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Hearing glasses
Feeling hot, feeling cold

39/4
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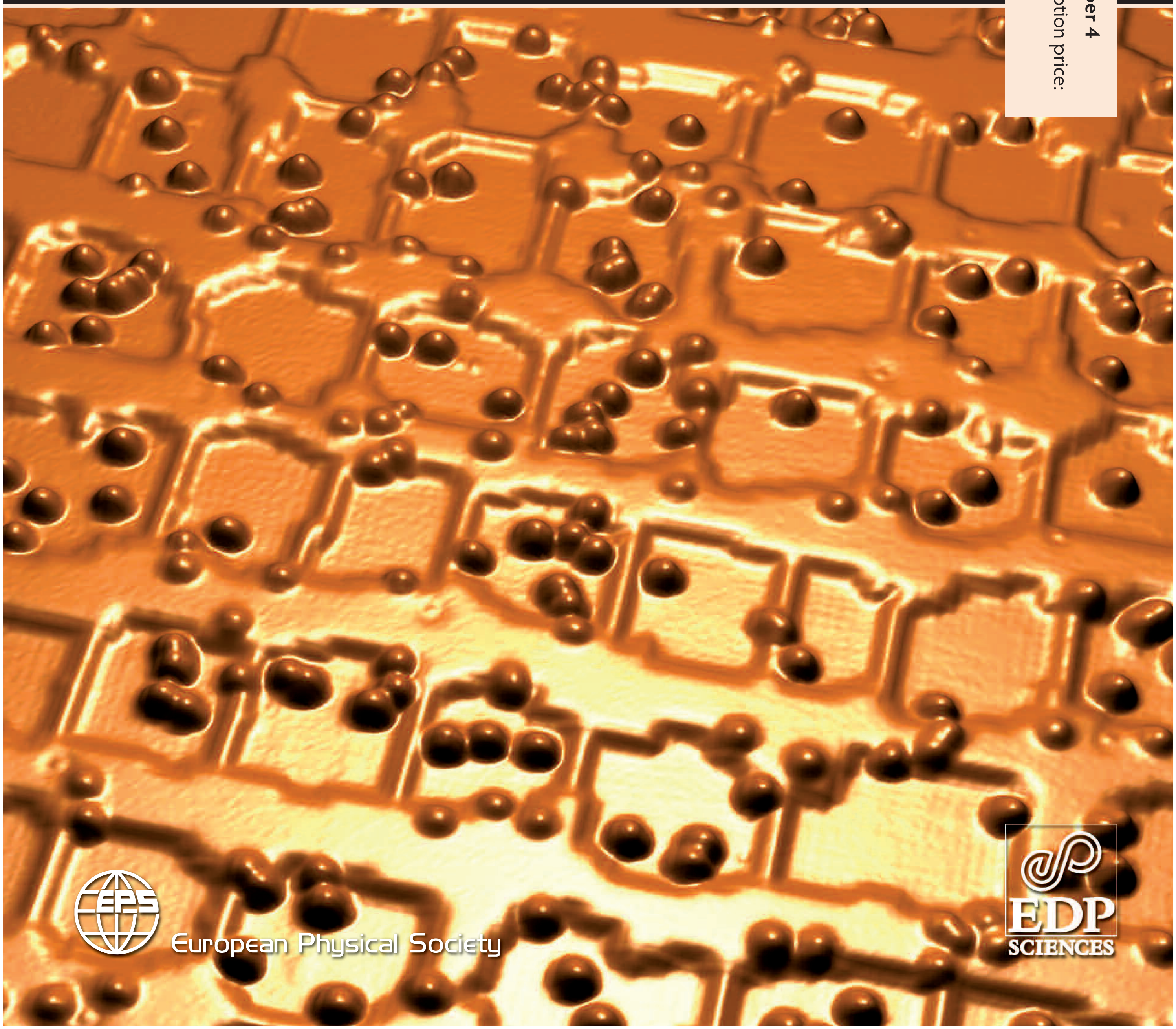

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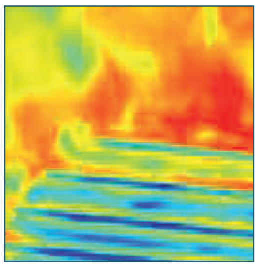
**cover picture:** Copper nitride islands on a copper substrate seen by scanning tunneling microscopy. See article p. 31



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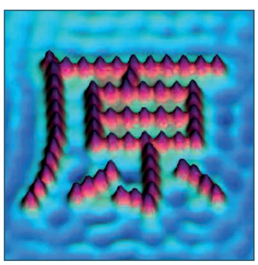
Bubbles, drops, films: transferring heat in space



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Can data be stored in a single magnetic atom ?

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Museum review: Deutsches Museum

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**Editor:** Claude Sébenne
Email: claude.sebenne@impmc.jussieu.fr

**Science Editor:** Jo Hermans
Email: Hermans@Physics.LeidenUniv.nl

**Executive Editor:** David Lee
Email: d.lee@eps.org

**Graphic designer:** Xavier de Araujo
Email: x.dearaujo@eps.org

**Director of Publication:** Jean-Marc Quilbé



**EDP Sciences**
**Managing Director:** Jean-Marc Quilbé

**Production:** Agnès Henri
Email: henri@edpsciences.org

**Advertising:** Aurelie Lefebvre
Email: lefebvre@edpsciences.org

**Address:** EDP Sciences
17 avenue du Hoggar, BP 112, PA de Courtabœuf,
F-91944 Les Ulis Cedex A • France
**tel:** +33 169 18 75 75 / **fax:** +33 169 28 84 91
**web:** www.edpsciences.org

**EPS Secretariat**
address: EPS • 6 rue des Frères Lumière
BP 2136 • F-68060 Mulhouse Cedex • France
**tel:** +33 389 32 94 40 / **fax:** +33 389 32 94 49
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# UNIVERSITIES, PHYSICS AND HIGHER EDUCATION

»» EDITORIAL

The research scene is changing rapidly these years. We all experience these changes whether we are seniors in science leadership, active scientists or young researchers fighting to gain a foothold. These changes are best characterized by the word corporatization.

Today science is viewed as a catalyst for economic growth, science funding is regarded as a strategic commodity and researchers as soldiers of war. In this development we see signs of a worrying nature, mostly in the interplay between higher education (HE), research and research funding and university employment.

In the US, aspects of this discussion have recently surfaced by the observation that young researchers face difficulty in attracting independent funding. Funding that increasingly is focused onto the strategic sphere following Matthew 13:12 that, *"for to those who have, more will be given, and they will have an abundance; but from those who have nothing, even what they have will be taken away"*.

This principle holds true both on the level of individual researchers, research groups and on the institutional level. This historical trend, from *unfettered serendipity towards strategy and societal relevance*, leave universities (and physics) with difficult choices on robust strategies in years to come.

Universities are responsible for development of talent through advanced education, PhD. training and post-doctoral employment. Successful hiring of new staff depends on this pool of new talent. However, the ability of universities to hire the best also depends on the status of the individual university as measured by status and ratings. X-factors (X=H) play more and more important roles in the corporatization and growth of modern universities. Ratings are today adapted in most countries under acronyms like "elite initiatives"; Matthew is alive and functioning.

This development has taken place during a period of time, where recruitment to modern science, particularly the exact sciences, has become increasingly difficult, while enrollment in non-science HE-programs generally has soared. It is my claim, that we must take a closer look at the science HE-system and its relation to the modern *research industry*. I further claim that the corporatization of science implies less readiness to take up risky research and that a lack of balance between *unfettered serendipity* and *strategy reduces* our ability to develop a strong science basis, in particular with a mind on higher education and the ability for young students to see themselves as part of *e.g.* physics.

There are two opposite forces at play in this development. Firstly, the owners of public universities expect a rate of return on their investments. Universities, on the other hand, have traditionally valued their independence. These two opposing trends are at loggerhead in today's development of modern universities. It is in this process that focus has been put on research performance more than on nurturing a new generation of creative and highly trained young scientists. Research may be "industrialized", but higher education certainly can not.

This is where the physics community could take action. Only those fields of science that can "win" the best of each generation, will stand a chance to develop themselves. This means more focus on physics curricula, advanced didactics and, most importantly, an attitude also making room in physics for groups of students not aspiring to become university physicists themselves. As for young physicists, opportunities must be established for them to prove themselves early in their career. For women physicists there exists a particular need for career planning in respect of family concerns.

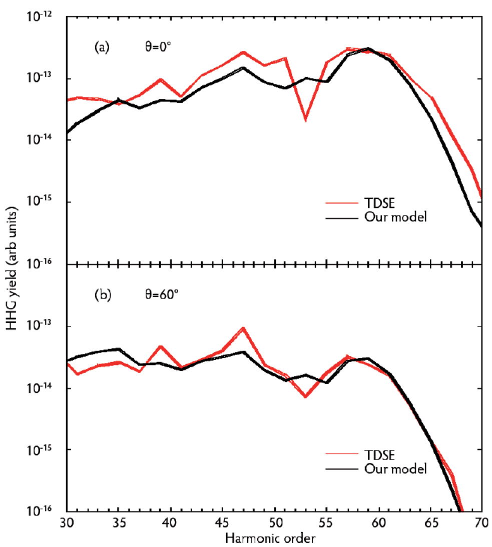
Corporatization in this sense implies finding a proper balance between the human factors so central to higher education and the innovation potential inherent to advanced research. ■

**Ove Poulsen**,
Past-president of the EPS (2005-2007)

# HIGHLIGHTS FROM EUROPEAN JOURNALS

## Ultrafast self-imaging of molecules under intense laser pulses

X-ray and electron diffractions are powerful tools for spatial imaging of structure at the atomic level, but they lack the temporal resolution needed for studying chemical transformations. Today infrared laser pulses of a few femtoseconds duration are widely available but their wavelengths are much too long for spatial imaging. However, when a molecule is exposed to an intense laser pulse, electron(s) that are released earlier by tunneling ionization may be driven back by the laser field to recombine with the molecular ion to emitted high energy photons, in a process called high-order harmonic generation (HHG). Since photo-recombination is the reverse of photo-ionization, which is the traditional tool for studying the structure of molecules, the emitted HHG spectra may be used for self-imaging of molecules, with temporal resolution of a few femtoseconds.




◄ **Comparison of HHG spectra at two alignment angles using our model against direct quantum calculations (TDSE).**

To demonstrate how this scheme works, we showed that accurate HHG spectra obtained for $H_2^+$ are well reproduced as the product of a returning electron wave packet with the photo-recombination cross section. This established the theoretical foundation that laser-induced HHG spectra of a molecule can be used to extract photo-ionization cross sections. Since the latter are very sensitive to the atomic arrangement in a molecule, accurate spatial information can be retrieved, thus proving the promise of using laser-induced HHG for ultrafast time-resolved imaging of transient molecules. ■

**A.T. Le**, **R. Della Picca**, **P. Fainstein**, **D. Telnov**, **M. Lein** and **C.D. Lin**, "Theory of high-order harmonic generation from molecules by intense laser pulses", *J. Phys. B: At. Mol. Opt. Phys.* **41**, 081002 (2008)

## Black holes in a water channel

Black holes are some of the most mysterious objects in the Universe, but scientists at Nice and St Andrews have created analogues of black holes in a water channel. Here they observed a vital indication for Stephen Hawking's prediction that black holes are not black after all.

Black holes resemble cosmic drains where space disappears in their singularities like water going down a plughole. Space seems to flow, and the closer one gets to the black hole the faster it flows. At the event horizon space appears to reach the speed of light, so nothing, not even light, can escape.

The team, led by Germain Rousseaux and Ulf Leonhardt, made horizons in a 30 meter long water channel with a powerful pump on one end and a wave machine on the other. The horizon is the place where the water begins to flow faster than the waves. They sent waves against the current, varied the parameters, and filmed the waves. Over several months the team painstakingly searched the videos for clues. They wanted to see whether the waves show signs of Stephen Hawking's famous prediction that the horizon creates particles and anti-particles.

Of course, flowing water does not create anti-particles, but it may create anti-waves. Normal waves heave up and down in the direction they move, whereas anti-waves do the opposite. As the team report in New Journal of Physics, they observed traces of such anti-waves in their videos. These waves are tiny, but they were still significantly stronger than expected.

Much work remains to be done, but, in any case, the paper shows that something as simple and familiar as flowing water may contain clues of something as mysterious and exotic as the physics of black holes. ■

**Water-wave horizon** ►

**G. Rousseaux**, **C. Mathis**, **P. Maïssa**, **T. G. Philbin** and **U. Leonhardt**, "Observation of negative-frequency waves in a water tank: a classical analogue to the Hawking effect?" *New J. Phys.* **10**, 053015 (2008)