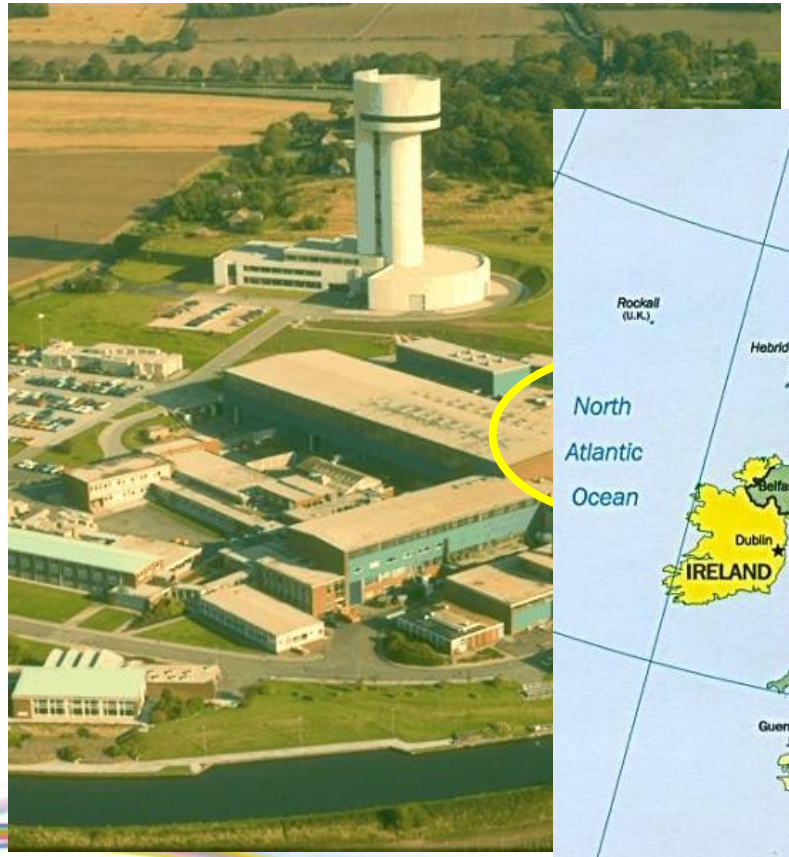
# The Industrial Diamond

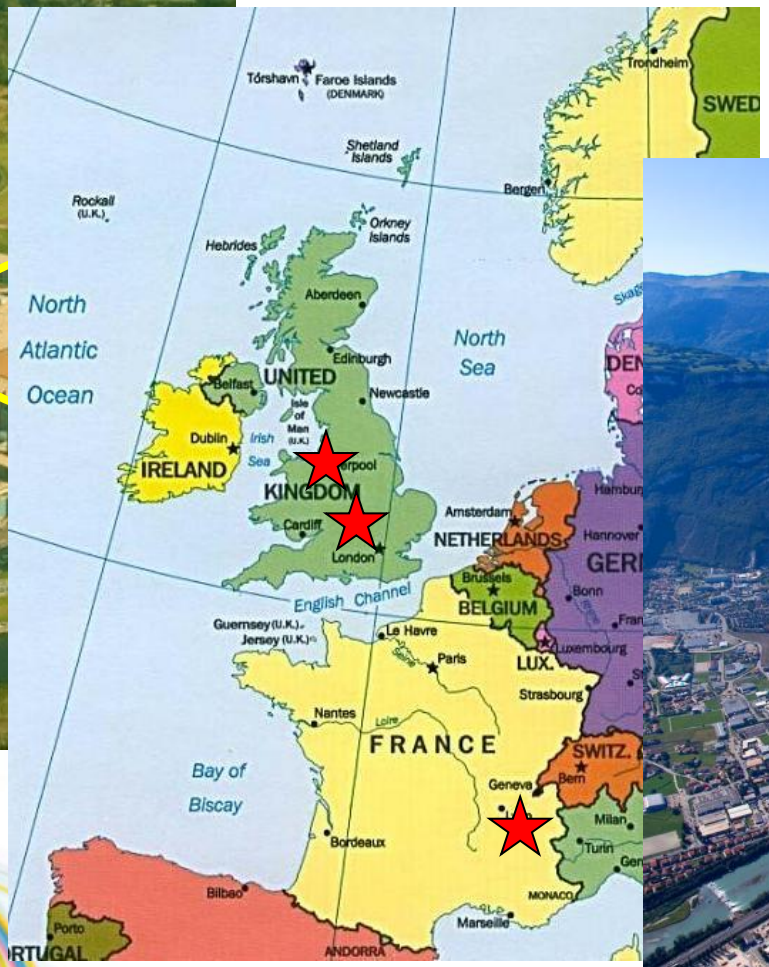
Dr Elizabeth Shotton
Head of Industrial Liaison

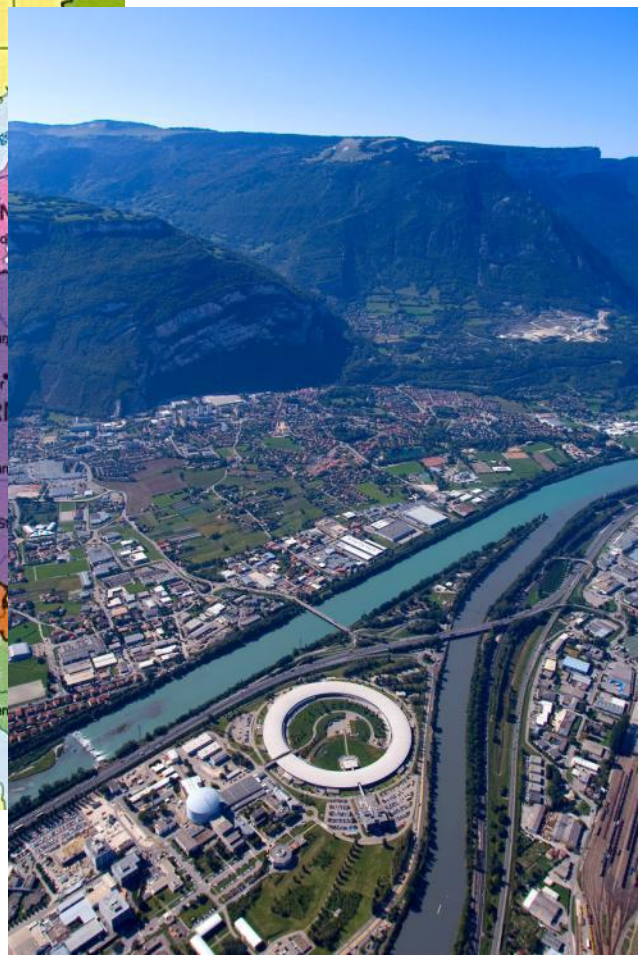
diamond

# 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%)

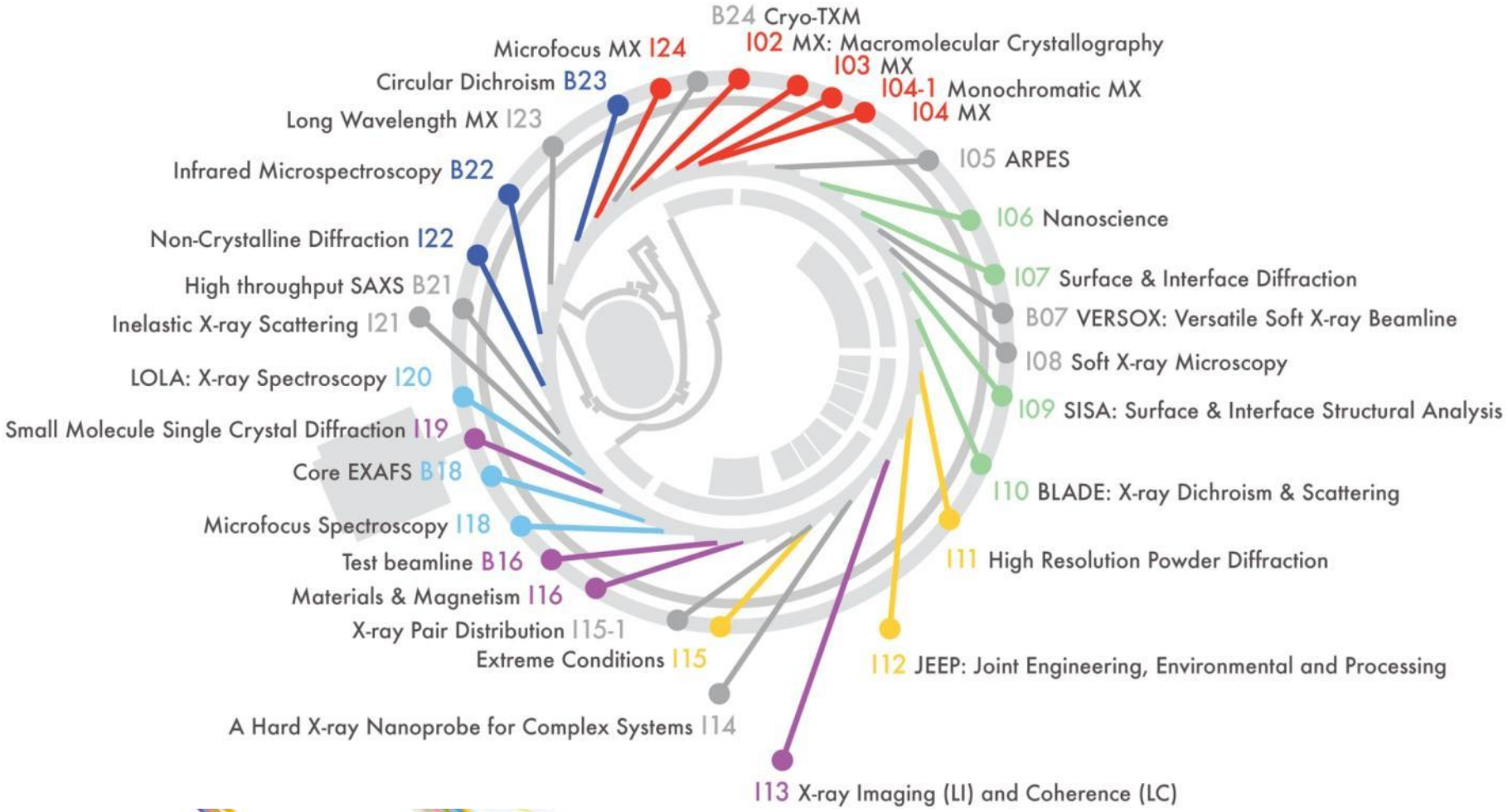
**Phase I:**
**7 beamlines - 2007**

**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

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# Industrial Access in the UK

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# DARTS @ Daresbury

DARTS
Fast Targeted Analytical Solutions

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


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**1985** industrial consortia access the SRS

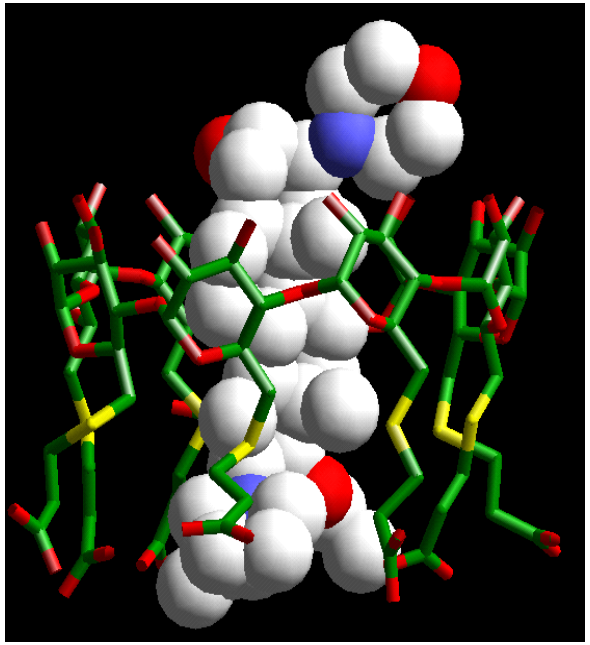
**1988 - 2000** Daresbury Research Services operational

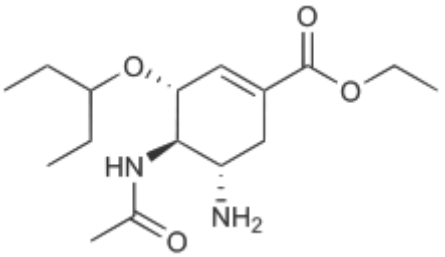
wider industrial access - beamtime only

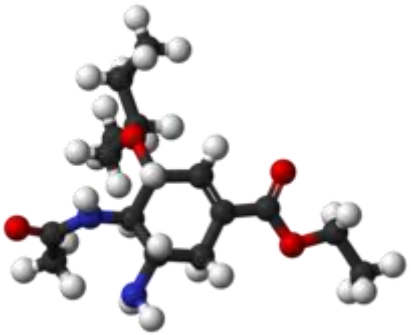
**1997 -** *DARTS* launched

service mode for XRD, SAXS and XAS

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





Oseltamivir - Tamiflu

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

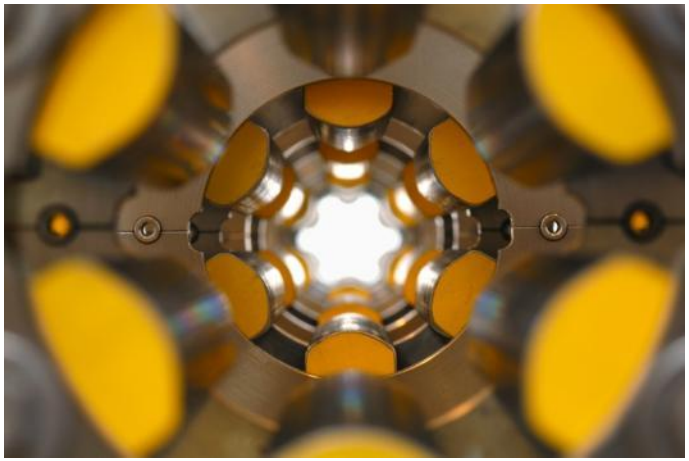

$69 million sales in Q2 2013



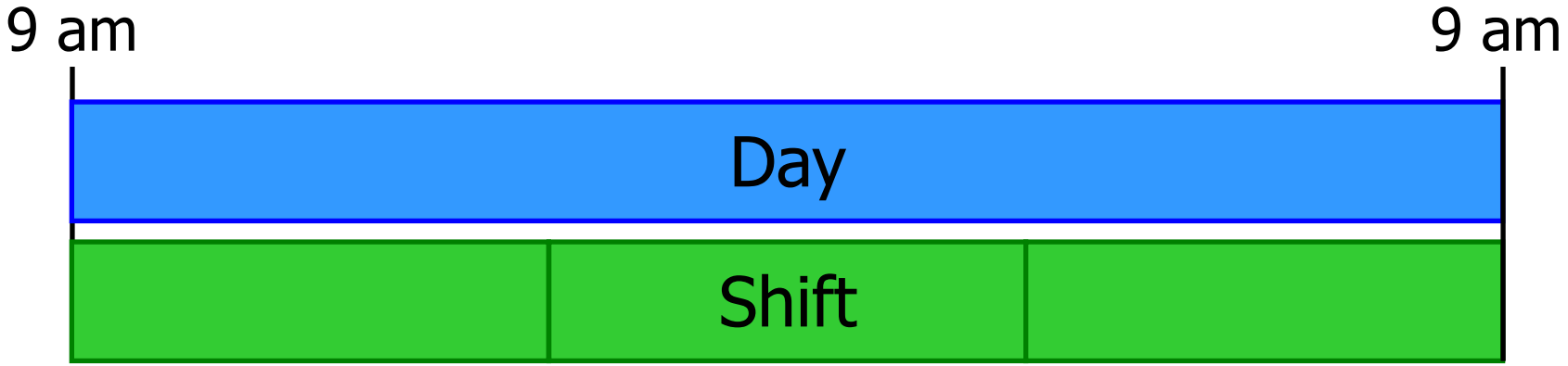
# Proprietary access – beamtime only

## 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

IMCA-CAT Industrial Macromolecular Crystallography Association Collaborative Access Team

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

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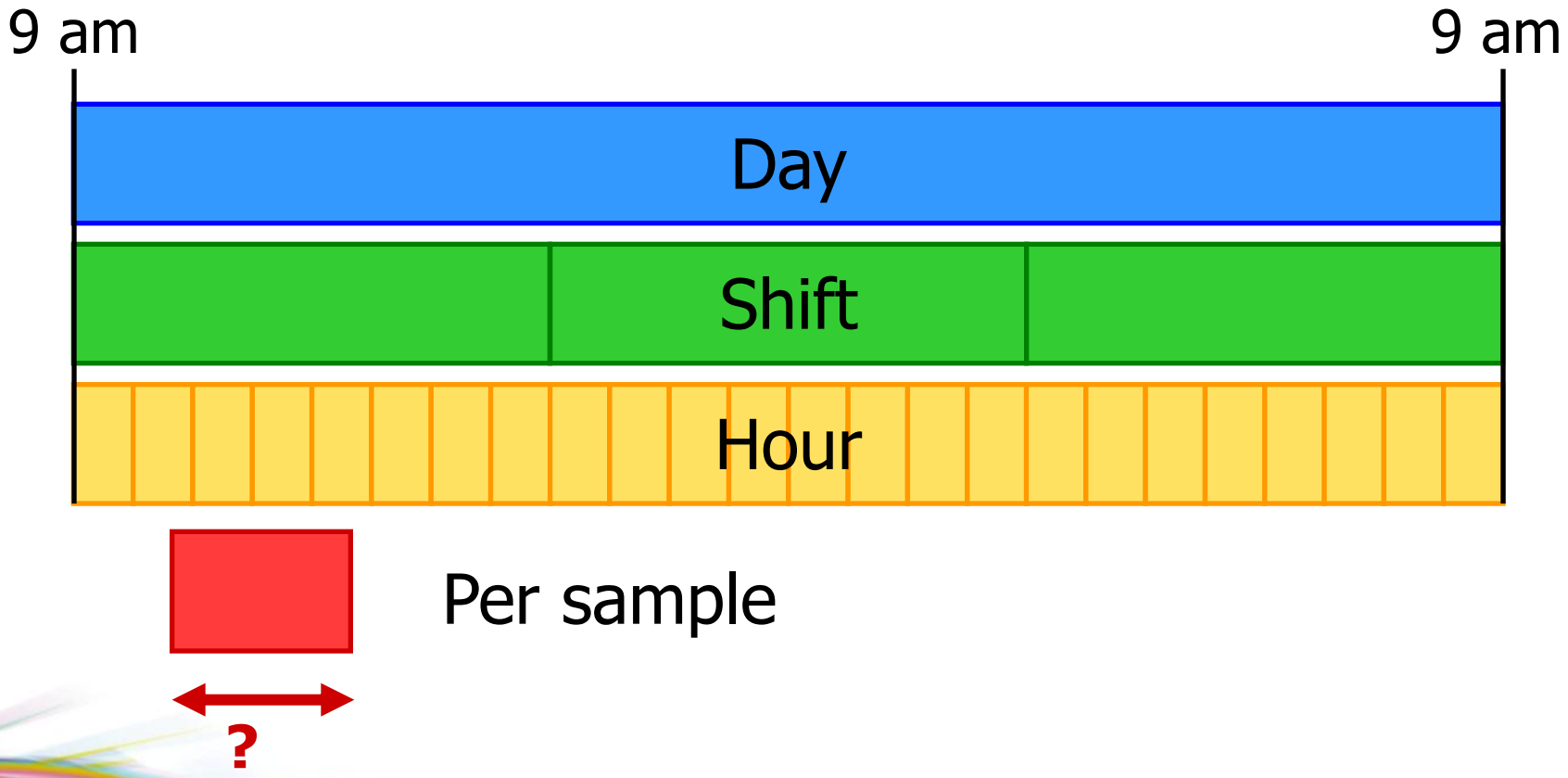
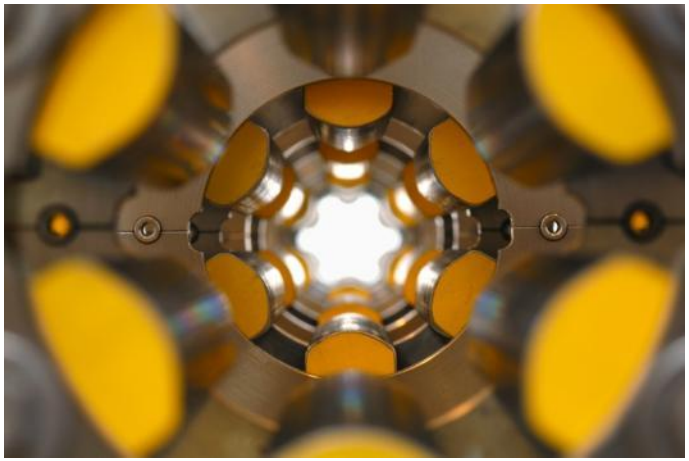
# Access options at Diamond



# Mail in service established

## Beamtime only

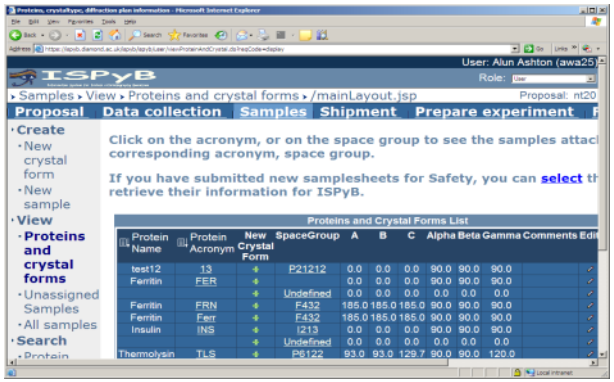
- Priority access
- Pay for what you need
- Ideal for experts



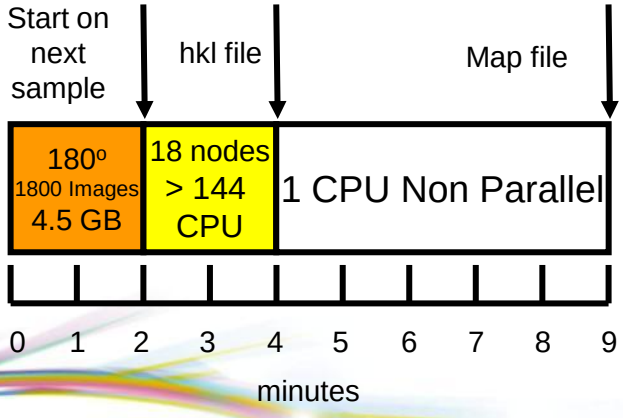
## Mail-in data collection service

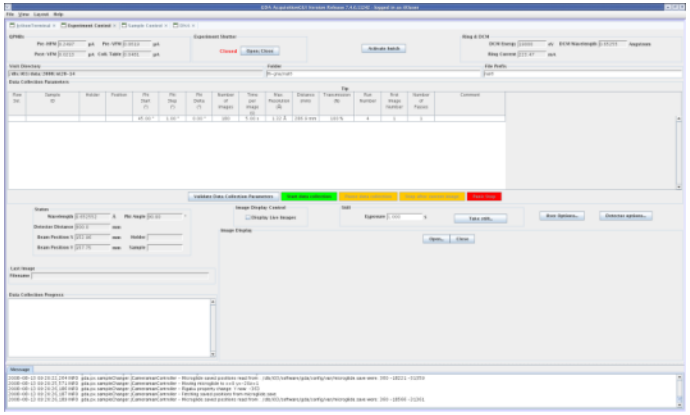
- Submit 1 to 100s of samples
- Rapid turnaround
- Multiple techniques

# Automation, automation, automation




ISPyB



Data acquisition

robotics

data processing pipeline

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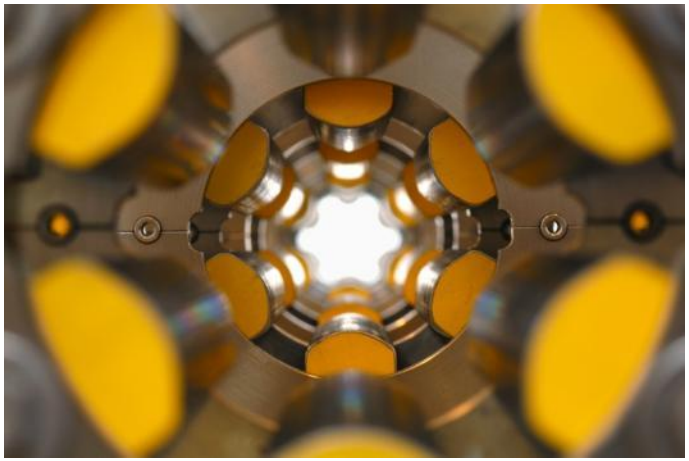
# Remote access for macromolecular crystallography

## 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

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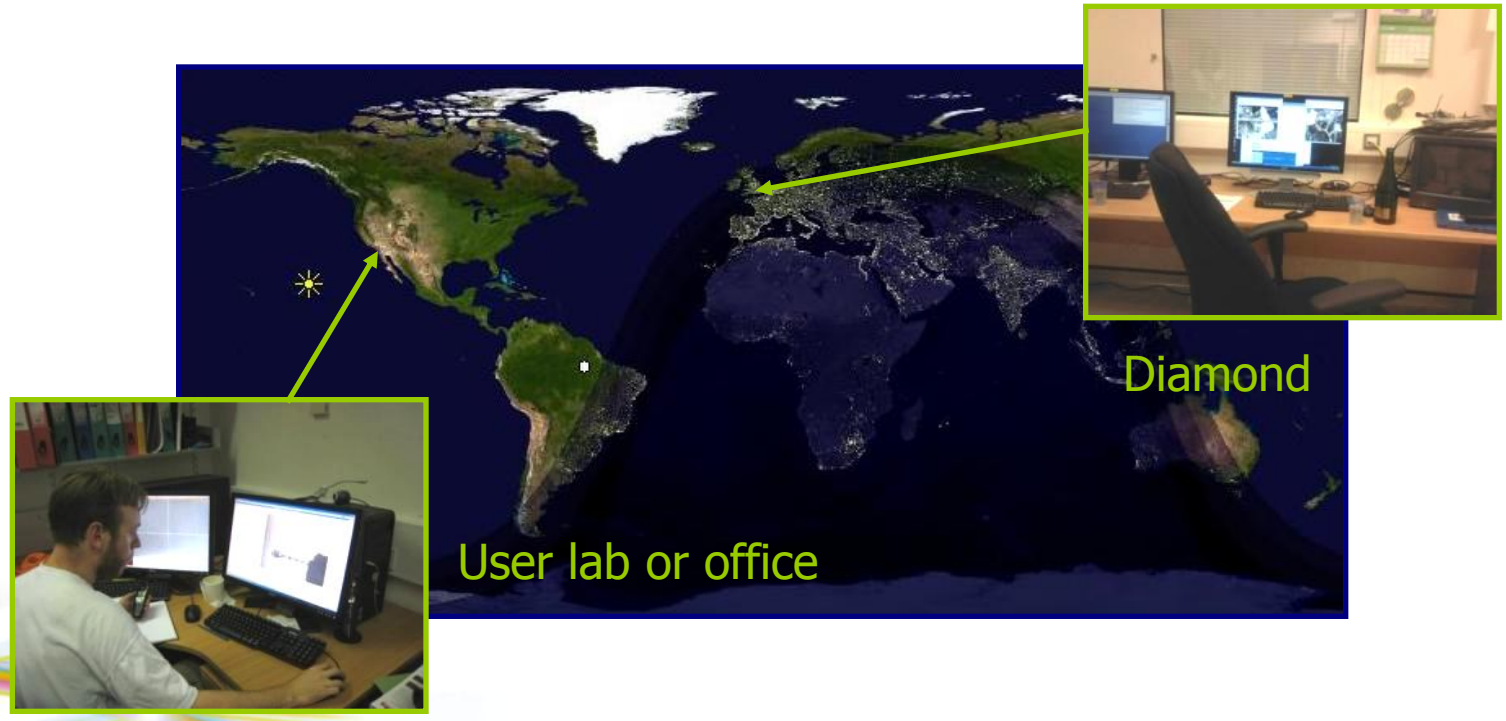
# Remote access

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

Diamond Industrial Science Committee (DISCo)

Diamond Board & Diamond Executive

Industrial Liaison Group

Scientific Advisory Committee

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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

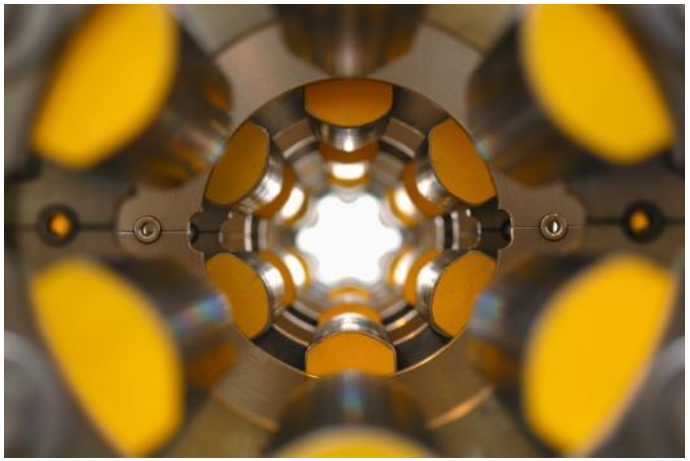
# Leading the way for industrial research

## Beamtime only

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

## Consultancy

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



## 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

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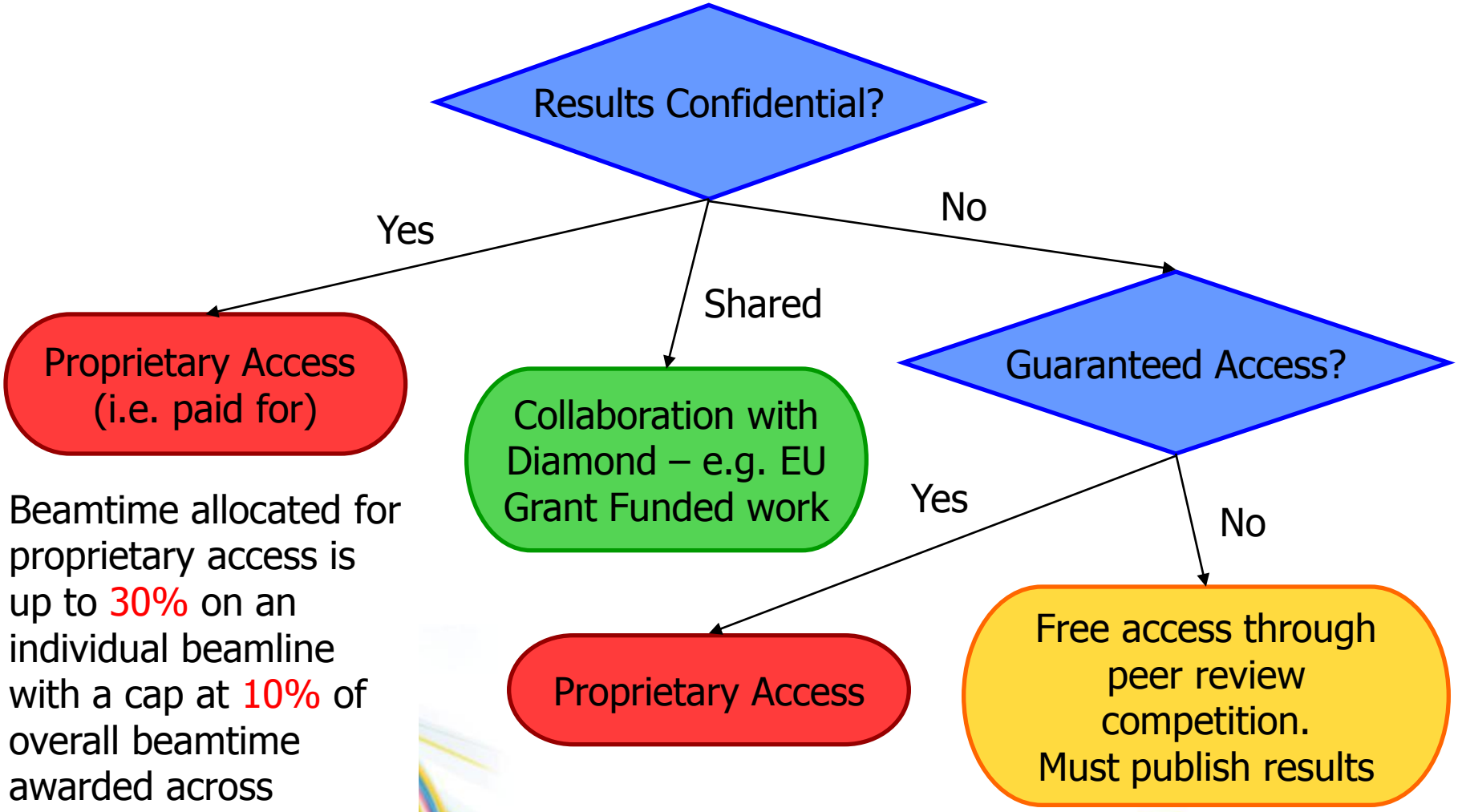
# Access modes for industrial users




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

Malcolm Skingle (chair)

Dave Brown

Anne Kavanagh

John Barker

Rob Cooke

Ken Lewtas

Peter Ash

Jonathan Hyde

Cheryl Doherty

David Rugg

Emily Nott

Ian Tucker

# Business Development

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# Bespoke Marketing Material

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# Website

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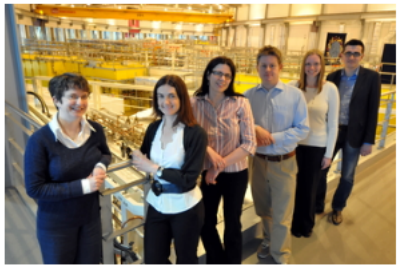
## Industrial Liaison Office

Industry | Experiments | Research Areas | Case Studies | News | Meet the Team | FAQ



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

**Industrial Liaison Office**
Tel: +44 (0) 1235 778797
E-mail: industry@diamond.ac.uk

Meet the team...

### Tweets

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**CanadianLightSource** 7 Jan
@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

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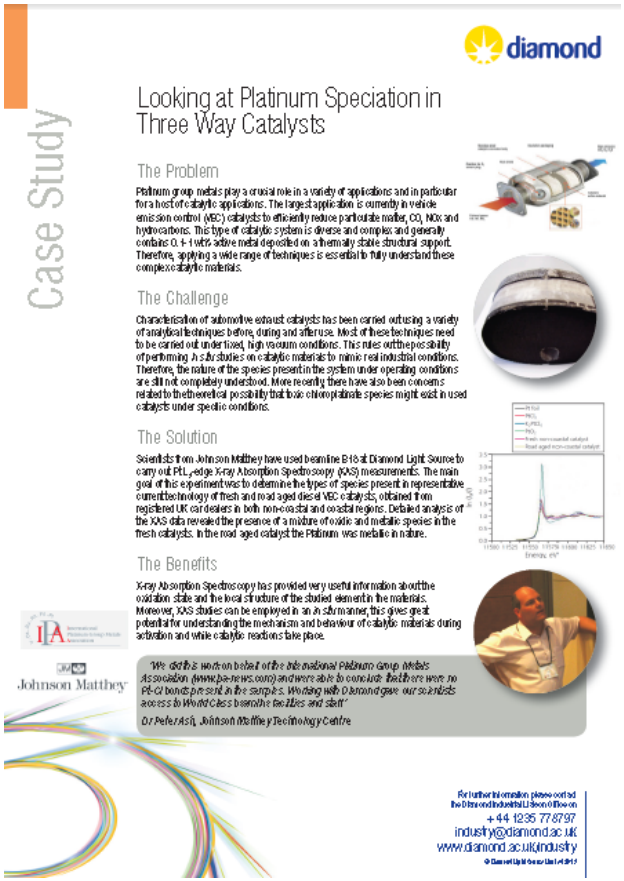
# Industry case studies

- 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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# Sector flyers

Diamond Light Source

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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.

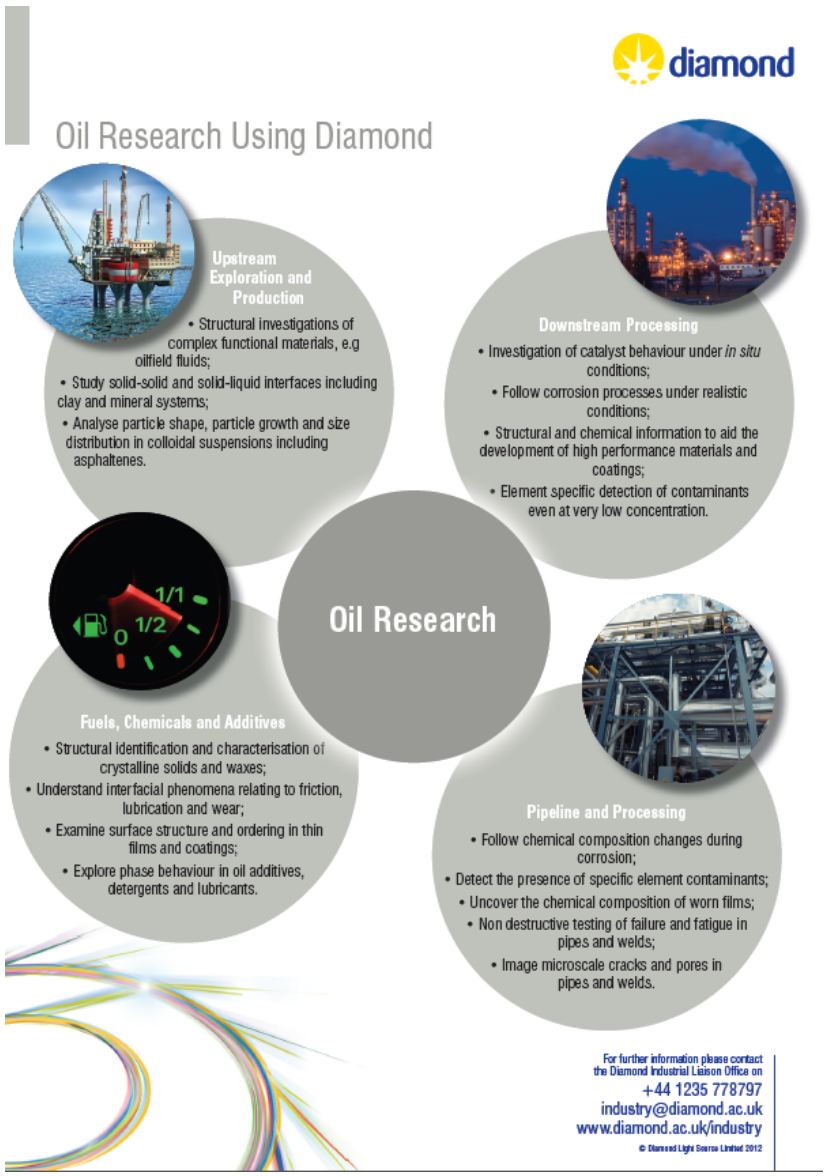
**Depending on your specific requirements, we offer a range of service levels:**

- 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
+44 1235 778797
industry@diamond.ac.uk
www.diamond.ac.uk/industry





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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.

**Oil Research**

**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.

For further information please contact the Diamond Industrial Liaison Office on
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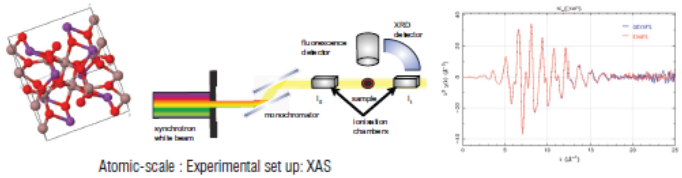
# Beamline flyers

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)<br>Y – U (L edges), Pt – onwards (M edges) |
| Beam Size (μm) at sample | 200 x 250<br>(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<br>GMSD gas microstrip detector<br>4 element Si DRIFT detector for the range 2-15 keV<br>9 element Ge monolithic detector above 15 keV |

For further information please contact the Diamond Industrial Liaison Office on
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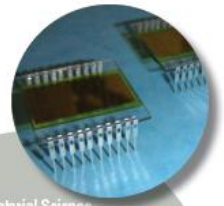
industry@diamond.ac.uk
www.diamond.ac.uk/industry


Applications

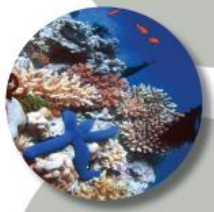
### Catalysts

- 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, advances materials.



## Industrial research at Diamond

### 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.

### Biology

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

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# Industrially-focused Conferences

iCar 2013

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

Infineum

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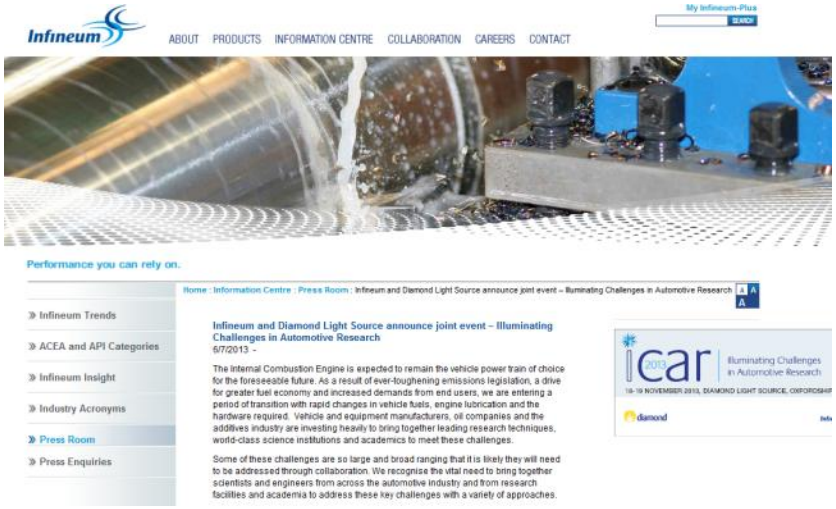
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Press Room
Press Enquiries
Infineum and Diamond Light Source announce joint event – Illuminating Challenges in Automotive Research
6/7/2013 -
The Internal Combustion Engine is expected to remain the vehicle power train of choice for the foreseeable future. As a result of ever-toughening 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.
iCAR 2013
Illuminating Challenges in Automotive Research
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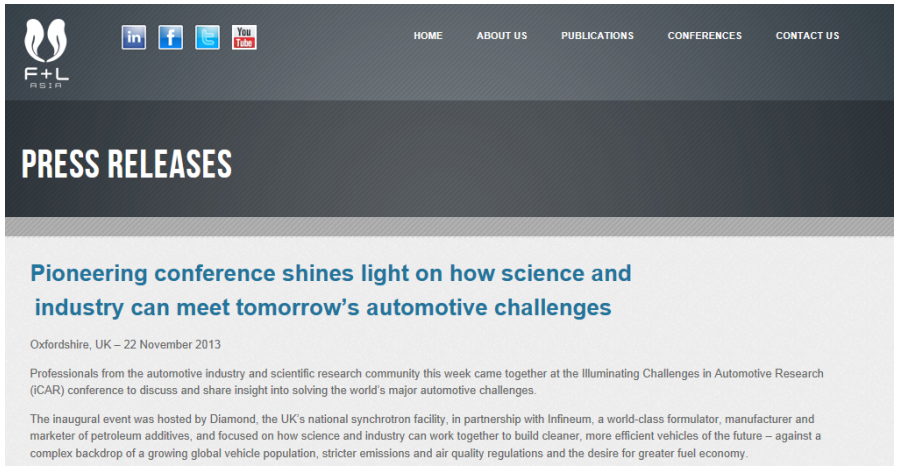
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PRESS RELEASES
Pioneering conference shines light on how science and industry can meet tomorrow's automotive challenges
Oxfordshire, UK – 22 November 2013
Professionals from the automotive industry and scientific research community this week came together 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.


Wednesday, 15 January 2014
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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


INSIGHT
From Infineum International Limited
INSIGHT EXPERTISE TRENDS NEWS SEARCH SIGN UP
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 Beddoes of CONCAWE who discussed how the role of refiners can evolve to meet the future needs of
iCAR 2013
Illuminating Challenges in Automotive Research
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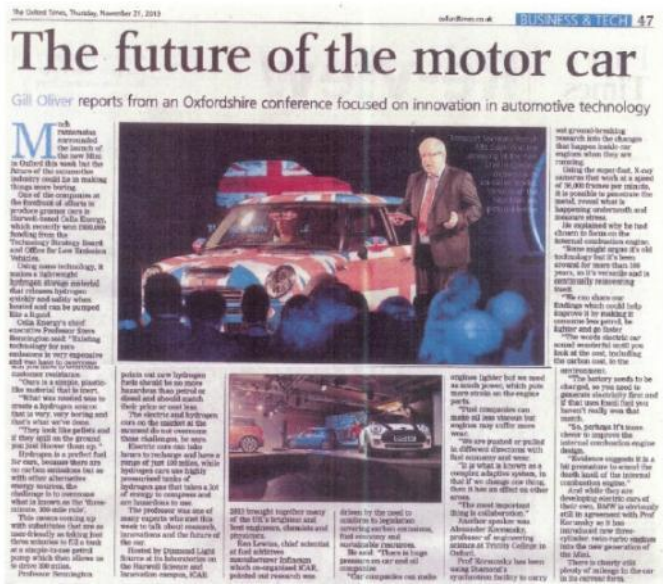
BUSINESS & TECH 47
The future of the motor car
Gill Oliver reports from an Oxfordshire conference focused on innovation in automotive technology

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# PR

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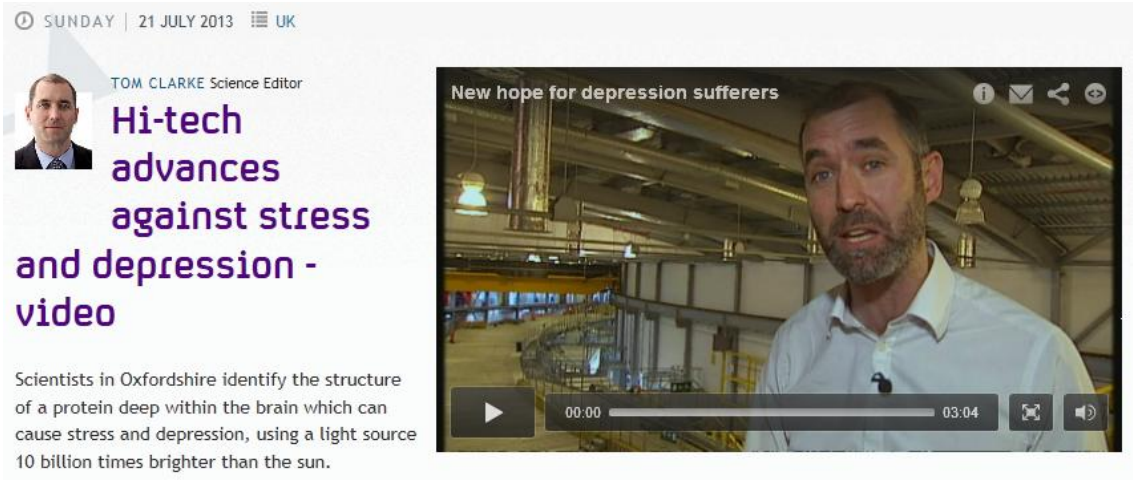
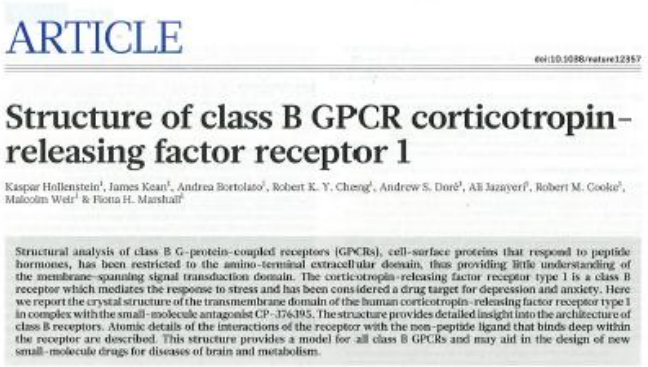
# Industry making the news











HEPTARES therapeutics

# Research

# Some of our projects

SEVENTH FRAMEWORK PROGRAMME

CARENA

PDC

ARKEMA
The world is our inspiration

diamond

TECHNION
Israel Institute of Technology

ECN

Institut Européen des Membranes

Acktar
Advanced Coatings

IRCELYON

EMH European Membrane House

SINTEF

Linde

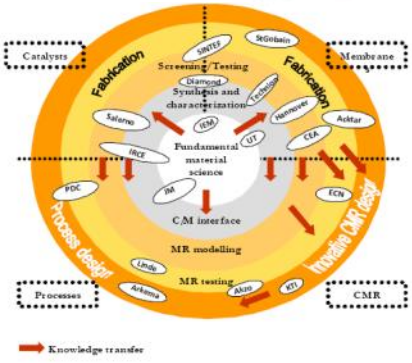
SAINT-GOBAIN

UNIVERSITY OF TWENTE.

AkzoNobel
Tomorrow's Answers Today

cnrs

Tecnimont KT




UCL

UNIVERSITY OF BIRMINGHAM

Cambridge University Rolls-Royce UTC

ilika
Science-led Materials Discovery

Technology Strategy Board
Driving Innovation

diamond

# OUTCOMES

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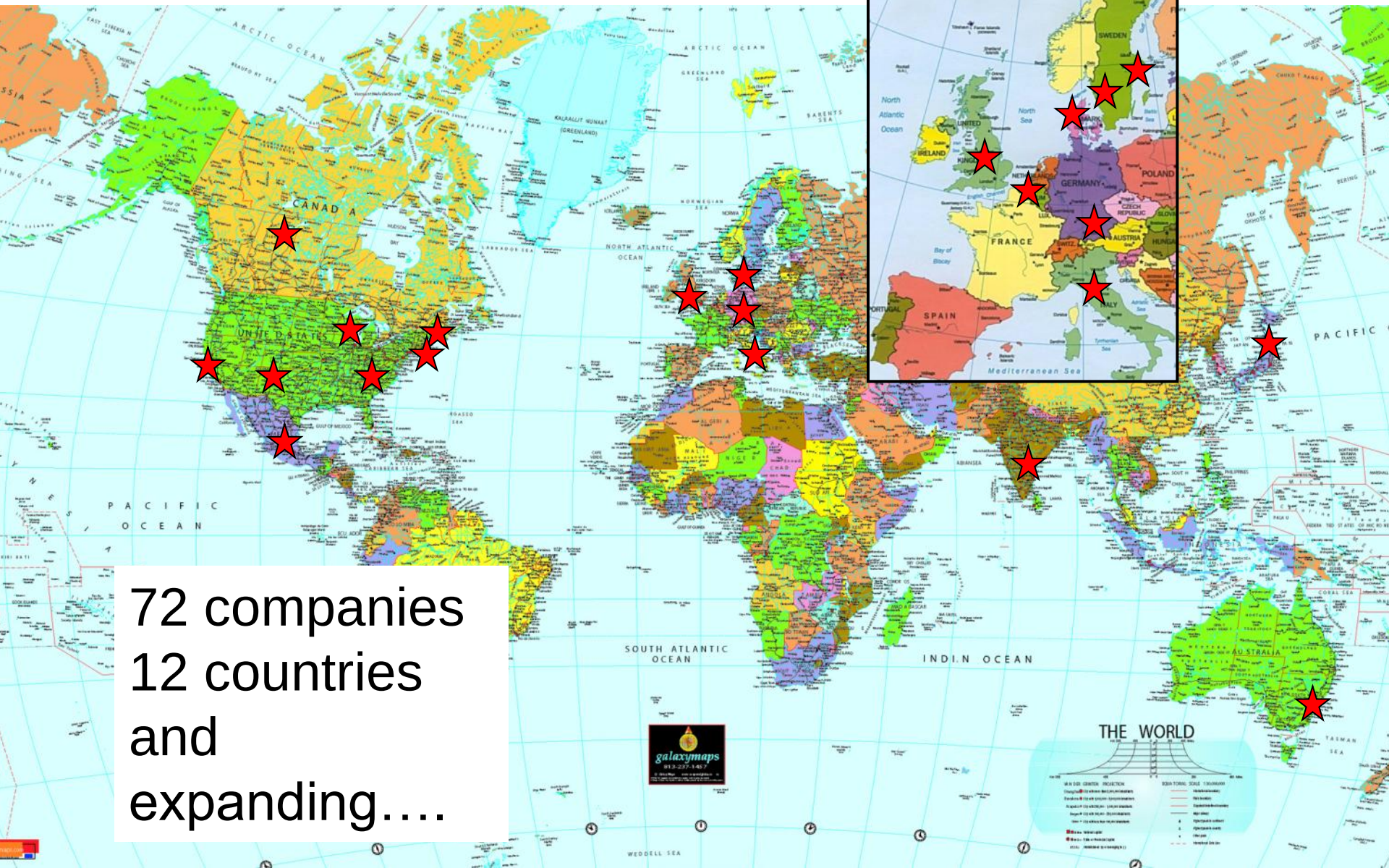
# A Worldwide Customer Base from Industry




72 companies
12 countries
and
expanding….

# Thank you for your attention

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