Research evaluation

EVALUATION REPORT OF THE UNIT

AFMB - Architecture et fonction des macromolécules biologiques

UNDER THE SUPERVISION OF THE FOLLOWING ESTABLISHMENTS AND ORGANISMS:

Aix-Marseille Université - AMU, Centre national de la recherche scientifique - CNRS, Institut national de recherche pour l'agriculture, l'alimentation et l'environnement - INRAe

EVALUATION CAMPAIGN 2022-2023

GROUP C

Rapport publié le 17/07/2023

In the name of the expert committee[1] :

Isabelle Landrieu, Committee Chairwoman

For the Hcéres[2] :

Thierry Coulhon, Président

Under the decree n° 2021-1536 of 29th November 2021:
[1] The evaluation reports "are signed by the chairperson of the expert committee". (Article 11, paragraph 2);
[2] The president of the Hcéres "countersigns the evaluation reports established by the expert committee and signed by their chairperson." (Article 8, paragraph 5).

This report is the result of the unit's evaluation by the expert committee, the composition of which is specified below. The appreciations it contains are the expression of the independent and collegial deliberation of this committee. The numbers in this report are the certified exact data extracted from the deposited files by the supervising body on behalf of the unit.

MEMBERS OF THE EXPERT COMMITTEE

Chairperson :	Mme Isabelle Landrieu, Centre national de la recherche scientifique - CNRS, Villeneuve d'Ascq
Experts :	M. Eric Ennifar, CNRS, Strasbourg (representative of CoNRS) Mme Anne Harduin-Lepers, CNRS, Villeneuve d'Ascq M. Jean-Michel Jault, CNRS, Lyon Mme Isabelle Landrieu, CNRS, Villeneuve d'Ascq M. Ludovic Pelosi, Université Grenoble Alpes – UGA (representative of CNU) M. Michel Thépaut, CNRS, Grenoble (representative of the supporting personnel)

HCÉRES REPRESENTATIVE

Mme Ina Attrée

CHARACTERISATION OF THE UNIT

- Nom : Architecture et Fonction des Macromolécules Biologiques
- Acronyme : AFMB
- Label et numéro : UMR 7257
- Nombre d'équipes : 6
- Composition de l'équipe de direction : M. Yves Bourne

SCIENTIFIC PANELS OF THE UNIT

SVE Sciences du vivant et environnement

SVE3 Molécules du vivant, biologie intégrative (des gènes et génomes aux systèmes), biologie cellulaire et du développement pour la science animale

THEMES OF THE UNIT

The AFMB primary objective is the characterisation of biological macromolecules and their complexes or assemblies and the interactions between macromolecules and their ligands to understand their structure-function relationships. AFMB teams also identify ways to act on these molecules for medicinal or biotechnological purposes. Big data issued from large-scale genome sequencing are analysed to understand the molecular diversity of members of some protein families. The AFMB research expertise is applied to various thematic areas: in glycogenomics and glycobiology, host-pathogen interactions/microbiology, virology and neurobiology.
The AFMB was organised into six teams during the previous contract, one of them (team 4) has left on the January 1, 2022. Team 1 investigates the functional role of disordered regions within viral proteins, Team 2 investigates the relationships between the primary sequence of carbohydrate-active enzymes (CAZymes) and their substrate specificity. Team 3 focuses on the molecular architecture of proteins with diverse interest including CAZymes, acetylcholine-binding enzymes and receptors, and neuronal cell-adhesion molecules. Team 4 characterises the molecules involved in host-pathogen interactions. Team 5 unravels the molecular mechanisms of emerging viruses and synthesise antiviral molecules targeting human pathogenic viruses. Team 6 characterises the structure and function of multifunctional viral macromolecular complexes.

HISTORIC AND GEOGRAPHICAL LOCATION OF THE UNIT

The laboratory AFMB emerged in 1988 as the 'Crystallisation and Crystallography of Biological molecules laboratory' (LCCMB) on the 'Faculté de Médecine Nord campus' in Marseille, before moving to the CNRS Joseph Aiguier campus in 1995 where it got its current name. Since 2005, it is located on the Luminy Campus. The AFMB lab is headed by Yves Bourne since 2008. It is housed into two separate buildings: 3-floor main building and 1-floor premises at Polytech Marseille, at about 400 m distance.

RESEARCH ENVIRONMENT OF THE UNIT

The laboratory AFMB is a joined research unit (UMR) affiliated to the CNRS and Aix-Marseille Université (AMU) and it is a 'Unit Under Contract' (USC) in partnership with INRAe. The AFMB lab is affiliated to the biology department of the Faculty of Sciences and the Polytech Marseille school for graduate engineers. AFMB is associated to the two doctoral schools Sciences of life and health (ED62, teams 1 to 6) and Chemical sciences (ED250, team 5) of AMU. The two shared technological facilities 'integrative structural biology' and 'anti-viral library screening' developed at the AFMB lab have a local 'Aix-Marseille' label, a national GIS-IBiSA label and are members of the two national research infrastructures in biology and health, Frisbi and ChemBioFrance, respectively. The 'CAZy bioinformatics' facility was a partner of the Bip: Bip project, financed within PIA 2011-2017, aiming at promoting an integrated use of known and modelled three-dimensional structures of proteins to help genome annotation.
The AFMB lab is a partner of the local Institute of 'Microbiology, Bioenergies and Biotechnology' (IM2B) created in 2019, which gathers eleven research labs and 25 technological facilities with the aim to strengthen interdisciplinary research and education in the field of microbiology and its applications in bioenergy, environment and health. Two teams of the AFMB lab are members of the integrated interdisciplinary Turing Centre for Living Systems (Centuri), which federates 20 teaching and research institutes in biology, physics, mathematics, computer science and engineering with the aim to decipher the complexity of biological systems.
In the frame of the partnership with INRAe, AFMB collaborates in the glycobiology field with the nearby 'Biodiversité et Biotechnologie Fongiques' (BBF) laboratory. With a key topic in virology, the lab has pursued collaborations with colleagues at the Méditerranée Infection Foundation located on the Timone campus, and

as so, it benefited from several doctoral and postdoctoral fellowships through the annual call of the Infectiopôle Sud Foundation.
The AFMB lab has coordinated the federative regional project 'Cryo-electron microscopy of Marseille' (CE2M) led by AMU and has acquired, in the frame of a national roadmap by the Frisbi infrastructure, a state-of-the-art 200 keV cryo-electron microscope to be installed at the AFMB lab and funded by the CPER 2021-2027. The installation of this equipment is planned for the end of the first semester 2023

UNIT WORKFORCE: in physical persons at 31/12/2021

Professors and associate professors	3
Lecturer and associate lecturer	4
Senior scientist (Directeur de recherche, DR) and associate	8
Scientist (Chargé de recherche, CR) and associate	4
Other scientists (Other scientists – Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	2
Research supporting personnel (PAR)	16
Subtotal permanent personnel in active employment	37
Non-permanent teacher researchers, researchers and associates	0
Non-permanent research supporting personnel (PAR)	15
Post-docs	11
PhD Students	18
Subtotal non-permanent personnel	44
Total	81

DISTRIBUTION OF THE UNIT'S PERMANENTS BY EMPLOYER: NON-TUTORSHIP EMPLOYERS ARE GROUPED UNDER THE HEADING 'OTHERS'.

Employeur	**EC**	**C**	**PAR**
CNRS	0	11	16
Aix-Marseille Université	6	0	3
Inserm	0	1	0
Université de Toulon	1	0	0
Inrae	0	0	1
Total	7	12	20

UNIT BUDGET

Budget récurrent hors masse salariale alloué par les établissements de rattachement (tutelles) (total sur 6 ans)	1841,0
Ressources propres obtenues sur appels à projets régionaux (total sur 6 ans des sommes obtenues sur AAP idex, i-site, CPER, collectivités territoriales, etc.)	397,0
Ressources propres obtenues sur appels à projets nationaux (total sur 6 ans des sommes obtenues sur AAP ONR, PIA, ANR, FRM, INCa, etc.)	2299,0
Ressources propres obtenues sur appels à projets internationaux (total sur 6 ans des sommes obtenues)	2208,0
Ressources issues de la valorisation, du transfert et de la collaboration industrielle (total sur 6 ans des sommes obtenues grâce à des contrats, des brevets, des activités de service, des prestations, etc.)	1436,0
Total en euros (k €)	8181,0

GLOBAL ASSESSMENT

The global quality of the AFMB scientific production is outstanding. The AFMB lab generated 470 publications in international peer-reviewed journals including 140 as first/last or corresponding authors. Publications reflected the laboratory expertise in biochemistry, molecular biology, microbiology, biotechnology & applied microbiology and virology disciplinary fields. 30 articles were selected as 'highly cited papers' and two as 'hot papers' as mentioned in the report. Notably, team members have published their research in prestigious journals including several specialised journals of the Nature and Cell series. The AFMB laboratory has an outstanding visibility stemming from its expertise in integrative structural biology approaches applied to the field of emerging viruses and carbohydrate-active enzyme (CAZyme) sequence analysis in the glycobiology field. This visibility is attested by invitations to international conferences (e.g. Gordon research conferences), organisation of conferences (e.g.13th Carbohydrate Bioengineering Meeting) and training schools (e.g. COST NGP-net Winter School). In addition, several staff members received prizes at different stages of their respective careers (e.g. Gold Medal Laureate, Foundation Méditerranée Infection, chevalier de la légion d'honneur).
The teams develop basic research with a mechanistic approach focused at the molecular level with biomedical or biotechnological impacts but manage at the same time excellent exploitation of their research outcomes through numerous interactions with companies (e.g. Private-public partnerships with Janssen Pharmaceutica, Pantheon, CisBio, Vivalis…). AFMB laboratory has demonstrated an outstanding capacity to attract funding though competitive calls to allow its scientific program to proceed: at the national level with 40 ANR-funded projects and one ATIP/Avenir project and at the European level, with nine large H2020 grants accounting to about 30% of its total budget. The laboratory has attracted two full-time researchers and a teacher-researcher during the period. The laboratory has trained 42 PhD students during the period, of which 24 graduated, and has welcomed 28 postdoctoral fellows.
The infrastructure is of very high quality and managed by support staff members of very high expertise recognised by a Cristal du CNRS awarded to one of them. The laboratory has structured its facilities to allow access to external academic and non-academic parties. The quality of these facilities is attested by Gis-Ibisa labels and their inclusion in national infrastructures (Frisbi, ChemBioFrance). Long-term financial sustainability of technological platforms is a concern but the AFMB laboratory has taken all opportunities to ensure their attractiveness by maintaining state-of-the-art facilities (4-8% of the grants are devoted to the infrastructure). AFMB has succeeded in funding a last generation cryo-electron microscope, in-line with its scientific and technologic programs that ensure increased international competitiveness. AFMB faces challenges as some leaders with well-identified expertise will give way to the next generation of AFMB researchers, which represents both an opportunity to (re)define a strong scientific policy open to the future and a risk to lose some visibility and unique expertise.
AFMB has shown an excellent capacity to interact with society at large, with regular participation to the 'Fête de la science' and other outreach activities such as 'Printemps des chercheurs', 'Nuit des chercheurs' and 'Souk des sciences'. Notably, AFMB members had an impressive interaction with the press and audiovisual media during the Covid-19 crisis, with more than 150 interviews and newspaper articles, contributing to providing accurate and science-based information to the public.

DETAILED EVALUATION OF THE UNIT

A – CONSIDERATION OF THE RECOMMENDATIONS IN THE PREVIOUS REPORT

Maintain the focus on a research synergy around a limited number of federating axes, takes full advantage of the complementary skills
· The emergence of a new research team in 2016 (team 6) contributed to reinforce the 'integrative structural virology' theme. The inter-team projects are attested by shared authorship of 45 publications (about 10% of the production), teams 5 and 6 being the most active in internal collaborations.
Intensify interactions with the UFR Science at AMU
· AFMB has intensified interactions with the Faculty of Sciences and taken the opportunity of the appointment of a new Vice-President in Biology and Health in 2020 to strengthen these interactions. However, the two-way communication with AMU is not yet optimal.
Establish a roadmap for the impending retirement of senior researchers
· Co-heads of two respective research teams retired during the period with smooth transitions to the current group leaders. A roadmap is in place, including attracting a new full-time researcher to the AFMB that could act as a new group leader to develop independent research emphasising on cryo-EM or integrative structural biology projects.
Intensify grant acquisition from H2020
· AFMB has obtained several large European grants.
Continue the good work on interaction with the social and economic environment
· AFMB has continued its efforts in interacting with the socio-economic world through its research and its platforms.
Review the job profile of the administrative staff, and consider shifting some responsibilities
· Hiring an additional staff member on short-term contract will (temporarily) ease the burden. The administrative work charge remains heavy and administrative task responsibilities are also taken by the scientific staff out of necessity. The two-site location worsens the situation and a temporary staff member was hired on team 5' own resources budget.
Unify the two sites
· This is not done yet despite efforts to mobilize AMU. A plan to move to the IGS building adjacent to the AFMB main building has not been officially validated. In addition, no budget is yet allocated to the renovation of the new space and will need to wait till the next CPER period, with some uncertainty remaining on the feasibility.
Install Cryo-EM facility at AFBM
· AFMB has been a strong advocate for the cryo-EM infrastructure necessity and has succeeded in the acquisition of a cryo-electron microscope that should be operational by the end of 2023 and accessible to the community.

B – EVALUATION AREAS

EVALUATION AREA 1: PROFILE, RESOURCES AND ORGANISATION OF THE UNIT

Assessment on the unit's resources

AFMB has the necessary resources to support research of its teams. AFMB benefits from outstanding technical infrastructures for multiple methods, managed by a highly qualified support staff, attractive to external academic and non-academic users. Given the attractiveness of the laboratory at the international level that leads to multiple collaborative requests for AFMB expertise, the last period has seen work overload for most of AFMB staff.

Assessment on the scientific objectives of the unit

The scientific objectives are well-defined around the common theme of deciphering the molecular basis of diseases and finding new compounds for therapeutic intervention. The arrival of the cryo-electron microscope will be an asset to reach scientific objectives, and potentially attract young researchers with expertise in this specific technology that could apply their research in the fields of interest for the Marseille campus at large.

Assessment on the functioning of the unit

The AFMB laboratories complies with multiple organisational institutional requirements to ensure the well-being and security of its staff. Recognition of all the individual contributions seems to be excellent as attested by the promotion received by its staff. The inter-team interactions are very good and attested by co-authored publications. Half the AFMB recurring budget is redistributed to the teams and a percentage of the in-coming grants is devoted to common use, allowing the laboratory to support a scientific strategic policy. The location of the Unit in two separate building remains an unresolved issue for a long-time that affects the cohesiveness of the unit, involves unnecessary duplication of equipment and complicates administrative tasks especially from the team located in Polytech building.

1/ The unit has resources that are suited to its activity profile and research environment.

Strengths and possibilities linked to the context

AFMB benefits from excellent technical infrastructure for multiple methods organised in two shared technological facilities 'integrative structural biology' and 'anti-viral library screening' that benefit from GIS-IBiSA support label and at the national level from support by research infrastructures in biology and health Frisbi and ChemBioFrance, respectively. The 'CAZy bioinformatics' facility has benefited from funding by the PIA Bip: Bip project until 2017. Since 2019, the AFMB lab coordinates the project 'cryo-electron microscopy in Marseille' (CE2M) for the CPER 2021-2027 that allows the acquisition of a last generation 200 kV automated cryo-electron microscope for a total budget of 3.4 M€.

One full-time researcher and one teaching-researcher joined AFMB during the period. The ratio researcher/support staff is 1:1, benefiting the management of the two technological facilities 'integrative structural biology' and 'anti-viral library screening', and research projects of the teams.

The AFMB laboratory receives recurring funding from its governing bodies (CNRS, AMU, INRAe) that represent about 15% of the annual budget (excluding salaries of the permanent staff). The laboratory collects 4-8% of all incoming research grants to cover shared consumable and maintenance costs of common equipment. AFMB redistribute about half of the annual recurring resource to the teams. Since 2021 the Unit allocates a 10 k€ annual budget for the funding of three Master-2 internships in inter-team program. AFMB dedicates a budget for the weekly seminar program (including 115 invited external speakers on the period). The AFMB laboratory makes advances of the costs for the annual access to the cryo-EM facility of the CNB-CSIC in Madrid, which are then reimbursed by the concerned teams at the end of each mission. As a member of the SBGrid consortium, the lab pays annual membership fees to access and support a large number of scientific applications in bioinformatics, x-ray crystallography and cryo-EM.

Weaknesses and risks linked to the context

The current housing situation of the AFMB lab, spread over two separate buildings, strongly disserves communication and scientific interaction between lab members and financial/organisational and administrative optimisation of mutualised resources.
Team 5 suffers from insufficient office and bench spaces.
The recruitment do not compensate for the outgoing mobilities.

2/ The unit has set itself scientific objectives, including the forward-looking aspect of its policy.

Strengths and possibilities linked to the context

The common goal of AFMB teams is the understanding of the molecular basis of diseases and the identification of innovative therapeutic approaches. This expertise is applied in various fields that all have impact in human health or biotechnological applications (in the case of carbohydrates). AFMB has an outstanding expertise in a number of topics with a strong international visibility, including in the field of annotation and classification of carbohydrate-active enzymes (CAZymes) and in virology including, in the last period, Covid-19-related projects.

Scientific and strategic objectives are discussed at the executive committee level.

Weaknesses and risks linked to the context

Representativity of the teams in the executive committee do not reflect the teams' size.

3/ The functioning of the unit complies with the regulations on human resources management, safety, the environment and the protection of scientific assets.

Strengths and possibilities linked to the context

Two staff members (AP) are trained in prevention techniques, one for each building location. The incoming members are made aware of security risks, by a visit and a dedicated booklet. A dedicated booklet is available to record work accidents. The unique safety document with a risk prevention plan is updated yearly to cover the three main risks related to the AFMB scientific activities: biological, chemical and ionising and non-ionising radiation. The agreement for the use of genetically modified organisms (GMO) in a confined environment has been renewed in 2021 for five years. The activities related to the use, import, export, storage, purchase and transport of biological materials from pathogenic microorganisms, including viruses, and toxins (MOT), have been granted authorisation by the ANSM, renewed in 2019, to fulfil the biological safety and security requirements. A staff member is manager in biosafety and biosecurity. The manipulation of radioactive elements is confined to a dedicated room located in the Polytech building and requires a renewable license.

The AFMB lab was a laureate of the CNRS 'Qualité de vie au travail' in 2019.

The computing resources of the AFMB lab are located behind a firewall and the network access is controlled by AMU. The local mail server is hosted by AMU.

The AFMB lab has a procedure for re-cycling hard-paper, paper, plastics and glass. The staff is sensitised to energy and resource savings.

Weaknesses and risks linked to the context

A global data backup solution and a lab data management plan are not in place. The IT management is a risk with only one 'overloaded' person to manage not only day-to-day informatic maintenance and network but also to support more scientifically oriented actions (e.g. installation and set-up of applications for EM data treatment) and data management.

Collective reflection on carbon footprint reduction has not been initiated.
There are only two women amongst the seven teams (co)leaders and lab director/deputies.
The prevention of psychosocial risks is not formalised. The lab director is the contact person, which might not be the best choice in regard to the hierarchical position with intimidating consequences for some individuals. A very limited assistance from the medical or human resources of the governing bodies is reported.

EVALUATION AREA 2: ATTRACTIVENESS

Assessment on the attractiveness of the unit

AFMB team members have an outstanding level by their capacity to secure funding at the national and international scale attesting of the quality of their research and collaborative networks given the level of competition and showing the attractiveness of their research. AFMB has an outstanding attractiveness linked to the quality of its infrastructures and expertise of the platform-dedicated staff members. Visibility is outstanding at the national and international levels, with strong participation to learned societies, institutional scientific committees and organisation/participation to conferences. AFMB teams were excellent in attracting and training a large number of early-stage researchers and interns, including on international mobility.

1/ The unit has an attractive scientific reputation and contributes to the construction of the European research area.

Strengths and possibilities linked to the context

AFMB members were awarded prizes including at the national level the prestigious 'Chevalier de la Legion d'honneur' and 'Cristal du CNRS' for a research support staff and 7 ″ prime d'excellence/d'encadrement' from CNRS. One gold medal, one silver medal and one price were received by PhD researchers from IHU and AMU. At the international level, IChemE energy award and one B.A. stone award were obtained. A 'grand prix de la presse médicale' was awarded for an article in Médecine/Science.
AFMB members have organised or co-organised ten scientific meetings including a Gordon Research Conference, three international training schools (COST action NGP net, Lake COMO School and Algo SB school) and an EMBL alumni network meeting.
Members of AFMB have been extremely active in providing their expertise as jury members of PhD including at the international level and habilitations, of project evaluation panels (ERC panel), of selection of prize award panels including at the international level (e.g. NovoNordisk prize), of selection of PhD fellowship panels including at the international level. Members of AFMB are equally active in participating in steering of supervising bodies by participating to CoNRS, Hcéres, ANR panels and given their specific expertise, Soleil and ESRF synchrotrons.
AFMB staff also participates to scientific council of associations (e.g. Sidaction, société française de virologie, tous chercheurs), infrastructures (e.g. ChemBio France) and learned societies (e.g. association de cristallographie ACAM).
AFMB researchers were invited and participated to national and international conferences, give seminars or provided webinars and early-stage researchers additionally presented results as posters. About 30 proceedings were produced.
The website of the Unit is informative.
Members of AFMB integrated the management structure of one COST action NGP net.

Weaknesses and risks linked to the context

No weaknesses noted.

2/ The unit is attractive for the quality of its staff hosting policy.

Strengths and possibilities linked to the context

The AFMB has recruited during the contract three researchers (one from AMU, one from CNRS and one from Inserm) and four technician and engineer staff members. Sixteen career development/promotion were obtained by six research staff members (3 CNRS and 3 AMU) and support staff members (15 CNRS and 1 AMU).
AFMB lab has welcomed 42 doctoral candidates, including fourteen international mobility, with 24 defenses during the period and 28 postdoctoral research fellows including eleven on international mobility. In addition, the laboratory has hosted about 63 masters and multiple internships at all stages of their studies, from high school to bachelor and from technician to engineer schools in France or abroad. Each year and on a rotation basis three Master-2 internship grants are supported on the laboratory budget; the additional ones are supported by the teams. Three HDR were obtained by AFMB team members that will sustain the supervising capacity.
A formal, unit-wide, process to attract a young researcher with potential to apply to researcher position is in place.
The laboratory hosted guest researchers for short stays and in two cases, up to one year.
The laboratory avoided work overload by using its own budget to compensate a personal deficit in the common service for biological preparations and in the common administrative and financial service.
Weekly seminars are organised by two dedicated coordinators and have welcomed 115 invited external speakers in addition to offering dedicated sessions to the teams, PhD/post-docs and trainees.

Weaknesses and risks linked to the context

Despite the strong proportion of support staff, including on short-term contracts, their workload is heavy to manage both the platforms and their research interests, given the attractiveness of both aspects. In addition, support staff on short-term requires training to gain the specific skills and expertise, adding to the workload.
The outgoing mobilities are not compensated by new arrivals on the period.

Attractiveness to local high-potential masters prepare to compete for the ministerial PhD fellowships is low, which might be due to the poor visibility of AFMB during their studies.

3/ The unit is attractive because of the recognition gained through its success in competitive calls for projects.

Strengths and possibilities linked to the context

At the national level 40 competitive ANR funding were granted (40% of the laboratory budget) including two 'young researcher' JCJC ANR and six Covid ANR, with a total of nineteen as coordinators (including all Covid ANR). In addition, one grant was obtained from the FRM and one from the CNRS. Funding from Ibisa (2) supported the infrastructures. Funding was also obtained from the PIA through the Bip: Bip project or from infrastructure for integrative structural biology Frisbi in support of the infrastructure. Additional funding was obtained by the ANRS (2), Amidex and non-profit foundations, including a large grant by the foundation Bettencourt-Shueller.
At the European level (30% of the laboratory budget), nine network H2020 grants were obtained, including one as coordinator and one doctoral training network PDZnet. In addition, one advanced ERC was granted.
At the international level, team members acted as subcontractors of two NIH grants.

Weaknesses and risks linked to the context

As a risk rather than a weakness, funding related to Covid might decrease.
As a risk rather than a weakness, extremely active and renown PIs will leave the units in the coming years.

4/ The unit is attractive for the quality of its major equipment and technological skills.

Strengths and possibilities linked to the context

The laboratory hosts three state-of-the-art technological facilities managed by ten team members (including 3 non-permanent positions): 'Carbohydrate-active enzymes database' (CAZy),' integrative structural biology' (PBSIM) and 'molecular screening' (PCML). The CAZy bioinformatics implement high-performance computing system. The integrative structural biology facility supports protein production in several cellular systems, including a high-throughput platform for protein production in bacteria, biophysical analyses of molecular interactions, and structural analyses by X-ray diffraction and cryo-electron microscopy. PCML facility is devoted to screening chemical libraries dedicated to antiviral drug, including against emerging viruses.
The facilities were upgraded during the period, with ~0.8 M€ investment for PBSIM including a new cell culture lab and updating the x-ray crystallography equipment. The PCML facility upgraded the liquid-handling robot (~0.2 M€) and reinforced its forefront position for identifying new antiviral agents during the Covid pandemic.
The laboratory has managed to attract funding for a cryo-microscope, to be installed in 2023, which will be a new central point of attractiveness for AFMB and the regional environment.

The facilities are used by staff members, including for teaching and very actively training by organising workshops and schools. Platforms are open to academic and industrial external users.

Weaknesses and risks linked to the context

In a manner not specific to AFMB, but nevertheless relevant, funding of the high costs of technological facilities is challenging.

EVALUATION AREA 3: SCIENTIFIC PRODUCTION

Assessment on the scientific production of the unit

The scientific production of the laboratory is outstanding and reflects its visibility for technological expertise, outstanding networking capacities and deep knowledge in the fields of emerging viruses, structural biology and glycobiology.

1/ The scientific production of the team meets quality criteria.

Strengths and possibilities linked to the context

The common goal of the teams is deciphering molecular mechanisms to understand protein functions in various field of biomedical and biotechnological interests. The biggest strengths of the Unit rely on its expertise in structural biology, emerging viruses and CAZymes sequence annotations using genomic bioinformatic methods. Within these fields, AFMB conducts competitive research at the international level despite the delay in the installation of the in-house cryo-electron microscope. The structural biology teams were able to adapt to the emerging power of cryo-microscopy and are now in excellent position to be a national leader in this technology and made significant scientific contributions, thanks to their fruitful efforts to fund an in-house cryo-microscopy facility. To take one impressive example of the related achievements on the last period, the Cryo-EM structures of the Chikungunya virus nsP1 contributes to deciphering the association of viral replication machinery with virus-induced membranous organelles within host cells (Nature, 2021). The long-term research conducted on emerging viruses has in recent years due to the last coronavirus pandemic taken a new turn, as this somewhat neglected field has become at the forefront of public attention and of funding bodies. AFMB teams have use their long-term research and expertise to show a commendable reactivity to the challenges caused by the pandemic. Team 5 discovered by bioinformatic analysis of the sequence that the now famous coronavirus Spike protein contains a Furin cleavage site (Antiviral Research, 2020), attracting a very broad interest of the scientific community.

The scientific contribution of Team 2 is best exemplified by the CAZy database maintenance and upgrade (published in NAR database issue) that is a pilar of the glycobiology community shown by the outstanding track record and the very high number of citations. Team 2 also contributed its expertise to international research networks, notably annotation of the CAZymes of the microbiote colonizing gnotobiotic mice that show the impact of the diet change from fiber-rich to fiber-free, leading to a shift from fiber to mucus utilisation, in accordance with observations of the mucus barrier erosion by fiber-deprived microbiota (Cell, 2016). Team 3 complements very-well the glycobiology axis of the unit with structural studies of enzymes that lead to understanding of binding and catalytic mechanisms, such as structure of the human heparan sulfate d-glucuronyl C5 epimerase (Proc Natl Acad Sci USA, 2019).

Finally, Team 4 made an original contribution on anti-CRISPR proteins evolved by bacteriophages that block CRISPR-Cas9 immunity using structural and functional data highlighting the unique allosteric inhibition mechanism used by the anti-CRISPR protein AcrIIA6 to inactivate Cas9, modifying Cas9 conformational dynamics thereby preventing its binding to target DNA within cells (Nat Comm 2018).

AFMB is also very active in methodological developments and contributed within an EU training network to the set-up of high-throughput quantitative interactomes, herein applied to the PDZ interactome that has millions of interactions (Team 6, Nat Comm 2022)). In the field of disordered proteins, Team 1 contributed to method development on a long-term collaborative study that resulted in a new methodology based on high speed atomic force microscopy measurements to evaluate disordered protein conformations and dynamics and monitor disorder/order transitions (Nature Nanotechnol, 2021).

Weaknesses and risks linked to the context

None given the competitiveness and interest of the AFMB research within the scientific community.

2/ Scientific production is proportionate to the research potential of the unit and shared out between its personnel.

Strengths and possibilities linked to the context

All the teams contributed to the research production. All staff professional categories are included in the publication authorship. PhD students and postdoc researchers have globally a strong participation to the laboratory publications.
All the teams contributed to the research production. The scientific production is very high in regard to the permanent staff force. The AFMB lab generated 470 publications in international peer-reviewed journals, including 37 review articles and 140 as first/last or corresponding authors. Publications reflected the laboratory expertise in biochemistry, molecular biology, microbiology, biotechnology & applied microbiology and virology disciplinary fields. 30 articles were selected as 'highly cited papers' and two as 'hot papers'. Collaboration between the six research teams was reflected in 45 publications with shared authorship between teams. Contribution from the technological facilities is estimated at about 100 publications.
Notably, team members have published their research in prestigious journals Nature Nanotechnology (1, as corresponding), Nature Chemical Biology (4, 1 corresponding), Nature (6, 2 as corresponding), Science (3, not corresponding), Science Advances (1, corresponding), Nature Communications (20, 4 as corresponding), Nature Microbiology (6, 1 as corresponding), Nature biotechnology (1, not corresponding), Nature ecology & evolution (1, not corresponding), Nature Genetics (1, not corresponding), Nature Structural & Molecular Biology (1, not corresponding), PLoS Pathogens (4, 3 corresponding), PNAS (11, 3 corresponding), Cell (4, not corresponding), Molecular cell (1 as corresponding), Cell reports (2, not corresponding), JACS (1 as corresponding), ELife (2, not corresponding), Lancet (1, not corresponding), PLoS Biology (2, not corresponding), PLoS Genetics (3, not corresponding) and well-regarded journals: Nucleic acid research (9, 5 as corresponding), JBC (20, 2 as corresponding), ACS chemical biology (3 as corresponding), JMB (9, 3 as corresponding), Structure (2, 1 corresponding), J. Med Chem (4, none as corresponding).

Weaknesses and risks linked to the context

None given the outstanding production of the laboratory

3/ The scientific production of the unit complies with the principles of research integrity, ethics and open science.

Strengths and possibilities linked to the context

Most publications are open-access (80% reported) and deposited in HAL archive. The laboratory team members deposit data in specialised repositories (e.g. pdb). All publications are peer-reviewed. Pre-print is submitted as open-access manuscripts (e.g. BioRXiv).
All the staff is associated to the publications of the Unit. All the individual contributions seem to be properly taken into account. Support staff from the facilities are highly involved in research projects.

Team members participate to the management of open-access databases that support scientific innovations e.g. CAZy and PULDB by team 2, DisProt by team 1.

Weaknesses and risks linked to the context

Internal data sharing server and use of Lab notebooks could even better facilitate analysis of the raw data.

EVALUATION AREA 4: CONTRIBUTION OF RESEARCH ACTIVITIES TO SOCIETY

Assessment on the inclusion of the unit's research in society

AFMB team members contribute very actively to societal challenges by the quality of their fundamental research, demonstrated in the last period by its major involvement in coronaviruses research and discoveries based on a long-term investment in emerging virus projects. In addition, AFMB teams have demonstrated outstanding capacities to interact in multiple ways with the economic world within their field of expertise and to increase the visibility of their research to the larger public.

1/ The unit stands out by the quality of its non-academic interactions.

Strengths and possibilities linked to the context

AFMB knowledge and know-how are of high interest for the non-academic world for its long-standing expertise in technologies related to biophysics, structural biology and data mining as well as for the biomedical and biotechnological impacts of its fundamental research in the glycobiology and virology fields.

AFMB teams have interactions with companies in multiple forms: one on one collaboration resulting in shared publication (e.g. Teclis Instruments with team 1) or collaboration within large project (e.g. Inside the IMI-CARE project for team 5 with major partners such as Takeda, Merck, Pfizer for team 5), industrial service for a fee contracts (e.g. Adocia with team 1) including with the facilities (e.g. to evaluate compounds, Eukaryis, Pantheon Biosciences with team 5), collaboration contracts (e.g.BioXtal SARL with team 3), hosting and non-disclosure agreements (e.g. Tafalgie therapeutics SAS with team 3), company funded staff in the team (e.g. 3 persons by Innate Pharma for team 4), public-private partnerships (e.g. with several major actors in the virology and drug-design field, such as Johnson & Johnson, Jansenn, Atea pharmaceuticals for team 5). Funding from annual financial contracts with the BioXtal/Theranyx (2016-2018) and CytoBodX (2021-present) companies for the use of technological facilities also contributed to pay the maintenance costs of common equipment and personal employments.

AFMB laboratory also indirectly contributes to the competitiveness of companies by providing knowledge/knowhow of high scientific value, e.g. HTP screening method making use of the Sars-CoV2 polymerase complex provided by team 5 or freely available published information to promote and boost scientific discoveries by team 1.
AFMB laboratory supports the development of start-up with subcontracting and hosting scientists (eg. CytobodX with team 5).

Team 5 provided expertise and recommendation to a number of public bodies to inform policy making during the Covid-19 pandemic crisis.

Post-doctoral fellows are mostly funded by ANR grants and only partly by foundations (IHU, FRM) and companies (Johnson & Johnson, Atea). Doctoral students are financed entirely or partly by non-academic partners such as foundations (1 postdoc and 1 PhD by the FRM, 2 × 1 additional year of a PhD, by the ARC association (1 additional year of a PhD), by the association Vaincre La Mucoviscidose (VLM), the association Vaincre les Maladies Lysosomales.

Weaknesses and risks linked to the context

None

2/ The unit develops products for the socioeconomic world.

Strengths and possibilities linked to the context

The AFMB laboratory addressed societal challenges by its fundamental research program that has strong impact in the biomedical and biotechnology fields.

Team members have deposited patents (3). One project (Cordial project) is in a maturation program with SATT Nord and Sud-Est to develop an assay for the rapid detection of Sars-Cov.

Weaknesses and risks linked to the context

None

3/ The unit shares its knowledge with the general public and takes part in debates in society.

Strengths and possibilities linked to the context

The laboratory has both a 'Correspondant communication' in charge of advertising publications and events on the lab website and via Twitter and a 'Responsable de la culture scientifique'.

Members of all AFMB teams have been very active in communication to the larger public of their research interests, such as bacterial pathogenesis, biomass conversion, genome evolution and especially viral pandemics as well as principles of crystallisation and X-ray crystallography. AFMB lab members have used all opportunities of interaction like 'La fête de la science', 'Le souk des Sciences', 'La Nuit des Chercheurs' and speed-searching events.
In addition, each year the AFMB lab welcomes high school classes for 'La journée des futurs bacheliers' and college students for a one week-stay as vocational internships.

During the last three years, team members have participated in the organisation of the 'Concours de Croissance Cristalline' (3C3) in the Provence-Alpes Côte d'Azur region, addressing middle and high school students. Presentations are available on YouTube.

Team members are involved in many other science outreach activities: punctual conferences for the large public, participation in the organisation of exhibitions, organisation of meetings around the theme science-education or science-art, etc.
PhD students have been encouraged to be trained in science outreach exercise by the AMU Scientific Culture unit and had the opportunity to implement this training. In terms of outreach to media, the Covid-19 crisis engendered hundreds of media interventions (press, radio, TV channels, …) by the members of the team 5 'Viral Replicases: Structure, function and drug-design', engaged in research on coronavirus replication mechanisms for over twenty years.
In addition, CNRS and Inserm press releases have been prepared to share research results of interest for a broader audience.

Articles were published in the journal Médecine/Science describing in layman terms research from AFMB team, including one that received a prize.
MOOC project centred around integrative structural biology was prepared, and two videos produced.

Weaknesses and risks linked to the context

None

C – RECOMMENDATIONS TO THE UNIT

Recommendations regarding the Evaluation Area :1 Profile, Resources and Organisation of the Unit

There is no mid-term solution to the major concern of the laboratory to be separated on two distinct sites and that should be faced by facilitating administrative procedures, communication and representation of Team 5 as not to engender a sentiment of isolation from the rest of the laboratory. For the long-term, the laboratory would benefit from the current plan to move Team 5 to the building adjacent to AFMB main location.

The executive and technical committees should meet regularly and representation within this committee has to be considered. The technical committee would benefit from representative(s) of the researcher staff (not including the PI) and the executive committee would benefit from a balanced representation that might take the size of the teams into account. The 'conseil de laboratoire' should be organised so that the laboratory representatives might be in position to provide a meaningful contribution and feed-back, by providing timely agenda and minutes.

Regarding the advancements of administrative and technical staff, an increased attention to the quality of communication regarding results of applications would be appreciated, particularly for the AMU support staff that represents a minority in this category.

Attractiveness of the AFMB has a down-side, as it engenders work overload, in particular given the success of the technological platforms and the deep interest in the community for the CAZymes sequence analysis. PIs and operational leaders might need to regulate networking and platform access in regard to the available workforce.

The committee strongly feels that the fellowships obtained from the Fondation Infectiopôle-Mediterranée should be negotiated to meet the standards of other comparable fellowships, including social protection, or be abandoned as a funding resource.

Data management and IT management are challenging and both rely on the support of only one (very active) staff. This risk should be taken into account although they are no simple solutions to this concern. Support might be requested from institutions or some tasks sub-contracted.

Recommendations regarding the Evaluation Area 2: Attractiveness

As a minor recommendation, some parts of the website (e.g. research team project summaries) could be better to increase international visibility.

Recommendations regarding Evaluation Area 3: Scientific Production

Keep up the AFMB outstanding fundamental research along the many research lines of interest that have grown during the previous period and maintain your deep technological expertise that benefit the community at large.

Recommendations regarding Evaluation Area 4: Contribution of Research Activities to Society

None

TEAM-BY-TEAM ASSESSMENT

Team 1: Désordre structurel et Reconnaissance Moléculaire

Name of the supervisor: Mme Sonia Longhi

THEMES OF THE TEAM

The team provides new methodology related to the characterisation of intrinsically disordered proteins (IDPs) and applications to the understanding of interactions of these IDPs in the context of the viral transcription/replication complexes. It makes use of a valuable combination of bio-informatics, biophysics and biochemical approaches. This expertise is applied to the elucidation of the functional role of structural disorder within proteins of the replicative complex of three human pathogenic paramyxoviruses and within fungal Lytic Polysaccharide Mono Oxygenases. A new original research line concerns the functional role in the host innate immune response evasion of phase separation and fibrillation of a viral amyloid formed by an IDR common to the P, V and W proteins from henipaviruses.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The work of viral IDPs would benefit from integrated approaches.
The team has delved deeper into the functional aspects of the investigation by evaluating the impact of interactions of IDPs/multimerisation in viral gene expression, thanks to national collaborations (Plos Pathogens 2016; Sci Adv 2019).

Limited internal collaboration.
Two publications correspond to collaboration within the unit but integration to the unit expertise in virology has not been achieved.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	0
Lecturer and associate lecturer	0
Senior scientist (Directeur de recherche, DR) and associate	1
Scientist (Chargé de recherche, CR) and associate	0
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	1
Subtotal permanent personnel in active employment	**2**
Non-permanent teacher researchers, researchers and associates	0
Non-permanent research supporting personnel (PAR)	1
Post-docs	2
PhD Students	2
Subtotal non-permanent personnel	5
Total	**7**

EVALUATION

Overall assessment of the team

The team had a very good level of scientific production taking into account the small size of the team, with a few highlights of high visibility and impact thanks to its expertise in the field of intrinsically disordered protein functions in virus and a very wide network of international collaborations with excellent laboratories. Altogether, the team is in an excellent position to pursue high levels fundamental scientific projects in the field of intrinsically disordered proteins, although the future of the team heavily relies on its very active team leader. The team is well-placed to expend its valorisation potential.

Strengths and possibilities linked to the context

The team benefits from a wide-range of methodological expertise for the characterisation of intrinsically disordered domains and proteins (IDPs), ranging from bioinformatics to biophysical characterisation including CD, small-angle X-ray scattering and NMR, as well as biochemical approaches.
The team published 39 original articles with 23 as first/last or corresponding authors, in well-regarded journals (J Mol Biol, ACS chemical biology, J Biol Chemistry, Cellular and Molecular life sciences, FEBS Journal, Biophysical Journal, Plos Pathogens) with highlights in high-profile publications such as Science Advances, Nature Chemical Biology, Nature Nanotechnology. This latest publication stems from a long-term collaborative project with Japan that involved several PhD students along the years. The team has established a wide-net of world-wide collaborations that proves to be successful as a majority (78%) of the scientific production involved international collaborations with excellent laboratories. The team also contributes to the availability of data for the whole scientific community by depositing data and metadata in databases (SASBDB, BMRB, PDB, PED, DiSProt...) and the vast majority of its production is open-access. The interest of the team contribution is certified by 3% of its production being in Top1% most cited articles worldwide (and 10.8% in Top10%). Seven book chapters contribute to the team production. All the PhD students have an excellent record of publications. Two publications have been co-authored with other teams from the unit.
The international visibility of the team is excellent with seventeen invitations of the team PI to international conferences, including one to the Gordon Research Conference on IDPs, and eleven invitations to give seminars. The team leader has been involved during the period in the steering committee of a COST action on non-globular proteins and organised three international school events (COST training School, Como Lake School, AlgoSB). PhD students and postdoctoral fellows supervised in the team were on international mobility, with one PhD in international co-supervision. The team leader has been invited to fifteen PhD panels, of which three international, and two HDR.
The team secured funding and supervised three postdoctoral and six PhD young researchers, including 1 PhD fellowships from the French-Italian University (UFI) and one postdoctoral fellowship by Instituto Pasteur Italia-Fondazione Cenci Bolognetti. Four PhD students graduated during the period. Three international fundings were obtained corresponding to two sub-contracting from NIH and one ANR.
Projects that were conducted during the present period have led to original and relevant perspectives in the field of phase separation, leading to an ANR project in 2021.
The team has a collaborative publication with a company. The team leader is involved in organising events for the 'fête de la science' and provided three press released to the INSB of CNRS associated to publication relevant to the bio-medical field.

Weaknesses and risks linked to the context

Funding remains a risk given that only one ANR was obtained during the period.
The team heavily relies on the team leader dynamism given its small size.

RECOMMENDATIONS TO THE TEAM

The necessary steps should be taken to maintain on the long-term the expertise and international network in place within the laboratory.
Some contacts with companies have been initiated that could represent new opportunities in the future to increase the translational aspects.
The team should continue to maintain its excellent level of young researcher supervision and increase its efforts to fund its research project

Team 2: Glycogénomique

Name of the supervisor: M. Nicolas Terrapon

THEMES OF THE TEAM

The glycogenomics team aims at establishing the relationships between the amino acid sequence of Carbohydrate-Active enZymes (CAZymes) and their precise specificity. The team devotes huge efforts to the annotation and classification of these enzymes including Glycoside hydrolases (GH) Glycosyl Tranferases (GT), carbohydrate Esterase (CE), polysaccharide lyases (PL) and auxillary Activities (AA) using the tools of bioinformatics. This includes the intense surveillance of scientific literature and reports on the freely available website CAZy.org for scientific community. The team has been working in various areas from the exploration of the gut microbiota to the search of novel enzymes for biofuel production. In addition, the team proposes fundamental theories and integrates novel methodologies like sequence similarity networks and comparative genomics strategies to improve the functionfattentional annotation in large and diverse CAZy families thereby participating in the discovery of novel enzyme families.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

One major recommendation to the team was to prepare for the departure of the team leader and address the potentially sharp drop in scientific outlook. This was taken into account and a talented young assistant professor took over the lead of the team. Another recommendation was to further develop their own functional studies and hypothesis-driven research to raise the level of their own original publications possibly through the recruitment of a full-time researcher. This step is not fully achieved, yet as a first step, the team has increased internal collaborations and 8 papers were published in collaboration with other AFMB teams.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	1
Lecturer and associate lecturer	3
Senior scientist (Directeur de recherche, DR) and associate	0
Scientist (Chargé de recherche, CR) and associate	0
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	2
Subtotal permanent personnel in active employment	**6**
Non-permanent teacher researchers, researchers and associates	0
Non-permanent research supporting personnel (PAR)	3
Post-docs	1
PhD Students	0
Subtotal non-permanent personnel	**4**
Total	**10**

EVALUATION

Overall assessment of the team

The glycogenomics team had an outstanding level of attractiveness and scientific production taking into account the small size and youngness of the team since the recent retirement of its charismatic leader. In terms of academic reputation and appeal, the team conserved an excellent international outreach both within the academic and industry fields. Novel bioinformatics strategies have been developed opening new and original avenues that need to be maintained in the future. However, the team's achievement in terms of training through research of PhD students could be improved.

Strengths and possibilities linked to the context

The team puts efforts to maintain and update the CAZy resource which is freely available on-line database. It benefits from a strong know-how and worldwide recognition for its leadership in glycogenomics. The scientific output of the team during the last period under evaluation is of outstandingly high level and its global outreach in the field of glycogenomics is remarkable. The team published over 190 original papers and three book chapters, fifteen of which are in first/last or corresponding authors in excellent scientific journals (Nature Chemical Biology, Nature communications, Journal of Biological Chemistry, Current opinion in Chemical Biology, Nucleic Acids Research); 74 % publications are in the best visible scientific journals, 95% are resulting from international collaborations and 8 papers were published in collaboration with other AFMB teams.
The team has a very high attractiveness and was successful to partner with other groups outside the unit (National and International academic and non-academic collaborations) to perform experimental characterisation of CAZymes. Strong collaborations were developed with IZInovation/BBF in Marseille (filamentous fungi), BioIntrant/Lemire in Lyon, NovoNordisk foundation (Denmark). The team participated in several collaborative projects (1 Era CoBioNet (Synbiogas project) and two ANR (PULmarin, Brown sugar), expanding the annotation of CAZymes to several new genomes. This led to numerous co-publications (95% of the publications of the team) of the highest international level. In this context, a large number of undergraduate and PhD students were supervised and formed to CAZymes annotation and 8 international postdoctoral fellows were recruited during the 2016-2021 period.
One team member (retired and Emeritus since 2020) has an outstandingly high recognition at international level and provided solid contribution to the team. He received several prizes (IChemEn; BA sonte), organised several conferences (Gordon Research Conferences, 13th Carbohydrate Bioengineering Meeting, LPMO symposium), participated to one ERC (Human micro project 2014-2019), five ANR (Funlock, Funtune, Cesbic, 1000 CAZymes, PUL marin), one PIA (BIP : BIP 2011-2017) and was invited in various juries (Novozymes price, ERC LS9 panel) and in foreign laboratories (DTU, Copenhagen, Denmark).
The young assistant professor, now heading the team is developing novel bioinformatics strategies opening new and original avenues for the characterisation of CAZymes. He secured funding and obtained one ANR JCJC (ODE, 2021-2023) to develop innovative operon-based methodologies for the discovery of novel CAZymes. He also participated to two ANR (Brown sugar 2020-2024, CoBiotech Synbiogas 2020-2023) as a scientific partner.

Weaknesses and risks linked to the context

No PhD student was enrolled in the team and no PhD defense is mentioned during the 2016-2021 period which might be related to be fact that only one senior member of the team has an HDR.
The team members do not drive most of the papers and previous team leader retirement already had a negative impact on the scientific production of the team.
Implication of the team to the functional characterisation of newly annotated CAZymes is not so much documented.
It is difficult to assess the implication and participation of all the team members in this rather small and young team. There is no more full-time researcher and team members (even PAR) are highly implicated in teaching duties.

RECOMMENDATIONS TO THE TEAM

The CAZy database is a must in the glycosciences field and functional annotation of CAZymes in genomes is extremely challenging for non-specialists. The young team leader took over an important project for the scientific community; Therefore, long-term sustainability of the team is essential and needs to be ensured. The number of qualified research supervisors (HDR) should be increased in this young team. Faculty members could take advantage of their involvement in training programs to increase the number of master and PhD students

enrolled in the team and the level of young researcher supervision. Involvement of all the team members in the project needs to be clarified.

Team 3: Glycobiologie et Neurobiologie Structurales

Name of the supervisors: M. Yves Bourne et Mme. Pascale Marchot

THEMES OF THE TEAM

The research themes of the team focus on three main themes, with a global structure/function approach:
• carbohydrate-active enzymes (CAZymes) and their relatives. The team focuses, in collaboration with team 2, on particular family of glycoside hydrolases, which have an interest for biomedical and biotechnological applications.
• membrane sensors involved in biofilm formation of *Pseudomonas aeruginosa* pathogenic bacteria and enzymes involved in lipid metabolism of *Mycobacterium tuberculosis*
• enzymes of the α/β-hydrolase fold and their relatives, cell adhesion molecules, and receptors/channels with a neurobiological interest. In particular team members have expertise in the study of acetylcholinesterase, the extracellular ligand-binding domain of the nicotinic acetylcholine receptor and neuroligins, which are cellular adhesion molecules.
The team methodological approaches involve recombinant protein design and production in prokaryotic and eukaryotic cell systems, along with complementary biochemical, biophysical, functional and structural (X-ray crystallography - electron microscopy) characterisation of these proteins and their functional partnerships.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

-try to have a more integrative approach, with an increased collaboration between teammates and more applications resulting in a more readable vision of the team strategy, what may lead to greater success in fundraising.
This point was not perceived to be resolved. The notoriety of the team may induce a lot of solicitations, long-term collaborations and opportunities that may not facilitate refocusing. An important reorganisation of the team is foreseen with the anticipated retirement of the two PIs of the team at the end of the next period, which might be an opportunity to reconsider the recommendation.

-improve the visibility of the team in the Glycoscience community like it is already the case in the community of structural biology.
Two papers in Glycobiology, the organisation of Lytic Polysaccharide MonoOxygenases (LPMO) symposium (Nov 2018), invitation to Carbohydrate Bioengineering Meeting (2017) and Eurocarb (2019) and oral presentation at GDR Gagosciences (2017) have been noted in activity of the team during the evaluation period, which all contribute to an increased visibility in the field.

-increase the number of publications per students.
Three students of the team obtain their PhD during the evaluation period. One was first author of 3 publications during the year after his defense, but it seems that publication is still awaited for the two others.

-maintain the efforts of the team in research training and in interaction with the cultural environment.
Report shows that the team activities on both aspects are still excellent.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	0
Lecturer and associate lecturer	0
Senior scientist (Directeur de recherche, DR) and associate	2
Scientist (Chargé de recherche, CR) and associate	1
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	3
Subtotal permanent personnel in active employment	**6**
Non-permanent teacher researchers, researchers and associates	0
Non-permanent research supporting personnel (PAR)	2
Post-docs	0
PhD Students	0
Subtotal non-permanent personnel	**2**
Total	**8**

EVALUATION

Overall assessment of the team

The team has an excellent scientific production attested by articles of significant impact in the field and a very good financial independence with a significant increase of financial capacity in recent years. This, ensure the financial future of the team for next years. But for the long-term perennity of the team two important points have to be taken into account and anticipated, the future of the direction and the financing of the team, which actually relies strongly on the two team leaders. Another important point is to strengthen the basis of the team by bringing attention to the vital forces of the research constituted by the PhDs and by thinking to recruitment of new researchers to maintain a good 'personnel d'appui à la recherche' over researcher ratio.

Strengths and possibilities linked to the context

The team reported the production of three book chapters and 30 publications, including fifteen as first/last authorship and almost 50% resulting from the international collaboration with excellent teams. Several articles were published in excellent journals like one PNAS, one Neuron, one Nature Comm and one JACS and two of the articles resulting from collaborations were accepted in Nat Chem Biol and Nucleic Acids Research. The quality of the team contribution is certified by 6.7% of its production being in Top1% most cited articles worldwide and 13.3% in Top10%.

The team ensure its national and international visibility through the organisation of congresses (Sfet each year, congrès de l'association française de cristallographie 2016…) and by participating regularly to conferences or learned society congresses (30 oral communications including one keynote address, fifteen international/national invitations and six selected communications). Team members were involved in organisation of four international symposiums. Two members of the team sit in national and regional learned society comities, for which they regularly organize congress. A PI received the 'Prime d'Excellence Scientifique (PES) du CNRS'. One team PI is very active in the editorial process (J Biol Chem, Scientific Reports, J Neurochem, Toxins) and associated editor of 'Société Française pour l'Etude des Toxines' annual meeting booklet.

Based on their recognised expertise, team members are invited in multiple evaluation processes of labs/units through Hcéres campaign, of research projects for ANR, CNRS (Momentum), AFM-Telethon, FNRS (Belgium), NMRC (Singapore) and of infrastructure access in structural biology (for ESRF, Soleil, MAX4, iNEXT). Team members participated to in eleven PhD and four HDR juries. The technical staff is also largely involved (for 50% of their working time) in shared services of AFMB, from recombinant protein production in eukaryotic systems to crystallography, biophysical characterisation and crystallisation, benefiting the community.

The team has obtained one ANR funding as coordinator and participated to six ANR projects as partner. Some alternative sources of credits were obtained from charity associations (2VLM, 1VML). At the international level, the team was part of a 'laboratoire international associé' with the University of California-San Diego. The team was awarded a European Prestige grant to support a Post-doc mobility to France. Notably, the average annual amount of financing has almost doubled (from ~25k€/year from previous grants to>40k€/year for current ones). This ensures the future financial independence of the team for the next few years. In addition, the team benefited from grants to support platform infrastructure by IBiSA and Frisbi.

During the assessed period, the team has hosted 22 students in internship, three PhD students (all have defended), three postdocs and seven fixed-term contracts. One HDR was obtained in 2017.
The team was involved in the organisation of multiple educational events to popularize science targeting the general public, including pupils, like 'fête de la Science', 'Concours de Croissance Cristalline dans l'Académie Aix-Marseille', 'Nuit Européenne des Chercheur. e. s' or videos for the MOOC series 'Voyage au coeur du vivant'.

Weaknesses and risks linked to the context

PhD supervision is a point of potential concern. There are three HDR in the team, which lead to defenses of three PhDs in 2016, 2017 and 2020, but since the end of September 2020, no more PhD is present in the lab (end of evaluating period: 31/12/2021). This is striking because at the same time seventeen students were trained during the evaluation period and notably ~2.5 M2 students were supervised each year of the evaluation period. This low PhD/M2 ratio might be due to personal lack of motivation from the students to pursue a PhD and lack of success at the doctoral school exam. A better coordination with members of the lab in charge of teaching at AMU could improve this situation by selecting M2 students with potential to obtain a thesis fellowships.

The mid-term anticipated departure of renown PIs from the team will cause a risk regarding funding.

RECOMMENDATIONS TO THE TEAM

A long-term view of the future of the team will have to be considered to face the difficulties potentially caused by the foreseen retirement of the two PI. A plan may have to be put in place to ensure the development and the perennity of the team and to maintain its actual increasing success in terms of financing. It could also be an opportunity, as suggested in the previous report to refocus on fewer research lines. Finally, anticipation of that situation will give the time to build the future team on the basis of new PhDs or Post-Doc who may have the possibility to forge the beginning of their career for a potential future recruitment.

Team 4: Interactions Hôte-Pathogène

Name of the supervisor: M. Alain Roussel

THEMES OF THE TEAM

The team focuses on improving knowledge the interactions of pathogens with their host, leading to its infection and possible destruction. Their targets of interest are diverse and include bacteriophages, secretion systems, and the host immune response. These last years, the team studied the structure and adhesion mechanism of bacteriophages infecting *Lactococcus lactis*. They determined the structures of several phage virions by electron microscopy and that of the anti-receptors by X-ray diffraction. Still in the field of virology, the team recently launched a project on the human hepatitis E virus (HEV). With regard to bacterial infections, they tackled the study of bacterial secretory systems using approaches including electron microscopy and X-ray diffraction. In the spring 2021, team 4 moved to the LISM lab on the CNRS Joseph Aiguier campus and its relocation was effective in January 2022.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

In the previous evaluation campaign (2016-2017), no recommendation was provided for the assessment of scientific quality and outputs. The committee of experts recommended keeping up the excellent work. About the assessment of the team academic reputation and appeal, the current visibility of the team could be temporally weakened with the retirement of its historical, charismatic leader. The transition to a new leadership seems to be effective and well established during the period. About assessment of the strategy and the five-year plan, the competitiveness of the team is highly dependent on three platforms that are lacking technicians and engineers with permanent position. The committee of experts recommended making specific effort to ensure the viability of the platforms through recruitment. Unfortunately, the situation remains unchanged.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	1
Lecturer and associate lecturer	0
Senior scientist (Directeur de recherche, DR) and associate	1
Scientist (Chargé de recherche, CR) and associate	2
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	1
Subtotal permanent personnel in active employment	**5**
Non-permanent teacher researchers, researchers and associates	0
Non-permanent research supporting personnel (PAR)	5
Post-docs	1
PhD Students	3
Subtotal non-permanent personnel	9
Total	**14**

EVALUATION

Overall assessment of the team

This team presents outstanding performances in the field of host-pathogen interactions, which is very internationally competitive. The numerous and recent publications of the team in prestigious journals such as Molecular Cell, Nature Communications, Nature Microbiology, etc., demonstrate its scientific excellence at an international level and despite the Cov19 pandemic. Moreover, structural and functional approaches developed by this team are at the forefront of this research topic. Its arrival in the LISM lab comes with the loss of several technical permanent personnel. To maintain this scientific quality, it is essential for the team to strengthen its human resource potential.

Strengths and possibilities linked to the context

During the assessed period, the team has published more than 80 articles among which 34 are signed by an author in key position (either first, last or corresponding). Five articles involved a collaboration with another team of the laboratory. Those articles were published in excellent journals such as Nature, Cell, Frontiers in Immunology, Journal of Biological Chemistry (JBC), MBio, Molecular Microbiology, Journal of Molecular Biology (JMB), PNAS, *etc*. Researchers from the team have also been associated with excellent publications (in Nature Communications, PNAS, JBC, Journal of Innate Immunity, JMB, *etc*.) which attests the quality of their collaborations. Added to this list, eight chapters of book including five whose authorship are shared with other teams of the unit (Teams 1 and 6). In summary, this assessment shows that team 4 has an excellent scientific reputation as testified by the top-quality of its publication record. The highest national award given to one member of the team (the Legion of Honor) also recognised this quality. Moreover, a silver medal from CNRS rewarded another member of the team. The team has obtained several competitive grants and funding. This includes funding EU Projects in which the team was coordinator and ten grants from the ANR (6 coordinated by a member of the team and 4 as partner). The reputation and appeal of the team have led to a successful partnership with industrial companies. In addition, the team benefited from a maturation program from SATT Nord and SATT SE in order to create a start-up to commercialise its products (Cordial-IT in which the headed group is involved). During the assessed period, the team has hosted five postdocs (only one to date), nineteen students in internships and eight PhD students (5 of which have defended and 1 PhD students is in fourth year).

Weaknesses and risks linked to the context

The research of this team will rely, in the future, to the infrastructure of a new laboratory and the team is reduced to four permanent personnel. Research supporting personnel is only based on non-permanent positions and several important partnerships are linked to the use of the platforms, which are still present in AFMB main building.

RECOMMENDATIONS TO THE TEAM

The committee of experts recommends continuing the excellent scientific contribution but note the need to strengthen human resource potential and secure access to the needed infrastructure.

Team 5: Réplicases virales : structure, fonction et Drug-design

Name of the supervisor: M. Bruno Canard

THEMES OF THE TEAM

The team has a long history of working on viral enzymes (RNA polymerases, RNA capping enzymes, RNA exonucleases) of emerging RNA viruses with the aim of understanding the structure/function relationship of these viral machinery. Working since the 2002 pandemic on coronaviruses, the team has come to the forefront and taken a leading role following the Sars-CoV-2 outbreak in late 2019. The important work done by the team on this virus has thus propelled it to the forefront of the international scene and has had a significant impact during the reference period of the evaluation. In particular, the team was responsible for the discovery of the furin cleavage site, a remarkable feature of Sars-CoV-2. This insertion is recent, as no known virus containing it is close to the same family and allows it to cross the species barrier to humans. The team also identified and characterised inhibitors of the virus' RNA polymerase, and proposed a strategy based on 'catastrophe mutations' targeting this enzyme as an antiviral strategy. In addition to this work, the team has also made important contributions to the mechanisms of action of the Ebola virus L protein methyltransferase activity.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The team has continued its excellent work noted in the previous evaluation and has established very appropriate collaborations.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	1
Lecturer and associate lecturer	2
Senior scientist (Directeur de recherche, DR) and associate	3
Scientist (Chargé de recherche, CR) and associate	1
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	5
Subtotal permanent personnel in active employment	**12**
Non-permanent teacher researchers, researchers and associates	0
Non-permanent research supporting personnel (PAR)	5
Post-docs	5
PhD Students	10
Subtotal non-permanent personnel	**20**
Total	**32**

EVALUATION

Overall assessment of the team

Over the reference period, the team has an outstanding record. The team has been able to perfectly leverage its expertise in the frame of the Covid pandemic and is at the forefront internationally.

Strengths and possibilities linked to the context

The perseverance of the team in its themes despite the difficulty to find funding before the pandemic is certainly a strong point. The two leaders of the team have a high international visibility and have been able to establish extremely fruitful collaborations, which is reflected in the funding (national but also European) acquired after the Covid-19 pandemics as well as in the publications in the second part of the reference period. The multidisciplinarity is also an asset for the team, with the capacity to provide innovation in medicinal chemistry on top of its capacity to decipher the mechanism of action of multiple enzymes involved in virus life cycle. These enzymes are assembled within a biobank that provides targets for HTS.
The team has produced 72 peer-reviewed publications mostly in excellent journals (PNAS, Nature Communications, NAR, PLoS Pathogens, TIBS, Antiviral Research, J. Virol, Sci. Reports, …). Three of these publications have already received more than 600 citations (one more than 1600 citations), showing the strong impact in the field. Team members were invited to major virology conferences and to universities (CSHL, Gordon Conf., SFM, SFV, Columbia, DKG, I. Pasteur, …).
The team participated to EU grants involving large consortium IMI-CARE (> 50 labs), SCORE (7 labs), EVAg and Zikalliance and to a training network ITN-MSCA (2PhDs). Team members received ANR (9, with 6 as coordinators) and ANRS (1) funding and were twice laureate of 'FRM Teams'. two of the ANR projects are in collaboration with team 6.
The team provided training to ten PhD students, ten postdoc fellow and ten M2 interns.
The team manages the PCML platform that supports the identification of compounds with antiviral potential, with a focus on emerging RNA viruses (e.g. Ebola, coronaviruses…). The platform has an Ibisa label and is included in national ChemBiofrance and ChemBioScreen networks.
The team has obtained one patent and had multiple collaborations with industrial partners (Partnerships: Janssen Ph., Pantheon, CisBio, Vivalis, Eukaryis, Atea Ph., CytobodX and international collaborations: Takeda, USA; Janssen, Belgium; Pfizer, USA; Merck, USA).
The team has been extremely active in communication to the larger public with more than 100 media communications at the international levels, in major newspapers, radio and TV, contributing to accurate and fact-based information. The team also provided recommendations to national public bodies during the Covid crisis (Senate, National assembly…).

Weaknesses and risks linked to the context

The difficulties inherent to the relocation of the team in relation to the rest of the laboratory, and to the limited available current space, raise some serious problems that will not be easy to solve in the short and medium term.

RECOMMENDATIONS TO THE TEAM

In addition to the observation linked to the problems of the team's offices and lab spaces mentioned above, the problem posed by the IHU thesis grants should be remedied as soon as possible in order to complement them and bring them to the level of normal doctoral contracts.

Team 6: Complexes Macromoléculaires Viraux

Name of the supervisor: M. Juan Reguera

THEMES OF THE TEAM

This team works on mechanistic aspects of RNA virus replication of the toscana (TOSV) and the chikungunya viruses. They carried out structure-function analyses on macromolecular complexes (e.g. the cap-snatching endonuclease from TOSV, and the nsP1 protein from the chikungunya virus). 3-D structure determinations of these complexes rely on X-rays crystallography or on single particle cryo-electron microscopy and are backed by enzymatic and biophysical studies. In addition, this team has optimised a high-throughput interactomic approach allowing quantitative information about the affinity between two partners (proteins or domains/signatures thereof), the HTP holdup assay. This technique was notably used to analyse the PDZ-PBM interactome.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

Beyond the scientific quality of this team that was appreciated by the previous Hcéres committee, some recommendations were made (in italic characters below).

- *the thematic proximity with the team of Bruno CANARD needs to be valued*
The collaboration with team 5 has been strengthened as two grants were jointly obtained with this team (1 ANR/DGA, 237 k€ and 1 FRM, 289 k€, JR being co-responsible for this latter grant); this is also highlighted by fife joint publications.
- the team has just started and will need to assure that momentum is maintained (e.g. funding)
The team has secured several grants over the period considered (see below).
- The eukaryotic expression services (currently insect cells) could possibly be expanded to mammalian cells attracting more users at AFBM and beyond (pending further funding)
A eukaryotic platform (HEK cells) is present in another team

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	0
Lecturer and associate lecturer	0
Senior scientist (Directeur de recherche, DR) and associate	1
Scientist (Chargé de recherche, CR) and associate	0
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	2
Subtotal permanent personnel in active employment	**3**
Non-permanent teacher researchers, researchers and associates	0
Non-permanent research supporting personnel (PAR)	1
Post-docs	1
PhD Students	2
Subtotal non-permanent personnel	**4**
Total	**7**

EVALUATION

Overall assessment of the team

This is an excellent team with outstanding performances in the field of molecular virology positioning this team at the forefront of this research theme. This exceptional quality should be maintained despite the future managing/administrative task the PI is about to embody.

Strengths and possibilities linked to the context

The team has an excellent scientific reputation as testified by the top-quality of its publication record: six publications with a leading role (1st author and/or corresponding author) in first ranked-journals including one Nature (2021), one JBC (2021), one NAR (2019), one PLoS Path (2016) (and also 1 FEBS J and 1 Virus Res.) and six book chapters. In total, they published 35 papers including twelve whose authorships are shared with other teams in the unit. This team plays a central role in the unit. The development of the 'HT interactomic platform' has already foster several successful collaborations.

The quality of this team is also underlined by its involvement in assessing the research in different committees or as experts: three Hcéres committees (RV); Ten times as project evaluators; as members of the Inserm CSS1 (since 2022). This quality was also recognised by the prize attributed by the CNRS: 'Cristal du CNRS' (2019).

In line with the scientific recognition of this team, they regularly obtain grants from either European or French organisations: two European grants (RV 601 k€ and 20 k€); three ANR (RV 116 k€; JR 190 k€ and JR* 231 k€); one ANR/FRM (JR* 150 k€); one ANR/DGA and 1 FRM (both with team 5, 237 k€ and JRco* 289 k€); one Bettencourt Sheller Foundation (JR* 300 k€) and one Foundation Aix-Marseille (JR* 20 k€)

A newly recruited CNRS scientist has joined the team. She was already a postdoc in the lab so her integration should run smoothly.

Weaknesses and risks linked to the context

The research of this team will rely, in the future, on the access to a new cryo-EM (a Glacios 200 keV is expected in 2023 and will be installed in AFMB)

The PI of the team will become the new director of the unit and this might threaten the pace of the scientific discovery.

This team has presently two PhD students in fourth years + one in co-direction who started in Spain in 2017

RECOMMENDATIONS TO THE TEAM

This scientific quality of this team is excellent and they are pioneers in their research field. The team members should pursue on the same track.
Being a director of a research unit can be quite time-consuming so it is important to find the right balance between science and administrative tasks. The PI is well-aware of that and will have two deputy directors so he could share the administrative duties.

Because the Cryo-EM is not present in Marseille yet (or arrives with a possible delay?), this team should maintain their very efficient and productive collaborations with external teams, either in France (IBS) or abroad (Spain), to keep having access to state-of-the-art equipment.

CONDUCT OF THE INTERVIEWS

DATE

Start: November 02, 2022 at 8:30 a.m.

End: End: November 02, 2022 at 018:00 a.m.

Interviews conducted: remote

INTERVIWS PROGRAMME

8:30 Test Zoom connections

8:35 – 8:45 Closed session/Committee (if needed) https://hceres-fr.zoom.us/j/96431722849

Scientific sessions https://hceres-fr.zoom.us/j/95318830352

8:45 - 8:55 Introduction / Presentation of the Committee members

9:00 – 9:25 Unit presentation by the DU (15'+ 10' discussion)

9:30 – 10:50 3 Teams (10' + 10' discussion)

9:30-9:50	Team 1	Désordre structural et Reconnaissance Moléculaire
9:50-10:10	Team 2	Glycogénomique
10:10-10:30	Team 3	Glycobiologie et Neurobiologie Structurales

Break/debrifieng committee (30')

11:00- 13:00 3 Teams (10' + 10' discussion)

11:00-11:20	Team 4	Interactions Hote-Pathogène
11:20-11:40	Team 5	Réplicases virales: structure, fonction et Drug-design
11:40-12:00	Team 6	Complexes Macromoléculaires Viraux

Break/debriefing committee (15')

12:15-13:30 **Lunch break/debriefing committee, if needed**

13:30 –14:00 Meeting Committee with Supervising bodies (CNRS, AMU, INRAe)

https://hceres-fr.zoom.us/j/98066649416?pwd=VFZUcTF5b2I2QWF6YVQwVlpwNzZvdz09

Interviews

https://hceres-fr.zoom.us/j/94921287469?pwd=SkJXSXFqK1pDeFc4bWpjRTVGTUF6UT09

14:00- 14:30 Meeting w/ technical staff

14:45– 15:15 Meeting w/students

15:30– 16:00 Meeting w/researchers and EC (no team leaders)

16:00- Discussion Committee – DU https://hceres-fr.zoom.us/j/96431722849

Committee/Report briefing https://hceres-fr.zoom.us/j/96431722849

SPECIAL POINTS TO MENTION

None

GENERAL OBSERVATIONS OF THE SUPERVISORS

Le Président de l'université

au

Département d'Évaluation de la recherche - Hcéres

Objet : Observations de l'unité relatives au rapport d'évaluation des experts Hcéres

N/Réf. : VPR/LS/AMS/CM – 23-07

Dossier suivi par : Cécile Merle
Tél : 04 13 94 95 90
cecile.merle@univ-amu.fr

Vos réf :
DER-PUR230022960 - AFMB - Architecture et fonction des macromolécules biologiques

Marseille, le jeudi 15 juin 2023

Madame, Monsieur,

Je fais suite au mail que vous nous avez adressé le 30/05/2023 dans lequel vous me communiquiez le rapport d'évaluation Hcéres de l'Unité AFMB - Architecture et fonction des macromolécules biologiques.

Comme demandé dans ledit mail, je vous fais part des observations de portée générale en vous reportant les commentaires de la direction de l'unité :

We thank the committee for the fair evaluation, the positive and pertinent comments and the constructive few recommendations. We truly believe that these recommendations will benefit to the future of our laboratory.

Overall, the teams sincerely appreciated both the overall positive evaluation by the committee and the relevant recommendations.

Comments concerning the evaluation of the unit

We are of course concerned by a collective reflection to reduce our carbon footprint and we started to put in place a working group which will combine efforts with the neighboring laboratories. Similarly, a tandem dedicated to the gender parity and equality will be nominated shortly.

We are also concerned by the non-standard grant level for PhD students and post-docs funded by the "Méditerranée Infection" foundation. While the grant level has been raised recently, we will do anything possible with the support of tutelles to bring them to a standard level.

Comments concerning the evaluation of team 3

We feel that the Structural Neurobiology theme in team 3 has been somehow overlooked in the scientific evaluation (e.g., frame on top of p. 12, 1rst paragr on p. 13) despite its contribution to national and international collaborations, grants, publications, hosted postdocs and students, boards and committees, and invited conferences during the evaluated period.

Vous souhaitant bonne réception des présentes,

Je vous prie de croire, Madame, Monsieur, l'expression de mes respectueuses salutations.

Eric BERTON

Les rapports d'évaluation du Hcéres
sont consultables en ligne : www.hceres.fr

Évaluation des universités et des écoles
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