

Newsletter

OPTICA

Advancing Optics and Photonics Worldwide

Optics for Energy

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FOREWORD

Mission and Goals

The group's aim is to connect professionals and students in optics and energy through: Technical events, Educational webinars, Networking activities, Social media engagement.
MUCH MORE would be possible with your contributions!

Meet the team



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ALC 2026

17th African Laser Centre Student Workshop

7 December – 9 December 2026

Stellenbosch, South Africa

LOCAL ORGANIZING COMMITTEE:

Dr Gurthwin Bosman (SU)
Prof Andrew Forbes (WITS)
Prof Pieter Neethling (SU) (Chair)
Prof Erich Rohwer (SU)
Dr Christine Steenkamp (SU)

Elsabe Bosch (secretariat)



The purpose of the symposium is to bring together ALC grant holders and partners from across Africa, and students at South African Universities who are working in the various ALC sponsored projects. The workshop programme is designed to facilitate student presentations and interaction with project leaders. Time is allocated for getting to know one another and to exchange ideas and to share knowledge. The format of the workshop will be as follows:

- ✓ Each project leader will have the opportunity to introduce the project, followed by a student presentation (Total time allowed 30 minutes)
- ✓ Additional project presentations in the form of posters
- ✓ A limited number of rental pool student presentations will also be accommodated
- ✓ Three keynote speakers will also address delegates
- ✓ Tutorial lectures on lasers and optics will be presented

The conference venue is STIAS in Stellenbosch. The fact that the workshop is limited to ALC associated researchers and students, will encourage interaction between grant holders and students.

Registration Deadline: 4 October 2026

For more information visit the workshop website

[Link to website](#)

Contact: AfricanLaser@gmail.com



ALC Workshop 2026



Modern Aspects of Photonics

10 – 11 December 2026

STIAS, Stellenbosch, South Africa

Topics

Photonics applications in quantum optics, quantum computing, laser light manipulation, imaging, spectroscopy, microscopy, biophotonics and medical applications

Organising Committee

Workshop Chair
Programme
Technical
Scientific

Prof Pieter Neethling
Prof Erich Rohwer
Dr Gurthwin Bosman
Prof Andrew Forbes

Workshop secretary

Mrs Elsabe Bosch

Registration Deadline: 4 October 2026

For more information visit the workshop website

[Link to website](#)

Contact: AfricanLaserWorkshop@gmail.com



PUBLICATION REVIEW

How do sub-bandgap reflectors affect the performance of PV modules?

Authors: Klaus Jäger, Optics for Energy TG member,
Jyotirmoy Mandal, Barry P. Rand, Forrest Meggers and
Christiane Becker

Introduction

Elevated temperatures reduce the power conversion efficiency (PCE) and the lifetime of photovoltaic (PV) modules. As a result, the cumulative energy yield from PV modules over their lifetime is substantially reduced, especially in warmer climates. To keep the modules and hence the solar cells cooler during operation, various cooling techniques have been proposed and tested with the goal to increase the modules' energy yield and reduce PV performance degradation.

The paper proposes sub-bandgap reflectors (SBR) to reduce the temperature of PV modules by reflecting the near-infrared region of the solar spectrum with photon energies smaller than the electronic bandgap of the solar cell absorber material. An ideal SBR is considered, which reflects 100% of non-harvestable low-energy photons but does not alter the reflectivity of the PV module for usable high-energy photons, as shown in Fig. 1(a). An estimate of how reducing the module temperature with the SBR affects the annual and the cumulative energy yield of silicon PV modules is provided. Two modules, in open-rack and closed-roof configurations, are assessed, as shown in Fig. 1(b).

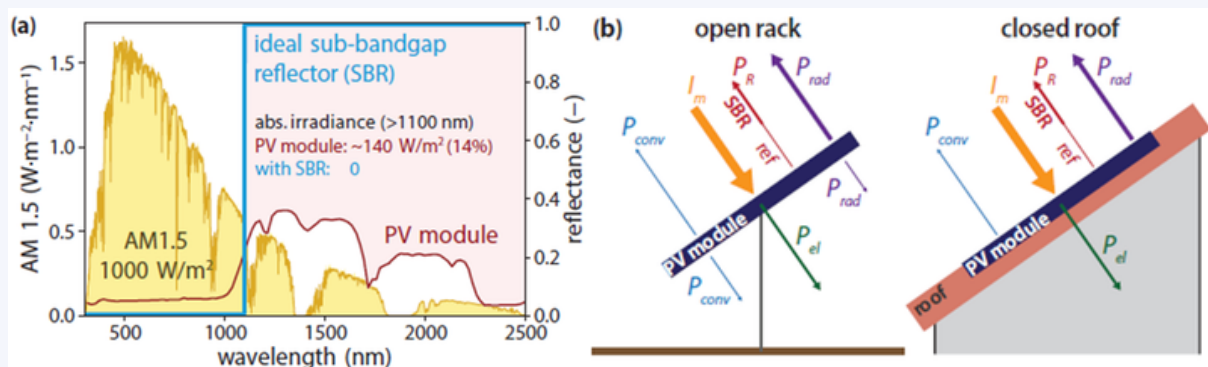


Fig. 1. (a) The AM1.5 reference solar irradiance spectrum (left y-axis) and the reflectance spectra of a solar module and an ideal sub-bandgap reflector (right y-axis). (b) The power flows for an open rack and a closed-roof mounted PV module: the incident solar irradiance I_m , the electrical output power P_{el} , the reflected power P_R , the radiative power P_{rad} and convective power P_{conv} . Placing an SBR on top of the PV module increases P_R .

The Structure Proposed

For silicon with a bandgap of about $E_g = 1.1$ eV, corresponding to $\lambda_g \approx 1100$ nm wavelength, about 20 % of the incident solar irradiance cannot be used because the photon energy is smaller than the bandgap and therefore too small to generate electron hole pairs. If these photons are absorbed elsewhere in the PV module, their energy will heat up the module. Hence, maximizing the sub-bandgap reflectivity of the solar module will keep the module temperature lower during operation, and this cooling effect is significantly larger than radiative cooling. An ideal SBR would reflect 100 % of the incident light below the bandgap of silicon ($\lambda > \lambda_g = 1100$ nm) but would not alter the reflectivity of the PV module above the bandgap (hence, the SBR has 0 reflection and 100 % transmission for $\lambda < \lambda_g$). It is further assumed that the SBR does not alter the emissive properties of the PV module for $\lambda > 4 \mu\text{m}$ so that it does not alter radiative cooling.

Results and Discussion

A. Annual energy yield

The annual energy yield (AEY) was calculated with a chain of models as illustrated in Fig. 2: Using weather data from the National Solar Radiation Database (NSRDB) by the US National Laboratory of the Rockies (NLR) and the position of the Sun, the illumination model calculates the irradiance on the plane of array of the PV module I_m . From the irradiance, the optical model determines the maximum achievable current density J_{ph} . Using weather data and I_m , a temperature model calculates the solar-cell temperature T_c . Finally, an electrical model uses J_{ph} and T_c to calculate the electrical output power density. The electrical model contains the temperature coefficients β_v and β_j for the open-circuit voltage and short-current density, respectively, denoting by which percentage these values change per kelvin increase in temperature. The AEY is then calculated with weather data given for one year.

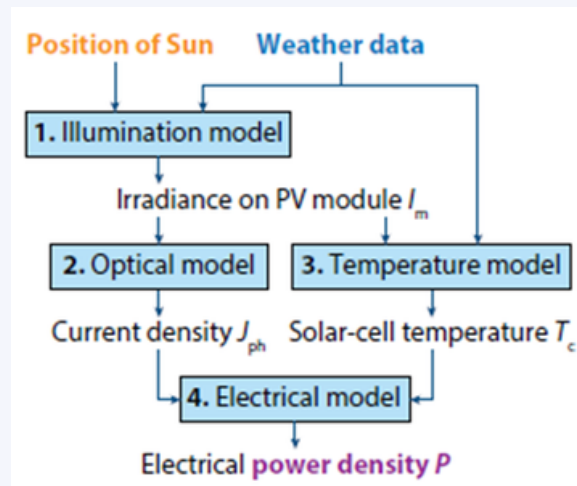


Fig. 2. Flowchart illustrating the data sets and models required to calculate the electrical power density and hence energy yield of a PV module.

Six locations with different climates and illumination conditions were considered to estimate the effects of ideal subbandgap reflectors on the AEY. Assuming temperature coefficients of $\beta_v = -0.40$ %/K and $\beta_j = +0.003$ %/K, an ideal subbandgap reflector can increase the annual energy yield between 1.0 % and 1.5 % for a glass/glass module in open-rack mount and between 1.6 % and 2.4 % in a close-roof mount. For close-roof

mount, the sub-bandgap coating has a much larger effect on the temperature, because convective heat transfer happens only on the front side, increasing the non-radiative fraction of the total heat transfer. Further, for close-roof mounted modules, AEY_{SBR} is always less than AEY_{ref} for open rack mounted PV modules, because the temperature of close-roof mounted modules is generally higher than for open-rack mounted modules. A non-ideal SBR would however induce some non-intended losses by partially reflecting the incident light for wavelengths shorter than the silicon bandgap. These small irradiance losses might counterbalance the gain in energy yield leading to a net loss. This effect is more severe for open-rack mounted modules.

From these results it can be concluded that the effect of SBRs has little to no beneficial effect on the instantaneous power conversion efficiency and the resulting annual energy yield of a single-panel PV system. For perovskite solar cells, temperature coefficients which are significantly below the values for silicon solar cells were reported. This makes the benefit of a passively cooling SBR on the instantaneous power conversion efficiency and the resulting AEY even smaller. However, SBRs might reduce degradation and hence increase the lifetime of PV modules and the cumulative energy yield over the whole module lifetime.

B. PV module degradation

Many different mechanisms contribute to the degradation of PV modules. Therefore, modelling PV degradation is a complex undertaking, which has been approached with data-driven and analytical (or physics based) models. For assessing how sub-bandgap reflectors affect the degradation rate, physics-based models, which have the module temperature as input are required. Temperature is well known to affect the reaction rate of chemical reactions, and therefore the degradation rate of devices such as PV modules. For polymers, which are present in all PV modules, an often-used rule of thumb states that the reaction rate doubles with every 10 °C increase in temperature. To get a qualitative understanding on how the temperature reduction caused by an SBR could affect the degradation of PV modules, a simple Arrhenius model of the degradation rate k is used: $k = \gamma \cdot \exp(-E_a/k_B T)$, with the activation energy E_a , the temperature T (in kelvin), the Boltzmann constant k_B and a constant γ . A value of the degradation rate of a reference PV module mounted in open-rack configuration is set to $k_{yr} = 1$ %/yr, which corresponds to a lifetime of about 20 years. The constant γ is then determined for the different activation energies. For the open-rack configuration, an ideal SBR would increase the lifetime between 7 % for $E_a = 0.4$ eV and 23 % for $E_a = 0.8$ eV. For closed-roof mount, the lifetimes for the reference module are much shorter because of the constantly elevated temperature of the PV module w.r.t. the open-rack-mounted modules. Even though this qualitative analysis does not allow to predict how an SBR would affect the degradation rate of a specific PV module, it demonstrates how beneficial SBRs would be to increase the longevity and stability of PV modules. This might be even more relevant for perovskite solar cells, where temperature variations have been identified as critical for long-term stability.

Conclusion and Outlook

An idealized passive cooling sub-bandgap reflector (SBR) would affect the annual and cumulative energy yield of silicon PV modules. For a typical PV module, an ideal SBR would moderately increase the annual energy yield (AEY) between 1.0 % and 1.5 % for open rack mounted modules and between 1.6 % and 2.4 % for close-roof mounted PV modules. This small increase can be rapidly negated in case of a non-ideal SBR with reduced transmissivity in the spectral solar cell absorption regime. Whether a non-ideal SBR provides a benefit in actual deployments strongly depends on the location and the optical properties of the coating for short wavelengths, where the incident light can be utilized by the solar cells. Beyond effects on the instantaneous power conversion efficiency and hence the AEY, a SBR might also reduce the degradation of the PV module because of the reduced temperature. Interesting and relevant topics for future research are the design and fabrication of SBRs with production costs that justify the modest, expected gains in efficiency and lifetime. It should also be investigated how thermal management with SBRs affects the surrounding temperatures in large PV plants with many PV modules and in urban environments.

<https://doi.org/10.48550/arXiv.2604.20757>



This review provided by Prof. Ahmed Hisham Morshed aims at promoting the research of one of our group members, Dr. Klaus Jäger. The physicist works on optical simulations of solar cells at the Helmholtz-Zentrum Berlin for Materials and Energy. Jäger's work revolves around the question of how to design a solar cell so that it absorbs light as effectively as possible.

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OPTICS FOR ENERGY ARTICLE

When Light Carries More Than Data

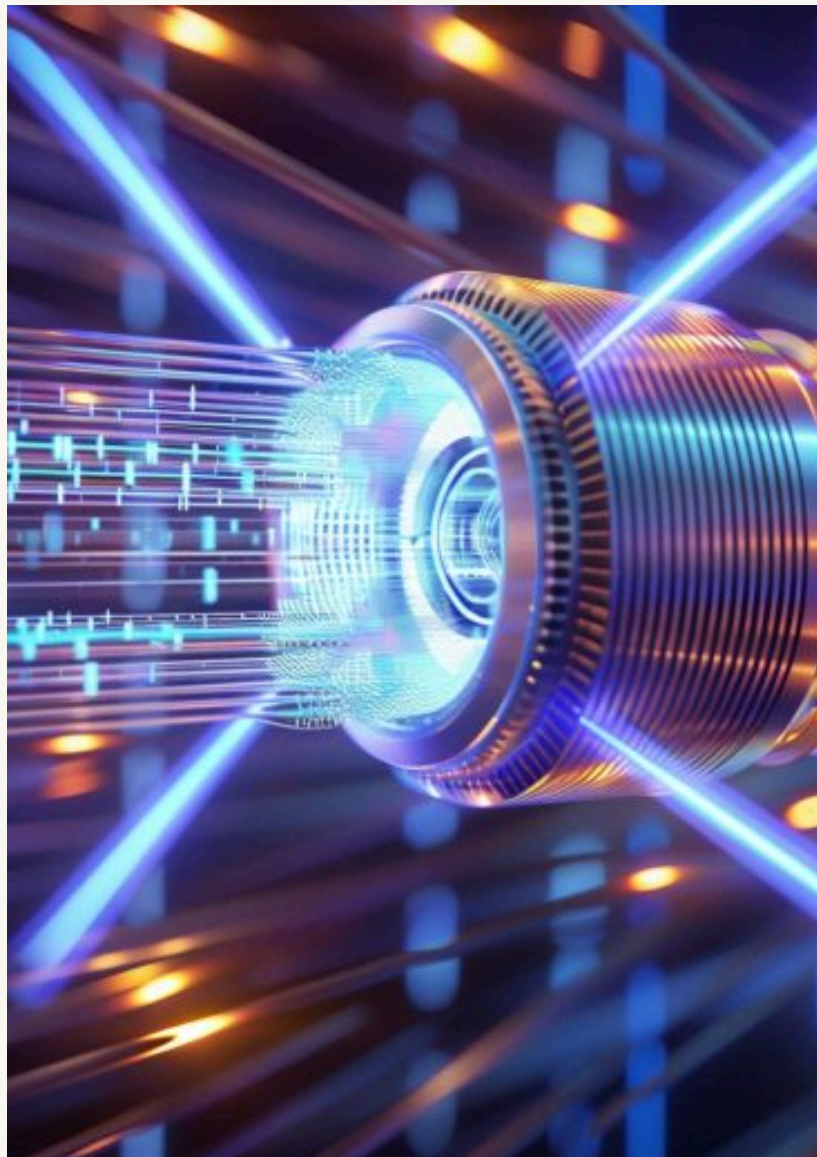
By Rodgers Mutugi

Introduction

The expansion of the Internet of Things (IoT), wearable devices, sensors and distributed monitoring systems is creating a fundamental challenge on how we can connect billions of devices without continuously increasing their energy consumption!

For many low-power devices, communication is one of the most energy-intensive operations. A sensor may require only a small amount of energy to measure temperature, pressure or motion, yet transmitting that information wirelessly can consume a significant fraction of its available power. As networks become increasingly dense and devices become smaller, energy-efficient communication technologies are therefore becoming essential.

One promising approach is to use light itself as a medium for communication. Optical wireless communication (OWC) uses visible, infrared or other optical wavelengths to transmit information through free space. Beyond providing high communication bandwidth, advances in photonic devices are now demonstrating the possibility of transmitting large amounts of data with remarkably low optical power.



Credit: [SciTechDaily.com](https://www.scitechdaily.com)

Why Optics?

Conventional wireless communication relies primarily on radio-frequency (RF) waves. Optical communication offers a different part of the electromagnetic spectrum and introduces several potential advantages, including abundant bandwidth, spatial confinement and reduced electromagnetic interference.

An example is Light Fidelity (LiFi). Similar to Wi-Fi, LiFi provides wireless connectivity, but information is transmitted by rapidly modulating the intensity of a light source, such as an LED or laser. A photodetector receives these changes and converts them into an electrical signal.

For energy applications, however, the more important question is not simply whether light can carry data. The question is, how much information can be transmitted for a given amount of energy? The shift from data rate alone towards energy per bit is central to the development of sustainable communication systems.



From “Energy per Bit” to “Energy per Photon”

A way to understanding this challenge is to consider the relationship between the amount of information transmitted and the number of photons required to transmit it reliably. In optical communication, information is ultimately encoded onto light, and the receiver detects that optical signal in the presence of noise and other sources of uncertainty.

This creates an opportunity for energy-efficient communication. If a system can reliably recover information from a very weak optical signal, the transmitter does not necessarily need to generate a large amount of optical power. Advances in photodetectors, modulation techniques and signal processing are therefore becoming increasingly important in reducing the energy required for communication.

The goal is not simply to make the light source more efficient. It is to optimize the entire communication chain.

Photonics for Low-Power Devices

This is relevant for emerging networks of small, distributed devices. Sensors used in buildings, industrial systems, healthcare monitoring and environmental applications may need to operate for long periods with very limited access to energy.

For such devices, communication can represent a significant part of the total energy budget. Reducing the energy required to transmit each bit could therefore extend battery life, reduce maintenance requirements and enable new applications where replacing or recharging batteries is difficult. Optical wireless communication may be attractive for short range applications where highly directional links are possible. Instead of broadcasting a signal in all directions, light can be directed

towards a specific receiver. This spatial confinement can reduce unwanted interference and potentially improve the efficiency with which optical power is used.

More Than Communication

Light source, for example, can provide illumination while also transmitting information through rapid modulation that is imperceptible to the human eye.

This concept creates the possibility of combining lighting, communication, sensing and positioning within the same infrastructure. In buildings, factories and other controlled environments, such integration could reduce the need for separate systems and make more efficient use of existing resources.

However, optical communication is not automatically more energy efficient than every RF-based alternative. The overall energy consumption depends on the transmitter, receiver, optical losses, signal processing and operating environment.

The challenge is moving from demonstrating that information can be transmitted using extremely small amounts of optical power to developing practical systems in which every part of the communication chain is optimized for energy efficiency.

As the number of connected devices continues to grow, this distinction will become increasingly important. The future of wireless communication may not be defined only by higher data rates, but also by how efficiently those data rates can be achieved.

Light, therefore, may offer more than a new way to carry information. It could become part of a broader strategy for reducing the energy cost of communication itself.

DISCUSSION FORUM



Light for data+energy transmission

Conventional wireless → Optical communication

data rate
↓
energy per bit

advantages {
• *abundant bandwidth*
• *spatial confinement*
• *reduced EM interference*

To discuss:

*What are the main challenges of using light as
carrier for both data and energy?*



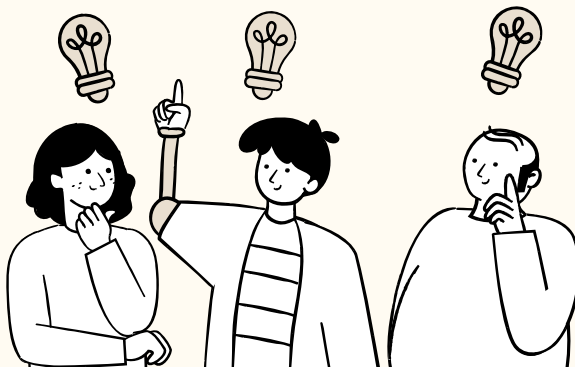
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INSIGHTS

Plug-in Solar: Adoption of DIY Solar Install in Europe

By Rodgers Mutugi

Solar Photovoltaics (PV) is no longer limited to homeowners with a suitable roof. Across Europe, a smaller and simpler form of PV is gaining ground, often called balcony solar or “balcony power plants”. These systems typically consist of one or two PV modules, a microinverter and a cable that connects to a household electrical circuit. Their appeal is straightforward: relatively low upfront cost, simple installation, ability to move with the system for renters and the ability to generate electricity even for households without a large rooftop or a rooftop. Often described as plug-in PV and a rapidly emerging segment, with Germany clearly leading European adoption.

Germany provides the clearest indication of how quickly the concept can scale. By the end of 2024, around 800,000 plug-in solar systems were registered in Germany, representing more than 700 MW of registered capacity. However, the German Environment Agency's analysis suggests that the real number was substantially higher because many systems were not registered. Its modelling estimates that almost 2.9 million plug-in systems were actually in operation by the end of 2024.



Germany's Federal Network Agency recorded approximately 430,000 new plug-in solar installations during 2025, adding around 0.5 GW of capacity indicating a continued growth. An open-data analysis of the German market register placed the number of registered systems at more than 1.4 million by July 2026.

What makes this development interesting is the role of DIY installation. Unlike conventional rooftop PV, plug-in systems are designed around a much simpler installation process, making solar accessible to tenants and apartment residents as well as homeowners. Germany's regulatory changes in 2024 simplified requirements for these small systems, while Austria has also established an 800 W threshold for mini-PV systems that can be connected without formal grid-operator approval, although notification is still required. Austria has additionally made installation easier within condominium properties since September 2024.



Source: Robert Poorten / AdobeStock

Other European markets are now beginning to follow this path. In Belgium, approved Plug&Play devices have been permitted to connect to household electrical installations since 17 April 2025, following changes to the technical connection rules. Wallonia, for example, allows these systems to be connected through a normal socket but requires the installation to be declared to the distribution network operator.

The attraction is not only convenience. Plug-in systems are strongly oriented towards self-consumption since the electricity generated is used directly by appliances in the home, reducing the amount of electricity purchased from the grid. The German Environment Agency estimates that plug-in systems generated around 1.7 TWh of electricity in 2024, of which approximately 1.1 TWh was consumed directly by households.

The European story, however, is still fragmented. Regulations, electrical standards, registration procedures, landlord permissions and grid-connection requirements differ considerably between countries. SolarPower Europe identifies this regulatory patchwork as one of the major remaining barriers to wider adoption.

The larger significance of plug-in solar may therefore be less about the amount of electricity produced by each individual panel and more about who can participate in solar generation. By turning PV into a product that can be purchased, installed and operated on a much smaller scale, DIY solar is lowering the practical barrier between consumers and energy generation. Europe is beginning to move from solar on buildings towards solar by households.

CAREER FOCUS

Good Explanations; The Paradox of Simplicity in Complexity

By Banafshe Zakeri

Spending many hours a day, compounding into months and even years, to prove something that started with a mere hypothesis. That's the norm for people in scientific communities. Then you stand in front of a poster or look at presentation slides, trying to understand all the steps taken with patient curiosity and diligent effort. Assuming you have a similar background, because otherwise what are you doing at that conference!, a series of facts formulated in standard scientific language will be presented to you, and you will be left with tiny pieces of a huge puzzle. Of course, you can make notes if you are interested in the topic, to do more research later, perhaps finding other pieces of the puzzle. That's also the norm in scientific communities. As a result, conferences have become more and more places for introducing new ideas and less and less a discussion forum. Why?! Is it because we consider a specific, complex language for science? Do thinkers in a society necessarily need to be or sound complex, especially for those who don't have a similar background? Should they think about how much less they know than a scientist and how huge the gap is between the worlds they live in? In the end, gravity works the same for all of us, regardless of whether we know the exact science or the complex formulation behind it!

In recent years, the rapidly growing interest in bringing scientific ideas to market by solving the real problems of the world has brought us to the realization of how bad we are at communicating our work with the people outside scientific communities. Consequently, there have been many thoughts, workshops, and seminars on improving communication skills, especially when presenting ideas to non-experts in your field. But could the problem possibly be rooted somewhere else?

In communicating any idea, one usually considers the knowledge of the audience about the topic as the baseline, a starting point. For people spending much of their lives in conference halls and among scientists, the baseline is naturally taken very high. That's normal; no one should describe a subject for a scientist the same way for a kid! However, there is a difference between simplicity in content and the simple way of expression. In other words, good explanations are audience-independent, and, as the theoretical physicist David Deutsch said, "good explanations are strikingly simple or elegant". Seeking simplicity in complexity is a paradox that makes a good explanation. This is perhaps how we should start to think, and to do so systematically at any point, either when presenting our ideas among scientific communities or when pitching the idea to non-experts!

What are the criteria for a good explanation in science?

- **simple**
- **what else?!**

Join the discussion forum...



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Check out OPTICA upcoming webinars on career developmen:

29 October 2026

- Surviving & Thriving in Scary Interviews ([registration link](#))

12 November 2026

- Building, Maintaining, and Leveraging Your Professional Network ([registration link](#))

Opportunities



Scholarship

Optics and Photonics Africa
Scholarship (SPIE)



Africa



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studies in Africa

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Awards

Adolph Lomb Medal



Worldwide



Early career
contributions



Closes 18 Sep 2026

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ERC 2027 Starting Grant



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Closes Jul 15,
2026



Scholarship

Women in Optics Scholarship
(SPIE)



Global



\$ 10,000

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CLEO Conference and
Exhibition



LongBeach, USA



Worldwide



02- 07 May 2027

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Conference

Optica Design and Fabrication
Congress



Antwerp, BE



Worldwide



11 - 15 April 2027

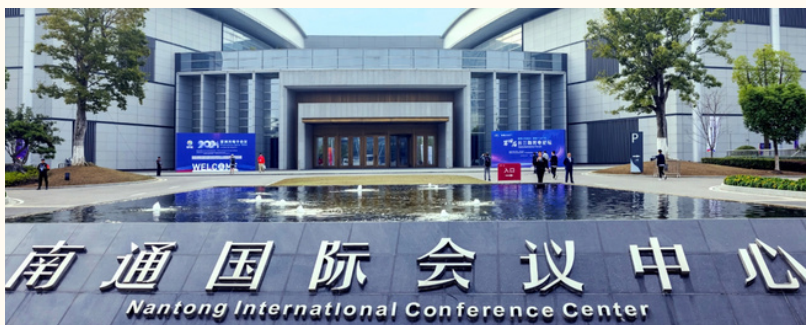
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ACROSS CONTINENTS

Upcoming Conferences in Asia (2026)

Still Open for Registration



SPIE. Photonics Asia - Photonics for Energy VI

Place: China

Time: 24 - 25 October

<https://spie.org/PA26/conferencedetails/photonics-for-energy>



17th International Conference on Fiber Optics
and Photonics

Topic Category: Green & Perovskite Photonics (GPP)

Place: India

Time: 09 - 13 December

<https://photonics2026.iith.ac.in>

Upcoming Event



NETWORKING ONLINE COFFEE CHAT

Optics for Solar Energy, a Roadmap

*A guideline presented by the experts in the field
for students and early career researchers interested
in exploring ideas in the field of solar energy*

Communication and Engagement

DISCUSSION

EVENT UPDATES

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