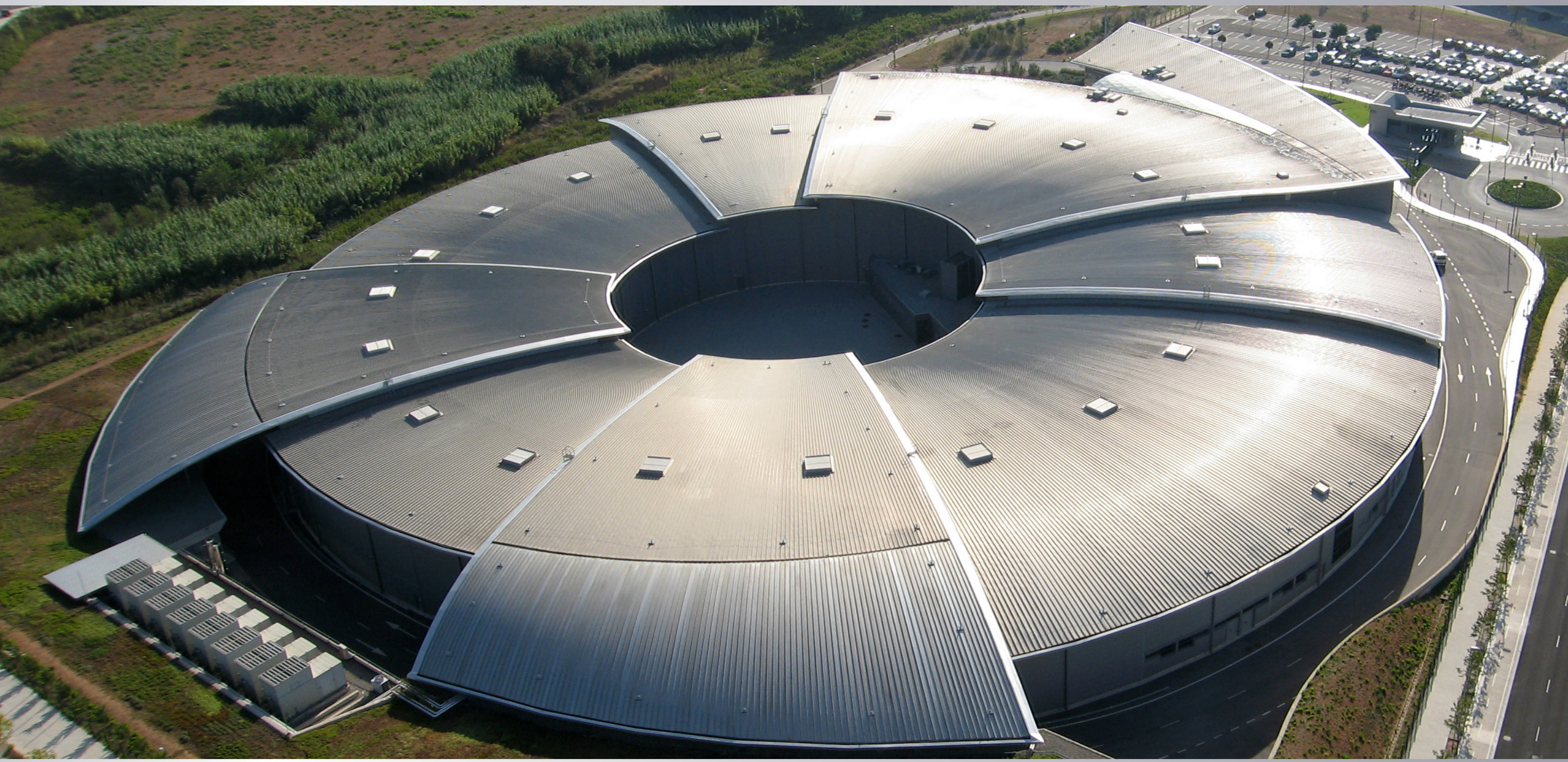

ALBA

# STRATEGY PLAN 2017 - 2020

MAY 2018

Generalitat de Catalunya
Departament d'Empresa i Coneixement

GOBIERNO DE ESPAÑA
MINISTERIO DE ECONOMÍA, INDUSTRIA Y COMPETITIVIDAD

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ALBA synchrotron light source is an instrument for providing solutions to societal challenges, from health to energy production and storage, from environmental defies to communication advances, from understanding to preserving our cultural heritage. It is managed by the Consortium for the Construction, Equipment and Exploitation of a Synchrotron Light Laboratory (CELLS) and is in exploitation since 2012. It is included in the Spanish Map of *Infraestructuras Científico-Técnicas Singulares* (ICTS), and is a public entity participated by the Spanish and Catalan Governments. It is the only user facility of this kind in the southwest of Europe and it is open to access to users from the public sector and from private entities. The infrastructure contains the accelerator systems where the 3GeV electron beam produces synchrotron radiation, the beamlines (BLs) where the synchrotron light is exploited, and several ancillary laboratories.

ALBA is situated in the *Parc de l'Alba*, a public consortium of 340 ha, 60 of them devoted to research, development and innovation, of which CELLS owns a part corresponding to 6 ha. The *Parc* is being slowly occupied mainly by technological companies. The possibility of including other scientific infrastructures is open. Examples are cited in the last part of this document 4.2.16.

In a nutshell we consider that in a decade from now ALBA must have about 20 operating beamlines maintaining day ones fully competitive, with an average of some 4000 users per year. This will correspond to a community of synchrotron radiation Spanish users comparable to other European countries similar in size and research level. Let us recall that the last estimate of the overall European user community ranges in about 25000 users [1].

We aim at doubling during next decade the number of the exclusively industrial customers. To be mentioned that a significant fraction of industrial usage develops through the open innovation, in cooperation with academic research and included in the competitive access to the facility. This trend is expected to increase in the next period, also thanks to the EU Commission engagement in this sense.

CELLS must continue its contribution to fill the technological gap of national high level companies related to accelerator technologies as for example those grouped under "Inducienca" [2].

As a consequence, the main priorities in the next decade will be

- Complete the BL portfolio to ca. 20 BLs, considering that this a reasonable number when taking into account the foreseen evolution of the national scientific community and the offer from other synchrotrons
- Progress in the specialization on the techniques aiming at further developing the scientific priorities (nanomagnetism, catalysis, drug design and characterization, energy related materials)
- Maintain the excellent level in operation, reliability, user support and safety
- Exploit in new projects the present leading position in control system design and operation
- Further develop BL optical design and metrology capacities
- Maintain national leadership for accelerator science and technologies and their transfer to industries
- Start the preparation of the upgrade towards diffraction limited storage ring (ALBA II)

The participation in the recently created League of European Accelerator-based Photon Sources (LEAPS [3]) will enable ALBA to better identify those niches and necessities not only at national but also at international level that will value the facility. One strong point is to become a reference centre for Synchrotron Radiation (SR) for the Middle East and North Africa with new Partner BLs or Association Agreements, possibly to be extended to Latin-American countries.

# 1. ANALYSIS OF COMPLIANCE WITH THE PREVIOUS STRATEGIC PLAN

A first ALBA Strategic Plan (SP) was produced in 2009 for the period 2010-2014 [4], and a second one in 2013 for the period 2013-2016 [5]. Both plans, requested by the Spanish administration involved in the consortium, were successfully evaluated by external panels.

In general terms ALBA has fulfilled its Mission as stated in the previous SP, "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", and has complied with its Vision, "to research in, deliver and maintain methods and techniques with which to conduct cutting edge Synchrotron Light based research and development, in such a way that knowledge and added value are pumped 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".

The general economic crisis started in 2008 has implied a considerable general reduction of the science budget in Spain. ALBA has been one of the few facilities whose operation budget has not suffered cuts, however some of the more ambitious plans foreseen in the 2013-2016 SP could not be encountered due to the lack of the needed new investments.

ALBA economy up to 2016 has been based on the plurennial budget approved in 2008, which covers operation of the infrastructure with Phase I BL and only 3000 hours of operation per year. Nevertheless, ALBA has over performed in BL and operation hours per year with respect to the provisions of the assigned budgets. European Regional Development Funds (ERDF) and other public sources (16 M€), corresponding to the 2014-2020 period, were assigned to ALBA to be cofunded with the same amount to provide 32 M€ for new investments. These funds have started to be delivered only in 2017.

Figure 1 shows the budget evolution (not including the loan return) during the period 2013-16, together with what was requested in the 2013-16 SP. The funding gap (the difference between what was foreseen in the SP and the effective income) during this period amounts to 40M€, of which 7.5 have been covered with income from industrial usage, saving and remnants. In spite of the evidence that accomplishing what was described in the SP four years ago has been out of reach, we can proudly show that a large part of the plan has been accomplished, and new projects have been started, applying a careful and austere budget administration. The achievements of the actions proposed in the last SP, together with what has not been achieved and the principal reasons why this has happened are hereby listed.

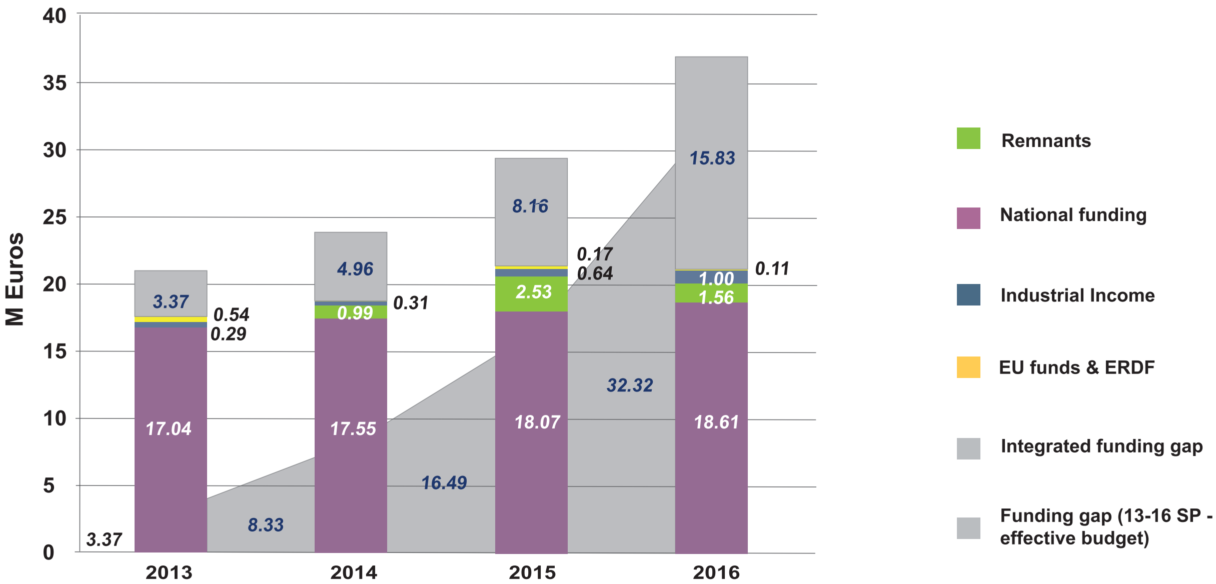



Figure 1 – Requested Budget and Budget Gap evolution during the 2013-2016 period (excluding loan return).

The main goals proposed for the period 2013-2016 were summarized as:

- Ramp up the number of operating hours/year to 6000.
- Bring the current accelerator and beam-lines to full exploitation conditions by 2016.

- Increase and consolidate the community of non-proprietary users, with a continuous improvement policy, based on having user service as a priority.
- Generate and retain a client portfolio of proprietary users.
- Initiate a new BL program with the construction at a rate of two BL every year, with a construction/ commissioning time of four years per BL, so that by the year 2026 the facility were operating at full capacity.
- Launch an accelerator upgrade program to expand the capabilities of the current one.
- Study different possibilities for a new photon sources program including collaboration with other infrastructures.

The first four points have been accomplished while the remaining three only partially. Details can be found in the associated document [6]

- Yearly operational hours have progressively increased from 4464 in 2013 to 5744 hours in 2016.
- Top up injection has been implemented and the accelerator current has reached 150 mA at the end of 2016. The seven Phase I BL have been operative for external users during the whole period and a new BL (MIRAS) has come into operation during 2016.
- The non-proprietary user community is consolidated with an average overbooking factor of 2. More than one thousand users in 2016 have visited the facility after obtaining beamtime through the competitive calls, of which one third corresponds to international users.
- A portfolio of more than 20 proprietary users (part of them not from Spain) by the end of 2016, with an increasing trend, is consolidated. More than 350 hours of beam time has been offered during 2016.
- The lack of new investment funds has obliged to reconsider the construction of new BLs: a rhythm of starting one BL per year since 2014 has been maintained with an accurate planning of economic and staff investments. The two Phase II BL were started in 2014 and 2015: MIRAS, dedicated to infrared spectroscopy and operational since 2016, and LOREA, for low-energy ultra-high resolution angle resolved photoemission. Six projects constitute the Phase III program, whose definition procedure was completed in 2014: call for proposals open to the scientific community, selection and assessment by the Scientific Advisory Committee (SAC), and approval by Governing Bodies. The construction of the first Phase III BL, XAIRA, dedicated to macromolecular crystallography with microbeam, started in 2016.
- As far as the accelerator program the current has been increased to 150 mA, which has proven to provide a photon flux constant and adequate for these first years of operation. The increase up to the nominal current, 250 mA, has been postponed due to radio frequency (RF) power supply problems of reliability for which an intensive program for IOTs replacement has been successfully completed in 2017. Photon beam availability has been 97.6% in 2016 (98.3 % in 2017) and it has been privileged towards high photon flux. Top up injection and all feedback systems are operational. The 3rd Harmonic Cavity, which needs a substantial investment, has been postponed.
- Several collaborations have been promoted with other infrastructures. A system of partnership (Partner BLs, PBL) and Collaboration Agreements (such as the one with the Iranian ILSF) has been established. The study of different possibilities for new photon sources program has been postponed.

Additionally the completion of the CLEAR instrument in CLAESS BL and the MARES end station at BOREAS BL have been accomplished; other continuous upgrades in all BLs to keep them at the technology forefront have been carried out; the construction and equipment of ancillary laboratories has been completed; and a large and fruitful effort has been devoted to computer and control development and electronics to improve BL performances and service to users.

# 2. MISSION AND VISION

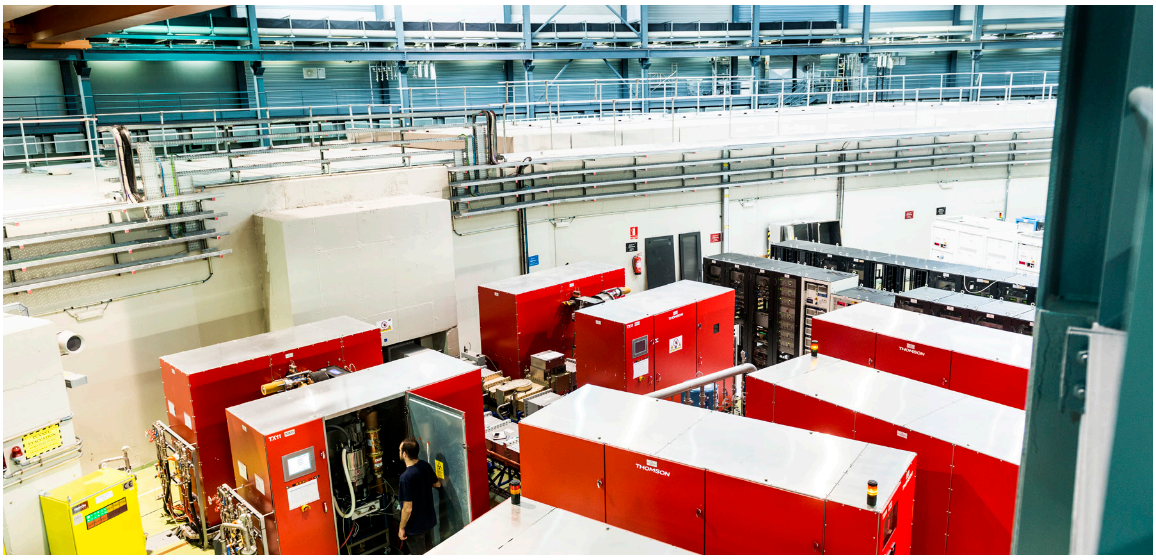
Our vision and mission are built on ALBA values of honesty, equality, social responsibility, and sustainability.

## 2.1. MISSION

- Contribute to the improvement of well-being and progress of society as a whole through provision of scientific instruments dedicated to solving societal challenges such as health, environment, energy and communication.
- Be a center of excellence in synchrotron radiation (SR) science and technology at European level and consolidate the status of CELLS as a recognized world class facility in its field.

## 2.2. VISION

- Provide access at state of the art experimental techniques based on SR to academic and industrial scientific communities improving its methods and techniques.
- Foster development and innovation of the Spanish scientific community and industrial environment to strengthen its competitiveness in a rapidly evolving world as the largest national scientific user facility in Spain.
- Collaborate with similar facilities in promoting the quality and impact of the fundamental, applied and industrial research carried out at the respective installations.
- Inspire a new generation of scientists, engineers and administrators and participate actively in the education of society in science and technology and in its public perception.
- Operate in a safe, healthy and attractive environment for staff, users, students and collaborators.
- Offer to the international community those instruments which are unique or which complement other light sources capacities.
- Increase the internationalization of CELLS through PBL and Collaboration Agreements.
- Endorse and support the development of complementary and synergetic research facilities.



## 3.1. STRENGTHS

- Reference laboratory in Spain for usage of SR methods in basic and applied scientific research activities, public and private.
- Reference laboratory in Spain for Accelerator Science and Technology.
- State of the art experimental facilities including cutting-edge scientific instruments and technical services and laboratories.
- Multidisciplinary areas of research coexisting on the same large infrastructure.
- Driving force for industrial applications and technological transfer.
- Reference institution at national level for conventional and radiological safety culture for complex infrastructures.
- Experience on administration of multi user large facility.
- Experience in scientific and technical international collaborations.
- Capacity for training personnel of different education levels.
- Dissemination of scientific knowledge in the society thanks to an extensive outreach plan.
- Multicultural/international staff, flexible internal organization, young staff and a certain gender equilibrium, good in comparison with similar facilities.
- Possibilities of implementing new BLs and experimental techniques due to the capacity of the experimental hall.

## 3.2. WEAKNESSES

- Limited number of BLs and related SR techniques to fully exploit the infrastructure capacities.
- Possible lack of adequate reaction to instrument obsolescence due to limited fund availability.
- Limited staff number in risk of saturation, hampering self-driven development capacities for the facility, its technology and social impact.
- No access to common R&D national excellency certifications in spite of demonstrated excellence in characteristic performance indicators.
- No possibility of financing general transnational access by own present funds.

## 3.3. OPPORTUNITIES

- Further collaboration with the nearby universities and related research centers.
- Possibility of ERDF reception with a 50% co-financing.
- Capacity for attracting collaborations by means of PBL and Association Agreements, with particular attention to the Middle East, North Africa and Latino America.
- Operation during the forthcoming dark period of synchrotrons upgrading to low emittance lattices (i.e. ESRF-EBS [7]) for academic and industrial user attraction.
- Possibility to become a nanoscience and structural biology service center.
- Excellent location close to the Barcelona universities cluster with advanced research institutes, industries and facilities.

## 3.4. THREATS

- Lack of access to solid/stable funds for developing strong personnel and infrastructure strategies with present financial forecast as established in 2008 based on minimum assumptions of operation time and operating instruments.
- Hampered attraction and maintenance capacities of expert staff due to salary, contract regulations, administrative and budget constraints and to the risk of regional political instability.
- Weak involvement of national industries into R&D activities if compared to other EU countries.
- Legal framework for the consortium status, administrative ties, limits for labor contracts and budgets not well adapted to R&D, risking jeopardizing the scientific excellence of the facility.
- Risk of lagging behind EU photon sources and other fore-front laboratories due to non-adequate investment capabilities.

- Risk of not attracting competitive companies for tenders due to small volume contracts and administrative complexities.
- Spanish economic reduction in R&D during the last lustrum which imply restrictions in user research groups.
- Not enough visibility for the general public, due to the weak national societal and politic interest towards science.
- Further delay in the *Parc de l'ALBA* development around the facility which has a non-exploited capability in terms of infrastructures and high tech companies.

# 4. OBJECTIVES OF THE NEXT FOUR-YEAR PERIOD

The main ALBA objectives for the 2017-2020 period are meant to improve the capacities of serving the society and the community of SR users.

## 4.1. DESCRIPTION OF THE OBJECTIVES

### 4.1.1. Prioritize scientific research

ALBA is a multidisciplinary instrument, and its user community covers a wide variety of scientific fields, as shown in Figure 2, where the example of 2017 granted proposals is shown. Existing capabilities will thoughtfully be maintained with special emphasis in ***operation excellence***, and improved to satisfy user demands. At the same time special attention will be dedicated to increase the capacities in four ***priority scientific areas***, hereafter described, related with national and European societal challenges as defined in research plans and H2020. Collaborations at national and international level will be bolstered to this end.

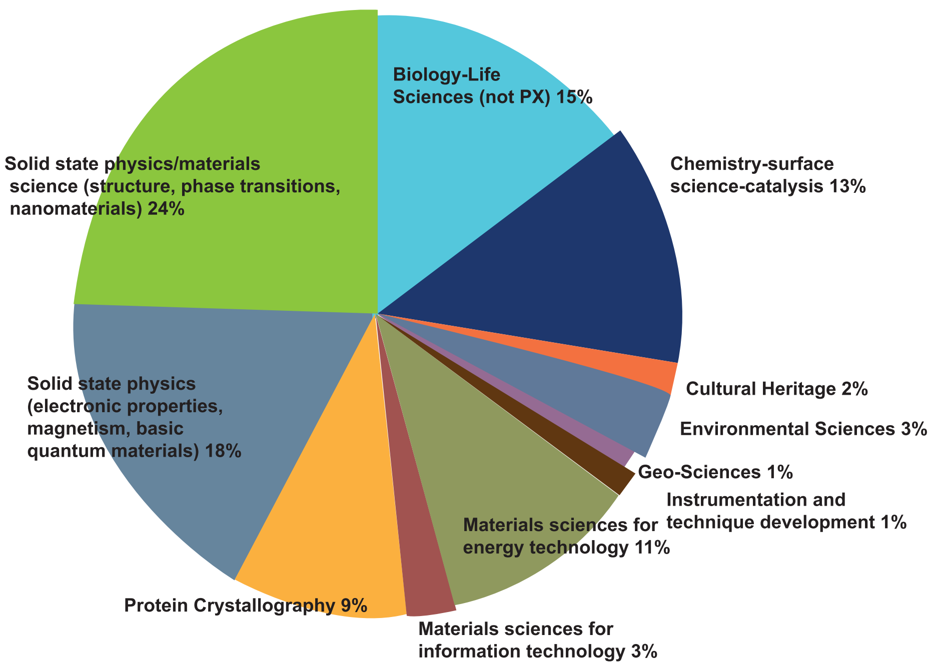



Figure 2 – Research area of proposals granted during 2017

***a) Drug design and characterization and biological processes involving drugs.***

Synchrotron radiation is a potent allied for successfully taking on health challenges, from infectious, age-related, genetic, cardiovascular and cancerous diseases, to drug developments or food industry improvement in terms of quality, sustainability and waste reduction. On average almost 20% of all scientific articles published by European light sources are related to biological research. ALBA is powerfully participating in better understanding basic processes behind pathogenic processes and the emergence of drug resistance and therefore in improving treatments. 3D imaging down to the cellular level is a reality in MISTRAL [8]; proteins are resolved in XALOC [9]; SAXS for scattering of biological macromolecules and diffraction on fibrous materials is available at NCD [10]; and the Infrared (IR) spectroscopy and microscopy of MIRAS [11] is extensively used for tissue examination.

The construction of XAIRA [12] and FaXToR [13] will enhance present capabilities. Skiron [14] would allow investigating secondary structure of proteins.
Additionally, cryo-transmission electron microscopy in collaboration with other institutes will be carefully considered as a future implementation due to its high impact in structural biology.

***b) Magnetic nanomaterials***

High scientific activity worldwide in nanomagnetism is specially driven by requests in computer technology and is expected to increase in the future. At BOREAS [15], CIRCE [16] and also MISTRAL, through the magnetic dichroism effect, state of the art research in nanomagnetism producing high impact publications is being performed. CIRCE and MISTRAL produce magnetic images of surface and of buried interfaces respectively, and BOREAS can precisely determine the magnetization of extremely diluted samples under high magnetic fields and low temperatures. Current developments with high future expectations include the implementation of a reflectometer in BOREAS especially suited for research in magnetization depth profile, magnetic and electronic nanoscale ordering; the pump-probe experiments at CIRCE for magnetic dynamics; and the development of vectorial tomography at MISTRAL for determining internal magnetic distributions. LOREA [18] with its spin dependent analysis will be a key beamline for magnetic research and the SubMicro BL [19] for spintronics.

***c) Catalysis and environmental sciences***

Understanding and minimizing the impact of humanity on the natural environment is one of the biggest challenges facing society. In the next one-two decades' research in catalysis will continue helping to plan a sustainable future for our society: energy storage, progressive reduction of fossil fuels, methanol and methane chemistry, and solar driven chemistry. SR techniques (mainly XAS and powder crystallography and more recently ambient pressure photoemission) are used to investigate the chemical characteristics and crystallographic structure of catalysts since decades. The activity in catalysis research at ALBA is significant and sustained in CLAESS [20], MSPD [21] and CIRCE. It will be enhanced in the forthcoming years addressing more ambitious targets in terms of *in-situ* and *operando* research, closer to the actual reaction conditions in industry. The new BL NOTOS [22] will perform quasi simultaneous absorption and diffraction measurements under *operando* conditions and the SubMicro BL will also allow investigation of soil and food contaminants.

***d) Materials for energy-related applications***

Research on energy related material for improved solar cells and batteries is a major field worldwide. At ALBA, this research is mostly concentrated in MSPD, CLAESS, MISTRAL and CIRCE NAPP endstation. In the next decade we will see the continuous development of methodologies to further investigate electrochemical systems in operation with different SR techniques including absorption spectroscopy, microscopy, microspectroscopy and imaging. Experimental tools compatible with the existing advanced synchrotron techniques will be developed to get deeper insight in the operation of energy-related devices. Some examples are electrochemical cells compatible with photoemission (CIRCE PEEM endstation), IR (MIRAS) and X-ray (MISTRAL) microscopies; electrochemical systems operating above room temperature (MSPD); and reaction cells optimized for electrochemistry or photochemical process (CLAESS, NOTOS). LOREA will have a prominent role in revealing the details of the electronic structure of these new materials.

#### 4.1.2. Technological Development and Technology Transfer

Developing accelerator technology and scientific equipment for the experimental stations is a crucial part of the research and development activities still with growing possibilities.
ALBA engineering capabilities are mature in optics, mechanics, sample environments, vacuum, RF systems, magnet technology, electronics and software, and involved in developing instruments not commercially available with major scientific benefits. This activity provokes the creation of new market niches allowing technology transfer into the synchrotron supplying industry. Innovations may be transferred or licensed to companies helping them to increase their market share as well as their international competitiveness.
Part of the inherent activities at ALBA is the design of scientific instruments that are afterwards installed in the accelerator and the beamlines.

### 4.1.3. Educate for the future

Our society is only partially aware of the absolute need of research activities for the sustainability and progress of our world. As scientists we have the responsibility to contribute in the future generation education towards a research driven society. We have to aim not only to those who will undertake scientific careers, but also to the general public, among which there are the future decision makers. A large facility as ALBA is an excellent instrument to complement the regular education in this sense at different levels, starting from schools, passing through universities and general public, and reaching political class.

Capabilities on training activities for technical schools, undergraduate and PhD students will be continuously pursued in collaboration with universities and external institutions.

### 4.1.4. Add international value

ALBA is one of the funding members of LEAPS [3], together with all European synchrotrons and FEL facilities, which are joining forces to enhance European science, innovation and integration.

The LEAPS members have a collective understanding that the future technological developments require resources and competences that surpass the capabilities of individual research infrastructures (RIs), and that tackling the entire spectrum of technological challenges can only be done by a concerted effort of all LEAPS institutes as well as industrial partners. The proposed ambitious LEAPS Research Infrastructure and Technology Roadmaps will lead to ground-breaking new technologies, keeping Europe's RIs at the highest level of competitiveness. The roadmap will be executed as a coupled open innovation effort with industry stakeholders extending their product portfolios and markets.

ALBA will continue opening to collaborations beyond Europe, with the model of those already undergoing, for enriching scientifically and culturally the ALBA community.

### 4.1.5. Prepare Long Term Strategy

The Spanish SR community deserves maintaining in the future the possibility of conducting cutting-edge research in a national facility. A long term plan to introduce in ALBA forthcoming developments such as new accelerator technologies, high throughput detectors, extremely precise optics, big data handling, etc., needs to be started now.

## 4.2. STRATEGIES AND THEIR DEVELOPMENT TO ACHIEVE THE OBJECTIVES

We present here the strategies together with the envisaged actions for their development. For each case we specify in the title the objective to which mainly refer, even if all of them are of course closely related to each other. The priority level of the action (High, Medium or Low) is reflected in the investment table and in the Annex containing the investment report.

### 4.2.1. Construction of new BLs (Objectives 4.1.1, 4.1.2, 4.1.4)

At the time of writing (2018 Q1) we are finishing the Phase II BL program and are developing the Phase III, which was defined in the year 2014.

The second Phase II BL **LOREA** [18] is dedicated to angular-resolved photoemission spectroscopy (ARPES) for understanding the electronic structure of graphene-based material, topological insulators and other advanced and complex materials. The design was carried out during the period 2015-16. The BL source (a helical undulator) and the corresponding front end were installed during 2017. The target is to complete the installation during 2018, commission it in 2019 and open to user operation in spring 2020.

The first Phase III BL, **XAIRA** [12], is dedicated to macromolecular crystallography with microbeam. The Project Initiation Document (PID), key for defining the main ingredients of the project and establishing the scope, quality, cost and schedule boundary conditions, has been approved in 2017 and the target is welcoming the first users by the end of 2020.

The original mission of **NOTOS** [22], second Phase III BL, was mainly the development of scientific instrumentation and innovation, with a robust program of technology transfer to Spanish companies. This mission is now strengthened by the strategic technological roadmap shared with LEAPS members. Its initial design has been modified due to the decision of the Spanish Ministry of merging the present branch A of the Spanish CRG BM25 at ESRF with the original NOTOS, incorporating a considerable part of elements from BM25-A to the initial design. The NOTOS BL will serve also users in EXAFS and power diffraction. Its design is in progress and it is expected to be open to users by spring 2020.

**FaXToR** (Fast X-ray Tomography and Radioscopy) BL [13], also on the Phase III program, is aimed at 2D and 3D imaging materials. It will allow *in-situ* experiments and hosting complex sample environments. The initial portfolio of environments comprises compression/straining, high temperature, high gas pressure and cryo-cooling devices. The focus will be on hard X-ray, 10-50 keV, large field of view illumination and time resolution at the level of ms. High data throughput detector systems will be one of the most challenging characteristics of the BL. FaXToR will cover a broad range of applications mainly in materials science and related topics and fully matches our related scientific priorities. It is very relevant for a wide range of industrial applications such as conventional and additive manufacturing, electrical and electronic, food industry, biomaterials, etc. and other areas such as cultural heritage, paleontology, etc. Its design will start during 2018 and it will host first users in 2022.

The **Submicrometer-beam diffraction, fluorescence and absorption BL,** SubMicro [19] is meant to carry out micro X-ray diffraction and scattering, micro X-ray fluorescence and micro X-ray absorption. Scientific fields addressed by this BL include, but are not restricted to, earth and environmental sciences, cultural heritage and bio-medicine, since heterogeneity and small size are inherent characteristics of their samples. The design should start in 2019, after a revision of its scope and characteristics which were defined in 2014.

Other two BLs complete the Phase III program: **SIRENA, Surface, Interface and REsonant diffraction BL at ALBA** [23], dedicated to investigating surface and interfacing atomic structures and dynamical processes with grazing angle X ray diffraction including GI-SAXS, and **Skiron** [14] an advanced chiroptical spectroscopy BL for dichroism characterization of advanced samples. Their construction is expected to be initiated in 2019 and 2020. We foresee to dedicate specialized workshops for discussing the strategic instruments ALBA will need for completion of the first operation decade, also considering the possible future evolution of the light source and the rapidly evolving scientific requirements ant technical possibilities. We will include in this discussion the revision of these two BLs, as reflected in our investment plan (see Annex).

#### 4.2.2. Upgrade and evolution of the existing BLs (Objectives 4.1.1, 4.1.2, 4.1.4)

ALBA has been already operating for several years. Maintaining state of the art performances asks for upgrades and calling into question the existing instruments in connection with advances in the fields, in particular for all beamlines.

The **NCD** beamline has been already upgraded with substantial improvements in the optics, detector and beam diagnostics, improving quality and reliability of the SAXS data. In addition, the grazing angle of incidence technique (GISAXS) has been implemented allowing to address new research areas as nanoscience, catalysis and new aspects of material science.

The next beamline that will require a significant upgrade will be **MISTRAL**, with the renewal of some optical elements and the improvement of some mechanical parts. The microscope will need to be analyzed in view of a future upgrade. During 2018 new gratings for the monochromator have been purchased. In addition, phase contrast imaging will be implemented as a new technique for imaging of low contrast samples.

The third beamline to be upgraded can be **MSPD** for diffraction at high photon energies, requiring a new detector, ancillary equipment and some optical components upgrade.

Phase I BL upgrading process will proceed sequentially and we estimate a cost of the order of 500 per beamline. Two of the beamlines, XALOC and MIRAS, have the possibility of a second branch and an upgrade of the MIRAS end station in order to incorporate capabilities for catalysis in collaboration with a requested ERC grant is also being considered. Special systems that could be used by different beamlines are also taken into account, as for example a laser for pump and probe experiments.

We will also closely monitor the overbooking factors of the condensed matter BLs: an example is the strongly overbooked CIRCE BL, whose two instruments, PEEM and NAPP, could be housed in two different beamports. And in the future we will check the coexistence of two protein crystallography BLs, whose use will be influenced by the cryo-microscope infrastructures, which are starting to develop all around Europe, which may lead to an evolution of XALOC.

#### 4.2.3. Consolidation and development of user services (Objectives 4.1.1, 4.1.4)

The User Office, in collaboration with other European user offices, will extend the support to the new BLs, cover new circumstances as the new transnational access or the participation of associated partners, and consolidate the recently introduced remote access system.

We are aiming at building a Guest House, for offering to users a much more comfortable access to our facility with respect to the present usage of the hotel at the UAB Campus, which is not at walking distance from ALBA. We are exploring two alternatives: it could be sited inside the ALBA plot of land, and as such fully funded and managed by ALBA, or included in the development of the *Parc de l'ALBA* Consortium, with a construction nearby ALBA premises, shared with other private and public institutions present in the park.

Scientific publications coauthored by ALBA staff (in the different modalities: golden, green) will be available through the UAB repository (https://ddd.uab.cat/). The contract to regulate this usage is currently under discussion. In a later stage, appropriated technical reports as well as other documents like abstracts presented to scientific congresses, etc., will be also made freely available.

#### 4.2.4. Accelerator performance consolidation and further developments (Objectives 4.1.1, 4.1.2)

The ALBA accelerators have been operating for the last years with excellent levels of reliability while, at the same time, improving and upgrading their performances. The objective for the following years is to maintain the same level of reliability, while increasing the operating current and offering new modes of operation in order to guarantee the high level quality of the research done at the BLs. In addition, we will continue fostering national and international collaborations in development and research in accelerator technologies, with the magnetic and RF labs as international references.

***a) Reliability***

ALBA is in the sixth operating year. The beam availability (BA) has been steadily increasing since the first year. To keep up with the present number (BA=97.6% in 2016, 98.3% in 2017) and stay in level with similar facilities around the world the main strategies include a plan to reach Mean Time Between Failures (MTBF) above three days, contemplating refurbishment or replacement of obsolete components and a plan to reduce the Mean Time To Repair (MTTR) below one hour.

A priority is increasing the reliability of the RF system to maintain the availability while increasing the operating current (see next point). Two actions are foreseen, the upgrade of the IOT system replacing the IOTs devices with by new TH795 and L3, and a gradual introduction of Solid State Amplifiers which are inherently more reliable by their internal configuration, starting in 2018 with the one corresponding to the Booster, and thereafter implemented stepwise in the Storage Ring, from 2019 onwards. Reinforcing the operator and support teams for speeding up the reaction time to failures is also foreseen.

#### *b) Operational Current Increase*

The nominal current is 250 mA, value reached in machine days but not yet used in operation, since reliability has always been prioritized versus photon flux. The usual operating current is currently 180 mA. During 2017 a 200 mA operation period provoked numerous quenches in the SC wiggler which acts as photon source for the MSPD BL. Only when the problems of this Insertion Device will be solved, hopefully during 2018, the current will be increased. In the meantime it has been shown that all the other elements are capable of reaching the nominal operating status: the IOTs improved availability and performances, the Fast Orbit Feedback (FOFB) and the Bunch by Bunch Transverse Feedback (BbB) ensure the beam stability.

#### *c) Improvement of beam stability*

Increasing the current will reduce beam lifetime and instability threshold, what will be counteracted by the implementation of a 3rd Harmonic Cavity. The final decision on when it will be installed will be taken according with tests results with higher current.
In addition, the injection process creates a distortion in the stored beam orbit, that even if it is in a very short period of time, it may affect the quality of data acquisition in the beamlines. For this reason, it is foreseen to implement one of the newest developments in accelerators: a Multipole Injection Kicker, which allows to perform the injection process with not distortion of the beam orbit.

#### *d) Hybrid mode of operation*

Operation of the Storage Ring with different bunch distribution patterns is important for BLs performing time resolved experiments, asking for a high purity on the bunch population. Measurement of bunch population with large dynamic range and electron cleaning methods systems are available [24]. The next step is to routinely provide this capability in user operation mode. A dedicated timing, diagnostics and control system have been tested along 2017. CIRCE and BOREAS BLs will profit from this feature to perform experiments on dynamical processes in magnetic systems, and at a longer term MSPD and NCD BLs will also benefit to investigate dynamics of structural transformations.

### 4.2.5. Data handling evolution (Objectives 4.1.1, 4.1.2, 4.1.4)

Data management is a critical factor for the scientific success of any large scientific infrastructure. Data quality relies on the consistency of the datasets, the completeness of the metadata, and on the interoperability of the scientific data processing and analysis. Cutting edge scientific publications increasingly derive from the combination of several experiments with various techniques across different facilities, often involving big data sets and high performance computing power. Handling data with suitable policies shared by a number of facilities eases the data processing, improves the user perception and reduces the maintenance cost per facility in the long run.
Data obtained in a public institution as ALBA must be open to the general community. A data policy is a key step for ensuring professional data management and FAIR (Findable, Accessible, Interoperable and Reusable) data. The guidelines and directives were defined in the European FP7 PaNData-Europe [25], although the individual terms, infrastructure and specifics of the final implementation were to be approved and worked out by each institute.
The data policy defines ALBA as the custodian of raw data and metadata of all experiments carried out at its BLs for a period of time, typically five years. On a best effort basis, ALBA will keep the data accessible online for few months, after which it can be archived on a tape library or a warehouse. Access to raw data and the associated metadata obtained from an experiment is restricted to the experimental team for three years. After the embargo period is over, the data and metadata will become publicly accessible unless for some reason requested and accepted otherwise.
This strategy establishes the grounds for data integration and interoperability and tools across different BLs and facilities within the prospects of the European Open Science Cloud (EOSC) [26].
The availability and open access to experimental data on the cloud enable a step forward in data analysis and provides the means of accessing and introducing archived datasets from different authors and facilities in the data curation processes, improving the performance and the results. To move forward in this direction

it is considered of high importance the increase of the current data network bandwidth connection between the RedIRIS [27] network, currently connected through CSUC's Anella Científica in Barcelona city, and ALBA. Ideally this could be achieved with the deployment of a direct optical fiber between the two institutes. This bandwidth increase is considered strategic for near future scenarios when more demanding experimental data storage, archive and data analysis will be widely required.

At the same time, nowadays mainstream X-ray detectors reach data rates in the order of GBytes/sec, producing very large datasets at faster paces than the analysis processes. New machine learning algorithms will play an important role in the acceleration of data analysis, the triage of datasets and the availability of information for the decision-making processes during the experiments data collection. Live data analysis considerably improves the overall quality of datasets by providing the scientists with precious information during the experiment an also reduces the number of measurements and the final cost [28].

#### 4.2.6. Electronics and Detectors developments (Objectives 4.1.1, 4.1.2, 4.1.4)

Electronics instrumentation and detectors are key elements at the heart of the competitiveness of BLs and accelerators. Their development has been and will be a critical success factor. The new experimental techniques require superior synchronization capabilities, like higher motion speeds, and better temporal and spatial resolutions. ALBA has embraced this strategy by several means.

Concerning electronics developments ALBA is joining international cutting-edge collaborations, such as the IcePaP motor controller with the ESRF and recently MAX-IV. ALBA is taking the lead in some selected domains particularly strategic to our BLs and accelerators and with a high expertise in-house as, for example, the electrometer Em#, a new design for accurate measurements of very low currents (from µA to fA) whose performance tests and ALBA know-how attracted other institutes turning the project into an international collaboration, or the Digital Low Level RF, with the ALBA design being used now by MAX-IV, DIAMOND, SOLARIS and SIRIUS.

Within the wide detector domain, ALBA has focused on a few well-defined developments aware of the current limitations in terms of resources, expertise and workforce. Consequently the strategy has been identifying partners for research and development in the field, such as it has been the case with CNM-CSIC for the development of transmissive diodes for X-ray diagnostics, or the participation to mini-Attract [29] projects in collaboration with IFAE [30].

ALBA needs an appropriate centralized expertise to properly support specification, characterization, integration in the Control System and operational support of detectors; this will be eventually complemented by creating a transversal detector pool. In addition, the development of far-reaching detectors projects will be bolstered fostering collaborations with nearby institutes.

#### 4.2.7. Support laboratories upgrades and exploitation (Objectives 4.1.1, 4.1.2, 4.1.4)

Support laboratories are key tools for in-house developments, covering industrial needs and strengthening national and international collaborations. Some of the foreseen actions are here listed, and they will be further developed inside the LEAPS partnership.

The **Optics and Metrology Laboratory** will keep its capabilities tuned with state-of-the-art X-ray mirrors, and with developments in adaptive optics through three main actions. The addition of a second optical sensor to the ALBA-NOM (the scanning slope-measuring profilometer), to improve the spatial resolution of the instrument, as well as its noise level and acquisition speed. The implementation of stitching with the Fizeau interferometer will provide its capability to measure the 3D profile of long mirrors. And the extension of the range of applicability of the ALBA bender will upgrade it to a nano-focusing device.

The existing test bench for closed structures of the **Magnetic Laboratory** will be upgraded for measuring larger and cryogenic magnetic structures. Preparation for measuring high gradient–small aperture magnets as well as the upgrade of the power supplies, the electronics and computing systems is foreseen.

The **RF Laboratory** will be upgraded incorporating the new solid state technology, and new electronics systems with broader frequency range, namely 1.5 GHz of the 3rd harmonic cavity and 3.0 GHz of the LINAC.

Other laboratories open to users for sample preparation (biology, chemistry high-pressure, material science), and those which give support to the infrastructure activities (He liquefaction plant, vacuum and cryogenics, survey and alignment, electronics) and mechanical workshops will be kept updated with dedicated budget in accordance with needs, and will be offered to users.

#### 4.2.8. Innovation and technology transfer (Objectives 4.1.1, 4.1.2, 4.1.3, 4.1.4)

The industrial program is based on four pillars. The first pillar, strengthening industrial outreach, include facility visits of companies and the organization of events addressed to specific industrial sectors, in ALBA or elsewhere. The second pillar, an enhanced full industrial service, includes the regular data treatment and collection, the industrial problem understanding, sample preparation, data analysis and interpretation by experts. The third pillar, expanding current operational synchrotron techniques, provides a complete/competitive service to industry. And the fourth pillar, an integrated industrial platform, essential to make available to industry all existing light synchrotron techniques. CALIPSO+ [31] and LEAPS are good examples of the kind of foreseen collaboration.

#### 4.2.9. Student program (Objective 4.1.3)

The present program of hosting PhD students in collaboration with other institutions in a cofounding scheme will be further developed, targeting to one student per operating BL plus approximately five students on accelerator, engineering and computing areas. Access to industrial PhD program will be supported and the new Early-Stage Researchers (ESR) day consolidated.

ALBA will continue with the present format of yearly calls for a dozens of undergraduate/master university students, opening to *ad-hoc* agreements with local universities for collaborating grants aiming at longer student internships; maintain partial involvement in educational programs with already collaborating universities, and search for new alliances to existing multidisciplinary research educational initiatives, always balancing resources with the outcome of the program.

ALBA plans to continue with FP dual education students, revising when needed the profiles to better fit ALBA evolution, aiming at a total number of ca. 15 students.

Exceptionally other externally funded student internships may be considered such as Erasmus or high school students with exceptionally brilliant grades.

#### 4.2.10. Communication and outreach (Objectives 4.1.3, 4.1.4)

The communication and outreach activities will be conducted along the following main lines: general public, mainly through the Open Day, high school and university students and other types of groups, and institutional visits.

The ALBA e-news magazine and the ALBA yearly activity report will cover the information to the scientific community, with special emphasis on synchrotron users, general scientific community, science managers and policy makers. Outreach papers (1 or 2 per year) will be published in reviews such as SRN, REF, etc. Other needs will be covered by means of ALBA web news and press releases.

In addition, ALBA may continue supporting or eventually choose to discontinue other activities, such as few-day training courses for high school teachers, depending on the availability of external funding and on the internal human resources available. Also some other background activities will be dealt with, such as support for organization of conferences and other events, with special emphasis on those with an industrial impact.

#### 4.2.11. ALBA II conceptual design preparation (Objective 4.1.5)

Maintaining ALBA at levels of scientific excellence when compared with the rest of Europe and the world means that an upgrade of the photon source and related beamlines refurbishments have to be considered for realization in approximately one decade from now.

On that long term purpose, the objective along the period 2017-2020 is to start a project for investigating possibilities of a future upgrade, including optical lattice, dynamic studies and components design, in addition with a preliminary budget envelope.

In the development of new technologies, ALBA strategy will be aligned with LEAPS strategy, with the intention of producing prototypes of critical state-of-the-art components, like multipole kickers or a longitudinal variable bending magnet.

#### 4.2.12. Health and Safety (All objectives)

The main objective for the period 2017-20 in terms of safety is achieving each year zero accidents involving medical leave during work activity at ALBA.

In the occupational aspects the Health and Safety Group, with the support given by the external prevention service, will improve and consolidate a solid safety culture at ALBA, extended to staff, users, trainees and external companies or collaborators, the excellence of which has been recently recognized by the award of the “Asepeyo Prize” [32] It is, and will continue to, be based on the message that safety is the job of everyone and working unsafe is not an option. This requires keeping continuously updated the preventive system, which includes preventive plan, norms, procedures, etc., emergency tools, encoded in the existing self-protection

plan, and all the risk assessments.
The radiation protection rules, procedures, practices and formal documents with the changes required by Consejo de Seguridad Nuclear for new BLs or other modifications in the facility will be kept updated.
The Health and Safety group will evolve towards the implementation of a SPP (*Servicio de Prevención Propio*), mandatory when the total staff will be larger than 250 people.

### 4.2.13. Scientific and technological excellence program (All objectives)

ALBA is both a user facility and a research institution, for whose excellence to be measured a set of parameters which go beyond those needed for evaluating pure research centers are needed.
The present successful Spanish scientific excellence programs, like *Severo Ochoa* or *María de Maeztu*, are specific for research institutions or special departments, but not for user facilities which develop not only scientific objectives but also technological developments and user services.
We aim at reaching a level of excellence in all our performance indicators, in line with non-national sister facilities, with the wish to open the opportunity for a future development of national dedicated excellence programs acknowledging the specific characteristics of ICTS serving user communities.

### 4.2.14. Excellence in procedures for personnel and budget management (All objectives)

ALBA will aim at obtaining the Human Resources Strategy for Researchers (HRS4R) award, optimizing, where necessary, procedures for welcome programs, training, etc. and implementing strategies for increasing attractiveness as a working environment, following the standard EUROAXESS rules.
Special attention to gender equality policy will be continued and reinforced. Present gender diversity in hiring committees will be maintained.
Actions will be continued pursuing a new national regulation for research institutions like ALBA in order to achieve the necessary flexibility for running the consortium, always within the approved budget and a posteriori audit of the activities.

### 4.2.15. Reinforcing collaborative policy (All objectives)

ALBA will continue with the possibility of collaboration with other entities, through two tools: the Partner BL (PBL) and the Association Agreement schemes. In principle this should increase the internationalization, but could be also used by other national entities or bodies, which could take the opportunity of building specialized instruments at their large disposal, profiting from the infrastructure services.
A good example is the existing Association with the IPM (Institute for Research in Fundamental Physics) from Teheran, which is hosting the ILSF (Iranian Light Source Facility [33]) project group, dedicated to the construction of a 4th generation synchrotron light source in Qazvin, north-west of Teheran.
ALBA will identify some world leading user groups in the priority scientific research fields and establish long-term research plans that will include sharing personnel and equipment, and joint applications for research grants, offering, when required, special regulated access to beamlines.
Inside LEAPS, ALBA participates to the critic survey of existing techniques, of their demand and of foreseen developments, as well to the proposal of technological roadmaps to be presented to European Commission for its effective support in the period after H2020, the 9th Framework Program.

### 4.2.16. CELLS complementary developments (All objectives)

This section is devoted to desirable complementary developments of the ALBA facility that we consider would be convenient to host in our neighbourhood or even inside the ALBA experimental hall, stressing once more that in any case the main goal of ALBA is to fully exploit the synchrotron radiation source. ALBA entourage, with universities, research centres and companies, is already an important focus for research and innovation, but other investments are necessary to complement the facility, improve the services to users and increase the research in fields related to accelerator science and technology, as it has happened in other similar facilities.
In a certain sense this section is a complement of the long term strategic framework that has been exposed in chapter 4.1.5.
Probably our list is not complete, but we are convinced that the list includes the most interesting. Each improvement will of course need its own specific budget and personnel,some of which we are specifying in the Annex as one of the low priority proposed investment. We are not including in the list any research center related to nanomaterials since in the neighborhood of ALBA exist an Institute for Material Science and an Institute for Nanoscience and Nanotechnology.
We are not giving a priority list, even if the order in which we are presenting the different options reflects the time

schedule that we think would be the most appropriate, based also on on-going negotiations and discussions with related institutions.

### *i) Advanced electron microscope center*

Electron microscopy has strongly evolved during the last decade, with applications both to life science and material science, complementing synchrotron radiation techniques. In most advanced synchrotron centres (see for example ESRF and DIAMOND), advanced microscopes are offered to users who strongly benefit from the synergy between different techniques.

Such advanced microscopes, complementing the ones already existing in Spain, are intensely demanded by users. A consensus exists that ALBA is the perfect hosting institution, because scientific synergy and for its well run-in user service structure. The proposal has two pillars, one for material science and the other for life science. The pillar for material science consists in a 300 kV transmission electron microscope (TEM) with a double aberration correction system (probe and image) with monochromatic beam. The pillar for life science consists in the installation of a mid-range 200 kV cryo-microscope for single particle imaging, tomography, sample screening and its prior characterization before being introduced into the high-end microscope, to be complemented in the future, once funding will be available, with a cutting-edge 300 kV cryo-microscope.

### *ii) Opening to time resolved science*

The community of ultrafast science with photons is growing worldwide with the advent of FELS and compact X-ray sources. In Spain, which is associated to the European XFEL, groups of ultrafast laser users [34] are active as shown by the activities at CLPU [35] and ICFO [36], but no accelerator based short pulse photon source still exists.

Merging the “Laser know-how” of the ICFO and the CPLU with ALBA “Accelerator know-how”, can be the basis for the construction of a new facility at the forefront of technology that will evolve to cover the production and exploitation of extremely short and high brightness pulses.

We propose to realize the first user facility providing attosecond-duration to soft X-ray pulses (SXR) with end-stations for X-ray absorption (XANES and EXAFS) and photoemission spectroscopy (PES). Novel is the combination of temporal duration on the order of 100 attoseconds with the soft X-ray photon energy range above 200 and up to 1000 eV, thus uniting real-time resolution with element specificity and atomic site selectivity. Such facility would be unique providing unprecedented means to study electronic, atomic, and lattice dynamics in real-time and in a simultaneous manner.

### *iii) Structural Biology Center*

The vicinity of Structural Biology centers to synchrotron facilities has proved in all cases to be an asset for scientific excellence and production, as in the case of ESRF and Diamond. The proposal of such a center existed at the time of ALBA design but was not pursued mainly due to economic restrictions.

The project will have a strong synergy with the ALBA BLs like MISTRAL, XALOC, XAIRA, MIRAS, and NCD and will take profit of the existence of SBU [37], a CSIC unity of the IBMB [38].

### *iv) Accelerator collaborative developments*

The project for a high brightness photoinjector, which could be used as a seed for different opportunities (as Ultrafast Electron Diffraction, Laser Plasma Wakefield Acceleration, Infrared Free Electron Laser, Compton backscattering energy tunable X-ray source) is kept as possibility and fed by the active accelerator international community collaborations (see CLIC, CompactLight projects).

Being ALBA the reference centre for accelerator technologies in Spain, we are prepared to contribute to any accelerator based facilities that are envisaged in the next future. We can mention for example future initiatives as could be DONES [39], in case of success of the Granada candidature, the IV ELI Pillar, whose feasibility is still at a very preliminary stage or collaboration with a Hadrontherapy centre for treating radio-resistant or inoperable tumors. In Spain there are no Hadrontherapy centres. At present there are some incipient projects in different places based on proton accelerators. It would be interesting to complement the healthcare interests with some technology development, which could face carbon ion-based therapies, or new accelerator techniques for simplifying the proton-based therapies.

## 4.3. RESOURCES

Resources needed to accomplish the strategies above described are hereby summarized, detailing investments costs, staff resources, and corresponding staff costs. We include also a summary of the total operating budget, including the loan return. The details are specified in the Annex.

### 4.3.1. INVESTMENT BUDGET

The investment profile during the period 2017-2020 is shown in Figure 3, detailing the three priority levels. We include here those investments whose expenditure period overlaps with the quadrennium, but extends before or after, as for example the LOREA beamline, started in 2015. We mark in grey those investments outside the considered period which have complemented in the past or will complement in the future this strategy plan, the future one based on a very preliminary estimation. The integral of the investments amounts to about 95 M€. The 50% corresponding to high priority includes the part already executed during 2015/2018 (˜17 M€), plus a total of ˜10 M€ which sums the yearly amount of 2.5 M€, usually spent for investments regarding the continuous improvement of the installation and incorporated in the approved budget of the installation. The remaining ˜20 M€ should be provided through ERDF funds and related cofunding.

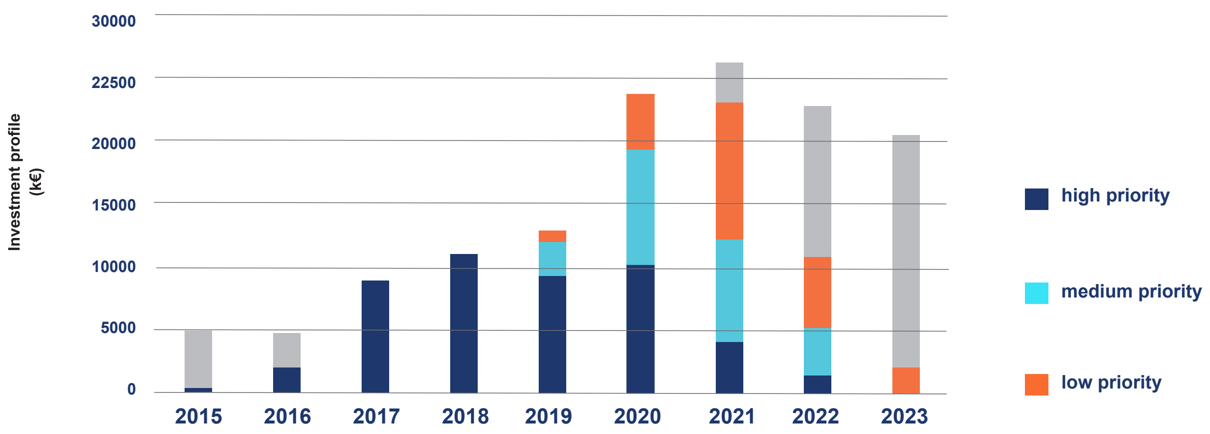



Figure 3 –Investment budget profile during the period 2017-2020 and adjacent periods.

### 4.3.2. STAFF RESOURCES

The staff needed for the implementation of this SP is detailed in the annex, indicating for each new activity the extra resources to be added to those already present. We mention only the structural positions, with the hypothesis of maintaining an additional staff quota at the level of 10% through external projects and collaborations. We differentiate the staff according to the priority level of the corresponding investment.

Each additional BL needs 4 staff scientists (including a post-doc), 3 support staff (including all areas, direct and indirect support) and an administrative position, that may be dedicated to general support, user office, industrial/ project office, etc. The staff incorporation is progressively completed during the four years of the BL construction and commissioning.

Data shown above, combined with the schedule for new investments, yields a progressive increase of staff which is summarized in Figure 4.

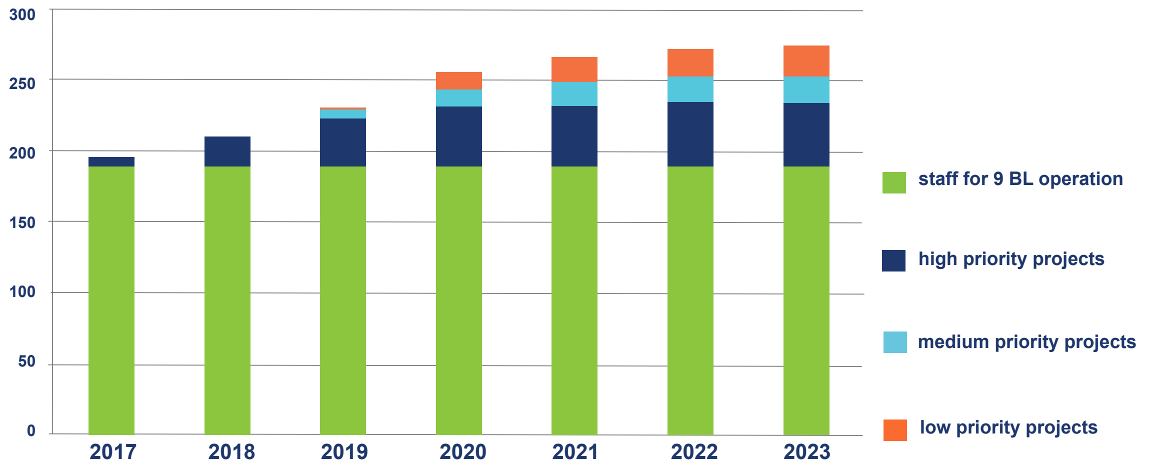



Figure 4 – Proposed evolution of ALBA staff until 2023. Green color corresponds to staff for 9 BL operation, dark blue, light blue and orange correspond to high, medium and low priority projects respectively.

### 4.3.3. TOTAL BUDGET

For completeness we show in Figure 5 the total budget, including operation budget as defined in 2008, deficit with respect to that prevision, where the operation of the new beamlines is included, loan return, new investments and related staff cost, these last differentiated according to priority level and normalised to the average ALBA cost per person, incremented 1% by every year. To be noticed that if the loan return could be renegotiated and spread over a longer period all high priority and most of medium priority investments could be funded without increasing the yearly administration contribution. Annex contains the details.

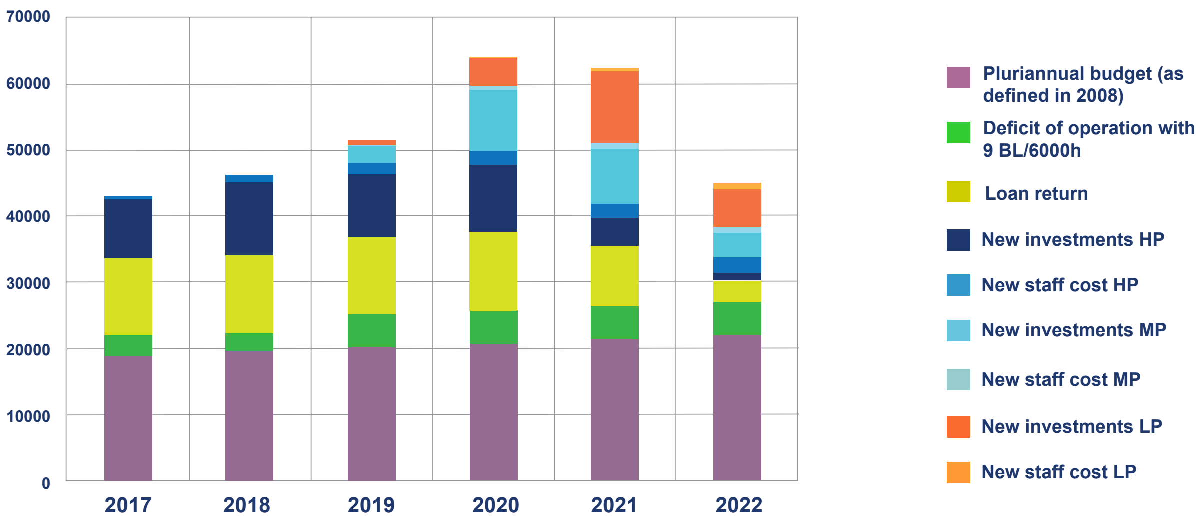



Figure 6 – Total budget of the facility (HP, MP, LP stays for High, Medium, Low priorities).

# 5. SCHEDULE AND FOLLOW-UP

We briefly describe the expected timeline of the main actions presented in this SP.

## 5.1. SCHEDULE

This chapter summarizes ALBA simplified timeline in the perspective of more than two decades' period which covers from the moment of the project approval up to the possible major upgrade of the facility. We simplify because we highlight only BLs, while the facility, as shown along the whole document, is a much more complex system than a sum of BLs, but we can agree that those specific instruments are the best representation of the source capability and status of completion. Details on timeline for other investments are summarized in Annex.

At ALBA the seven Phase I BLs entered in operation in 2012. Discussions on the evolution were already carried out in 2009, resulting in two BL projects (Phase II), whose construction suffered years of delay due to what we call 'the austerity period', from which we are now slowly emerging; period which, on the other hand, was fully profited for consolidating the facility operation at very high standards.

Phase III process in 2014 defined six projects, three of which are now in realization, even if at a rhythm lower than what our technical and scientific capabilities would allow, were the funding accessible. What is of furthermore importance is to obtain funds before the end of the period considered in this SP for starting the construction of the full Phase III program. We may nevertheless critically reexamine the characteristics of the last three Phase III projects in view of the scientific and technical evolutions to which the field has been submitted during the last few years, and this process could be initiated in 2019.

We have just started the preliminary considerations for a future upgrade of the accelerator, namely ALBA-II (see 4.2.11), which of course needs to be based on an appropriate scientific case and planning of the evolution of all existing BLs. We think that the upgraded facility should be made available for the Spanish community and its collaborators around 2030. Without claiming that these dates are precise we here stress the need of planning for the future of the source on the long term period.

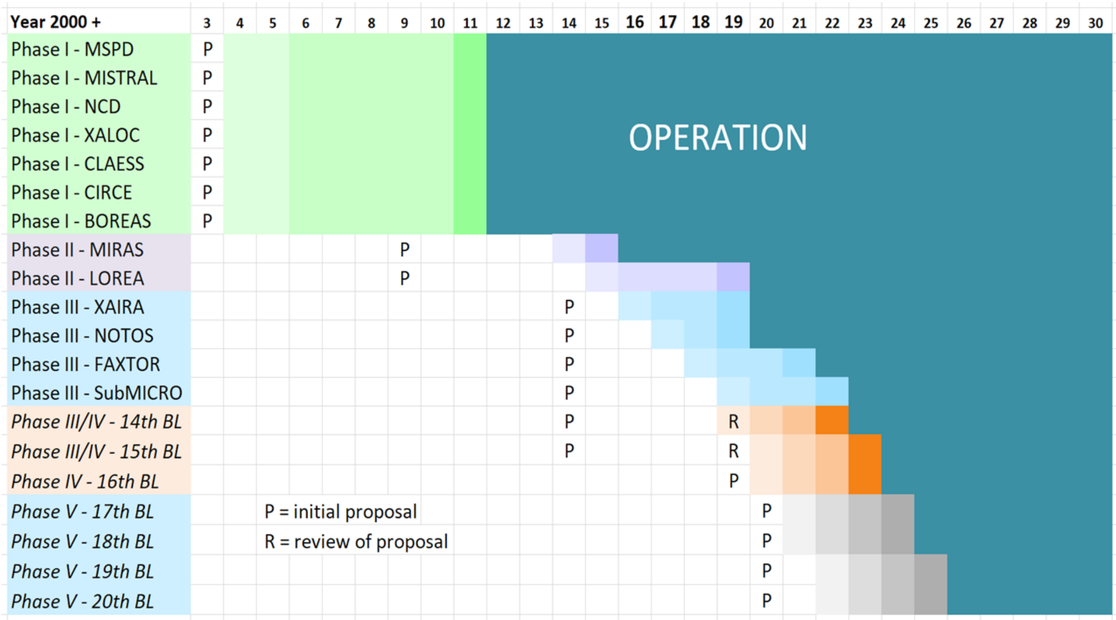



Figure 7 – Strategic Plan Timeline. F or each BL the color code represents, from lighter to darker, design/construction/installation/commissioning periods.

## 5.2. FOLLOW-UP INDICATORS

***Measurements of efficiency***

The performance indicators of the installation, of which the facility will keep a registry are the following:

a) Accelerator availability (delivered hours versus scheduled hours per year)

b) Mean time to repair for accelerators

c) Mean time between failures for accelerators

d) Number of delivered user shifts/year versus the number of scheduled ones

e) Hours of user beam, i.e. the sum of delivered station hours to users

f) Number of accelerator failures and reasons

g) Efficiency per station, i.e. hours delivered versus hours scheduled

h) Number of user groups/year

i) Number of user visitors/year, i.e. mean size of user group

j) Statistics on publications

k) Statistics on user nationality

l) Station shifts requested versus station shifts allocated (per station)

m) PhD degrees awarded from work carried out at the facility

n) PhD degrees awarded from work carried out using data taken at the facility

o) Station shifts for proprietary work

p) Number of proprietary users

q) Number of patents and licenses

r) Number of SAC and evaluation panels meetings

s) Number of competitive projects

t) Income from competitive projects

u) Income from proprietary usage of beamtime, labtime and others

v) Staff statistics, including gender, nationality, external contracts

w) Number of student training

x) Number of visits to the facility

y) Key steps in construction of BLs

z) Statistics on incidents/accidents

***Risk plan***

This Strategy Plan has obviously risks not always easy to manage. The most serious one is related to the non-availability of the appropriate budget, which will hamper any possibility of accomplishing the plan.

Other risks are related to failures in the operation of a facility that needs the correct operation of more than 7000 pieces of equipment connected by some 18,000 cables extended over 220 km.

With the experience acquired during the first years of operation we have detected the most frequent possible failures and we have reduced the failures and the time to recover the operation to figures which are among the best facilities over the world. We are prepared to failures in the RF systems, the power supplies, the water system, etc. and we have replacements or are in the process of securing the critical stocks for the main components.

Nevertheless, as any complex infrastructure, we are subjected to unexpected failures that have not appeared before and that may produce problems in the accelerators or in one or more beamlines. The accomplishment of the investments needed for maintenance, spares availability and replacements is therefore of major importance, as well the availability of enough staff for quick and effective recovery.

# ACKNOWLEDGEMENTS

This Strategic Plan, even if signed only by the Facility Director, is the team work of the whole ALBA staff. ALBA Management Board members have strongly participated in the preparation process, Section heads and BL responsibles have directly given their constructive input, based on their knowledge and on communication with the whole staff.

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By using Cocoon Silk rather than a non-recycled paper, the environmental impact was reduced by :

**308** litres of water

**18** kWh of energy

**11** km travel in the average European car

Sources : Carbon Footprint data evaluated by Labelia Conseil, Virgin fibres from non-integrated mill latest European BREF data.

ALBA

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