LASERLAB Amsterdam

Institute for Lasers,
Life and Biophotonics

ANNUAL REPORT 2012

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1. PREFACE

This is the third annual report of LaserLaB Amsterdam, the inter-faculty Research Institute of the VU University in collaboration with the VU Medical Center, the University of Amsterdam and the Academic Medical Center. LaserLaB Amsterdam was established in spring 2010. The opening of LaserLaB Amsterdam was celebrated on October 22, 2010 with a symposium at the Koninklijke Nationale Academie voor Wetenschappen, Trippenhuis, Amsterdam.

In 2012, LaserLaB Amsterdam could celebrate the award of a VICI grant to Dr. John Kennis and a VIDI grant to Dr. Jeroen Koelemij. LaserLaB Amsterdam has now 7 VICI recipients among its staff. Furthermore, the high quality of staff was recognized by the award of 2 (out of a total of 5) VU campus wide University Research Chairs (URC's) to LaserLaB faculty Dr. Erwin Peterman and Dr. Davide Iannuzzi. Also LaserLaB faculty Dr. Kjeld Eikema was appointed full professor.
LaserLaB Amsterdam continued to fare well within the national competition with grants from FOM, NWO-ECHO, STW, and ZonMW.

LaserLaB Amsterdam (LLAMS) is one of the founding fathers of LASERLAB-Europe, an Integrated Infrastructure Initiative of the European Union, forming a consortium of the 27 major laser centers in Europe. Within LASERLAB-Europe, LLAMS provides Transnational ACCESS to European scientists, who are welcome to use our advanced laser-based facilities. LASERLAB-Europe successfully applied for a 4-year renewal proposal, which started in 2012. Strategically, Laserlab Amsterdam is firmly embedded in the activities of LASERLAB-Europe, participating in the innovative radiation sources at the extremes (INREX) and Laser and Photonics for Biology and Health (BIOPTICHAL) programs of the awarded prolongation Laserlab Europe III.

In summary, we can look back at a very successful year.

Johannes F. de Boer
Director

LASERLAB-Europe: a consortium of the 27 major laser centers in Europe

2. DESCRIPTION OF LASERLAB AMSTERDAM

A) MISSION

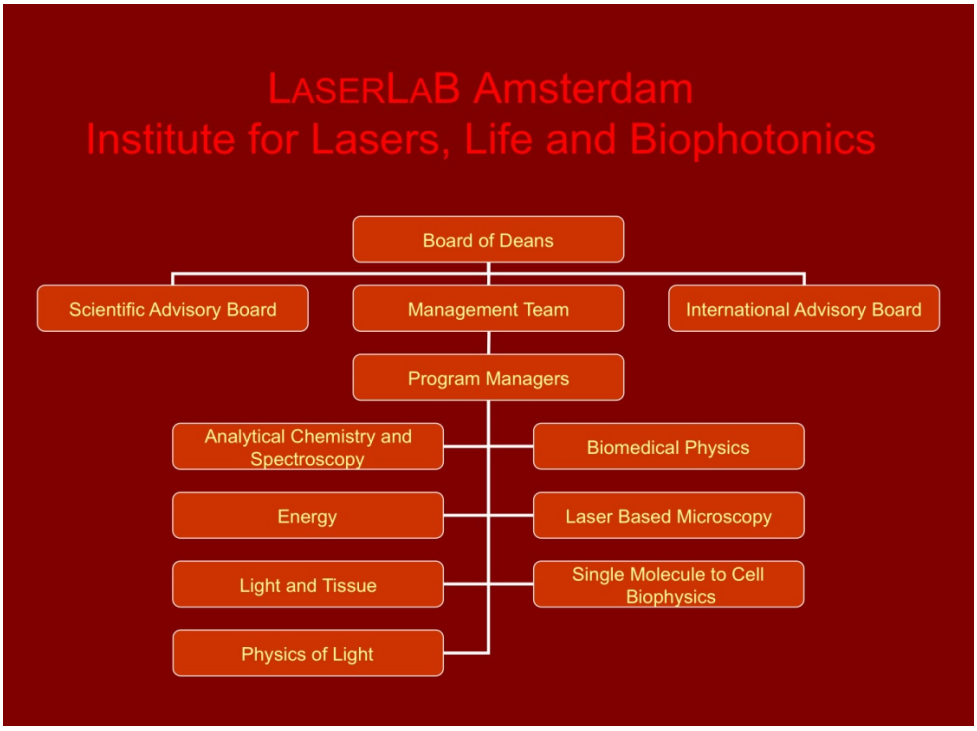
The mission of LaserLaB Amsterdam is groundbreaking scientific research based on the interaction of light with matter, spanning from the research on atoms and molecules to the investigation of living cells and tissue and sustainable energy sources. Within LaserLaB, research is conducted in close collaboration between physicists, chemists, biologists and physicians.

LaserLaB Amsterdam is hosted at the VU University, with participating research groups at the UvA, AMC and VUmc. LaserLaB is a founding partner of the new VU University medical imaging center. LaserLaB Amsterdam is part of LASERLAB-Europe, an Integrated Infrastructure Initiative of the European Union, forming a consortium of the 28 major laser centers in Europe.

B) STRATEGY and FUTURE VISION

The increasing demand for health and longevity requires a better understanding of the basic processes of life. The LaserLaB research is focused on the development and application of novel optical methods, techniques and instruments to study the interaction between proteins, DNA, cells and tissue. This knowledge will lead to innovative diagnostic and therapeutic techniques.
Energy production will play a crucial role in our future. The process of photosynthesis in plants serves as an example for renewable energy production. By studying this process, it is possible to develop more efficient solar cells or biofuels. The laser has made it possible to study the structure of living materials and matter and the chemical and physical processes that take place within them.
Fundamental laser physics is firmly anchored within LaserLaB, studying the evolution of spectral lines in the universe, developing new X-ray sources, and advancing ultra-precise atomic clocks and GPS navigation.
LaserLab will serve as a powerful multidisciplinary educational faculty, especially for national and international (Master's) students and strives to continue and strengthen its unique position in Europe.

3. STRUCTURE OF LASERLAB AMSTERDAM



The core of LaserLaB Amsterdam are the programs directed by the program managers. Programs are centered on 7 themes that constitute the long term research goals of the institute.

1 Analytical Chemistry and Spectroscopy

Program manager: Prof. dr. W.J. Buma

Both Amsterdam universities have a strong history and track record in the area of analytical chemistry and spectroscopy, in particular with respect to the application of laser-based research. Currently, three groups (one in analytical chemistry, two in fundamental spectroscopy) are active. The research theme comprises activities in Molecular spectroscopy (Buma/Brouwer/Woutersen/Williams/Zhang UvA), Ultrafast photodynamics and spectroscopy in the gas phase (Janssen, VU), and Biomolecular (Analysis and) Spectroscopy (Ariese/van der Zwan, VU). Each of the three groups thus brings in complementary expertise that allows them to cover together the full range of chemical-spectroscopic research. Research in the area of analytical chemistry and spectroscopy is dedicated to both fundamental science and applications, with a close connection to industry.

2 Biomedical Physics

Program manager: Prof. dr. J.F. de Boer

The long-term goal of the research program Biomedical Physics is to develop the next generation optical techniques for the diagnosis, understanding, and treatment of disease. In clinical medicine, significant progress in screening, diagnosis and treatment has been fuelled by the exact sciences and has for instance led to imaging techniques such as X-ray, MRI and PET imaging. Optical techniques have the advantages of using non-ionizing radiation, being non- or minimally invasive with unprecedented resolution (down to molecular level), and having the capability of spectroscopic analysis of tissue. A main thrust of the research is in the area of Optical Coherence Tomography (OCT). OCT creates in-vivo cross-sectional images approaching the cellular level in a non-invasive or minimally invasive way. OCT can potentially provide “optical biopsies” for real time in-vivo diagnosis. Just as fluorescence has revolutionized cell biology, we expect minimally invasive imaging of targeted fluorophores to have a major impact in clinical medicine. Research is sponsored by FOM, NIH (USA), STW, and ZonMW through a VICI grant (Dr. de Boer).

3 Energy

Program manager: Prof. dr. R. van Grondelle and Prof. dr Roberta Croce.

Energy Research in LaserLaB Amsterdam is focused on the study of the fundamental events of the natural process of Photosynthesis. These include the capture of solar photons, the transfer of the electronic excitation to the photosynthetic reaction center where a charge separation is driven. All these events occur on a timescale of 10^{-15} to 10^{-9} seconds and are studied with ultrafast pulsed lasers using techniques such as pump-probe spectroscopy in the visible and mid-infrared, multi-dimensional photon echo, streak-camera detected fluorescence. Based on this knowledge artificial, bio-inspired photosynthetic systems are designed and studied using the same methods with the aim to develop a future ‘bio-solar cell’.

4 Laser-Based Microscopy

Program manager: Prof. dr. M.L. Groot

Within this program we develop nonlinear and coherent microscopic tools for studies on cellular and tissue scale in the field of neurobiomedical research. The ability to look at living organisms with microscopic resolution has been of tremendous importance for understanding biological structure and function. Here, we develop nonlinear optical techniques to obtain images in deep-tissue with sub-cellular resolution, with and without external contrast agents (dyes, GFP). Label-free in-vivo images are obtained through third harmonic generation. Current research lines are the development of multipulse microscopies to obtain sub-diffraction resolution and the application of THG and digital holography in neuromedical research. This research is closely integrated with the Neuroscience Campus Amsterdam.

5 Light and Tissue

Program manager: Prof. dr. T.G. van Leeuwen

The research activities in the program “Light and Tissue” at the Academic Medical Center focus on the physics of the interaction of light with tissue, and to use that knowledge for the development, introduction and clinical evaluation of (newly developed) optical imaging techniques for gathering quantitative functional and molecular information of tissue. Within our group, we focus on optical techniques as optical coherence tomography (OCT), spectrographic monitoring and imaging, photo-acoustic and fluorescence imaging, along the following research lines:

1. Functional imaging and forensic applications: VIDI grant of Dr Aalders, in cooperation with Neonatology, Ophthalmology and the Netherlands Forensic Institute.
2. Molecular imaging: VENI grant of Dr Faber, with clinical spin-offs towards Ophthalmology and Urology and the NKI.
3. Integration and combination of different imaging technologies, (“from cleanroom to clinic”) in cooperation with TU/e, UT, gastro-enterology and experimental clinical chemistry.

6 Single Molecule to Cell Biophysics

Program manager: Prof. dr. G. Wuite

The research in this program focuses on exploring biophysical questions on the level from single molecules to cells. A central question is how protein and DNA structural dynamics are related to their function. The aim is to work with increasingly complex assemblies of biomolecules in order to investigate the emergent properties from these systems. This approach bridges experimental systems biology and single-molecule manipulation techniques. We are also focusing more and more on single-biomolecule dynamics in living cells or organisms. We use a variety of optical techniques such as super-resolution fluorescence microscopy, single-molecule fluorescence spectroscopy, optical tweezers, tethered particle motion, AFM, as well as combinations of these techniques. The data obtained are related to biochemical studies and used for theoretical modeling.

7 Physics of Light and Matter

Program manager: Prof. dr. K.S.E. Eikema

The research activities carried out in the program “Physics of Light and Matter” concentrate on performing ultra-precision experiments, which includes the development of advanced lasers sources (such as frequency comb lasers, ultra-stable lasers, extreme ultraviolet lasers and TeraWatt short pulse lasers) and spectroscopic methods to cool, manipulate and trap atoms, molecules and ions. The exciting possibilities due to advanced lasers and methods to control matter are explored in two major themes. One is “Fundamental physics at the atomic scale”, which includes searching for a possible variation of fundamental constants, testing quantum-electrodynamic theory in atoms and small molecules, and studying matter at ultra-low temperatures. The other theme is “Applied Laser Spectroscopies” which ranges from spectroscopy of astrophysically relevant gas-phase species, sensitive detection of molecules in liquids and mono-layer surfaces, light scattering studies, development of miniature lasers for length measurement, to imaging with ultrafast X-rays a at sub-cellular level.

Participating faculties:

1. Faculty of Sciences at VU University Amsterdam
2. Faculty of Earth and Life Sciences at VU University Amsterdam
3. Faculty of Medicine at VU University Amsterdam
4. Faculty of Science at University of Amsterdam
5. Faculty of Medicine at University of Amsterdam

Themes/programmes/subprogammes:

1. Analytical Chemistry and Spectroscopy
2. Biomedical Physics
3. Energy
4. Laser Based Microscopy
5. Light and Tissue
6. Single Molecule to Cell Biophysics
7. Physics of Light

Organization (board, management):

Scientific Director: Prof. Dr. J.F. de Boer
Financial Manager/Treasurer: Dr. F. Ariese
Access Manager: Prof. Dr. M.H.M. Janssen
Publick Relations: Dr. Y. Bollen
Member: Prof. Dr. K.S.E. Eikema
Member: Dr. J. Kennis
Management Assistant: Ms. M.E. Herronen

Scientific advisory board members:

Prof.dr. R. van Grondelle
Prof.dr. W.M.G. Ubachs
Prof.dr. C. Gooijer
Prof. Dr. H. Lill
Prof. Dr. G. van Dongen

4. SWOT ANALYSIS

Strengths
The strength of LaserLaB Amsterdam is its faculty. Hiring within the LaserLaB Programs and the Dept of Physics has been based for a long time on potential earning capacity of faculty candidates. The strong performance in ERC (EU), Innovational Research Incentives Scheme (vernieuwingsimpuls), and national program and project grants is a result of this policy. LaserLaB Europe provides a strong platform for international visibility and exchange of scientists through the Access program. Within the VU University, LaserLaB Amsterdam is considered a research crown jewel with the largest number of NWO-scholarships (Veni, Vidi, Vici) on VU-campus. Research cores are well positioned to participate in regional and national funding initiatives. Neuroscience campus, the institute AIMMS, the institute Quantivision, and the VU medical Imaging center provide an excellent environment for cross disciplinary collaborations on the campus.

Weaknesses
LaserLaB Amsterdam has three main research cores, Physics of Light and Matter, Sustainable Earth/Energy/Environment, and Life & Health. The latter two are firmly embedded within the focus areas of the campus, while Physics of Light and Matter forms a foundation for the two other core activities through the development of advanced (laser)techniques. Each of the themes has not yet enough mass to achieve an agenda setting position within the national or European research agenda. Mass has to be generated by strategic alliances within the regional and national setting.

Opportunities
Within the Life & Health research core, LaserLaB has a strategic alliance with the UvA (Prof. Buma) and the AMC (Prof. van Leeuwen) as participants. The topsector area plans for Life Sciences and Health provides a strong opportunity to expand the research. The Innovative Medical Device Initiative (IMDI) is mentioned at several occasions in the Life Sciences and Health topsectorplan. LaserLaB participates in the institute Quantivision (iQ) which is a joint initiative of the VUmc, VU, NKI, UvA and AMC and one of the eight cores of excellence of the IMDI initiative. iQ provides the critical mass within the Amsterdam region to achieve an agenda setting research program. LaserLaB also participates in the VU Medical imaging center to shape the life and health research agenda. In the context of the Amsterdam Faculty of Science discussion, the Life & Health core of LaserLaB is a strong partner in the new Amsterdam Bio Science Campus (ABSC), the “red life” science research center that aims to be established on the VU campus.

VU and UvA both participate in a major initiative “Solardam” of which the research core is Sustainable Earth/Energy/Environment. The initiative is based on the strong photosynthesis activity at VU and aims to establish a FOM/NWO focus group that will form the core of a joint VU-UvA Energy program, including research in photosynthesis, catalysis, photoconversion & artificial photosynthesis, theoretical systems physics/biology, microbiology, theoretical chemistry and photochemistry. The program will include a VU-UvA Energy&Sustainability master teaching program.

Within the Physics of Light and Matter (PLM) core, LaserLaB provides a nucleus within the Netherlands for ultra-high precision tests of physics and development of techniques for controlling atomic, molecular, and ionic matter. Efforts are ongoing for ultraprecise optical clock dissemination on a European scale and for navigation of the future. The advanced laser techniques that are developed at the PLM core provide strong opportunities for collaborations with the two other core activities within LaserLaB Amsterdam and Laserlab Europe (Joint Research Activities INREX and BIOPTICHAL). PLM is well positioned through international

collaborations with Fritz Haber Institute (G. Meijer, Berlin) and the ETH (F. Merkt, Zurich), with companies such as Menlo and Toptica in Germany and IMRA in the USA, and research groups worldwide for theoretical support.

Threats

The biggest and most urgent threat to LaserLaB has been the outcome of the Amsterdam Faculty of Science discussion, with plans to divide LaserLaB over two campus sites. Despite a strong desire by LaserLaB staff to remain united in a single new high tech facility and explore and capitalize on the multidisciplinary environment, LaserLaB will be divided over two sites.

This poses new challenges and probably the need for a new organizational structure, which needs to play out over the coming years.

Housing in the near and distant future remains a topic of crucial importance. The excellent research facilities of LaserLaB require the lowest vibration levels possible for the lab space. The strategic alliance of the VU exact sciences with the UvA has resulted in the relocation of the major part of LaserLaB to Science Park, constituting a serious threat to the cohesion within LaserLab and the presence of a high-tech exact science facility at the VU campus. At the same time, new high tech facilities need to become available at Science Park to accommodate the majority of LaserLaB staff that will relocate there.

In general the downward pressure on budgets for investment in research and education remains a threat. The strategy to counter this threat is excellence and relevance. LaserLaB Amsterdam strives for excellence, as is evident from the success in European and national competitions, and has focused its efforts on two of the major societal problems that will have a national and global impact: Energy and Life & Health.

5. GRANTS, NEWS AND HIGHLIGHTS OF THE YEAR 2012

RESEARCH GRANTS

In 2012 LaserLaB researchers received several prestigious grants from international and national funding sources.

VICI
Dr. John Kennis: *Controlling life processes by means of light* (27 January 2012)

VIDI
Dr. Jeroen Koelemeij: *Super-GPS through optical fibers* (3 July 2012)

Foundation Kinderen Kankervrij: *Diagnosis of vital tumor tissue by OCT and MRI in retinoblastoma patients*
Dr. Annette Moll (VUmc) and Prof.dr. Johannes de Boer (260 keuro), 2012

STW HTSM 2012 grant: *Quantitative disease characterization and Retinal tracking in Ophthalmic Imaging (Q-ROI)*
Prof.dr. Johannes de Boer (669 keuro), December 2012

ZonMW topsubsidie: *Quantitative in vivo characterization of optical properties of ocular tissue for diagnosis and monitoring of chorioretinal diseases.*
Prof.dr. Johannes de Boer (675 keuro), December 2012

NWO-BAZIS grant *Photons for Chemistry*
Fred Brouwer, Wybren Jan Buma and Maurice Janssen (450 keuro), 2012

FOM projectruimte *The protonic Hall Effect*
Wouterse (UvA) and Bakker (Amolf), 400 keuro, 2012

KNAW-China *Sensitive in-situ detection of circulating cancer cells using a multifunctional fiber modified with photonic nanoconjugates*
Hong Zhang, Wybren Jan Buma (UvA), Ton van Leeuwen, Maurice Aalders (AMC), and the Changchun Institute of Applied Chemistry of the Chinese Academy of Sciences (250 keuro), 2012

FOM-Projectruimte *Self-assembly of nano-shells*
Prof. dr. A. Heck, Prof. dr. Gijs Wuite and dr Wouter Roos (550 keuro)**,** 2012

FOM-projectruimte Methanol in the early Universe; a sensitive probe for drifting constants
Prof.dr. W. Ubachs and dr. R. Bethlem, (400 keuro), 2012

FOM-Projectruimte *The size of the helium nucleus*
Dr. W. Vassen (539 keuro), 2012

FOM-program 2012 grant: *"Crowd management: The physics of genome processing in complex environments"*
Prof. dr. Gijs Wuite and 7 other PI's in the Netherlands (3000 kEuro, of which 382 kE to LaserLaB), (Dec 2012)

An **ASPASIA** grant was offered to *Prof. Roberta Croce*.

Hong Zhang is part of a consortium in China that received a grant from the Ministry of Education of China for the project "*Functional micro- and nanomaterials and applications*" (2200 kEuro).

EU-Integrated Infrastructure Initiative grant: A 10 Meuro renewal LASERLAB EUROPE-3. was accepted and started in May 2012 (funds for LaserLaB Amsterdam 413kE). In addition, because of the extra access offered during LLE-2, and additional 140 kE was allocated to Amsterdam.

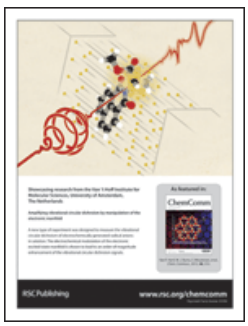
RESEARCH AND PUBLICITY HIGHLIGHTS OF 2012

Publications of Analytical Chemistry well presented on journal covers.

Publications of the Analytical Chemistry programme at Van't Hoff Institute for Molecular Sciences at University of Amsterdam have been well presented on the journal covers of Physical Chemistry Chemical Physics and Chemical Communications.

Time-Resolved Vibrational Spectroscopy of a Molecular Shuttle
M.R. Panman, P. Bodis, D.J. Shaw, B.H. Bakker, A.C. Newton, E.R. Kay, D.A. Leigh, W.J. Buma, A.M. Brouwer, and S. Woutersen
Phys. Chem. Chem. Phys., DOI: 10.1039/C1CP22146A.

Amplifying vibrational circular dichroism by manipulation of the electronic manifold



S.R. Domingos, M.R. Panman, B.H. Bakker, F. Hartl, W.J. Buma, and S. Woutersen
*Chem. Comm.***48**, 353 (2012).

VICI grant for John Kennis; VU designs tools to control cells with light

One of the great challenges in biology is to control life processes in cells and organs by means of light. In this way, scientists can obtain deep insights in how such processes proceed and they may intervene in cellular processes if so desired. John Kennis, biophysicist at the Physics Department of the Faculty of Sciences at VU University has been rewarded a Vici subsidy to develop, study and improve the tools that enable such cellular control by means of light.

Light-sensitive proteins in plants and animals

Light sensitive proteins – so-called photosensory proteins are found in organisms such as plant, bacteria and algae, but also in animals. They are responsible for specific light-controlled functions: the well-known response of plants to grow towards light, the response of algae to swim towards or away from a light source. Photosensory proteins are increasingly being used for so-called 'optogenetic' applications: the control of life processes by means of light. Optogenetics is an emerging field with tremendous potential and has been declared 'Method of the Year 2010' by the prestigious Nature journal.

Controlling neurons by means of light

In optogenetics, photosensory proteins that naturally occur in certain organisms are being engineered to fulfill a certain designed function in a different organism, cell or tissue of choice. For instance, in neuroscience specific neurons in a mouse brain can be brought under light control by expression of a light-gated ion channel that naturally occurs in algae. In this way, scientists can understand neuronal circuits and even control the animal's behaviour. Yet, little is known about the light-activated function of photosensory proteins that make such novel scientific approaches possible.

How photosensory proteins change their shape after light activation

John Kennis will study the light-activated function of designed photosensory proteins by means of advanced laser techniques: time-resolved two-dimensional infrared spectroscopy and stimulated Raman spectroscopy. In this way, he will obtain a detailed view of how the protein changes it shape after light absorption, and how the protein generates a signal that activates a desired function in the targeted cell or tissue. With the obtained knowledge, photosensory proteins can be improved, or even given new functionalities for optogenetic purposes. In addition, the research will provide, for the first time, a detailed 'molecular movie' of functional structural changes in a protein upon stimulation.

Vici-subsidy

The Vici-subsidy of the Netherlands Organization of Scientific Research (NWO) is aimed at experienced researchers that have demonstrated their ability of setting up an independent, innovative line of research and act as a coach for young scientists. The grant involves 1.5 million Euro and is highly competitive. John Kennis will use the grant mainly to appoint young researchers in his research group.

Publication by Dr. W. Roos in the prestigious journal Proceedings of the National Academy of Sciences.

Spotted under the microscope: how a virus puts on its armor.
Biophysicists visualize surprising tricks of viruses.
Scientists from VU University Amsterdam, Scripps Research Institute and the University of Michigan discovered how a virus 'puts on its armor'. This 'armor', consisting of mere proteins, is initially flexible and weak, but subsequently goes through an exceptional strengthening process. Surprisingly, the reinforcement of the virus does not occur in one, but in three, independent ways. The researchers reported their results in the online version of the prestigious journal *Proceedings of the National Academy of Sciences*.

Pierre Mangeol awarded with Fondation de France Jacques Monod prize

Post doc fellow Pierre Mangeol, from Single Molecule to Cell-level Biophysics laboratory, was awarded with the Fondation de France Jacques Monod prize for his PhD work on the study of RNA-protein interactions at the single molecule level.

This prize is awarded to researchers who worked in French laboratories on molecular aspects of cellular regulation. The awarding jury consists of leading reseachers, most of which worked with Jacques Monod.
During his PhD, Pierre Mangeol built a double optical tweezers setup, which enables to probe molecular interactions, one molecule at the time. He used this setup to probe protein-RNA interactions that take place in the ribosome as well as interactions responsible for expression regulation during protein translation.

Aspasia grant for young female scientists

Department of Physics and Astronomy has, in connection with the VICI grant of Prof. Roberta Croce, received a special ASPASIA-grant from NWO. Part of this grant is to "stimulate young female scientists in their career".

NWO grant `Photons for Chemistry` received by Brouwer, Buma and Janssen

Within the NWO-Chemical Sciences programme BAZIS (Basis Apparatuur Zwaartepunten In Scheikunde) a joint proposal `*Photons for Chemistry*` was granted to 3 researchers of LaserLaB Amsterdam, prof. Fred Brouwer (UvA), prof. Wybren Jan Buma (UvA) and prof. Maurice Janssen (VU). The joint research proposal is part of the UvA-VU Sectorplan Focus area *Analytical Chemistry and Spectroscopy*, and is fully embedded as one of the Research Programmes of LaserLaB Amsterdam The total support (incl. matching) is 450 kE which will be used for a 'High-repetition rate femtosecond laser system`, a 'High-power nanosecond laser system` and a `Fluorescence spectrometer`. The equipment grant will support three new projects within LaserLaB Amsterdam:

- the development of a novel microscope for the ultra-sensitive detection of chiral (bio)molecules
- the study of structure and dynamics of molecular machines by excited state spectroscopy
- a fluorescence spectrometer to characterize (supra)molecular excited states in molecular motors

The novel equipment will be embedded within LaserLaB Amsterdam as a user facility. Since LaserLaB Amsterdam is part of LaserLab-Europe (www.laserlab-europe.eu), external groups within Europe will be able to perform experiments with the novel laser facilities granted by NWO-Chemical Sciences.

The network of European laser research on the threshold to the future
Third phase of LASERLAB-EUROPE starts in Bratislava

LASERLAB-EUROPE, the consortium of the major European laser research institutions, gathered in Bratislava to enter a new phase of collaboration. It celebrated this event together with representatives of the European Commission, the Slovak Government and the Slovak Academy of Sciences at a launch ceremony on 15 March.

The local host, the International Laser Centre (ILC) / Medzinárodné Laserové Centrum, with its Director František Uherek and Deputy Director Dušan Chorvát, became a member of LASERLAB-EUROPE in early 2009. Since then it plays a key role as national contact point in one of the EU's new Member States, and as coordinator of LASERLAB-EUROPE's training activities.

"We have deliberately chosen Bratislava for this important event and are grateful to our hosts" says Prof. Wolfgang Sandner of Max Born Institute in Berlin who coordinates the LASERLAB-EUROPE consortium. "Lasers and photonics, one of only five key technologies of the European Union, are not only essential for the scientific but also for the socio-economic future of any country."

The world's most powerful scientific lasers, comprising the European "Extreme Light Infrastructure" ELI, a close collaborator of LASERLAB-EUROPE, are presently being established in three sites in the Czech Republic, Hungary, and Romania. Another civilian European mega-project, HiPER, will investigate the possibility of creating energy from fusion, a clean and practically inexhaustible source of energy which also powers the sun. The latest generation of laser devices developed within the LASERLAB-EUROPE consortium span the bridge from these two mega-projects to world-leading table-top devices for science, life sciences, medicine, engineering, or environmental sciences.

In the now starting phase 2012 - 2015 LASERLAB-EUROPE comprises 28 of the largest European laser infrastructures and, together with subcontractors and associate partners, covers 19 European countries. The consortium regularly offers free access to its facilities for a large number of single principal investigator groups from European universities. "Thanks to LASERLAB-EUROPE the community of European laser researchers has established close bonds. Today, Europe appears to be the most powerful and successful region for laser research worldwide", says Sandner.

Laserlab Europe expands in third phase
David Pile, Nature Photonics, Volume: 6, Pages: 568–570 (2012) DOI: doi:10.1038/nphoton.2012.219 Published online 03 September 2012

The consortium that brought together laser research institutions from across Europe has been extended for three more years. The geographical expansion of the group, particularly in central and Eastern Europe and scientifically less well-developed countries, paints a picture for photonics in Europe.

Website Laserlab Europe

Testing Quantum Electro Dynamic Theory

Wim Vassen will carry out extremely precise measurements on helium atoms, trapped and cooled by lasers. He will aim for a precision to the 13nd or 14th digit, for which a second, ultrastable laser will be employed, coupled to an atomic clock. This way Quantum Electro Dynamic theory will be tested.

Jeroen Koelemeij receives Vidi grant for research on SuperGPS

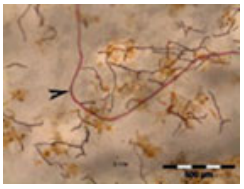
Dr. Jeroen Koelemeij received a Vidi grant from NWO and STW to develop the building blocks for a 'SuperGPS' system. In the near future, this system may be used to back up and improve the functionality of the existing Global Positioning System by means of accurate time and frequency distribution through the optical fiber telecom network. At LaserLaB, Koelemeij will develop the components and lasers needed for such a system, including an extremely accurate optical atomic clock. This clock, based on the ultrastable oscillations of a single aluminum ion at rest in an ion trap, will be so accurate that it will be sensitive to the gravitational potential difference corresponding to a vertical displacement of several centimeters. The new SuperGPS technology will be tested through the existing SURFnet optical fiber link, running between LaserLaB VU and KVI Groningen.

De Volkskrant reports about the "SuperGPS" optical connection between LaserLaB VU and the nuclear accelerator facility KVI in Groningen, which runs through the SURFnet optical fiber network. In the future, this SuperGPS connection should enable much more precise timing and positioning than is currently possible with Global Positioning System, GPS.

Physicists develop new 3D microscope technique, relevant for very small endoscopes for hospital diagnostics

VU LaserLaB physicists **Prof. Johannes F. de Boer** and **dr. Mattijs de Groot**, in collaboration with Massachusetts General Hospital have developed a new microscope technique that can provide three-dimensional images. This will be relevant for clinical diagnostics, where doctors use very small endoscopes, too small to house conventional depth scanning options. The technique will enable the detection of small numbers of molecules, with a depth resolution of tens of nanometers. The results were reported in *Optics Express*.

Raman spectroscopy applied in environmental sciences to detect plastic contamination in wastewater effluents



Miriam Moester and Freek Ariese of the VU LaserLaB have collaborated with Heather Leslie and Dick Vethaak of the VU Institute for Environmental Studies, Deltares and the TU Delft in a search for microplastics in waste water treatment systems. Microplastics are tiny particles or fibers of synthetic polymers that enter wastewater streams from households and urban runoff. This highly durable material may reach wastewater through down-the-drain personal care products containing microplastics or from the synthetic textile fibers that come off your clothes in the washing machine. These household microplastics and microplastics from other sources end up in our wastewater and sewage sludge. The researchers used light microscopy to examine filtrates of treated wastewater effluents that are emitted to the environment. They detected microparticles in a kaleidoscope of shapes, sizes and colours, and have applied Raman spectroscopy to identify a number polymers. Since the plastic particles in wastewater effluent are not easily visible to the naked eye, the term plastic "bouillon" might be more befitting than plastic soup. The results of a preliminary study can be found in a joint VU-Deltares-TU Delft scientific publication in the Dutch water management journal *H2O* (6 July 2012).

PhD student Gareth Dickenson from the Atomic, Molecules and Lasers group won the Molecular Physics Prize 2011, a competition for young authors.

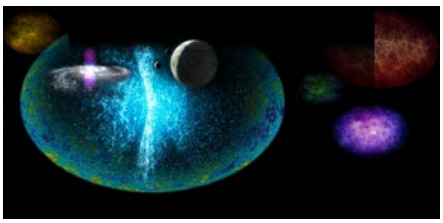
His article **VUV spectroscopic study of the D^1Pi_u state of molecular deuterium** describes a spectroscopic study on the deuterium molecule. The research was performed with a unique Fourier-transform spectrometer operational in the vacuum ultraviolet wavelength range. The work is carried out at the French synchrotron SOLEIL near Paris.

Wim Ubachs receives "New Frontiers in Cosmology" prize for research on fundamental constants.

Prof. Dr Wim Ubachs was awarded one of the "New Frontiers in Cosmology" prizes for his research "Search for Drifting Constants via Extra-galactic Alcohol". The prize amounts to 250000 US $, provided by the Templeton Foundation, and will be invested in research.

The prize was established to encourage researchers to look for answers to the "Big Questions":

- What was the earliest state of the Universe ?
- Is our Universe unique or is it part of a much larger multiverse ?
- What is the origin of complexity in the Universe ?
- Are we alone in the Universe ?



Wim Ubachs received the prize at a symposium with all prize winners in Philadelphia, 12-13 October 2012.

John Kennis is awarded the Japanese Morino Lectureship 2012

John Kennis has been awarded the 2012 Morino Lectureship for the Promotion of Molecular Sciences. He received ¥ 1000,000 (€ 10.000) to travel to Japan, where he gave the Morino Lecture on November 15 at the Nogaya Institute of Technology, followed by a series of lectures in Kyoto, Osaka, Nagoya, Hamamatsu and Tokyo.

The Morino Lectureship was established in 1985 by the late Professor Yonezo Morino, a renowned Japanese molecular spectroscopist, to support and encourage young scientists in the field of molecular science. It was designed to give the opportunity for a foreign distinguished scientist to come to Japan to instruct young scientists and students who are working at the frontier of various fields of molecular science.

John Kennis, Associate Professor at the Physics Department at VU University, is the first person from the Netherlands to receive the award. Past lecturers to win the prestigious award have included Nobel Prize winner Robert Curl of Rice University, Richard Saykally of UC Berkeley, Richard Zare of Stanford University and Thomas Elsaesser of the Max-Born Institute.

The research of John Kennis involves the physico-chemical mechanisms of reception, storage and processing of photic energy and information in biology and biomimetic systems. To this end, he employs advanced time-resolved spectroscopic methods such as ultrafast optical

spectroscopy, time-resolved (two-dimensional) vibrational spectroscopy and multi-pulse spectroscopy. His research projects are focused on light-driven signal transduction mediated by newly discovered photoreceptor proteins with a high potential for practical applications and energy storage and regulatory phenomena in natural and artificial photosynthesis. Earlier this year he was awarded a prestigious VICI fellowship from the Netherlands science foundation. John Kennis considers the award as a great honor, especially because the Japanese scientific community has had a long-standing reputation of expertise, excellence and innovation in the research fields where he is active.

Davide Iannuzzi and Erwin Peterman appointed University Research Chairs
At the 132nd Dies Natalis of VU University dr. Davide Iannuzzi and dr. Erwin Peterman were appointed University Research Chair professors because of their excellent achievements.

The University Research Chair (URC) is a special professor appointment. With a URC VU University acknowledges its excellent scientists, who are being regarded as future leaders in their fields.

Appointment
Each year maximum five URCs are being appointed, The number of nominations is limited and depends on the size of the Faculties. Only Faculty deans can nominate candidates for a URC appointment. A committee selects the best candidates and advises the College of Deans; this committee consists of three conrectors, two full professors and is chaired by the rector magnificus. A suitable candidate amply fulfills the requirements for full professor, excels in his/her research area and shows great potential for further growth.

Davide Iannuzzi designs instruments on top of optical fibers; measurement devices not larger than a hair. With these instruments topological and pressure measurements can be performed at the nanometer scale, and they offer possibilities for nanomicroscopy. For this 'fiber-top technology' he received in 2008 an ERC Starting Grant and in 2011 an ERC-Proof of Concept grant. In the meantime he has also founded a company Optics11.

Erwin Peterman studies the physics of life processes at the molecular scale. In 2010 he received a Vici-subsidy of NWO for his research. He makes use of advanced techniques such as single-molecule fluorescence microscopy and optical tweezers.

FOM-Projectruimte for Virus Research
Gijs Wuite and Wouter Roos want to unravel virus assembly.
FOM, the organisation funding Physics research within the Netherlands, has awarded a "Projectruimte" grant to virus researchers from our Physics and Astronomy department and the Universiteit Utrecht. The VU researchers Gijs Wuite and Wouter Roos, from the section Physics of Living Systems, will supervise a Ph. D. student who, using several Biophysical techniques, will try to unravel how viruses succeed to assemble themselves. This fascinating process still bears many mysteries, for instance it remains unclear what the interactions between viral proteins and the viral RNA is, how fast viral particles self-assemble and how stable the assembled shell is. The student will tackle these questions using a combination of Atomic Force Microscopy, Optical Tweezers and advanced fluorescence microscopy techniques. Working in collaboration with the group of Albert Heck (Universiteit Utrecht), who will perform Mass Spectrometry experiments on viral structure, Wuite and Roos will obtain a comprehensive picture on the physics of viral assembly.

Dr. Kjeld Eikema is appointed per 1 Jan. 2013 to full professor in Physics, in the area of "Ultrafast laser physics and precision metrology"

Dr. Kjeld Eikema is doing his research in the inter-faculty Research Institute LaserLaB. He also is Special Professor at the University of Groningen (RUG).

Science publication: Molecular matter hasn't changed a bit in seven billion years

A proton weighs 1836.152672 as much as an electron. Experiments with extragalactic alcohol show that this ratio was the same seven billion years ago, at least within the experimental error of 10^{-5} percent. Therefore, the value of this fundamental constant – and therefore the structure of molecular matter – has not changed during the second half of the lifetime of the Universe. This was published by a Dutch-German research team led by FOM project leader Wim Ubachs in *Science*.

The idea started when it was realized that the structure of the methanol molecule is very sensitive to changes in the mass-electron ratio. This structure when measured in extragalactic methanol could therefore provide information on the history of this ratio. They proposed to German researchers to use their 100-m diameter radiotelescope in Eiffelsberg to look for extragalactic methanol. Indeed in a distant galaxy they found molecules absorbing at the characteristic frequencies of methanol, From the cosmological red-shift they could determine its age as 7 billion years. From ultraprecise frequency measurements they managed to determine that the fundamental constant had not changed, at least not more than 10^{-5} percent. The study was carried out by physics professor Wim Ubachs (VU), FOM-PhD student Julija Bagdonaite (VU), Paul Jansen (VU), Rick Bethlem (VU) and two radio astronomers of the Max Planck Institute in Bonn.

Prizes LaserLaB Symposium 2012
The winner of the Best Paper Award 2012 was announced during the LaserLaB Symposium.

The annual award for the best paper under the young LaserLaB scientists was announced during the annual LaserLaB symposium on Friday 7 December 2012.
This year's winner comes from the research program Physics of Light.

Itan Barmes won the prize with his article: "Spatial and spectral coherent control with frequency combs", Nature Photonics 2012, doi:10.1038/nphoton.2012.299.

This year we also had a poster competition. The first prize went to University of Freiburg to Mattia Walschaers for his poster "Centro-symmetric Hamiltonians foster quantum transport", and the second prize was received by Tjaart Kruger from the VU University Amsterdam for the poster "Controlled disorder explains photosynthetic protein multifunctionality".

Alison Telfer and Mattia Walschaers

Alison Telfar and Tjaart Kruger

6. INPUT LASERLAB AMSTERDAM

Research input is calculated according to the following general guidelines for VU interfaculty research institutes (IOZIs): Scientific staff is assumed to spend 40% of time on research, postdoctoral researchers and PhD students 100%. Technical support staff is not included

VU University (incl. FOM employees)

- Total fte FEW (including PhD students): 103.3
  1st funding (incl./excl. PhD students) 8.3/6,3
  2nd funding 61.6
  3rd funding 33.4

- Total fte PhD student FEW: 60.8
  1st funding 2.0
  2nd funding 37.3
  3rd funding 21.5

- Total new started PhD students FEW: 15
  1st funding 0
  2nd funding 9
  3rd funding 6

  Total fte FALW: 1.7

University of Amsterdam

- Total fte: 20
- Total fte PhD students: 14

Amsterdam Medical Centre

- Total fte: 13
- Total fte PhD students: 9

Total LaserLaB Amsterdam

- Total fte (including PhD students): 138
- Total fte PhD student: 84

Earning power (FEW only)

Total value of grants acquired in 2012: 6 600 k€
(of which 5800 k€ 2nd and 800 k€ 3rd funding)

Research input FEW WP1 = fte (staff 40% + PD 100%) 6.3

Earning power per 10 WP1 = 10 500 k€

Total research input FEW WP (staff 40% + PD 100% + PhD 100%) = fte 103.3

Earning power per 10 WP = 640 k€

(In comparison: in 2011 the total grant value acquired at FEW was 10 800 k€; the earning power per 10 WP1 (7.0 fte) was 15 400 k€ and the earning power per 10 WP total (80.0 fte) was 1350 k€.)

7. OUTPUT RESEARCH INSTITUTE

A) SCIENTIFIC OUTPUT

Overall scientific output LaserLaB Amsterdam

Total number of theses: 12

Total number of scientific papers, refereed: 174

PER RESEARCH PROGRAM

Scientific Output Theme Analytical Chemistry and Spectroscopy

- Number of theses: 1

  C.P. Groen
  Structural and thermodynamic investigations of lanthanide halide species in metal halide discharge lamps
  promotor: prof.dr. A.M. Brouwer; co-promotor: dr. A. Oskam
  date: 7 November 2012

- Number of scientific papers, refereed: 38

1. D. Bleger, J. Schwarz, A.M. Brouwer & S. Hecht (2012). o-Fluoroazobenzenes as Readily Synthesized Photoswitches Offering Nearly Quantitative Two-Way Isomerization with Visible Light. Journal of the American Chemical Society, 134(51), 20597-20600.

2. W.D.A.M. de Boer, D. Timmerman, T. Gregorkiewicz, H. Zhang, W.J. Buma, A. N. Poddubny, A.A. Prokofiev & I.N. Yassievich (2012). Self-trapped exciton state in Si nanocrystals revealed by induced absorption. Physical Review B, 85(16).

3. P. Contreras Carballada, N. Mourtzis, M. Felici, S. Bonnet, R.J.M. Nolte, R.M. Williams, L. De Cola & M.C. Feiters (2012). Variation of the Viologen Electron Relay in Cyclodextrin-Based Self-Assembled Systems for Photoinduced Hydrogen Evolution from Water. European Journal of Organic Chemistry.

4. S.R. Domingos, MM. Almasian, J. Grzetic, J. van Maurik, J.D. Steill, G. Berden, S. Ingemann, W.J. Buma & J. Oomens (2012). Non-equilibrium isomer distribution of the gas-phase photoactive yellow protein chromophore. The Journal of Physical Chemistry Letters, 3(16), 2259-2263.

5. S.R. Domingos, M.R. Panman, B.H. Bakker, F. Hartl, W.J. Buma & S. Woutersen (2012). Amplifying vibrational circular dichroism by manipulation of the electronic manifold. Chemical Communications, 48(3), 353-355.

6. S.R. Domingos, P.S. Pereira Silva, W.J. Buma, M.H. Garcia, N. C. Lopes, J. A. Paixao, M. R. Silva & S. Woutersen (2012). Amplification of the linear and nonlinear optical response of a chiral molecular crystal. Journal of Chemical Physics, 136(13).

7. D.D. Günbaş & A.M. Brouwer (2012). Degenerate molecular shuttles with flexible and rigid spacers. The Journal of organic chemistry, 77(13), 5724-5735.

8. A. Jacquart, R.M. Williams, A.M. Brouwer & E. Ishow (2012). Decoupling fluorescence and photochromism in bifunctional azo derivatives for bulk emissive structures. Chemistry - A European Journal, 18(12), 3706-3720.

9. T. Kumpulainen & A.M. Brouwer (2012). Excited-state proton transfer and ion pair formation in a Cinchona organocatalyst. Physical Chemistry Chemical Physics, 14(37), 13019-13026

10. V.A. Nguyen & R.M. Williams (2012). Bis-semiquinone (bi-radical) formation by photoinduced proton coupled electron transfer in covalently linked catechol-quinone systems: Aviram's hemiquinones revisited. Photochemical & Photobiological Sciences, 11(6), 957-961

11. M.R. Panman, P. Bodis, D.J. Shaw, B.H. Bakker, A.C. Newton, E.R. Kay, D.A. Leigh, W.J. Buma, A.M. Brouwer & S. Woutersen (2012). Time-resolved vibrational spectroscopy of a molecular shuttle. Physical Chemistry Chemical Physics, 14(6), 1865-1875.

12. M. Plugge, V. Alain-Rizzo, P. Audebert & A.M. Brouwer (2012). Excited state dynamics of 3,6-diaryl-1,2,4,5-tetrazines: experimental and theoretical studies. Journal of Photochemistry and Photobiology A-Chemistry, 234, 12-20.

13. T.N. Raja, A.M. Brouwer, T. Nabuurs & R. Tennebroek (2012). A fluorescence approach to investigate repartitioning of coalescing agents in acrylic polymer emulsions. Colloid and polymer science, 290(6), 541-552.

14. Bald, D. & Koul, A. (2012). Advances and strategies in discovery of new antibacterials for combating metabolically resting bacteria. *Drug Discovery Today*.

15. Bollen, Y.J.M., Westphal, A.H., Lindhoud, S., Berkel, W.J. van & Mierlo, C.P. van (2012). Distant residues mediate picomolar binding affinity of a protein cofactor. *Nature Communications, 3*, 1010.

16. Bruel, N., Castanié-Cornet, M.P., Cirinesi, A.M., Koningstein, G.M., Georgopoulos, C., Luirink, J. & Genevaux, P. (2012). Hsp 33 Controls Elongation Factor-Tu Stability and allows Escherichia coli growth in the absence of the major DnaK and Trigger Factor Chaperones. *Journal of Biological Chemistry, 287*, 44435-44446.

17. Daleke, M.H., Woude, A.D. van der, Parret, A.H.A., Ummels, R., Groot, A.M., Watson, D., Piersma, S.R., Jimenez, C.R., Luirink, J., Bitter, W. & Houben, E.N.G. (2012). Specific Chaperones for the Type VII Protein Secretion Pathway. *Journal of Biological Chemistry, 287*(38), 31939-31947.

18. Eyles, C.J., Brouard, M., Chadwick, H., Hornung, B., Nichols, B., Yang, C.-H., Kłos, J., Aoiz, F.J., Gijsbertsen, A., Wiskerke, A.E. & Stolte, S. (2012). Fully Λ- doublet resolved state-to-state differential cross sections for inelastic scattering of NO(X) with Ar. *Physical Chemistry Chemical Physics - PCCP, 14*(16), 5403-5419.

19. Eyles, C.J., Brouard, M., Chadwick, H., Aoiz, F.J., Kłos, J., Gijsbertsen, A., Zhang, X. & Stolte, S. (2012). The effect of parity conversation on the spin-orbit conserving and spin-orbit for the differential cross sections for inelastic scattering of NO(X) by Ar. *Physical Chemistry Chemical Physics - PCCP, 14*(16), 5420-5439.

20. Harvey, C.E., Petterson, I.E.I., Weckhuysen, B.M., Gooijer, C., Ariese, F. & Mank, A.J.G. (2012). Looking Inside Catalyst Extrudates with Time-Resolved Surface-Enhanced Raman Spectroscopy (TR-SERS). *Applied Spectroscopy, 66*(10), 1179-1185.

21. Hollund, H.I., Ariese, F., Fernandes, R., Jans, M.M.E. & Kars, H. (2012). Testing an alternative high-throughput tool for investigating bone diagenesis: FTIR in attenuated total reflection (ATR) mode. *Archaeometry, 2012*.

22. Houben, E.N.G., Bestebroer, J., Ummels, R., Wilson, L., Piersma, S.R., Jimenez, C.R., Ottenhoff, T.H.M., Luirink, S. & Bitter, W. (2012). Composition of the type VII secretion system membrane complex. *Molecular Microbiology, 86*(2), 472-484.

23. Jin, B., Wang, G.X., Millo, D., Hildebrandt, P. & Xia, X.A. (2012). Electric-field controle of the pH-dependent redox process of cytochrome c immobilized on gold electrode. *Journal of Physical Chemistry C. Nanomaterials and Interfaces, 116*, 13038-13044.

24. Jong, W.S.P., Soprova, Z., Punder, K. de, Hagen-Jongman, C.M. ten, Wagner, S., Gier, J.W. de, Andersen, P., Wel, N.N. van der & Luirink, S. (2012). A structurally informed autotransporter platform for efficient heterologous protein secretion and display. *Microbial Cell Factories, 11*(85).

25. Kozuch, J., Steinem, C., Hildebrandt, P. & Millo, D. (2012). Combined electrochemistry and surface-enhanced infrared absorption spectroscopy of gramicidin A incorporated into tethered bilayer lipid membranes. *Angewandte Chemie International Edition in English, 51*, 8114-8117.

26. Lammers, I., Lhiaubet-Vallet, V., Jimenez, M.C., Ariese, F., Miranda, M.A. & Gooijer, C. (2012). Stereoselective Binding of Flurbiprofen Enantiomers and their Methyl Esters to Human Serum Albumin Studied by Time-Resolved Phosphorescence. *Chirality, 24*(10), 840-846.

27. Lehmann, C.S., Ram, N.B. & Janssen, M.H.M. (2012). Velocity map photoelectron-photoion coincidence imaging on a single detector. *Review of Scientific Instruments, 83*(9).

28. Luirink, S., Yu, Z., Wagner, S. & Gier, J.W. de (2012). Biogenesis of inner membrane proteins in Escherichia coli. *Biochimica et Biophysica Acta. Bioenergetics, 2012*(6), 965-976.

29. Millo, D. (2012). Spectroelectrochemical analysis of electroactive microbial biofilms. *Biochemical Society Transactions, 40*, 1284-1290.

30. Sauri, A., Hagen-Jongman, C.M. ten, Ulsen, J.P. van & Luirink, S. (2012). Estimating the size of the active translocation pore of an autotransporter. *Journal of Molecular Biology, 2012*(3), 335-345.

31. Schkolnik, G., Utesch, T., Salewski, J., Tenger, K., Millo, D., Kranich, A., Zebger, I., Schulz, C., Zimanyi, L., Rakhely, G., Mroginski, M.A. & Hildebrandt, P. (2012). Mapping local electric fields in proteins at biomimetic interfaces. *Chemical Commununications, 48*, 70-72.

32. Schkolnik, G., Salewski, J., Millo, D., Zebger, I., Franzen, S. & Hildebrandt, P. (2012). Vibrational Stark effect of the electric-field reporter 4-mercaptobenzonitrile as a tool for investigating electrostatics at electrode/SAM/solution interfaces. *International Journal of Molecular Sciences, 13*, 7466-7482.

33. Sezer, M., Millo, D., Weidinger, I.M., Zebger, I. & Hildebrandt, P. (2012). Analyzing the catalytic processes of immobilized redox enzymes by vibrational spectroscopies. *IUBMB Life, 64*, 7466-7482.

34. Shanmugham, A., Bakayan, A., Völler, P., Grosveld, J., Lill, H. & Bollen, Y.J. (2012). The hydrophobic core of twin-arginine signal sequences orchestrates specific binding to Tat-pathway related chaperones. *PLoS ONE, 7*, e34159.

35. Tardioli, S., Lammers, I., Hooijschuur, J.H., Ariese, F., Zwan, G. van der & Gooijer, C. (2012). Complementary Fluorescence and Phosphorescence Study of the Interaction of Brompheniramine with Human Serum Albumin. *Journal of Physical Chemistry B, 116*(24), 7033-7039.

36. Tornero, J., Chao, M.-S., Lin, K.C., Jiang, D., Stolte, S. & González Ureña, A. (2012). Quantum decoherence mechamism in atom-molecule – collisions: NO-Ar. *AIP Conference Proceedings, 1501*, 1324-1329.

37. Utesch, T., Millo, D., Castro, M., Hildebrandt, P., Zebger, I. & Mroginski, M.A. (2012). Effect of the protonation degree of a self-assembled monolayer on the immobilization dynamics of a [NiFe] hydrogenase. *Langmuir*.

38. Woude, A.D. van der, Sarkar, D., Bhatt, A., Sparrius, M., Raadsen, S.A., Boon, L., Geurtsen, J.J.G., Houben, E.N.G., Besra, G.S., Bitter, W., Sar, A.M. van der & Luirink, S. (2012). Unexpected link between lipooligosaccharide biosynthesis and surface protein release in Mycobacterium marinum. *Journal of Biological Chemistry, 287*(24), 20417-20429.

Scientific Output Theme Biomedical Physics

- Number of Theses: 1

  Frank Helderman
  On the pathological remodeling of large arteries
  promotor: prof.dr. A Vonk Noordegraaf, Prof. dr. R. Krams
  defense: 23 April 2012

- Number of scientific papers, refereed: 15

1. Braaf, B., Vermeer, K.A., Vienola, K.V. & Boer, J.F. de (2012). Angiography of the retina and the choroid with phase-resolved OCT using interval-optimized backstitched B-scans. *Optics Express, 20*(20), 20516-20534.

2. Cuper, N.J., Graaff, J.C. de, Hartman, B.J., Verdaasdonk, R. & Kalkman, C.J. (2012). Difficult arterial cannulation in children: is a near-infrared vascular imaging system the answer? *British Journal of Anaesthesia, 109*(3), 420-426.

3. Cuper, N.J., Graaff, J.C. de, Dijk, A.T.H. van, Verdaasdonk, R., Werff, D.B.N. van der & Kalkman, C.J. (2012). Predictive factors for difficult intravenous cannulation in pediatric patients at a tertiary pediatric hospital. *Paediatric anaesthesia, 22*(3), 223-229.

4. Gemert, M.J.C. van, Geld, C.W. van der, Bruijninckx, C.M.A., Verdaasdonk, R. & Neumann, H.A.M. (2012). Comment to Vuylsteke ME and Mordon SR. Endovenous Laser Ablation: A Review of Mechanisms of Action. Ann Vasc Surg 2012;26:424-33. *Annals of Vascular Surgery, 26*(6), 881-883.

5. Groot, M. de, Evans, C.L. & Boer, J.F. de (2012). Self-interference fluorescence microscopy: three dimensional fluorescence imaging without depth scanning. *Optics Express, 20*(14), 15253-15262.

6. Heuveling, D.A., Visser, G.W.M., Groot, M. de, Boer, J.F. de, Salumbides - Baclayon, M., Roos, W.H., Wuite, G.J.L., Leemans, C.R., Bree, R. de & Dongen, G.A.M.S. van (2012). Nanocolloidal albumin-IRDye 800CW: a near-infrared fluorescent tracer with optimal retention in the sentinel lymph node. *European Journal of Nuclear Medicine and Molecular Imaging, 39*(7), 1161-1168.

7. Islam, M.S., Oliveira, M.C., Wang, Y., Henry, F.P., Randolph, M.A., Park, B. H. & Boer, J.F. de (2012). Extracting structural features of rat sciatic nerve using polarization-sensitive spectral domain optical coherence tomography. *Journal of Biomedical Optics, 17*(5).

8. Kim, K.H., Pierce, M. C., Maguluri, G. N., Park, B. H., Yoon, S.J., Lydan, M., Sheridan, R. & Boer, J.F. de (2012). In vivo imaging of human burn injuries with polarization-sensitive optical coherence tomography. *Journal of Biomedical Optics, 17*(6), 066012-066012.

9. Li, J.A., Groot, M. de, Helderman, F., Mo, J., Daniels, J.M.A., Grünberg, K., Sutedja, G.T. & Boer, J.F. de (2012). High speed miniature motorized endoscopic probe for optical frequency domain imaging. *Optics Express, 20*(22), 24132-24138.

10. Munck, J.C. de, Houdt, P.J. van, Verdaasdonk, R. & Ossenblok, P.P.W. (2012). A semi-automatic method to determine electrode positions and labels from gel artifacts in EEG/fMRI-studies. *Neuroimage, 59*(1), 399-403.

11. Sheehy, C.K., Yang, Q., Arathorn, D.W., Teeruveedhula, P., Boer, J.F. de & Roorda, A.J. (2012). High-speed, image-based eye tracking with a scanning laser ophthalmoscope. *Biomedical Optics Express, 3*(10), 2611-2622.

12. Vermeer, K.A., Schoot, J.H. van der, Lemij, H.G. & Boer, J.F. de (2012). RPE-Normalized RNFL Attenuation Coefficient Maps Derived from Volumetric OCT Imaging for Glaucoma Assessment. *Investigative Ophthalmology and Visual Science, 11*(3), 6102-6108.

13. Vienola, K.V., Braaf, B., Sheehy, C.K., Yang, Q., Tiruveedhula, P., Arathorn, D.W., Boer, J.F. de & Roorda, A.J. (2012). Real-time eye motion compensation fot OCT imaging with tracking SLO. *Biomedical Optics Express, 11*(3), 2950-2963.

14. Wu, H., Boer, J.F. de & Chen, T.C. (2012). Diagnostic Capability of Spectral-Domain Optical Coherence Tomography for Glaucoma. *American Journal of Ophthalmology, 153*(5), 815-826.

15. van der Schoot, J., Vermeer, K.A., Boer, J.F. de & Lemij, H.G. (2012). The Effect of Glaucoma on the Optical Attenuation Coefficient of the Retinal Nerve Fiber Layer in Spectral Domain Optical Coherence Tomography Images. *Investigative Ophthalmology and Visual Science, 53*(4), 2424-2430.

Scientific Output Theme Energy

- Number of theses: 2

Emilie Wientjes
Revealing the light-harvesting properties of Photosystem I from single antenna to supercomplex (Cum Laude)
promotor: prof.dr. R. Croce
defense: 19 January 2012

Alessandro Marin
Energy trasport pathways in photosynthetic antennas
promotor: prof.dr. R. van Grondelle
defense: 18 April 2012

- Number of scientific papers, refereed: 22

1. Berera, R., Stokkum, I.H.M. van, Gwizdala, M.S., Wilson, A., Kirilovsky, D. & Grondelle, R. van (2012). The photophysics of the Orange Carotenoid Protein, a light-powered molecular switch. *Journal of Physical Chemistry B, 116*, 2568-2574.

2. Croce, R. & Amerongen, H. van (2011). Light-harvesting and structural organization of Photosystem II: from individual complexes to thylakoid membrane. *Journal of Photochemistry and Photobiology B. Biology, 104*, 142-153.

3. Drop, B.A., Webber-Birungi, M., Fusetti, F., Kouril, R., Redding, K., Boekema, E.J. & Croce, R. (2011). Photosystem I of Chlamydomonas reinhardtii is composed of nine Light-harvesting complexes (Lhca) located on one side of the core. *Journal of Biological Chemistry, 286*, 44878-44887.

4. Gall, A., Berera, R., Alexandre, M.T.A., Pascal, A.A., Bordes, L., Mendes-Pinto, M.M., Andrianambinintsoa, S., Stoitchkova, K.V., Marin, A., Valkunas, L., Horton, P., Kennis, J.T.M., Grondelle, R. van, Ruban, A. & Robert, B. (2011). Molecular Adaptation of Photoprotection: Triplet States in Light-Harvesting Proteins. *Biophysical Journal, 101*(4), 934-942.

5. Hogewoning, S.W., Wientjes, I.E., Douwstra, P., Trouwborst, G., Iperen, W. van, Croce, R. & Harbinson, J. (2012). Photosynthetic Quantum Yield Dynamics: from Photosystems to Leaves. *The Plant Cell*.

6. Laptenok, S., Stokkum, I.H.M. van, Borst, J.W., Oort, B. van, Visser, A.J.W.G. & Amerongen, H. van (2012). Disentangling picosecond events that complicate the quantitative use of the calcium sensor YC3.60. *Journal of Physical Chemistry B, 116*(9), 3013-3020.

7. Lian, L.J., Stokkum, I.H.M. van, Koehorst, R.B.M., Jongerius, I., Kirilovsky, D. & Amerongen, H. van (2011). Site, rate, and mechanism of photoprotective quenching in cyanobacteria. *ACS Nano, 133*(45), 18304-18311.

8. Marin, A. (2012, april 18). *Energy transport pathways in photosynthetic antennas.* VU Vrije Universiteit. Prom./coprom.: prof. dr. R. van Grondelle.

9. Marin, A., Stokkum, I.H.M. van, Novoderezhkin, V.I. & Grondelle, R. van (2012). Excitation-induced polarization decay in the plant light-harvesting complex LHCII. *Journal of Photochemistry and Photobiology A. Chemistry, 234*, 91-99.

10. Mathes, T., Zhu, J., Stokkum, I.H.M. van, Groot, M.L., Hegemann, P. & Kennis, J.T.M. (2012). Hydrogen Bond Switching among Flavin and Amino Acids Determines the Nature of Proton-Coupled Electron Transfer in BLUF Photoreceptors. *Journal of Physical Chemistry Letters, 3*(2), 203-208.

11. Mathes, T., Stokkum, I.H.M. van, Stierl, M. & Kennis, J.T.M. (2012). Redox modulation of flavin and tyrosine determines photoinduced proton-coupled electron transfer and photoactivation of BLUF photoreceptors. *Journal of Biological Chemistry, 287*, 31725-31738.

12. Oort, B.F. van, Veer, M.J.T. ter, Groot, M.L. & Stokkum, I.H.M. van (2012). Excited state proton transfer in strongly enhanced GFP (sGFP2). *Physical Chemistry Chemical Physics - PCCP, 14*(25), 8852-8858.

13. Pandit, A., Shirzad-Wasei, N, Wlodarczyk, L.M., Van Roon, H., Boekema, E.J., Dekker, J.P. & Grip, W.J. de (2011). Assembly of the major light-harvesting complex II in lipid nanodiscs. *Biophysical Journal, 101*, 2507-2515.

14. Romero Mesa, E., Diner, B.A., Nixon, P.J., Coleman, W.J., Dekker, J.P. & Grondelle, R. van (2012). Mixed exciton–charge-transfer states in photosystem II: Stark spectroscopy on site–directed mutants. *Biophysical Journal, 103*(2), 185-194.

15. Snellenburg, J.J., Laptenok, S., Seger, R., Mullen, K.M. & Stokkum, I.H.M. van (2012). Glotaran: A Java-Based Graphical User Interface for the R Package TIMP. *Journal of Statistical Software, 49*(3), 1-22.

16. Stahl, A.D., Crouch, L.I., Jones, M.R., Stokkum, I.H.M. van, Grondelle, R. van & Groot, M.L. (2012). Role of PufX in Photochemical Charge Separation in the RC-LH1 Complex from Rhodobacter sphaeroides: An Ultrafast Mid-IR Pump-Probe Investigation. *Journal of Physical Chemistry B, 116*(1), 434-444.

17. Sytina, O., Stokkum, I.H.M. van, Heyes, D.J., Hunter, C.N. & Groot, M.L. (2012). Spectroscopic characterization of the first ultrafast catalytic intermediate in protochlorophyllide oxidoreductase. *Physical Chemistry Chemical Physics - PCCP, 14*(2), 616-625.

18. Wientjes, I.E., Roest, G.J. & Croce, R. (2012). From blue to red to far-red in Lhca4: how does the protein modulate the spectral properties of the pigments? *Biochimica et Biophysica Acta. Bioenergetics, 1817*, 711-717.

19. Wientjes, I.E. & Croce, R. (2012). Photosystem I electron donor or fluorescence quencher. *Photosynthesis Research, 111*, 185-191.

20. Wientjes, E. & Croce, R. (2011). The light-harvesting complexes of higher-plant Photosystem I: Lhca1/4 and Lhca2/3 form two red-emitting heterodimers. *Biochemical Journal, 433*, 477-485.

21. Wientjes, E., Stokkum, I.H.M. van, Amerongen, H. van & Croce, R. (2011). The role of the individual Lhca's in Photosystem I excitation energy trapping. *Biophysical Journal, 101*, 745-754.

22. Zhu, J., Mathes, T., Stahl, A.D., Kennis, J.T.M. & Groot, M.L. (2012). Ultrafast mid-infrared spectroscopy by chirped pulse upconversion in 1800-1000cm(-1) region. *Optics Express, 20*(10), 10562-10571.

Scientific Output Theme Laser Based Microscopy

- Number of theses: **0**

- Number of scientific papers, refereed: 7

1. Mathes, T., Zhu, J., Stokkum, I.H.M. van, Groot, M.L., Hegemann, P. & Kennis, J.T.M. (2012). Hydrogen Bond Switching among Flavin and Amino Acids Determines the Nature of Proton-Coupled Electron Transfer in BLUF Photoreceptors. *Journal of Physical Chemistry Letters, 3*(2), 203-208.

2. Oort, B.F. van, Veer, M.J.T. ter, Groot, M.L. & Stokkum, I.H.M. van (2012). Excited state proton transfer in strongly enhanced GFP (sGFP2). *Physical Chemistry Chemical Physics - PCCP, 14*(25), 8852-8858.

3. Scrutton, N.S., Groot, M.L. & Heyes, D.J. (2012). Excited state dynamics and catalytic mechanism of the light-driven enzyme protochlorophyllide oxidoreductase. *Physical Chemistry Chemical Physics - PCCP, 14*(25), 8818-8824.

4. Stahl, A.D., Crouch, L.I., Jones, M.R., Stokkum, I.H.M. van, Grondelle, R. van & Groot, M.L. (2012). Role of PufX in Photochemical Charge Separation in the RC-LH1 Complex from Rhodobacter sphaeroides: An Ultrafast Mid-IR Pump-Probe Investigation. *Journal of Physical Chemistry B, 116*(1), 434-444.

5. Sytina, O., Stokkum, I.H.M. van, Heyes, D.J., Hunter, C.N. & Groot, M.L. (2012). Spectroscopic characterization of the first ultrafast catalytic intermediate in protochlorophyllide oxidoreductase. *Physical Chemistry Chemical Physics - PCCP, 14*(2), 616-625.

6. Witte, S.M., Plauska, A., Ridder, M.C., Berge, L. van, Mansvelder, H.D. & Groot, M.L. (2012). Short-coherence off-axis holographic phase microscopy of live cell dynamics. *Biomedical Optics Express, 3*(9), 2184-2189.

7. Zhu, J., Mathes, T., Stahl, A.D., Kennis, J.T.M. & Groot, M.L. (2012). Ultrafast mid-infrared spectroscopy by chirped pulse upconversion in 1800-1000cm(-1) region. *Optics Express, 20*(10), 10562-10571.

Scientific Output Theme Light and Tissue

- Number of theses: 6

R. de Kinkelder
Optical diagnostic techniques in ophthalmology.
promotor: prof.dr. A.G.J.M. van Leeuwen; copromotores: F.D. Verbraak, D.J. Faber
defense**:** 8 November 2012

B. Stam
Three dimensional modeling of bruise evolution for improved age determination.
promotores: prof.dr. A.G.J.M. van Leeuwen, prof.dr. M.J.C. van Gemert;
copromotor: M.C.G. Aalders MCG
defense: 10 April 2012

Jithin Jose
Prospects of Passive Element Enriched Photoacoustic Computed Tomography (PER-PACT)
promotor: prof.dr. A.G.J.M. van Leeuwen; copromotor: S. Manohar
defense: 5 April 2012

A. Leproux
Breast lesion detection using diffuse optical imaging.
promotores: prof.dr. A.G.J.M. van Leeuwen, B.J. Tromberg; copromotores: M. van der Voort, A.E. Cerussi
defense: 4 April 2012

V.M. Kodach
Development of functional near-infrared optical coherence tomography.
promotor: prof.dr. A.G.J.M. van Leeuwen; copromotors: J. Kalkman, D.J. Faber
defense: 14 March 2012

N. Bosschaart
Quantitative and localized spectroscopy for non-invasive bilirubinometry in neonates.
promotor: prof.dr. A.G.J.M. van Leeuwen; copromotor: M.C.G. Aalders MCG
defense: 8 March 2012

- Number of scientific papers, refereed: 21

1 Akca BI, Nguyen VD, Kalkman J, Ismail N, Sengo G, Sun F, Driessen A, van Leeuwen TG, Pollnau M, Worhoff K, de Ridder RM, **Toward Spectral-Domain Optical Coherence Tomography on a Chip.** IEEE J SEL TOP QUANT 2012;18 (3):1223-1233

2 Barwari K, de Bruin DM, Faber DJ, van Leeuwen TG, de la Rosette JJ, Laguna MP, **Differentiation between normal renal tissue and renal tumours using functional optical coherence tomography: a phase I in vivo human study.** BJU INT 2012;110 (8 Part B):E415-E420

3 Bosschaart N, Aalders MCG, van Leeuwen TG, Faber DJ, **Spectral domain detection in low-coherence spectroscopy.** BIOMED OPT EXPRESS 2012;3 (9):2263-2272

4 Bosschaart N, Kok JH, Newsum AM, Ouweneel DM, Mentink R, van Leeuwen TG, Aalders MCG, **Limitations and opportunities of transcutaneous bilirubin measurements.** PEDIATRICS 2012;129 (4):689-694

5 Bremmer RH, de Bruin KG, van Gemert MJC, van Leeuwen TG, Aalders MCG, **Forensic quest for age determination of bloodstains.** FORENSIC SCI INT 2012;216 (1-3):1-11

6 Cernohorsky P, de Bruin DM, van Herk M, Bras J, Faber DJ, Strackee SD, van Leeuwen TG, **In-situ imaging of articular cartilage of the first carpometacarpal joint using co-registered optical coherence tomography and computed tomography.** J BIOMED OPT 2012;17 (6):060501

7 de Kinkelder R, van Leeuwen TG, Verbraak FD, **Detection of early-stage age related macular degeneration with a compact rarebit test.** BRIT J OPHTHALMOL 2012;96 (10):1354-1355

8 Edelman GJ, Gaston E, van Leeuwen TG, Cullen PJ, Aalders MCG, **Hyperspectral imaging for non-contact analysis of forensic traces.** FORENSIC SCI INT 2012;223 (1-3):28-39

9 Edelman G, Manti V, van Ruth SM, van Leeuwen T, Aalders M, **Identification and age estimation of blood stains on colored backgrounds by near infrared spectroscopy.** FORENSIC SCI INT 2012;220 (1-3):239-244

10 Edelman G, van Leeuwen TG, Aalders MCG, **Hyperspectral imaging for the age estimation of blood stains at the crime scene.** FORENSIC SCI INT 2012;223 (1-3):72-77

11 Grootendorst DJ, Jose J, Wouters MW, van Boven H, van der Hage J, van Leeuwen TG, Steenbergen W, Manohar S, Ruers TJM, **First experiences of photoacoustic imaging for detection of melanoma metastases in resected human lymph nodes.** LASER SURG MED 2012;44 (7):541-549

12 Hartsuiker L, Petersen W, Rayavarapu RG, Lenferink A, Poot AA, Terstappen LWMM, van Leeuwen TG, Manohar S, Otto C, **Raman and Fluorescence Spectral Imaging of Live Breast Cancer Cells Incubated with PEGylated Gold Nanorods.** APPL SPECTROSC 2012;66 (1):66-74

13 Heijblom M, Meijer LM, van Leeuwen TG, Steenbergen W, Manohar S, **Monte Carlo simulations shed light on Bathsheba's suspect breast.** J BIOPHOTONICS 2012;ahead of print

14 Heijblom M, Piras D, Xia W, van Hespen JCG, Klaase JM, van den Engh FM, van Leeuwen TG, Steenbergen W, Manohar S, **Visualizing breast cancer using the Twente photoacoustic mammoscope: what do we learn from twelve new patient measurements?.** OPT EXPRESS 2012;20 (11):11582-11597

15 Jose J, Willemink RGH, Steenbergen W, Slump CH, van Leeuwen TG, Manohar S, **Speed-of-sound compensated photoacoustic tomography for accurate imaging.** MED PHYS 2012;39 (12):7262-7271

16 Kalkman J, Bykov AV, Streekstra GJ, van Leeuwen TG, **Multiple scattering effects in Doppler optical coherence tomography of flowing blood.** PHYS MED BIOL 2012;57 (7):1907-1917

17 Nguyen VD, Weiss N, Beeker W, Hoekman M, Leinse A, Heideman RG, van Leeuwen TG, Kalkman J, **Integrated-optics-based swept-source optical coherence tomography.** OPT LETT 2012;37 (23):4820-4822

18 Stam B, van Gemert MJC, van Leeuwen TG, Aalders MCG, **How the blood pool properties at onset affect the temporal behavior of simulated bruises.** MED BIOL ENG COMPUT 2012;50 (2):165-171

19 van der Pol E, van Gemert MJC, Sturk A, Nieuwland R, van Leeuwen TG, **Single vs. swarm detection of microparticles and exosomes by flow cytometry.** J THROMB HAEMOST 2012;10 (5):919-930

20 Weiss N, van Leeuwen TG, Kalkman J, **Doppler-based lateral motion tracking for optical coherence tomography.** OPT LETT 2012;37 (12):2220-2222

21 Wessels R, de Bruin DM, Faber DJ, van Boven HH, Vincent AD, van Leeuwen TG, van Beurden M, Ruersa TJM, **Optical coherence tomography in vulvar intraepithelial neoplasia.** J BIOMED OPT 2012;17 (11):116022

Scientific OutputTheme Single Molecule to Cell Biophysics

- Number of theses: 1

Niels Laurens
A biophysical exploration of proteins and their substrates
promotor: prof.dr.ir. G.J.L. Wuite
defense: 29 March 2012

- Number of scientific papers, refereed: 18

1. Bobbert, P.A., Sharma, A., Matthijssen, S.J.G., Kemerink, M. & Leeuw, D.M. de (2012). Operational Stability of Organic Field-Effect Transistors. *Advanced Materials, 24*, 1146-1158.

2. Broedersz, C.P., Sheinman, M. & MacKintosh, F.C. (2012). Filament-Length-Controlled Elasticity in 3D Fiber Networks. *Physical Review Letters, 108*(6).

3. Farge, G.A., Laurens, N., Broekmans, O.D., Wildenberg, S.M.J.L., Dekker, L.C.M., Gaspari, M., Gustafsson, C. M., Peterman, E.J.G., Falkenberg, M. & Wuite, G.J.L. (2012). Protein sliding and DNA denaturation are essential for DNA organization by human mitochondrial transcription factor A. *Nature Communications, 3*(1013).

4. Heuveling, D.A., Visser, G.W.M., Groot, M. de, Boer, J.F. de, Salumbides - Baclayon, M., Roos, W.H., Wuite, G.J.L., Leemans, C.R., Bree, R. de & Dongen, G.A.M.S. van (2012). Nanocolloidal albumin-IRDye 800CW: a near-infrared fluorescent tracer with optimal retention in the sentinel lymph node. *European Journal of Nuclear Medicine and Molecular Imaging, 39*(7), 1161-1168.

5. Klug, W. S., Roos, W.H. & Wuite, G.J.L. (2012). Unlocking Internal Prestress from Protein Nanoshells. *Physical Review Letters, 109*(168104).

6. Laurens, N., Driessen, R.P.C., Heller, I., Vorselen, D., Noom, M.C., Hol, F.J.H., White, M.F., Dame, R.T. & Wuite, G.J.L. (in press). Alba shapes the archaeal genome using a delicate balance of bridging and stiffening the DNA. *Nature Communications, 3*.

7. Laurens, N., Rusling, D.A., Pernstich, C., Brouwer, I., Halford, S.E. & Wuite, G.J.L. (2012). DNA looping by FokI: the impact of twisting and bending rigidity on protein-induced looping dynamics. *Nucleic Acids Research, 40*(11), 4988-4997.

8. MacKintosh, F.C. (2012). Active diffusion: The erratic dance of chromosomal loci. *Proceedings of the National Academy of Sciences of the United States of America, 109*(19), 7138-7139.

9. Roos, W.H., Gertsman, I., May, E.R., Brooks, C.L., Johnson, J.E. & Wuite, G.J.L. (2012). Mechanics of bacteriophage maturation. *Proceedings of the National Academy of Sciences of the United States of America, 109*(7), 2342-2347.

10. Rusling, D.A., Laurens, N., Pernstich, C., Brouwer, I., Wuite, G.J.L. & Halford, S.E. (2012). DNA looping by FokI: the impact of synapse geometry on loop topology at varied site orientations. *Nucleic Acids Research, 40*(11), 4977-4987.

11. Sharma, A., Oost, F.W.A. van, Kemerink, M. & Robbert, P.A. (2012). Dimensionality of charge transport in organic field-effect transistors. *Physical Review B, 85*(23), 235302.

12. Sheinman, M., Broedersz, C.P. & MacKintosh, F.C. (2012). Actively Stressed Marginal Networks. *Physical Review Letters, 109*(23).

13. Sheinman, M., Benichou, O., Kafri, Y. & Voituriez, R. (2012). Classes of fast and specific search mechanisms for proteins on DNA. *Reports on Progress in Physics, 75*(2), 026601.

14. Sheinman, M. & Kafri, Y. (2012). How does the DNA sequence affect the Hill curve of transcriptional response? *Physical Biology, 9*(5).

15. Sheinman, M., Broedersz, C.P. & MacKintosh, F.C. (2012). Nonlinear effective-medium theory of disordered spring networks. *Physical Review E, 85*(2).

16. Snijder, J., Reddy, V.S., May, E.R., Roos, W.H., Nemerow, G.R. & Wuite, G.J.L. (in press). Integrin and defensin modulate the mechanical properties of adenovirus. *Journal of Virology*.

17. Snijder, J., Ivanovska, I.L., Salumbides - Baclayon, M., Roos, W.H. & Wuite, G.J.L. (2012). Probing the impact of loading rate on the mechanical properties of viral nanoparticles. *Micron, 43*(12), 1343-1350.

18. Stuhrmann, B., Soares e Silva, M., Depken, S.M., MacKintosh, F.C. & Koenderink, G.H. (2012). Nonequilibrium fluctuations of a remodeling in vitro cytoskeleton. *Physical Review E, 86*(2).

Scientific Output Theme Physics of Light

- Number of theses: 1

  Rob van Rooij
  Frequency Metrology in Quantum Degenerate Helium
  promotores: prof.dr. W.M.G. Ubachs, copromotor: dr. W. Vassen
  defense: 8 June 2012

- Number of scientific papers, refereed: 53

1. Bagdonaite, J., Murphy, M.T., Kaper, L. & Ubachs, W.M.G. (2012). Constraint on a variation of the proton-to-electron mass ratio from H-2 absorption towards quasar Q2348-011. *Monthly Notices of the Royal Astronomical Society, 421*(1), 419-425.

2. Barmes, I., Witte, S.M. & Eikema, K.S.E. (2012). Doppler-Free Two-Photon Direct Frequency Comb Spectroscopy With Coherent Control. In *CLEO: Science and Innovations, OSA Technical Digest* (pp. CF1C.6). Optical Society of America.

3. Barmes, I., Witte, S.M. & Eikema, K.S.E. (2013). Spatial and Spectral Coherent Control over Direct Frequency Comb Excitation. In *Proceedings of the XVIIIth International Conference on Ultrafast Phenomena*. EPJ Web of Conferences.

4. Benko, C., Ruehl, A., Martin, M.J., Eikema, K.S.E., Fermann, M.E., Hartl, I. & Ye, J. (2012). Full phase stabilization of a Yb:fiber femtosecond frequency comb via high-bandwidth transducers. *Optics Letters, 37*(12), 2196-2198.

5. Borbely, J. S., Rooij, R. van, Knoop, S. & Vassen, W. (2012). Magnetic-field-dependent trap loss of ultracold metastable helium. *Physical Review A, 85*(2).

6. Butz, A., Galli, A., Hasekamp, O., Landgraf, J., Tol, P.J.J. & Aben, E.A.A. (2012). TROPOMI aboard Sentinel-5 Precursor: Prospective performance of CH4 retrievals for aerosol and cirrus loaded atmospheres. *Remote Sensing of Environment, 120*(SI), 267-276.

7. Chavan, D.C., Watering, T.C. van de, Gruca, G.L., Rector, J.H., Heeck, K., Slaman, M.J. & Iannuzzi, D. (2012). Ferrule-top nanoindenter: An optomechanical fiber sensor for nanoindentation. *Review of Scientific Instruments, 83*(115110).

8. Cipullo, A., Gruca, G.L., Heeck, K., De Filippis, F., Iannuzzi, D., Minardo, A. & Zeni, L. (2012). Numerical study of a ferrule-top cantilever optical fiber sensor for wind-tunnel applications and comparison with experimental results. *Sensors and Actuators A-Physical, 178*, 17-25.

9. Cipullo, A., Gruca, G.L., Heeck, K., De Filippis, F., Iannuzzi, D., Minardo, A. & Zeni, L. (2012). Velocity measurements of low speed air ows by ferrule-top cantilever optical ber sensor. *Sensors and Actuators A-Physical, 17*.

10. Dickenson, G.D., Salumbides, E.J., Niu, M., Jungen, C., Ross, S.C. & Ubachs, W.M.G. (2012). Precision spectroscopy of high rotational states in H-2 investigated by Doppler-free two-photon laser spectroscopy in the EF (1)Sigma(+)(g)-X (1)Sigma(+)(g) system. *Physical Review A, 86*(3).

11. Dickenson, G.D. & Ubachs, W.M.G. (2012). The D-1 Pi(u) state of HD and the mass scaling relation of its predissociation widths. *Journal of Physics B. Atomic, Molecular and Optical Physics, 45*(14).

12. Fischer, D.G., Dijk, T. van, Visser, T.D. & Wolf, E. (2012). Coherence effects in Mie scattering. *Journal of the Optical Society of America. A: Optics, image science, and vision., 29*(1), 78-84.

13. Galli, A., Butz, A., Scheepmaker, R.A., Hasekamp, O., Landgraf, J., Tol, P.J.J., Wunch, D., Deutscher, N.M., Toon, G.C., Wennberg, P.O., Griffith, D.W.T. & Aben, E.A.A. (2012). CH4, CO, and H2O spectroscopy for the Sentinel-5 Precursor mission: an assessment with the Total Carbon Column Observing

14. Gan, C. H., Gu, Y.L., Visser, T.D. & Gbur, G.J. (2012). Coherence Converting Plasmonic Hole Arrays. *Plasmonics, 7*, 313-322.

15. Gruca, G.L., Chavan, D.C., Cipullo, A., Babaei Gavan, K., De Filippis, F., Minardo, A., Rector, J.H., Heeck, K., Zeni, L. & Iannuzzi, D. (2012). Development of fiber optic ferrule-top cantilevers for sensing and beam-steering applications. *Proceedings of SPIE, 84390E*.

16. Gruca, G.L., Chavan, D.C., Watering, T.C. van de, Rector, J.H. & Iannuzzi, D. (2012). Ferrule-top cantilevers for measurements in harsh environments. *SPIE Newsroom*.

17. Gu, Z.Y., Vieitez, M.O., Duijn, E.J. van & Ubachs, W.M.G. (2012). A Rayleigh-Brillouin scattering spectrometer for ultraviolet wavelengths. *Review of Scientific Instruments, 83*(5).

18. Haddad, M.A., Zhao, D., Linnartz, H.V.J. & Ubachs, W.M.G. (2012). Spin-orbit Splitting and Lifetime Broadening in the A(2)Delta Electronic State of l-C5H. *Chinese Journal of Chemical Physics, 25*(2), 129-134.

19. Hooghiemstra, P.B., Krol, M.C., Bergamaschi, P., Laat, A.T.J. de, Werf, G.R. van der, Novelli, P.C., Deeter, M.N., Aben, E.A.A. & Rockmann, T. (2012). Comparing optimized CO emission estimates using MOPITT or NOAA surface network observations. *Journal of Geophysical Research, 117*(D06309).

20. Hooghiemstra, P.B., Krol, M.C., Leeuwen, T.T. van, Werf, G.R. van der, Novelli, P.C., Deeter, M.N., Aben, E.A.A. & Rockmann, T. (2012). Interannual variability of carbon monoxide emission estimates over South America from 2006 to 2010. *Journal of Geophysical Research, 117*.

21. Ilyushin, V.V., Jansen, P., Kozlov, M.G., Levshakov, S.G., Kleiner, I, Ubachs, W.M.G. & Bethlem, H.L. (2012). Sensitivity to a possible variation of the proton-to-electron mass ratio torsion-wagging-rotation transitions in methylamine CH3NH2. *Physical Review A, 85*(3).

22. Knoop, S., Borbely, J. S., Rooij, R. van & Vassen, W. (2012). Nonexponential one-body loss in a Bose-Einstein condensate. *Physical Review A, 85*(2).

23. Knoop, S., Borbely, J., Vassen, W. & Kokkelmans, S.J.J.M.F. (2012). Universal three-body parameter in ultracold 4He*. *Physical Review A, 6*(86).

24. Knoop, S., Borbely, J. S., Vassen, W. & Kokkelmans, S.J.J.M.F. (2012). Universal three-body parameter in ultracold 4He*. *Physical Review A, 86*(6).

25. Koelemeij, J.C.J., Noom, D.W.E., Jong, D. de, Haddad, M.A. & Ubachs, W.M.G. (2012). Observation of the v '=8 <- v=0 vibrational overtone in cold trapped HD+. *Applied Physics B. Lasers and Optics, 107*(4), 1075-1085.

26. Laat, A.T.J. de, Dijkstra, R., Schrijver, H., Nedelec, P. & Aben, E.A.A. (2012). Validation of six years of SCIAMACHY carbon monoxide observations using MOZAIC CO profile measurements. *Atmospheric Measurement, 5*(9), 2133-2142.

27. Laat, A.T.J. de, Dijkstra, R., Schrijver, H., Nedelec, P. & Aben, E.A.A. (2012). Validation of six years of SCIAMACHY carbon monoxide observations using MOZAIC CO profile measurements (vol 5, pg 2133, 2012). *Atmospheric Measurement, 5*(10), 2431-2431.

28. Lange, A. de, Dickenson, G.D., Salumbides, E.J., Ubachs, W.M.G., Oliveira, N. de, Joyeux, D. & Nahon, L. (2012). VUV Fourier-transform absorption study of the Lyman and Werner bands in D-2. *Journal of Chemical Physics, 136*(23).

29. Meerakker, S.Y.T. van de, Bethlem, H.L., Vanhaecke, N. & Meijer, G. (2012). Manipulation and Control of Molecular Beams. *Chemical Reviews, 112*(9), 4828-4878.

30. Morgenweg, J. & Eikema, K.S.E. (2012). A 1.8 mJ, picosecond Nd:YVO4 bounce amplifier pump front-end system for high-accuracy XUV-frequency comb spectroscopy. *Laser Physics Letters, 9*(11), 781-785.

31. Morgenweg, J. & Eikema, K.S.E. (2012). Tailored pulse sequences from an 880 nm pumped Nd:YVO4 bounce amplifier. *Optics Letters, 37*(2), 208-210.

32. Nijs, A.J. de & Bethlem, H.L. (2012). On deflection fields, weak-focusing and strong-focusing storage rings for polar molecules. *Physical Chemistry Chemical Physics - PCCP, 13*, 19052-19058.

33. Nijs, A.J. de, Ubachs, W.M.G. & Bethlem, H.L. (2012). Sensitivity of rotational transitions in CH and CD to a possible variation of fundamental constants. *Physical Review A, 86*(3).

34. Pang, X.Y., Fischer, D.G. & Visser, T.D. (2012). Generalized Gouy phase for focused partially coherent light and its implications for interferometry. *Journal of the Optical Society of America. A: Optics, image science, and vision., 29*(6), 989-993.

35. Pinkert, T.J., Salumbides, E.J., Tahvili, M.S., Ubachs, W.M.G., Bente, E.A.J.M. & Eikema, K.S.E. (2012). Frequency comb generation by CW laser injection into a quantum-dot mode-locked laser. *Optics Express, 20*(19), 21357-21371.

36. Quintero Perez, M., Jansen, P. & Bethlem, H.L. (2012). Velocity map imaging of a slow beam of ammonia molecules inside a quadrupole guide. *Physical Chemistry Chemical Physics - PCCP, 14*(27), 9630-9635.

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B) SCIENTIFIC QUALITY

Analytical Chemistry and Spectroscopy

- Total number of citations

	2012	*Total*
A.M. Brouwer:	274	2501
W.J. Buma:	169	1783
M.H.M. Janssen:	62	1575
F. Ariese:	326	3217
G. van der Zwan:	137	2738
S. Woutersen:	197	2544
R.M. Williams:	214	2343
H. Zhang:		

- Mean H-index of tenured staff

A.M. Brouwer:	23
W.J. Buma:	24
M.H.M. Janssen:	23
F. Ariese:	29
G. van der Zwan:	23
S. Woutersen:	23
R.M. Williams:	24
H. Zhang:	

Biomedical Physics

- Total number of citations

	2012	*Total*
J.F. de Boer:	815	7581
R.M. Verdaasdonk:	31	635

- Mean H-index of tenured staff

J.F. de Boer:	45
R.M. Verdaasdonk:	15

Energy

Total number of citations	*2012*	*Total*
R. van Grondelle:	1268	13335
R. Croce:	333	3073
J.P. Dekker:	386	7153
R.N. Frese	61	604
J.T.M. Kennis:	327	2449
I.H.M. van Stokkum:	483	2912

- Mean H-index of tenured staff

R. van Grondelle:	61
R. Croce:	35
J.P. Dekker:	51
R.N. Frese	9
J.T.M. Kennis:	30
I.H.M. van Stokkum:	32

Laser Based Microscopy

- Total number of citations

	2012	*Total*
M.L. Groot:	87	324
S.M. Witte:	52	485

- Mean H-index of tenured staff

M.L. Groot:	11
S.M. Witte:	10

Light and Tissue

- Total number of citations

	2012	*Total*
A.G.J.M. van Leeuwen:	419	2477
M.C.G. Aalders:	120	807
D.J. Faber:	140	888

- Mean H-index of tenured staff

A.G.J.M. van Leeuwen:	28
M.C.G. Aalders:	14
D.J. Faber	16

Single Molecule to Cell Biophysics

- Total number of citations

	2012	*Total*
D. Bald:	124	1150
Y.J.M. Bollen:	37	214
H. Lill:		1590
J. Luirink:	393	5155
F.C. MacKintosh:	760	6733
E.J.G. Peterman:	193	2094
W.H. Roos	118	314
G.J. Stephens	74	200
P. van Ulsen:	75	646
G.J.L. Wuite:	387	2259

- Mean H-index of tenured staff

D. Bald:	17
Y.J.M. Bollen:	7
H. Lill:	22
J. Luirink:	43
F.C. MacKintosh:	41
E.J.G. Peterman:	30
W.H. Roos	11
G.J. Stephens	6
P. van Ulsen:	13
G.J.L. Wuite:	26

Physics of Light

- Total number of citations

	2012	*Total*
H.L. Bethlem:	185	2173
K.S.E. Eikema:	142	1202
D. Iannuzzi:	210	938
S. Knoop:	86	435
J.C.J Koelemeij:	125	422
W.M.G. Ubachs:	456	3690
W. Vassen:	124	1630
T.D. Visser:	255	2486

- Mean H-index of tenured staff

H.L. Bethlem:	22
K.S.E. Eikema:	20
D. Iannuzzi	16
S. Knoop	10
J.C.J. Koelemeij:	9
W.M.G. Ubachs:	32
W. Vassen:	22
T.D. Visser:	29

C) INDICATORS OF ESTEEM

Analytical Chemistry and Spectroscopy

Special professors:
- Prof. dr. H.J. Bakker
- Prof. dr. W.L. Meerts
- Prof. dr. W.M.A. Niessen
- Prof. dr. J. Oomens

Energy

Prestigious grants:
- VICI: Dr. John Kennis, k€ 1500

Special professors:
- Prof. dr. H.J. Hellingwerf
- Prof. dr. G.J.M. Stienen

Light and Tissue

Editorships:
- Journal of Biomedical Optics: Prof. dr. T.G. van Leeuwen
- Optics Letters: Prof. dr. T.G. van Leeuwen
- Lasers in Medical Science: Prof. dr. T.G. van Leeuwen
- International Journal of Cardiovascular Imaging: Prof. dr. T.G. van Leeuwen

Single Molecule to Cell Biophysics

Prestigious grants:
- FOM-Projectruimte: Prof.dr. Gijs Wuite, k€550

Special professors:
- Prof. dr. G.H. Koenderink
- Prof. dr. P.R. ten Wolde

Physics of Light

Prestigious grants:
- VIDI: Dr. Jeroen Koelemeij, k€ 800

Special professors:
- Prof. dr. E.A.A. Aben
- Prof. dr. L. Kaper
- Prof. dr. H.V.J. Linnartz

D) SOCIETAL IMPACT

Technical or economic impact

Fiber-top technology forms basis for new VU spin-off company Optics11.
In 2005, research by physicist Davide Iannuzzi and colleagues led to the development of fiber-top technology. After five years of further research, this technology is now launched onto the market