ALBA
news
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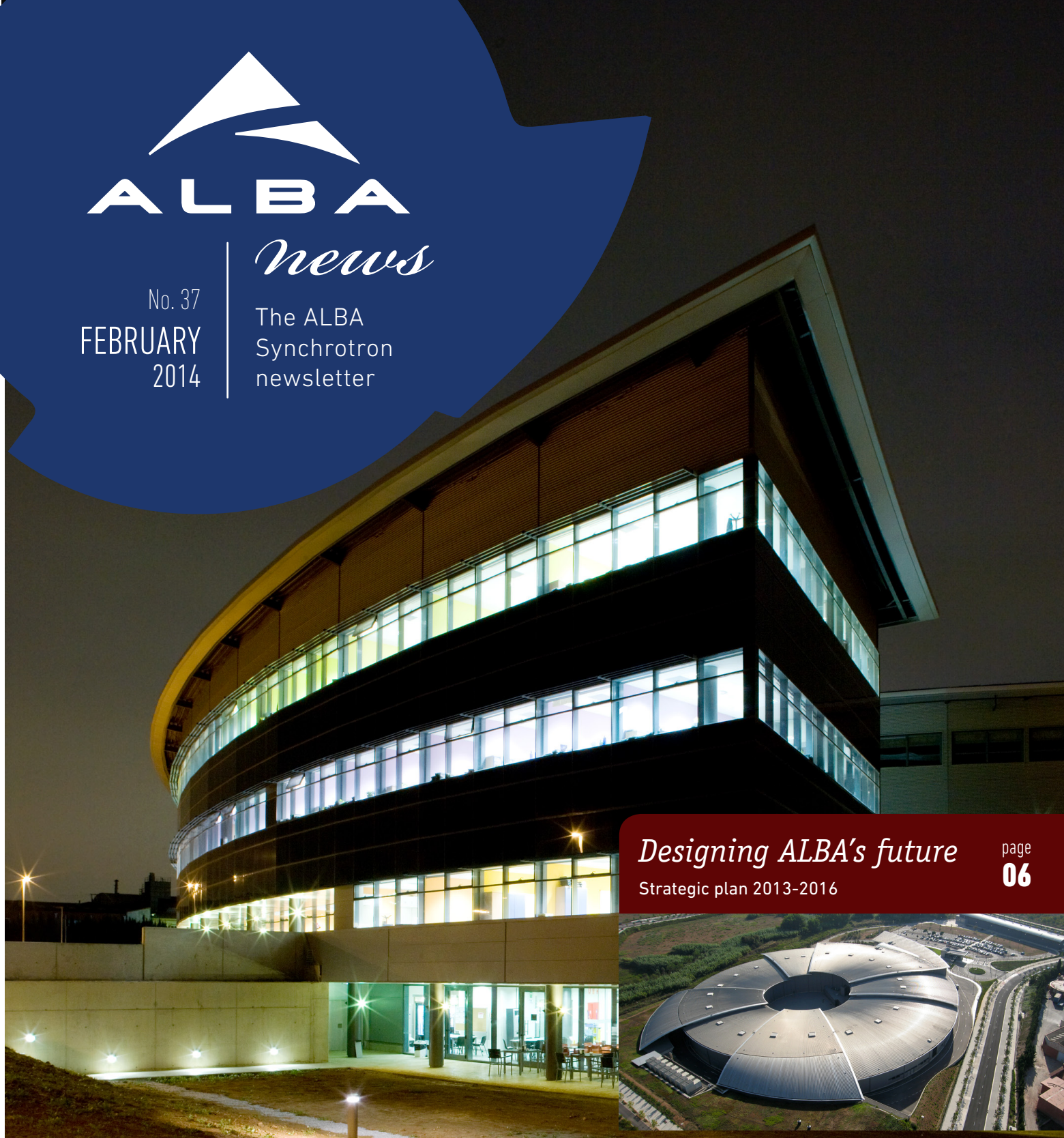
The ALBA
Synchrotron
newsletter



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Welcome again to the ALBA News magazine, a place where we share our activities, the achievements of the last months, and prospects for the future with the scientific community. This period has represented an intense work, dealing with experiments and upgrades in our infrastructure.

Today ALBA is a facility in regular operation offering excellent outcomes. We are obtaining our first publications in scientific journals –some of them of high impact– as well as other interesting contributions in experiments and thesis. We have recently closed the panel evaluation of the 3rd Call and we are glad to confirm the quality and competitiveness of the new arriving proposals.

2014 represents a new challenge for ALBA: we are starting the construction of the phase II beamlines. It is of vital importance to design a progressive growth of our facility, answering scientific demands and current economic constrains. Because of its strategic relevance, we'd like to count with the support of our users to create a successful development plan for ALBA.

Finally, I want to dedicate some words to the International Year of Crystallography, declared by the United Nations this 2014. Crystallography has hugely contributed to science and to society. Synchrotron-based research wouldn't be understood without crystallography and, at the same time, crystallographers have found in synchrotron facilities a great help to obtain quality data. You'll find in this issue some example of recent results obtained in XALOC, our BL dedicated to Macromolecular Crystallography.

Enjoy the reading.

Sincerely,

Caterina Biscari
ALBA Director

Agreement for training professional education students at ALBA

ALBA and the Education department of the Catalonia regional government (Generalitat de Catalunya) are working on an agreement to train professional education students at ALBA's facilities.

The students participating in this program will be enrolled in the so-called dual education, which implies a genuine combination of lecturing at the education center and hands on training at a company or research institution (ALBA, in this case). Eight students, from nearby education centers chosen by the Generalitat de Catalunya, are expected to arrive gradually at ALBA along 2014 for 10 month part-time stays.

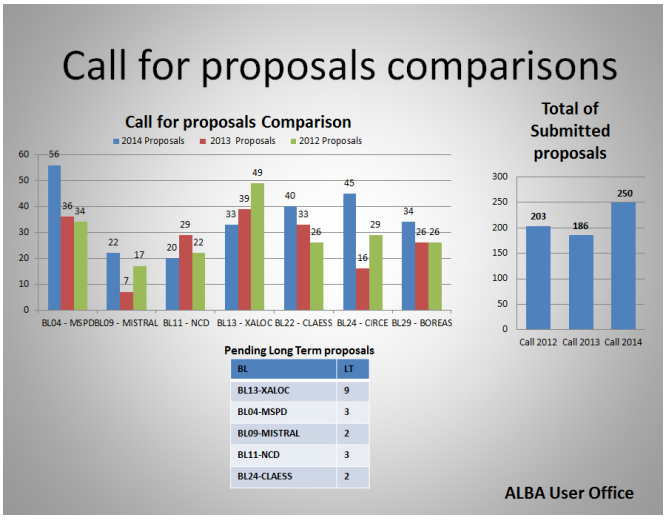
With this move ALBA supports the strong bet on dual education done by the Generalitat de Catalunya and reiterates its vocation of contributing to society and wellbeing in all possible aspects, remarkably education.

Results of the 3rd call for proposals

A total of 250 proposals were submitted in the 2014 ALBA call for proposals, representing a 35% more than in 2013 call. These experiments will be performed from May to December 2014 in the seven beamlines of ALBA.

The 3rd ALBA Call of Proposals was opened from October 7th to November 4th 2013. 250 proposals (64 more than in the previous call) were submitted. The experiments belong to materials science (38%), hard condensed matter and electromagnetic properties (16%), chemistry (16%), macromolecular crystallography (10%), biology (9%), soft condensed matter and biomaterials (7%),environment and cultural heritage (3%) and methods and instrumentation (1%).

Most requested beamlines are powder diffraction MSPD beamline 04, absorption and emission spectroscopy CLAESS beamline 22 and photoemission spectroscopy and microscopy CIRCE beamline 29.



The international participation has considerably increased in this call, having a 73% of Spanish proposals and a 27% of proposals from other countries such as Germany, Italy, United Kingdom and France, among others.

Graphics comparing results from the 2012, 2013 and 2014 ALBA call for proposals. Graphics: User Office, ALBA

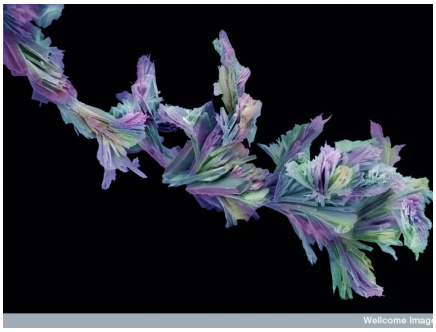
International Year of Crystallography

This year 2014 has been declared by the United Nations as the International Year of Crystallography. During the year, different activities will be organized to explain what crystallography is and which applications this science has on people's everyday life. The ALBA Synchrotron uses crystallography and X-ray diffraction in three beamlines.

The opening ceremony of the International Year of Crystallography was held on 20th January 2014 at the UNESCO headquarters in Paris. Crystallography is the science in charge of studying the arrangement of atoms and molecules in space. During 2014, many conferences, seminars and expositions are being organized to highlight this scientific area.

Three of the beamlines at the ALBA Synchrotron uses X-ray diffraction. XALOC, specialized in macromolecular crystallography, can solve protein structures at atomic level. MSPD (Materials Science and Powder Diffraction) performs diffraction experiments with high resolution and high pressure. SAXS (Small Angle X-ray Scattering) at NCD (Non-Crystalline Diffraction) beamline offer structural information of large molecular assemblies like polymers or fibers, among others.

More information at the official website of the International Year of Crystallography: http://www.iycr2014.org



B0006253 Aspirin crystals. Credit: Annie Cavanagh. Wellcome Images

PHASE-III BEAMLINES

Workshop

10th April 2014
ALBA Synchrotron

Call for phase-III beamlines proposals opened till 30th March 2014

More information
http://indico.cells.es/indico/event/ALBAPhaseIIIWorkshop

Designing ALBA's future

Since 2012, the ALBA Synchrotron is in full operation with seven Phase-I beamlines hosting academic and industrial users. Once the commissioning of the facility had been accomplished, ALBA prepared a strategic plan covering the period from 2013 to 2016. This article summarizes the objectives of the facility to achieve the full exploitation of the infrastructure and its future evolution.

In the next few years the first ALBA priority is the full exploitation of the present infrastructure, together with the affordable development of specific scientific areas, which will define the path toward new beamline investments.

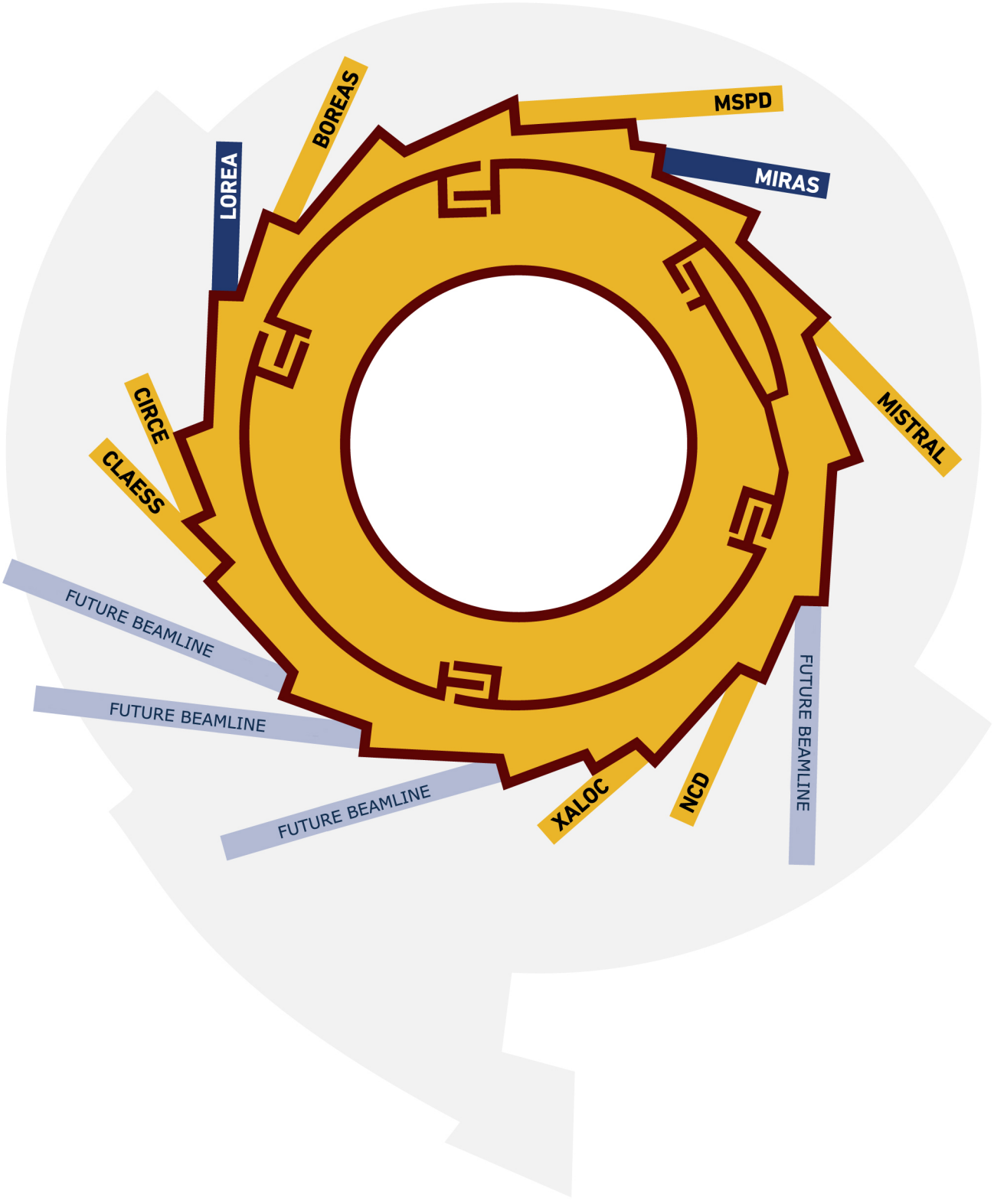
ALBA has identified three scientific areas where synergies could be effectively exploited: nanoimaging, time resolved pump-and-probe experiments and coherent diffraction-related techniques. These synergies must be accompanied by other key development upgrades for the seven ALBA's beamlines, laboratories, as well as the accelerator improvement thanks to the implementation of the Top-Up mode and reaching the nominal operation current of 250 mA.

In order to develop the scientific strategy of ALBA, a proposal of seven future beamlines is presented in its strategic plan. New beamlines investment will boost the efficiency of the whole facility as the large investment for the infrastructure, accelerator complex and the computing services has already been carried out.

Phase II beamlines are already underway. The Infrared microspectroscopy beamline (MIRAS) will be devoted to infrared spectro-imaging. It is the most widely used characterisation technique in the world due to its wide versatility and the comprehensive information it can provide for the study of molecules. This beamline is currently under construction and it is foreseen to be available for users at the end of 2016. Low-energy ultra-high resolution angular photoemission beamline (LOREA) is being designed at present. It will be an extremely useful beamline for the understanding of the electronic structure of graphene-based material, topological insulators and other advanced materials. The necessary funding for constructing these two beamlines would combine ALBA internal resources and 2014-2020 structural funds.

Phase III beamlines are in definition at this moment. In April 10th 2014, a workshop is organized in ALBA to launch the elaboration of scientific cases for future beamlines. As a result of the workshop, a list of new beamlines will be evaluated by the Scientific Advisory Board of ALBA for eventual approval. Here, we mention a selection of possible beamlines to be built in ALBA.

Regarding the user services, one of the most ambitious projects is the Digital User Office, providing a platform for evaluation of proposals, feed-back and tracking of the experiments,



FUTURE BEAMLINES

BEAMLINES PHASE II: MIRAS (in construction), LOREA (in design phase)

OPERATIONAL BEAMLINES PHASE I

schedule, users' reception, safety issues related to experiments, funding and refund requests, etc. This Portal will allow an updated information service, with records of users, successes and failures, user feed-back comments, publication records, etc. It is remarkable the creation of the Industrial and Project Office, which develops different activities to attract proprietary users.

VISION

ALBA wants to become a **center of excellence** in synchrotron light scientific and industrial applications at European level and to achieve the status of a recognized world class facility in its field.

MISSION

To research in, deliver and maintain methods and techniques with which to conduct **cutting edge synchrotron light based research and development**, pumping knowledge and added value into the scientific and industrial communities, particularly the Spanish ones, with the ultimate goal of contributing to the improvement of **well-being and progress of society** as a whole.

ALBA Phase-III workshop - Thursday 10th April 2014

More information:
http://indico.cells.es/indico/event/ALBAIIIPhaseWorkshop

What does the Spanish synchrotron community think about future developments in ALBA?

After the VI National Meeting of AUSE and the first ALBA User Meeting, the ALBA Synchrotron and the Spanish Synchrotron User Association (AUSE) prepared a survey addressed to synchrotron users. The aim of this survey was to identify the present and future scientific fields of interest of the Spanish synchrotron light source community.

The survey included information about the most used and interesting techniques for synchrotron users, as well as the social, scientific and industrial challenges of synchrotron-based research in the future. 266 responses were collected from Spanish institutions mainly.

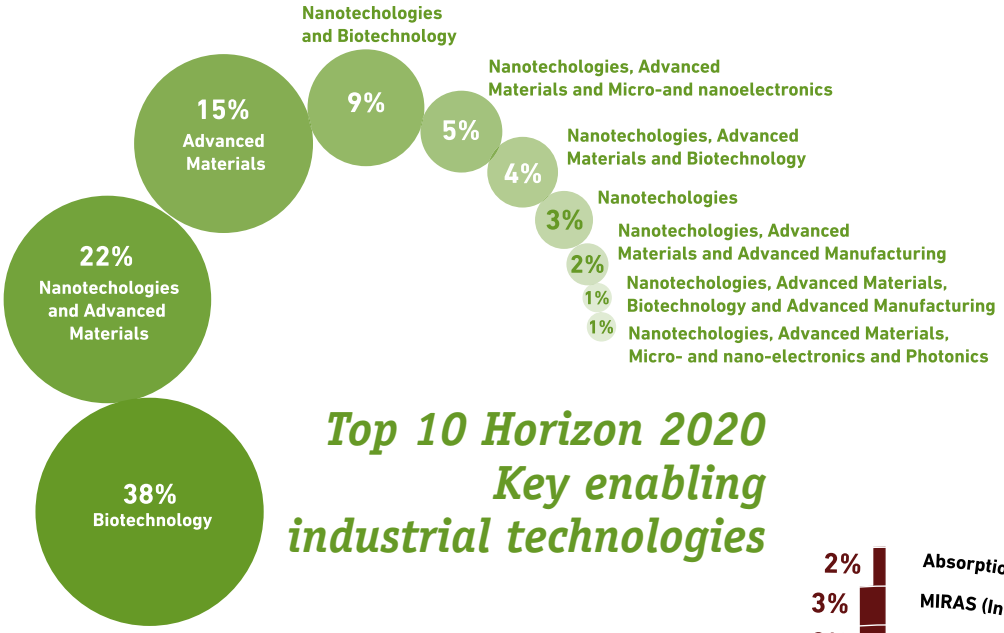
Synchrotron users who participated in the survey pointed out that diffraction, reflectivity and scattering techniques are the most used. In particular, macromolecular crystallography (PX), coherent diffraction (CD) and powder diffraction (PD) were selected by the largest number of users.

Diffraction techniques (Micro PX and Single Crystal Diffraction) and infrared spectroscopy (MIRAS) were also the ones arising a higher degree of interest, showing a strong support by respondents.

According to the survey participants, synchrotron-based research can significantly contribute to the development of biotechnology, nanotechnology and advanced materials, with impact on Horizon 2020 challenges such as health, demographic change and wellbeing.

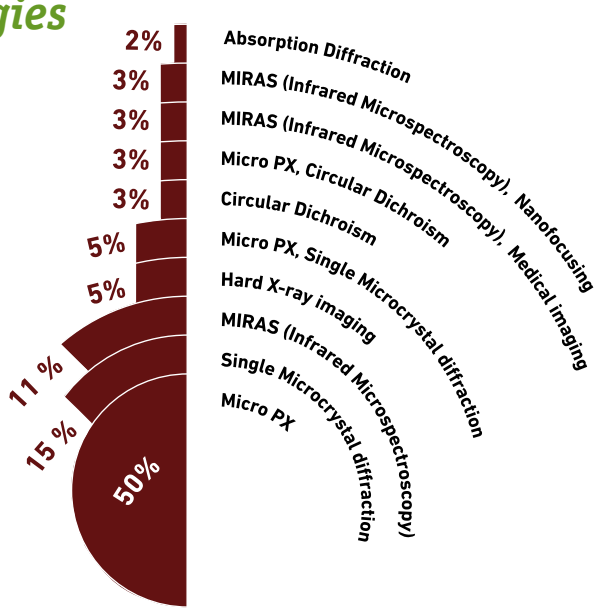
The ALBA Synchrotron and the Spanish Association of Synchrotron Users (AUSE) thank the respondents as this information is very important to decide the future of new developments in ALBA.

You can download the complete report from this link.

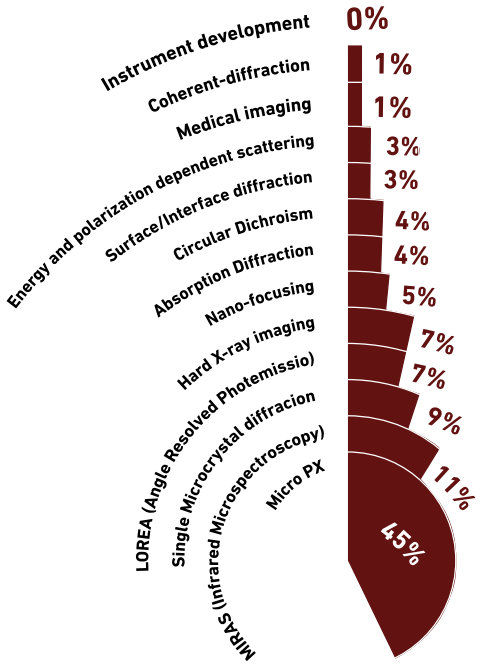


Top 10 Horizon 2020 Key enabling industrial technologies

Interest, may become a user



Strong interest, will actively support it



Top 10 Horizon 2020 Societal challenges

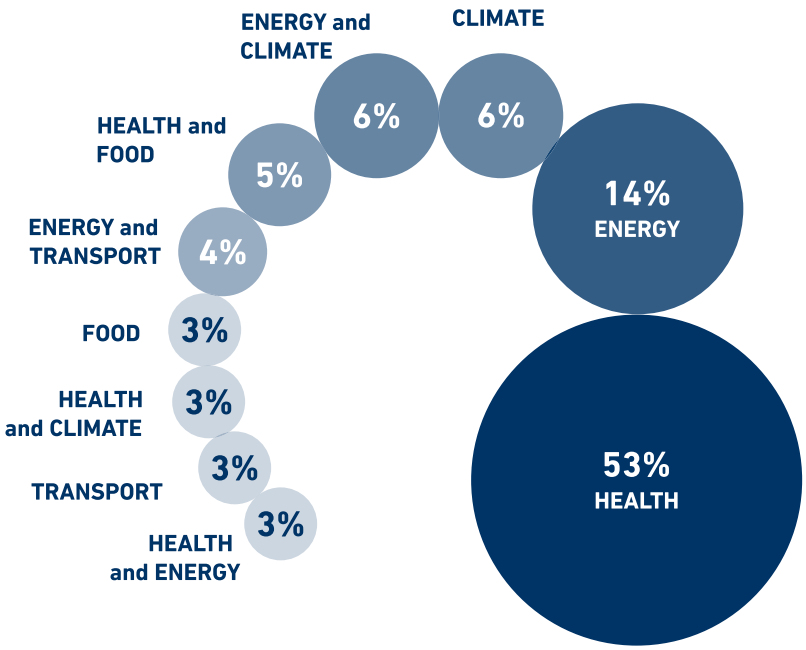


Photo taken by John R Helliwell in his garden.

The inner life of plants and their responses

Have you ever wondered why plants in an identical pot and under obviously identical weather conditions respond differently? This photo (above) from my own garden in mid-February shows one part of a plant pot that has given up and one part that is still green and obviously alive. Have you ever read the Day of the Triffids by John Wyndham with the giant plants that take over the world? Or have you considered these ideas about life on Mars and beyond in potentially different atmospheres and soils than our own Earth?

● Plant response factors are the biochemical details to address such questions. Recent research published in Cell involves the auxin response. Auxin was originally discovered in research started by Charles Darwin and his son Francis looking at how plant growth responds to the direction of the light illumination (http://en.wikipedia.org/wiki/Auxin#Discovery_of_auxin).

Indole-3-acetic acid is the most abundant and basic auxin in plants. Auxin acts via regulation of genes in the plant. In the study by Boer et al published in Cell [1] they made a truly comprehensive study involving biophysical and biochemical characterisation techniques, including X-ray crystallography data quite recently measured at ALBA on the Xaloc beamline, as well as earlier data measured at ESRF in Grenoble before ALBA came online. From the 3D protein and nucleic acid structures the critical amino acids involved in the gene regulation could be identified. Modern genetics allows specific amino acids to be changed. The modified protein can be isolated and crystallised for further X-ray crystal structure analysis. The mutant G245A (glycine changed to alanine at position 245 in the particular protein polypeptide chain studied) was the one studied at ALBA. Earlier studies involved mutations at several other key places of the protein. These changes were deliberately introduced to disrupt or distort the protein nucleic acid interaction.

Prof John R Helliwell DSc
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With these site specific molecular changes in the genes the 'genetically modified plant' of the Arabidopsis (a small flowering plant related to cabbage and mustard) could be grown. These showed a variety of poor or compact (ie bushy) growing features.

How might this fundamental science make its way to impacting on society at large? Of course, as it did with this writer, it fuelled the imagination from arousing my renewed curiosity of what is happening in my own garden and on to my wilder imagination as to its implications in 'astrobiology'. Genetically modified (GM) crops are the more 'bread and butter' aspects. These are welcomed in some countries e.g. where hunger and famine are common place and controversial in others, notably where the citizens are well fed. How might this research help both community factions? For the hungry in the world such fundamental research will surely assist a more penetrating set of ideas and discoveries as to how to work with plant growers and agriculturalists as well as ultimately farmers. For the GM sceptics such research shows explicitly and clearly how plants respond to their environment via their genes and their biochemical response molecules, in this case auxin. Thus the wish by the sceptics of GM for a greater clarity on the effect of a given genetic mutation within the plant is achieved.

For myself I think the impact of this work is several fold. The team involved in the publication is clearly broad and each team is at the forefront of such modern day research; I am full of admiration. Secondly, as Chairman of the ALBA Beamtime Panel and of the Science Advisory Committee, for me to be able to see over a 4 years period of time the ALBA facility in general and Xaloc in particular move from build to commissioning to regular use is a marvellous thing. The Spanish community in all its range of science and technology skills can be rightly proud of this achievement with ALBA. Thirdly I have learnt a lot more than I did about plant molecular biology. Fourthly, maybe it is time for me to start that novel as a modern successor to the 'Day of the Triffids'!

[1] Boer et al Cell Volume 156, Issue 3, 577-589, 30 January 2014.

If you want to know more about this experiment, go to page 15.

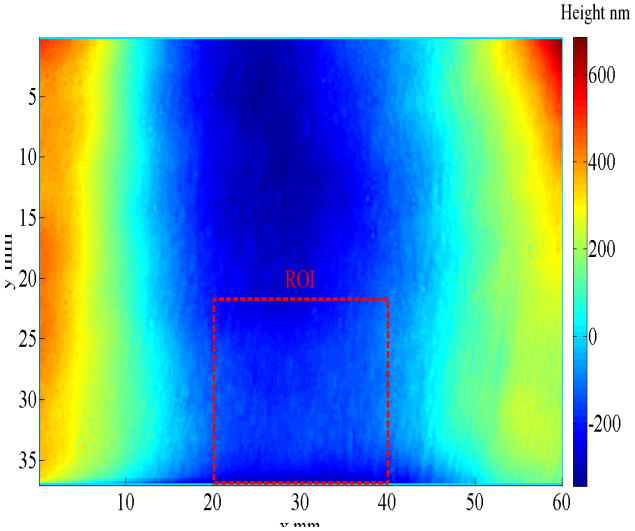


Figure 1: Flatness measurement of the Thales-SESO mirror performed with the Fizeau interferometer in the metrology lab. The red rectangle represents the region of interest (ROI), that is where the selected synchrotron radiation hits the mirror.

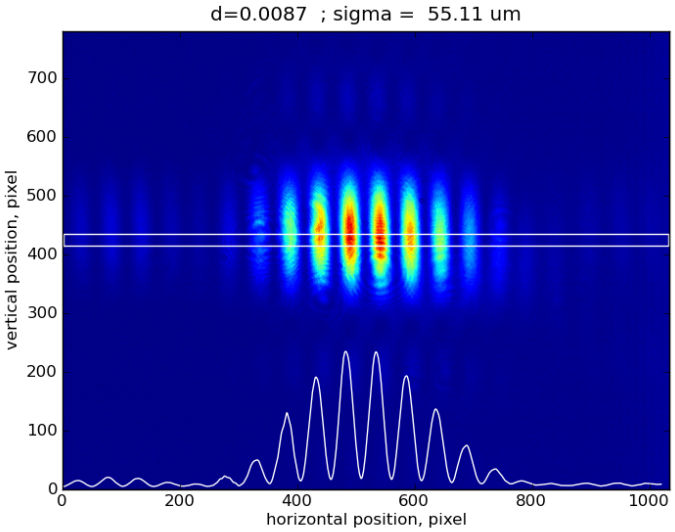
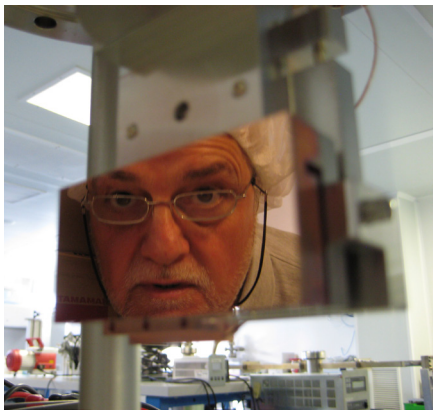


Figure 2: Interference pattern used to measure the electron beam x-dimension obtained at Xanadu.

Upgrade of the Xanadu Diagnostic Beamline

ACCELERATORS

Xanadu is the visible ALBA beamline entirely dedicated to beam diagnostic. Some improvements have been done in this beamline to increase the quality of the radiation reaching the optical hutch.



ALBA scientist removing the old mirror from Xanadu beamline. Photograph: ALBA

● In order to characterize the beam, transverse and longitudinally, the visible part of the synchrotron radiation is extracted from the tunnel and is guided through a chicane of mirrors up to the optical hutch, where several experiments are performed to diagnose the electron beam. One of these experiments is to measure the transverse beam size using double slit interferometer. Light reaching the optical table intercepts the double slit system and the resulting interference pattern is detected by a CCD camera. The analysis of this interference provides a measurement of the beam size and eventually, the electron beam emittance.
To perform this experiment, the light wavefront shall not be distorted during the transport through the optical components, which requires an optical surface flatness of $\lambda/10$, meaning that the height distance between a peak and it subsequent valley cannot be larger than 63nm.

The most delicate part of the light path is the extraction of the radiation from the vacuum chamber. The so called "extraction mirror" is located in-vacuum with an orientation of 45 degrees with respect to the photon beam. The light is deviated and extracted from the vacuum pipe through an "extraction window". In January 2014 both the extraction mirror and the extraction window were exchanged by two other components manufactured ad-hoc for ALBA by external companies.

The new Xanadu components in the Front End are the extraction mirror (manufactured by Thales-Seso) and the extraction window (manufactured by TorrScientific). Both components have been optically characterized at the ALBA metrology lab, and confirmed a surface flatness better than $\lambda/10$ in the Region of Interest (ROI), and in the case of the window, a parallelism better than 1 arc sec, confirming the required optical requirements.
To increase the radiation reaching Xanadu, the six mirrors of the chicane were exchanged as well. Again, in this case the company Thorlabs manufactured 4 inches mirrors with a flatness better than $\lambda/10$ (usually this kind of mirrors are only produced with a diameter up to 2 inches).

Using this new set-up the quality of the radiation reaching the optical hutch is greatly improved. For example, using a Hartmann mask and a lens it is now possible to focus the radiation in a single spot, and preliminary tests show an interference pattern independently from the position of the double slits in the radiation footprint. This was not possible with the old optical components since the wavefront was strongly affected by the characteristics of the old mirror.
In the near future, the experimental setup will be fixed in a robust way to routinely provide measurements of the machine emittance in both horizontal and vertical plane.

CULTURAL HERITAGE

Shedding light to historical glaze decorations

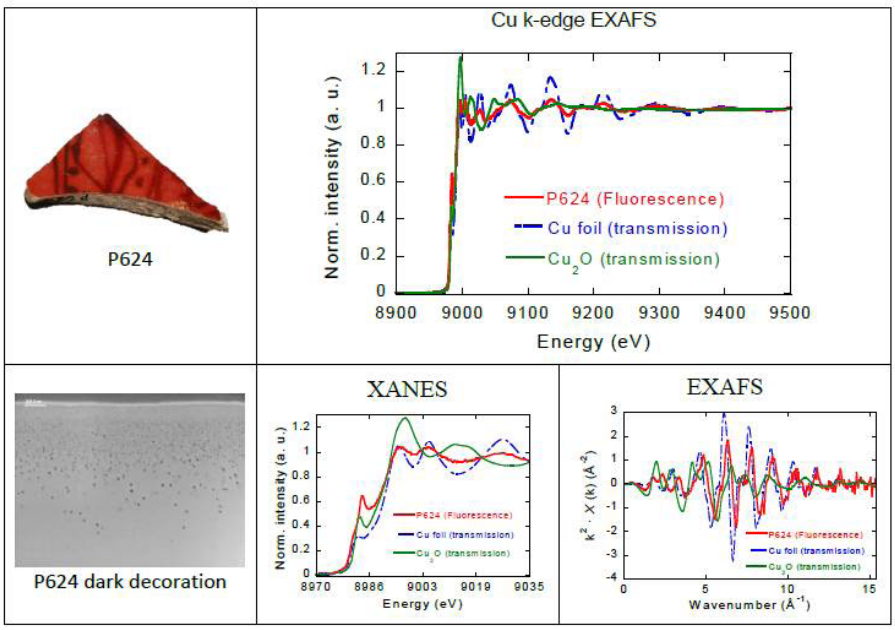
BL04-MSPD and BL22-CLAESS

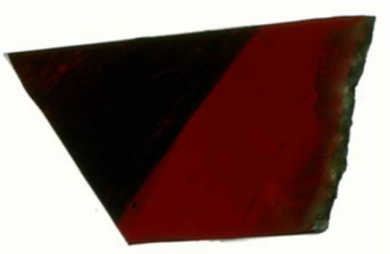
A group of researchers from Universitat Politècnica de Catalunya (Trinitat Pradell and Gloria Molina) and from Universitat de Vic (Joaquim Pla and Judit Molera) have measured in ALBA different decorations in glass and glazed ceramics from the historical periods of early Islamic glazes and late Renaissance. The aim of this research is to determine the differences in materials and technology in the periods and regions analyzed.

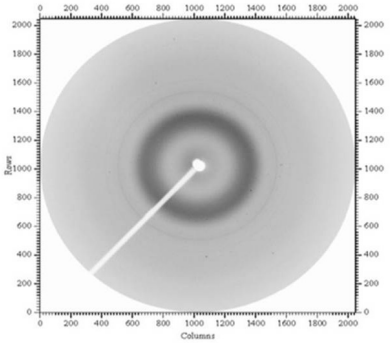
This group focused their research on the micro-and nano-crystalline compounds responsible for the colors and decorations in historic glass and glazed ceramics. The nature of these decorations depends on the procedures followed to obtain them. Two main sets of historic materials were studied: decorated stained glass fragments from various periods and cathedrals in Spain (14th to 16th AD) to discover materials and methods used and early opaque Islamic glazes from Syria and Egypt (7th and 8th AD) to identify the connection with opaque glass technology.

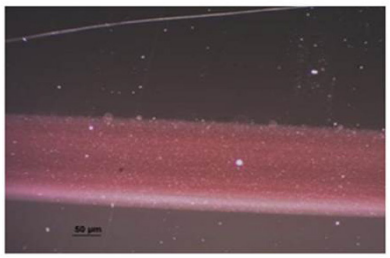
In this project, measurements were performed in two different ALBA beamlines. The focusing capability, high brilliance of the micro-XRD setup at beamline 04-MSPD allows researchers to identify the crystalline compounds of samples.

They also investigated at beamline 22-CLAESS copper speciation in polychrome Islamic lustre decorations from the earliest production (Iraq 9th century AD) belonging to the Ashmolean Museum (Oxford, UK); in particular, those showing silver-golden and red-coppery decorations. Both metallic silver (5-20 nm) and copper (10-70 nm) nanoparticles are present respectively, copper may also happen as Cu^{2+}, Cu^{+} dissolved or forming Cu_2O nanoparticles in the glass giving different color and shine to the lustre layers.









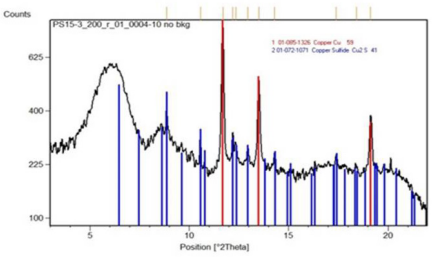


Figure 3 (above): The figure shows the identification of the crystalline compounds in the 15th century "plaqué" red glass; a red layer of 100 µm applied between two transparent glasses. Although the crystalline compounds are present in very small amounts as can be seen in the CCD image of the detector, metallic copper particles, Cu°, and Cu_2S are clearly identified.

Figure 4 (left): A characteristic fluorescence spectrum of Cu, 200x200 µm2 area corresponding to the black decoration, is shown. The data is compared to the Cu° foil and Cu2O standards measured in transmission. The reduced intensity of the spectrum is related to the small size of the metallic copper nanoparticles, Cu+ is also observed, most of it dissolved in the glassy matrix; full analysis of the data will also determine or withdraw the presence of cuprite nanoparticles.

BIOSCIENCES

Bacteria Trans-infect T lymphocytes through the Immunological Synapse

BL09 - MISTRAL

The group led by Esteban Veiga at CNB-CSIC and Instituto de Investigación Sanitaria Princesa at Hospital de la Princesa (Madrid) investigated by soft X-ray cryo-tomography (SXT) the interaction between infected dendritic cells contacting T cells during the course of antigen presentation.

● During infections, several bacterial species survive phagocytosis and disseminate systemically through infected antigen presenting cells (APC) such as dendritic cells (DC). It has been proposed that T cells could also serve as bacterial reservoir during infections in mice. However, taken into account that primary T cells are infected poorly in vitro, the route bacteria invade T cells remains unknown.

We have demonstrated that T cells take up bacteria from infected DCs through the Immunological Synapse (IS). T cells acquire bacteria more efficiently from infected DCs carriers than by direct exposition to bacteria, in a process remarkably enhanced by antigen recognition.

Reference: "Bacteria trans-infect T lymphocytes through the Immunological Synapse." Cruz et al. Manuscript sent to Cell Host & Microbe (under revision).
Contribution by E. Veiga, G. Ramirez-Santiago, F.J. Chichón, A. Sorrentino & E. Pereiro.

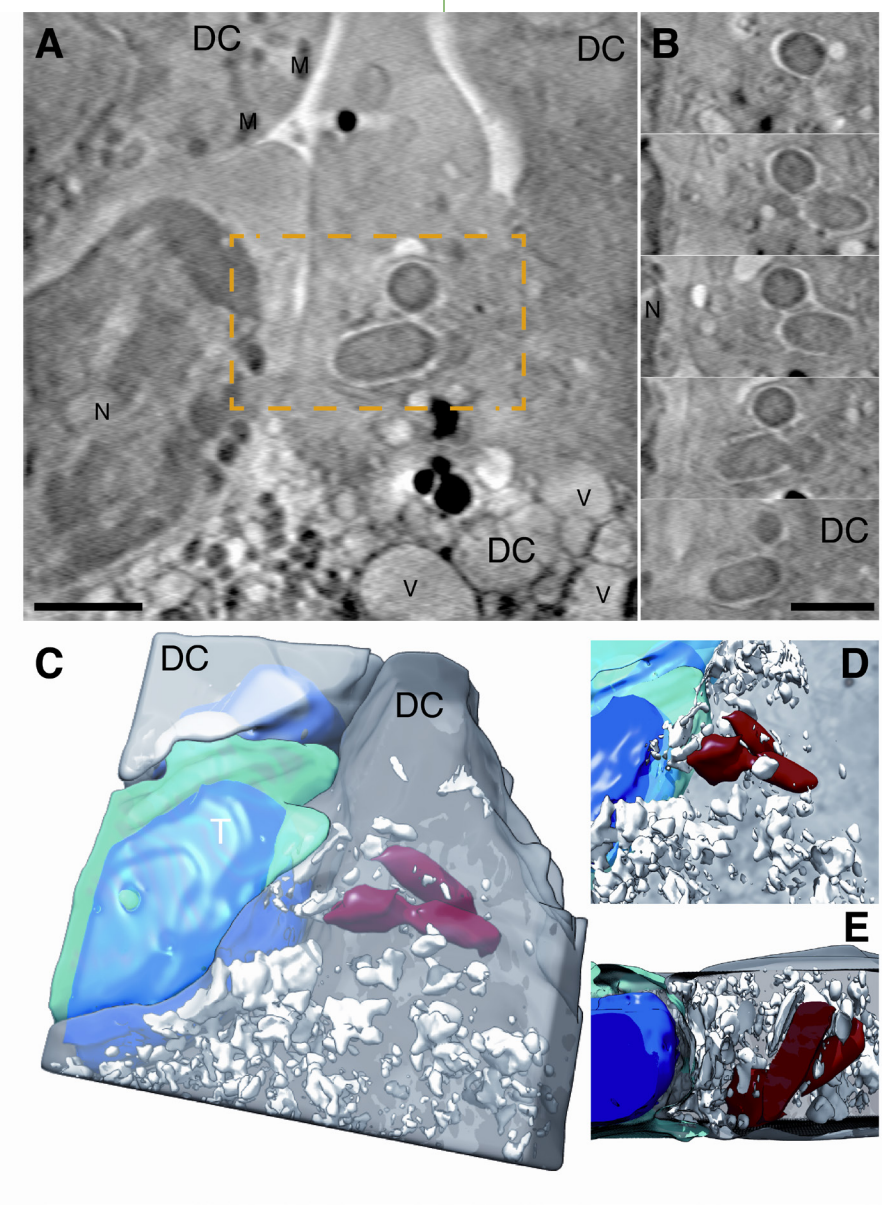


Figure 5: In the figure below: A) Virtual slice of a tomogram showing an infected dendritic cell (DC) exposing internal bacteria near the immune synapse (IS) with a T cell (T). N labels the nucleus position of the T cell and V some vesicles. Bacteria are visible in the dashed orange square. B) Consecutive virtual slices every 460 nm showing the proximity of the three bacteria, in the orange square of A, to the IS with a T cell. Scale bars in A and B represent 2 microns. C, D and E) Volumetric representations of the tomogram in A and B. The T cell is represented in cyan and its nucleus is shown in blue. The dendritic cells (DC) are shown in grey and the bacteria in red.

BIOSCIENCES

Scientists unveil a molecular mechanism that controls plant growth and development

BL13 - XALOC

Researchers from the Institute for Research in Biomedicine (IRB), the Molecular Biology Institute of Barcelona (IBMB-CSIC) and the University of Wageningen (The Netherlands) have discovered how auxin hormone-regulated proteins activate development genes in plants. Some of the measurements of this study- published in Cell- were performed at XALOC beamline.

Auxins are plant hormones that control growth and development, that is to say, they determine the size and structure of the plant. Among their many activities, auxins favor cell growth, root initiation, flowering, fruit setting and delay ripening.

At the molecular level, the hormone serves to unblock a transcription factor, a DNA-binding protein, which in turn activates or suppresses a specific group of genes. Some plants have more than 20 distinct auxin-regulated transcription factors. They are called ARFs (Auxin Response Factors) and control the expression of numerous plant genes in function of the task to be undertaken, that is to say, cell growth, flowering, root initiation, leaf growth etc.

This joint study, headed by Miquel Coll at the IRB and the IBMB-CSIC, has analyzed in detail the DNA binding mode used by various ARFs using X-ray diffraction techniques at the ALBA Synchrotron and at the European Synchrotron Radiation Facility (Grenoble, France). Researchers solved the 3D structures revealing why a given transcription factor is capable of activating a single set of genes, while other ARFs that are very similar with only slight differences trigger a distinct set.

Reference: "Structural basis for DNA binding specificity by the auxin-dependent ARF transcription factors" D. Roeland Boer, Alejandra Freire-Rios, Willy van den Berg, Terrens Saaki, Iain W. Manfield, Stefan Kepinski, Irene López-Vidrieo, Jose Manuel Franco, Sacco C. de Vries, Roberto Solano, Dolf Weijers, and Miquel Coll. Cell (2014) 156:577-589

IRB link

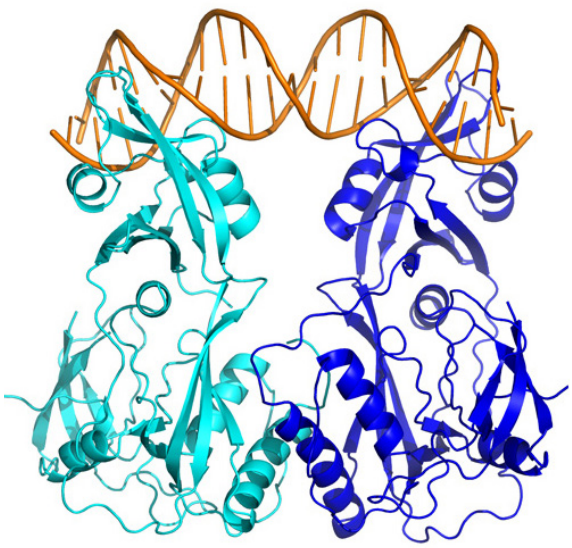


Figura 6: Atomic structure of an ARF/DNA complex. Auxins control the growth and development of plants through ARF (Author: R. Boer, IRB/CSIC)

Check the article written by John Helliwell about this experiment on page 10.

First PhD thesis with experimental data from XALOC

BL13 - XALOC

José Ignacio Baños Sanz, from the Universidad Complutense de Madrid and Instituto de Química Física Rocasolano (CSIC), used the macromolecular crystallography beamline in ALBA for his thesis study titled "Structural Biology of inositol kinases, enzymes in charge of regulation of inositol phosphates".

Inositol phosphates are wide group of second messengers, involved in key cellular events. The levels of these compounds are regulated by different Inositol Kinases. One of this enzymes is Inositol Trisphosphate 3-Kinase (IP3-3K). IP3-3K is a enzyme with key roles in inositol phosphates synthesis and Ca2+ homeostasis. The enzyme is regulated by its interaction with calmodulin, but to date, no structural information about this interaction is available

As a part of his thesis, José Ignacio Baños solved at XALOC beamline, assisted by the scientific beamline staff, the crystal structure of the complex between calmodulin and IP3 3-K. This work will represent an important step to know how IP3 3-K is regulated by calmodulin and how inositol phosphates levels are regulated in the cells.

Reference: "Structural Biology of inositol kinases, enzymes in charge of regulation of inositol phosphates", José Ignacio Baños Sanz, directors: Beatriz González Pérez and Juliana Sanz Aparicio, Universidad Complutense de Madrid and Instituto de Química Física Rocasolano (CSIC).

BIOSCIENCES

Breathing chemistry investigated at NAPP

BL24 - CIRCE

In October 2013, a friendly users group, formed by Celia Rogero, Jorge Lobo-Checa and Mikel Abadía from the Centro de Física de Materiales (CSIC-UPV/EHU) and Donostia International Physics Center, performed at the Near Ambient Pressure Photoemission branch an experiment of attraction/liberation of dioxygen by phthalocyanine molecules. The main aim was to understand the reactivity of biological molecules in contact with metal surfaces. The experiment was fully performed inside the NAPP UHV chambers (sample cleanness, molecular deposition and surface analysis at different pressures).

The adsorption and self-assembly of biological species on solid surfaces can provide important information to understand basic biological reactions, such as one of the most important reaction in living organisms: breathing. This process consists on the transport and storage of the dioxygen/carbon dioxide molecules thanks to haemoglobin formed by Fe tetrapyrrole molecules. In order to mimic this process at CIRCE beamline we exposed Fe-phthalocyanine molecules, which had been previously evaporated in vacuum on a clean Au(111) surface, to different O_2 partial pressures. By means of a combination of XPS and NEXAFS we detected the anchorage of O_2 when pressure in the chamber was changed from UHV to around $1x10^{-2}$ mbar, being this process reversible. Thus, when the O_2 partial pressure was reduced again O_2 liberation took place.

This reversibility was basically detected by analyzing the O 1s core level photoelectron spectra and the Fe 2p absorption edge of the system under different pressure conditions inside the chamber. When pressure was around 10^{-2} mbar, a new component appeared in the O 1s core level region in the XPS spectrum. This new component was completely separated from the O_2 in the gas phase, disappeared when the gas was removed and was not observed for the clean Au(111) under the same pressure conditions. Such behaviour indicates that this feature is related with the O_2 molecules bonded to the Fe ions in the FePc molecules. Moreover, Fe 2p absorption edge reveals that Fe(II) ions change their conformation during O_2 bonding. The central metal core of the phthalocyanine moved from the initial planar configuration to a more tetrahedral structure when the O_2 was temporarily bonded to the surface. This change is again reversible, i.e. the system returns to the flat configuration when the gas is removed. Similar conformational changes have been reported in living organisms for the haemoglobin during the breathing process. Thus with this system we confirm that it is possible to mimic these biological processes at the nanoscale.

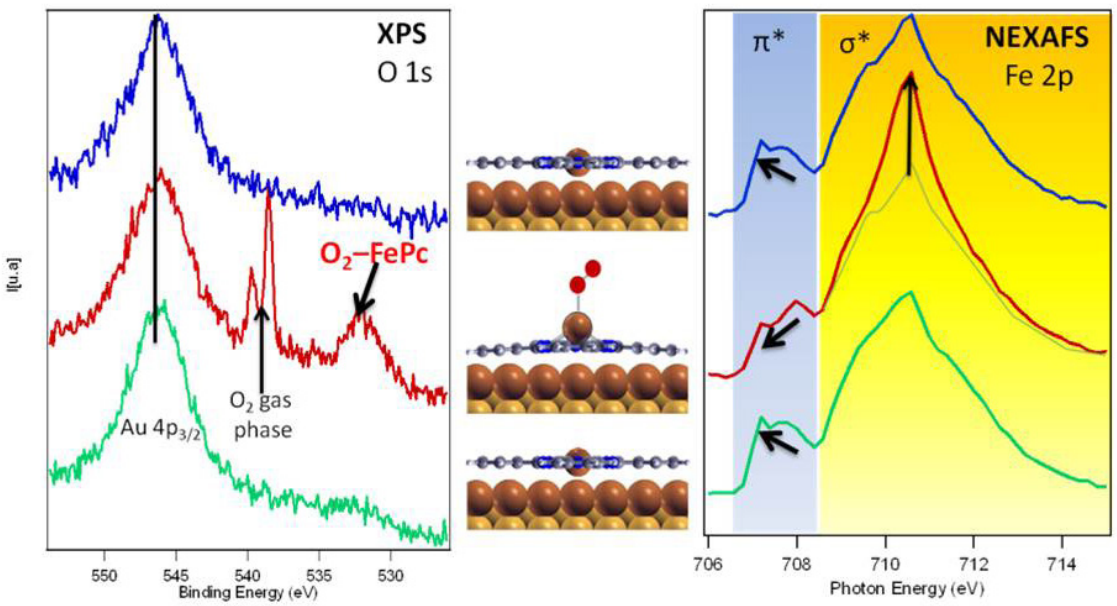


Figure 7: O1s XPS spectra (left) and Fe 2p absorption edges (right) of FePc/Au(111) measured at a base pressure of $7x10^{-10}$mbars (blue spectrum), during O_2 partial pressure of 10^{-2}mbars (red spectrum) and after removing the O_2, measured at pressure of $1x10^{-9}$mbars (green spectrum). Schemes illustrate the conformation of the molecules due to the bond between Fe ions and O_2 molecules.

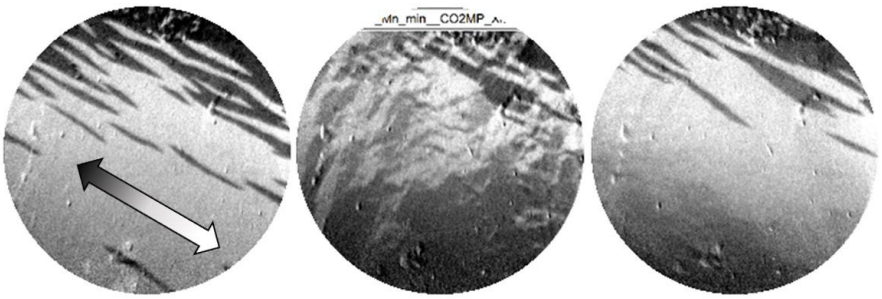
Imaging electric field induced magnetic switching in PEEM

BL24 - CIRCE

David Pesquera, Blai Casals, Gervasi Herranz and Josep Fontcuberta from the Institut de Ciència de Materials de Barcelona (ICMAB-CSIC) have used new in-situ electrical poling capabilities at the PEEM microscope to image magnetic switching in a ferromagnetic $La_{2/3}Sr_{1/3}MnO_3$ (LSMO) thin film.

● Magnetic microscopy images (XMCD-PEEM) were recorded in different poling states of the PMN-PT piezoelectric substrate, showing reversible switching between different magnetic anisotropies resulting in characteristic domain configurations.

Approaches for magnetic switching triggered by electric fields are considered a promising way to enhance the energy efficiency and information density of magnetic data storage technologies because they can avoid detrimental effects associated to electric current flow like Ohmic losses, heat dissipation and electromigration.



While in conventional approaches, electric currents are needed for the generation of Oersted magnetic fields or Spin transfer torque effects, the mechanism investigated in this work is essentially current free.

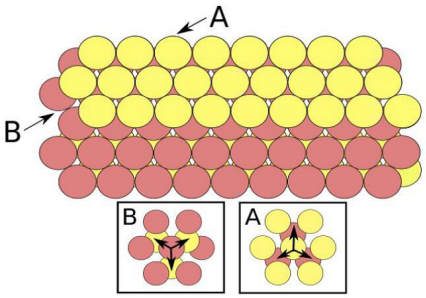
Figure 8: Magnetic microscopy images (Field of view 50um, XMCD-PEEM at Mn-L3) of the LSMO thin film at the same location: from the left with +240 V, -240 V and again +240 V voltage applied across the piezoelectric substrate. The arrow indicates the direction of the greyscale magnetic contrast.

Valence Band Circular Dichroism from single Ru(0001) terraces

BL24 - CIRCE

Laura Martín and Juan de la Figuera (Instituto de Química Física "Rocasolano"- CSIC) together with their colleagues Beatriz Martínez-Pabón, Arantzazu Mascaraque, L. Pérez and Manuel Abuín (Universidad Complutense de Madrid) have measured circular dichroism in the Ru valence band at the CIRCE-PEEM.

● For the nonmagnetic hexagonal Ru crystal no such effect is allowed in the chosen experimental geometry for symmetry reasons. However, at the surface, two different terminations with three-fold symmetry exist and can be readily imaged by dark field LEEM (Figure 9). Acquiring photoemission from a single atomic terrace, surface related features were detected at the Fermi energy with three-fold symmetry and clear dichroic character (Figure 10), which was reversed on the two types of terrace. This effect is important for a better understanding of the spectra of thin magnetic films and multilayers grown on Ru.



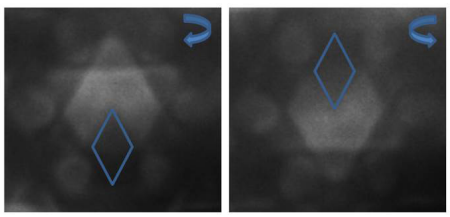


Figure 10: Fermi surface of a single atomic terrace area for opposite helicities of the incoming photon beam. Dichroic features in the angular distribution of photoelectrons are highlighted.

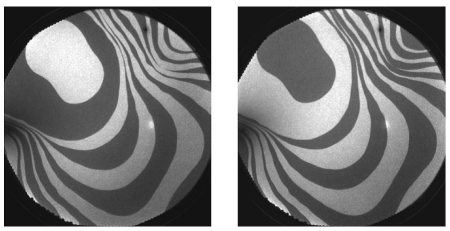


Figure 9: Scheme of the Ru (0001) surface terminations and 20 um dark field LEEM images illustrating the contrast inversion of the two terrace types upon imaging with different first order electron diffraction beams.

MATERIAL SCIENCES

First publication with data collected at NCD beamline

BL11 - NCD

Researchers from the Instituto de Ciencia y Tecnología de Polímeros (ICTP-CSIC) and the Centro Tecnológico Repsol have studied the development of the mesophase in random propylene-co-1octene copolymers. X-ray diffraction experiment was performed at NCD beamline to determine the nature of the different transitions. These results have been published in Macromolecules journal.

The structure development is one of the most studied areas in polymer science. In particular, propylene-co-1octene copolymer is a thermoplastic polymer used in a wide variety of applications including packaging and labeling, textiles (e.g., ropes, thermal underwear and carpets), stationery, plastic parts and reusable containers of various types, laboratory equipment, loudspeakers, automotive components, and polymer banknotes.

A group of researchers, led by Ernesto Pérez (from the ICTP-CSIC), have analyzed the mesophase formation in random propylene-co-1-octene. To ascertain the nature of the phases involved, researchers did X-ray diffraction patterns at NCD beamline.

Results of their research show that mesophase formation rate of these materials can be tailored in a broad range of magnitudes and that the "kinectic" parameters in the ordering of iPP copolymers can be also tailored independently of the transition temperatures.

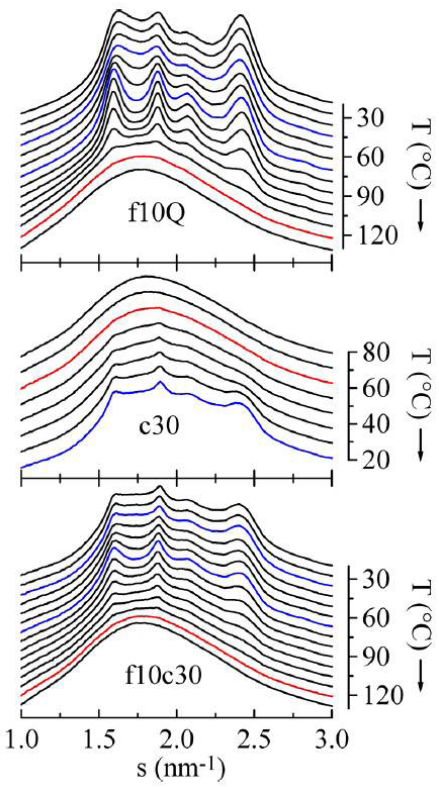


Figure 11: Plots of X-ray diffraction patterns at variable temperature (heating rate of 10 °C/min), corresponding to cP06 for the initial heating run of a quick crystallised sample (upper frame), the cooling from the molten state at 30 °C/min (middle frame), and the second melting (lower frame). For better clarity of the plots, not all diagrams have been represented.

Reference: "Mesophase formation in random propylene-co-1-octene copolymers", Javier Arranz-Andrés, Rosa Parrilla, María L. Cerrada, Ernesto Pérez. Macromolecules 2013, 46, 8557-8568

MATERIAL SCIENCES

Researchers from ITQ (UPV-CSIC) elucidate the structure of a new microporous zeolite

BL04 - MSPD

ITQ-52 is a new zeolite that could find industrial applications in catalysis, gas adsorption and separation, encapsulation and controlled release of molecules, among others. It can be very useful to obtain high-quality petrol. The structure of ITQ-52 has been solved using high resolution synchrotron X-ray diffraction data collected at beamline 04-MSPD. This research has been published in the *Journal of the American Chemical Society.*

Zeolites are microporous crystalline materials with a regular structure of pores that allows the entrance of molecules through and permits chemical reactions depending on the topology of their structural pores. "The structure acts as a sieve, enabling the molecules to pass through only if they are smaller than the pores", says José Luis Jordá, one of the researchers of the project. This is why they are frequently used in many catalytic processes, having a great impact on several industries such as the petrochemical, fine chemical production and air separation.

In this research, members of the Instituto de Tecnología Química (UPV-CSIC) from Valencia have synthetized this new zeolite (named ITQ-52) using amino-phosphonium cations as organic structure-directing agents (OSDA) to control the size and shape of the pores.

High resolution diffraction experiments were performed at beamline 04-MSPD of the ALBA Synchrotron for solving the structure of zeolite ITQ-52. Knowing the structure of the new zeolite helps researchers to find possible applications of the new material by matching the pore geometry with the chemicals, intermediate states and products involved in the target process.

Possible processes for application of this new zeolite ITQ-52 could be alkylation of aromatics or selective separation of hydrocarbons, in which the pore structure is of paramount importance. "It can be very useful to obtain high-quality petrol", says Fernando Rey, researcher from ITQ.

The main conclusion of this research is the demonstration of the effectiveness of amino-phosphonium cations to be used as structure directing agents for creating new zeolitic catalysts with improved performance.

Reference: "A new microporous zeolitic silicoborate (ITQ-52) with interconnected small and medium pores" Raquel Simancas, Jose Luis Jordá, Fernando Rey, Avelino Corma, Ángel Cantín, Inma Peral, Catalin Popescu *Journal of the American Chemical Society.* DOI: 10.1021/ja411915C

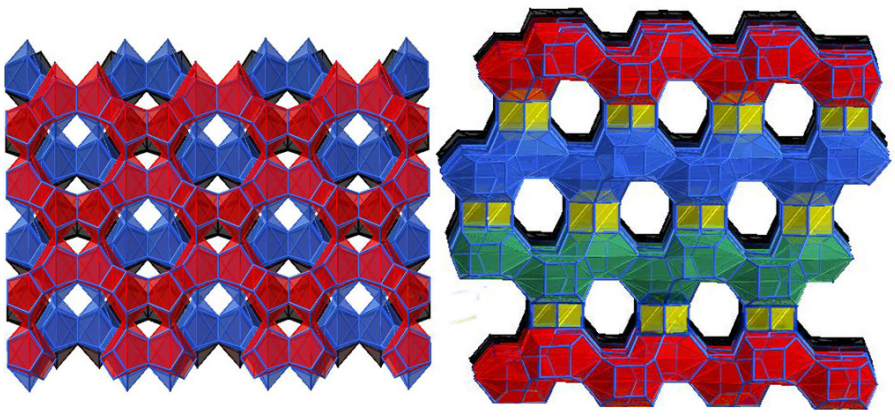


Figure 12: The structure of ITQ-52 can be described as a stacking of layers. Each layer (in a different color in the figure) contains the large pores, while the stacking forms the smaller ones.

MATERIAL SCIENCES

The new ICP-ITQ-ICIQ-ALBA Capillary flow cell performed its first experiment

BL04 - MSPD

The new ICP-ITQ-ICIQ-ALBA Capillary flow cell allows to perform high pressure (up to ~15 bars) and high temperature experiments (up to 750C) and/or flow gas(es) during data acquisition. The capillary flow cell is shown in figure 13. The gas flow, temperature and pressure are remotely controlled with the ITQ-ALBA cabinet.

The construction and commissioning of the cell has been the result of the collaboration of a group of researchers of the Spanish community: Laura Barrio (from EQS group at ICP), Fernando Rey's group (from ITQ) and Atsushi Urakawa's group (from ICIQ) with the scientific staff of the MSPD beamline. The design is based on the design by Peter Chupas et. al.J. Appl. Cryst. (2008). 41, 822–824

This first user experiment of the cell has consisted in the in-situ structural characterization (by powder diffraction) of MOF-like metal phosphonates conducted under high CO_2 pressure. The research group of Dr. Cabeza, from the Department of Inorganic Chemistry (Universidad de Málaga) has studied the structural changes occurring *in situ* upon CO_2 uptake, conducted from 1 to 14 bar. Among the variable responses to CO_2 adsorption found, it is highlighted the high structural flexibility of $Mg[(HO_3PCH_2)_2N(H)(CH_2)_6N(H)(CH_2PO_3H)_2]\cdot 2H_2O$ ($MgHDTMP\cdot 2H_2O$) to accommodate CO_2 guest molecules. The 3D pillared open-framework (Figure 14a) exhibits a permanent splitting of the diffraction peaks upon CO_2 uptake, attributed to different conformations of the pillaring alkyl chains (Figure 14b and c).

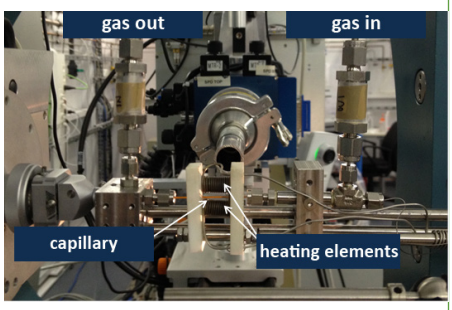


Figure 13. The ICP-ITQ-ICIQ-ALBA capillary flow cell installed at the MSPD beamline, in the powder diffraction endstation.

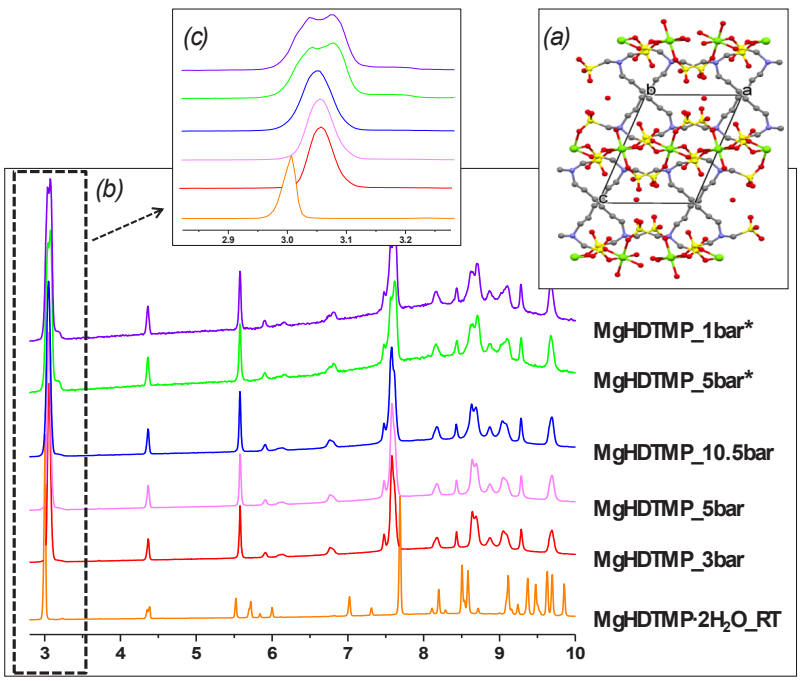


Figure 14. (a) View of the crystal structure of $MgHDTMP\cdot 2H_2O$ along the b-axis. (b) X-ray diffraction patterns at different CO_2 pressures. The inset (c) shows the evolution of the peaks during the CO_2 adsorption-desorption. (*desorption).

CHEMISTRY

First publication with data measured at CLAESS beamline

BL22 - CLAESS

A paper from a group of researchers from Finland, Czech Republic, Germany and Russia -led by Martina Stekrova- has been published in the journal "Applied Catalysis A: General". Part of the data of this research was acquired at CLAESS beamline.

The α-pinene is an organic compound obtained from turpentine oil and represents a valuable material for the production of compounds used by the chemical industry. In particular, the α-pinene oxide can be converted into different substances such as flavors, fragrances and pharmaceutical compounds.

Researchers have studied the isomerization process of α-pinene oxide over different catalysts. XANES and EXAFS spectra were recorded at beamline 22-CLAESS (and also at Hasylab) for analyzing a variety of Fe substrates heterogeneous catalysts in order to elucidate the influence of the support on the reactivity.

Reference: "Isomerization of α-pinene oxide using Fe-supported catalysts: Selective synthesis of campholenic aldehyde." M. Stekrova, N. Kumar, A. Aho, I. Sinev, W. Grünert, J. Dahl, J. Roine, S.S. Arzumanov, P. Mäki-Arvela, D. Yu Murzin. Applied Catalysis A: General 470 (2014) 162-176

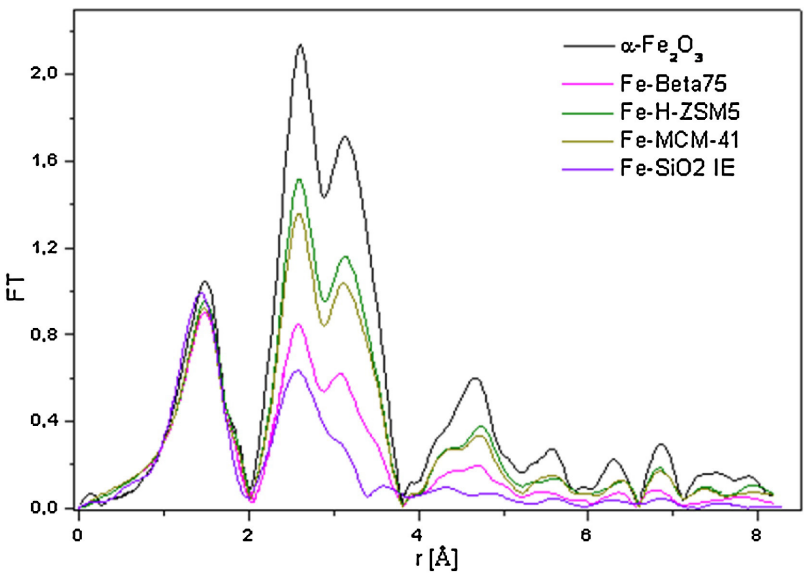


Figure 15: The image shows an EXAFS spectra (modulus of the Fourier- transformed, k2-weighted spectra) of samples under study compared with reference α -Fe_2O_3 spectrum.

MAGNETISM

First PhD thesis with results measured at BOREAS

BL29 - BOREAS

Eduardo Solano, from the Universitat Autònoma de Barcelona (UAB) and the Institut de Ciència de Materials de Barcelona (ICMAB-CSIC), obtained his PhD degree last November 2013 with a work about the synthesis of nanoparticles and the generation of new nanocomposite superconducting layers. Some of the measurements were acquired at BOREAS beamline in ALBA Synchrotron.

The objective of his PhD study was to generate new nanocomposite superconducting layers with magnetic ferrite nanoparticles embedded within the structure. To do so, he developed a new synthetic methodology to produce $MnFe_2O_4$ nanoparticles and embedded these nanostructures inside $YBa_2Cu_3O_{7-\delta}$ superconducting layers.

He used synchrotron radiation techniques, in particular X-Ray Magnetic Circular Dichroism (XMCD) at BOREAS beamline in ALBA to deeply study the structure, composition and behavior of the new nanoparticles in the nanocomposite.

Reference: "Synthesis and characterisation of ferrite nanoparticles for $YBa_2Cu_3O_{7-\delta}$ – Nanocomposite superconducting layers: a neutron and synchrotron study", Eduardo Solano, directors: Susana Ricart Miró (ICMAB-CSIC) and Josep Ros Badosa (UAB).

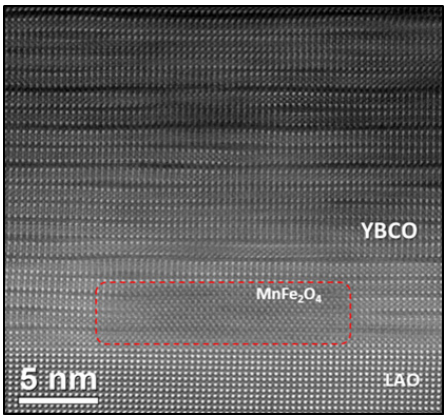


Figure 16: $MnFe_2O_4$ magnetic nanoparticles embedded in the $YBa_2Cu_3O_{7-\delta}$ superconducting matrix

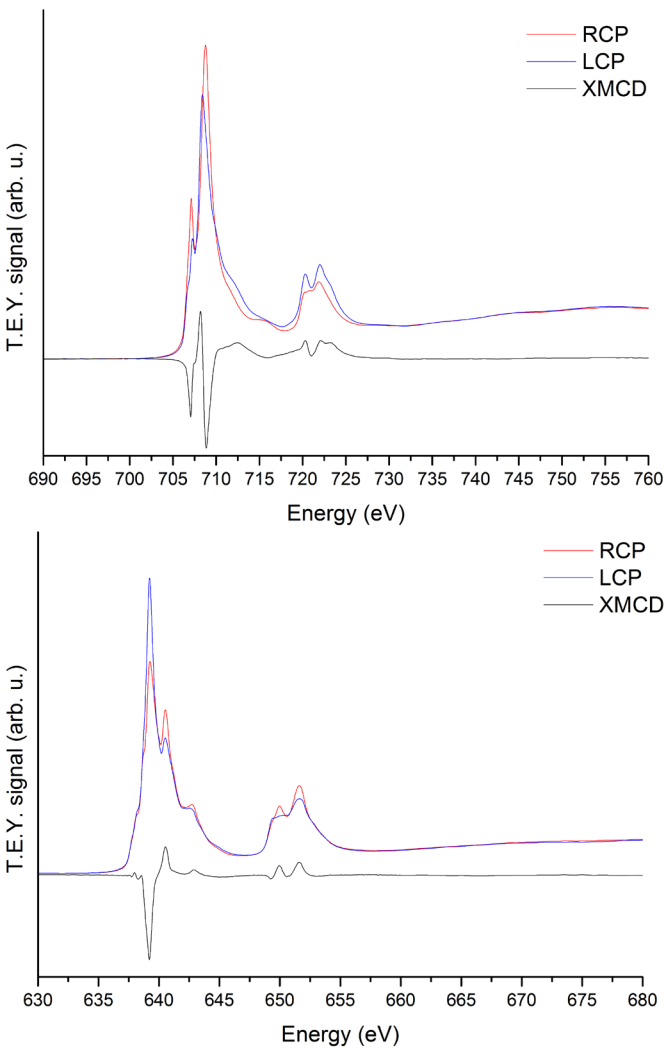


Figure 17 $MnFe_2O_4$ XMCD spectra obtained in BOREAS beamline: top, Fe edge; bottom, Mn edge.

CRYSFORMA characterizes polymorphs for the pharmaceutical industry at the ALBA Synchrotron

CRYSFORMA, a unit from the Institute of Chemical Research of Catalonia (ICIQ) managed by Dr. Jordi Cerón, provides complete scientific support to the pharmaceutical and fine chemistry industry in the field of pharmaceutical solid state development. CRYSFORMA is currently applying its expertise to use the ALBA synchrotron facilities in its projects in the area of polymorphism.

Polymorphism is the ability of a solid substance to crystallize in more than one crystalline structure, resulting from a different arrangement of the molecules within the crystal lattice. Each of these different crystalline phases are known as polymorphs. Polymorphs of Active Pharmaceutical Ingredients (APIs), although being the same chemical entity, can have different physicochemical properties, which can affect the bioavailability of the final drug, or its processability during the manufacturing process. For this reason polymorphs are of special interest in the pharmaceutical industry.

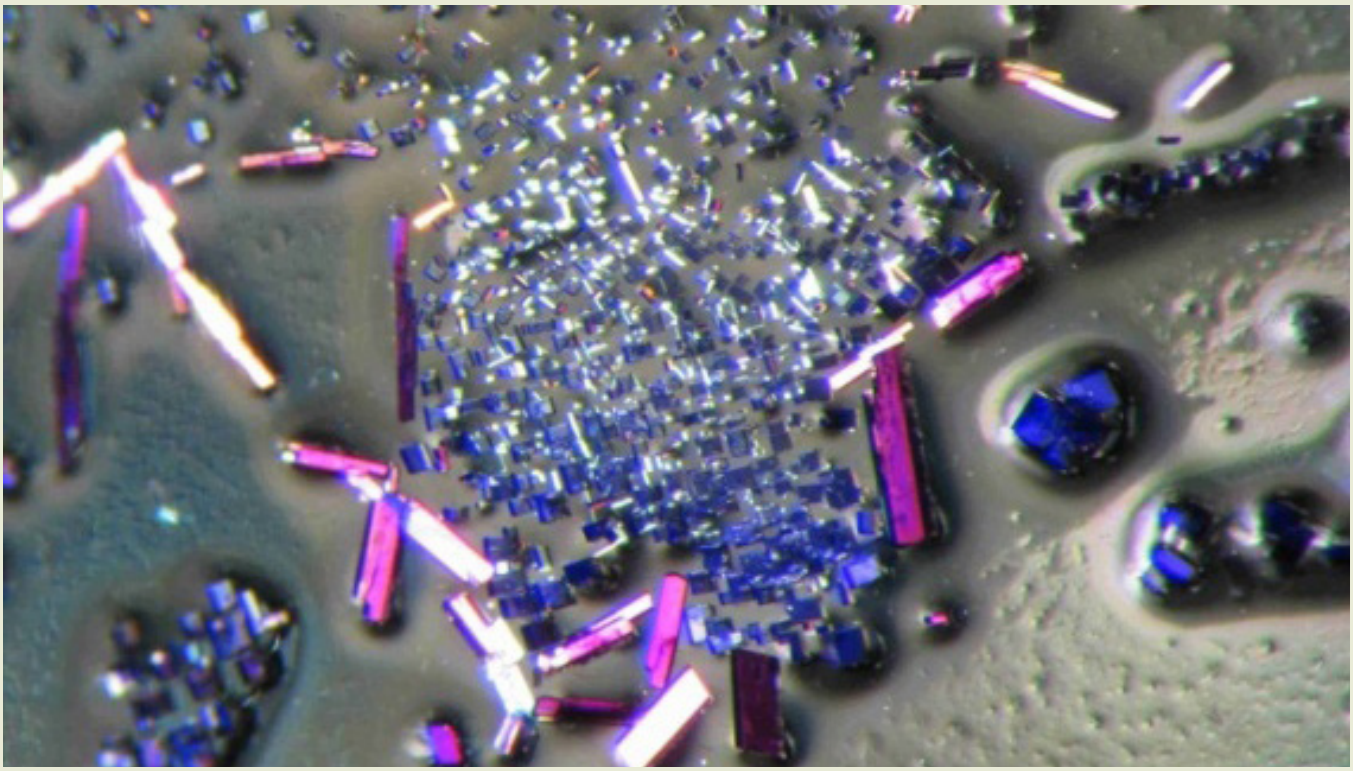
Powder X-ray diffraction (PXRD) is probably the most extended analytical technique in development and analytical laboratories to determine the polymorph present in an API or drug sample and to ensure the absence of undesired polymorphs. Although a standard laboratory PXRD diffractometer is a fairly powerful technique with a detection limit acceptably low (0.1-1% depending on the API), sometimes even lower quantities of an undesired polymorph need to be detected in order to avoid transformation (due to microseeding), to comply with regulatory aspects or to avoid any legal issues concerning patent infringement.

These technical principles can be applied using the high energy synchrotron light at ALBA (beamline BL04 - MSPD: Materials Science and Powder Diffraction), giving more sensitive data and a much better peak resolution. Thus, the signal intensity compared to the background noise is increased, and the broadness of signals is reduced, which allows lowering the detection limit in a much shorter time of analysis.

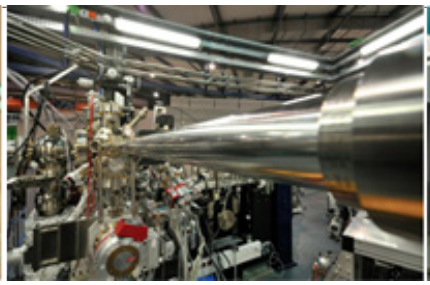
CRYSFORMA is currently using the ALBA synchrotron facilities to solve different issues concerning the characterization of the solid state of APIs, offering the service of analysis and data interpretation to the pharmaceutical industry.

Further information:
www.iciq.com
www.crysforma.com

CRYSFORMA
crystallization solutions



Microphotography of crystals with different morphology corresponding to different polymorphs. Image courtesy of CRYSFORMA.



Prof. Jianhua He, from SSRF, during his presentation. Photograph: ALBA.

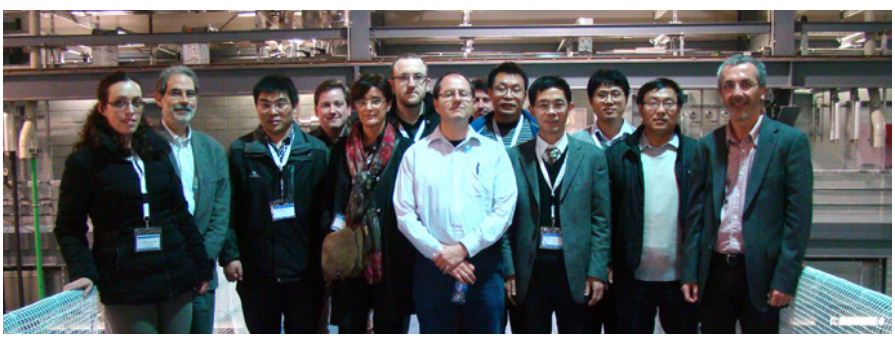
Bilateral workshop between ALBA and SSRF

Last December the first bilateral ALBA-SSRF workshop was held at the ALBA premises, in Cerdanyola del Vallès. ALBA and the Shanghai Synchrotron Radiation Facility (SSRF) have shown the will, with this first workshop, of strengthening their mutual collaboration and finding synergies and common interests.

The workshop lasted three days and was focused on analyzing the R&D activities of both facilities in a number of selected areas, where mutual interest had been identified previously, such as soft X-ray beamlines, controls, radiofrequency, optics and metrology, among others. The Chinese delegation, led by Prof. Jianhua He, SSRF deputy director and leader of the Life science area, had the chance to know first-hand the ALBA facilities and share with ALBA staff a focused view of both labs' activities in areas of common interest. The meeting included the presence of several Spanish science industry companies, invited by ALBA (with the assistance of CDTI) in order to foster collaboration opportunities with the Chinese institution.

The meeting finished with a joint wrap-up session in which the ALBA director, Caterina Biscari, and SSRF deputy director, Prof. Jianhua He, stressed the interest of both institutions on exploring specific joint collaborations and stating the will of doing a second workshop, presumably within the first half of 2015, this time in Shanghai.

SSRF is one of the most important scientific facilities of China. It is a third generation synchrotron light source with operational parameters not far from those of ALBA. Furthermore, both facilities have come into operation with a difference of only a few years. Both projects have been challenging for the respective communities and in both cases the result has been a successfully operating facility, with the potential of becoming an excellence hub for science and innovation. SSRF, which started operations with an initial portfolio of seven beamlines, similarly to ALBA, is now strongly engaged in a rapid growth, involving many new beamlines for diverse applications.



Delegates from SSRF and ALBA management at the experimental hall. Photograph: ALBA.

Photograph taken during the poster session held at the ALBA Experimental Hall. Photograph: ALBA.

Spreading ALBA possibilities among those researchers not familiar with synchrotron radiation

From November 14th to 15th 2013, a workshop entitled: "ALBA Synchrotron, new instrumentation for Nanoscience and Molecular Materials Characterization" took place in ALBA. The main objective was to promote the use of synchrotron light among those researchers still being unfamiliar with the associated instrumentation and its analytical possibilities.

During the first day, there were different presentations by ALBA scientists describing the available tools and the potential of the current ALBA beamlines. The second day consisted of a visit to the experimental hall to see the tools previously described, and a poster session. The poster session showed an overview of the attendants' own research in order to discuss with ALBA staff about the synchrotron instrumentation that could be applied to succeed in their scientific challenges.

The attendance limit was reached, with up to 50 persons participating in this workshop and ALBA staff received a very positive feedback. Encouraged by the good acceptance, ALBA plans to continue with similar activities aiming at disseminating the different techniques currently available at ALBA and those which are considered for future developments according to the needs of the user community.

This workshop was an ALBA initiative co-funded by ALBA and the "Grupo Especializado en Nanociencia y Materiales Moleculares" (MAM) from the "Real Sociedad Española de Química (RSEQ) y de Física (RSEF) ".

58 ALBA volunteers gave explanations and assisted visitors during the ALBA Open Day. Photograph: Pepo Segura.

More than 1.500 visitors participated in the ALBA Open Day

In spite of the non-optimum weather conditions, on Saturday 16th November 2013, the ALBA Synchrotron opened its doors to 1.584 visitors. Following an itinerary of about one hour and 30 minutes, visitors had the opportunity to learn from ALBA scientists and technicians what a synchrotron is, how it works and which its main applications are. One of the most successful novelties of this year were the activities arranged for kids.

For the second year in a row, the ALBA Synchrotron opened its doors to the public to explain the aim and main features of the Spanish synchrotron radiation facility. 1,584 people attended the ALBA Open Day in spite of the rough weather, showing their interest and passion for science.

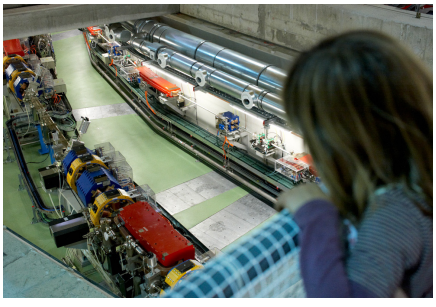
The visit was organized around a circuit with several exhibition areas. Visitors were able to see the devices through which the electrons pass, observe the interior of the accelerator's tunnel – which was only opened on occasion – and ask and talk to ALBA scientists and technicians, who participated in the event as volunteers.

According to Caterina Biscari, director of the ALBA Synchrotron, it is essential to get the society to know the activity developed in ALBA. "We are a public service, so it is very important that people know what we do here, why we do it and the possibilities for current and future scientists in our facility".

The ALBA Synchrotron has developed an outreach program, which includes the organization of the ALBA Open Day as well as guided tours inside the facility. In 2013, the ALBA Synchrotron has already received more than 5,000 visitors.

Explaining the function of bending magnets in the Accelerators area. Photograph: Pepo Segura.

The ALBA Open Day was organized with the support of the Spanish Foundation for Science and Technology (FECYT), the Spanish Ministry of Economy and Competitiveness, the Catalan Government and the sponsorship of La Caixa Foundation and Banc de Sabadell.



View of the ALBA tunnel opened on occasion for the ALBA Open Day. Photograph: Pepo Segura

One of the practical activities organized with teachers to demonstrate Lorentz force. Photograph: ALBA.

High school teachers learned about synchrotron light

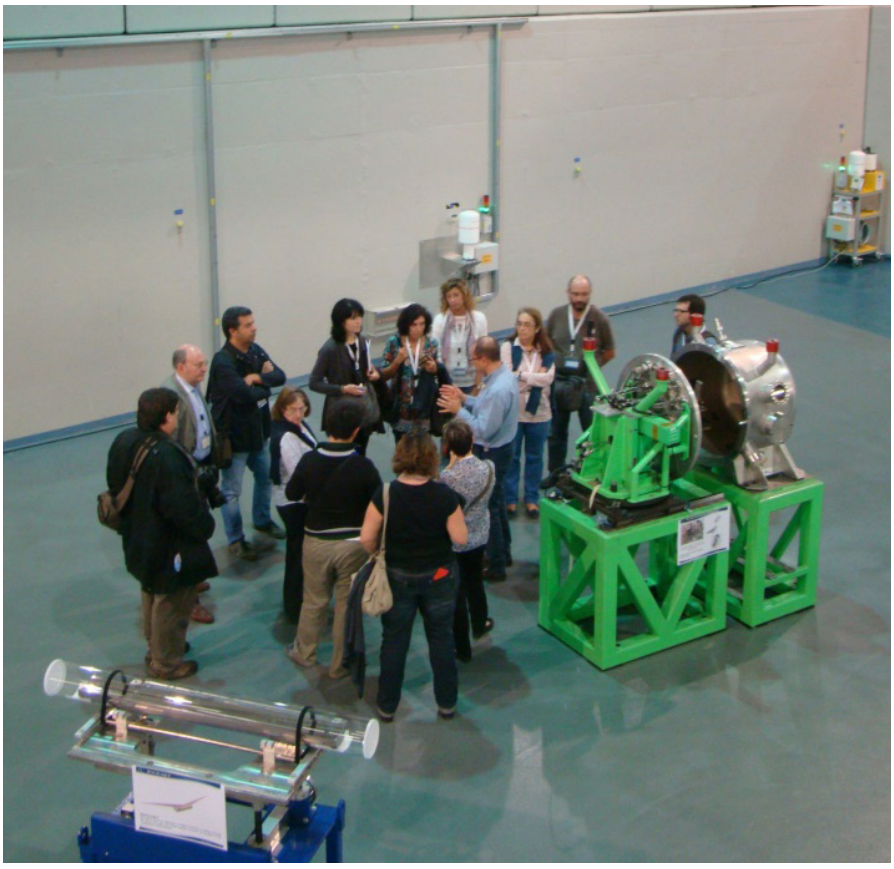
November 6th and 8th 2013, the ALBA Synchrotron and the Catalunya-La Pedrera Foundation organized a seminar for high school teachers in order to increase their knowledge of synchrotron light and its properties. The seminar combined theoretic and practical contents, materials and examples to be used with students in the classroom and a visit to ALBA's facilities.

31 high school teachers from varied scientific fields and different parts of Catalonia attended the two-day seminar organized by the ALBA Synchrotron and the Catalunya-La Pedrera Foundation. This seminar was included inside the 5th edition of "Teachers and Science" program, whose objective is establishing contact between high school teachers and research centers with the aim of improving the specialized knowledge of teachers.

The seminar explored the physical principles behind the synchrotron light as well as its diverse applications in different scientific areas, including practical and do-it-yourself activities for students. It was conducted by Gaston García, deputy director of ALBA, Salvador Ferrer, director's associate of ALBA, and Montse Pont, section head of Accelerator Operations.

The results were very positive because the participation was very high and contents of the seminar were extremely appreciated by participants.

Lecture about particle accelerators and synchrotron light facilities by Montse Pont. Photograph: ALBA.



Teachers visiting ALBA's facilities during the seminar. Photograph: ALBA.

Pictures of recent incorporations in ALBA. Photograph: ALBA

New faces in ALBA

During the last months, the ALBA Synchrotron has welcome new staff on board. Experiments division has incorporated five new people. The Accelerators division, the Engineering division, the Computing division and the Industrial office of ALBA have also new staff.

● Four new scientists have started working inside the Experiments division of ALBA. They are Ana Pérez (MISTRAL beamline), Eva Crossas (NCD beamline), Oriol Vallcorba (MSPD beamline) and Pablo Pedreira (Optics and Metrology). Robert Oliete (beamline technician) completes the total number of new staff of the Experiments Division.

The Accelerators division also counts with the support of two new operators: Juan Carlos Giraldo and Andryi Nosych.

Two new engineers work at the Engineering division. They are Joaquín González and Raquel Monge.

Finally, Antoni Fernández joined the Computing division and Núria Valls is the scientist of the Industrial office.

Caterina Biscari and Pietro Sebastiani at the embassy of Italy in Madrid. Photograph: ALBA

Award of the Italian government to Caterina Biscari

On November 30th 2013, the director of the ALBA Synchrotron was awarded by the ambassador of Italy, Pietro Sebastiani, with the "Ufficiale dell'Ordine della Stella d'Italia" for her contribution to strengthen links between Italy and Spain.

● Last 30th November 2013, Caterina Biscari, director of the ALBA Synchrotron, received at the embassy of Italy in Madrid the recognition "Ufficiale dell'Ordine della Stella d'Italia" for her role in promoting and improving the relationship between Italy and Spain.

The award "Ufficiale dell'Ordine della Stella d'Italia" (Order of the Star of Italy) is given by the President of the Italian Republic to Italian citizens who live abroad or foreigners who benefit the relationship of Italy with other countries.

The scientific director of ALBA has been elected vice-president of the ESRF Council

During the 60th meeting of the European Synchrotron Radiation Facility (ESRF) Council, held last 25th November 2013, Miguel Ángel García Aranda, scientific director of the ALBA Synchrotron, was elected vice-president of the ESRF Council. García Aranda combines his position at the ESRF Council with his current position as scientific director of ALBA since the 1st January 2014.

● Miguel Ángel García Aranda, PhD in Chemistry at the University of Málaga, is bringing his wide experience in the field of synchrotron radiation to the ESRF Council since the 1st January 2014. The European Synchrotron Radiation Facility (ESRF) is the 3rd generation European synchrotron with an annual budget of 97 M€. Nowadays, it is finishing its phase I upgrade while it is programming a phase II upgrade, which includes a new storage ring to lower the emittance from 4000 to 150 picometres.

Miguel Ángel García Aranda is the scientific director of the ALBA Synchrotron since September 2012.

Andreu Mas-Colell. Photograph: Generalitat de Catalunya

Interview with Andreu Mas-Colell

Minister of Economy and Knowledge of the Catalan Government since 2010, Professor Andreu Mas-Colell chairs the Board of Trustees of the ALBA Synchrotron. He contributes to this issue of the ALBA Newsletter debating on the state of the art of European research and shedding some light on how the ALBA Synchrotron enhances the Catalan and the Spanish scientific environment.

• How would you deem the progress of science in Europe over the past 10 years?
There have been three major developments. In the first place the launching of the European Research Area and the Higher Education European Space as key tools towards fostering a more integrated European research. In the second place, unlike a decade ago, research and innovation policies are aligned. And third, European research is increasingly committed to social challenges, which often fosters multidisciplinary approaches.

• How would you qualify the current situation of research in Europe, Spain and Catalonia?
At European level I think the European Council made the right diagnose in Lisbon. However the targets of the Lisbon strategy were unrealistic. We are now committed to a strategy (Europe 2020) less ambitious but more realistic: aimed at avoiding decline. The target is not anymore catching the US R&D system but to avoid being pushed aside by emerging systems. China, for instance, has increased its R&D expenditure by 430% since 2000, and in 2012 reached 1.98% of its GDP. As for Spain and Catalonia, the economic crisis interrupted the trend of the previous decade: increases of public funds that enabled our R&D system to undergo a great leap forward. The Catalan R&D system is dealing with the crisis in a reasonable way. Proof of this is that the share of funding attracted from FP7 has steadily increased since it was launched in 2007. Also, a strong commitment to R&D has been maintained. Although some cuts have been necessary, we have given priority treatment –even with budget increases– to the excellence axes: talent attraction, research centres and large infrastructures. Our current challenge is to consolidate the strength achieved and to enhance the private funding in R&D activities.

"Our current challenge is to consolidate the strength achieved and to enhance the private funding in R&D activities"

• Do you consider that there is social perception of this progress? Or is citizenship largely unaware of it?
It largely depends on the country. Traditionally, science has been more present in the "mental landscape" of the North than the South. But this is changing. And I am certain that between us social attention will further turn towards science as it becomes evident that we need a model of society based on knowledge. For instance, Catalonia has the honour of having the scientific Telethon with the highest crowd-funding per capita in the world. Indeed, Catalan society is starting to integrate the message that research is one of our strongest capacities.

There is a good political message behind any large infrastructure: 'we are committed to science'.

• What are the main challenges of European research?
We need more private involvement. Also, the institutional landscape is still too fragmented. Networks give strength but powerful nodes are indispensable for excellence. If we refer to goals, we should not forget about the social challenges: research and innovation not only with the purpose of a wiser and richer society but also for the sake of a sustainable and socially inclusive growth.

"Catalan society is starting to integrate the message that research is one of our strongest capacities"

• Do you think that the European research system should undergo a particular change?
Currently, R&D activities are embedded into different "system layers" that are not always coordinated. This lack of coordination may lead to either duplicities or gaps resulting on a waste of resources and missed opportunities. The aim of an "overall strategy" is behind the Regional Innovation for Smart Specialisation Strategies (RIS3), a very good development that reemphasizes the recognition of R&D activities as engines for economic and social progress and in this perspective links the objectives of Horizon 2020 and of structural funds policies.

• What is the role of large research infrastructures in the development of scientific excellence?
Large infrastructures require large investments, which only make sense when there is a large demand from the scientific community. This means that they are meant to be shared, and therefore they must be open to a scientific community as broad as possible. Naturally a careful global long run and collaborative strategy is required, such as the road map drawn by the European Strategy Forum on Research Infrastructures (ESFRI).

• Regarding the ALBA Synchrotron, which is its contribution to the enhancement of Science in Catalonia and Spain?
First of all, there is a good political message behind any large infrastructure: "we are committed to science". The costs for public finances is so considerable that it is unthinkable that any Government would involve itself with a large infrastructure unless there is a sound, long run, commitment, or at least developing it at the same time. Secondly, the ALBA synchrotron is not only one of the largest scientific facilities within Spain but also a very singular one: it's the first synchrotron light laboratory in South-western Europe of interest to many scientific areas, spanning from archaeology to biochemistry. So far, this feature has been attested by R&D activities funded mainly by the public sector. The challenge now is gaining a similar interest from private firms.

• Within the current economic crisis, brain drain has become a threat. What measures could foster attracting and retaining scientific talent?
Mobility is at the very root of research. The question for the European Research Area, is: as a whole, are we loosing or gaining talent? My impression is that we are still gaining, probably not as much as we would like to, but nevertheless still gaining. As for ourselves, in Catalonia the Government maintains its bet for talent attraction (including retention and recovery) which is implemented through the ICREA programme.
We should remove any barrier constraining the recruitment of scientific talent regardless of its origin. This idea is at the very heart of the European Charter for Researchers. Consequently, all Research calls of the European Union should be open to the scientific community beyond the EU limits. This is the case, with some success, for the European Research Council. It is also so for all research calls of the Catalan Government, where nearly 50% of the grants are awarded to non-Spanish researchers.

• How else has the economic crisis affected scientific development?
The recent Innovation Union Scoreboards show that one of the effects of the economic crisis has been the halting of a trend of slow, but steady, internal convergence between the different R&D systems within the EU. This can only be viewed as a deplorable development. Either an open, competitive, integrated European Research Area fosters convergence, or in the long run it is threatened.

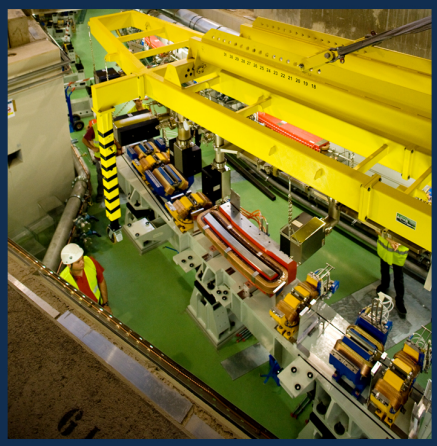
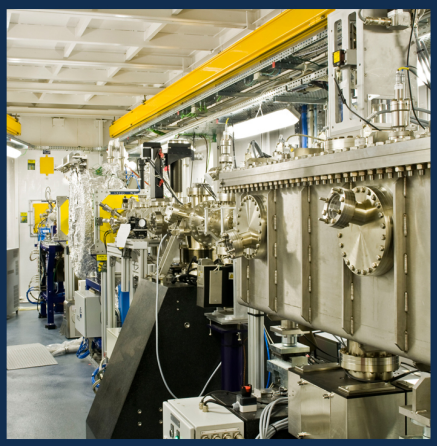
ALBA

INDUSTRY EVENT

Synchrotron applications for **chemical and materials companies**

15th April 2014
ALBA Synchrotron

Registrations open!

More information
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