Not seeing is believing
‘X-ray specs’ effect created in Imperial lab

Abigail Smith Communications

A new optical effect created in an Imperial laboratory may mean solid objects could one day be rendered transparent.

The technique, reported in an advance online publication of Nature Materials, has been pioneered by UK and Swiss scientists led by Professor Chris Phillips, in the Department of Physics. It is based on the development of a new material that exploits the way atoms in matter move to make them interact with a laser beam in an entirely new way.

The work relies on a breakthrough which contradicts Einstein’s theory that in order for a laser to work, the light-absorbing material it contains, usually a crystal or glass, must be brought to a state known as ‘population inversion’. This refers to the condition of the atoms within the material, which must be excited with enough energy to make them emit rather than absorb light. Quantum physicists, however, have long predicted that by interfering with the wave-patterns of atoms, light could be amplified without population inversion. This has previously been demonstrated in the atoms of gases but has not before been shown in solids.

In order to make this breakthrough, the team created special crystals, patterned on length scales of only a few billionths of a meter, that behaved like ‘artificial atoms’. When light was shone into the crystals, it became entangled with the crystals at a molecular level rather than being absorbed, causing the material to become transparent.

This new transparent material created by the entanglement is made up of molecules that are half matter and half light. This allows light to be amplified without population inversion for the first time in a solid.

Professor Phillips says:

“This real life ‘x-ray specs’ effect relies on a property of matter that is usually ignored – that the electrons it contains move in a wave-like way. What we have learnt is how to control these waves directly. The results can be pretty weird at times, but it’s very exciting and a fundamental. At the moment the effect can only be produced in a lab under specific conditions but it has the potential to lead to all sorts of new applications.”

The man also discovered that as light passes through this new material, it slows down and could potentially be used to completely stop and store. Professor Phillips believes this has important implications for entirely secure information networks. He says:

“When we send information, for example by sending light pulses down optical fibres, it can only be accessed by making a form of measurement, and these measurements always disturb the information. This technology offers us a means of sending light signals through a network without us having to disturb them ourselves. Now, if confidential information is being sent on the, the disturbance shows up straight away and we can sub the eavesdropper with 100% certainty.”

The importance of being ethical

Wendy Raeside Communications

HIGH ethical standards are essential in any successful modern institution. That’s why Imperial College has unveiled a draft Ethical Policy Framework which it hopes will inform all future activity by staff and students.

The Framework has been put together by Professor Chris Hankin, Pro Rector for Research, who told Reporter about its importance:

“The draft Framework covers all aspects of College business from teaching and research to interactions with the local community and industry.

“Ethical behaviour is such a fundamental part of College life that we want to ensure both staff and students have a chance to comment on the Framework before it becomes College code.”

Professor Hankin explained that at present the only guidance given to staff was in the Code for Proper Scientific Conduct. This sets down broad ethical principles, but does not cover a number of issues that occur in a modern research context. Two topics not covered, for example, are ghost authorship and outsourcing of research in the rather than absorb light. Quantum physicists, however, have long predicted that by interfering with the wave-patterns of atoms, light could be amplified without population inversion. This has previously been demonstrated in the atoms of gases but has not before been shown in solids.

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A thermodynamic personality

Laura Gallagher went to meet Dr Erich Müller, Reader in Thermodynamics, who gives his students both an insight into the similarities between molecules and people and a new perspective on what happens in the kitchen, whilst teaching them about thermodynamics.

DR Erich Müller, who came to the Department of Chemical Engineering from Venezuela in March last year, likes to use intriguing examples to breathe life into his thermodynamics lectures. Thermodynamics deals with energy and the way it is transformed, and it is a core course for many engineering students.

“I open up students’ minds and make them ponder, for example why does a metal change colour when you heat it?” he explained. “Do you know why a microwave pizza heats up quickly but an oven-cooked one can stay warm for a long time?”

“Researchers have found that when you measure their temperatures they are both the same?” he said. “I make lectures a little more light-hearted to get everyone interested. Thermodynamics can be very close to everyday things but some of the textbooks can make it seem abstract. There is no need for it always to look that scary.”

Dr Müller compares people with molecules to help his students understand interactions between molecules and visualise how they behave. “Liquids come together because their molecules attract each other, just like humans being who like to get close together at parties. However, molecules repel each other when they are too close in the same way that no-one wants to be approached by a ‘close talker’.”

These individual characteristics account for molecules’ collective behaviour. A group of molecules is said to stick together, just as a group of people might.

“Oil and water don’t mix because they have a very different interaction—they prefer to be amongst molecules similar to each other instead,” he said.

“This is like humans and gulls—in Copenhagen, for example, they tried to integrate the immigrant population with the otherwise rather homogeneous population by placing people in different parts of the city, but the immigrants eventually moved together and formed a ghetto,” he explained. “However, in a mayonnaise, you can have oil and water mixed together in an apparent single phase provided you have a molecule called a surfactant, which is fanciful by building and can bring them together. In a similar way, only by including people who can talk to conflicting sides can different groups mix,” he continued.

Dr Müller hopes his analogies will not be taken too seriously: “Obviously people are much more complicated than molecules—cartoon science is just a way to help someone understand something. One molecule may form strong bonds to another of the same type but I would hope that your decision to marry would be a little more complex than that!”

Dr Müller answers some energy questions

A pizza heated in the microwave cooks down quicker than an oven-cooked one, which takes a long time to cool down. Why is this?

(M) Microwave energy is “tuned” to the hydrogen bond frequency. Therefore, when water (or sugars) receive the energy in a selective, only the water in a microwave you actually heat the water, which is a minor component; in a conventional oven you are heating energy to all of the parts of the pizza at the same time.

A peach’s skin and its peel are too close for the fruit to seat and you will agree that the meat is colder. So why don’t they heat exactly the same temperature when you measure their temperatures with a thermometer?

(E) Your body (and foods) are at a much higher temperature than the chair. What you feel is not the temperature of the object but whether the object is absorbing or emitting energy due to the temperature differences. This is called heating or cooling as heat transports less heat through the fruit than the table; meaning that your skin feels colder after touching the metal.

An astronout on the moon holds a thermometer in his hand. What will the thermometer read?

(E) Anything, since it is in vacuum (it touches nothing); it then has nothing to measure. Therefore the temperature it reads is its own temperature, if it is in direct sunlight, thousands of degrees in the shade, possibly -100°C.

If I could convert all the calories in my daily intake into electricity, how much would it be?

(EN) Not much, barely enough to keep a small light bulb on. Typical daily intake is 2,500 calories, roughly equal to 1268 day, equal to 1.2 Watts. No wonder you have to eat to have really brilliant ideas.

30 not out

Wendy Raeside Communications

Choosing slightly this month, 30 not out looks at how a childhood love of plants has turned into a lifetime’s labour for Jim Harden, Head Gardener at Wye, who has worked at the college for almost half a century.

Jim joined the gardening team in 1958 as an apprentice at the age of 15 after showing an early aptitude for botany.

“He liked working with plants at school and know that I didn’t want to follow my dad and brothers into farming. I was not up at Wye and I was going where ever since.

In his first years, Jim, now aged 62, was mainly based in the campus’ tropical house. In those days, he says, “we raised all the plants for the campus gardens in the glasshouses.”

At that time, the college at Wye specialised in agriculture and horticulture with around 250 students living on campus. Jim particularly enjoyed helping with student practicals twice a week.

The workload for Jim and his team increased in the late 1960s as the woodlands and sports grounds were added to their list of places to look after. He remembers that Commemoration was a particularly busy time of year. “There was always a big fuss on graduation day—everything had to be perfect to be absolutely spotless.”

Jim also remembers a long-standing feature of Wye campus—the college cricket. As an amateur, as he was known, lived by the park and was a student for many years. His fame even extended to being promoted to Queen Elizabeth The Queen Mother during her visit in 1958.

In 1985, Jim was appointed Head Gardener, which maintained the wounding down of many commercial aspects of horticulture at the college—including pick your own fruit and sales of plants.

Among the most memorable events for Jim was the great hurricane of 1987, which caused immense damage around the campus. Jim remembers 20 oak trees at Withdenham “just flopping over” and the enormous clean up afterwards to clear roads and paths.

Fortunately, however, the oldest tree on campus—a 200-year-old mulberry at the site of a former building—survived the winds and can still be seen beside the herb garden today.

Jim’s lifetime interest in the college has extended to other members of his family—his wife Saran has worked for the Distance Learning Programme for the past 10 years and his children—son Grant and daughter Emma—completed work experience at the college during their last years at school.

Jim lives close to the campus, at nearby Bishop’s, outside work, he is a keen cricketer and, as a youth, was a member of the Kent Under 16 and Under 19 squads. Nowadays, he doesn’t play as much—but going to matches at the Nevill side of the coin—occasionally—but he does enjoy a round of golf.

He also spends much of his spare time on his own walled garden at home but, at work, prefers tending flowers to looking after the trees. “I am not a woodman at heart,” he says, “I have always enjoyed flower growing.”

Jim has so far served the College for 47 years and will have notched up 50 by the time of his retirement in three years’ time. His outstanding long service has already received several recognitions—including a tankard and Long Service Award from the Kent Show, a Long Service Medal from the Royal Horticultuural Society and a National Gardens Award to mark 40 years.

Jim continues to enjoy his work and is looking forward to further accolades when he hits the half-century.

Nineteenth century ammeter

EXTENSIVE collaborative work in the late nineteenth century between Professors William Edward Ayrton (1847-1900) and John Perry (1850-1920) led to the development and manufacture of the ammeter now in possession of Imperial’s archives.

An ammeter is designed to measure the flow of electric current. This particular ammeter was made in November 1883 during Ayrton and Perry’s most prolific years. In 1880, they devised the Permanent Magnet Ammeter and by 1883 they had developed a second form, the Magnifying Spring Ammeter.

Differences in design between ammeters are a result of the work that is intended to measure the direction of the current as well as its strength. The materials used will also affect the instrument’s performance as it becomes a part of the instrument circuit.

Having met in Japan, Ayrton and Perry were working at The City and Guilds Technical College (now part of the University of London) when the ammeter was developed. Advanced in ammeter design at the time reflected the growth in high voltages of electricity, and advocated by Ayrton himself. Ayrton and Perry also collaborated on many other forms of measuring electricity, as well as on the development of the electric triangle and a surface-contact system for electric railways.

An ammeter, made in 1883 and designed to measure the flow of electric current, has its roots at Imperial.

Perry also collaborated on many other forms of measuring electricity, as well as on the development of the electric triangle and a surface-contact system for electric railways.

The text inside the lid of the instrument reads:

Ammeter No 301
1st deflection = 1.8 Asperlings throughout the scale
Resistance = 0.0008ohm at 12.5°C
Signed Ayrton and Perry
13/11/18

Archive Corner Quiz winners are:
1st prize: Simon Archer, Division of Biology 2nd prize, Helen Kenawby, Library 3rd prize, Norman Smith, Civil Engineering
New head for the Department of Materials

Laura Gallagher Communications

Professor Bill Lee is the new head of the Department of Materials, having joined Imperial in January from the University of Sheffield, where he was Professor of Ceramic Science and Engineering. Here, he tells Reporter about what led him to academia, materials and Imperial—and how he is finding his new life here.

What made you decide to become an academic?
I liked studying. My family tell what I hope is an apocryphal story of me going to a birthday party when I was seven, taking my homework along, and actually doing it during the party.

How did you become interested in materials science? What do you think makes it an exciting subject?
I enjoyed science and maths at school (although I was better at the arts) and felt I would get a better job studying them. As English or history I did an undergraduate degree in physical metallurgy, moved to ceramics for my PhD and never went back. However, all the principles I learned as an undergraduate applied to metals as much as to ceramics, I enjoyed the fact that some of it is very challenging. Things like dislocation theory, space groups and ternary phase diagrams really tested me as a student; I get very frustrated when I cannot understand something and work at it until I do.

The study of materials is exciting as it requires engineers to know something about from processing (actually making something useful) to understanding properties (all types, such as mechanical, electrical, thermal and optical) and structure (which might be macrostructure, microstructure, defect structure or crystal structure). You have to know a lot of physics, chemistry, maths and engineering to do materials. I think we are Jacks of all trades and masters of all too! You also get to work in multidisciplinary teams spanning engineering, physics and biosciences. The future is interdisciplinary research involving such teams as those in the London Centre for Nanotechnology, and this is demonstrated by the Energy Futures initiatives at the College.

Why did you want to join Imperial?
The Department of Materials has a long and distinguished history, with great staff and students. It is relatively small in academic and staff numbers by Imperial standards but is the UK's largest materials department in terms of undergraduates. This was a chance to work on expanding the Department's research effort and extending links and collaborations with all other departments, while maintaining the size and quality of the teaching side.

What do you think of the College so far? What differences have you noticed between here and Sheffield, both in terms of living in different cities and in terms of your work?

The College is clearly investing enormous sums in improving the buildings and infrastructure, which is impressive. We are also bringing in very high quality people which shows long term ambition and planning. The quality of the people and facilities across the College is fantastic and another reason I came. I had a great life in Sheffield and London much as yet, as I am still living in the Peak District and commuting down Mondays and going back Fridays. Happily, this will get sorted soon as I am not too happy about seeing my wife, Jacky, and daughter, Alex, who is 6, only at weekends.

What's the most challenging thing about your new role?
Worrying about money, people and space while trying to retain a research and teaching profile.

What's the best thing about your new role?
Worrying about money, people and space while trying to retain a research and teaching profile.

How do you relax after a hard day running the Department?
I eat, drink and fall asleep, usually not always in that order. I am more of a morning person and usually get up early to get some exercise such as running or swimming.

Multi-disciplinary researchers translate between disciplines

Abigail Smith Communications

CREATING a new generation of researchers equipped to work across scientific disciplines is the aim of a postgraduate training centre at the College.

The Chemical Biology Doctoral Training Centre, launched in 2002, sees its first PhD students graduate later this year. With funding from the Engineering and Physical Sciences Research Council and GlaxoSmithKline, it is now able to offer 16 fully-funded four-year PhD studentships.

The Centre trains science and engineering graduates to apply their expertise to emerging challenges in medicine and biology, and expects to have taught over 50 students by 2010. Among them is Roberto Abbondati, a physics graduate who is now focused on understanding the structure of membrane proteins in the brain. He said: "Since my father was a doctor I had some medical understanding, but I didn't expect to be heading in that direction myself. However, I found myself more and more interested in seeing how the physics principles I learnt could be applied in a different way."

Chemical biology is the application of chemical understanding and techniques to the study of biological systems at a molecular level. Discovering how molecules work within and between cells is fundamental to understanding, treating and preventing diseases such as cancer and HIV, and demands the varied skills of biologists, chemists and physical scientists.

However researchers in these disciplines can often be separated by differences in perspective and methodology, sparking a need for researchers who can translate between disciplines. This is something Roberto Abbondati experienced first-hand when he spent the summer following his graduation as an intern in Imperial spin-out Delato, a company applying particle physics technology to biomolecular research.

"Working at Delato forced me to think about how to apply the principles of physics to solve problems that were very different from those I had previously encountered," he says. "It made me realise how important working across disciplines can be."

Following his internship, Roberto began his PhD at the Centre taking courses in advanced biochemistry and biomolecular techniques. His neuroscience-based PhD demands a diverse range of knowledge, from structural biology to electron microscopy and image analysis, that would not be covered in a traditional PhD programme. He believes this variety will be a good foundation for his future career.

"Science topics seem to come up in greater frequency at the forefront of current affairs, in the media as well as policy and political debate," he says. "I'd be interested in continuing the pattern of diversification that I have been able to follow up to now, perhaps moving into science roles in government or public policy."

Developing this kind of highly trained multidisciplinary scientist who can approach a problem with a variety of skills and perspectives is the chief goal of the Doctoral Training Centre, according to its Director Richard Temple, who is also Imperial's Head of Chemistry. He says: "We are training a new breed of researcher. It is becoming increasingly important for physical and biological scientists to work more effectively in order for advances in medicine and life sciences to be made. There is strong demand from the wider academic community for scientists with these broad skills and that is why the Centre was founded."

The Centre is based within the Department of Chemistry and is a joint venture with the Institute of Cancer Research and Cancer Research UK.

Visit www.chemicalbiolgue.ac.uk for more information about the Centre. Go to www.chemicalbiolgue.ac.uk/vacancies/default.aspx for information on studentships.

MEDIA MENTIONS

Abigail Smith Communications

The plans to close the London Planetsarium to make room for more of Madame Tussauds' waxworks is "a disaster for astronomy education in the UK", says Michael Rowan-Robinson, Physics, in a letter to The Guardian (04.02.96). He adds: "Many children have had their understanding and appreciation of the night sky enormously enhanced by a trip there and it has been one of the major science tourists attractions of London."

Spinning gold

Nearly forty years of research has culminated in the establishment of two spin-out companies by 80-year-old Professor Colin Carr, Bioengineering, the Times Higher Education Supplement reports. The two companies, Vervan Medical and HeatIllusiv Technology, reflect Professor Carr's twin interests in medical technology. "Some people have ideas in their twenties, others in their eighties," he says. "I felt I had a worthwhile contribution to make and with these two companies, I am working harder than ever before in my career."

Natural born killers

Shunning synthetic materials in favour of "natural" ingredients isn't necessarily the way to a long and healthy life, according to the Observer (22.02.96). The warning from toxicologists and chemists who fear the consequences of misconceptions about chemicals in everyday life is supported by health and safety experts who emphasise the importance of correct, non-hazardous products.

"A few people travel a lot and if a bill gets into one of their wallets, then it can easily turn up on the other side of the country," he says. "The jet set are crucial when it comes to spreading infections, and being able to put numbers on the behaviour of those people is very important."

Kryppy Kreme universe

A newly-discovered pattern in the hot and cold spots of the "afterglow" of the big bang fireball may mean that the pictures science currently has of the universe is flawed, reports The Independent (01.02.06). This irregularity where randomness was expected has been dubbed "the kiss of evil" by Joao Magueijo, Physics, and could indicate that the universe is not the same in all places or dimensions but has a special direction. He adds that there are a number of ways in which this could be the case, including the possibility that the universe is shaped like a giant ring doughnut.
Spotlight on Spectrum

Buying software

Peter Gillings Communications

IMPERIAL College staff can go to the online ICT software shop to browse a large range of software products. The shop’s ‘wishpages’ have comprehensive details of what is available for College and home use and educational discounts, as well as the latest software news. Accessible by staff using a College login, the pages provide pricing, licensing and payment information for many products, such as Adobe, Macromedia, Corel, MatLab, Microsoft, RedHat Linux and agreements such as Edwork (CHEST).

Software to download

Some applications, such as RealPlayer, RedHat Linux and Norton, are available free of charge and others, such as Microsoft Office, are included in existing College licence agreements and can be downloaded directly from the website following user registration. Staff working from home may be entitled to install a range of Microsoft products on their own computers under the current Microsoft Campus Agreement. Full details on eligibility, installation and registration are available from the website.

Student software

Go to www.imperial.ac.uk/ICT/Services/Software/StudentSoftwareParchances for software at affordable student prices.

See www.imperial.ac.uk/ICT/Services/Software/SoftwareShop for full details of products available, shop location and opening times.

Fine Art Competition

Amanda Cerny, Communications

The Blyth Gallery is holding a Fine Art Competition to discover the creative talent of staff and students at Imperial. Around 20 of the best entries will be exhibited by the gallery between 7–23 June. Organiser Mindy Lox, Artist-in-Residence, hopes the show will bring together many artists from across the College, displaying varied works encompassing collage, drawing, painting, photography, sculpture and installation.

Each person may submit one piece of work. The entry should be sent as a jpeg to blyth.june@imperial.ac.uk. Applications should include your name, job title or student details, title of the artwork, medium, dimensions and date of creation. (Please note that video or slide projections cannot be included.)

The deadline for submissions is Sunday 7 May 2006 and successful entrants will be notified by Friday 26 May. Reporter hopes to feature the winning entries in the summer term.

Working towards good health

Sheila Boyle, Occupational Health

All sorts of concerns can affect your health and well-being. Pressure at work, family rows, a sick relative, bereavement or money worries, for example. If not managed effectively, these can lead to anxiety, depression or difficulty coping. Many of us struggle without realising it or knowing what to do.

Care First is an independent organisation that provides a free 24-hour confidential counselling, help and information service to Imperial and MRC/CSC staff.

Some of the typical issues Care First can help with are difficult situations at work, personal relationship problems, financial worries, housing, and caring for children, teenagers or elderly relatives. Legal matters can also be clarified.

You can discuss your concerns over the telephone, or you can arrange to see someone face-to-face away from your home or work, usually within 48 hours.

Calls are answered by fully qualified counsellors experienced in dealing with workplace and domestic issues. Telephone support is also available to immediate family members.

Care First can also provide information

BA Medi Fellowships

Amanda Cerny, Communications

The British Association for the Advancement of Science is offering Media Fellowships to create a greater awareness and understanding of the workings of the media among practising scientists, clinicians, social scientists and engineers. The Fellowships provide summer placements of three to eight weeks working with a journalist from the national press, TV or internet. Fellows will gain valuable experience of producing accurate, well-informed pieces about developments in science and

will be better equipped to communicate their research and expertise to the public and their colleagues. Ainsley Newson, Postdoctoral Associate, Medical Ethics Unit, was picked as one of ten media fellows last year. The diary of her time spent at The Times is available at www.the-ba.net/the-ba/ScientificSociety/Schemes_and_awards/MediaFellowships/AinsleyNewson_soundsdiary.htm.

Visit www.the-ba.net/mediafellow for further information and an online application.

Alumni Quiz Night

Liz Gregory Office of Alumni and Development

FORMER students of Imperial are invited to take part in a Quiz Night on Wednesday 15 March. If you want to form a team, colleagues and friends are also welcome.

Taking place in the Senior Common Room, Sherfield Building, South Kensington Campus, the quiz starts at 19.00 with tickets costing £7 per person. The ticket price covers entry and a curry supper at the end of the evening. A cash bar will also be available.

Contact Heather Campbell on 020 7594 6138 and at h.campbell@imperial.ac.uk for more information. Visit www.imperial.ac.uk/alumni/events/quiznight to book tickets online.

What’s on...

Wednesday 8 March 17.30

Lecture and discussion on climate change

Dr Tim Flannery will be discussing his latest book The Weather Makers, Professor Ralph Tuomi will give the academic perspective from Imperial College. G16, Sir Alexander Fleming Building, South Kensington Campus Email: c.murtagh@imperial.ac.uk

Thursday 9 March 18.00

The 46th Ernst Chryssogelis Lecture

Professor Andrew Michael, FRS The T-cell virus interface Clore Lecture Theatre, Huxley Building, South Kensington Campus

Email: aelden@imperial.ac.uk

Visit www.imperial.ac.uk/events for a full listing of events at Imperial. Email events@imperial.ac.uk to subscribe to the Events E-Bulletin.

Noticeboard

Good news, bad news and, worst of all, hidden news

How can hidden information be brought to light? The traditional answer is by statistics, but for that you need statisticians. An attractive alternative to statistics is Information Visualisation, which allows your data to be viewed with no knowledge of computing, statistics or mathematics. The technique converts data into pictures making its significance immediately obvious. You could, of course, apply this new-fangled technique, confident that there are no surprises hidden within your data. But are you absolutely sure? Go to www.imperial.ac.uk/comp/infoplot/index.htm for details of the Centre for Professional Development’s one-day course.

Reporter is published every three weeks during term time. The copy deadline for issues ending 26 March is 15 March. Contributions are welcome (no more than 500 words). Please note the editor reserves the right to cut or amend the articles as necessary. Information correct at time of going to press.

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