LASERLAB Amsterdam

Institute for Lasers,
Life and Biophotonics

ANNUAL REPORT 2014

LIST OF CONTENTS

1. PREFACE

This is the fifth 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 the spring of 2010, founded on the former Laser Centre VU (LCVU). The opening of LaserLaB Amsterdam was celebrated on October 22, 2010 with a symposium at the Koninklijke Nationale Academie voor Wetenschappen, Trippenhuis, Amsterdam.

LaserLaB Amsterdam received a glowing midterm review from the Universitaire Toetsingscommissie (UTC) in May 2014, and was deemed a crown jewel and prime example of the success of the VU iOZI policy. At the same time, the midterm review expressed concern with respect to the future of the multidisciplinary research environment of LaserLaB related to housing, experimental facilities and bi-locations as a consequence of the AFS. Despite the glowing review, financial support of the IOZI LaserLaB is in uncertain, where the burden has been completely put on the department of physics and astronomy.

In 2014, LaserLaB Amsterdam could celebrate the award of an starting ERC grant to Dr. Stefan Witte, an STW Perspectief grant to Prof. Ton van Leeuwen and Dr. Wouter Roos, and VENI's to AMC/UvA researchers Dr. ir. Nienke Bosschaart and Dr. ir. Frank A.W. Coumans. LaserLaB Amsterdam has 7 VICI recipients among its staff. LaserLaB Amsterdam continued to fare well within the national and international competition with grants from the ERC, FOM, NWO-ALW, NWO-ECHO, STW, and ZonMW. The acquisition of grants in 2014 was 4.0 M€ and 5.9 M€ for VU and VU-AMC-UvA, respectively.

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 30 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. 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. LASERLAB-Europe successfully applied for a 4-year renewal proposal, which is expected to start in December 2015.

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

Johannes F. de Boer
Director

LASERLAB-Europe: a consortium of the 30 major laser centers in Europe

2. DESCRIPTION OF LASERLAB AMSTERDAM

A) MISSION

LaserLaB Amsterdam (Institute for Lasers, Life sciences and Biophotonics) was founded in the spring of 2010 as a continuation of the Laser Centre VU (established in 1992), with the addition of non-VU participants (UvA and AMC) and the formal establishment as a VU "Interfacultair Onderzoeks Instituut" (IOZI). The mission of LaserLaB Amsterdam is to perform 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 and a founding partner of the IMDI Quantivision. Similarly LaserLaB members made a decisive contribution to the winning bid for attracting the ASML-funded Advanced Research Center for Nanolithography (ARCNL) to Amsterdam. LaserLaB Amsterdam is part of LASERLAB-Europe, an Integrated Infrastructure Initiative of the European Union, forming a consortium of the 30 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.

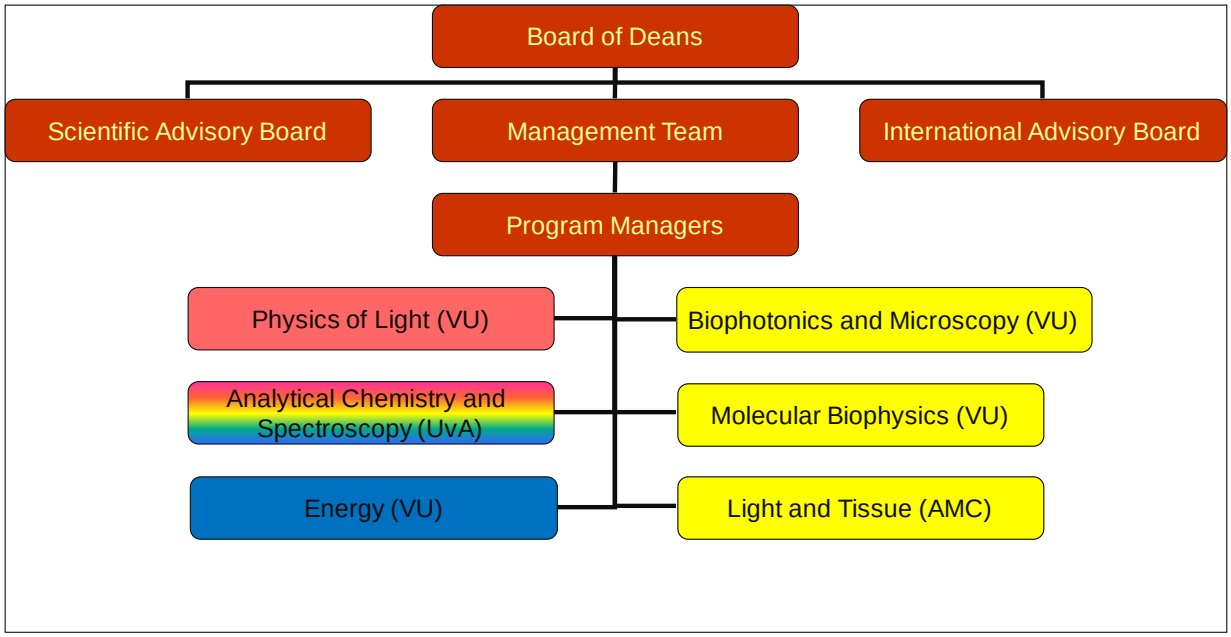
Energy production will play a crucial role in our future. The process of photosynthesis in plants is the process that sustains virtually all life on Earth and is also an excellent example of renewable energy production. By studying this process, it is possible to develop more efficient natural and artificial cells solar energy converters for production of food and fuel. 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. Laser-produced plasma sources are a cornerstone of the next generation lithography process technology for producing semiconductor chips.

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

LASERLAB Amsterdam
Institute for Lasers, Life and Biophotonics



Organogram of LaserLaB Amsterdam. There are three core areas: Physics of Light and Matter (Red), Sustainable Earth/Energy/Environment (Blue) and Life &Health (Yellow), which are subdivided in programs directed by the program managers. Programs are organized along 6 themes that constitute the long term research goals of the institute.

The core of LaserLaB Amsterdam are the programs directed by the 6 program managers.

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 are active. The research theme comprises activities in Molecular spectroscopy (Buma/Brouwer/Woutersen/Williams/Zhang UvA), and Ultrafast photodynamics and spectroscopy in the gas phase (Janssen, VU). Each of the two 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) Biophotonics and Microscopy

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 to have a major impact in clinical medicine. A second research line is the development of nonlinear and coherent microscopic tools for studies on cellular and tissue scale in the field of neurobiomedical research. 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 or Raman spectroscopy in different modes. Current research lines are the development of multipulse microscopies to obtain sub-diffraction resolution, fiber-tip technologies, stimulated Raman scattering microscopy, and the application of THG and digital holography in neuromedical research. This research is closely integrated with the Neuroscience Campus Amsterdam. Research is sponsored by FOM, ERC, NIH (USA), STW, CW, ALW, and ZonMW through a VICI grant (Dr. de Boer).

3) Energy

Program manager: Prof. dr. Roberta Croce.

Energy Research in LaserLaB Amsterdam is focused on the study of the fundamental events of the natural process of Photosynthesis, on biomimetic and biohybrid systems and on organic and solid-state energy materials. These include the capture of solar photons, the transfer of the electronic excitation to the photosynthetic reaction center where a charge separation is driven. Likewise, electron and proton transfer in biomimetic and biohybrid systems and charge carrier dynamics in energy materials are characterized. All these events occur on a timescale of 10^{-15} to seconds and are studied with advanced ultrafast pulsed lasers using techniques such as pump-probe spectroscopy in the visible and mid-infrared, multi-dimensional photon echo, streak-camera detected fluorescence. The aim is to use this knowledge to improve the photosynthetic process in algae and plants and to design artificial and bioinspired photosynthetic systems for an efficient solar to fuel conversion.”

4) 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.

5) 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.

6) 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. Biophotonics & Microscopy
3. Energy
4. Light and Tissue
5. Single Molecule to Cell Biophysics
6. 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
Public Relations: Dr. Y. Bollen
Member: Prof. Dr. K.S.E. Eikema
Member: Prof. Dr. R. Croce
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 Department 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. The EU Infrastructures project 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 one of the largest number of NWO-scholarships (Veni, Vidi, Vici) on the VU-campus.

Research cores are well positioned to participate in regional and national funding initiatives. On the Zuidas Neuroscience campus, the institute AIMMS, the institute Quantivision, the VU medical Imaging center, and the emphasis on Red Life sciences on the VU campus provides a stimulating and challenging research environment for Applied Physics in Life Sciences.
On the Science Park Campus the synergy of fundamental and energy physics (Solardam) of VU and UvA, the establishment of ARCNL with joint faculty of the VU and UvA, the presence of AMOLF and NIKHEF, and the potential move of SRON to Science Park provides a sciences cluster with strong potential for (cross disciplinary) collaboration and high international visibility.

Weaknesses

As illustrated in the organogram of Section 1c, LaserLaB Amsterdam has three main research cores (Physics of Light and Matter, Sustainable Earth/Energy/Environment, and Life & Health) and six programs. Except for Biophotonics and Microscopy, all programs will move to the Science Park location in the pending AFS plans, which will affect the daily interactions for the program remaining at the VU campus and threaten the cohesion of LaserLaB Amsterdam. On the other hand, the focus on Red Life Sciences on the Zuidas campus and the move of related UvA faculty to the Zuidas will strengthen this theme and can create a fruitful environment for Applied Physics in Life Sciences core. Achieving an agenda setting position at the national or European level remains a challenge. Mass has to be generated by strategic alliances within the regional and national setting. The clustering as envisaged in the Amsterdam Faculty of Sciences plan could provide the base for additional mass.

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 for Life Sciences and Health provides a strong opportunity to expand the research. LaserLaB Amsterdam participates in the institute Quantivision (iQ) which is a joint initiative of the VUmc, VU, NKI, UvA and AMC and is one of the eight cores of excellence of the IMDI initiative. LaserLaB also participates in the VU Medical imaging center to shape the life and health research agenda of the VUmc. The Life & Health core of LaserLaB closely collaborates with Neuroscience Campus,

ties that will be strengthened further with the plans to house Neuroscience campus and LaserLaB Life & Health core in the new Schoolwerktuinen building in 2021. The new Amsterdam Bio Science Campus (ABSC), the "red life" science research institute that aims to be established on the VU campus, Instutite Quantivision, Neuroscience campus, imaging center and Medical Natural Sciences (MNW) will provide a fruitful environment to establish Applied Physics in Life Sciences on the Zuidas.

LaserLab together with other groups at VU and UvA, AMOLF and ECN participate in the "Solardam" consortium that focuses on solar energy research with the goal of increasing the use and the efficiency of the solar energy conversion. The initiative is based on the strong activities in photosynthesis, photoconversion & artificial photosynthesis, catalysis, theoretical systems physics/biology, microbiology, theoretical chemistry and photochemistry in Amsterdam. By bringing together expertise and sharing facilities the consortium aims at finding innovative solutions in the field of solar energy. Laser-based research represents an essential component of the consortium. The consortium has strong links with the national initiative "BioSolar Cells" and with the top solar energy research centers in US, UK and Germany. The program includes a VU-UvA Energy&Sustainability master teaching program. The Top Sector Energy and expecially the Top consortium Knowledge and Innovation (TKI) Solar Energy represent excellent opportunities for the future of the solar energy research in Amsterdam.

The recent establishment of a new and well-funded center for nanolithography (ARCNL) at the Science Park location supported by ASML, FOM/NWO and UvA/VU provides a unique opportunity for further fundamental research as well as collaboration with industry. 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). Laser research continues to be a focus point for European research infrastructure consortia as exemplified by the third renewal of Laserlab Europe which will start in Dec 2015. PLM is well positioned through international collaborations with companies such as Menlo and Toptica in Germany and IMRA in the USA, and research groups worldwide for theoretical support.

Threats

The outcome of the AFS discussion resulting in a geographic separation of the three different cores of LaserLaB over two locations could lead to a loss of cohesion between the cores. This poses new challenges which needs attention over the coming years.

Housing in the near and distant future remains a topic of crucial importance. The research facilities of LaserLaB require the lowest vibration levels possible and very accurate temperature control of the lab space. Special attention needs to be paid to accommodate the LaserLaB cores at their respective sites with laboratory space and facilities that allow LaserLaB

to maintain its leading research position and its reputation of excellence. New high tech facilities need to become available at Science Park and VU campus to accommodate the LaserLaB staff that will locate there. The cohesion and visibility of LaserLaB as multidisciplinary research institute within the AFS needs attention.

In general the downward pressure on budgets for investment in research and education remains a threat. The acquired funding of LaserLaB Amsterdam has declined significantly from 2013 to 2014, however this should be viewed in the context of a doubling in size of LaserLaB Amsterdam between 2010 (64 FTE) and 2014 (124FTE), where the strong growth over the past years needs consolidation. Nevertheless, the physics department ranks number one in active research grants on its balance sheet (49 Meuro) within the Faculty of Sciences (FEW), outperforming other departments by at least a factor of 1.6. The reduction of support staff at the VU has also contributed to this trend, where the administrative burden has shifted significantly to the staff, consuming valuable time that could have been spend more effectively on research, funding, and education. 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 2014

RESEARCH GRANTS
In 2014, in spite of reduced funding opportunities, LaserLaB researchers received many prestigious grants from international and national funding sources, totaling 5.9 Million Euro (of which 4.0 Meuro for VU) as listed here. More detailed descriptions of the projects can be found in the next Section.

ERC Starting grant
Dr. Stefan Witte: *High-resolution imaging without lenses: a new generation of imaging technology* (1.500.000 euro) (November 2014)

STW Perspectief
Prof.dr. Ton van Leeuwen and Dr. Wouter Roos (5.700.000 of which AMC 1.000.000 euro and VU 700.000 euro) (November 2014)

STW
Johannes de Boer, Femke Bouwman, Arjen Brussaard, Matthijs de Groot, Stevie Tan, Frank Verbraak: Alzheimers detection in the eye (750.000) euro (December 2014)

Vrije FOM programma
Dr. Greg Stephens and Prof.dr. Erwin Peterman: *The signal is the noise: seeking physical origins of fluctuation in organism-scale behavior* (2.4 ME, of which 488 kE for LaserLaB) (November 2014)

FOM valorisation grant
Kjeld Eikema and Stefan Witte: *Compact lensless microscopes for quantitative phase contrast imaging* (50 k€) (Februari 2014)

STW Valorisation Grant
Dr. Jeroen Koelemeij (15.000 euro) (May 2014)

ISAO grant
Prof.dr. Johannes de Boer: *In vivo optical detection of Amyloid Beta plaques in the human retina* (100 k€) (November 2014)

Human Frontiers of Science grant (1 ME)
Prof. dr Erwin Peterman" Single-molecule studies of ribosome assembly: Coupling transcription and assembly" (250 kE, 2014)

ERC Proof of concept grant
Prof. dr. Gijs Wuite: Preparing market introduction of DN-X-PRO - a breakthrough solution for real-time studies of DNA-protein interactions at single molecule resolution (150 kE, 2014)

Three proposals of chemistry researchers from the Amsterdam Universities were selected for the final matching phase of the '**Computational Sciences for Energy Research**' public-private partnership, a multi-million euro research initiative of Shell, the Netherlands Organisation for Scientific Research NWO and the Foundation for Fundamental Research on Matter (FOM).
Solar Energy Conversion – Breaking the 700 nm Absorption Barrier
Koop Lammertsma, Wybren Jan Buma, Matthias Bickelhaupt
(ca. 100 kEuro)

NWO-NCI Programme (Fonds Nieuwe Chemische Innovaties)
Molecular Photonics (Wybren Jan Buma, UvA), Theoretical Chemistry (Luuk Visscher, VU), Scientific Computing & Modelling N.V. (Nederland) and BioTools, Inc.(Verenigde Staten): *Development of a Vibrational Optical Activity analysis toolbox from chiroptical spectra to molecular stereochemistry and conformation* (1147 kEuro of which ca. 300 kEuro for LaserLaB)

VENI
Dr. ir. F. (Frank) A.W. Coumans (m), UvA/AMC - Biomedical Engineering & Physics: ***ExoFlow: leren luisteren naar fluisterende cellen.***
Cellen in ons lichaam kunnen met elkaar praten via kleine 'spraakbalonnen' in het bloed. In dit project wordt de techniek ontwikkeld om 'spraakbalonnen' te onderscheiden van het 'achtergrondlawaai'. Dit maakt het mogelijk om de 'spraakbalonnen' te lezen, waardoor ernstige ziekten eerder te voorspellen zullen worden. (250 kE)

VENI
Dr. ir. N. (Nienke) Bosschaart (v), UvA/AMC - Biomedical Engineering & Physics: ***Meten zonder prikken****.*
Zieke of te vroeg geboren baby's worden soms wel drie keer per dag geprikt om hun bloedwaarden te bepalen. Het doel van dit onderzoek is om deze bloedwaarden niet-invasief (zonder prikken) te meten met een nieuwe techniek: laag-coherente spectroscopie. (250 kE).

RESEARCH AND PUBLICITY HIGHLIGHTS OF 2014

02/27/2014

Compact lensless microscopes for quantitative phase contrast imaging

Phase contrast microscopy is an essential tool for cell biology and clinical imaging.

Recent research efforts at LaserLaB, VU University, have resulted in the development of a novel type of microscope, which provides quantitative phase contrast images with micrometer resolution. The remarkable aspect of this imaging system is that it does not contain any optical components such as lenses. Therefore, the microscope can be kept extremely compact, robust, and cost-effective.

This invention enables quantitative phase imaging with a compact alignment-free device that can be used e.g. for automated live cell imaging inside incubators, to facilitate affordable diagnostic imaging in remote locations, and more.

With this grant, Dr. Stefan Witte and Prof. Dr. Kjeld Eikema will pursue the valorisation opportunities of these lensless microscopes in collaboration with the company Optics11, and further develop this promising imaging technology for new applications.

03/10/2014

Best Speaker Award VUmc Science Exchange Day 2014 to LaserLaB PhD student Boy Braaf

Boy Braaf from the LaserLaB programme Biomedical Physics won the best Pecha Kucha speaker award of the VUmc Science Exchange Day 2014 held on 7th of March.

His talk on Non-invasive in vivo angiography of the human eye with Doppler Optical Coherence Tomography was selected as winner from nominated presentations of each interfaculty research institute (iOZI) affiliated with the VU/VUmc.

03/24/2014

Human Frontier Science Research Grant on Single-molecule studies of ribosome assembly awarded to an international team including Erwin Peterman

The Human Frontier Science Program has announced that it has awarded a Research Grant to a collaborative team consisting of Erwin Peterman (VU University Amsterdam), Knud Nierhaus (Max Planck Institute, Berlin), Taku Ueda (University of Tokyo) and Ulrich Bockelmann (ESPCI, Paris; team leader).

The team will use this grant to unravel how ribosomes, the protein factories in our cells consisting of an intricate structure of proteins and ribonucleic acids, are assembled. The team will test the hypothesis that assembly is tightly coupled to the generation of RNA via transcription, resulting in vectorial production of RNA, tightly determining the order for folding and assembly. The team, consisting of two biophysics and two biochemistry groups will apply an interdisciplinary approach, including the correlative optical tweezers single-molecule fluorescence approach that is the specialty of the VU University group of Erwin Peterman and Gijs Wuite. The goal is to better understand the formation of ribosomes, one of the most

complex structures in nature. A better understanding of this process can have important implications for the improvement of cell-free protein-production assays.

04/14/2014
LaserLaB Master student Leah Wilk wins Amsterdam Master of Physics Award 2014

On 11th April 2014, students of the Vrije Universiteit / Universiteit van Amsterdam Master of Physics programme presented the results of their research projects in competition for the Amsterdam Master of Physics Award.

The jury, consisting of Kareljan Schoutens (IOP/UvA), Els de Wolf (Nikhef/UvA) and Gijs Wuite (Physics of Living Systems/VU), selected Leah Wilk as the winner.

Leah completed her Master internship in the group of Prof. Johannes F. de Boer under the supervision of PhD student Boy Braaf at the Rotterdam Ophthalmic Institute. She received a prize money of 400 Euros for her presentation titled: "On the reliability of retinal blood flow detection using Phase-Resolved Optical Frequency Domain Imaging".

Leah also received the audience award including a prize money of 100 Euros.

04/14/2014
Third prize for Steven Beekmans' poster

Steven Beekmans won the third prize with his poster 'Measuring mechanical changes of brain tissue in an Alzheimer's mouse model in vivo'. He was one of the 50 participants in the competition.

Steven won the prize at the poster competition at 10th International Young Scientist conference "Developments in Optics and Communications" and Laserlab III Training School for Potential Users "Laser Applications in Spectroscopy, Industry and Medicine at Riga, Latvia on April 9-12, 2014.

05/15/2014
VU spinoff Lumicks brengt interactie moleculen realtime in beeld

Weer een stap dichterbij het voorkomen en genezen van kanker.

LUMICKS is een spinoff van de Vrije Universiteit Amsterdam die het mogelijk maakt om de interactie tussen moleculen zoals DNA en eiwitten realtime in beeld te brengen, iets dat nog niet eerder mogelijk was. Realtime is belangrijk omdat men dan de dynamiek van biologische processen, zoals repair van DNA, kan volgen als het gebeurd, en onder realistische omstandigheden. De kennis die dat gaat opleveren is belangrijk in onderzoek naar het voorkomen en genezen van kanker.

05/26/2014
Eliane van Dam won Gouden Spatel

Eliane van Dam, who did her internship at LaserLaB under supervision of Dr. Diego Millo, won the "Gouden Spatel".

Hogeshool Leiden student Eliane van Dam won the best thesis prize with her thesis 'In situ pH measurements of electroactive microbial biofilmswith surface-enhanced Raman spectroscopy'.

07/02/2014

FOCUS ON LIGHT: Natural strategies for photosynthetic light harvesting

In the July focus issue of *Nature Chemical Biology* a Perspective article by Roberta Croce (VU) and Herbert van Amerongen (WUR) introduces the design principles of light harvesting in photosynthetic organisms and discusses possible strategies for improving light capture.

R. Croce and H. van Amerongen "Natural strategies for photosynthetic light harvesting"
Nature Chemical Biology 10, 492–501 (2014)

07/21/2014

First prize for Fabio Feroldi's poster

Fabio Feroldi won the first prize with his poster 'In vivo endoscopic polarization sensitive Optical Coherence Tomography' at a summer school. He was one of the 50 participants in the competition.

Fabio won the prize at the poster competition of the 5th international Biophotonics and Imaging Graduate Summer School (BIGSS) held in Galway, Ireland on 15-20th June 2014. Fabio is currently a PhD candidate in the Biophotonics and Medical Imaging section of the LaserLab Amsterdam, under the supervision of Professor Johannes F. de Boer.

Mt. Changbai Friendship Award

Prof.dr. Steven Stolte as Friendship Foreign Expert at the State University of Jilin, China. (29 September 2014)

11/12/2014

Steven Beekmans in Delta

Delta, the Technical magazine of TU Delft published Steven Beekmans' report of his research to sensitivity of the needle.

11/16/2014

ARCNL geopend door Sander Dekker en Martin van den Brink

Op dinsdag 11 november 2014 openden Staatssecretaris Sander Dekker van Onderwijs, Cultuur en Wetenschap en Martin van den Brink, president en CTO van ASML, het Advanced Research Center for NanoLithography (ARCNL) op het Amsterdam Science Park. Met een druk op de knop zetten Dekker en Van de Brink een krachtige laser in werking die een lint met daarop het ARCNL logo doorbrandde. Ze gaven daarmee het sein aan twee in laboratoriumpakken gestoken medewerkers om de deuren te openen van het nieuwe laboratorium van ARCNL.

Voorafgaand aan deze openingshandeling luisterden zo'n driehonderd genodigden naar vertegenwoordigers van alle partijen die betrokken zijn bij ARCNL. Theater- en filmmaker Jan van den Berg presenteerde het programma en introduceerde de vertegenwoordigers. Deze sprekers lieten ieder vanuit een eigen invalshoek zien wat het belang is van deze bijzondere samenwerking tussen private (ASML) en publieke partijen (Stichting FOM, NWO, de Universiteit van Amsterdam en de Vrije Universiteit Amsterdam). Zo sprak staatssecretaris Sander Dekker over de voorbeeldfunctie die de samenwerkende partners vervullen voor toekomstige publiek-private samenwerkingen op het snijvlak van wetenschap en bedrijfsleven.

Na de spectaculaire openingshandeling konden de bezoekers een kijkje nemen in de nieuwe laboratoria. Directeur Joost Frenken wilde de bezoekers graag laten proeven van het enthousiasme waarmee ARCNL wordt opgebouwd.

Het Advanced Research Center for Nanolithography (ARCNL) is een publiek-private samenwerking tussen FOM, de Universiteit van Amsterdam, de Vrije Universiteit Amsterdam en ASML, de producent van lithografiemachines voor de chipindustrie, met aanvullende financiële steun van de gemeente Amsterdam en de provincie Noord-Holland. ARCNL verricht fundamenteel onderzoek op het gebied van de nanolithografie, in het bijzonder voor toepassing in de halfgeleiderindustrie. In eerste instantie richt het centrum zich op de fysische en chemische processen die cruciaal zijn voor lithografie met Extreem Ultraviolet (EUV) licht.

11/24/2014

Greg Stephens and Erwin Peterman participate in M€2,4 FOM programme on "The signal is the noise: seeking physical origins of fluctuation in organism-scale behaviour"

Variability in the behavior of living organisms has traditionally been studied by distinguishing the effects of 'nature' (i.e. genetics) from those of 'nurture' (i.e. environmental effects). Yet from a physical perspective, sources of variability exist even among genetically identical individuals in exactly the same environment. Fluctuations in physical processes at the level of molecules inject randomness into biological dynamics, and it is now well established that such molecular 'noise' in key biochemical processes (for example, in the production of proteins) can cause highly variable behaviors at the level of individual cells. On the other hand, physical principles suggest that fluctuations at such minute scales will have little impact on phenomena at macroscopic scales. Thus, how a complex multi-cellular organism made of many cells generates random behavior remains a fundamental mystery.

In this program, researchers address this challenging question by focusing on the nematode worm *C. elegans* – one of the simplest forms of life with a nervous system. These organisms demonstrate strong behavioral variability and feature a remarkably simple and comprehensively characterized neural anatomy (302 neurons connected by ~7000 synapses). By connecting fluctuations in the worms' motile behavior, the production and movement of proteins, and the activity of neurons, they seek to explain variability at the organism level in terms of physical principles.

Program leader Tom Shimizu (AMOLF): "Our program brings together a unique combination of expertise in precision biophysical measurements at multiple scales – from molecules to the whole organism – as well as theoretical methods to bridge these scales. We're very excited that this FOM Program will seed a new effort to develop biophysics at the organism scale through studies of fluctuations."

This program is a collaboration between:

- AMOLF: Dr. T.S. Shimizu, Dr. J.S. van Zon
- Vrije Universiteit Amsterdam: Dr. G.J. Stephens, Prof. dr. E.J.G. Peterman
- Hubrecht Institute (KNAW): Prof. dr. A. van Oudenaarden, Dr. H.C. Korswagen
- Utrecht University: Prof. dr. S.J.L. van den Heuvel
- Erasmus MC: Dr. G. Jansen

With the 'Vrije programma's' FOM brings together the best research groups in their respective fields in the Netherlands. In each research program the specialists from the various Dutch knowledge institutes combine their strengths. With this FOM realises what is termed 'focus and mass' in policy jargon: working on a limited number of challenging scientific subjects, with a large number of the best researchers in the Netherlands, with the research being coordinated at a national level.

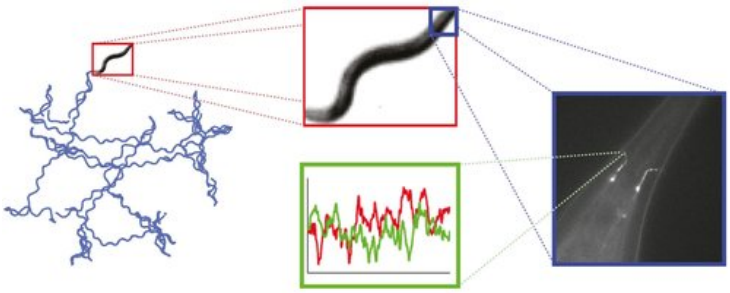


Figure: Connecting variability across scales. Fluctuations in the behavior of *C. elegans* worms will be studied at multiple scales: at the level of the worm's random-walk trajectories in space (blue curves, left), at the level of postural movements (red box, above), at the level of neuronal activity and protein movement (blue box, right), and at the level of protein production (green box, below).

11/20/2014

Ton van Leeuwen and Wouter Roos participate in M€ 5.7 STW perspectief programme

All sorts of cells excrete vesicles containing a lot of information about the cell and its environment. As tumor cells also produce these extracellular vesicles, such particles provide an attractive target for cancer diagnosis and monitoring. A team of 9 research groups will, together with industrial partners, combine forces to develop technology to identify and analyse these vesicles.

The researchers from universities and medical centres in Amsterdam, Twente, Utrecht, Wageningen, Delft and Rotterdam apply a variety of complementary techniques to identify the vesicles. The combined subprojects of the Van Leeuwen group at the Academic Medical Centre and of the Roos group at the Vrije Universiteit, both in Amsterdam, amount to ~M€1.3. They will use this money to develop advanced *flow cytometry*, *Coherent Anti-stokes Raman scattering (CARS)* and *scanning probe* techniques for identification and the probing of the physico-chemical properties of these particles.

A variety of companies have joined the consortium and for instance in the Roos lab one PhD student and one Post-doc will develop innovative analysis techniques together with the industrial partner Leiden Probe Microscopy. Joint with the approaches developed by the other partners in the consortium it is expected that these efforts will lead to more effective and specific treatments of cancer.

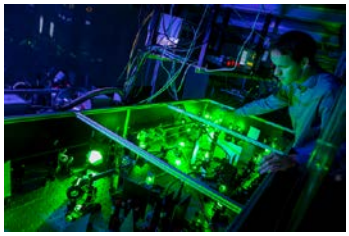
11/24/2014

ERC Starting grant for Stefan Witte

The European Research Council has awarded Stefan Witte with a prestigious Starting Grant.

With this grant, he will develop new methods that allow high-resolution microscopy without the use of lenses. While imaging technology is one of the most widespread diagnostic techniques in science and industry, the need for specialized optical components can be problematic in many cases. Lensless imaging is an elegant approach to microscopy, in which a sharp image of an object is retrieved by numerical means rather than by actual optical components such as lenses.

Witte's group will take an integrated approach to lensless microscopy, by developing novel imaging methods that can be applied in a wide variety of experiments. Surprisingly similar techniques can then be exploited for the development of miniature microscopes, imaging through scattering media, and even for ultrahigh-resolution imaging using extreme-ultraviolet and soft-X-ray radiation. The possibility of lensless microscopy provides exciting new prospects for fundamental science and technology alike.



European Research Council
Established by the European Commission

12/12/2014

Best Paper Award 2014

Winner of the Best Paper competition was announced during the Annual LaserLaB Symposium.

On Friday 12 December during the Annual LaserLaB Symposium Gerrit Sitters was announced as the winner of the Best Paper Award 2014 with his article "*Acoustic force spectroscopy*" in Nature Methods

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 FEW + FALW (incl. FOM employees)

▪ Total fte (including PhD students):	123.9
1st funding (incl./excl. PhD students)	7.5
2nd funding	76.5
3rd funding	39.9
▪ Total fte PhD students	69
1st funding	0.5
2nd funding	47.9
3rd funding	20.6
▪ Total new started PhD students FEW:	24
1st funding	0
2nd funding	17
3rd funding	7

University of Amsterdam

▪ Total fte:	16.4
▪ Total fte PhD students:	5.5

Amsterdam Medical Centre

▪ Total fte:	17
▪ Total fte PhD students:	10

Total LaserLaB Amsterdam

▪ Total fte (including PhD students):	157.3
▪ Total fte PhD student:	84.5

Earning power (VU FEW + FALW only)

Total value of grants acquired in 2014 (whole LaserLaB)	5.9 M€
Total value of grants obtained by VU (FEW + FALW)	4.0 M€
(of which 2.4 M€ 2nd and 1.6 M€ 3rd funding)	
Research input VU WP1 = fte (staff 40% + PD/PhD 100%)	7.5 fte
Earning power per 10 WP1 =	5.3 M€

Total research input VU WP (staff 40% + PD/PhD 100%) = 123.9 fte

Earning power per 10 WP = 323 k€

7. OUTPUT RESEARCH INSTITUTE

A) SCIENTIFIC OUTPUT

Overall scientific output LaserLaB Amsterdam

Total number of theses':

Total number of scientific papers, refereed:

PER RESEARCH PROGRAM

Scientific Output Theme Analytical Chemistry and Spectroscopy

- Number of theses: 3

  Huerta Viga, A. (2014, May 9). Coupled vibrations in peptides and proteins: Structural information using 2D-IR spectroscopy. UvA. Promotor: Prof. dr. S. Woutersen

  Tan, E.M.M. (2014, November 25). Structural dynamics of isolated biological and synthetic photoswitches. UvA. Promotoren: Prof. dr. W.J. Buma & Prof. dr. J. Oomens

  Liu, K. (2014, December 16). Functionalized upconversion nanoparticles for cancer imaging and therapy. UvA. Promotoren: Prof. Dr. W.J. Buma, Prof. dr. X.G. Kong & Prof. dr. M.C.G. Aalders; copromotor Dr. H. Zhang

- Number of scientific papers, refereed: 25

1. Brouard, M., Chadwick, H., Gordon, S.D.S., Hornung, B., Nichols, B., Klos, J., Aoiz, F.J. & Stolte, S. (2014). Fully quantum state-resolved inelastic scattering of NO(X) plus Kr: Differential cross sections and product rotational alignment. *Journal of Chemical Physics, 141*:164306(16). 10.1063/1.4897558

2. Chadwick, H., Nichols, B., Gordon, S.D.S., Hornung, B., Squires, E., Brouard, M., Klos, J., Alexander, M.H., Aoiz, F.J. & Stolte, S. (2014). Inelastic Scattering of NO by Kr: Rotational Polarization over a Rainbow. *Journal of Physical Chemistry Letters, 5*(19), 3296-3301. 10.1021/jz501621c

3. Conyard, J., Heisler, I.A., Browne, W.R., Feringa, B.L., Amirjalayer, S., Buma, W.J., Woutersen, S. & Meech, S.R. (2014). Ultrafast Excited State Dynamics in 9,9 '-Bifluorenylidene. *The Journal of Physical Chemistry. A*, 118 (31), 5961-5968. doi: 10.1021/jp504391s

4. Domingos, S.R., Sanders, H.J., Hartl, F., Buma, W.J. & Woutersen, S. (2014). Switchable Amplification of Vibrational Circular Dichroism as a Probe of Local Chiral Structure. *Angewandte Chemie*, International Edition, 53 (51), 14042-14045. doi: 10.1002/anie.201407376

5. Domingos, S.R., Huerta-Viga, A., Baij, L., Amirjalayer, S., Dunnebier, D.A.E., Walters, A.J.C., Finger, M., Nafie, L.A., Bruin, B. de, Buma, W.J. & Woutersen, S. (2014). Amplified Vibrational

Circular Dichroism as a Probe of Local Biomolecular Structure. *Journal of the American Chemical Society*, 136 (9), 3530-3535. doi: 10.1021/ja411405s

6. Huerta-Viga, A., Domingos, S.R., Amirjalayer, S. & Woutersen, S. (2014). A salt-bridge structure in solution revealed by 2D-IR spectroscopy. *Physical Chemistry Chemical Physics*, 16, 15784-15786. doi: 10.1039/C4CP00233D

7. Knie, C., Utecht, M., Zhao, F., Kulla, H., Kovalenko, S., Brouwer, A.M., Saalfrank, P.,Hecht , S. & Bléger, D. (2014). ortho-Fluoroazobenzenes: Visible Light Switches with Very Long-Lived Z Isomers. *Chemistry - A European Journal*, 20 (50), 16492-16501. doi: 10.1002/chem.201404649

8. Li, P., Amirjalayer, S., Hartl, F., Lutz, M., Bruin, M. de, Becker, R., Woutersen, S. & Reek, J.N.H. (2014). Direct Probing of Photoinduced Electron Transfer in a Self-Assembled Biomimetic [2Fe2S]-Hydrogenase Complex Using Ultrafast Vibrational Spectroscopy. *Inorganic Chemistry*, 53 (10), 5373-5383. doi: 10.1021/ic500777d

9. Liu, K., Wang, Y., Kong, X., Liu, X., Zhang, Y., Tu, L., Ding, Y., Aalders, M.C.G., Buma, W.J.& Zhang, H. (2014). Multispectral upconversion luminescence intensity ratios for ascertaining the tissue imaging depth. *Nanoscale*, 6 (15), 9257-9263. doi: 10.1039/c4nr02090a

10. Liu, Y.X., Ma, L., Yan, D.T., Zhu, H.C., Liu, X.L., Bian, H.Y., Zhang, H. & Wang, X.J. (2014). Effects of encaged anions on the optical and EPR spectroscopies of RE doped C12A7. *Journal of Luminescence*, 152, 28-32. doi: 10.1016/j.jlumin.2013.10.066

11. Loop, T.H. van der, Ottosson, N., Lotze, S., Kentzinger, E., Vad, T., Sager, W.F.C., Bakker, H.J. & Woutersen, S. (2014). Structure and dynamics of water in nanoscopic spheres and tubes. *Journal of Chemical Physics*, 141 (18), 18C535. doi: 10.1063/1.4898380

12. Loop, T.H. van der, Ruesink F., Amirjalayer, S., Sanders, H.J., Buma, W.J. & Woutersen, S. (2014). Unraveling the Mechanism of a Reversible Photoactivated Molecular Proton Crane. *The Journal of Physical Chemistry*. B, 118 (45), 12965-12971. doi: 10.1021/jp508911v

13. Manton, J.C., Amirjalayer, S., Coleman, A.C., McMahon, S., Harvey, E.C., Greetham, G.M., Clark, I.P., Buma, W.J., Woutersen, S., Pryce , M.T. & Long, C. (2014). Excited State Evolution towards ligand loss and ligand chelation at group 6 metal carbonyl centres. *Dalton Transactions*, 43 (47), 17797-17805. doi: 10.1039/C4DT01544D

14. Meuzelaar,H., Tros, M., Huerta-Viga, A., Dijk, C.N. van, Vreede, J. & Woutersen, S. (2014). Solvent-Exposed Salt Bridges Influence the Kinetics of α-Helix Folding and Unfolding. *The Journal of Physical Chemistry Letters*, 5 (5), 900-904. doi: 10.1021/jz500029a

15. Panman, M.R., Shaw, D.J. Ensing, B. & Woutersen, S. (2014). Local orientational order in liquids revealed by resonant vibrational energy transfer. *Physical review letters*, 113 (20), 207801. doi: 10.1103/PhysRevLett.113.207801

16. Pei, X., Tian, H., Zhang, W., Brouwer, A.M. & Qian, J. (2014). Colorimetric and fluorescent determination of sulfide and sulfite with kinetic discrimination. *Analyst*, 139 (20), 5290-5296. doi: 10.1039/c4an01086h

17. Qu, S., Shen, D., Liu, X., Jing, P., Zhang, L., Ji, W., Zhao, H., Fan, X. & Zhang, H. (2014). Highly Luminescent Carbon-Nanoparticle-Based Materials: Factors Influencing Photoluminescence

Quantum Yield. *Particle & Particle Systems Characterization*, 31 (11), 1175-1182. doi: 10.1002/ppsc.20140005

18. Schach, D., Globisch, C., Roeters, S.J., Woutersen, S., Fuchs, A., Weiss, C.K., Backus, E.H.G., Landfester, K., Bonn, M., Peter, C. & Weidner, T. (2014). Sticky water surfaces: Helix-coil transitions suppressed in a cell-penetrating peptide at the air-water interface. *Journal of Chemical Physics*, 141 (22), 22D517. doi: 10.1063/1.4898711

19. Shao, D., Li, J., Guan, F., Pan, Y., Xiao, X., Zhang, M., Zhang, H. & Chen, L. (2014). Selective inhibition of liver cancer growth realized by the intrinsic toxicity of a quantum dot-lipid complex. *International Journal of Nanomedicine*, 9 (1), 5753-5769. doi: 10.2147/IJN.S73185

20. Siekierzycka, J.R., Hippius, C., Würthner, F., Williams, R.M. & Brouwer, A.M. (2014). A multi-property fluorescent probe for the investigation of polymer dynamics near the glass transition. *Central European Journal of Chemistry*, 12 (9), 937-952. doi: 10.2478/s11532-014-0544-0

21. Sun, M., Qu, S., Hao, Z., Ji, W., Jing, P., Zhang, H., Zhang, L., Zhao, J. & Shen, D. (2014). Towards efficient solid-state photoluminescence based on carbon-nanodots and starch composites. *Nanoscale*, 6 (21), 13076-13081. doi: 10.1039/C4NR04034A

22. Tan, E.M.M., Amirjalayer, S., Mazzella, P., Bakker, B.H., Maarseveen, J.H. van, Bieraugel, H. & Buma, W.J. (2014). Molecular Beam and ab Initio Studies of Photoactive Yellow Protein Chromophores: Influence of the Thioester Functionality and Single Bond Rotation. *The Journal of Physical Chemistry*. B, 118 (43), 12395-12403. doi: 10.1021/jp5075169

23. Tan, E.M., Hilbers, M. & Buma, W.J. (2014). Excited-State Dynamics of Isolated and Microsolvated Cinnamate-Based UV-B Sunscreens. *The Journal of Physical Chemistry Letters*, 5 (14), 2464-2468. doi: 10.1021/jz501140b

24. Vachon, J., Carroll, G.T., Pollard, M.M., Mes, E.M., Brouwer, A.M. & Feringa, B.L. (2014). An ultrafast surface-bound photo-active molecular motor. *Photochemical & Photobiological Sciences*, 13 (2), 241-246. doi: 10.1039/c3pp50208b

25. Xia, L., Kong, X., Liu, X., Tu, L., Zhang, Y., Chang, Y., Liu, K., Shen, D., Zhao, H. & Zhang, H. (2014). An upconversion nanoparticle - Zinc phthalocyanine based nanophotosensitizer for photodynamic therapy. *Biomaterials*, 35 (13), 4146-4156. doi: 10.1016/j.biomaterials.2014.01.068

Scientific Output Theme Biophotonics and Microscopy

- Number of Theses: 2

1. Chavan, D.C. (2014, Januari 13). *Applications of Fiber-top technology for Material Property Characterization at Nanoscale.* VU Vrije Universiteit. Prom./coprom.: prof. dr. D. Iannuzzi.

2. Gruca, G.L. (2014, Februari 20). *Ferrule-top micromachined devices.* VU Vrije Universiteit. Prom./coprom.: prof. dr. D. Iannuzzi.

- Number of scientific papers, refereed: 8

1. Alasil, T, Wang, K., Yu, F., Field, M.G., Lee, H., Baniasadi, N., Boer, J.F. de & Coleman, A.L. (2014). Correlation of Retinal Nerve Fiber Layer Thickness and Visual Fields in Glaucoma: A Broken Stick Model. *American Journal of Ophthalmology, 157*(5), 953-959. 10.1016/j.ajo.2014.01.014

2. Braaf, B., Vermeer, K.A., Groot, M. de, Vienola, K.V. & Boer, J.F. de (2014). Fiber-based polarization-sensitive OCT of the human retina with correction of system polarization distortions. *Biomedical Optics Express, 5*(8), 2736-2758. 10.1364/BOE.5.002736

3. Cerini, F., Ferrari, M., Ferrari, V., Russo, A., Azpeitia Urquia, M., Ardito, R., De Masi, B., Almasi, A., Iannuzzi, D. & Sedmik, R. (2014). Investigation of the effects of hydrodynamic and parasitic electrostatic forces on the dynamics of a high aspect ratio MEMS accelerometer. In *EUROSENSORS 2014, the 28th European Conference on Solid-State Transducers Vol. 2014. Procedia Engineering* (pp. 827). Elsevier.

4. Helmes, M.H.B., Breel, E.J., Iannuzzi, D. & Velden, J. van der (2014). Measuring Work Loops in Intact Isolated Cardiac Myocytes by Controlling Pre- and Afterload using a New Generation Force Transducer. *Biophysical Journal, 106*(2), 564A-564A.

5. Hoorn, C.H. van, Chavan, D.C., Tiribilli, B, Margheri, G, Mank, A.J.G., Ariese, F. & Iannuzzi, D. (2014). Opto-mechanical probe for combining atomic force microscopy and optical near-field surface analysis. *Optics Letters, 39*(16), 4800-4803. 10.1364/OL.39.004800

6. Li, J. & Boer, J.F. de (2014). Coherent signal composition and global phase determination in signal multiplexed polarization sensitive optical coherence tomography. *Optics Express, 22*(18), 21382-21392. 10.1364/OE.22.021382

7. Noom, D.W.E., Boonzajer Flaes, D.E., Labordus, E., Eikema, K.S.E. & Witte, S.M. (2014). High-speed multi-wavelength Fresnel diffraction imaging. *Optics Express, 22*(25), 30504-30511. 10.1364/OE.22.030504

8. Vermeer, K.A., Mo, J., Weda, J.J.A., Leij, H.G. & Boer, J.F. de (2014). Depth-resolved model-based reconstruction of attenuation coefficients in optical coherence tomography. *Biomedical Optics Express, 5*(1), 322-337. 10.1364/BOE.5.000322

Scientific Output Theme Energy

- Number of theses: 0

- Number of scientific papers, refereed: 40

1. Alexandre, M.T.A., Gundermann, K., Pascal, A.A., Grondelle, R. van, Buchel, C. & Robert, B.H. (2014). Probing the carotenoid content of intact Cyclotella cells by resonance Raman spectroscopy. *Photosynthesis Research, 119*, 273-281. 10.1007/s11120-013-9942-y

2. Chernov, I., Greb, H., Janssen-Bienhold, U., Parisi, J., Weiler, R. & Hauff, E.L. von (2014). Binding and potential-triggered release of L-glutamate with molecularly imprinted polypyrrole in neutral pH solutions. *Sensors and Actuators B-Chemical, 203*, 327-332. 10.1016/j.snb.2014.06.030

3. Cohen, E., Gruber, M., Romero, E., Yochelis, S., Grondelle, R. van & Paltiel, Y. (2014). Properties of Self-Assembled Hybrid Organic Molecule/Quantum Dot Multilayered Structures. *Journal of Physical Chemistry C. Nanomaterials and Interfaces, 118*(44), 25725-25730. 10.1021/jp507825r

4. Croce, R. & Amerongen, H. van (2014). Natural strategies for photosynthetic light harvesting. *Nature Chemical Biology, 10*(7), 492-501. 10.1038/NCHEMBIO.1555

5. Dinc, E., Ramundo, S., Croce, R. & Rochaix, J.D. (2014). Repressible chloroplast gene expression in Chlamydomonas: A new tool for the study of the photosynthetic apparatus. *Biochimica et Biophysica Acta (BBA) - Bioenergetics, 1837*(9), 1548-1552. 10.1016/j.bbabio.2013.11.020

6. Drop, B.A., Yadav, K.N.S., Boekema, E.J. & Croce, R. (2014). Consequences of state transitions on the structural and functional organization of Photosystem I in the green alga Chlamydomonas reinhardtii. *Plant Journal, 78*(2), 181-191. 10.1111/tpj.12459

7. Drop, B.A., Webber-Birungi, M., Yadav, S.K.N., Filipowicz-Szymanska, A., Fusetti, F., Boekema, E.J. & Croce, R. (2014). Light-harvesting complex II (LHCII) and its supramolecular organization in Chlamydomonas reinhardtii. *Biochimica et Biophysica Acta (BBA) - Bioenergetics, 1837*(1), 63-72. 10.1016/j.bbabio.2013.07.012

8. Ferretti, M., Duquesne, K., Sturgis, J.N. & Grondelle, R. van (2014). Ultrafast excited state processes in Roseobacter denitrificans antennae: comparison of isolated complexes and native membranes. *Physical Chemistry Chemical Physics - PCCP, 2014*(16), 26059-26066. 10.1039/c4cp02986k

9. Gibasiewisz, K., Adamiec, M., Lucinski, R., Giera, W., Chelminiak, P., Szewcyk, S., Sipinska, W., Glow, E., Karolczak, J., Grondelle, R. van & Jackowski, G. (2014). Monte Carlo simulations of excitation and electron transfer in grana membranes. *Biochimica et Biophysica Acta (BBA) - Bioenergetics*. 10.1016/j.bbabio.2014.12.004

10. Grondelle, R. van & Gorkom, H.J. van (2014). The birth of the photosynthesic reaction center: the story of Lou Duysens. *Photosynthesis Research, 120*, 3-7. 10.1007/s11120-013-9959-2

11. Janssen, P.J.D., Lambreva, M.D., Plumeré, N., Bartolucci, C., Antonacci, A., Buonasera, K., Frese, R.N., Scognamiglio, V. & Rea, G. (2014). Photosynthesis at the forefront of a sustainable life. *Frontiers in chemistry, 36*, 1-22.

12. Kamran, M., Delgado, J.D., Friebe, V.M., Aartsma, T.J. & Frese, R.N. (2014). Photosynthetic Protein Complexes as Bio-photovoltaic Building Blocks Retaining a High Internal Quantum Efficiency . *Biomacromolecules, 15*, 2833-2838. 10.1021/bm500585s

13. Kruger, T.P.J., Ilioaia, C., Johnson, M.P., Ruban, A. & Grondelle, R. van (2014). Disentangling the low-energy states of the major light-harvesting complex of plants and their role in photoprotection. *Biochimica et Biophysica Acta*. 10.1016/j.bbabio.2014.02.014

14. Liguori, N., Roy, L.M., Opacic, M. & Croce, R. (2014). Structural Basis for the Non-Photochemical Quenching Switch of the Green Alga Chlamydomonas Reinhardtii. *Biophysical Journal, 106*(2), 182A-182A.

15. MacKenzie, R.C.I., Goeritz, A., Greedy, S., Hauff, E.L. von & Nelson, J. (2014). Theory of Stark spectroscopy transients from thin film organic semiconducting devices. *Physical Review B, 89*:195307(19). 10.1103/PhysRevB.89.195307

16. Mahaputra Wijaha, M., Iwata, T., Yamamoto, J., Hitomi, K., Iwai, S., Getzoff, D., Kennis, J.T.M., Mathes, T. & Kandori, H. (2014). FAD Chromophore Charge Controls the Conformation of CPD-Photolyase α-Helices. *Biochemistry, 2014*(53), 5864-5875. 10.1021/bi500638b

17. Mathes, T., Stokkum, I.H.M. van & Kennis, J.T.M. (2014). Photoactivation mechanisms of flavin-binding photoreceptors revealed through ultrafast spectroscopy and global analysis methods. *Methods in Molecular Biology, 2014*(1146), 401-442.

18. Meisenheimer, S.K., Jüchter, S., Hoehn, O., Hauser, H., Wellens, C., Kuebler, V., Hauff, E.L. von & Blaesi, B. (2014). Large area plasmonic nanoparticle arrays with well-defined size and shape. *Optical Materials Express, 4*(5), 944-952. 10.1364/OME.4.000944

19. Natali, A., Roy, L.M. & Croce, R. (2014). In Vitro Reconstitution of Light-harvesting Complexes of Plants and Green Algae. *Journal of Visualized Experiments*, e51852-e51852. 10.3791/51852

20. Nolasco, J.C., Ramos-Ortiz, G., Maldonado, J.L., Barbosa-Garcia, O., Ecker, B. & Hauff, E.L. von (2014). Polymer/cathode interface barrier limiting the open circuit voltage in polymer:fullerene organic bulk heterojunction solar cells: A quantitative analysis. *Applied Physics Letters, 104*:043308(4). 10.1063/1.4863755

21. Okamura, M., Wraight, C.A. & Grondelle, R. van (2014). Special issue of photosynthetic research. *Photosynthesis Research, 120*, 1-2. 10.1007/s11120-013-9952-9

22. Oort, B.F. van, Kargul, J., Maghlaoui, K., Barber, J. & Amerongen, H. van (2014). Corrigendum to Fluorescence kinetics of PSII crystals containing Ca(2+) or Sr(2+) in the oxygen evolving complex. *Biochimica et Biophysica Acta, 2014*. 10.1016/j.bbabio.2013.11.008

23. Passarini, F., Xu, P., Caffarri, S., Hille, J. & Croce, R. (2014). Towards in vivo mutation analysis: Knock-out of specific chlorophylls bound to the light-harvesting complexes of Arabidopsis thaliana - The case of CP24 (Lhcb6). *Biochimica et Biophysica Acta (BBA) - Bioenergetics, 1837*(9), 1500-1506. 10.1016/j.bbabio.2014.02.012

24. Ramanan, C., Berera, R., Gundermann, K., Stokkum, I.H.M. van, Buchel, C. & Grondelle, R. van (2014). Exploring the mechanism(s) of energy dissipation in the light harvesting complex of the photosynthetic algae Cyclotella meneghiniana. *Biochimica et Biophysica Acta (BBA) - Bioenergetics, 2014*(9), 1507-1513. 10.1016/j.bbabio.2014.02.016

25. Ravensbergen, J., Abdi, F., Santen, J.H. van, Frese, R.N., Dam, B., Krol, R. van de & Kennis, J.T.M. (2014). Unraveling the Carrier Dynamics of BiVO4: A Femtosecond to Microsecond Transient Absorption Study. *Journal of Physical Chemistry, 2014*(118), 27793-27800.

26. Rombouts, J.A., Ravensbergen, J., Frese, R.N., Kennis, J.T.M., Ehlers, A.W., Slootweg, J.C., Ruijter, E., Lammertsma, K. & Orru, R.V.A. (2014). Synthesis and photophysics of a red light absorbing supramolecular antenna system having stable photophysical properties upon

binding of pyridines. *Chemistry: A European Journal, 20*, 10285-10291. 10.1002/chem.201402398

27. Rombouts, J.A., Ravensbergen, J., Frese, R.N., Kennis, J.T.M., Ehlers, A.W., Slootweg, J.C., Ruijter, E., Lammertsma, K. & Orru, R.V.A. (2014). Synthesis and Photophysics of a Red Light Absorbing Supramolecular Chromophore System. *Chemistry: A European Journal, 2014*(20), 1-8.

28. Romero, E., Augulis, R., Novoderezhkin, V.I., Ferretti, M., Thieme, J., Zigmantas, D. & Grondelle, R. van (2014). Quantum coherence in photosynthesis for efficient solar-energy conversion. *Nature Physics*, 676-682. 10.1038/NPHYS3017

29. Schlau-Cohen, G.S., Yang, H.Y., Gwizdala, M.S., Kruger, T.P.J., Xu, P., Croce, R., Grondelle, R. van & Moerner, W. E. (2014). Single-Molecule Exploration of the Photodynamics of LHCII Complexes in Solution. *Biophysical Journal, 106*(2), 182A-182A.

30. Stierl, M., Penzkofer, A., Kennis, J.T.M., Hegemann, P. & Mathes, T. (2014). Key Residues for the Light Regulation of the Blue Light-Activated Adenylyl Cyclase from Beggiatoa sp. *Biochemistry, 2014*(53), 5121-5130. 10.1021/bi500479v

31. Stojkovic, E.A, Toh, K.C., Alexandre, M.T.A., Baclayon, M., Moffat, K. & Kennis, J.T.M. (2014). FTIR Spectroscopy Revealing Light-Dependent Refolding of the Conserved Tongue Region of Bacteriophytochrome. *Journal of Physical Chemistry Letters, 2014*(5), 2512-2515. 10.1021/jz501189t

32. Stokkum, I.H.M. van & Laptenok, S. (2014). Quantitative Fluorescence Spectral Analysis of Protein Denaturation. *Methods in Molecular Biology, 2014*, 43-51. 10.1007/978-1-62703-649-8_3

33. Swainsbury, D.J.K., Scheidelaar, S., Grondelle, R. van, Killian, J.A. & Jones, M.R. (2014). Bacterial reaction centers purified with styrene maleic acid copolymer retain native membrane functional properties and display enhanced stability. *Angewandte Chemie International Edition in English, 2014*(53), 1-6. 10.1002/1nie.201406412

34. Swainsbury, D.J.K., Friebe, V.M., Frese, R.N. & Jones, M.R. (2014). Evaluation of a biohybrid photoelectrochemical cell employing the purple bacterial reaction centre as a biosensor for herbicides. *Biosensors and Bioelectronics, 58*, 172-178. 10.1016/j.bios.2014.02.050

35. Synooka, O., Eberhardt, K.R., Singh, C.R., Hermann, F., Ecke, G., Ecker, B., Hauff, E.L. von, Gobsch, G. & Hoppe, H. (2014). Influence of Thermal Annealing on PCDTBT: PCBM Composition Profiles. *Advanced Energy Materials, 4*:1300981(5). 10.1002/aenm.201300981

36. Sznee, K.E., Crouch, L.I., Jones, M.R., Dekker, J.P. & Frese, R.N. (2014). Variation in supramolecular organisation of the photosynthetic membrane of Rhodobacter sphaeroides induced by alteration of PufX. *Photosynthesis Research, 119*(1-2), 243-256. 10.1007/s11120-013-9949-4

37. Unlu, C., Drop, B.A., Croce, R. & Amerongen, H. van (2014). State transitions in Chlamydomonas reinhardtii strongly modulate the functional size of photosystem II but not of photosystem I. *Proceedings of the National Academy of Sciences of the United States of America, 111*(9), 3460-3465. 10.1073/pnas.1319164111

38. Wahadoszamen, M.D., Margalit, I., Ara, A.M., Grondelle, R. van & Noy, D. (2014). The role of charge-transfer states in energy transfer and dissipation within natural and artificial bacteriochlorophyll proteins. *Nature Communications, 5*, 5287-5287. 10.1038/ncomms6287

39. Zhu, J., Vreede, J., Hospes, M., Arents, J., Kennis, J.T.M., Stokkum, I.H.M. van, Hellingwerf, K.J. & Groot, M.L. (2014). Short Hydrogen Bonds and Negative Charge in Photoactive Yellow Protein Promote Fast Isomerization but not High Quantum Yield. *Journal of Physical Chemistry B, 2015*(119), 2372-2383. 10.1021/jp506785q

40. d'Haene, S., Crouch, L.I., Jones, M.R. & Frese, R.N. (2014). Organization in photosynthetic membranes of purple bacteria in vivo: the role of carotenoids. *Biochimica et Biophysica Acta (BBA) - Bioenergetics, 10*, 1665-1673.

Scientific Output Theme Light and Tissue

- Number of theses: 4

1. de Bruin D.M. (2014, March 13). *Clinical applications of functional optical coherence tomography*. Universiteit van Amsterdam. Promotor(s): Prof. dr. A.G.J.M. van Leeuwen, Prof. dr. M.P. Mourits; copromotor(s): Dr. D.J. Faber, Dr. F.D. Verbraak.

2. Edelman, G.J (2014, April 15). *Spectral analysis of blood stains at the crime scene.* Universiteit van Amsterdam. Promotor(s): Prof. dr. M.C.G. Aalders, Prof. dr. A.G.J.M. van Leeuwen.

3. Karakullukçu, B. (2014, February 27). *New insights into photodynamic therapy of the head and neck.* Universiteit van Amsterdam, onderzoek bij Netherlands Cancer Institute/Antoni van Leeuwenhoek Hospital. Promotor(s): Prof. Dr. A.G.J.M. van Leeuwen, Prof. dr. I.B. Tan; copromotor(s): Dr. H.J.C.M. Sterenborg, Dr. D.J. Robinson.

4. van Dam, A. (2014, September 19). *Fingermarks, more than just a ridge pattern.* Universiteit van Amsterdam. Promotor(s): Prof. dr. M.C.G. Aalders, Prof. dr. A.G.J.M. van Leeuwen; copromotor(s): Dr. S.A.G. Lambrechts SAG.

- Number of scientific papers, refereed: 13

1. Bosschaart, N., Edelman, G.J., Aalders, M.C.G., van Leeuwen, T.G., Faber, D.J., A literature review and novel theoretical approach on the optical properties of whole blood, *Lasers Med. Sci.* (2014) 29 (2):453-479.

2. Bosschaart, N., van Leeuwen, T.G., Aalders, M.C.G., Faber, D.J., Quantitative comparison of analysis methods for spectroscopic optical coherence tomography: reply to comment, *Biomed. Opt. Express* (2014) 5 (9):3034-3035.

3. Coumans, F.A.W., van der Pol, E., Böing, A.N., Hajji, N., Sturk, G., van Leeuwen, T.G., Nieuwland, R., Reproducible extracellular vesicle size and concentration determination with tunable resistive pulse sensing, *J. Extracell Vesicles* (2014) 3:25922.

4. Grundeken, M.J., Garcia-Garcia, H.M., Kraak, R.P., Woudstra, P., de Bruin, D.M., van Leeuwen, T.G., Koch, K.T., Tijssen, J.G., de Winter, R.J., Wykrzykowska, J.J., Side branch healing patterns of the Tryton dedicated bifurcation stent: a 1-year optical coherence tomography follow-up study. *Int. J. Cardiovas. Imag*. (2014) 30 (8):1445-1456.

5. Heijblom, M., Meijer, L.M., van Leeuwen, T.G., Steenbergen, W., Manohar, S., Monte Carlo simulations shed light on Bathsheba's suspect breast, *J. Biophotonics* (2014) 7 (5):323-331.

6. Stehouwer, M., Tan, S.H., van Leeuwen, T.G., Verbraak, F.D., Senile retinoschisis versus retinal detachment, the additional value of peripheral retinal OCT scans (SL SCAN-1, Topcon), *Acta Ophthalmol*. (2014) 92 (3):221-227.

7. van Dam, A., Aalders, M.C.G., de Puit, M., Gorré, S.M., Irmak, D., van Leeuwen, T.G., Lambrechts, S.A.G., Immunolabeling and the compatibility with a variety of fingermark development techniques, *Science & Justice* (2014) 54 (5):356-362.

8. van Dam, A., Schwarz, J.C.V., de Vos, J., Siebes, M., Sijen, T., van Leeuwen, T.G., Aalders, M.C.G., Lambrechts, S.A.G., Oxidation Monitoring by Fluorescence Spectroscopy Reveals the Age of Fingermarks, *Angew. Chem. Int. Ed*. (2014) 53 (24):6272-6275.

9. van Dam, A., van Nes, K.A., Aalders, M.C.G., van Leeuwen, T.G., Lambrechts, S.A.G., Immunolabeling of fingermarks left on forensic relevant surfaces, including thermal paper, *Anal. Methods* (2014) 6 (4):1051-1058.

10. van der Pol, E., Coumans, F.A.W., Grootemaat, A.E., Gardiner, C., Sargent, I.L., Harrison, P., Sturk, A., van Leeuwen, T.G., Nieuwland, R., Particle size distribution of exosomes and microvesicles determined by transmission electron microscopy, flow cytometry, nanoparticle tracking analysis, and resistive pulse sensing*, J. Thromb. Haemost.* (2014) 12 (7):1182-1192.

11. van der Pol, E., Coumans, F.A.W., Sturk, A., Nieuwland, R., van Leeuwen, T.G., Refractive Index Determination of Nanoparticles in Suspension Using Nanoparticle Tracking Analysis, *Nano Lett.* (2014) 14 (11):6195-6201.

12. Wessels, R., de Bruin, D.M., Faber, D.J., van Leeuwen, T.G., van Beurden, M., Ruers, T.J.M., Optical biopsy of epithelial cancers by optical coherence tomography (OCT), *Lasers Med. Sci*. (2014) 29 (3):1297-1305.

13. Yurtsever, G., Weiss, N., Kalkman, J., van Leeuwen, T.G., Baets, R., Ultra-compact silicon photonic integrated interferometer for swept-source optical coherence tomography, *Opt. Lett*. (2014) 39 (17):5228-5231.

Scientific Output Theme Single Molecule to Cell Biophysics

- Number of theses: 1

  Hoekstra, T. (2014, March 26). The cost of being right: DNA replication in optical tweezers. VU Vrije Universiteit. Promotoren: Prof. dr. G.J.L. Wuite & Prof. dr. E.J.G. Peterman

- Number of scientific papers, refereed: 39

1. Atakhorrami, M., Koenderink, G.H., Palierne, J. F., MacKintosh, F.C. & Schmidt, C.F. (2014). Scale-Dependent Nonaffine Elasticity of Semiflexible Polymer Networks. *Physical Review Letters, 112*:088101(8). 10.1103/PhysRevLett.112.088101

2. Biebricher, A.S., Heller, I., Peterman, E.J.G. & Wuite, G.J.L. (2014). DNA-Intercalation Kinetics Elucidated by Single-Dye Fluorescence Microscopy and Force Spectroscopy. *Biophysical Journal, 106*(2), 277A-277A.

3. Broedersz, C.P. & MacKintosh, F.C. (2014). Modeling semiflexible polymer networks. *Reviews of Modern Physics, 86*(3), 995-1036. 10.1103/RevModPhys.86.995

4. Brouwer, I., Giniatullina, A., Laurens, N., Groffen, A.J.A. & Wuite, G.J.L. (2014). Direct Visualization and Quantification of Doc2B-Mediated Membrane Fusion. *Biophysical Journal, 106*(2), 517A-517A.

5. Buijsman, W. & Sheinman, M. (2014). Efficient fold-change detection based on protein-protein interactions. *Physical Review A, 89*:022712(2). 10.1103/PhysRevE.89.022712

6. Candelli, A., Holpthausen, J.T., Depken, M, Brouwer, I., Franker, M.A.M.L., Marchetti, M., Heller, I., Bernard, S., Garcin, E.B., Modesti, M., Wyman, C., Wuite, G.J.L. & Peterman, E.J.G. (2014). Visualization and quantification of nascent RAD51 filament formation at single-monomer resolution. *Proceedings of the National Academy of Sciences of the United States of America, 2014*(111), 15090-15095. 10.1073/pnas.1307824111

7. Daleke, M.H., Felix, T., Soprova, Z., Hagen-Jongman ten, C.M. ten, Vikström, D., Majlessi, L., Beskers, J., Follman, F., Punder, K. de, Wel, N.N. van der, Baumgarten, T., Pham, T.V., Piersma, S.R., Jimenez, C.R., Ulsen, P. van, Gier, J.W. de, Leclerc, C., Jong, W.S. & Luirink, S. (2014). Decoration of outer membrane vesicles with multiple antigens using an autotransporter approach. *Applied and Environmental Microbiology, 80*(18), 5854-5864. 10.1128/AEM.01941-14

8. Driessen, R.P.C., Sitter, G., Moolenaar, G.F., Wuite, G.J.L., Goosen, N. & Dame, R.T. (2014). Effect of Temperature on the Intrinsic Flexibility of DNA and Its Interaction with Architectural Proteins. *Biochemistry, 2014*(53), 6430-6438. 10.1021/bi500344j

9. Fakhri, N., Wessel, A.D., Willms, C., Pasquali, M., Klopfenstein, D.R., MacKintosh, F.C. & Schmidt, C.F. (2014). High-resolution mapping of intracellular fluctuations using carbon nanotubes. *Science, 344*(6187), 1031-1035. 10.1126/science.1250170

10. Farge, G.A., Mehmedovic, M., Baclayon, M., Wildenberg, S.M.J.L., Roos, W.H., Gustafsson, C. M., Wuite, G.J.L. & Falkenberg, M. (2014). In Vitro-Reconstituted Nucleoids Can Block Mitochondrial DNA Replication and Transcription. *Cell reports, 2014*(8), 66-74. 10.1016/j.celrep.2014.05.046

11. Girard, J.J. & Peterman, E.J.G. (2014). Temporal Focusing, Line and Point-Scanning Two-Photon Fluorescence Microscopy for In Vivo Imaging: A Comparative Study of Signal Levels and Bleaching Rates. *Biophysical Journal, 106*(2), 603A-604A.

12. Guo, M., Ehrlicher, A.J., Jensen, M.H., Renz, M., Moore, J.R., Goldman, R.D., Lippincott-Schwartz, J., MacKintosh, F.C. & Weitz, D.A. (2014). Probing the Stochastic, Motor-Driven Properties of the Cytoplasm Using Force Spectrum Microscopy. *Cell, 158*(4), 822-832. 10.1016/j.cell.2014.06.051

13. Heerden, J.H. van, Wortel, M.T., Bruggeman, F.J., Heijnen, J.J., Bollen, Y.J.M., Planque, R., Hulshof, J., O'Toole, T.G., Wahl, A. & Teusink, B. (2014). Fatal attraction in glycolysis: how Saccharomyces cerevisiae manages sudden transitions to high glucose. *Microbial Cell, 1*(3), 103-106. 10.15698/mic2014.01.133

14. Heerden, J.H. van, Wortel, M.T., Bruggeman, F.J., Heijnen, J.J., Bollen, Y.J.M., Planque, R., Hulshof, J., O'Toole, T.G., Wahl, S.A. & Teusink, B. (2014). Lost in transition: start-up of glycolysis yields subpopulations of nongrowing cells. *Science, 343*:1245114(6174). 10.1126/science.1245114

15. Heller, I., Sitters, G., Broekmans, O.D., Biebricher, A.S., Wuite, G.J.L. & Peterman, E.J.G. (2014). Mobility Analysis of Super-Resolved Proteins on Optically Stretched DNA: Comparing Imaging Techniques and Parameters. *Chemphyschem, 15*, 727-733. 10.1002/cphc.201300813

16. Heller, I., Hoekstra, T.P., King, G.A., Peterman, E.J.G. & Wuite, G.J.L. (2014). Optical Tweezers Analysis of DNA-Protein Complexes. *Chemical Reviews, 114*(6), 3087-3119. 10.1021/cr4003006

17. Janmey, P.A. & MacKintosh, F.C. (2014). Cytoplasmic Transport: Bacteria Turn to Glass Unless Kicked. *Current Biology, 24*(6), R226-R228. 10.1016/j.cub.2014.02.018

18. Jaspers, M., Dennison, M., Mabesoone, M.F.J., MacKintosh, F.C., Rowan, A.E. & Kouwer, P.H.J. (2014). Ultra-responsive soft matter from strain-stiffening hydrogels. *Nature Communications, 5*:5808. 10.1038/ncomms6808

19. Jong, W.S.P., Daleke, M.H., Vikstrom, D., Hagen-Jongman ten, C.M. ten, Punder, K. de, Wel, N.N. van der, Sandt, C.E. van de, Rimmelzwaan, G.F., Follman, F., Agger, E., Andersen, P., Gier, J.-W. de & Luirink, J. (2014). An autotransporter display platform for the development of multivalent recombinant bacterial vector vaccines. *Microbial Cell Factories, 13*(1), 162.

20. King, G.A. & Wuite, G.J.L. (2014). BIOPHYSICAL CHEMISTRY Strength in numbers. *Nature Chemistry, 6*(1), 13-14. 10.1038/nchem.1831

21. King, G.A., Cortini, R., Lee, D.J., Kornyshev, A. & Wuite, G.J.L. (2014). Friction and Interactions between Bare DNA Molecules: The Role of DNA Handedness. *Biophysical Journal, 106*(2), 439A-440A.

22. King, G.A. & Wuite, G.J.L. (2014). Strength in numbers. *Nature Chemistry, 6*, 13-14. 10.1038/nchem.1831

23. Koul, A., Vranckx, L., Dhar, N., Göhlmann, H., Özdemir, E., Neefs, J.-M., Schulz, M., Lu, P., Mortz, E., McKinney, J.D., Andries, K. & Bald, D. (2014). Delayed bactericidal response to

bedaquiline involves extensive remodeling of metabolic pathways in Mycobacterium tuberculosis. *Nature Communications, 5*(3369).

24. Liang, Y., Baclayon, M., Valk, R. van der, Dame, R.T., Roos, W.H. & Wuite, G.J.L. (2014). Probing the Unbinding Kinetics of DNA-H-NS-DNA Protein Complexes by a High-Speed and High-Throughput Single-Molecule Pulling Assay using Atomic Force Microscopy. *Biophysical Journal, 106*(2), 386A-386A.

25. Lu, P., Lill, H. & Bald, D. (2014). ATP synthase in mycobacteria: special features and implications for a function as drug target. *Biochimica et Biophysica Acta (BBA) - Bioenergetics, 1837*, 1208-1218. 10.1016/j.bbabio.2014.01.022

26. Lu, P., Villelas, C., Koul, A., Andries, K., Lill, H. & Bald, D. (2014). The ATPsynthase inhibitor bedaquiline interferes with small-molecule efflux in Mycobacterium smegmatis. *The Journal of Antibiotics*. 10.1038/ja.2014.74

27. Luque, D., Snijder, J., Brasch, M., Burnley, R.J., Koay, M.S.T., Carrascosa, J.L., Wuite, G.J.L., Roos, W.H., Heck, A.J.R., Cornelissen, J.L.M., Torres, CastonT. & Caston, J.R. (2014). Self-assembly and characterization of small and monodisperse dye nanospheres in a protein cage. *Chemical Science, 5*, 575-581. 10.1039/c3sc52276h

28. Mangeol, P.J.J. & Peterman, E.J.G. (2014). Direct Three-Dimensional Imaging with Multiple Point of View Microscopy. *Biophysical Journal, 106*(2), 203A-203A.

29. Muiznieks, L.D., Cirulis, J.T., Reinhardt, D.P., Wuite, G.J.L., Pomes, R. & Keeley, F.W. (2014). Modulated growth, stability and interactions of liquid-like coacervate assemblies of elastin. *Matrix Biology, 2014*(36), 39-50. 10.1016/j.matbio.2014.03.008

30. Oswald, F., Bank, E., Bollen, Y.J.M. & Peterman, E.J.G. (2014). Imaging and quantification of trans-membrane protein diffusion in living bacteria. *Physical Chemistry Chemical Physics - PCCP, 16*(25), 12625-12634. 10.1039/c4cp00299g

31. Prevo, B. & Peterman, E.J.G. (2014). Forster resonance energy transfer and kinesin motor proteins. *Chemical Society Reviews, 43*, 1144-1155. 10.1039/c4cp00299g

32. Prevo, B., Oswald, F., Mangeol, P.J.J., Scholey, J.M. & Peterman, E.J.G. (2014). Illuminating the Cooperative Action of Kinesin-II and OSM-3-Kinesin in the Chemosensory Cilia of Caenorhabditis Elegans. *Biophysical Journal, 106*(2), 353A-353A.

33. Rahman, S., Arenas, J., Oztürk, H., Dekker, N. & Ulsen, P. van (2014). The polypeptide transport-associated domains of TpsB transporters determine the system specificity of two-partner secretion systems. *Journal of Biological Chemistry, 289*(28), 19799-19809. 10.1074/jbc.M113.544627

34. Roussel-Jazédé, V., Arenas, J., Langereis, J.D., Tommassen, J. & Ulsen, P. van (2014). Variable processing of the IgA protease autotransporter at the cell surface of Neisseria meningitidis. *Microbiology, 2014*(160), 2421-2431. 10.1099/mic.0.082511-0

35. Singh, R., Kraft, C., Jaiswal, R., Sejwal, K., Kasaragod, V.B., Kuper, J., Berger, J., Mielke, T., Luirink, J. & Bhushan, S. (2014). Cryo-Electron Microscopic Structure of SecA Bound to the 70S Ribosome. *Journal of Biological Chemistry*. 10.1074/jbc.M113.506634

36. Sitters, G., Kamsma, D., Peterman, E.J.G. & Wuite, G.J.L. (2014). smAP: Manipulating DNA by Ultrasound - Single-Molecules Go Acoustic. *Biophysical Journal, 106*(2), 387A-387A.

37. Ulsen, P. van, Rahman, S.U., Jong, W.S.P., Daleke, M.H. & Luirink, J. (2014). Type V secretion: From biogenesis to biotechnology. *Biochimica et Biophysica Acta. Molecular Cell Research, 1843*(8), 1592-1611. 10.1016/j.bbamcr.2013.11.006

38. Vorselen, D., Roos, W.H., MacKintosh, F.C., Wuite, G.J.L. & Loon, J.J.W.A. van (2014). The role of the cytoskeleton in sensing changes in gravity by nonspecialized cells. *FASEB Journal, 28*(2), 536-547. 10.1096/fj.13-236356

39. Woude, A.D. van der, Stoop, E.J.M., Stiess, M., Wang, Q., Ummels, R., Stempvoort, G. van, Piersma, S.R., Cascioferro, A., Jimenez, C.R., Houben, E.N.G., Luirink, J., Pieters, J., Sar, A.M. van der & Bitter, W. (2014). Analysis of SecA2-dependent substrates in Mycobacterium marinum identifies protein kinase G (PknG) as a virulence effector. *Cellular Microbiology, 16*(2), 280-295. 10.1111/cmi.12221

Scientific Output Theme Physics of Light

- Number of theses: 4

1. Nijs, A.J. de (2014, October 2). *Molecular radicals in the search for drifting constants*. VU Vrije Universiteit. Prom./coprom.: Prof. dr. W.M.G. Ubachs & Dr. H.L. Bethlem.

2. Quintero Perez, M. (2014, September 8). *Preparation of an ultra-cold sample of ammonia molecules for precision measurements.* VU Vrije Universiteit. Prom./coprom.: Prof. dr. W.M.G. Ubachs & Dr. H.L. Bethlem.

3. Morgenweg, J. (2014, June, 18). *Ramsey-comb spectroscopy.* VU Vrije Universiteit. Promotor: Prof. dr. K.S.E. Eikema.

4. Haddad, M.A. (2014, March 24). *Cavity Ring-Down Laser Spectroscopy of Carbon-Chain Molecules*. VU Vrije Unviersiteit. Prom./coprom.: Prof. dr. W.M.G. Ubachs & Prof. dr. H.V.J. Linnartz; Dr. D. Zhao.

- Number of scientific papers, refereed: 35

1. Bagdonaite, J., Ubachs, W.M.G., Murphy, M.T. & Whitmore, J.B. (2014). Analysis of molecular hydrogen absorption toward QSO B0642-5038 for a varying proton-to-electron mass ratio. *Astrophysical Journal, 782*:10(1). 10.1088/0004-637X/782/1/10

2. Bagdonaite, J., Salumbides, E.J., Preval, S.P., Barstow, M.A., Barrow, J.D., Murphy, M.T. & Ubachs, W.M.G. (2014). Limits on a gravitational field dependence of the proton-electron mass ratio from h_{2} in white dwarf stars. *Physical Review Letters, 113*(12), 123002. http://dx.doi.org/10.1103/PhysRevLett.113.123002

3. Berg, J.E. van den, Mathavan, S.C., Meinema, C., Nauta, J., Nijbroek, N.H., Jungmann, K., Bethlem, H.L. & Hoekstra, S. (2014). Traveling-wave deceleration of SrF molecules. *Journal of Molecular Spectroscopy, 300*(SI), 22-25. 10.1016/j.jms.2014.02.004

4. Dickenson, G.D. & Ubachs, W.M.G. (2014). VUV spectroscopic study of the B '' (B)over-bar(1) Sigma(+)(u) state of H-2. *Molecular Physics, 112*(8), 1089-1093. 10.1080/00268976.2013.830811

5. Gu, Z. & Ubachs, W.M.G. (2014). A systematic study of Rayleigh-Brillouin scattering in air, N-2, and O-2 gases. *Journal of Chemical Physics, 141*:104320(10). 10.1063/1.4895130

6. Gu, Z., Ubachs, W.M.G. & Water, W. van der (2014). Rayleigh-Brillouin scattering of carbon dioxide. *Optics Letters, 39*(11), 3301-3304. 10.1364/OL.39.003301

7. Haddad, M.A., Zhao, D., Linnartz, H.V.J. & Ubachs, W.M.G. (2014). Rotationally resolved spectra of the 4051 angstrom comet band of C-3 for all six C-12 and C-13 isotopologues. *Journal of Molecular Spectroscopy, 297*, 41-50. 10.1016/j.jms.2014.01.010

8. Heays, A.N., Visser, R., Gredel, R., Ubachs, W.M.G., Lewis, B.R., Gibson, S.T. & Dishoeck, E.F. van (2014). Isotope selective photodissociation of N-2 by the interstellar radiation field and cosmic rays. *Astronomy and Astrophysics, 562*:A61. 10.1051/0004-6361/201322832

9. Jansen, P., Bethlem, H.L. & Ubachs, W.M.G. (2014). Perspective: Tipping the scales: Search for drifting constants from molecular spectra. *Journal of Chemical Physics, 140*:010901(1). 10.1063/1.4853735

10. Janssen, M.H.M. & Powis, I. (2014). Detecting chirality in molecules by imaging photoelectron circular dichroism. *Physical Chemistry Chemical Physics - PCCP, 16*(3), 856-871. 10.1039/c3cp53741b

11. Knoop, S., Zuchowski, P.S., Kedziera, D., Mentel, L., Puchalski, M., Mishra, H.P., Flores, A.S. & Vassen, W. (2014). Ultracold mixtures of metastable He and Rb: Scattering lengths from ab initio calculations and thermalization measurements. *Physical Review A, 90*:022709(2). 10.1103/PhysRevA.90.022709

12. Koelemeij, J.C.J. (2014). MOLECULAR SPECTROSCOPY Forbidden vibrations. *Nature Physics, 10*(11), 800-801. 10.1038/nphys3113

13. Ma, Y., Li, H., Gu, Z., Ubachs, W.M.G., Yu, Y., Huang, J., Zhou, B., Wang, Y. & Liang, K. (2014). Analysis of Rayleigh-Brillouin spectral profiles and Brillouin shifts in nitrogen gas and air. *Optics Express, 22*(2), 2092-2104. 10.1364/OE.22.002092

14. Morgenweg, J., Barmes, I. & Eikema, K.S.E. (2014). Ramsey-comb spectroscopy with intense ultrashort laser pulses. *Nature Physics, 10*(1), 30-33. 10.1038/NPHYS2807

15. Morgenweg, J. & Eikema, K.S.E. (2014). Ramsey-comb spectroscopy: Theory and signal analysis. *Physical Review A, 89*:052510(5). 10.1103/PhysRevA.89.052510

16. Nijs, A.J. de, Ubachs, W.M.G. & Bethlem, H.L. (2014). Ramsey-type microwave spectroscopy on CO (alpha(3) II). *Journal of Molecular Spectroscopy, 300*(SI), 79-85. 10.1016/j.jms.2014.03.020

17. Niu, M., Salumbides, E.J., Dickenson, G.D., Eikema, K.S.E. & Ubachs, W.M.G. (2014). Precision spectroscopy of the X-1 Sigma(+)(g), v=0 -> 1(J=0-2) rovibrational splittings in H-2, HD and D-2. *Journal of Molecular Spectroscopy, 300*(SI), 44-54. 10.1016/j.jms.2014.03.011

18. Noom, D.W.E., Boonzajer Flaes, D.E., Labordus, E., Eikema, K.S.E. & Witte, S.M. (2014). High-speed multi-wavelength Fresnel diffraction imaging. *Optics Express, 22*(25), 30504-30511. 10.1364/OE.22.030504

19. Noom, D.W.E., Eikema, K.S.E. & Witte, S. (2014). Lensless phase contrast microscopy based on multiwavelength Fresnel diffraction. *Optics Letters, 39*(2), 193-196. 10.1364/OL.39.000193

20. Notermans, R.P.M.J.W. & Vassen, W. (2014). High-Precision Spectroscopy of the Forbidden 2(3)S(1) -> 2(1)P(1) Transition in Quantum Degenerate Metastable Helium. *Physical Review Letters, 112*:253002(25). 10.1103/PhysRevLett.112.253002

21. Notermans, R.P.M.J.W., Rengelink, R.J., Leeuwen, K.A.H. van & Vassen, W. (2014). Magic wavelengths for the 2 3 S→2 1 S transition in helium. *Physical Review A, 90*:052508. 10.1103/PhysRevA.90.052508

22. Pang, X., Fischer, D.G. & Visser, T.D. (2014). Wavefront spacing and Gouy phase in presence of primary spherical aberration. *Optics Letters, 39*(1), 88-91. 10.1364/OL.39.000088

23. Quintero Perez, M., Wall, T.E., Hoekstra, S. & Bethlem, H.L. (2014). Preparation of an ultra-cold sample of ammonia molecules for precision measurements. *Journal of Molecular Spectroscopy, 300*(SI), 112-115. 10.1016/j.jms.2014.03.018

24. Rafiee Fanood, M.M., Powis, I. & Janssen, M.H.M. (2014). Chiral Asymmetry in the Multiphoton Ionization of Methyloxirane Using Femtosecond Electron-Ion Coincidence Imaging. *Journal of Physical Chemistry A, 118*(49), 11541-11546. 10.1021/jp5113125

25. Salumbides, E.J., Bailly, D., Vervloet, M. & Ubachs, W.M.G. (2014). B1Su+ and EF1Sg+ level energies of D2. *Journal of Molecular Spectroscopy, 305*, 34-39. 10.1016/j.jms.2014.09.009

26. Salumbides, E.J., Ubachs, W.M.G. & Korobov, V.I. (2014). Bounds on fifth forces at the sub-angstrom length scale. *Journal of Molecular Spectroscopy, 300*(SI), 65-69. 10.1016/j.jms.2014.04.003

27. Schmidt, M.R., Krelowski, J., Galazutdinov, G.A., Zhao, D., Haddad, M.A. & Linnartz, H.V.J. (2014). Detection of vibronic bands of C-3 in a translucent cloud towards HD 169454. *Monthly Notices of the Royal Astronomical Society, 441*(2), 1134-1146. 10.1093/mnras/stu641

28. Steimle, T. & Ubachs, W.M.G. (2014). Introduction to the Special issue Spectroscopic Tests of Fundamental Physics. *Journal of Molecular Spectroscopy, 300*(SI), 1-2. 10.1016/j.jms.2014.04.004

29. Tenner, V.T., Eikema, K.S.E. & Witte, S.M. (2014). Fourier transform holography with extended references using a coherent ultra-broadband light source. *Optics Express, 22*(21), 25397-25409. 10.1364/OE.22.025397

30. Ubachs, W.M.G., Salumbides, E.J., Eikema, K.S.E., Oliveira, N. de & Nahon, L. (2014). Novel techniques in VUV high-resolution spectroscopy. *Journal of Electron Spectroscopy and Related Phenomena, 196*, 159-164. 10.1016/j.elspec.2013.11.016

31. Witschas, B. & Ubachs, W.M.G. (2014). Temperature retrieval from Rayleigh-Brillouin scattering profiles measured in air. *Optics Express, 22*(24), 29655-29667. 10.1364/OE.22.029655

32. Witte, S.M., Tenner, V.T., Noom, D.W.E. & Eikema, K.S.E. (2014). Lensless diffractive imaging with ultra-broadband table-top sources: from infrared to extreme-ultraviolet wavelengths. *Light: Science & Applications, 3*:e163. 10.1038/lsa.2014.44

33. Wouters, S.H.W., ten Haaf, G., Notermans, R.P.M.J.W., Debernardi, N., Mutsaers, P.H.A., Luiten, O.J. & Vredenbregt, E.J.D. (2014). Performance predictions for a laser-intensified thermal beam for use in high-resolution focused-ion-beam instruments. *Physical Review A, 2014*:063817(90). 10.1103/PhysRevA.90.063817

34. Wu, G. & Visser, T.D. (2014). Correlation of intensity fluctuations in beams generated by quasi-homogeneous sources. *Journal of the Optical Society of America. A: Optics, image science, and vision., 31*(10), 2152-2159. 10.1364/JOSAA.31.002152

35. Wu, G. & Visser, T.D. (2014). Hanbury Brown-Twiss effect with partially coherent electromagnetic beams. *Optics Letters, 39*(9), 2561-2564. 10.1364/OL.39.002561

B) SCIENTIFIC QUALITY

Analytical Chemistry and Spectroscopy

- Total number of citations

	2014	*Total*
A.M. Brouwer:	285	3177
W.J. Buma:	202	2217
M.H.M. Janssen:	95	1464
S. Woutersen:	285	4014
R.M. Williams:	189	2806
H. Zhang:	440	2983

- H-index of tenured staff

A.M. Brouwer:	27
W.J. Buma:	25
M.H.M. Janssen:	23
S. Woutersen:	29
R.M. Williams:	29
H. Zhang:	32

Biophotonics & Microscopy

- Total number of citations

	2014	*Total*
J.F. de Boer:	827	9494
R.M. Verdaasdonk:	65	746
F. Ariese:	235	3772
M.L. Groot:	139	1648
S.M. Witte:	101	678
D. Iannuzzi:	87	1001

- H-index of tenured staff

J.F. de Boer:	49
R.M. Verdaasdonk:	16
F. Ariese:	31
M.L. Groot:	23
S.M. Witte:	13
D. Iannuzzi	16

Energy

Total number of citations	*2014*	*Total*
R. van Grondelle:	1461	23073
R. Croce:	517	4031
J.P. Dekker:	424	8291
R.N. Frese	68	1368
E. von Hauff	188	700
J.T.M. Kennis:	348	3538
I.H.M. van Stokkum:	747	8707

- H-index of tenured staff

R. van Grondelle:	78
R. Croce:	40
J.P. Dekker:	54
R.N. Frese	17
E. von Hauff	15
J.T.M. Kennis:	34
I.H.M. van Stokkum:	56

Light and Tissue

- Total number of citations

	2014	*Total*
A.G.J.M. van Leeuwen:	544	3507
M.C.G. Aalders:	209	1698
D.J. Faber:	179	1114

- H-index of tenured staff

A.G.J.M. van Leeuwen:	35
M.C.G. Aalders:	20
D.J. Faber	17

Single Molecule to Cell Biophysics

- Total number of citations

	2014	*Total*
D. Bald:	153	1428
Y.J.M. Bollen:	33	263
H. Lill:	257	3791
J. Luirink:	434	6029
F.C. MacKintosh:	972	8711
E.J.G. Peterman:	325	2700
W.H. Roos	198	1091
G.J. Stephens	172	1028
P. van Ulsen:	109	856
G.J.L. Wuite:	499	3317

- H-index of (non)-tenured staff

D. Bald:	19
Y.J.M. Bollen:	8
H. Lill:	34
J. Luirink:	46
F.C. MacKintosh:	48
E.J.G. Peterman:	33
W.H. Roos	19
G.J. Stephens	16
P. van Ulsen:	17
G.J.L. Wuite:	30

Physics of Light

- Total number of citations

	2014	*Total*
H.L. Bethlem:	226	2644
K.S.E. Eikema:	200	1595
S. Knoop:	72	609
J.C.J Koelemeij:	152	713
W.M.G. Ubachs:	577	4687
W. Vassen:	100	1842
T.D. Visser:	143	2095

- H-index of (non)-tenured staff

H.L. Bethlem:	26
K.S.E. Eikema:	23
S. Knoop:	13
J.C.J. Koelemeij:	10
W.M.G. Ubachs:	36
W. Vassen:	23
T.D. Visser:	25

C) OTHER INDICATORS OF ESTEEM

Analytical Chemistry and Spectroscopy

Special professors:

- Prof. dr. H.J. Bakker, Molecular Biophysics, FOM institute AMOLF
- Prof. dr. W.L. Meerts, Molecular and Biophysics Group, Radboud Univ. Nijmegen (em.)
- Prof. dr. J. Oomens, Molecular Structure & Dynamics Group, Radboud Univ. Nijmegen

Energy

Special professors:

- Prof. dr. K.J. Hellingwerf, Molecular Microbial Physiology Group, UvA
- Prof. dr. G.J.M. Stienen, Institute for Cardiovascular Research, VUmc
- Prof. B. Robert, Institut de biologie et de technologies de Saclay (France)

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

Special professors:

- Prof. dr. G.H. Koenderink, Biology Soft Matter group, FOM institute AMOLF
- Prof. dr. P.R. ten Wolde, Theoretical Physics of Life, FOM institute AMOLF

Physics of Light

Special professors:

- Prof. dr. E.A.A. Aben, SRON Netherlands Institute for Space Research
- Prof. dr. L. Kaper, Astrophysics, UvA
- Prof. dr. H.V.J. Linnartz, Leiden Observatory