenges in establishing your own group in attosecond science, and what helped you stay motivated during difficult times? What are the lessons you would like to pass on to the researchers who are new to the field?

Tenured positions in science are very rare and additionally, in Europe the academic model is rarely based on tenure-track positions. This has been the most challenging part for me. As a result, early-career scientists have to move their research and lab after some years to a new location and sometimes repeat it for several times. And during these transports, it is very difficult to transfer the know-how or properly move with the family.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

We need more female scientists in leading roles in our field or generally in Physics. I have seen many talented brilliant female students and post-docs with promising futures who left academia very early. We can definitely improve the stability of the scientific career to an extent that provides an appealing outlook for female scientists besides their other options in the market.

Prof. Li Fang

University of Central Florida, FL USA

What inspired your interest to attosecond science and what drives you the most about your research now?

My PhD work concerns vibrational coherence in molecules induced by femtosecond pulses. It is natural to wonder about the electronic dynamics that proceed and lead to the nuclear motion. By the time I graduated, I had been exposed to the attosecond technology and its application in scientific research through literatures and conference presentations. It was and still is a fascinating idea that we can time-resolve the motion of an electron and understand at the most fundamental level many electron-motion-driven phenomena.

From a general perspective, I hope the truth about the nature that our research efforts unveil can help advance humankind continuity, if not directly by improving a material world, at least through strengthening faith in a meaningful life and opening a window to envision appealing future possibilities.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

Being curious, hardworking, collaborating with an open mind. I think they help stay in the community.

What were the main challenges in establishing your own group in attosecond science, and what helped you stay motivated during difficult times? What are the lessons you would like to pass on to the researchers who are new to the field?

Building a lab that is equipped with high power femtosecond lasers, several ultrahigh vacuum chambers and advanced spectrometer systems is in general challenging. I think the field is lack of the workforce with the needed skills and experience to build a lab for attosecond science.

During difficult times, if you are not considering quitting, I guess the only way remaining is working on it to move forward.

To new researchers to this field, think big but preserve that magnificent blueprint in mind and start with something relatively simple and feasible – just to share some advice from some senior PIs.

Prof. Linda Young

Argonne National Laboratory and University of Chicago, IL USA

Tell us about yourself and your journey to attosecond science.

I am the mother of two daughters who have become scientists themselves and am married to another wonderful scientist, a professor of chemistry at UChicago. We enjoy each other's company, sports, nature, hiking. It is somewhat accidental to have landed, peripherally, in the attosecond science world – as my career has been largely at Argonne National Laboratory where unique facilities, e.g. the nation's brightest x-ray storage ring and newest exascale supercomputer, drive many projects, and attosecond science has been more the domain of individual university laboratories.

What inspired your interest to attosecond science and what drives you the most about your research now?

As a person who has always been attracted to exploration and discovery, my opportunity to delve into the attosecond domain was inspired by the new capabilities at the LCLS x-ray free-electron laser at SLAC. In 2020 at the LCLS, scientists have developed extremely powerful, tunable attosecond pulses that enable for the first time attosecond pump/attosecond probe experiments in the x-ray domain. This would allow us to study the origins of x-ray ionization processes in complex systems in an entirely new, but relevant time domain. How does a complex system respond after an inner-shell hole is created at a particular site? How does this hole transfer energy and charge onto neighboring atoms? What happens to the primary ejected electron and the ensuing secondaries? Answering these questions has implications for understanding radiation induced processes associated with curing cancer, extending spaceflight, and remediating nuclear waste. It is fabulous for the entire scientific community to have access to these unique tools and opportunities via a competitive proposal process.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

It is helpful to be optimistic and flexible, as invariably the experiments or the experimental campaign, will not go exactly as planned. Recognizing and taking joy in the little bits of progress as they happen helps to keep the entire team engaged toward the final goal. It is also helpful to share results with researchers who have similar interests – so the ability to network with others, theorists in my case, has brought fresh perspectives and insights into our joint work.

What were the main challenges in establishing your own group in attosecond science, and what helped you stay motivated during difficult times? What are the lessons you would like to pass on to the researchers who are new to the field?

In this user-facility oriented style of attosecond science, a main challenge is the long wait for, or between, beamtimes and keeping the team

motivated. Fortunately, our group can perform complementary theoretical simulations (using the Argonne supercomputer) and complementary experiments at longer timescales using visible or IR probes that fill in the context around the attosecond experiments. One should keep in mind that there is more than one interesting problem to be solved.

What is your mentorship philosophy?

I try to provide opportunities for my students, postdocs and, staff to distinguish themselves by helping them choose problems that are of true interest to them, the scientific community, the world, and, importantly, that are doable. Then I try to ensure that the resources are available and to provide introductions to the other researchers in the field.

At its inception, attosecond science was done by only few isolated groups. In the last two decades, however, it has expanded, with many projects including multiple PIs. How has this increase in teamwork and collaboration impacted your approach to research?

The facility-based attosecond research community is by its very nature a collaborative one – i.e. between the PIs, their teams and the facility personnel. This is in fact a very rich learning environment for students and postdocs, as there is the opportunity to learn many different skills from practicing professionals, e.g. in detector technology, big data handling, laser-accelerator synchronization, at several different locations – as the availability of attosecond x-ray pulses expands to include not only SLAC, but soon the EuXFEL in Germany and SwissFEL in Switzerland. This community could benefit from more involvement from the individual university lab-based PIs and their students.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

Again, my experience is mostly with the facility-based attosecond science community which has evolved only recently – much of it during pandemic times. However, one can look to the free-electron laser community at large as an example, and this community has come of age during the past decade. While it is not easy to know about LGBTQia involvement, it should be noted that there are quite a few standouts female researchers engaged in FEL science – and perhaps this is true opportunity for women, as a premium is placed on articulating an important problem and organizing a team for its solution.

Prof. Ursula Keller

ETH Zurich, Switzerland

Tell us about yourself and your journey to attosecond science.

My normal CV and biography you find online (link[1])

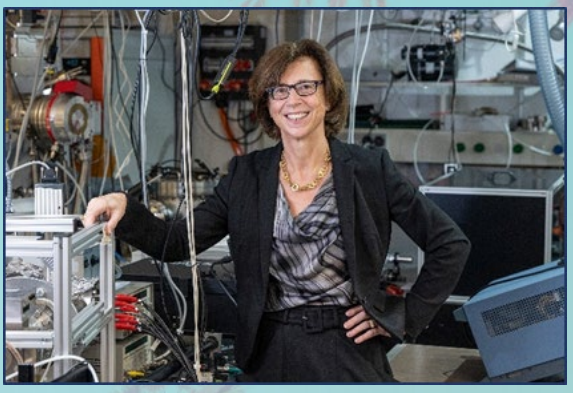
What inspired your interest to attosecond science and what drives you the most about your research now?

I started my research in ultrafast laser physics with the invention of the Ti:sapphire laser which revolutionized ultrafast science. It was a really exciting time with many new discoveries. We also pushed the performance frontiers in few-cycle pulse generation and solved the fundamental problem with the stabilization of the electric field underneath the pulse envelope, typically referred to as the carrier envelope offset. The attosecond regime was the next logical step forward in terms of shorter pulse durations.

Meanwhile I have written a graduate textbook on "Ultrafast Lasers", published earlier this year. This book explains the basics and also gives a historical perspective (link[2]).

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

After a master's in physics at ETH Zurich, I did my PhD at Stanford in Applied Physics, where I obtained a broader interdisciplinary education into microwave electronics, lasers, and ultrafast measurement techniques with a special interest



in semiconductor relaxation dynamics. My professor was in electrical engineering and was a pioneer in laser noise optimization to make signals visible that nobody could see before. This helped me throughout my research afterwards.

I also learned at Bell Labs in my own independent research how important it is to have access to special materials and that it is good to invest some of your resources into special material knowhow. In my case it was MBE grows for SESAMs, VECSELs and MIXSELs.

What were the main challenges in establishing your own group in attosecond science, and what helped you stay motivated during difficult times? What are the lessons you would like to pass on to the researchers who are new to the field?

Attosecond science is an expensive research area. I was able to obtain significant funding through my efforts in both applied (i.e. ultrafast lasers) and fundamental (i.e. attosecond science) research which helped me to build-up the attoclock (link[3]) and the attoline lab (link 1[4], link 2[5]).

What is your mentorship philosophy?

I have published an article about my philosophy for a PhD program (link[6]).

[1] https://ulp.ethz.ch/people/kursula.html
[2] https://ulp.ethz.ch/publications/book-chapters.html
[3] https://ulp.ethz.ch/research/attoclock.html
[4] https://ulp.ethz.ch/research/attoline.html
[5] https://ulp.ethz.ch/research/attosecond-science.html
[6] https://ulp.ethz.ch/group/vision_phd.html

Not every professor is a perfect fit for every PhD student. It should be easy to change groups within the first year of the PhD. We had such a program at Stanford, and I changed the group after one quarter.

We also published a book with many women professor role models which I recommend (link[7])

At the beginning of my research career, I believed I could achieve as much as my male colleagues. All that matters are good results. This however did not turn out to be true. The more successful I became the more I was sidelined in my department.

I believe it is important that we all help to change the culture in a male dominated department with better governance (see talk number 1 with the following link[8]). This means that minorities need to learn to help each other, get networked and reach out into politics to obtain an academic funding approach that promotes inclusive excellence with measurable results. The Juno-type programs in the U.K. can serve as a positive role model. See for example talk given by Prof. Nicola Wilkin (see talk number 7 with the following link[8]):

See also my recent news item where I share some of my experiences as the first tenured physics professor at ETH Zurich and my recommendations to improve the current culture (link[9]).

- Some additional published info by Prof. Keller:

*2020-9-16 creating a university culture where women thrive***.**

Viewgraphs can be downloaded here (link[10]). The talk is also uploaded on YouTube (link[11]).

2021-9-10 Mentoring for women in STEM fields (webpage link[12] and YouTube link[13]).

2021-9-17 Unusual keynote talk invitation: Do photons show gender bias?
(webpage link[14] and YouTube link[15]).

At its inception, attosecond science was done by only few isolated groups. In the last two decades, however, it has expanded, with many projects including multiple PIs. How has this increase in teamwork and collaboration impacted your approach to research?

I think the next generation needs access to a shared ultrafast laser facility to benefit from technical staff and different laser parameters. We therefore developed the concept of the FastLab within the NCCR MUST program (link[16])

It is important that new experts in condensed matter physics, physical chemistry, biology etc. get access to such state-of-the-art laser systems allowing for attosecond time resolutions, core-level spectroscopy, and X-ray diffraction. These researchers will not need to be laser experts anymore and will use many different experimental tools to address open scientific questions. Therefore, it makes sense to establish such an interdepartmental ultrafast laser technology platform at a university. This will also allow for a broader education of students in ultrafast science with hands-on experience in the lab.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

I believe that such a shared facility (e.g. FastLab) would make it more inclusive.

[7] https://ulp.ethz.ch/group/InspiringConversations.html
[8] http://www.nccr-must.ch/equal_opportunities/gender_science_meeting_2022.html
[9] https://ulp.ethz.ch/news/ulp-news/2022/01/what-makes-me-tick-why-do-i-still-want-change-for-more-women-in-stem.html
[10] http://www.nccr-must.ch/nccr_must/news_4.html?4919
[11] https://www.youtube.com/watch?v=4Db49ZIfUL8
[12] http://www.nccr-must.ch/nccr_must/news_4.html?5031
[13] https://www.youtube.com/watch?v=XRD7D_rxXqo
[14] http://www.nccr-must.ch/nccr_must/news_4.html?5020
[15] https://www.youtube.com/watch?v=I0emYhM0CHs
[16] https://fastlab.ethz.ch/

Aderonke Folorunso

Louisiana State University, LA USA

Tell us about yourself and your journey to attosecond science.

My name is Aderonke Folorunso. I am a self-motivated, enthusiastic, and hardworking 4th-year Ph.D. candidate at the Chemistry department, Louisiana State University. My journey to the attosecond science world started 3.5 years ago when I joined my advisor's (Professor Kenneth Lopata) group as a new Ph.D. student. Since then, I have been working on many individual and collaborative projects with a focus on Charge Migration using the first-principle simulation method.

What inspired your interest in attosecond science and what drives you the most about your research now?

Although my advisor and reading literature works inspired my interest in attosecond science, my interest has grown exponentially since I started my research work. In my present research, my drive to keep exploring attosecond science is mainly its future applications i.e., the mere fact that my research discovers new trends/rules that would be useful in the experimental study of charge migration and eventually its application.

What traits, habits, and skills have been important as your career progressed? How did they help you stand out in the community?

Self-discipline, diligence, and teamwork spirit have been the core skills that helped my growth as a researcher and individual. The ability to learn and adjust to constructive criticism helps me stand out in this community. As regards the educational skills, having a background in python language, simulation software, and Linux environment play a major role in my day-to-day research work.

You are a protagonist in the future story of attosecond science: how will attosecond science change the world?

The field of attosecond science is prominent in many disciplines because it opens the door to explaining ultrafast phenomena in atomistic physics, molecular physics, chemical physics, advanced materials, biology, condensed matter, and other areas. Hence, my role will be to harness these pros to further increase its applications.

What do you look for in a mentor? What are the best lessons you have learned from your mentors? What will you do differently?

A mentor should be able to effectively communicate, constructively criticize, encourage and be supportive of their mentee.

At its inception, attosecond science was done by only a few isolated groups. In the last two decades, however, it has expanded, with many projects including multiple PIs. How do you navigate this complex collaboration network?

Google Scholar has been a great tool for navigating this complex collaboration network. I keep up by searching for discoveries in published papers. Additionally, I attend attoscience technology conferences, workshops, and webinars. In these places, I learn about attoscience discoveries as well as build new networks.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

Yes, attosecond science has been inclusive because I have read a lot of research works from different parts of the world.

Amelie Schulte

Max Planck Institute of Quantum Optics (MPQ), Germany

Tell us about yourself and your journey to attosecond science.

My name is Amelie and I'm a 2nd-year PhD student in attosecond science at the Max-Planck-Institute of Quantum Optics (MPQ). My field of studying is field-resolved light-matter interactions in the ultraviolet range.

I studied physics at the University of Göttingen and University of Amsterdam with the focus on optics and solid state physics. Already during my Bachelor's I worked on a project with the focus on HHG and found it very interesting. While learning more about it, attosecond science came across and captured me.

What inspired your interest to attosecond science and what drives you the most about your research now?

During my Master's I followed a class on ultrafast laser physics in Amsterdam, which I really liked. I was always interested in optics, working with lasers and studying materials. Now, I want to know what is really happening in the materials. Attosecond science makes it possible to study the ultrafast electron behavior while interacting with light - this is what drives my research the most.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

Being interested in and fascinated by the science you are working on is the key to work in research. Moreover, it is very important to have perseverance, discipline and resilience in experimental physics, because it does not always work as you would wish or expect. But if the research drives you, it makes it much easier to keep going also during frustrating times.

You are a protagonist in the future story of attosecond science: how will attosecond science change the world?

We are hoping to understand the dynamics in various materials on the attosecond timescale. There, attosecond science will help us to understand fundamental properties of materials, for example charge transfer, which could be useful in terms of understanding and controlling catalysis in photo-chemistry. Moreover, attosecond science enables field sampling metrology, which is now becoming more and more solid-state based. This is exciting because it opens the door for opto-electronic devices with ultrafast optical switching in the PHz scale. Using this knowledge and apply it in industry would have a huge impact.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

Yes, I have experienced attosecond science as inclusive community. We have scientists from so many various nationalities, which makes it interesting to work together. However, I would wish for a more balanced distribution of women and men, as it is not the case in almost all areas of Physics studies.

Dr. Angana Mondal

ETH Zurich, Switzerland

Tell us about yourself and your journey to attosecond science.

I am currently pursuing my postdoctoral research in liquid generated high-harmonic spectroscopy in Prof. Hans Jakob Woerner's group at ETH Zurich, Switzerland.

My journey to attosecond science was slightly different from what you would generally expect from researchers pursuing this field of science. I come from a background of high-intensity laser matter interaction. I completed my PhD. From the Tata Institute of Fundamental Research, Mumbai, India in 2020, where my research was focused on generation megaelectron volt electron and X-ray sources using table-top, millijoule-class lasers. You would expect someone from such a background to do further research in the same field. However, I deviated and steered to attosecond science mostly because I wanted to develop techniques that could bring cutting-edge research to small-scale lab set-up.

Generally, these types of research require big facilities like FELS and synchrotron, where getting a beamtime is obviously not easy. This I believe limits the research to a great extent. The challenge of developing alternate yet equivalent research techniques that makes "expensive science" (be it high power lasers to generate high energy electron sources or synchrotron sources for attosecond science) available to smaller research facilities is probably what directed me towards this field.

What inspired your interest to attosecond science and what drives you the most about your research now?

Apart from the above-mentioned reason, I think my motivation for pursuing attosecond science, is simply the fascination of being able to understand, observe and control fundamental dynamics at an attosecond time-scale.

Currently I am studying high-harmonic generation from liquids, and we are trying to develop an intuitive picture as to how harmonic generation occurs in such disordered, multi-particle medium. Though liquids had been established as a high-brightness source of high-harmonics for quite some time now, the complexity of modelling strong-field interactions in liquids has prevented harmonic generation to be used as a spectroscopy probe to study dynamic processes in the liquid-phase. Attosecond spectroscopy is mostly performed in gaseous phase because single particle interaction approximation makes it easier to model and understand the fundamental dynamics. However, majority of biologically relevant reactions happen in liquid phase, therefore extending high harmonic spectroscopy to liquid phases is probably one of the next

crucial steps. I guess the dream that drives me is to be able to lay down the first stepping-stones towards that direction.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

I guess the most important trait that has been helpful to me is to always be ready to learn and to keep asking questions. It's ok to not know stuff at the first go, as research today is as diverse as it gets, but it's important to communicate and interact with people from different fields of research and more than often you will find connections and unique understanding of your problem when viewing through a different perspective.

Also, as an experimentalist, looking at your data and thinking about it helps a lot. It might sound kind of obvious but what I mean is research on a topic doesn't end with publishing the results. I have realized, the more experience I have, the newer insights I gain even looking at "older data". Lastly, diversifying my secondary skills, like learning a new software, or developing simple codes to test ideas or even learning how to make 3D engineering drawings, have helped me become a bit more self-reliant as a pursue my research career.

I am not sure about standing out in the community, but as far as my research goes, I feel the above few traits have helped me in developing a clearer picture of the science I am investigating and the problems that I wish to pursue.

You are a protagonist in the future story of attosecond science: how will attosecond science change the world?

It gives you the power to understand and tweak fundamental physics happening 10^ (-18) of a second timescales, what else can you want?

What do you look for in a mentor? What are the best lessons you have learned from your mentors? What will you do differently?

The most important aspect that I look for in a mentor is approachability. A mentor should have an open-door policy and be there to guide, when necessary, since he/she has generally more experience in the field. However, it is equally important that they trust students and researchers to do research independently without constant supervision.

The best lessons I have learnt from my mentors are to always encourage discussions, even when they have opposing views and to be enthusiastic about the student's progress, no matter how small. In certain cases, my mentors have been more enthusiastic than me about my experiments and results and this I feel gives a researcher more confidence and motivation to do better.

When I become a PI or mentor, I would like to be a bit more involved in the actual experiments and hands-on lab work. However, I believe with the added scientific and administrative responsibilities this becomes more and more difficult as you progress in your scientific career, but this is something that I would still want to pursue.

At its inception, attosecond science was done by only few isolated groups. In the last two decades, however, it has expanded, with many projects including multiple PIs. How do you navigate this complex collaboration network?

I think having a clear idea about who is expected to be responsible for which aspect of a project is important. Especially when multiple PIs and students are involved, having a clear pre-plan and frequent communication helps in coordinated progress and equal division of work.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

My experience is limited currently to my research group, so commenting on this would not be fair. However, I would love to see more female scientists in this field of research the gender ratio is currently too disproportionate.

Anne Weber

King's College London, UK

Tell us about yourself and your journey to attosecond science.

I just started my PhD in February 2022 with Dr. Emilio Pisanty at King's College London. Before that I did my bachelor and master's degree at the Friedrich-Schiller University Jena. For my master's thesis I worked on the simulation of HHG by bi-elliptical two-laser fields, using the semi-classical quantum-orbit approach. As I realized that there are still so many unsolved questions, I decided to pursue a PhD. In my spare time I enjoy doing acrobatics and juggling.

What inspired your interest to attosecond science and what drives you the most about your research now?

In attosecond science, I really appreciate the fact that we can compare our theoretical results to the experimental data, which is not the case for other topics in theoretical physics; thereby we can prove, question, inspire and surprise each other. Moreover, I really enjoy being part of a comparatively young community which is still open to so many new methods and ideas.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

I don't think I have any "career" yet, neither do I stand out by any means. However, in general I believe that it is important to enjoy yourself with what you do, and if you don't like it, then having the confidence to change something.

What do you look for in a mentor? What are the best lessons you have learned from your mentors? What will you do differently?

I enjoy having a knowledgeable and passionate supervisor whom I can trust, both personally and scientifically. Moreover, I value honesty and patience. With respect to that, (so far) I was always extremely lucky.

Dr. Asimina Papoulia

Lund University, Sweden

Tell us about yourself and your journey to attosecond science.

I am originally from Greece, and nine years ago, I moved to Sweden to complete my graduate education and obtained a master's degree in theoretical physics. Being fascinated by the interplay between atomic and nuclear physics to study exotic nuclei, I subsequently pursued a doctoral degree in computational atomic structure with a focus on nuclear effects and fundamental physics. I completed my PhD studies a year ago, and a few months later, I joined the group of theoretical attosecond physics at Lund University (Sweden) as a post-doctoral fellow. Being part of attosecond science offers me a great opportunity to expand my expertise within the field of atomic physics, while I continue being involved in method and code development, which I am passionate about.

What inspired your interest to attosecond science and what drives you the most about your research now?

Conducting my doctoral studies as part of both Malmö and Lund Universities, I had always been aware of the work that is performed at the experimental and theoretical attosecond physics groups at Lund University, as well as the multiple collaborations between them. In view of the rapid advancements in attosecond science, the theoretical group of Marcus Dahlström recently started to develop relativistic time-dependent methods for simulating atoms in strong laser fields, which I find very intriguing. Even though the importance of relativistic effects has so far been demonstrated in several experiments, this subject remains greatly unexplored, and I am therefore looking forward to performing more detailed investigations based on relativistic calculations.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

I would describe myself as careful and thorough, with a distinct sense for details. These traits have on several occasions helped me succeed in anticipating the small factors that can ultimately prove to be decisive in a project. I am also diligent and persistent in completing tasks. Taking the time to self-reflect and developing a certain level of self-awareness have been key factors in creating habits that fit my personality. Structuring my workday so that it fits the hours when I am sharp and most productive is one of them. Appropriate technical skills are essential components in all professions and even more so in physics careers and science in general. Besides these hard skills, I put a lot of emphasis in effectively communicating the complex concepts we are dealing with and doing my best to adapt my communication style to different situations and personalities. As I have only recently become a member of the community of attosecond science, it is too early to ascertain that these traits, habits, and skills have helped me stand out in the community, but they have

without a doubt been decisive in my career as a researcher.

What do you look for in a mentor? What are the best lessons you have learned from your mentors? What will you do differently?

Research is a lot about performing individual work and spending a great deal of time focusing on a particular problem. This often makes one lose sight of the bigger picture. To me, a vital aspect of mentorship is to be reminded of the broader context of a research question. Other important qualities that I seek in a mentor are insightful thinking, the ability to come up with creative ideas and inspire, as well as reflective listening. Although mentorship can be critical in one's career path, in most cases, I learn lessons following my own journey and self-reflecting on it. As research is a very dynamic field, with projects being continuously initiated, one has to be able to judge what is meaningful to pursue so that the focus and effort is directed accordingly. During my PhD studies, I learnt that sometimes is preferable to give up on a project for the shake of prioritizing what is more important. Having said that, as a mentor, I would however try to not dismiss work that is promising and which a lot of effort has been put into in favor of an easier and less risky project.

At its inception, attosecond science was done by only few isolated groups. In the last two decades, however, it has expanded, with many projects including multiple PIs. How do you navigate this complex collaboration network?

As I already mentioned, I am a relatively new member of attosecond science. However, the transition from the smaller community of atomic structure that I was previously part of has already equipped me with the experience of such a big change (as the one described in the question). Before I would spend a considerable amount of time working individually. Since I became a member of the theoretical attosecond physics group at Lund University, I found myself being part of a larger team, where I have to perpetually seek the balance between deep individual work and collaboration. To effectively collaborate with the other group members, as well as the external network, it is important to define roles that keep everyone motivated and satisfied. This requires communication openness and putting additional effort in relating to the different personalities.

Dr. Bethany de Roulet

University of California, Berkeley, CA USA

Tell us about yourself and your journey to attosecond science.

My name is Bethany de Roulet. I recently graduated from the University of California, Berkeley with a Ph.D. in physical chemistry. I initially started using soft x-ray photoemission, absorption, and fluorescence spectroscopy to study solid state materials as an undergraduate. Toward the end of my undergraduate education I learned of high harmonic generation. The uniqueness of being able to see the fastest processes that occur in materials still inspired (and still inspires!) me to push the boundaries of our current scientific knowledge about solid materials.

What inspired your interest to attosecond science and what drives you the most about your research now?

The desire to explore the unknown is a part of human nature. While living in Boston I realized that I despise snow, so exploring the North Pole was never going to be part of my life. For me, I am highly motivated by finding and exploring new scientific ground. Initially, I was motivated by the novelty of a technique that temporally observes materials with x-rays. As I have read more and gained a more holistic view of the current, basic physics knowledge of solid-state materials I see attosecond science as an important tool to be used to push scientific knowledge further and further. This larger picture view is now my primary source of motivation.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

There are two main traits I've intentionally grown that have greatly helped me to keep my creativity and passion for science. First, having times more devoted to work and times more devoted to rest has helped me preserve the spark of interest I have in scientific exploration. Secondly, one of the biggest areas of growth for me during graduate school has been balancing perseverance and adaptability. These two truths are held in tension with one another. There are times when a scientific study in the next obvious direction is too far of a jump to take. However, there are times where the scientific discovery is so great that the price of perseverance is worth it. Understanding what tests help tease out whether perseverance or adaptability is appropriate for a particular scientific idea has helped me be far more efficient in my work. As for how I've stood out in the community, I think I'm maybe still too early in my career to know how to answer that.

What do you look for in a mentor?

I particularly look for people who are honest and who follow through on their promises. These character traits have consistently led to advisors who have fostered scientific creativity in me and who have stood by me when I needed it. What are the best lessons you have learned from your mentors? For me, people always come first. When someone comes to me with troubles, the ability to physically turn from what I'm doing, look at them, and then listen with no expiration on our time together has been the best mentoring skill I've learned. What will you do differently? I think the power of encouragement is generally undervalued in the scientific community as a whole. Establishing a culture where good work (helping others in their work, having integrity over urgency, publishing a well-written paper, etc.) is celebrated has the power to create an open and free environment. When people are valued and have hope they are able to be more creative, collaborative, and work more diligently.

Dr. Heide Ibrahim

Institut National de la Recherche Scientifique, Québec Canada

Tell us about yourself and your journey to ultrafast science.

I came to ultrafast science through the fascination for colors and the curiosity about light and photography. The first time I saw blue coherent light hooked me to lasers. At university, we generated our own holograms and characterized moving objects with holographic measurement techniques. From there I came to wave packet interferometry in small molecules and finally molecular movies. And the fact that light can not only measure but also control ultrafast dynamics added another degree of fun. My goal is to understand small but critical cogs in the complex clockwork of light-matter interactions.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

For some reasons I always end up dealing with complex problems. Enjoying the search for answers itself, not only the moment when we find them certainly helps... And reaching out to other research groups relevant to the work, even if you don't know them. This combination helped me to keep going in our last project imaging the roaming dynamics in the formaldehyde molecule; even though many experts told me that I was on the wrong way and that what we saw in the experiment could not be related to what I was looking for - in the end, we could prove that our assumption was right, even though it took years to do so.

What do you look for in a mentor? What are the best lessons you have learned from your mentors? What will you do differently?

Trust, openness and discretion, as well as the ability to connect without judgement to people, no matter where they stand. The best lessons I have learned from experienced peers involved help in projecting the possible future outcome of decisions that had to be taken. And I always appreciated encouragement and creativity to find the best pathway for each person – there is no one-size-fits-all career.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

You were so kind to include me here, even though I do femtosecond science – that's pretty inclusive! No, seriously, in the last years, I can see efforts to open up the community and this conference is a positive example. But there is still quite a way ahead of us. One important aspect I am missing in such kind of discussions is the fact how family-unfriendly the life of researchers often is. Universities offer in general permanent positions only for either professors or the administration. There are various good reasons why one might look for stability in a research job on other levels too, be it a stepping stone on the way to becoming professor, be it the destination. I see this policy as one significant force driving for example women out of research, but wherever you look, the already small number of such permanent positions keeps being reduced.

Dr. Kalyani V Chordiya

ELI-ALPS, Hungary

Tell us about yourself and your journey to attosecond science.

I started my journey towards attosecond science unknowingly in the quest to design an efficient dye for charge transfer. Over the years, I went from experimental synthesis and characterization of the molecules to theoretical understanding of ultrafast charge migration dynamics in a system. For me this is a pursuit to have collective information about my system and analyze the data carefully. Perhaps one day this will help me in designing a system that can migrate/transfer charge as fast and slowly as I wish.

What inspired your interest to attosecond science and what drives you the most about your research now?

The field of attosecond science is so vast, full of opportunities and is ready to be explored. What drives me is that zoo of information is generated by experimental pump-probe measurement, however, we still lack tools/method to understand, sort and analyze this information. I find it a challenge to analysis this data, I look forward to finding a way where we can develop a theoretical method to reconstruct the charge migration process.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

Never give up, don't give reasons for not being able to solve a problem, instead figure out why it is not solved?

You are a protagonist in the future story of attosecond science: how will attosecond science change the world?

At the moment experimentally and theoretically we are handling small molecules or atoms. However, in future when these measurements are used to explore larger systems, we will be able unleash wild development in quantum computers, efficient LED, photovoltaics, large energy lasers, radiation therapy and the list goes on.

What do you look for in a mentor? What are the best lessons you have learned from your mentors? What will you do differently?

Support to explore different opportunities. Be persistent and patient.

At its inception, attosecond science was done by only a few isolated groups. In the last two decades, however, it has expanded, with many projects including multiple PIs. How do you navigate this complex collaboration network?

Still, there are a few groups which have deep roots and better understanding of the topic. I follow the research of those groups and keep myself updated with the topic using google scholar notifications for specific topics or work of specific group. When I begin with a topic, I go through the reviews written by the pioneers in the field.

Dr. Kathryn Hamilton

Drake University, IA USA

Tell us about yourself and your journey to attosecond science.

Hi! My name is Kathryn Hamilton, and I am currently a postdoctoral researcher at Drake University in Des Moines, Iowa, but will start an Assistant Professor position at the University of Colorado at Denver in August. I completed both my undergraduate degree and PhD at Queen's University Belfast. When I am not carrying out calculations on supercomputers all around the world, I like to play traditional Irish music (very badly) on my violin or banjo, and domesticate stray cats.

My interest in science started at a young age and was mostly influenced by the terrible sci-fi movies my mum permitted my brother and I to watch. From the ages of 8 to 14 I cycled through many potential careers including paleontologist (Jurassic Park), astronomer (Star Wars) and volcanologist (Dante's Peak), before settling on something that would involve physics and maths, my two favorite subjects at school. During my undergraduate degree in Applied Mathematics and Physics I really enjoyed the atomic physics and numerical analysis courses, but really fell in love with ultrafast physics when I joined Jason Greenwood and Ian William's lab for my MSci project. I knew I wanted to do postgraduate research in the same area, and luckily for me that year Andrew Brown and Hugo van der Hart were looking for a PhD student in computational attosecond science. The rest is history!

What inspired your interest to attosecond science and what drives you the most about your research now?

I just find the whole concept of understanding and controlling electron dynamics extremely fascinating. In one regard, everything you need to know about laser-electron interactions is contained within the time-dependent Schrödinger equation, but at the same time actually solving the equation for realistic systems is incredibly difficult, and the spectrum of electron behavior is so vast. It's also really cool that these processes are happening all around us trillions of times every second entirely unseen by us.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

I think the ability to not take oneself too seriously is a good trait to have. Sometimes you make mistakes or things just don't work out, and it's really important to be able to accept this, move on, and not let professional "failures" diminish your perception of your worth as a person. Regarding skills, I think it is worthwhile to invest time in improving your oral communication skills. People might not remember the content, but will remember if you gave a great talk, and you will probably have to give one as part of a job interview! I wish I could say that I have the habit of writing something

every day, so that will be my resolution for the start of the new academic year.

What do you look for in a mentor? What are the best lessons you have learned from your mentors? What will you do differently?

I really appreciate mentors who let me have the independence to follow my own ideas but are still supportive and interested in my work. Some of the best lessons I have learned from a mentor (in this case Andrew Brown) are about mentoring itself! I remember the topic came up in one of our Monday afternoon discussions, and his message essentially was that while you might have an over-arching mentoring style, every student is unique, and therefore will need different amounts of help in different areas. I could tell that being a good mentor to me was something that was really important to him, and something he continuously worked at, and I really hope to be the same kind of mentor for my future students.

At its inception, attosecond science was done by only few isolated groups. In the last two decades, however, it has expanded, with many projects including multiple PIs. How do you navigate this complex collaboration network?

I am still relatively new to the attosecond community, so I am interested to see what the other answers are! I don't think one can really go wrong by treating other people with respect and grace. As a newcomer, having a very close-knit community can be intimidating to break in to, but once you collaborate with one group, you are suddenly connected to so many other people.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

In my personal experience attosecond science has been a really welcoming and inclusive community. I have been very lucky to have had fantastic mentors and collaborators who have all been invested in my success and professional development, however I am aware that not everyone has such a positive experience. I think the physics community is in an interesting place right now where most people recognize that diversity, equity, and inclusion are important things, and some are really energized to try and change the composition of the field, but we simply lack the resources as individuals to enact long-term change. To recruit and retain a more diverse group of physics researchers I believe we need to change certain institutional policies which tend to disproportionally effect under-represented scientists. Things like increased parental and/or medical leave, flexible working arrangements, and officially recognizing the increased service load that minority physicists face could all be good first steps to foster a more diverse physics community.

Lisa-Marie Koll

Max Born Institute, Germany

Tell us about yourself and your journey to attosecond science.

My name is Lisa-Marie Koll, I am a second year PhD student at the Max-Born Institute in Berlin. I was always fascinated by lasers, but actually only stumbled over attosecond science by chance and was of course immediately fascinated by the idea of working with lasers with the shortest pulse duration.

What inspired your interest to attosecond science and what drives you the most about your research now?

Most fascinating about attosecond science is in my opinion, how this research field is linked to so many different fields of physics, like optics, solid state physics, quantum mechanics, but also since recently quantum information. There is so much to learn, so it never gets boring.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

Since I only started my career a bit more than a year ago, I wouldn't say, that I stand out yet. But I think some very important skills or qualities are curiosity, resilience, patience, and stubbornness.

You are a protagonist in the future story of attosecond science: how will attosecond science change the world?

In general, attosecond science helps us to shed light on fast charge transfer processes. It may be useful for technological developments in the future, but at this point I think it is purely fundamental research. It definitely drives our curiosity on how the world works.

What do you look for in a mentor? What are the best lessons you have learned from your mentors? What will you do differently?

A mentor should be a scientific role model and a supporter during professional difficulties or personal problems. I think it's really important that the mentor is interested in your success and your personal growth and that you feel comfortable in consulting them regardless in which matter.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

In my opinion attosecond science is a very welcoming community. You can always find someone, who can help you with your scientific struggles. Of course, but I think this is a general problem in physics, we have to aim to attract and include more female/diverse scientists.

Dr. Nathalie Nagl

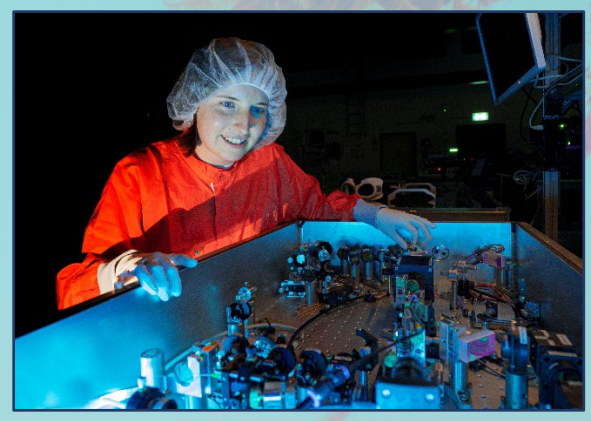
Max Planck Institute of Quantum Optics, Germany

Tell us about yourself and your journey to attosecond science.

As a passionate scuba diver, I love to explore the unknown and enter territories that nobody has touched before. One important rule is to stay focused and act carefully if something unforeseen happens. Therefore, there is a strong connection to my professional life as a physicist. Starting with my Bachelor thesis on single-photon sources for quantum cryptography, I had to experience that experiments often do not work as expected and require a certain amount of creativity, self-confidence, and frustration tolerance to proceed.

Soon after my bachelor's degree, I did not only want to dive deeper, but also focus a lot more on laser physics. This is how I came across the attoworld-group in Garching – a unique family of highly motivated people that strive to advance science, technology, and medicine by means of ultrafast laser technology. The longer I worked in the group, the more I began to understand how I myself can contribute to our grand goal of shaping the future of healthcare. Therefore, it is not surprising that I am still part of attoworld and continuing my work as a Postdoc and project manager after doing my master's and PhD work here.

Though I have not been directly in touch with attosecond science yet, our team is working hard to develop the next-generation laser systems with ultra-low amplitude and phase noise, which could also act as a frontend for attosecond experiments. Via nonlinear processes, the few-cycle laser pulses can be exploited to produce highly reproducible electric field waveforms in a wide variety of spectral ranges, potentially



including the generation of sub-femtosecond UV pulses as well.

What inspired your interest to attosecond science and what drives you the most about your research now?

One of the points that drives me the most about my research is the ability to work on something which has not been tried out yet. There is a high and unique degree of research freedom in academia that is very different from the classic R&D sector in industry. Moreover, if it comes to new scientific breakthroughs, it is a very rewarding experience for all the efforts that you put into your project – in particular, when many people might benefit from your new findings. I am thinking of the laser technology that we are working on at the moment and its potential use for the early detection of diseases like cancer.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

Naturalness is a wonderful virtue and associated with modesty. Some people define it as enthusiasm for the little things in life. In other words, I also try to enjoy the small things and be grateful for them. During stressful times, this personal trait helps me to stay focused and keep my pace while having high expectations and goals. Also, when you behave natural and spread positive feelings, you will never have any severe conflicts with your colleagues.

Another important skill is related to the balance between time for work and time for other aspects of life, including family-related and

personal interests. Maintaining a proper balance allows me to release stress, to stay very productive despite busy schedules and to live a healthy life. Though I am working for many hours per day, I try to have some time for myself in the evening and do things that I enjoy most over the weekends. I am very thankful to be able to spend a lot of time with my (grand)parents and partner and to pursue my hobbies, including diving and riding a motorcycle. Finding the right balance, however, is a skill that requires training.

When talking to colleagues or giving presentations, a good verbal expressiveness is essential to catch people's attention and getting to the point. I am continuously working on this soft skill and feel that I have made quite some progress over the past few years. Moreover, I realized that people provide me with very positive and encouraging feedback after presentations – which is one of the best rewards.

Last but not least, I have never made a difference between me and my (mostly male) colleagues and always raised my voice if necessary. I guess this is one of the main reasons why I never had to deal with any problems related to gender inequality or similar aspects.

What do you look for in a mentor? What are the best lessons you have learned from your mentors? What will you do differently?

A mentor should be open-minded and listen to your ideas. In science, we often want to try out things that are not part of the original plan. Moreover, I would like to have a person to learn from and look up to because of his/her great level of experience. I find it always very useful to receive constructive feedback from such a person and it shows that he/she has interest in my personal development.

One of the best lessons I have learned from my mentors is that you should always have a clear vision – a big picture – in mind that guides you along your way. In doing so, I realized that I better understand the value of my scientific contributions and keep up my high motivation even when experiments are not going well.

In general, it would be great if mentors and leaders also acknowledge smaller achievements. Though they look small on paper, it could have required a great deal of work and time to get them to run. This is simply because experimental work also requires solving problems other than just scientific ones. That's what I will keep in mind when acting myself as a mentor.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

Up to now, I have never struggled with any issues – neither from a personal point of view nor have I heard of any severe problems within our own research group. For me it is always astonishing and at the same time enriching to experience how many different nationalities work together in our team. You begin to realize how different our cultural backgrounds are when a team member talks about his/her recent holidays spent with family members abroad. It is all more enjoyable to experience a wonderful team spirit with a lot of mutual respect for each other, mixed with the curiosity for the cultural diversity. Such kind of multicultural environment is typical for academia, and it would be an enormous achievement if we could expand part of this spirit to our society as a whole.

Nicolette Puskar

University of California, Berkeley, CA USA

Tell us about yourself and your journey to attosecond science.

My name is Nicolette and I am a rising 3rd year chemistry PhD student co-advised by Dr. Stephen Leone and Dr. Daniel Neumark at the University of California, Berkeley. I grew up in Vero Beach, FL and went to college at Lawrence University and Conservatory in Appleton, WI. I would say my journey to attosecond science began the first day of my quantum mechanics class. I was fascinated with how the mathematical language so aptly described universal phenomena. By the end of the course, I knew that I wanted to become fluent in that language. To aid in my fluency, I decided to study spectroscopy: lasers are excellent liaisons that help us talk to atoms and molecules in real time! Ultimately, I was converted by quantum weirdness and became a budding academic, where the only place I could more deeply explore these curiosities was at a doctoral program researching attosecond science.

What inspired your interest to attosecond science and what drives you the most about your research now?

I knew I would study attosecond science in graduate school after using a laser in my first spectroscopic research project. I was extremely fascinated with the technology and wanted to use it to study small systems at the fastest timescales currently available. This is what drives me the most in my research: attosecond science's ability and potential to explore fundamental research at an unprecedented temporal resolution.

What traits, habits and skills have been important as your career progressed? How did they help you stand out in the community?

Perhaps the most important individual skill I've learned throughout my academic career is practicing tangible goal setting. Outlining my short-term, medium-term, and long-term goals in calendar format keeps me on top of my tasks, on track for my projects, and keeps me motivated and happy with my progress in my career. In addition, looking back on what I've previously accomplished also helps to build my self-confidence. A more collective trait that has been extremely important for me during my academic career is practicing community building. As a queer woman in attosecond science, I believe that engaging in DEI initiatives, providing service for department engagements, and volunteering for roles outside of the lab has a profound impact on the culture of science while simultaneously diversifying the academic landscape. My own community recognizes that I care about improving my department in all of the ways listed above: it's why I was elected President of UC Berkeley's Chemistry Graduate Life Committee.

You are a protagonist in the future story of attosecond science: how will attosecond science change the world?

If I must be objective, I could comment on the potential of controlling electronic and nuclear dynamics of light-driven ultrafast processes most relevant to society, such as making solar fuels through artificial photosynthesis, repairing radiation-damaged DNA for cancer treatments, and creating bio-inspired solar cells through charge migration methods. However, I prefer to be poetic, and will quote Isaac Newton: "*If I have seen further than others, it is by standing on the shoulders of giants.*" Every small discovery contributes to a larger body of knowledge, and that is what changes the world.

What do you look for in a mentor? What are the best lessons you have learned from your mentors? What will you do differently?

The main trait I look for in a mentor is someone who believes in their students: their intellect, their ability, and their potential. From my academic mentors, the main lesson I've learned can be summed up as: "*If you want to study attosecond science, you belong in this community*." This is a mantra I carry with me and aim to share with all my students in the future.

At its inception, attosecond science was done by only few isolated groups. In the last two decades, however, it has expanded, with many projects including multiple PIs. How do you navigate this complex collaboration network?

I believe it is necessary to acknowledge that: 1. Everyone within this network is doing important and groundbreaking work, and 2. Everyone has a niche area of wisdom from which we can learn. I navigate this network with humbleness, curiosity, and positivity: a combination that has resulted in fruitful scientific discussions within this circle.

In your experience, has attosecond science been an inclusive community? What changes, if any, would you like to see?

While my experience in the attosecond science community is still quite limited, all of my interactions so far have been incredibly positive. I'd like to note that I think this project is a lovely way to promote inclusivity. Visibility in the sciences is crucial and I appreciate the opportunity to contribute to this very important collection of interviews. On the note of change, I would love to see this type of project occur more often at conferences: highlighting under-represented scientists and sharing their perspectives for all community members to see.

Tran-Chau Truong

University of Central Florida, FL USA

Tell us about yourself and your journey to attosecond science. What inspired your interest to attosecond science and what drives you the most about your research now?

I'm Chau Truong, a PhD student in University of Central Florida. I'm from Vietnam where I studied the Atomic, Molecular and Optics for my Master degree. From that I wished to see how behaviors of atoms and molecules can be observed through experiments so I decided to study aboard instead of in my country where we cannot afford for expensive laser facilities. Fortunately, University of Central Florida where they have a high-ranking optic field, especially having modern attosecond facilities, gave me a chance to study here. That's why I'm now a PhD student in LUMAS group of Prof. Michael Chini, where we study the electron dynamic in materials using intense laser field. At present, we are working on generating few-cycle light source from commercial Yb:KGW laser.

You are a protagonist in the future story of attosecond science: how will attosecond science change the world?

I hope to see the research results in attosecond science can help people to understand and control chemical reactions at atomic, molecular level for creating efficient drugs to cure human diseases or new materials.

What do you look for in a mentor? What are the best lessons you have learned from your mentors? What will you do differently?

I was looking for a mentor who supports and inspires students. Luckily my mentor has these, and we learn a lot of things from him.