

Scientific Report Tulip Summer School 2012

A) Summary

The Tulip Summer School was held from 10-13 April 2012 in Fletcher Hotel De Witte Raaf, Noordwijk, The Netherlands. The School was attended by 60 participants, 6 lecturers and 2 organizers. It is worth noticing that the number of applicants was larger than 60, the maximum number that could be hosted, showing that the School by now has acquired quite an impressive reputation. Each of the 6 lecturers presented 2 sessions of 1.45 hours each on selected topics in the field of spectroscopic and dynamical studies of structure and dynamics of molecular systems as well as nanophotonics. The topics included attosecond spectroscopy, strong field molecular dynamics, biomolecular spectroscopy, manipulation of light in nanoscale structures, metrology and spectroscopy, and microscopy

The subjects that were chosen for the 2012 School are at the forefront of modern science. All lecturers have in the recent past published one or more articles in high- impact journals such as Nature, Science, PNAS, PRL, etc.. The Tulip School has provided the participants with an overview of the latest developments in these selected areas of gas-phase, condensed-phase, biomolecular dynamics, and microscopy, as well as materials science with a special emphasis on the application of ultrafast laser techniques to study structural dynamics.

Besides these lectures there was a special session with 4 short talks by PhD students which were selected from the submitted abstracts. In two poster sessions some 55 posters were presented and discussed. For the best presentation two Poster Prizes have been awarded: the *PCCP* Poster Prize and the *Society for the Advancement of Natural and Medical Sciences* Poster Prize, while the two runner-ups were awarded a prize as well. A special Prize was awarded to the participant that was most active during the lectures in asking questions.

The 60 participants came from 11 different European countries: Netherlands (30), United Kingdom (6), Germany (5), Denmark (3), Switzerland (3), Austria (2), Sweden (2), France (2), Italy (1), Finland (1), Ireland (1), and from 2 countries outside the EC: India (2) and USA (2). Furthermore, we remark that the majority of the “Dutch” PhD or postdoc participants have non-Dutch nationality.

At a more general level, the School has contributed to strengthen the education of young researchers in Europe.

B) Scientific Content

Prof. dr. Mattanjah de Vries, Department of Chemistry, University of California, Santa Barbara, USA.

High-resolution spectroscopy of biomolecular building blocks

In his series of lectures prof. de Vries described experimental methods to study biomolecular building blocks of increasing complexity, and how to incorporate influences of the environment into such studies. He showed how such a reductionist approach is able to achieve specificity for single conformers, tautomers and cluster structure that would be difficult to achieve in any kind of bulk measurement. These methods were illustrated with the results of studies on peptide folding at the level of the “hinges”, studies on the excited-state dynamics of nucleobases in relation to why nature has in the end chosen these particular nucleobases, and studies on DNA base pairing.

Prof. dr. Stefan Hell, Max Planck Institute for Biophysical Chemistry, Göttingen, Germany.

Microscopy beyond the diffraction limit

Tremendous developments have taken place in recent years in the field of microscopy. Prof. Hell discussed in his lectures how his group developed novel approaches based on elementary transitions between the states of a fluorophore to eliminate the limiting role of diffraction. He showed how nanoscopic schemes like STED are used to study dynamic processes in cells in real time, and how this concept is actually implemented in commercial microscopes. In his second lecture he showed how the underlying “on-off” concept of STED has now evolved into many other schemes like PALM, STORM, and GSDIM, and is transforming many areas in life and material sciences.

Prof. dr. Kobus Kuipers, FOM-Institute AMOLF, Amsterdam, The Netherlands.

Nanophotonics

Prof. Kuipers covered in his first lecture the basic physics and technology development associated with controlling light at length scales below its wavelength. He showed how nowadays it is possible to obtain such control using photonic crystals and plasmonic metallodielectrics. Amongst the exciting possibilities for application are concepts for perfect lenses and cloaking. In his second lecture he discussed how one could actually measure light propagation at the nanoscale using a special near-field microscope, and how this is then used to study coupling of light to plasmonic nanowires. He ended his series with some recent breakthroughs like the measurement of the magnetic field of light.

Prof. dr. Frederic Merkt, ETH Zürich, Switzerland.

Ultra-high-resolution molecular spectroscopy and cold molecules

In his first lecture Prof. Merkt started with a detailed discussion on the properties of Rydberg states and their applications in physics and chemistry. He illustrated the close relationship between Rydberg states, electron-ion collisions and photoionization with studies using ultra-narrow VUV laser sources and millimeter-wave radiation sources. The first lecture ended with a discussion of how photoelectron spectroscopy has contributed to answer questions concerning the structure and dynamics of molecular ions. In his second lecture precision spectroscopy on the dissociation and ionization energies of molecular hydrogen was discussed. Prof. Merkt showed that the state-of-the-art is nowadays such that comparison between theoretical and experimental quantities is limited by the uncertainty in the proton-to-electron mass ratio. Finally, Prof. Merkt discussed the development of methods to generate (ultra)cold molecular samples using Rydberg-Stark deceleration and multistage Zeeman deceleration.

Prof. dr. Anne L'Huillier, Lund University, Sweden.

Attosecond science: generation and application of attosecond pulses

Prof. L'Huillier started her series of lectures with the description of the physics leading to the generation of attosecond pulses. She showed how the main ideas arose and progressively went from nonlinear optics, the generation of high-order harmonics in gases, to ultrafast optics. In her second lecture she described how attosecond pulses are characterized with a special emphasis on RABBIT (Reconstruction of attosecond beating by interferences of two-photon transition) and streaking. She concluded her lecture series with examples of the application of attosecond spectroscopy in atomic and molecular physics.

Prof. dr. Henrik Stapelfeldt, Aarhus University, Denmark.

Alignment and orientation of molecules by strong laser pulses

Prof. Stapelfeldt discussed in his lectures the basic principles and ideas of laser induced alignment and orientation. Topics that were discussed included (i) adiabatic and nonadiabatic alignment, (ii) fixing the three-dimensional orientation of asymmetric top molecules, (iii) rotational wave packet dynamics, (iv) mixed-field orientation by combining strong laser pulses with a weak static electric field, and (v) ultimate alignment using quantum state-selected molecules. These principles were subsequently illustrated with state-of-the-art applications with an emphasis on time-resolved imaging of torsion in axially chiral molecules and photoelectron spectroscopy from fixed-in-space molecules.

C) Assessment of results and impact

The program was intensive, but balanced we believe, with one afternoon off for recreational activities. Because all participants were staying in the same location - which was somewhat isolated from the village of Noordwijk - there was ample time for informal discussions and talks during the breakfasts, lunches and dinners, which were in the Hotel and the coffee/tea breaks.

The Lecture notes were prepared ahead of the School thanks to the excellent work of the lecturers who submitted the course material in time. We produced a CD-ROM containing all the School material prior to the meeting which gave the participants good opportunities to browse and study the material during the week, and to pay attention to the lecturer without the need to try to 'copy by handwriting' the presented material.

From the reactions we received (see inquiry below), we believe the research subjects of the School were interesting and state-of-the art, and overall the participants seemed enthusiastic about the quality of the presentations.

We, as organizers, believe that the format of the School - having each lecturer present 2 double presentations - certainly strengthened the atmosphere of a School for graduates and postdocs. The lecturers had time to really go in depth into the material and interact and respond to questions during and after the lectures. Because of the strong minority of senior people (basically only the lecturers themselves and the organizers) in the audience the atmosphere was really dominated by the young participants. This in contrast to the larger

general scientific meetings, where the atmosphere and discussions are usually dominated by established seniors. We hope we helped to create a high-quality learning environment for the students and postdocs.

In summary

We believe that the format of the Tulip School and the support of the ESF were an excellent match and that these kind of dedicated workshops/schools for young researchers should definitely be continued the coming years. We hope that in 3 years we will find again the means to organize such a school to strengthen the education of young researchers in Europe.

Prof. Maurice H.M. Janssen

Prof. Wybren Jan Buma

24 May 2012

Evaluation form

1. Variety of spectroscopic topics	8	15	35	Average		2,3 = diverse
	very similar	similar	ok	diverse	too diverse	
	1	2	3	2	1	
2. Length of lectures			53	3	2	2,9 = ok
	too short	short	ok	long	too long	
	1	2	3	2	1	
3. Level of lectures			49	7	1	2,8 = ok
	1	2	3	2	1	
	too short	short	ok	long	very long	
4. Overall quality of lectures			1	22	26	4,5 = good to very good
	very bad	bad	neutral	good	very good	
	1	2	3	4	5	

In specific:

Stefan W. Hell	8	26	23	4,5 = good to very good		
	1	2	3	4		
Kobus Kuipers	5	16	37	4,6 = good to very good		
	1	2	3	4		
Anne L'Huillier	1	3	9	21	24	4,1 = good
	1	2	3	4	5	
Frédéric Merkt	1	4	23	29	4,4 = good to very good	
	1	2	3	4	5	
Henrik Stapelfeldt	1	4	24	29	4,4 = good to very good	
	1	2	3	4	5	
Mattanjah S. de Vries	2	20	35	4,6 = good to very good		
	1	2	3	4	5	

5. Quality of educational material		2	16	23	15	3,9	= good
	very bad	bad	neutral	good	very good		
	1	2	3	4	5		
6. Quality of housing/rooms			7	21	30	4,4	= good to very good
	very bad	bad	neutral	good	very good		
	1	2	3	4	5		
7. Quality of food/drinks		1	3	26	27	4,3	= good to very good
	very bad	bad	neutral	good	very good		
	1	2	3	4	5		
8. Convenience of location for travel from abroad			13	21	11	4,0	= good
	very bad	bad	neutral	good	very good		
	1	2	3	4	5		
9. Conference fee		7	18	21	11	3,6	= good
	too high	high	neutral	reasonable	good		
	1	2	3	4	5		
10. Overall organization and support			11	22	25	4,2	= good
	very bad	bad	neutral	good	very good		
	1	2	3	4	5		

PROGRAMME

Tuesday 10/4/2012

- 11.00 – 12.45** **Arrival and registration**
- 12.45 – 14.00 Lunch
- 14.00 – 14.15** **Opening and welcome**
- 14.15 – 16.00** **Mattanjah de Vries** (*University of California at Santa Barbara, USA*)
Biomolecular Spectroscopy 1
- 16.00 – 16.30 Coffee/Tea break
- 16.30 – 18.15** **John van Geuns Lecture:**
Stefan Hell (*MPI Goettingen, Germany*)
Microscopy 1
- 18.30 – 20.00 Dinner Buffet and **Poster Session 1** (*Odd Numbers*)
- 20.15 – 22.00** **Kobus Kuipers** (*AMOLF, Amsterdam, the Netherlands*)
Nano-photonics 1

Wednesday 11/4/2012

- 8.45 – 10.30** **Frederic Merkt** (*ETH, Zurich, Switzerland*)
Metrology 1
- 10.30 – 11.00 Coffee/Tea break
- 11.00 – 12.45** **Anne L'Huillier** (*Lund, Sweden*)
Attosecond Dynamics
- 12.45 – 14.00 Lunch
- 14.15 – 16.00** **Henrik Stapelfeldt** (*Aarhus, Denmark*)
Strong Field Dynamics 1
- 16.00 – 16.30 Coffee/Tea break
- 16.30 – 18.15** **John van Geuns Lecture:**
Stefan Hell (*MPI Goettingen, Germany*)
Microscopy 2
- 18.30 – 20.00 Dinner
- 20.15 – 21.15** **Short Talks**
1. **David Staedter** (*Paul Sabatier University, Toulouse, France*)
2. **Simon Merz** (*Fritz-Haber Institute, Berlin, Germany*)
3. **Elisabet Romero** (*VU University Amsterdam, The Netherlands*)
4. **Yaroslav Sych** (*ETH Zurich, Switzerland*)
- 21.15 – 23.00** **Poster Session 2** (*Even Numbers*)

Thursday 12/4/2012

- 8.45 – 10.30** **Anne L’Huillier** (*Lund, Sweden*)
Attosecond Dynamics 2
- 10.30- 11.00 Coffee/Tea break
- 11.00 – 12.45** **Mattanjah de Vries** (*University of California at Santa Barbara, USA*)
Biomolecular Spectroscopy 2
- 12.45 – 14.00 Lunch
- FREE TIME
- 16.30 – 18.15** **Frederic Merkt** (*ETH, Zurich, Switzerland*)
Metrology 2
- 18.30 – 23.00 Dinner & Social Event

Friday 13/4/2012

- 8.45 – 10.30** **Henrik Stapelfeldt** (*Aarhus, Denmark*)
Strong Field Dynamics 2
- 10.30 – 11.00 Coffee/Tea break
- 11.00 – 12.45** **Kobus Kuipers** (*AMOLF, Amsterdam, the Netherlands*)
Nano-photonics 2
- 12.45 – 14.00 Lunch
- 14.15** **Departure by bus to Leiden Central Station**

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