



The Industrial Diamond

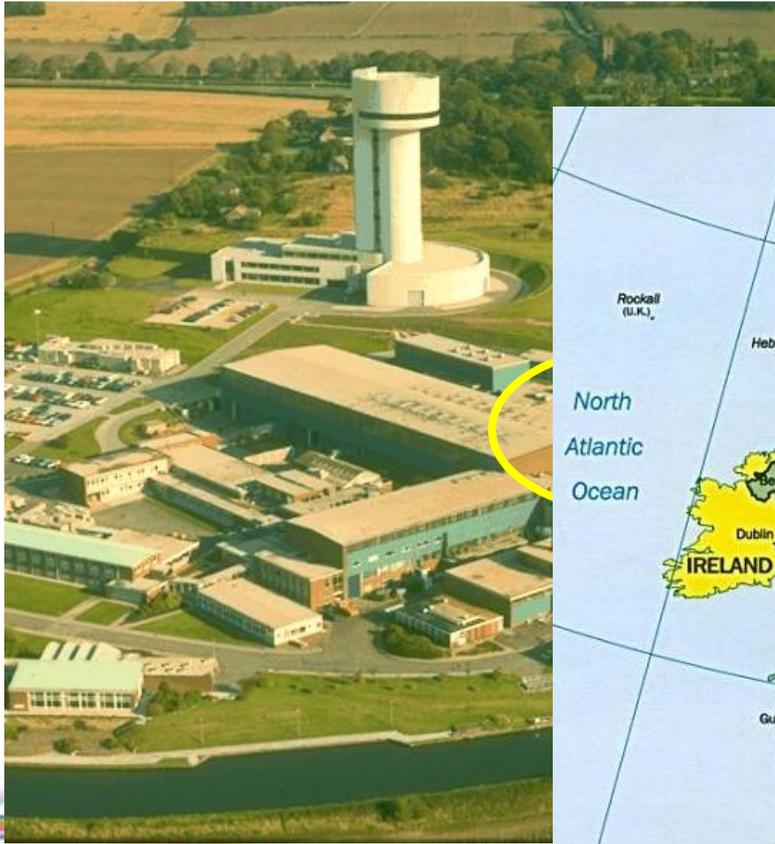
Dr Elizabeth Shotton
Head of Industrial Liaison



From the old to the new



A more convoluted route



Diamond Light Source

Opened for operations in January 2007

Diamond is a private company formed as a joint venture between STFC (86%) and The Wellcome Trust (14%)

**Phase I:
7 beamlines - 2007**

**Phase II:
+ 15 beamlines
completed - 2012**

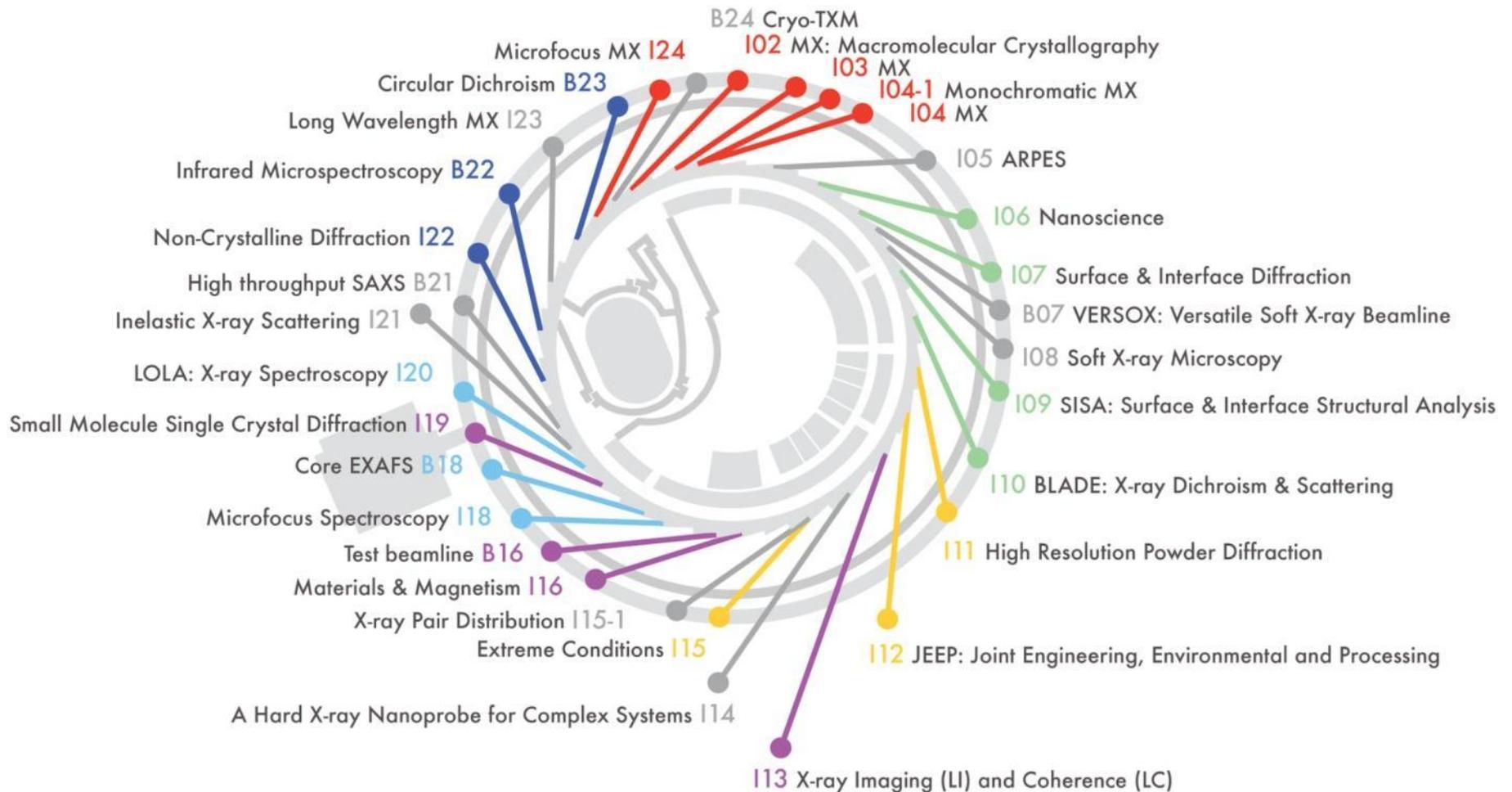
**Phase III:
+ 11 beamlines:
funding approved,
construction started**



All beamlines are owned and operated by Diamond



Beamlines at Diamond



Industrial Access in the UK

DARTS @ Daresbury



Developed industrial usage of synchrotron and introduced the concept of offering a service mode access.

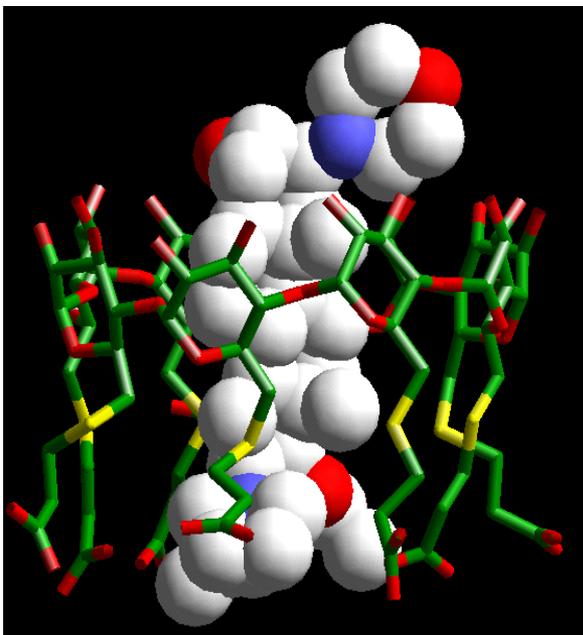


**1985 industrial consortia
access the SRS**

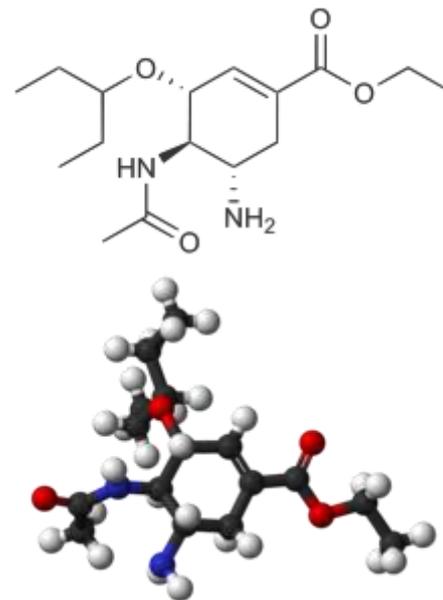
**1988 - Daresbury Research
2000 Services operational**
**wider industrial access -
beamtime only**

1997 - *DARTS* launched
**service mode for XRD, SAXS
and XAS**

**2000 - *DARTS*
expanded to
cover all
industrial use
of the SRS**



Angew. Chemie, **41**, 265, (2002)
Org. Biomol. Chem., **3**, 1863-1871, (2005)



Oseltamivir - Tamiflu



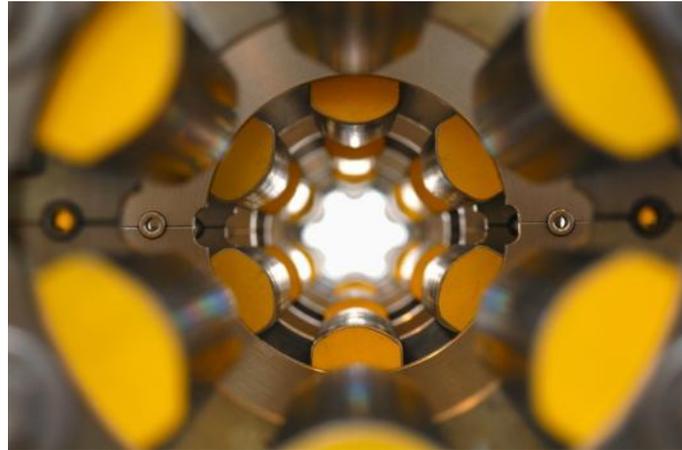
\$69 million
 sales in Q2
 2013



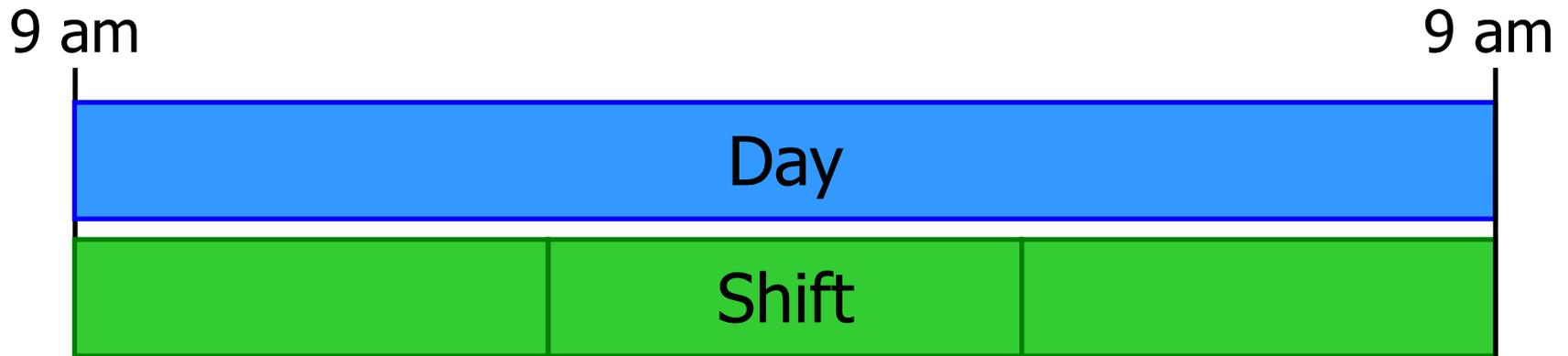
Proprietary access – beamtime only

Beamtime only

- Priority access
- Pay for what you need
- Ideal for experts



Historical access options



or build your own beamline!



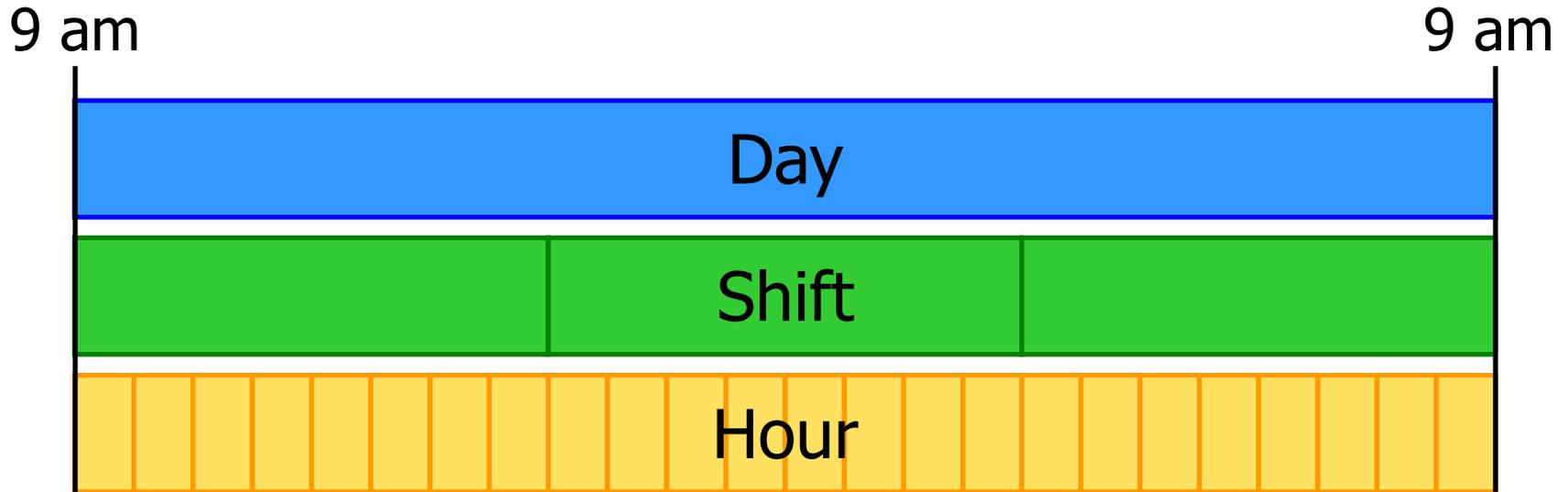
TOYOTA beamline at SPring-8, Japan



Abbott, Bristol Myers-Squibb, Merck, Novartis and Pfizer
beamline at APS, Chicago, US



Access options at Diamond



Per sample



?

Mail in service established

Beamtime only

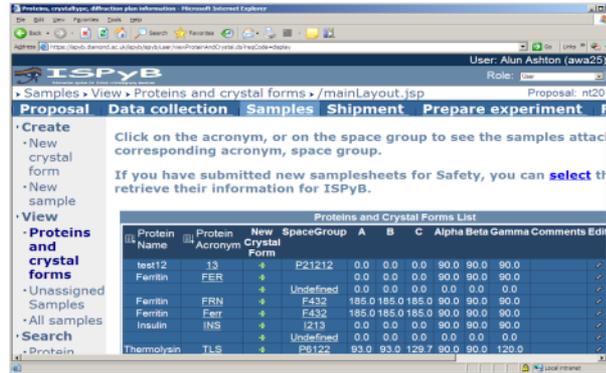
- Priority access
- Pay for what you need
- Ideal for experts



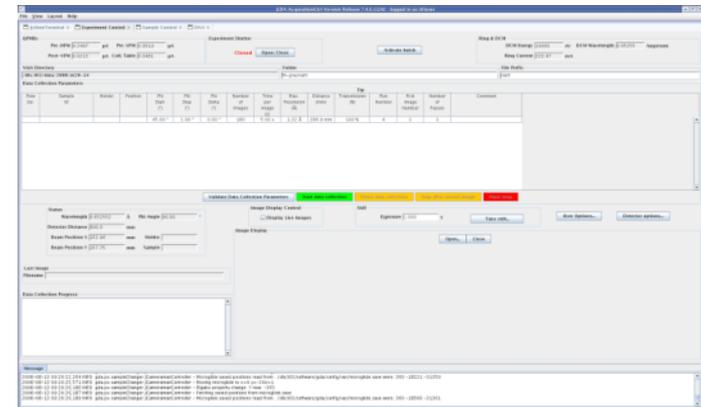
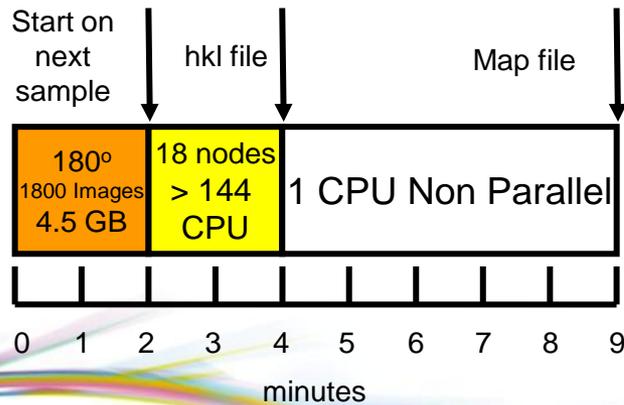
Mail-in data collection service

- Submit 1 to 100s of samples
- Rapid turnaround
- Multiple techniques

Automation, automation, automation



ISPyB



Data acquisition

data processing pipeline

robotics



Remote access for macromolecular crystallography

Beamtime only

- Priority access
- Pay for what you need
- Ideal for experts

Mail-in data collection service

- Submit 1 to 100s of samples
- Rapid turnaround
- Multiple techniques



Remote access

- Collect data from your home lab
- Minimise travel
- All team can participate

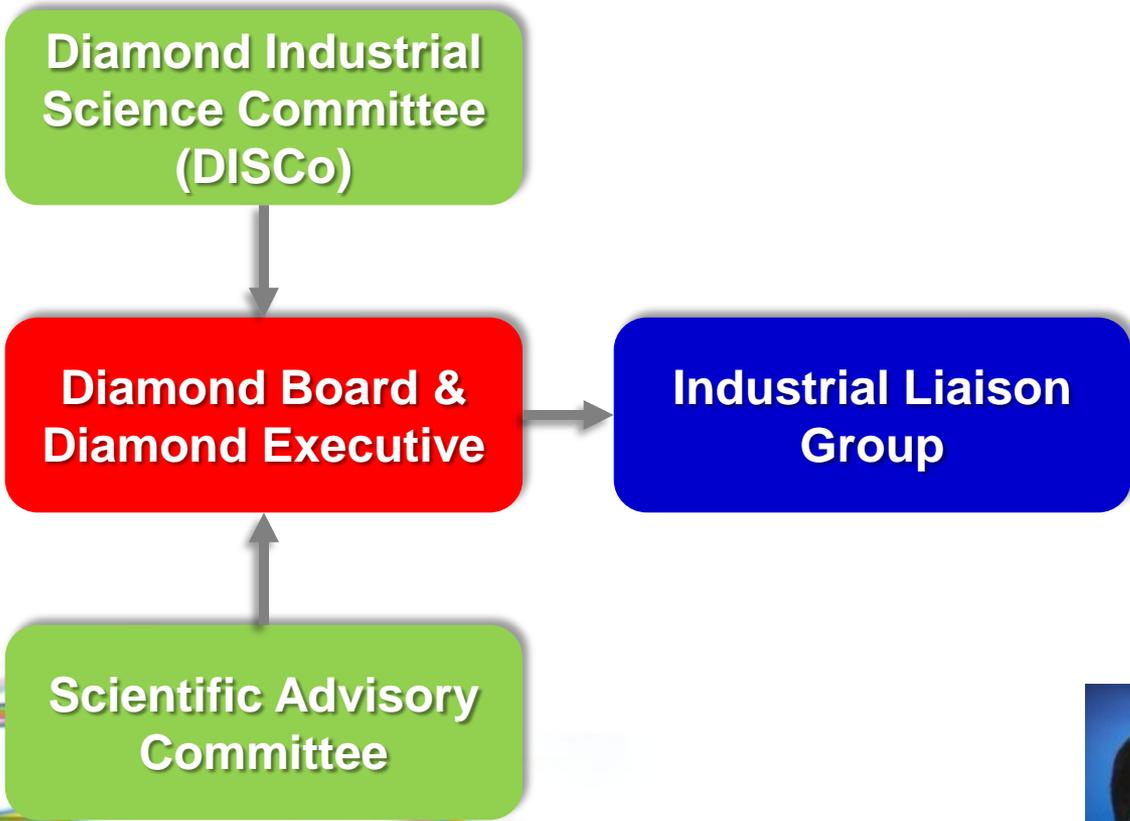
Remote access

Diamond is operational 24 hours a day, 6 days a week.



- Minimises user travel
- Allows customer to monitor service work and feed in comments
- No limit on number of experiment team members

The Industrial Liaison Group





Elizabeth Shotton

Head of Industrial Liaison

XRPD, SXTAL



Anna Kroner

Industrial Liaison Scientist

XAS



Leigh Connor

Industrial Liaison Scientist

XRPD,
Engineering



Claire Pizzey

Industrial Liaison Scientist

SAXS



Alex Dias

Industrial Liaison Scientist

MX



Jitka Waterman

Industrial Liaison Scientist

MX



Tobias Richter

Senior Software Scientist



Leading the way for industrial research

Consultancy

- Dedicated scientific team
- From experiment design to reporting
- No prior knowledge required

Beamtime only

- Priority access
- Pay for what you need
- Ideal for experts

Mail-in data collection service

- Submit 1 to 100s of samples
- Rapid turnaround
- Multiple techniques

Remote access

- Collect data from your home lab
- Minimise travel
- All team can participate



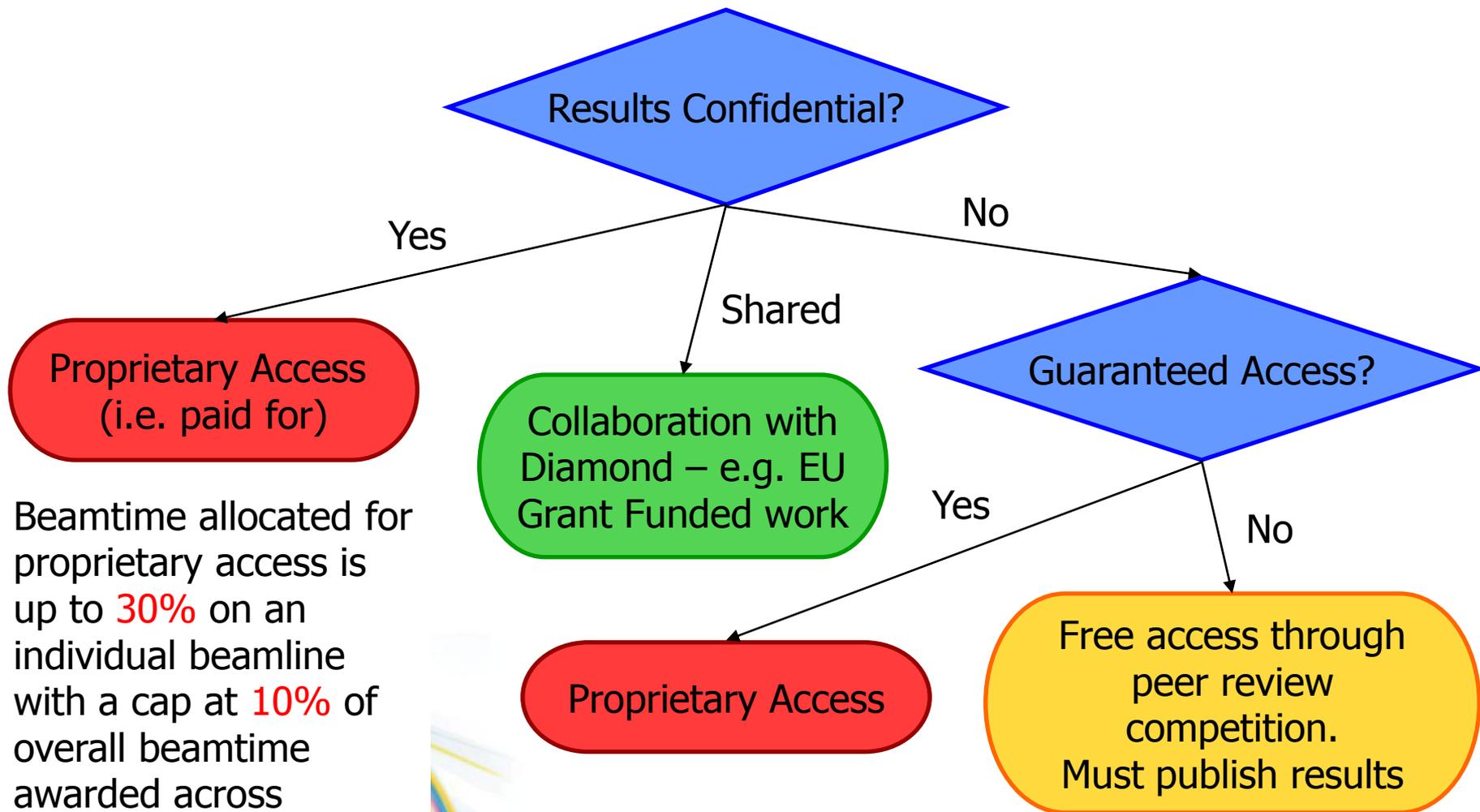
Peer review

- With Diamond
- With university
- Apply directly
- Free if awarded time

Collaboration

- Studentships
- Post-docs
- Grants – RCs, EU etc

Access modes for industrial users



Beamtime allocated for proprietary access is up to **30%** on an individual beamline with a cap at **10%** of overall beamtime awarded across Diamond

DISCo



Technology Strategy Board
Driving Innovation



Malcolm Skingle (chair)

Dave Brown

Anne Kavanagh

John Barker

Rob Cooke

Ken Lewtas

Peter Ash

Jonathan Hyde

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Welcome to the Industrial Liaison Office. We are here to help you with all aspects of your work with Diamond.

To find out more about how we can help with your project, please select from the following options:

- [What is Diamond and how can it help me?](#)
- [Why use Diamond?](#)
- [How can I use Diamond?](#)
- [What techniques are available?](#)
- [Latest case studies](#)
- [Information by research area](#)



Industry Day 2012 speakers

Featured Case Studies

Non-destructive strain measurement of a Trent 1000 fan blade

The Problem

Rolls-Royce apply a surface treatment to the base of the fan blades on some of their Trent engines to provide additional integrity margins by reducing the potential for initiation and propagation of cracks. During development of one of their latest turbofan engines, the Trent 1000, researchers from Rolls-Royce needed a material characterisation method so that they could assess the effectiveness of the local surface treatments.



[Read more...](#)

Looking at Platinum Speciation in Three Way Catalysts

The Problem

Platinum group metals play a crucial role in a variety of applications and in particular for a host of catalytic applications. The largest application is currently in vehicle emission control (VEC) catalysts to efficiently reduce particulate matter, CO, NOx and hydrocarbons. This type of catalytic system is diverse and complex and generally contains 0.1-1 wt% active metal deposited on a thermally stable structural support. Therefore, applying a wide range of techniques is essential to fully understand these complex catalytic materials.



[Read more...](#)

Contact Information

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[@CanLightSource](#)

Now we know how super-volcanoes blow: findings from the European Synchrotron Radiation Facility in Grenoble, France.
latimes.com/science/scienc...

↻ Retweeted by Diamond Light Source

[Show Summary](#)



Industry case studies

- 30 completed and published case studies including

- Unilever
- Infineum
- Luxfer Gas Cylinders
- Johnson Matthey
- 2 x Heptares
- Confocal Science
- BioFocus
- GSK
- SAFC Pharmorphix
- Rolls-Royce
- Vernalis
- HP Labs
- General Motors (with Nottingham)
- BP (with Cambridge)
- NHS




Case Study

Measuring stress in breathing apparatus cylinders

The Problem
Luxfer Gas Cylinders have been manufacturing high-pressure, self-contained breathing apparatus (SCBA) and life-support cylinders for fire-fighters and first responders since the early 1970s. Cylinders are required to be increasingly lightweight, efficient and safe storage solutions. Advanced carbon fibre-wrapped aluminium construction methods and a fabrication process called autofragging aim to reduce weight and increase maximum working pressure of cylinders. However, since cylinders can be exposed to demanding conditions, it's critical that their structural integrity is maintained.

The Challenge
Luxfer wanted to characterise stress states inside cylinders both as-manufactured and after being subjected to a standard drop test, the most common damage mechanism. This required cylinders to be measured in a non-destructive manner so that the same samples could be used for both tests, thus allowing Luxfer to understand the effect of autofragging pressure more accurately.

The Solution
A team of industrial engineers from Luxfer, University of Southampton and Diamond used energy dispersive diffraction (EDD) performed on beamline I120 to characterise the autofragging process and evaluate the effect of impact damage on gas cylinders. The high energy polychromatic X-rays available on I120 can penetrate through significant thicknesses of samples, allowing measurements that would not be possible using lab-based diffraction equipment.

The Benefits
Pioneering diffraction measurements carried out at Diamond allowed direct measurement of stress states inside as-manufactured Luxfer SCBA cylinders. Results were compared with lab-based micro-computed tomography and current finite element models, providing base information to improve current models. The combination of imaging and diffraction provides a powerful set of tools to evaluate damage-caused impact.

Luxfer Gas Cylinders
"Luxfer gas cylinders are designed with the excellent information obtained as a result of our collaboration with Diamond Light Source and the University of Southampton. The results achieved in our samples in the core represent our highest quality composite cylinders."
Dr Warren Hepburn, Luxfer Gas Cylinders Europe

Johnson Matthey
"We didn't even know about the beamline I120 at Diamond Light Source and were able to conduct tests on our samples. Working with Diamond gave us some great insights into our samples and their behaviour."
Dr Peter Ash, Johnson Matthey Technology Centre

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Case Study

Looking at Platinum Speciation in Three Way Catalysts

The Problem
Platinum group metals play a crucial role in a variety of applications and in particular for a host of catalytic applications. The largest application is currently in vehicle emission control (VEC) catalysts to efficiently reduce particulate matter, CO, NOx and hydrocarbons. This type of catalytic system is diverse and complex and generally contains 0.1-1wt% active metal deposited on a thermally stable structural support. Therefore, applying a wide range of techniques is essential to fully understand these complex catalytic materials.

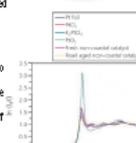
The Challenge
Characterisation of automotive exhaust catalysts has been carried out using a variety of analytical techniques before, during and after use. Most of these techniques need to be carried out under low, high vacuum conditions. This raises the possibility of performing XAS studies on catalytic materials to mimic real industrial conditions. Therefore, the nature of the species present in the system under operating conditions are still not completely understood. More recently there have also been concerns related to the potential possibility that toxic platinum species might exist in used catalysts under specific conditions.

The Solution
Scientists from Johnson Matthey have used beamline B10 at Diamond Light Source to carry out Pt L-edge X-ray Absorption Spectroscopy (XAS) measurements. The main goal of this experiment was to determine the types of species present in representative current technology of fresh and road aged diesel VEC catalysts, obtained from registered UK car dealers in both non-coastal and coastal regions. Detailed analysis of the XAS data revealed the presence of a mixture of oxidic and metallic species in the fresh catalysts. In the road aged catalyst the Platinum was metallic in nature.

The Benefits
X-ray Absorption Spectroscopy has provided very useful information about the oxidation state and the local structure of the studied elements in the materials. However, XAS studies can be employed in an in-situ manner, this gives great potential for understanding the mechanism and behaviour of catalytic materials during activation and while catalytic reactions take place.

Johnson Matthey
"We didn't even know about the beamline B10 at Diamond Light Source and were able to conduct tests on our samples. Working with Diamond gave us some great insights into our samples and their behaviour."
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Sector flyers

Diamond Light Source



We remain reliant on fossil fuels for our current and future energy supply and one of the greatest challenges facing scientists today is to make the most efficient use of our resources. This drive for increased efficiency affects all aspects of the oil industry from upstream enhanced oil recovery technologies to downstream refining processes through to lubricants, additives and coatings.

Located in South Oxfordshire, a region widely recognised for a strong technology business focus, the Diamond Light Source is a sophisticated synchrotron light facility which can generate highly intense beams of light ranging from IR and UV to X-rays, all of which are making research at the cutting edge of modern science possible. Diamond provides specialist analytical techniques for the atomic to microscale characterisation of materials ranging from crude oil, petroleum additives, lubricants and anti-corrosion coatings through to the next generation of catalysts for refining.

In order to facilitate the use of Diamond by researchers working in industry, an Industrial Liaison team has been established, comprising highly qualified scientists experienced in a range of technique areas. This team can help to translate your research problem into an analytical solution by making use of its diverse expertise in synchrotron methods.

Depending on your specific requirements, we offer a range of service levels:

- Beamtime only – you come to Diamond and collect your own data
- Data collection service – we collect your data and send it to you for analysis
- Full analysis service – we collect and analyse your data and present you with a detailed report.

Some examples of ways in which Diamond can provide research and development solutions for the oil industry are outlined overleaf.

For further information please contact the Diamond Industrial Liaison Office on
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Oil Research Using Diamond



Upstream Exploration and Production

- Structural investigations of complex functional materials, e.g. oilfield fluids;
- Study solid-solid and solid-liquid interfaces including clay and mineral systems;
- Analyse particle shape, particle growth and size distribution in colloidal suspensions including asphaltenes.



Downstream Processing

- Investigation of catalyst behaviour under *in situ* conditions;
- Follow corrosion processes under realistic conditions;
- Structural and chemical information to aid the development of high performance materials and coatings;
- Element specific detection of contaminants even at very low concentration.



Fuels, Chemicals and Additives

- Structural identification and characterisation of crystalline solids and waxes;
- Understand interfacial phenomena relating to friction, lubrication and wear;
- Examine surface structure and ordering in thin films and coatings;
- Explore phase behaviour in oil additives, detergents and lubricants.



Pipeline and Processing

- Follow chemical composition changes during corrosion;
- Detect the presence of specific element contaminants;
- Uncover the chemical composition of worn films;
- Non destructive testing of failure and fatigue in pipes and welds;
- Image microscale cracks and pores in pipes and welds.



Oil Research

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Beamline flyers

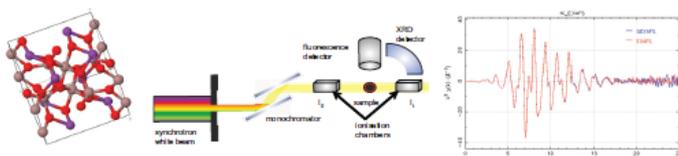
Technique Information



B18 – X-ray Absorption Spectroscopy

B18 is a general purpose XAS beamline at Diamond. This beamline is part of an integrated project devoted to XAS, which includes a microfocus XAS beamline (I18) and a high flux versatile scanning and dispersive XAS (I20). Therefore, B18 is dedicated for more general and less demanding specifications or preliminary studies, and it opens access to one-time and new users.

Moreover, the beamline has developed the Quick EXAFS technique, where a single XAS spectrum can be collected in a few seconds. This beamline also provides the option of a combined set up of XAS/XRD; we are working towards implementation of other complementary techniques within this set up to allow complex studies of various materials under time-resolved, *in situ* conditions. The experimental area has sufficient space and flexibility to allow the use of sample environments such as high throughput chambers and other spectroscopic probes e.g. IR, Raman.



Atomic-scale : Experimental set up: XAS

Beamline Specification

Energy range [keV]	2 – 35
Investigated elements	P – I (K edge) Y – U (L edges), Pt – onwards (M edges)
Beam Size (μm) at sample	200 x 250 (H x V)
Temperature range	77 – 1073 K
Techniques available	Step scan XAS, QEXAFS, Combined XAS/XRD, Space for other complementary techniques
Detector & Analyser	Electron yield GMSD gas microstrip detector 4 element Si DRIFT detector for the range 2-15 keV 9 element Ge monolithic detector above 15 keV

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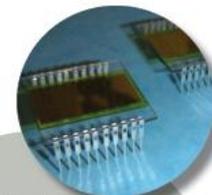
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Applications



Catalysts

- Direct studies of the structure and interaction of catalysts with chemical reagents under rapidly changing environmental conditions – three-way catalysts, fuel cells;
- Characterisation of redox-active nanocrystalline oxides, microporous materials;
- Study solution chemistry;
- Investigations of materials during hydrothermal reactions.



Material Science

- Study materials e.g. semiconductors under realistic conditions of high pressures and temperatures;
- Studies complex materials and catalysts by combined XAS/XRD to correlate changes in the short and long-range structures;
- Study kinetic processes in operating electrochemical cells;
- Design and characterisation of novel, advanced materials.



Environmental

- Study metal speciation of toxic materials to handle the remediation of environmental contamination;
- Study processes used for the disposal of toxic materials;
- Studies rocks, soils, sediments, plant materials, pollutants and radioactive waste issues on climate change.

Industrial research at Diamond

Biology

- Determination of the structure of metalloproteins;
- Study biochemical processes – the life mechanisms of photosynthesis or respiration.



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Industrially-focused Conferences



Illuminating Challenges
in Automotive Research



~100 delegates @ 2 day event

Speakers from industry,
academia and national labs
including:

- CONCAWE
- Jaguar LandRover
- Ricardo
- Shell
- OC Oerlikon Balzers AG
- MAHLE
- Infineum
- Sandia National Lab
- Argonne National Lab
- Diamond

Coverage in local and trade
press





Performance you can rely on.

Home - Information Centre - Press Room - Infineum and Diamond Light Source announce joint event – Illuminating Challenges in Automotive Research

Infineum Trends

ACEA and API Categories

Infineum Insight

Industry Acronyms

Press Room

Press Enquiries

Infineum and Diamond Light Source announce joint event – Illuminating Challenges in Automotive Research 6/7/2013 -

The Internal Combustion Engine is expected to remain the vehicle power train of choice for the foreseeable future. As a result of ever-tightening emissions legislation, a drive for greater fuel economy and increased demands from end users, we are entering a period of transition with rapid changes in vehicle fuels, engine lubrication and the hardware required. Vehicle and equipment manufacturers, oil companies and the additives industry are investing heavily to bring together leading research techniques, world-class science institutions and academics to meet these challenges.

Some of these challenges are so large and broad ranging that it is likely they will need to be addressed through collaboration. We recognise the vital need to bring together scientists and engineers from across the automotive industry and from research facilities and academia to address these key challenges with a variety of approaches.

PRESS RELEASES

Pioneering conference shines light on how science and industry can meet tomorrow's automotive challenges

Oxfordshire, UK – 22 November 2013

Professionals from the automotive industry and scientific research community this week came together at the Illuminating Challenges in Automotive Research (iCAR) conference to discuss and share insight into solving the world's major automotive challenges.

The inaugural event was hosted by Diamond, the UK's national synchrotron facility, in partnership with Infineum, a world-class formulator, manufacturer and marketer of petroleum additives, and focused on how science and industry can work together to build cleaner, more efficient vehicles of the future – against a complex backdrop of a growing global vehicle population, stricter emissions and air quality regulations and the desire for greater fuel economy.

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Conference

Illuminating Challenges in Automotive Research (iCAR 2013)

18 - 19 November 2013

A major new science conference, aimed at bringing together scientists and engineers working in the automotive, oil and petrochemical industries with leading science researchers and academics, is being held on the 18th and 19th November 2013 at Diamond Light Source



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22 November 2013

iCAR Conference

Pioneering conference shines light on how science and industry can meet tomorrow's automotive challenges

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Among the keynote speakers were Chris Beedoes of CONCAWE who discussed how the role of refiners can evolve to meet the future needs of



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The future of the motor car

Gill Oliver reports from an Oxfordshire conference focused on innovation in automotive technology

Mark Beadon has encouraged the search of an Oxford this week, but the future of the motor car industry could be in building things more boring.

One of the main themes of the conference of experts in production gathered on the Oxford-based site of the Diamond Light Source, which recently won the title of the 'most exciting' UK site for the Office for Low Carbon Travel.

Using new technology, it makes a lot of sense. It's not just about the car, but also about the way we drive. It's not just about the car, but also about the way we drive. It's not just about the car, but also about the way we drive.



and growth-breaking research into the changes that happen inside our engines when they are running.

But the major goal, it is to be able to power the car, it is to be able to power the car, it is to be able to power the car, it is to be able to power the car.

It is not just about the car, but also about the way we drive. It's not just about the car, but also about the way we drive. It's not just about the car, but also about the way we drive.

Electric cars can take hours to recharge and have a range of just 100 miles, while hydrogen cars use highly pressurised tanks of hydrogen gas that takes a lot of energy to compress and can be hazardous to use.

The professor was one of many experts who met this week to talk about research, innovation and the future of the car.



2013 brought together many of the UK's brightest and best engineers, chemists and physicists.

Tom Lewis, chief scientist at Ford, said: "There is huge potential for us to work together on car and oil."

Prof Beadon has been using Diamond's synchrotron facility to carry

engine lighter fuel we need to make it work. It's not just about the car, but also about the way we drive. It's not just about the car, but also about the way we drive.

"It is what is known as a 'clean' engine system, so that if we change the fuel, then it is not difficult to change over."

The world's most powerful engine lighter fuel we need to make it work. It's not just about the car, but also about the way we drive. It's not just about the car, but also about the way we drive.

"It is what is known as a 'clean' engine system, so that if we change the fuel, then it is not difficult to change over."

The battery needs to be charged, so you need to generate electricity first and if that can come from the sun, then it's really easy to do that.

It's not just about the car, but also about the way we drive. It's not just about the car, but also about the way we drive.



PR



Industry making the news

SUNDAY | 21 JULY 2013 | UK



TOM CLARKE Science Editor

Hi-tech advances against stress and depression - video

Scientists in Oxfordshire identify the structure of a protein deep within the brain which can cause stress and depression, using a light source 10 billion times brighter than the sun.



ARTICLE

doi:10.1038/nature12457

Structure of class B GPCR corticotropin-releasing factor receptor 1

Kaspas Hollenstein¹, James Keam¹, Andrea Bortolato², Robert K. Y. Cheng¹, Andrew S. Durr³, Ali Jazayeri², Robert M. Cooke⁴, Malcolm West¹ & Fiona H. Marshall¹

Structural analysis of class B G-protein-coupled receptors (GPCRs), cell-surface proteins that respond to peptide hormones, has been restricted to the amino-terminal extracellular domain, thus providing little understanding of the membrane-spanning signal transduction domain. The corticotropin-releasing factor receptor type 1 is a class B receptor which mediates the response to stress and has been considered a drug target for depression and anxiety. Here we report the crystal structure of the transmembrane domain of the human corticotropin-releasing factor receptor type 1 in complex with the small-molecule antagonist CP-376395. The structure provides detailed insight into the architecture of class B receptors. Atomic details of the interactions of the receptor with the non-peptide ligand that binds deep within the receptor are described. This structure provides a model for all class B GPCRs and may aid in the design of new small-molecule drugs for diseases of brain and metabolism.

HEPTARES
therapeutics

New hope for depression sufferers



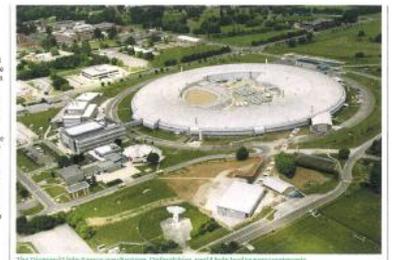
By Clive Cookson

The shape of things to come

Ultra-bright X-ray beams, produced by accelerating electrons to near the speed of light in a huge synchrotron machine, are revealing the structure of important biological molecules. Following a molecular stage enables scientists to design drugs to boost or block an activity. The latest discovery, published this week in Nature, is the structure of CRF1, a "receptor" protein in the brain, which helps to regulate the body's response to stress. It was first identified by scientists from the pharmaceutical company, working at Diamond Light Source, the 4.600m national synchrotron in Oxfordshire. A receptor sits on the cell surface to receive external signals. CRF1 is the docking point for a seven-membered hormone called corticotropin-releasing factor or CRF. Working out the accurate shape of CRF1 is important as a possible route to new treatments for disorders such as depression and anxiety. But it is also less widely recognised because CRF1 is the first member of a family of molecules known as "Class B G-protein-coupled receptors", many about the cellular connectivity — or "wiring" — of the brain.

CRF1 will provide a template to aid in finding the structure of other Class B receptors, which could help us to design drugs for diabetes, osteoporosis and migraine, says Fiona Marshall, Heptares' chief scientist. The company is particularly interested in the potential for CRF1 as a drug target in the treatment of depression. The structure of CRF1, another receptor for the stress hormone CRF, is particularly important in the treatment of depression as a drug target. The structure of CRF1 is particularly important in the treatment of depression as a drug target.

CRF1 is particularly important in the treatment of depression as a drug target. The structure of CRF1 is particularly important in the treatment of depression as a drug target. The structure of CRF1 is particularly important in the treatment of depression as a drug target.



The Diamond Light Source synchrotron, Oxfordshire, could help to design new treatments

receptor drugs fit in this pocket and there form the receptor. The shape of CRF1 is particularly important in the treatment of depression as a drug target. The structure of CRF1 is particularly important in the treatment of depression as a drug target.

When snails go hitchhiking

the shell spent on trying to outpace a bacterium. The study found that the snail's shell is made of a protein called chitin, which is also found in the shells of other mollusks. The study found that the snail's shell is made of a protein called chitin, which is also found in the shells of other mollusks.



Oh joy, misery molecule found

Jonathan Leake, Science Editor

SCIENTISTS have found the brain's most miserable molecule — the protein involved in all our feelings of stress, anxiety and even depression. They used one of the world's most powerful x-ray machines to study molecules that jut from the outer surfaces of cells in the brain's pituitary gland.

Scientists already knew that the pituitary plays a crucial role in anxiety and depression by releasing stress chemicals into the blood. What they did not know was how the response was triggered, although a protein named CRF was a suspect. "It activates its parent cell to release hormones that, over long periods, cause anxiety and depression."

Epstein, a spin-off from the Medical Research Council, used the Diamond Light Source, a particle accelerator at Harwell in Oxfordshire, which generates some of the world's most powerful x-ray beams, to work out the structure of CRF1. The results were published by Nature last week.

Marshall said the machine had illuminated the molecule's entire atomic structure — including a crevice within it that could prove an ideal target for new drugs.

"Now we know its shape, we can design a molecule that will lock into this crevice and block it so that CRF1 becomes inactive — ending the biochemical cascade that leads to misery," said researchers here. "Such receptors have far wider potential because they occur in many other parts of the body, where they are involved in mediating diseases such as diabetes, osteoporosis and anxiety more."

Heptares now plans to use the same technique to analyse the molecules involved in types 2 diabetes — hoping it might lead to a drug that aims only at the diabetes itself rather than the regular increases that diabetics must currently use.

Marshall said: "At the moment we find drugs largely by trial and error. Tools like the Diamond Light source mean we can design them for a precise purpose."

Research



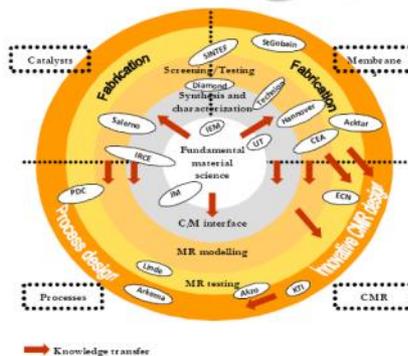
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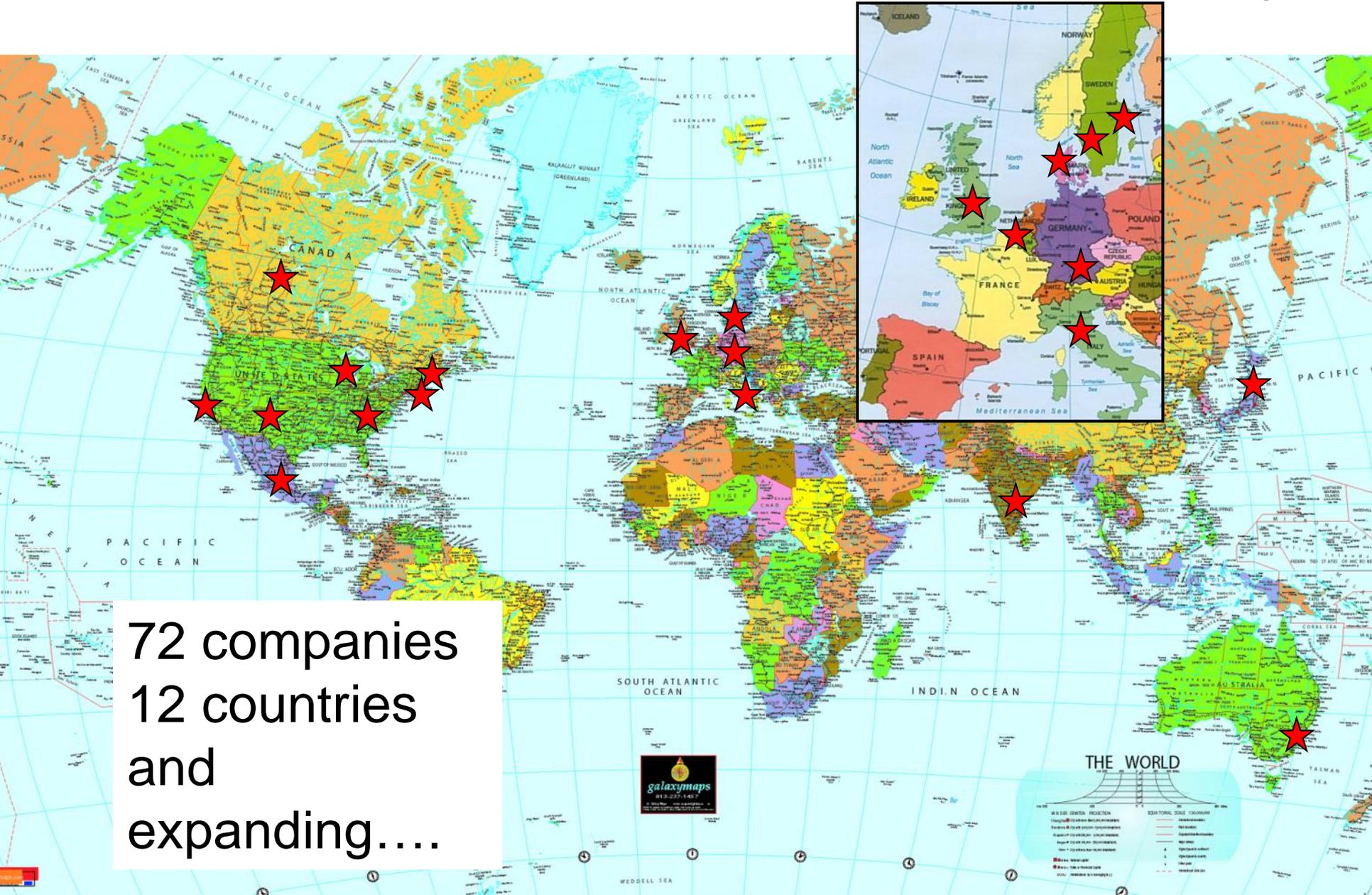
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