N°110

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Editorial

NICOLAS BONOD
Editor-in-Chief

Green photonics for blue horizons

The report released on August 9, 2021 by the *IPCC Working Group I* presents an increasingly accurate and realistic assessment of the climate crisis. It alerts us once more to the urgency of decarbonizing our societies. This report predicts an increase in the earth's average temperature of at least 1.5°C or 2°C during the 21st century. One month after the publication of this report, the *IUCN World Conservation Congress* was held in Marseille. Here again, their report is devastatingly worrying, with an alarming drop in biodiversity all over the world.

The challenges to be met in order to address these climatic and environmental issues are immense and will require a thorough-going transformation of our industries and ways of living. But these challenges also present great opportunities for photonic technologies which are strategically positioned to contribute to the development of green and low-carbon technologies. This is the reason why many companies in photonics are benefitting from this new momentum as they step up efforts to maximize their potential in the emerging field of green technologies.

Solar energy, bio-inspired materials and biomaterials, plastic detection, waste sorting, pollution sensors, UV treatments... the fields are vast and photonic technologies are well adapted to invest in these multiple domains and environments. Photonic technologies have gained in efficiency, reliability and ergonomics. They must now, with the help of decision-makers and investors, accelerate their development and deployment to embrace these different fields.

Courses in photonics must continue to gain momentum across European universities and schools so that students are being trained in these technologies. Graduate students will find themselves in the numerous positions of technicians and engineers in optics and photonics that will open up. They will also comprise the new generation of scientists and decision-makers who will govern the rise of green technologies.

In addition to the harmful impact they have on the climate, the capacity of greenhouse gases to absorb infrared radiation prevents telescopes on Earth from detecting infrared spectrum from space. One solution is to bypass the Earth's atmosphere by placing the telescope in space. The launch of the James Webb Space Telescope from Kourou scheduled for December 18 is certainly one of the major events of this year. The deployment of its 6.5 m mirror after its launch promises to bring space exploration into a new era. On Earth and in space, photonic technologies continue to open our eyes to blue horizons.

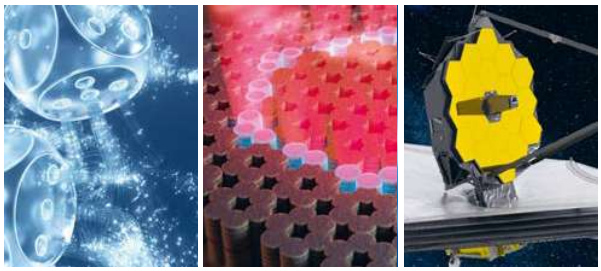


Table of contents

www.photoniques.com N° 110

Advertisers

SFO/EOS forewords

PHILIPPE ADAM
President of the French Optical Society

After the summer deadlines, the French Optical Society (SFO) is gradually back to its normal rhythm. A great moment in our associative life is the holding of the General Assembly, scheduled for October 18, whose objective is to make an annual report on the SFO activity.

Indicators are good: building on the dynamics of OPTIQUE Dijon, 2021 saw an increase in the number of members, by more than 30%. It is also a proof of our dynamism and of the interest through the diversity of the projects proposed.

The financial situation is also improving thanks partly to the OPTIQUE Dijon 2021 event. Of course, efforts are still needed, but we are on the right track.

Our contacts with our national community have grown. The SFP is a privileged partner and exchanges are frequent. The scientific editor EDP is also a very present partner. It helps us in the distribution of our PHOTONIQUES magazine and SFO participates in the Scientific Advisory Committee.

Internationally, we note the reactivation of the Territorial Committee France at ICO. The five members, all from the SFO Board, are now clearly identified; they recently participated in the election of the new ICO board. At this occasion, Nathalie WESTBROOK was nominated as Vice-President of the ICO.

EOS is a historic partner. SFO and EOS work in close collaboration to federate the driving forces of optics in Europe. EOSAM 2021 in Rome was a great success. The SFO is delighted and notes the solidity of the link and the expression of a clear dynamic.

Finally, every two years, part of the SFO Board is renewed. In 2021, five elective seats were renewed. The next Board, scheduled for November 18 will work with this new team. I will then ensure the handover with Ariel LEVENSON who will then chair the destinies of the SFO for the next two years.

Two years is both long and short: long because the period has been complicated. Short because the task was exciting. Ariel will take over: no doubt that a new dynamic will be put in place, with new ideas and this for the greater well of our Learned Society.

Thank you all for your listening, your initiatives and your help.

Optically yours

GILLES PAULIAT
President of the European Optical Society

Face-to-face seminars and conferences have finally resumed! Our photonics community has responded overwhelmingly and enthusiastically to theses in-person meetings. This underlines our need to exchange in order to develop new ideas for the future. The first EOS in-person meeting since 2019 was EOSAM 2021, organized on September 13-17 in Rome Italy. EOS organized it in close co-operation with the Societat di Ottica e Fotonica, SIOF, the Italian optical society Branch member of EOS, and the Universita di Roma La Sapienza. For the first time, EOSAM was held in a hybrid format mixing on-line attendees with on-site participants. With over 350 on-site attendees and 180 on-line attendees, from 33 countries worldwide, this hybrid format was a real success and worth to be repeated in the future! On-site participants benefited from an exceptional venue. The meeting was held in the premises of Universita di Roma La Sapienza, in the center of Roma. Among the EOSAM highlights, was the ICO award ceremony, the prize winner being M. Guizar-Sicairos. The awarding of this prize during EOSAM underlines once again the cooperation between the many learned societies around the world. Isn't the slogan of ICO, the International Commission for Optics, "The place where the world of optics meets"?

This need to exchange and communicate is a necessity and lies at the heart of our scientific activities. EOS was created by the learned National Societies in Europe to strengthen our links; and EOS is currently exploring new ways to reinforce this cooperation at the European level. Research is indeed about pushing the boundaries of knowledge. This is done, within each field, by an ever deeper understanding of physics. Other frontiers can be crossed by confronting our knowledge with the demands of society. This issue of the journal is an opportunity to reflect on this approach. Typically, green photonics is the answer of our community to a societal problem (energy, pollution...). This suggests that many other frontiers exist that we are probably not even aware of, in forestry, agriculture, food, health...

This is the role of our learned societies to build bridges to these other fields; EOS is working on this year.

Enjoy your reading!

SFO - ELECTIONS 2021

Results of the SFO board of directors Members elected for the period 2021-2025 (Alphabetical order)

Yannick DUMEIGE
Institut FOTON
University of Rennes 1

Claude FABRE
The Kastler–
Brossel Laboratory

Aurélie JULLIEN
Institut de Physique
de Nice

François SALIN
CEO of Ilasis Laser
Bordeaux

Marie-Claire SCHANNE-KLEIN
École Polytechnique

MEMBERS ELECTED FOR THE PERIOD 2019-2023

- ✓ **Nicolas BONOD** (Institut Fresnel, Marseille)
- ✓ **Arnaud BRIGNON** (Thales R&T, Palaiseau)
- ✓ **Sébastien CHÉNAIS** (LPL, Université Paris 13)
- ✓ **Agnès DESFARGES – BERTHELEMOT** (XLIM, Université de Limoges)
- ✓ **Sylvain GIGAN** (LKB, UPMC Paris)
- ✓ **Ariel LEVENSON** (C2N, Université Paris Saclay)
- ✓ **Inka MANEK - HÖNNINGER** (CELIA, Université de Bordeaux 1)

Results of ICO Bureau Elections 2021

Congratulations to our dear Nathalie, she is elected as ICO vice president.As you know, Nathalie Westbrook is Professor at Institut d'Optique and at the head of the Biophotonics group at Laboratoire Charles Fabry. She has been an elected member of the SFO executive Board for several years as vice-president.

OPTIQUE DIJON 2022: VENEZ À NICE

Save the date! The mobilization is strong around the OPTIQUE Nice 2022. This congress will take place in Nice from the 4th to the 8th of July 2022.

We have the commitment of more than 13 clubs and committees of the French Optical Society :

1. Guided Optics, Optical Fibers and Networks (JNOG Club)
2. Lasers and Quantum Optics (COLOQ club)
3. Crystals for Optics (JNCO club)
4. Nanophotonics
5. Optics and Photonics diagnostic (CDOP club)
6. Photonics and life science (PSV club)
7. Optics horizons (HORIZONS club)
8. Adaptive Optics (JRIOA club)
9. Lidar
10. Organic Photonics (JNPO club)
11. Physics and optical imaging (PIO club)
12. Teaching committee
13. Women in optics committee: to promote parity in optics

N.B. PAMO club of SFP (Atomic, Molecular, and Optical Physics) is invited

The congress facilities at Saint Jean d'Angély campus are well located and easy to reach. Université Côte d'Azur is ideally located between the coast and the mountains in a region known for its quality of life. At the heart of Europe, with easy access to the Nice Côte d'Azur International Airport, it is an open door to the photonic-optics community, academic and industrial world. The local organizing committee orchestrated by **Sébastien TANZILLY** is very happy to welcome hundreds of participants.

We invite you to submit and present your research and to make friendships in friendly atmosphere. Welcome to OPTIQUE Nice 2022!

Follow us: https://www.sfoptique.org/

OPTIQUE Nice 2022 in few figures

- 9th edition of the SFO congress
- 600 expected attendees
- 40 stands of compagnies in the ecosystem of optics and French photonics
- 10 educational stands
- 7 hours of plenary session
- 70 hours of specific sessions in parallel
- 5h30 dedicated to the industrial sector.
- 10 Thematic sessions

SFO and International Commission Optique sans frontière

Solar workshop for professional training in Ouagadougou from July 2 to 4, 2021.

The workshop went very well with 25 persons attending (university lecturers and high school teachers). The aim of the workshop was to build solar panels from solar cells and to characterize their performances. A second workshop will take on battery charge with application to led lighting and smartphone charge.
Arouna Darga, Lecturer at Sorbonne University organized this training.
This first "Experiment action" in Burkina Faso, was carried by SFO - Optique Sans frontière.

Diplôme d'ingénieur: Institut d'Optique's flagship degree in Optical science and egineering

Institut d'Optique Graduate School is a leader in France for research and higher education in optical science and engineering, based on 3 campuses: Paris-Saclay, Bordeaux and Saint-Etienne. Its flagship degree is the "Diplôme d'ingénieur", a highly selective and demanding integrated Master degree, translated to 'Master of Science in Engineering' (MScEng). In France, this kind of programme usually recruits students after two years of undergraduate studies at least, for the 3-year long MScEng programme itself, covering the equivalent of final year of bachelor and two years of master.

The main feeder for Institut d'Optique's MScEng programme is the scientific Classes préparatoires system (www.scei-concours.fr/concours.php). After 2 years of intensive undergraduate education in Maths, Physics and Engineering sciences, students sit for nation-wide competitive exams to enter the Grandes Ecoles, among which Institut d'Optique. Institut d'Optique has also developed an alternative admission scheme, enabling students from regular bachelor or master programmes in French universities to join its MScEng. Applicants are selected by screening their application materials, and if applicable by sitting exams at Institut d'Optique, including oral exams and interviews. Bachelor students can apply for an admission in first year whereas master students can apply directly for an admission in second year.

Amphitheater university Paris Saclay

For this Diplôme d'ingénieur (MScEng) programme, Institut d'Optique Graduate School has developed, in addition to its traditional student admission schemes in France, an international recruitment for students from foreign universities. This is enabled by the offer of courses taught in English in our Master level years. Abroad, Institut d'Optique recruits students through its own double-degree schemes, such as the 3+3 double-degree programme with Huazhong University of Science and Technology in China.

Additionally, Institut d'Optique participates in the ParisTech admission programme where 7 French Grandes Ecoles in Science and Engineering join forces to offer a common platform for applicants from abroad. ParisTech operates admission programmes in China, Brazil, Russia, Argentina, Colombia, and since 2021 several Asian territories. This enables Institut d'Optique to recruit students who are finishing their Bachelor into its 2 final years of the MScEng programme. The most represented nationalities are China, Brazil and Russia.

Students from the MScEng programme at any of Institut d'Optique's 3 campuses can also follow MSc programmes from local universities in parallel and get both degrees in the end. Around 1 graduate out of 3 chooses to continue towards a PhD, while the others join directly companies with an employment rate exceeding 87% two months after graduation, in France or abroad.

CONTACT: Pierre Baladi
pierre.baladi@institutoptique.fr
www.institutoptique.fr

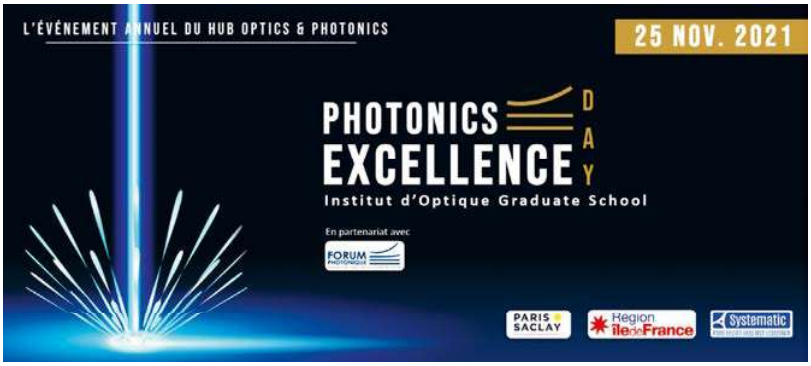
Photonics Excellence Day 2021: November, time to register!

For its 3rd edition, we are very pleased to announce the return of the Photonics Excellence Day in person!

Organized in partnership with the Photonics Forum, we invite you to join us on November 25, 2021 for the annual Photonics Excellence Day at the Institut d'Optique Graduate School in Palaiseau.

Discover the new uses of photonics through exclusive demonstrations, discuss the latest innovations with key players in the industry and build your network, these are just some of the great promises this day has in store for you!

-> Program online and registration open.



100% EUROPE:
CLUSTERS AT THE HEART OF EUROPE'S CHALLENGES

If you are an actor of the European research and innovation landscape, please join us on Thursday 18 November for an exceptional event with high value-added conferences and B2B meetings featuring Systematic's growing European ecosystem!

Systematic, European Deep Tech cluster, invites you to its latest edition of 100% Europe, with two major sequences:

10:00 - 13:00 | CONFERENCE - Clusters at the heart of Europe's challenges
- the twin transition - green and digital transition - under Horizon Europe
- hear about experiences with EU-funded projects from your peers
- have a chance to present for the next phase of Horizon Europe topics

14:00 - 18:00 | 1 TO 1 BUSINESS MEETINGS with our bespoke matchmaking platform

-> Program online and registration open.

At a glance

Lytid – New Member
Lytid develops commercial cutting edge photonics products for science and industy. Applications range from medical imaging, NDT for industry 4.0, industrial sensing or ultra-broadband telecom. From SWIR to Terahertz don't wait to discover their products!

Nanovation – New Member
World leader in the manufacture of thin-layers, nanostructures and oxide-based semiconductors, Nanovation joins the cluster and brings its expertise in fire/UV detection and space environment control, welcome!

PSHA – New Member
Located in the heart of Paris-Saclay, the PSHA Accelerator is a key player in industrial innovation. From idea to solutions, including design, prototyping, industrialization, pre-poduction, or simply take a step back in your project they will be the perfect partner for your innovative projects.

AGENDA

100% Europe
November 18, online

Photonics Online Meetings
November 23, online

Photonics Excellence Day
November 25, 9h30-17h30, Palaiseau, France

www.systematic-paris-region.org/evenements/

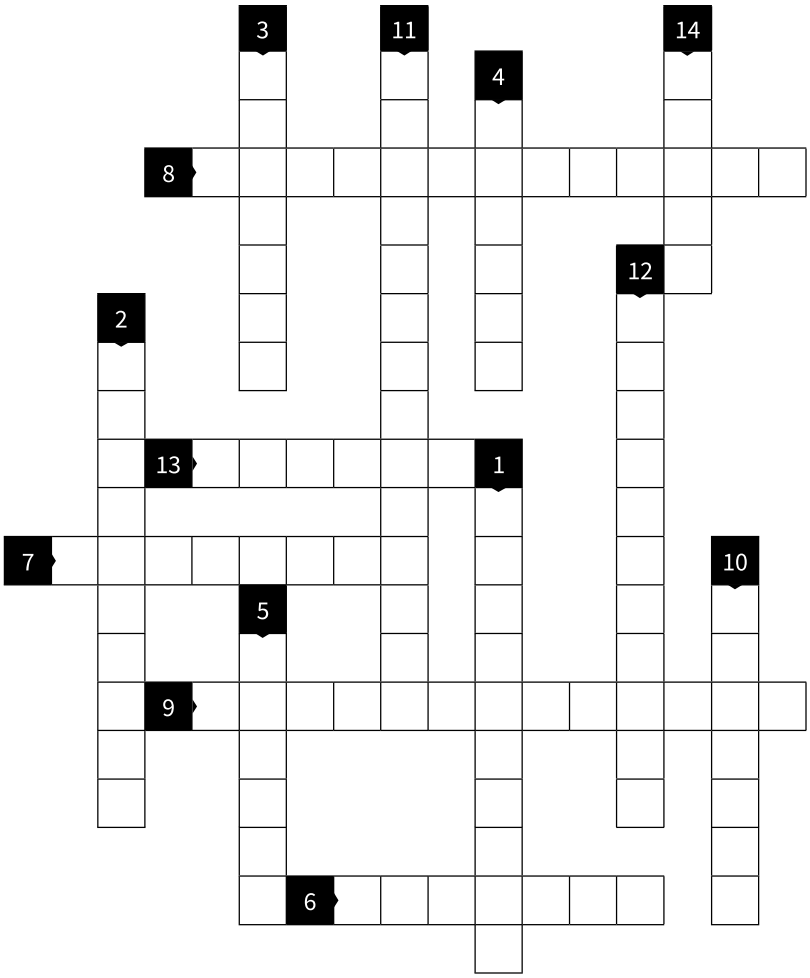
Want to join the Optics & Photonics Hub of Systematic? Don't wait any longer and contact:

Lola Courtillat, Hub Coordinator

lola.courtillat@systematic-paris-region.org

CROSSWORDS
ON BEAMS AND MATERIALS

By Marie-Claire Schanne-Klein (LOB-CNRS)



1 Rayleigh or Mie?
2 Bends light
3 At a metal-dielectric interface
4 Beam carrying OAM
5 Self-healing beams
6 Aberrant polynoms
7 The shape of usual beams
8 Light at nanoscales
9 Artificial and smart materials
10 Wave building on dispersion and nonlinearity
11 Broadband and similar to incoherent light
12 Unavoidable with waves
13 Optical resonator
14 Thinnest width of a beam

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Parametric driving of cavity solitons

Optical pulse trains are currently attracting a lot of attention because they provide a link between the optical and microwave domains. In particular, pulse trains formed by time localized nonlinear solutions that propagate unperturbed in driven optical resonators – Kerr cavity solitons - have been intensely studied recently. In the frequency domain, they correspond to an optical frequency comb, or optical ruler, the inventors of which were awarded the Nobel prize in 2005. Their wide range of applications include atomic clocks, astronomy and high precision metrology. So far, the focus has been on cavity solitons (CSs) driven at their natural oscillation frequency, *i.e.* with a driving laser at the carrier frequency of the soliton. But nonlinear systems can also be parametrically driven, which consists in driving the system by varying one of its parameters. The simplest example of so-called parametric driving is a pendulum which can be excited by periodically changing its length. Importantly, in that case the driving must be at twice the oscillation frequency.

A team of researchers at ULB (Brussels) has demonstrated that cavity solitons can also be driven at twice their carrier frequency. To achieve it, they used an all-fiber optical parametric oscillator that incorporates both second and third order nonlinearity. This special feature confers a totally random character to the sign of the cavity soliton's amplitude. The measurement of this sign allows the generation of a binary random number, paving the way to a new type of all-optical computer such as the Ising machine.

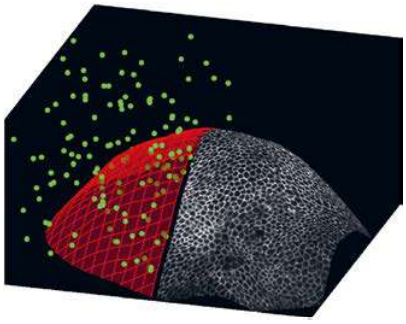
REFERENCE

N. Englebert, F. De Lucia, P. Parra-Rivas *et al.*, "Parametrically driven Kerr cavity solitons," Nat. Photon. (2021). https://doi.org/10.1038/s41566-021-00858-z

A SMART SCANNING MICROSCOPE FOR BETTER OBSERVATIONS OF CELL SHEETS

Modern biology is based on the observation of living cells, made possible within model organisms by the latest advances in optical microscopy. The widely used confocal fluorescence microscope generates volumetric images with high spatial resolutions, by scanning the volume point by point with a laser beam. However, current techniques are confronted with a problem of toxicity due to the illumination necessary for the excitation of fluorescent markings: prolonged illumination affects and slows down the growth of cells. Nevertheless in many situations, in particular in the case of embryos and developing tissues, cells are organized along sheets lying on curved surfaces. Conventionally, such objects are imaged by scanning the entire volume plane by plane, which is highly inefficient in terms of photon budget.

A team of researchers at Institut Fresnel in Marseille developed a new microscope that automatically estimates the surface on which these cells are distributed from a small number of random acquisitions (~0.1% of the voxels). The microscope can then concentrate the illumination around the surface of interest, allowing cell sheets imaging by scanning typically less than 5% of the volume. Additionally, it can also restrict illumination along the fluorescent cell contours by alternating acquisitions and prediction steps, further reducing the scanned volume up to 1%. The corresponding reduction in light dose on the sample had a profound effect on fluorophore stability and will improve viability of living samples over prolonged imaging.



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F. Abouakil, H. Meng, M. A. Burcklen, H. Rigneault, F. Galland, and L. LeGoff, "An adaptive microscope for the imaging of biological surfaces," Light Sci. Appl. **10**, 210 (2021). https://doi.org/10.1038/s41377-021-00649-9

Maria Mitchell

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Maria Mitchell was a pioneer in many aspects: first observer of a comet with a telescope, she received the Gold Medal from the King of Denmark and became the first female astronomer and astronomy professor in the United States of America. But she also got involved in feminism, participating in the foundation of the *Association for the Advancement of Women* in 1873 as well as promoting the access to higher education for women and their inclusion in science.

https://doi.org/10.1051/photon/202111028

First years

Maria Mitchell was born on August 1st 1818 on the Nantucket Island in Massachusetts. At this time, women did not have many opportunities to access proper education, but her situation was uncommon: her parents, Lydia Coleman Mitchell, a library employee, and William Mitchell, a teacher and amateur astronomer, were educated and raised their 10 children according to the Quaker religion, valuing women education as much as men education. As a teenager, Maria Mitchell assisted her father both at school and during night observations≤: she quickly learnt to use a telescope and became passionate about astronomy. At 17 years old, she founded her own school where she applied non-conventional teaching methods and allowed African-American students despite of the ongoing segregation in public institutions. She then became librarian at the Nantucket Atheneum, which enabled her to study on her own and, almost every night, she climbed on the Pacific Bank rooftop, where her father was working, to observe the night sky with a telescope provided for them by the Coast Survey.

Miss Mitchell's comet

It was during one of these night observations that, on October 1st 1847, at 29 years old, she discovered the comet C/1847 T1 (named 1847 VI back then), a so-called telescopic comet since it is invisible to the naked eye and can only be detected with a telescope. With this finding, she became the third woman to discover a comet after Maria Margarethe Kirch (comet of 1702) and Caroline Herschel (8 comets from 1786 to 1797) and the first American person, among both men and women, first detecting one. Two days later, Father Francesco de Vico in Rome (Italy) observed the same comet. Since he published its coordinates before Maria Mitchell did, he temporarily received credit for this discovery, resulting in a short argument

KEY DATES

August 1st 1818:
Birth (Nantucket Island, Massachusetts)

October 1st 1847
Discovery of the *Miss Mitchell's Comet*

1865:
Astronomer and professor at the Vassar College (New York State)

OPTICAL SPECTROSCOPY FOR THE DETECTION OF MICRO- AND NANOPLASTICS IN WATER

Matthieu ROUSSEY*, Benjamin O. ASAMOAH, and Kai-Erik PEIPONEN
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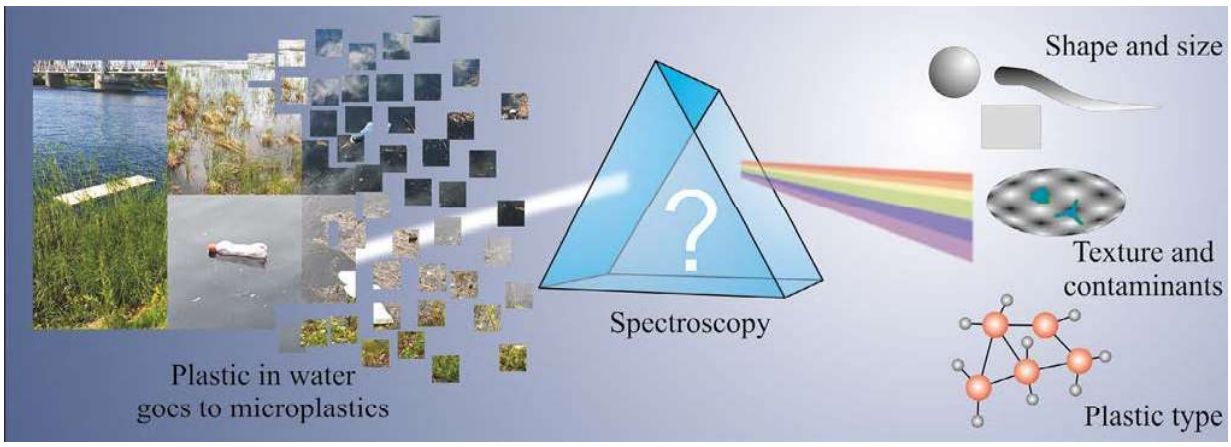

Optical spectroscopy techniques offer an additional dimension to classical methods for the detection and identification of complex particles in complex environments. We present some of these techniques applied in the frame of the fight against the plague of Micro- and Nano-plastics.

https://doi.org/10.1051/photon/202111040

Plastic products have much importance for human beings in our everyday life. The resulting wastes from these products are usually sent for recycling especially in developed countries. Despite the contemporary regulations and suggestions to recycle plastics, this has not been the case in the past. Moreover, in less developed countries, the recycling of local wastes is still an issue. Consequently, lots of plastic litter have been buried in soil or ended up in the seas and lakes, where light plastics are floating, and heavier ones settle at different depths in these environments. The presence of plastics and their degradation into micro- and nanoplastics (MNPs, 100nm < MP < 5mm, NP < 100nm), due to UV-radiation and weathering, for example, pose a threat to the environment. There is scientific evidence that both MPs and NPs can accumulate in Flora and Fauna. Associated health-related issues, such as the toxicity of MPs and NPs, are currently under continuous investigation. Whatsoever, the detection of MPs and NPs is still in its infancy and, probably, our current knowledge of these particles is still limited.

Optical spectroscopy or spectrophotometry is a field of Photonics for the investigation of the interaction of light with matter. It yields information on the nature of matter through spectral response, *i.e.*, how different wavelengths are transmitted, reflected, absorbed, or re-emitted by