

# CNB REPORT

2021\_2022

RESEARCH  
DEVELOPMENT  
INNOVATION



# CNB REPORT

2021\_2022

RESEARCH  
DEVELOPMENT  
INNOVATION

# INDEX

WELCOME TO THE CNB.....	7
MACROMOLECULAR STRUCTURES .....	11
<b>Biocomputing unit</b> .....	12
José María Carazo	
Carlos Oscar Sorzano	
<b>Cell-cell and virus-cell interactions</b> .....	13
José M Casasnovas	
<b>Viral molecular machines</b> .....	14
José R. Castón	
<b>Functional proteomics</b> .....	15
Fernando J. Corrales	
<b>Ultrastructure of viruses and macromolecular aggregates</b> .....	16
Jaime Martín-Benito Romero	
<b>Molecular biophysics of DNA repair nanomachines</b> .....	17
Fernando Moreno Herrero	
<b>Structural biology of bacteriophage and virus proteins</b> .....	18
Mark J. van Raaij	
<b>Cell structure laboratory</b> .....	19
Cristina Risco Ortiz	
<b>Structural and physical determinants of complex virus assembly</b> .....	20
Carmen San Martín Pastrana	
<b>Structure and function of molecular chaperones</b> .....	21
José M. Valpuesta	
MOLECULAR AND CELLULAR BIOLOGY.....	23
<b>Molecular bases of actin cytoskeleton reorganisation in cell motility, tumour generation and invasiveness</b> .....	24
Inés M. Antón Gutiérrez	
<b>Coronavirus: replication and transcription, virus-host interactions, and protection</b> .....	25
Luis Enjuanes	
Isabel Sola	
<b>Poxvirus and vaccines</b> .....	26
Mariano Esteban	
<b>Virus-host interactions in hepatitis B virus infection</b> .....	27
Urtzi Garaigorta de Dios	
<b>Hepatitis C and related virus infection</b> .....	28
Pablo Gastaminza Landart	
<b>Animal models by genetic manipulation</b> .....	29
Lluís Montoliu	
<b>Functional analysis of transcriptional repressor DREAM</b> .....	30
José Ramón Naranjo Orovio	
<b>Cerebral cortical development</b> .....	31
Marta Nieto López	
<b>Dynamics of RNA viruses in infected patients. New antiviral designs</b> .....	32
Celia Perales Viejo	
<b>Molecular characterisation and epidemiology of torovirus</b> .....	33
Dolores Rodríguez	
Fernando Almazán	
<b>Molecular biology of birnaviruses</b> .....	34
José F. Rodríguez Aguirre	
<b>Development, differentiation and regeneration in vertebrates</b> .....	35
Juan José Sanz Ezquerro	

<b>Bacteria-based immunotherapies against cancer</b> .....	36
Esteban Veiga Chacón	
<b>MICROBIAL BIOTECHNOLOGY</b> .....	39
<b>Genetic stability</b> .....	40
Silvia Ayora	
Juan Carlos Alonso	
<b>Stress and bacterial evolution</b> .....	41
Jesús Blázquez Gómez	
<b>Bacterial engineering for biomedical applications</b> .....	42
Luis Ángel Fernández	
<b>Intracellular bacterial pathogens</b> .....	43
Francisco García del Portillo	
<b>Synthetic bacterial amyloids (SynBAmyl)</b> .....	44
Rafael Giraldo	
<b>Molecular infection biology</b> .....	45
Daniel López Serrano	
<b>Ecology and evolution of antibiotic resistance</b> .....	46
José Luis Martínez	
<b>Regulation of gene expression and metabolism in bacteria</b> .....	47
Fernando Rojo	
<b>Microbial evolution and ecology</b> .....	48
Álvaro Sánchez	
<b>Plasmid biology and evolution</b> .....	49
Alvaro San Millán	
<b>PLANT MOLECULAR GENETICS</b> .....	51
<b>Natural variation of plant development</b> .....	52
Carlos Alonso Blanco	
<b>Plant immunity strategies against microbial pathogen infection</b> .....	53
Carmen Castresana	
<b>Genetic control of shoot branching patterns in plants</b> .....	54
Pilar Cubas Domínguez	
<b>Regulation of gene expression in plants</b> .....	55
Jose Manuel Franco Zorrilla	
<b>Plant-pathogen-interaction in viral infections</b> .....	56
Juan Antonio García Álvarez	
Carmen Simón Mateo	
<b>Mechanisms underlying nutrient uptake and phytoremediation</b> .....	57
Antonio Leyva	
<b>Regulation of gene activity in plants. The phosphate starvation rescue system</b> .....	58
Javier Paz-Ares	
<b>Signalling networks in plant development and defense responses</b> .....	59
Enrique Rojo	
José Sánchez-Serrano	
<b>Role of ubiquitin in the control of plant growth and stress tolerance</b> .....	60
Vicente Rubio	
<b>Jasmonate signalling in plants</b> .....	61
Roberto Solano	
<b>IMMUNOLOGY AND ONCOLOGY</b> .....	63
<b>Immunobiology of macrophages and dendritic cells</b> .....	64
Carlos Ardavín	
<b>Regulation of inflammation by p21 and mitochondrial ROS in autoimmunity and cancer</b> .....	65
Dimitrios Balomenos	

<b>Nanomedicine, cancer immunotherapy and autoimmune diseases</b> .....	66
Domingo F. Barber Castaño	
<b>Cardiac stem cells</b> .....	67
Antonio Bernad	
<b>B lymphocyte dynamics</b> .....	68
Yolanda R. Carrasco	
<b>Molecular targets in health and disease: focus on PI3-kinase</b> .....	69
Ana Clara Carrera Ramírez	
<b>Stress-activated protein kinases in inflammation and cancer</b> .....	70
Ana Cuenda	
<b>Physiopathology of chemokine receptor interactions</b> .....	71
Leonor Kremer	
<b>Signaling networks in inflammation and cancer</b> .....	72
Santos Mañes	
<b>Stem cells and immunity</b> .....	73
Carlos Martínez-A	
<b>Chemokine receptors: biology and clinical relevance in inflammation, cancer and AIDS</b> .....	74
Mario Mellado	
<b>Diacylglycerol kinases in the control of immune response and cancer progression</b> .....	75
Isabel Mérida	
<b>Transcriptional regulation of B lymphocyte differentiation</b> .....	76
Ignacio Moreno de Alborán	
<b>Receptor ligand interactions in immune responses to cancer and viruses</b> .....	77
Hugh Reyburn	
<b>Tumour immune activation and evasion</b> .....	78
Mar Valés Gómez	
 SYSTEMS BIOLOGY .....	 81
<b>Clocks and rulers in life</b> .....	82
Saúl Ares	
<b>Environmental synthetic biology</b> .....	83
Víctor de Lorenzo	
<b>Evolutionary systems</b> .....	84
Susanna Manrubia	
<b>Systems Biotechnology</b> .....	85
Juan Nogales	
<b>Computational systems biology</b> .....	86
Florencio Pazos	
<b>Logic of genomic systems</b> .....	87
Juan F Poyatos	
<b>Microbiome analysis</b> .....	88
Javier Tamames de la Huerta	
Carlos Pedrós-Alió	
 SCIENTIFIC FACILITIES AND RESEARCH PLATFORMS .....	 91
 INNOVATION .....	 107
 SCIENTIFIC EVENTS, FACTS AND FIGURES .....	 111
 SCIENTIFIC CAREER DEVELOPMENT .....	 123
 COMMUNICATION AND OUTREACH .....	 133
 EQUALITY .....	 141
 SUSTAINABILITY .....	 145
 CNB MANAGEMENT .....	 149





## Welcome to the CNB

This report summarises the activities of the CNB-CSIC (Centro Nacional de Biotecnología) through the years 2021 and 2022, a period still marked by the end of the pandemic caused by SARS-CoV-2.

The activity developed by CNB researchers during the pandemic has been outstanding, culminating with the application for a Phase I Clinical Trial for a CNB vaccine candidate. This candidate, based on the Modified Vaccinia Ankara (MVA) virus has shown, in preclinical trials, to generate a very robust cellular and humoral immune response in three different animal models (mice, hamsters and macaques). In addition, the CNB has developed a serological diagnostic kit which use has been made available to the World Health Organization (WHO) to be manufactured in African and other developing countries through the C-TAP WHO initiative to provide rapid, equitable and affordable access to Covid-19 health products. These and other activities are summarised by some very relevant scientific indicators, with more than 60 scientific publications on topics related to SARS-CoV-2, 12 patents developed and 17 contracts for technological support to companies.

We are now in a transition period connecting the hyperactivity during the pandemic with the regular scientific activity of a multidisciplinary research center such as ours. The CNB is nevertheless very interested in the continuance of the infrastructures developed to respond to SARS-CoV-2, as a way to be prepared to respond to the emerging viruses that are likely to play a key role in the next future. Another important aspect that can be nurtured by this experience is the development of platforms for the study of bacterial resistance, probably one of the major challenges for the global health system in the coming years. The CNB also wants to be a leader in facing this challenge.

During this period, we have also improved our technological offer and finished the development of the Bioimaging platform as a way to integrate all the CNB efforts to carry out multi-scale and multi-resolution microscopy approaches, as well as the two image analysis units to process the vast amount of information generated. In this context, the CNB hosts two facilities that belong to the INSTRUCT-ERIC network of European structural biology facilities: the cryoEM CNB-CSIC facility for data acquisition in cryoelectron microscopy and the Instruct Image Processing Center (I2PC) for processing electron microscopy data. This makes the CNB a unique Center where the whole process, from sample preparation to sample characterisation, data acquisition and advanced data processing can be carried out by the user.

Over this period of time, CNB researchers have contributed to the publication of 545 papers in ISI-listed journals with an average impact factor of 8.8. Significantly, 50% of these publications were among the top 10% of the most cited journals according to the Scimago database. As proof of their dynamism, CNB researchers obtained 220 grants (20 from international agencies), submitted 44 PhD theses,

taught more than 65 hours in Master's degree programs, hosted around 150 seminars, including webinars, and organised over 30 international workshops and meetings. The data speak for themselves of the international nature of the CNB; near 55% of the papers published by our scientists are the result of collaborations with international scientific groups from 120 countries. As a result, the CNB offers an attractive career destination for young scientist, with 10 new tenured scientists joining in 2022, which facilitate the renewal of the scientific staff.

As a continuance of their earlier support during the pandemic, in 2022, we have signed an agreement with the Jesus Serra Foundation to promote the career development of early career researchers at the CNB. Their support has offered the possibility to create 4 grants for emerging groups and a scholarship to pursue a doctoral thesis project in the CNB. This initiative is a great example of the fruitful collaborative efforts made to promote CNB scientific research in future years.

We have also continued the effort to strengthen the biotechnological value of the CNB. In 2021-2022, we have initiated the procedures for 24 patents and 3 licenses to companies with the idea that our research facilitates the quality of life for citizens.

Similarly, we have also reinforced our commitment to communicate with society. Our Scientific Culture Unit manages the CNB presence in social media, with accounts in Facebook (4,7K followers), Twitter (28K followers), LinkedIn (12K followers) and a new account in Instagram with over 700 followers. Our science and scientists have been featured more than 2000 times in the media (press, TV, radio and digital media). Although some outreach activities such as high school guided tours to the center were put on hold during the pandemic, we are back to receive schools' visits. The annual outreach events, such as the European Researcher's Night, the National Science and Technology Week or the celebration of February 11<sup>th</sup> (#11F), the International Day for Women and Girls in Science, have been celebrated the last two years with both virtual or in-person events, when possible, with the invaluable collaboration of CNB volunteers.

We have completed a second period as a Severo Ochoa Center of Excellence, fulfilling expectations and obtaining an excellent return on the investments made. The CNB has proven to be a mature research center capable of responding with interdisciplinary excellence to the challenges that society demands.

We would like to express our gratitude to the agencies and institutions that have funded CNB research in the last two years, especially the Spanish Ministry of Science and Innovation and the European Commission which, among others, supported the acquisition and maintenance of the new infrastructures. We are also indebted to the Spanish National Research Council (CSIC) for its continuous support to our projects.

Finally, we would also like to express our admiration and gratitude to all CNB personnel who, through their excellent work and commitment, contribute to keep our Institute running and moving forward towards the accomplishment of our objectives.

Mario Mellado  
*Director*