

REPORT OF  
ACTIVITIES

2012



Institut de Ciències del Cosmos



Hopefully, this year 2012 will be the peak of the crisis that is severely affecting the funding of research projects by the Spanish Ministry of Economics and Competitiveness (MINECO) as well as the endowment of the associated fellowships and contracts. Similarly, the new rules that govern the implementation of the Ramon y Cajal programme are so stringent that Spanish universities and CSIC will hardly be able to offer new positions. This is a big problem that certainly threatens to roll back the Spanish science to more than 10 years ago and thus makes Spain waste a unique opportunity of reaching the R&D level it deserves.

The news from the Universitat de Barcelona (UB) is equally bad. Financial straits have forced the UB to make a sever cut, of about 30 %, in the budget devoted to the Contract Programmes with its Instituts Propis de Recerca (University Institutes). And this is not all. Researchers in the last year of a Ramon y Cajal (RyC) contract at the UB will have next year the opportunity to apply to a Serra Hunter position, but it is not clear when this would take place. Such a wait is a dramatic unexpected situation for all these top-quality researchers. The future of the RyC contracts at the UB is something of a great concern as this is the only way for young talented researchers to access the Spanish science system, in particular our Institute.

Fortunately, there is also good news. Firstly, I am once more glad to mention the success of the ICC-UB in its participation in the 2011 call of the Severo Ochoa award to the Spanish research centres of excellence. The ICC-UB has again been finalist. Of course, we would rather prefer to have been directly awarded, but we were closer than ever to be so. We were indeed among the very few centres reaching the necessary score of 95 points over one hundred. Only the reduction this year by a factor two

of the total number of awarded centres prevented us from obtaining the prize. This result is particularly remarkable if we take into consideration that, in this second call, all the candidate research centres were more experienced and had more information about it, so the quality of the applications was notably higher than the first year.

Secondly, other facts that occurred during 2012 make us be particularly proud of the ICC-UB. On the one hand, Licia Verde, as a member of the team led by Charles Bennett, obtained the Gruber Prize of Cosmology for their analysis, in 2003, of the cosmic microwave background (CMB) anisotropies measured by the WMAP satellite. This work has meant the beginning of the so-called “cosmology precision era”. I want to remark that this is the second time that an ICC-UB member is awarded such a prestigious prize, considered to be an anteroom of the Nobel Prize. L. Verde played a crucial role in that work, which has already got more than 6,000 cites. In fact, L. Verde, with more than 20,000 cites (SAO/NASA Astrophysics Data System) is the most cited young female astrophysicist today in the world. On the other hand, David Mateos has been awarded with one ERC Starting Grant for the study of quantum chromo-dynamics using gauge/string duality. This ERC Starting Grant is to be added to that previously obtained by L. Verde.

All these very positive results show that, despite of the economic difficulties we are going through, the ICC-UB continues to be in the good track.

Eduard Salvador-Solé  
Director



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# STAFF

## Researchers

### *Permanent Staff*

Canal, Ramon (UB)  
Centelles, Mario (UB)  
Crusats, Joaquim (UB)  
D'Enterría, David (ICREA)  
Diéguez, Ángel (UB)  
El-Hachemi, Zoubir (UB)  
Emparan, Roberto A. (ICREA)  
Espriu, Domènec (UB)  
Estalella, Robert (UB)  
Fabricius, Claus Wilhelm (IEEC)  
Fernández-Varea, José M. (UB)  
Figueras, Francesca (UB)  
Fiol, Bartomeu (UB)  
Garrido, Lluís (UB)  
Garriga, Jaume (UB)  
Gómez, José M. (UB)  
Gómez, Gerard (UB)  
Gomis, Joaquim (UB)  
González- García, M. Concepción (ICREA)  
Graciani Díaz, Ricardo (UB)  
Graugés, Eugeni (UB)  
Guasch, Jaume (UB)  
Iwasawa, Kazushi (ICREA)  
Jiménez, Raúl (ICREA)  
Jordi, Carme (UB)  
Labay, J. Javier (UB)  
Latorre, José I. (UB)  
Llosa, Josep (UB)  
López, Rosario (UB)  
Luri, F. Xavier (UB)  
Manrique, Alberto (UB)  
Mateos, David (ICREA)  
Miralda-Escudé, Jordi (ICREA)  
Molina, Alfred (UB)  
Núñez, Jorge C. (UB)  
Padoan, Paolo (ICREA)  
Paredes, Josep M. (UB)  
Parreño, Assumpta (UB)  
Polls, Artur (UB)  
Pons, Josep M. (UB)  
Ramos, Àngels (UB)  
Ribó, Josep M. (UB)

Ríos, Ramon (ICREA)  
Ruiz-Lapuente, M. Pilar (UB)  
Ruiz, Hugo (UB)  
Russo, Jorge G. (ICREA)  
Sala, Ferran (UB)  
Salvador-Solé, Eduard (UB)  
Salvat, Francesc (UB)  
Sanahuja, Blai (UB)  
Solà, Joan (UB)  
Solanes, José M. (UB)  
Soto, Joan (UB)  
Taron, Josep M. (UB)  
Torra, Jordi (UB)  
Verdaguer, Enric (UB)  
Verde, Licia (ICREA)  
Viñas, Xavier (UB)

### *Ramon y Cajal Members*

Bosch-Ramon, Valentí  
Casalderrey-Solana, Jorge  
Iblisdir, Sofyan  
Magas, Volodymyr  
Mescia, Federico  
Migliari, Simone  
Notari, Alessio  
Peñaranda, Siannah  
Ribó, Marc

### *Juan de la Cierva Members*

Forini, Valentina  
Fors, Octavi  
Tarrío, Luis Javier  
Tywoniuk, Konrad  
Zanin, Roberta

### *Postdoc Fellows*

Àgueda, Neus  
Aran, Àngels  
Balaguer-Núñez, Dolores  
Cámara, Pablo G.  
Carrasco, José M.

Chang, Emmanuel Zhi Yin  
de Putter, Roland  
He, Zhi-Guo  
Hoyle, Ben  
Masana, Eduard  
Morales, Juan Carlos  
Niro, Viviana  
Noreña, Jorge  
Portell, Jordi  
Potterat, Cédric  
Prieto, Joaquin  
Racker, Juan  
Robaina, Aday  
Romero-Gómez, Mercè  
Sestayo, Yolanda  
Sharma, Bharat Kishore  
Tanabe, Kentaro  
Toribio, M.Carmen  
Urakawa, Yuko  
Voss, Holger  
Wagner, Christian  
Weiler, Michael  
Yencho, Brian Michael  
Yijun, Lian  
Zabalza, Víctor

### *Invited Researchers*

Andrianov, Alexander  
Casademunt, Jaume  
Labraña, Pedro Alberto  
Lizzi, Fedele  
Ruiz, Josep Xavier  
Talavera, Pere  
Torrelles, José M.

### *PhD Students*

Abedi, Hoda  
Alsina, Daniel  
Aprile, Francesco  
Ariño, Andreu  
Arnau, Eduard  
Baena, Roberto  
Barranco, Alejandro  
Boada, Octavi  
Camboni, Alessandro  
Carbone, Arianna  
Castañeda, Javier  
Cerutti, Francesco  
Czekaj, M. Anna

Darriba, Laura  
Di Dato, Adriana  
Fernández, Daniel  
Frau, Pau  
Fries, Aidan Dermot  
Fröb, Markus  
García-Gálvez, Teresa  
Garolera, Blai  
González-Fraile, Juan  
Grabalosa, Marc  
Haddad, Nidal  
Juan, Enric  
Marcote, Benito  
Mariño, Mauricio  
Martínez, Marina  
Masqué, Josep M.  
Merino, M. Teresa  
Moldón, Fco. Javier  
Monguió, Maria  
Munar-Adrover, Pere  
Olikara, Zubin Philip  
Oriol, Pablo  
Pablos, Daniel  
Paita, Fabrizio  
Palmer, Max  
Paredes-Fortuny, Xavier  
Pérez-Obiol, Axel  
Pérez, Ignasi  
Pérez, Daniel  
Planells, Xumeu  
Puig Navarro, Albert  
Puigdomènech, Daniel  
Renau, Albert  
Rives Molina, Vicente  
Roca Fàbrega, Santiago  
Salvadó, Jordi  
Tarrús, Jaume  
Torrents, Genís  
Vázquez Gómez, Ricard  
Viñas, Jordi  
Zumalacarregui, Miguel



## *Engineers and Technicians*

Antiche, Erika  
Borrachero, Raúl  
Casajús, Adrià  
Casanova, Raimon  
Clotet, Marcial  
Comerma-Montells, Albert  
Gallardo, Eva  
Garralda, Nora  
Gascón, David  
González, Juan José

Julbe, Francesc  
Lazovski, Nikola  
Molina, Daniel  
Pérez, Gabriel  
Picatoste Olloqui, Eduard  
Sabater, Josep  
Sagristà, Antoni  
Sanuy, Andreu  
Trenado, Juan  
Vilar, Cristian

## *Services and Administration Personnel*

Anglada, Mariona  
Frutos, Ariadna

Moreno, Ana Belén  
Olarte, Surinye

## *Collaborators*

Bordas, Pol  
Busquet, Gemma  
Els, Sebastian  
Gil-Marín, Héctor  
Gracia, Gonzalo  
Herrero, Enrique  
Julià-Díaz, Bruno  
Lorente, Óscar  
Pérez, Guillem

Ribas, Salvador  
Roca-Maza, Javier  
Rodríguez-Gasèn, Rosa  
Townsend, Paul  
Vidaña, Isaac  
Vieiro, Arturo

# RESEARCH ACTIVITY

## *Cosmology and Large Scale Structure*

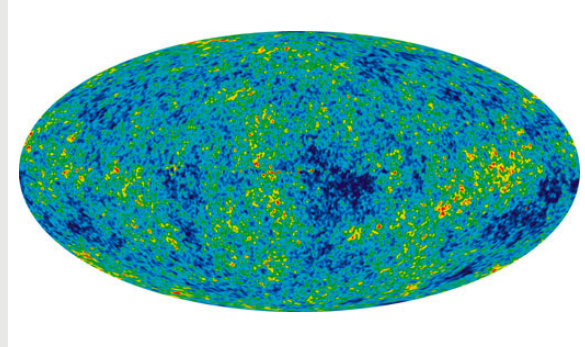
One of the main interests at the ICCUB is the study of the connection between cosmological observations and the physics behind the standard cosmological model, hoping to shed some light on the “open questions” in cosmology.

Cosmology confronted to astronomical observations is mostly carried out by researchers of the Astrophysics and Space Science Section. Their research ranges from the inflationary model, the Cosmic Microwave Background (CMB) and the epoch of reionization, to the formation and evolution of galaxies and the distribution of gas in space, including statistical applications and data analysis. Research is also being carried out into the nature of dark matter and the primordial fluctuations that gave rise to galaxies and larger structures in the universe. The observational tools available for these studies are gravitational lensing by galaxies, clusters of galaxies and large-scale structure, microlensing of stars or quasars by any kind of compact object, the spatial distribution of galaxies and of matter in intergalactic space that is measured from absorption signatures in spectra of background sources, and the structure of dark matter halos studied through the dynamics of galaxies in clusters.

The ICCUB is also involved in several cosmological projects of ground-based and space surveys, such as SSDS-III, the EUCLID science working group, the CORE science working group and the LSST large scale structure study group.

### *Members*

Ariño, Andreu; Arnau, Eduard; Canal, Ramon; de Putter, Roland; Hoyle, Ben; Jiménez, Raul; Juan, Enric; Labay, J. Javier; Manrique, Alberto; Miralda-Escudé, Jordi; Noreña, Jorge; Pérez, Ignasi; Prieto, Joaquin; Robaina, Aday; Ruiz-Lapuente, M. Pilar; Sala, Ferran; Salvador-Solé, Eduard; Verde, Licia; Viñas, Jordi; Wagner, Christian; Zumalacarregui, Miguel.



***Map of the CMB created from data gathered by the Wilkinson Microwave Anisotropy Probe (WMAP).***

The image reveals 13.77 billion year old temperature fluctuations (shown as color differences) that correspond to the seeds that grew to become galaxies. **Credit:** NASA/WMAP Science Team.

### *Lines of Research*

*Large scale structure of galaxies and the intergalactic medium.*

*Microwave background radiation anisotropies.*

*Baryonic acoustic oscillations.*

*Supernova cosmology.*

*Dark matter and dark energy.*

*Lyman-alpha emission from galaxies at high redshifts.*

*Reionization of the intergalactic medium.*

The ICCUB's experimental particle physicists are specialized in the study of flavor physics. Specifically in measuring CP violation effects and rare decays of particles containing b or c quarks. Their long track record in this field go back into the design, construction and exploitation in the Hera-B experiment at the Desy lab, in Hamburg and the participation in the BaBar experiment at the SLAC National lab, at Stanford, CA.

Currently the group is fully involved in the LHCb experiment data analysis and on its upgrade project. The LHCb detector, one of the four detectors of the Large Hadron Collider in CERN (Geneva), is designed to study this asymmetry through the b and anti-b particle pairs produced in proton collisions. The ICCUB, aside from its participation at a scientific level, undertook the design, production and installation of the electronics of the SPD (Scintillator Pad Detector) part of the calorimeter. In addition, the ICCUB participated in the development of the Data-GRID computer network and the DIRAC software, which are essential in the data analysis and simulation processes, not only in LHCb, but also in all HEP experiment nowadays.

An updated LHCb detector is currently being designed and scheduled for 2018 to start operation. The ICCUB participates in the design of the readout (RO) electronics of both the calorimeter and the new central tracker (to be based on Scintillating Fibers).

### Members

Potterat, Cédric; Rives Molina, Vicente; Garrido, Lluís; Graciani Díaz, Ricardo; Graugés, Eugeni; Ruiz, Hugo; Casajús, Adrià; Comerma-Montells, Albert; Lazovski, Nikola; Picatoste Olloqui, Eduard; Sanuy, Andreu; Trenado, Juan; Gascón Fora, David.



### The LHCb detector

The LHCb is one of the 4 detectors of the Large Hadron Collider (LHC). It is a single arm forward spectrometer designed to study CP violation effects and rare decays of hadrons containing b or c quarks. **Credit:** CERN.

### Lines of Research

*Physics of beauty and charm mesons.*

*Charge-Parity (CP) symmetry violation.*

*Search for deviations from the Standard Model in rare B (and charm) meson decays.*

*Quarkonium.*

*Development of distributed calculation methods using grid and cloud computing.*

*Design of Geiger mode avalanche photodiodes for tracking detectors of future accelerators.*

*Simulation and study of the radiation hardness of avalanche photodetectors.*

*Design, construction and operation of instrumentation for high energy, astrophysics and medical imaging experiments.*

## Galactic Astronomy

Research in galactic astronomy at the ICCUB is focused on the preparation of the scientific exploitation of the Gaia mission. The ICCUB's researchers are both developing detailed galaxy models and participating in huge on-ground spectroscopic survey complementary to Gaia.

The stellar clusters, excellent tracers of the chemo-dynamical evolution of the galactic disk, are being deeply analyzed. The connection between the stellar formation processes and the spiral arms and bar evolution is being addressed. New methods for accurate derivation of critical parameters such as ages and metallicities are being developed. In the Gaia era it is fundamental to establish a stellar luminosity calibration. Robust statistical techniques are being developed to achieve unbiased determination of stellar distances.

The ICCUB participates in an EC FP7 funded initiative named GREAT-ITN (2011-2015) aiming to form the next generation of experts in this field.

The ICCUB is also leading the Spanish Network for Gaia Science Exploitation (REG) with more than 140 Spanish researchers from 24 institutions.

## Extragalactic Astronomy

The ICCUB's interest in galactic astrophysics extends beyond the Milky Way and is concerned, too, with the formation of the first galaxies, which were formed from pristine matter. They comprised population III stars, which reionised the intergalactic medium, polluted it with metals and left behind the seeds of super massive black holes. These are processes currently being modeled at the ICCUB.

Detailed analytical models and huge numerical simulations are being developed which make use of the most powerful computational tools presently available. The resulting predictions are confronted with the latest, progressively complete, observations drawn from huge wide angle (all-sky) nearby galaxy surveys (e.g. SDSS, 2dF) as well as very deep, high-redshift, ones (e.g. Hubble Deep Field, GROTH, DEEP2), carried out by means of the new generation of very large ground-based telescopes and sophisticated detectors on board of satellites covering the whole electromagnetic spectrum, from gamma to radio wavelengths.



## Gaia and the Galaxy

How did the first galaxies form and evolve? How they distribute around the Universe? These are, among others, long standing questions aimed to understand the process of galaxy formation in the Universe. ESA's satellite Gaia will significant contribute to this challenge by providing the ultimate map of the sky. For certain, its catalogues will underpin pretty much all of astronomy for decades to come.

**Credit:** ESA.

## Lines of Research

*Semianalytical modeling of galaxy formation.*

*Dark matter clustering and halo structure and kinematics.*

*Galaxy evolution in groups and clusters.*

*Kinematics and structure of the galaxy.*

## Members

Abedi, Hoda; Balaguer-Núñez, M. Dolores; Carrasco, José M.; Castañeda, Javier; Czekaj, Maria A.; Darriba, Laura; Fabricius, Claus V.; Figueras, Francesca; Jordi, Carme; Luri, F. Xavier; Masana, Eduard; Monguió, Maria; Palmer, Max; Roca-Fàbrega, Santiago; Romero-Gómez, Mercè; Solanes, José M.; Toribio, M. Carmen; Torra, Jordi; Voss, Holger; Weiler, Michael.

The ICCUB's researchers carry out research in the areas of gravity, particle physics and the gauge/gravity correspondence. In the area of gravity, research is focused on the formulation of effective theories for black holes, inflationary models and quantum gravity in de Sitter spaces. In particle physics, the main topic is phenomenological implications of supersymmetric extensions of the Standard Model. Finally, the gauge/gravity correspondence is applied to the study of the quark-gluon plasma and the computation of observables in gauge theories.

### *Lines of Research*

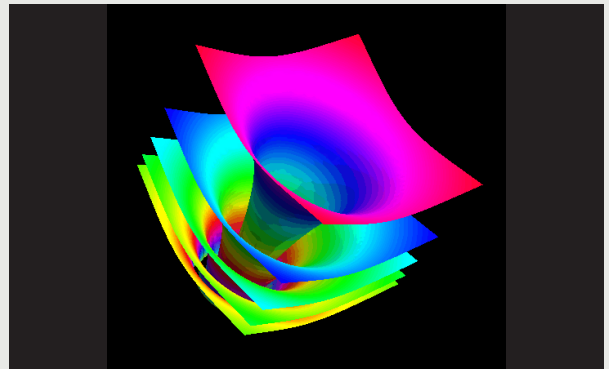
*Dark matter and dark energy in cosmology and in particle physics.*

*Quantum and semiclassical gravity.*

*Black holes and gravity: New perspectives from strings and higher dimensions.*

### *Members*

Di Dato, Adriana; Cámara, Pablo G.; Emparan, Roberto A.; Fernández, Daniel; Fiol, Bartomeu; Fröb, Markus; Garolera, Blai; Garriga, Jaume; Guasch, Jaume; Haddad, Nidal; Llosa, Josep; Martínez, Marina; Mateos Solé, David; Molina, Alfred; Notari, Alessio; Peñaranda, Siannah; Solà, Joan; Tanabe, Kentaro; Tarrío, Luis Javier; Torrents, Genís; Urakawa, Yuko; Verdaguer, Enric.



### ***Curved spacetime: from black holes to cosmology, from quarks to quantum gravity***

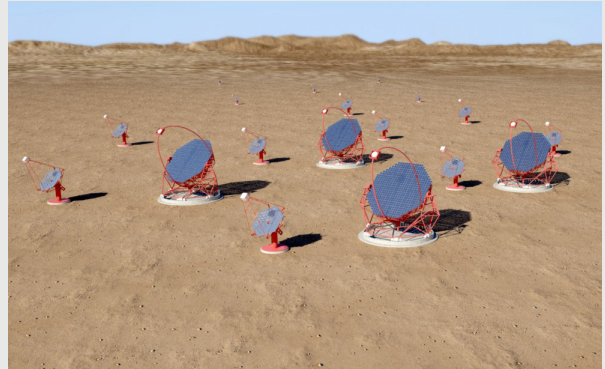
Einstein's theory of gravity tells us that the geometry of space and time gets dramatically distorted in the vicinity of black holes and at the beginning of the universe. This challenges the foundations of Einstein's theory itself and calls for the incorporation of the effects of quantum mechanics. A surprising spin-off of this research is the possibility of describing a ball of quark-gluon plasma as a black hole in a higher-dimensional space.

The general aim of the ICCUB's researchers working on this field is to achieve a better understanding of relativistic flows in three archetypical classes of sources: microquasars, gamma-ray binaries, pulsar wind nebulae and active galactic nuclei, focusing on their study at high energies. These sources are archetypical in the sense that they resemble in many aspects other types of objects (some of them non-relativistic), like young stellar objects with jets, massive star binaries with colliding winds, or gamma ray bursts. This aim will be attained by gathering data over a large wavelength range (from radio to TeV energies), as well as by modeling emission processes in different scenarios (jets, shocks, interaction with the interstellar medium, etc.).

Moreover, the ICCUB's high energy astrophysicists are members of the MAGIC Collaboration since February 2006, and are now participating, together with experimental physicists and engineers of the ICCUB, in the Cherenkov Telescope Array (CTA) project. CTA is an initiative to build the next generation ground-based very high energy gamma-ray instrument. It will serve as an open observatory to a wide astrophysics community and will provide a deep insight into the non-thermal high-energy universe. In addition to physics case studies, the ICCUB is involved in the design and prototyping of CTA telescope cameras. This activity involves designing ASICs (Application Specific Integrated Circuits) for pre-amplification, amplification, signal processing and triggering.

### Members

Bosch-Ramon, Valentí; Gascón, David; Iwasawa, Kazushi; Marcote, Benito; Migliari, Simone; Moldón, Fco. Javier; Munar-Adrover, Pere; Paredes-Fortuny, Xavier; Paredes, Josep Maria; Ribó, Marc; Sanuy Charles, Andreu; Zanin, Roberta.



### Cherenkov Telescope Array (CTA)

CTA is an initiative to build the next generation ground-based instrument for very-high-energy (VHE) gamma ray astronomy, ICCUB researchers are involved both scientifically and technically in the design of the project. **Credit:** G Pérez/IAC/SMM.

### Lines of Research

*High-energy and very-high-energy gamma-ray sources in the Galaxy.*

*Multi-wavelength observations and theoretical modeling.*

*Microquasars.*

*Gamma-ray binaries.*

*Pulsar wind nebulae.*

*Active galactic nuclei.*

*MAGIC and Cherenkov Telescope Array.*

## Nuclear and Hadronic Physics

Nuclear physicists at the ICCUB are actively participating in studies of neutron-rich nuclei, a research which is closely related to that conducted on the topics of nuclear equation of state and its astrophysical applications. They have also benefited from the computational power offered by the most modern supercomputers (JLab, Fermilab, Tungsten and Mare Nostrum), which has allowed them to perform large dynamical simulations related to their studies.

### Lines of Research

*Hadronic physics. Strangeness and charm in the nuclear medium.*

*Lattice QCD of low-energy hadronic interactions.*

*Nuclear structure. Nuclear symmetry energy.*

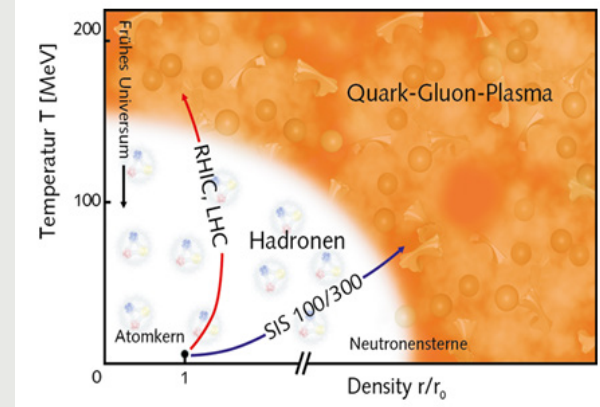
*Relativistic heavy ion collisions.*

*Dense and hot nuclear matter and applications in nuclear astrophysics.*

*Radiation transport and interactions of radiation with matter.*

### Members

Carbone, Arianna; Centelles, Mario; Chang, Emmanuel Zhi Yin; Magas, Volodymyr; Mateos, David; Parreño, Assumpta; Pérez-Obiol, Axel; Polls, Artur; Ramos, Àngels; Sharma, Bharat Kishore; Viñas, Xavier.



### Phase diagram of hadronic matter as predicted by theory

The diagram plots the temperature in units of one million electronvolt against the density in units of normal nuclear density  $\rho_0$ . At very high temperatures and densities, physicists expect that the quarks and their bonding particles, the gluons - normally locked up inside the nucleons - become liberated from their confinement and move as free particles in a so-called quark-gluon plasma.

**Credit:** FAIR@GSI.

The ICCUB has a wide spectrum of interests in the phenomenological and calculational aspects of particle physics, including many aspects of the areas reported in the hep-ph and hep-th archives.

Recently, its activity has been influenced to a large extent by the commissioning of the LHC. In this sense, the studies are being focused on effective theories of the symmetry breaking sector of the Standard Model, some aspects of supersymmetric theories, string phenomenology, flavour physics (particularly b-physics) and physics beyond the standard model that the LHC will continue to explore in years to come.

The ICCUB's researchers are also active in heavy-quark effective theories and other effective theories of QCD. Several key features of heavy ion collisions and the properties of QCD under extreme conditions are also receiving attention.

This area also includes work on lattice field theory, particularly in connection with b-physics.

The ICCUB's researchers have relevant activity in the development of parton distribution functions using neural networks.

The scope of future accelerators in the context of some extensions of the Standard Model are studied by researchers at the ICCUB.

Relevant contributions are also being made in the field of neutrino physics, axion physics and other dark matter candidates, and dark energy.

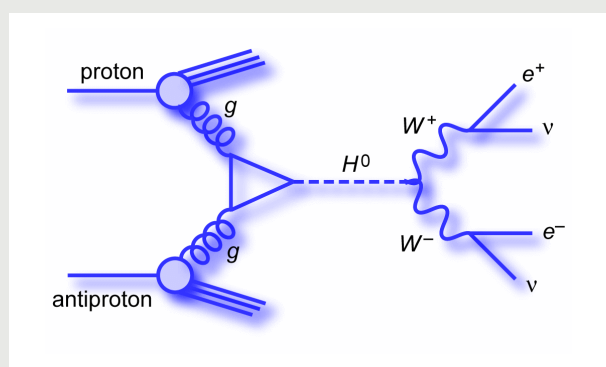
The ICCUB's researchers of this area have close interactions with the experimental particle physicists at the ICCUB and obviously with researchers in other theoretical areas.

### Members

Cámara Pablo G.; Casallerrey-Solana, Jorge; Cerutti, Francesco; D'Enterría, David; Espriu, Domènec; González Fraile, Juan; González-García, M. Concepción; Guasch Jaume; Latorre José I.; Mescia, Federico; Niro, Viviana; Pablos, Daniel; Planells, Xumeu; Racker, Juan; Renau, Albert; Salvadó, Jordi; Solà, Joan; Soto, Joan; Taron, Josep; Tarrús, Jaume; Tywoniuk, Konrad; Yencho, Brian; Zhi-Guo, He.

### Invited Researchers:

Andrianov, Alexander; Labraña, Pedro; Lizzi, Fedele.



**Feynman diagram for production and decay of a Higgs boson**

A Feynman diagram is a pictorial representation of mathematical expressions governing the behaviour of subatomic particles. The interaction of subatomic particles can be complex and difficult to understand intuitively, and the Feynman diagrams allow a simple visualization of what would otherwise be a rather abstract formula. **Credit:** Ann Heinson.

### Lines of Research

*Standard Model and beyond at the LHC.*

*B-physics, with an emphasis on the analysis and physical reach of the LHCb detector.*

*Phenomenology of supersymmetric theories.*

*String phenomenology.*

*Unification of the fundamental forces.*

*Heavy quark effective theory and other effective theories of QCD.*

*QCD in extreme conditions: heavy ion experiments at the LHC, FAIR and other accelerators.*

*Lattice QCD.*

*Perturbative QCD: parton distribution functions.*

*Studies of the physics of future colliders.*

*Physics of neutrinos, with an emphasis on astrophysics and cosmology.*

*Axions and other dark matter candidates.*



This is a miscellaneous group formed by small independent subunits devoted to the development of new scientific tools and technological applications useful for or arisen from the research of other ICCUB groups, or that could develop in new consolidated groups in the general domain of space sciences and quantum physics.

### *Lines of Research*

*Astrodynamics and celestial mechanics.*

*Astronomical image processing and high angular resolution techniques.*

*Chirality and prebiotic chemistry.*

*Data processing and analysis.*

*Heliospheric physics and space weather.*

*Instrumentation.*

*Microgravity.*

### *Astrodynamics and Celestial Mechanics*

The ICCUB's researchers on Astrodynamics are devoting their efforts to addressing some fundamental issues concerning formation flying for multiple spacecraft. These include: the transfer of a set of spacecraft to either an Earth orbit, or to a libration zone, the deployment of formations from stacks of satellites and the proximity manoeuvring for pointing and reconfiguration.

The main goal of the ICCUB's researchers is to develop and implement algorithms based on recent advances obtained by them and other collaborating teams. The proposed methodology will enable the transfer of spacecraft to tactical locations by developing a strategy that mimics those of flocks of birds.

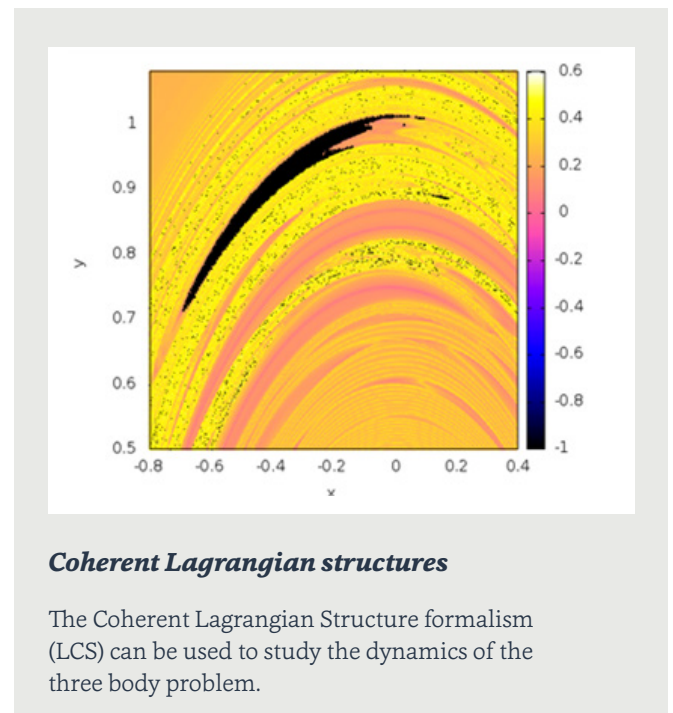
Further developments will incorporate collision avoidance algorithms currently under development in the area of complexity science, that have evolved from the principles of molecular dynamics. The implications of developing these methodologies are far reaching and could potentially impact on path planning methodologies throughout the physical sciences.

#### **Members**

Gómez, Gerard; Olikara, Zubin Philip; Paita, Fabrizio; Perez-Palau, Daniel; Yijun, Lian.

#### **Lines of Research**

*Develop tools to explain in a natural way different astronomical patterns.*



## Astronomical Image Processing and High Angular Resolution Techniques

The ICCUB's researchers in the field of image reconstruction are focused on exploiting the use of the wavelet transform to improve the ability of image sensors to detect faint stars and moving objects. The effects of the curvelet transform over interferometric images are also being studied, differential photometry is being estimated in adaptive optics observations using a wavelet-based maximum likelihood estimator.

The ICCUB's researchers are also working on obtaining super-resolution using additive-substitutive wavelets techniques on remotely sensed images, as well as in obtaining new high-sensitivity, milliarcsecond resolution results from observations of lunar occultations at Very Large Telescope (VLT) of the European Southern Observatory (ESO).

### Lines of Research

*Image deconvolution by means of multiresolution analysis (wavelet transform).*

*Image fusion by means of multiresolution analysis (wavelet and curvelet transforms).*

*Image superresolution by means of multiresolution analysis (wavelet transform).*

*Submilliarcsecond resolution of infrared sources by high time resolution lunar occultations technique.*

### Members

Baena, Roberto; Fors, Octavi; Merino, M. Teresa; Núñez, Jorge C.

## Chirality and Prebiotic Chemistry

Researchers at ICCUB have focused on the implementation of Mueller matrix methods in order to study the emergence of chirality by the application of a gradient of shear rates by flows in different chemical systems. Theoretical and experimental methods are studied in the deracemization and spontaneous emergence of chirality in crystallizations. Moreover, the ICCUB's researchers have proved mechanical chiral fields should be included among the few physical chiral forces that can induce chirality at the primordial scenarios (astrophysical or planetary) of the chemical evolution.

### Lines of Research

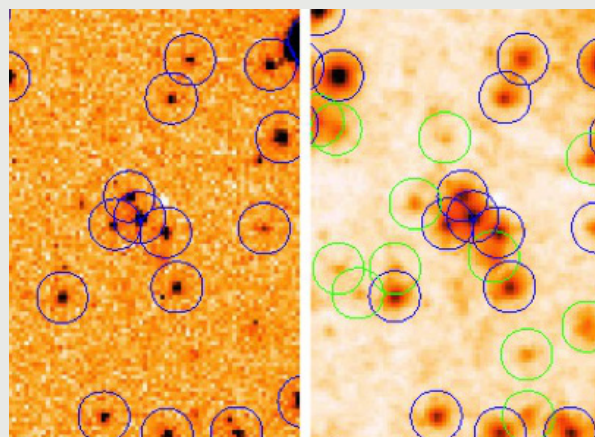
*Effect of mechanical forces (flows with gradient of shear rates) on the emergence of chirality in soft matter.*

*Mirror symmetry breaking in crystallizations and aggregations showing critical phenomena.*

*Organocatalysis in asymmetric synthesis.*

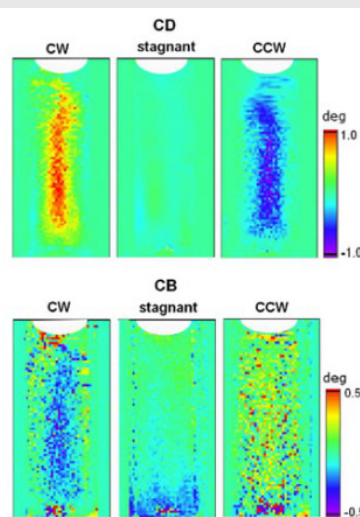
### Members

Crusats, Joaquim; Ribó, Josep M.; Ríos, Ramon; El-Hachemi, Zoubir.



### Image reconstruction

Image reconstruction makes substantial improvements in qualitative appearance and recovery of faint star images in terms of the number of stars that can be detected. In the raw frame (left) of a CCD exposure obtained with a Baker-Nunn camera, stars detected by the SExtractor algorithm are circled in blue. In the restored frame (right) the additionally detected stars are circled in green. The wavelet based AWMLE algorithm was used.



### Chirality

Scanning of CD and CB (natural optical activity) inside a 10 mm pathlength cuvette for clockwise (CW), counter-clockwise (CCW) and stagnant (no stirring). CD and CB have been calculated by ICCUB researchers from space-resolved measurements of the Mueller matrix performed in situ at 485 nm, that corresponds to a peak at high energy of the CD bisignated CD band.

## Data Processing and Analysis

The ICCUB's researchers are engaged since 1998 in the Gaia Data Processing and Analysis Consortium (DPAC) in charge of designing, implementing, managing and running the whole data reduction of the Gaia mission, from the storage of the telemetry to the production of the final catalogue.

The ICCUB has important responsibilities in four out of nine coordination units in DPAC: CU2 (simulations), CU3 (core processing), CU5 (photometric processing), CU9 (Catalogue Access) and in the Data Processing Center of Barcelona (comprising BSC and CESCA).

In this framework, the ICCUB also leads the EU FP7 funded initiative named GENIUS (2013-2016), aimed to significantly contribute to the development of the Gaia Archive: use the best state-of-the-art archive system; provision of exploitation tools to maximize the scientific return; ensuring the interoperability with future astronomical archives; and last but not least, the archive facilities outreach activities. Our team has one representative in the Gaia Scientific Team, one in the DPAC Executive, two deputy managers in CU2 and CU3, and leads the CU9.

Based on the expertise of our team on efficient compression systems for space, DAPCOM was created as a spin-off company dedicated to efficient data compression systems.

### Members

Antiche, Erika; Balaguer-Núñez, M. Dolores; Borrachero, Raul; Carrasco, José M.; Castañeda, Javier; Clotet, Marcial; Fabricius, Claus V.; Fries, Aidan Dermot; Gallardo, Eva; Garralda, Nora; González, Juan José; Jordi, Carme; Julbe, Francesc; Luri, F. Xavier; Masana, Eduard; Molina, Daniel; Portell, Jordi; Sagristà, Antoni; Torra, Jordi; Voss, Holger; Weiler, Michael.

## Heliospheric Physics and Space Weather

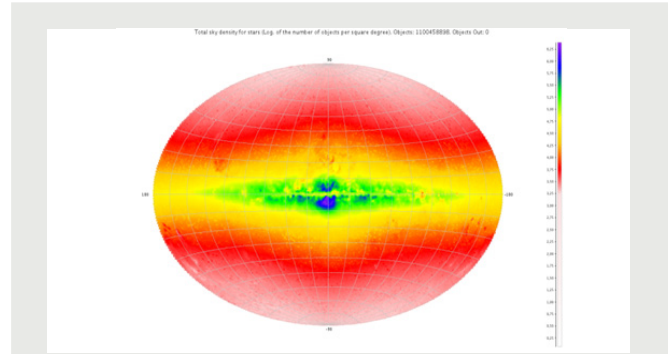
The ICCUB's lines of research of in heliophysics mainly deal with SEP events triggered by solar activity and interplanetary disturbances, i.e. energetic protons (~150 keV to 0.5 GeV) and near relativistic electrons (~20 keV up to 0.5 MeV). Solar flares and coronal mass ejections, which are the main agents of SEP-acceleration, together with proxies of solar activity (radioemission, H-alpha, X-ray, etc.), and the solar wind plasma and the interplanetary magnetic field, are also topics of research at the ICCUB, as are background components of the SEP scenario.

Similarly, the ICCUB's researchers are working on data analysis and the study of SEP events, individual cases and multispacecraft events (ACE, Wind, Ulysses, SOHO, ISEE-3, Helios, Goes, IMPs, Phobos, STEREO and other spacecraft and satellites), multi-instrument observations and interdisciplinary analysis of relevant solar events, from Sun to Earth magnetosphere. They are also modeling gradual proton events, and giving scientific support to the participation of technological groups of the UB in ESA's Solar Orbiter project: Polarimetric and Helioseismic Imager (PHI) and LET-EPD (Energetic Particle Detector) instruments.

Finally, space weather tools for the prediction of SEP intensity-time profiles are also being developed.

### Members

Àgueda, Neus; Aran, Àngels; Sanahuja, Blai.



### Simulation of the Milky Way as seen by Gaia

ESA's Gaia astrometric mission (2013-2018) will be the most accurate optical astronomy satellite ever built so far. It will create a census of a billion stars, finding clues of the origin, structure and evolution of our own Galaxy, the Milky Way. The development of the Gaia archive is one of the most demanding European Grand Challenge of the next decade.

### Lines of Research

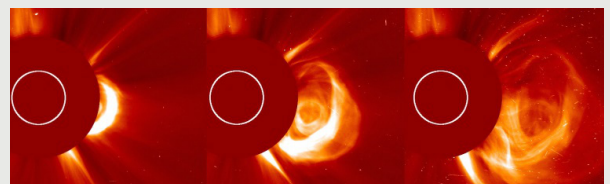
Data reduction of space missions.

Data compression.

Data mining.

Software engineering.

Parallel processing & massive data.



### Coronal mass ejection

On 2012 May 17 at 01:48 UT, a coronal mass ejection erupted from the west limb of the Sun (Active Region 1746) at speed of 1582 km/s. This eruption was accompanied by an M-class flare and produced a solar energetic particle event.

**Credit:** ESA & NASA/SOHO.

### Lines of Research

Solar energetic particle events, interplanetary shocks and related solar activity.

Modeling gradual proton events: magneto hydrodynamics (MHD) shock simulation plus particle transport simulation.

Modeling near-relativistic electron events: inversion methods.

Space weather: Engineering models for solar energetic particle events.

## Instrumentation

Within the context of instrumentation, the ICCUB participates very actively in:

### A positioner for SIDE, MEGARA and BIG-BOSS

The ICCUB has been responsible for the development of the electronics for the fiber positioner built by the AVS Company (Spain). This positioner has had successive prototypes starting with the one for the SIDE/GTC, up to the MEGARA/GTC (3th generation) MOS spectrograph. Both will operate in the Gran Telescopio de Canarias (GTC). The positioner has also been proposed for the BIG-BOSS Spectrograph (NOAO-USA).

### Deployable probe arms for MIRADAS

MIRADAS is a 3rd generation near-infrared multi-object echelle spectrograph working at spectral resolution of 20.000 for the GTC which is expected to start operations in 2016. The ICCUB, as member of the MIRADAS consortium, is in charge of the design of the deployable probe arms with pickoff mirror optics.

### Improvement of the TFRM (Fabra-ROA Telescope)

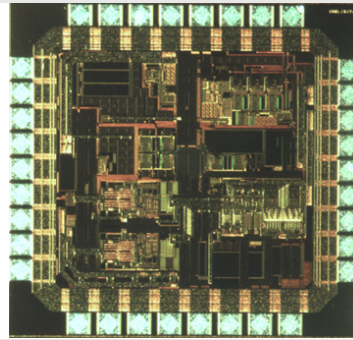
The ICCUB is involved in the improvement of the telescope, which has now begun observing Extrasolar planets, Space debris (ESA program), near-Earth objects (NEOs), Optical counterparts of gamma ray bursts (GRBs) and some X-Ray binaries (microquasars).

### Elaboration of the Science Case document of WEAVE

The ICCUB has participated in the elaboration of the Science Case document of WEAVE, a multi-object spectrograph for the William Herschel Telescope (Canary Islands) expected to be approved in 2013 and operational by the end of 2016. This instrument will provide complementary on-ground spectroscopic observations for the Gaia mission (ESA).

### Design of radiation-tolerant Application-Specific Integrated Circuits (ASICs) for CTA, LHCb upgrade and PET

The CTA project is an initiative to build the next generation ground-based very high energy gamma-ray instrument. In addition to physics case studies, the ICCUB is involved in the design and prototyping of CTA telescope cameras. This activity involves designing ASICs (Application Specific Integrated Circuits) for preamplification, signal processing and triggering). On the other hand, the ICCUB is also working in the design of an ASIC for the calorimeter of the upgraded LHCb and the development of ASICs for new PET (Positron Emission Tomography) systems based in silicon photomultipliers.



### ASICs for CTA

Low noise and high dynamic range preamplifier for photomultiplier tubes:

- 500 MHz bandwidth
- 16 bits dynamic range
- 1 bi-gain channel
- Technology: AMS SiGe BiCMOS 0.35 $\mu$ m
- Area: 2.4 mm<sup>2</sup>

### Projects

*A Positioner for SIDE, MEGARA and BIG- BOSS.*

*Deployable probe arms for MIRADAS.*

*Improvement of the TFRM (Fabra-ROA Montsec Telescope).*

*Elaboration of the Science Case document of WEAVE.*

*Design of radiation-tolerant Application- Specific Integrated Circuits (ASICs) for CTA, LHCb upgrade and PET.*

### Members

Casajús, Adrià; Comerma-Montells, Albert; Figueras, Francesca; Fors, Octavi; Garrido, Lluís; Gascón, David; Gómez, Jose M.; Graciani Díaz, Ricardo; Graugés, Eugeni; Jordi, Carme; Lazovski, Nikola; Núñez, Jorge C.; Picatoste Olloqui, Eduard; Ruiz, Hugo; Sabater, Josep; Sanuy, Andreu; Torra, Jordi; Trenado, Juan; Vilar, Cristian.

## ***Microgravity and Biphasic Fluxes***

The ICCUB's collaborators have focused on the formation and management of small bubbles under microgravity conditions, an area of fundamental interest in two phase-flows, with important applications in space technology, from life support systems to thermal control of satellites. Experiments are conducted in the ESA Drop Tower facility at ZARM (Bremen) and include the study of the interaction of bubbles and turbulence, and the formation of vapor bubbles by nucleate boiling. Researchers have obtained for the first time turbulent monodisperse bubble suspensions, and also for the first time, bubbles of controlled size by nucleate boiling.

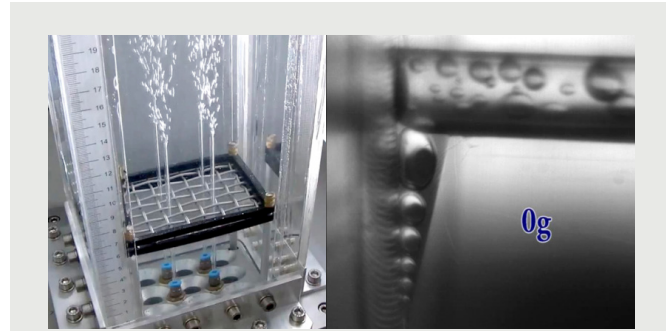
### ***Lines of Research***

*Bubble formation and dynamics in turbulent flows in microgravity.*

*Controlled nucleate boiling in confined geometries in microgravity.*

### ***Invited Researchers***

Casademunt, Jaume; Ruiz, Josep Xavier.



### ***Bubbles in microgravity***

Details of two setups used in Drop Tower experiments to study bubble formation and dynamics in turbulent flows and controlled boiling in confined geometries.

## Star Formation

The ICCUB's main research topic in the field of star formation is the detailed investigation of the first stages of stellar evolution in star-forming regions in our Galaxy. The ICCUB's researchers intend to acquire a perspective as wide as possible by including observations which range from the optical to the radio domain, and integrating the results within complete and self-consistent theoretical models, in what constitutes a double approach, theoretical and observational.

Star formation represents a challenge in observational techniques, since it takes place in high-density cores in the molecular clouds of the Galaxy, where extinction is very high. It is, furthermore, also a challenge to theoretical astrophysics. While the formation of an isolated low-mass star is a process well understood, there is still ample controversy on the mechanisms that allow to accrete the mass required to form a star of more than 10 times the mass of the Sun.

The ICCUB's researchers have been able to observe, through the polarization of the emission, the small-scale magnetic field around protostars, and the results obtained point to the magnetic field as responsible for controlling the onset of gravitational collapse of dense molecular cores.

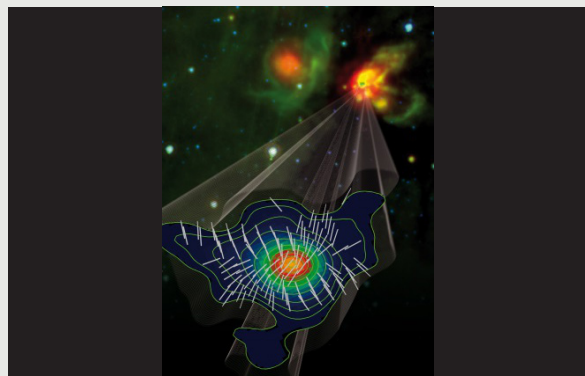
Other areas of research in this field include the chemical evolution of the molecular gas, the study of the launching and collimation of the astrophysical jets associated with young stellar objects and planetary nebulae; the investigation of the early stages of the formation of massive stars; the characterization of the gravitational collapse that drives the full process of star formation and the search for signatures of planet formation within the protoplanetary disks; and the study of the transition from hot molecular cores to bright HII regions.

### Members

Estalella, Robert; Frau, Pau; López, Rosario; Masqué, Josep M.; Padoan, Paolo.

### Invited Researchers

Torrelles, Josep M.



### **G31.41+0.31**

Contour map of the 879- $\mu\text{m}$  dust emission superposed on the color image of the polarized flux intensity in units of Jy per beam. Black thick bars indicate the position angle of the magnetic field. These maps were obtained by using a natural weighting to the visibility data, which yielded to a full width at half maximum synthesized beam of 1.34" x 0.83" with a position angle of 67°. **Credit:** Girart, J.M., Beltrán, M.T., Zhang, Q., Rao, R., Estalella, R.

### Lines of Research

*High-angular resolution observations of the first stages of stellar evolution.*

*Outflows, jets, and accretion disks in low- and high-mass young stellar objects.*

*Jets in planetary nebulae.*

*Computational models of star-forming clouds and star formation.*

ICCUB's activities cover an ample spectrum of the areas reported in the hep-th and quant-ph archives.

String theory has inspired in recent times enormous activity in the gauge/string duality conjecture that allows a treatment of some strongly coupled theories in terms of a gravity dual. These techniques are being applied to the study of the quark-gluon plasma. In this domain of physics, techniques such as the gauge/string duality meet nuclear phenomenology and effective theories and there is substantial cross-fertilization.

Duality techniques are also applied to a variety of strongly coupled condensed matter systems and in problems of quantum information.

Supersymmetric field theories are studied seeking to understand the ultraviolet behavior of theories with extended supersymmetries and deriving exact results.

In another line, some theories of emergent gravity have been proposed. There are also obvious connections with cosmology and the physics of black holes. Research in this area share many common interests with the Gravitation and Cosmology one.

The research in quantum information can be roughly divided into six topics: multiparticle entanglement; low energy properties of many-body quantum systems; quantum error correction; topological order; ultra-cold gases; and quantum simulation.

The quantum information researchers at the ICCUB are in close collaboration with some of the groups at ICFO.

## Members

Aprile, Francesco; Barranco, Alejandro; Boada, Octavi; Cámara, Pablo G.; Casalderrey-Solana, Jorge; Dector, Aldo; Espriu, Domènec; Fernández, Daniel; Fiol, Bartomeu; Forini, Valentina; Garolera, Blai; Gomis, Joaquim; Iblisdir, Sofyan; Latorre, José I; Mariño, Mauricio; Mateos, David; Pablos, Daniel; Pons, Josep M.; Puigdomènech, Daniel; Russo, Jorge G.; Solà, J.; Tarrío, Luis J.; Tywoniuk, Konrad.

## Invited Researchers

Lizzi, Fedele; Talavera, Pere.

| Category     | Particle                    | Mass                             | Charge         | Spin          |
|--------------|-----------------------------|----------------------------------|----------------|---------------|
| QUARKS       | u (up)                      | $\approx 2.3 \text{ MeV}/c^2$    | $\frac{2}{3}$  | $\frac{1}{2}$ |
|              | c (charm)                   | $\approx 1.275 \text{ GeV}/c^2$  | $\frac{2}{3}$  | $\frac{1}{2}$ |
|              | t (top)                     | $\approx 173.07 \text{ GeV}/c^2$ | $\frac{2}{3}$  | $\frac{1}{2}$ |
|              | d (down)                    | $\approx 4.8 \text{ MeV}/c^2$    | $-\frac{1}{3}$ | $\frac{1}{2}$ |
|              | s (strange)                 | $\approx 95 \text{ MeV}/c^2$     | $-\frac{1}{3}$ | $\frac{1}{2}$ |
|              | b (bottom)                  | $\approx 4.18 \text{ GeV}/c^2$   | $-\frac{1}{3}$ | $\frac{1}{2}$ |
| LEPTONS      | e (electron)                | $0.511 \text{ MeV}/c^2$          | $-1$           | $\frac{1}{2}$ |
|              | $\mu$ (muon)                | $105.7 \text{ MeV}/c^2$          | $-1$           | $\frac{1}{2}$ |
|              | $\tau$ (tau)                | $1.777 \text{ GeV}/c^2$          | $-1$           | $\frac{1}{2}$ |
|              | $\nu_e$ (electron neutrino) | $< 2 \text{ eV}/c^2$             | 0              | $\frac{1}{2}$ |
|              | $\nu_\mu$ (muon neutrino)   | $< 0.17 \text{ MeV}/c^2$         | 0              | $\frac{1}{2}$ |
|              | $\nu_\tau$ (tau neutrino)   | $< 15.5 \text{ MeV}/c^2$         | 0              | $\frac{1}{2}$ |
| GAUGE BOSONS | $\gamma$ (photon)           | 0                                | 0              | 1             |
|              | Z (Z boson)                 | $91.2 \text{ GeV}/c^2$           | 0              | 1             |
|              | W (W boson)                 | $80.4 \text{ GeV}/c^2$           | $\pm 1$        | 1             |
|              | H (Higgs boson)             | $\approx 125 \text{ GeV}/c^2$    | 0              | 0             |

**Standard model of elementary particles**

The Standard Model includes 12 fundamental fermions, 4 fundamental bosons and the postulated Higgs boson. However, it is not complete: why quarks and leptons have such different values? Why there exists three families of quarks and leptons? Why has the photon no mass and Z boson does? Where does dark matter fit into the model? **Credit:** Wikipedia.

## Lines of Research

String theory.

Supersymmetric field theories.

Applications of the gauge/string duality to QCD.

Application of the gauge/string duality to condensed matter systems.

Low energy properties of many-body quantum systems.

Quantum error correction.

Topological order.

Ultra-cold gases.

Quantum simulations.

# PROJECTS AND FUNDS

## National Plan Projects

### *Astrophysics and Space Sciences*

#### **Modelos experimentales y teóricos sobre la emergencia de quiralidad**

Reference: AYA2009-13920-C02-02

PI: Albert Moyano, UB (ICCUB: Josep M.. Ribó)

Agency: MICINN

Duration: 2010-2012

Amount: 136.000 €

#### **Fluctuaciones primordiales y física de cuásares con 100.000 espectros de cuásares**

Reference: AYA2009-09745

PI: Jordi Miralda-Escudé

Agency: MICINN

Duration: 2009-2012

Amount: 70.000 €

#### **Las componentes del universo**

Reference: AYA2009-13667

PI: M. Pilar Ruiz-Lapuente

Agency: MINECO

Duration: 2010-2012

Amount: 87.120 €

#### **Propiedades de la luz intragrupal y de las galaxias en grupos galaxias**

Reference: AYA2010-18605

PI: José M. Solanes

Agency: MICINN

Duration: 2011-2013

Amount: 35.695 €

#### **Contribución al desarrollo científico y tecnológico de la misión Gaia**

Reference: AYA2009-14648-C02-01

PI: Jordi Torra

Agency: MICINN

Duration: 2010-2013

Amount: 2.757.342 €

#### **High-energy phenomena in stellar objects. Theory and multi-wavelength observations**

Reference: AYA2010-21782-C03-01

PI: Josep M. Paredes

Agency: MICINN

Duration: 2011-2013

Amount: 129.470 €

#### **Participación española en la fase de preparación del "Cherenkov Telescope Array" (CTA)**

Reference: FPA2010-22056-C06-02

PI: Marc Ribó

Agency: MICINN

Duration: 2011-2013

Amount: 290.400 €

#### **CTA, el Cherenkov Telescope Array, una instalación avanzada para la astronomía gamma desde tierra**

Reference: EUI2009-04072

PI: Manuel Martínez, IFAE ( ICCUB: Josep M. Paredes)

Agency: MICINN

Duration: 2009-2012

Amount: 405.000 € (ICCUB: 200.000 €)

#### **Optimización del retorno científico de la observación astronómica. Nuevos desarrollos y aplicaciones**

Reference: AYA2008-01225

PI: Jorge Núñez

Agency: MICINN

Duration: 2009-2013

Amount: 85.000 €

#### **Explotación del modelo AMIGA de formación y evolución de galaxias**

Reference: AYA2009-12792-C03-01

PI: Eduard Salvador-Solé

Agency: MICINN

Duration: 2010-2012

Amount: 92.444 €

#### **Auto-organización en materiales blandos y materia viva: II) Fluidos complejos, células y tejidos**

Reference: FIS2010-21924-C02-02

PI: Jaume Casademunt

Agency: MICINN

Duration: 2011-2013

Amount: 217.800 €



***Sucesos de partículas solares energéticas: modelos. Aplicaciones para meteorología espacial***

Reference: AYA2010-17286  
PI: Blai Sanahuja  
Agency: MICINN  
Duration: 2011-2013  
Amount: 266.200 €

***Diseño detallado de SOLAR ORBITER/PHI***

Reference: AYA2011-29833-C06-05  
PI: Josep M. Gómez  
Agency: MINECO  
Duration: 2012-2013  
Amount: 640.090 €

***Interstellar medium at high-angular resolution: preparing for the ALMA era***

Reference: AYA2011-30228-C03-03  
PI: Robert Estalella  
Agency: MINECO  
Duration: 2012-2014  
Amount: 45.000 €

***Cosmology and the Origin of Matter. Sabor y Origen de la Materia (COM SOM)***

Reference: FPA2011-29678-C02-01  
PI: Licia Verde  
Agency: MINECO  
Duration: 2012-2014  
Amount: 148.000 €

***Nuclear and Particle Physics and Gravitation***

***Mantenimiento y operación de Tier2 español para LHCb y contribuciones al core computing de LHCb***

Reference: FPA2010-21885-C02-01  
PI: Ricardo Graciani Díaz  
Agency: MICINN  
Duration: 2011-2013  
Amount: 211.629 €

***Desarrollo de nuevos detectores para los futuros colisionadores en Física de Partículas***

Reference: FPA2010-21549-C04-01  
PI: Ángel Diéguez  
Agency: MICINN  
Duration: 2011-2013  
Amount: 459.800 €

***Estudio de la violación de CP con el detector LHCb***

Reference: FPA2011-30163-C02-01  
PI: Eugeni Graugés  
Agency: MICINN  
Duration: 2012-2014  
Amount: 655.820 €

***Teoría y fenomenología de las interacciones fundamentales: Gravitación y cosmología***

Reference: FPA2010-20807-C02-02  
PI: Roberto Emparan  
Agency: MICINN  
Duration: 2011-2013  
Amount: 213.000 €

***Información cuántica: entrelazamiento, redes de tensores y gases fríos***

Reference: FIS2010-16185  
PI: José Ignacio Latorre  
Agency: MICINN  
Duration: 2011-2014  
Amount: 187.550 €

***Simulación Monte Carlo del transporte de radiación. Física, métodos numéricos y aplicaciones***

Reference: FPA2009-14091-C02-01  
PI: Francesc Salvat  
Agency: MICINN  
Duration: 2010-2013  
Amount: 61.500 €

***Teorías efectivas de las interacciones fuertes: aplicaciones a quarkonium pesado y a QCD bajo condiciones extremas***

Reference: FPA2010-16963  
PI: Joan Soto  
Agency: MICINN  
Duration: 2011-2013  
Amount: 112.409 €

***Teoría y fenomenología de las interacciones fundamentales: Física de partículas y la unificación de las fuerzas***

Reference: FPA2010-20807-C02-01  
PI: Domènec Espriu  
Agency: MICINN  
Duration: 2011-2013  
Amount: 422.169 €

### **Sistemas cuánticos en interacción:**

#### **hadrones, núcleos y átomos**

Reference: FIS2008-01661

PI: Assumpta Parreño

Agency: MICINN

Duration: 2009-2012

Amount: 338.074 €

### **Sistemas de Fermi fuertemente correlacionados:**

#### **átomos, núcleos y hadrones**

Reference: FIS2011-24154

PI: Xavier Viñas

Agency: MICINN

Duration: 2012-2014

Amount: 204.490 €

## *Special and Complementary Actions*

### *Astrophysics and Space Sciences*

#### **Creación de la Red Española Gaia**

Reference: AYA2009-08488-E

PI: Francesca Figueras

Agency: MICINN

Duration: 2010-2012

Amount: 38.000 €

#### **Jornadas de impulso a la explotación científica de Gaia**

Reference: AYA2011-15133-E

PI: Francesca Figueras

Agency: MICINN

Duration: 2011-2012

Amount: 5.900 €

#### **Ampliación de actividades de la misión GAIA**

Reference: AYA2010-12176-E

PI: Jordi Torra

Agency: MICINN

Duration: 2011-2013

Amount: 184.000 €

#### **Fenómenos de alta energía en eyecciones relativistas**

Reference: AYA2010-09310-E

PI: Josep M. Paredes

Agency: MICINN

Duration: 2011-2012

Amount: 12.000 €

#### **Preparación del IPDR de SO/Phi por parte de la UB**

Reference: AYA2010-09789-E

PI: Josep M. Gómez

Agency: MICINN

Duration: 2011-2012

Amount: 20.000 €

#### **Participación española en la fase preparatoria del Cherenkov Telescope Array (CTA)**

Reference: AIC-A-2011-0660

PI: Manuel Martínez, IFAE (ICCUB: Josep M.Paredes)

Agency: MINECO

Duration: 2011-2014

Amount: 432.677 € (ICCUB: 0 €)

#### **La contribución de las ICTS**

##### **españolas a la misión Gaia de ESA**

Reference: MICINN-RIA

PI: Carme Jordi

Agency: MICINN

Duration: 2012

Amount: 8.800 €

### *Nuclear and Particle Physics and Gravitation*

#### **Desintegraciones raras e identificación del sabor de mesones B en LHCb**

Reference: AIC-D-2011-0681

PI: Hugo Ruiz

Agency: MICINN

Duration: 2011-2012

Amount: 3.300 €

#### **Ecuación de estado de materia nuclear asimétrica**

Reference: AIC10-D-000608

PI: Artur Polls

Agency: MICINN

Duration: 2010-2012

Amount: 2.900 €

#### **Desarrollo de la matriz densidad e interacciones nucleares efectivas para los campos Hartree-Fock y de apareamiento**

Reference: AIC10-D-000592

PI: Xavier Viñas

Agency: MICINN

Duration: 2010-2012

Amount: 4.550 €

***Participación en el Computing resources***

***Scrutiny Group del CERN***

Reference: FPA2011-13440-E  
PI: Domènec Espriu  
Agency: MICINN  
Duration: 2011-2013  
Amount: 9.000 €

***Ruptura de simetría en física de partículas:  
el Higgs y más allá***

Reference: AIC-D-2011-0815  
PI: Domènec Espriu  
Agency: MICINN  
Duration: 2012-2013  
Amount: 3.000 €

***Año dual España-Rusia: Física de Partículas,  
Física Nuclear y Astropartículas***

Reference: FPA2011-14321-E  
PI: Domènec Espriu  
Agency: MICINN  
Duration: 2011-2012  
Amount: 8.000 €

***Conferencia Internacional "International Conference  
on Hypernuclear and Strange Particle Physics"***

Reference: FIS2011-15579-E  
PI: Àngels Ramos  
Agency: MICINN  
Duration: 2012-2013  
Amount: 9.000 €

***National Plan Consolider-Ingenio Projects***

***Astrophysics and Space Sciences***

***Supercomputación y eCiencia***

Reference: CSD2007-00050  
PI: Mateo Valero, BSC  
(ICCUB: Jordi Torra)  
Agency: MEC  
Duration: 2007-2013  
Amount: 5.000.000 € (ICCUB: 150.000 €)

***Primera ciencia con el GTC: la astronomía española  
en vanguardia de la astronomía europea***

Reference: CSD2006-00070  
PI: José Miguel Rodríguez Espinosa, IAC  
(ICCUB: Eduard Salvador)  
Agency: MEC  
Duration: 2007-2012  
Amount: 5.000.000 € (ICCUB: 0 €)

***Nuclear and Particle Physics  
and Gravitation***

***Centro Nacional de Física de Partículas,  
Astropartículas y Nuclear***

Reference: CSD2007-00042  
PI: Antonio Pich, IFIC  
(ICCUB: Lluís Garrido)  
Agency: MEC  
Duration: 2007-2012  
Amount: 10.000.000 € (ICCUB: 479.200 €)

***Canfranc Underground Physics***

Reference: CSD2008-00037  
PI: M. Concepción González-García  
Agency: MICINN  
Duration: 2008-2013  
Amount: 5.000.000 € (ICCUB: 470.250 €)

***Consolidated Groups***

***Astrophysics and  
Space Sciences***

***Maximizing the  
scientific return of  
future galaxy surveys***

Reference: 2009SGR1280  
PI: Licia Verde  
Agency: AGAUR

Duration: 2009-2014  
Amount: 42.640 €

***Astronomía i Astrofísica***

Reference: 2009SGR217  
PI: Eduard Salvador-Solé  
Agency: AGAUR  
Duration: 2009-2013  
Amount: 58.240 €

## *Nuclear and Particle Physics and Gravitation*

### **Grup de Física Experimental d'Altes Energies**

Reference: 2009SGR1268

PI: Lluís Garrido

Agency: AGAUR

Duration: 2009-2013

Amount: 47.840 €

### **Gravitation, Particles and Strings**

Reference: 2009SGR168

PI: David Mateos

Agency: AGAUR, Generalitat de Catalunya

Duration: 2009-2013

Amount: 44.720 €

## *European Projects and Funds*

## *Astrophysics and Space Sciences*

### **Cosmological physics with future large scale structure surveys (PHYSS.LSS)**

Reference: 240117 (FP7-IDEAS-ERC)

PI: Licia Verde

Agency: European Research Council (ERC)

Duration: 2009-2014

Amount: 1.395.000 €

### **Gaia Research for European Astronomy Training (GREAT)**

Reference: 08-RNP-118

PI: Nick Walton, University of Cambridge (ICCUB: Carme Jordi)

Agency: European Science Foundation (ESF)

Duration: 2010-2015

Amount: 735.000 €

### **Gaia Research for European Astronomy Training (GREAT-ITN)**

Reference: 264895 (FP7-PEOPLE)

PI: Nick Walton (University of Cambridge; ICCUB: Francesca Figueras)

Agency: European Community (EC)

Duration: 2011-2015

Amount: 4.250.580 €

(ICCUB: 456.239 €)

### **Dosimetria i Radiofísica Mèdica**

Reference: 2009SGR0276

PI: Francesc Salvat

Agency: AGAUR

Duration: 2009-2013

Amount: 46.800 €

### **Grup de Física Teòrica d'Altes Energies**

Reference: 2009SGR502

PI: Joan Solà

Agency: AGAUR

Duration: 2009-2013

Amount: 58.240 €

### **Laboratori de física matemàtica**

Reference: 2009SGR417

PI: Josep Llosa

Agency: AGAUR

Duration: 2009-2013

Amount: 87.500 €

### **WGA1 Gaia model workshop:**

#### **Galaxy modelling with a Gaia mock catalogue**

Reference: PESC-3857

PI: Daisuke Kawata, UCL (ICCUB: Francesca Figueras)

Agency: European Science Foundation (ESF)

Duration: 2011-2012

Amount: 7.560 €

### **The Gaia DPAC Interface Management in the Gaia Project Office**

Reference: GAIA-CT-12000-178-CN

PI: Jordi Torra

Agency: Centre National d'Études Spatiales (CNES)

Duration: 2009-2013

Amount: 320.000 €

### **The Preparatory Phase for the Cherenkov Telescope Array (CTA-PP)**

Reference: 262053 (FP7-INFRASTRUCTURES)

PI: Werner Hofmann, Max Planck Gesellschaft (ICCUB: Josep M. Paredes)

Agency: European Community (EC)

Duration: 2010-2013

Amount: 5.200.000 €

### **Star Formation in the Turbulent Interstellar Medium**

Reference: PIRG07-GA-2010-261359 (FP7- PEOPLE)

PI: Paolo Padoan, Eduard Salvador-Solé

Agency: European Community (EC)

Duration: 2011-2014

Amount: 100.000 €

***Data Services and Analysis Tools for Solar Energetic Particle Events and Related Electromagnetic Emissions (SEPs)server***

Reference: 2010.2.1-03 (FP7-SPACE)

PI: Rami Vainio, University of Helsinki  
(ICCUB: Blai Sanahuja)

Agency: European Community (EC)

Duration: 2010-2013

Amount: 1.932.175 €

(ICCUB: 150.562,50 €)

***Protecting Space Assets from High Energy Particles by Developing European Dynamic Modelling and Forecasting Capabilities (SPACECAST)***

Reference: SPA. 2010.2.3-01 (FP7-SPACE)

PI: Richard Horne, British Antarctic Survey  
(ICCUB: Blai Sanahuja)

Agency: European Community (EC)

Duration: 2011-2014

Amount: 1.965.076 € (ICCUB: 160.004 €)

***SSA - CO-VI Optical Observations For Space Surveillance And Tracking Test And Validations (TFRM)***

Reference: 4000107443/12/D/MRP

PI: Jorge Núñez

Agency: European Space Agency (ESA)

Duration: 2012-2013

Amount: 50.000 €

***Demonstration Test-Bed for the Remote Control of an Automated Follow-Up Telescope (TFRM participation)***

Reference: G532-004GR

PI: I. Dominguez, Ground Station department, INSA  
(ICCUB: Jorge Núñez)

Agency: European Space Agency (ESA)

Duration: 2012-2014

Amount: 800.000 € (ICCUB: 38.000 €)

***The Astrodynamics Network (ASTRONET-II)***

Reference: PITN-GA-2011-289240 (FP7-PEOPLE)

PI: Gerard Gómez

Agency: European Community (EC)

Duration: 2012-2015

Amount: 3.888.318 €

***Nuclear and Particle Physics and Gravitation***

***Holography for the LHC era Reference (HoloLHC)***

Reference: 306605 (FP7-IDEAS-ERC)

PI: David Mateos

Agency: European Research Council (ERC)

Duration: 2012-2017

Amount: 1.419.424 €

***Advanced European Infrastructures for Detectors at Accelerators (AIDA)***

Reference: 262025 (FP7-INFRASTRUCTURES)

PI: Ángel Diéguez

Agency: European Community (EC)

Duration: 2011-2015

Amount: 8.000.000 € (ICCUB: 44.920 €)

***Study of Strongly Interacting Matter (HADRONPHYSICS3)***

Reference: INFRA-2011-1-1-20 (283286)  
(FP7- INFRASTRUCTURES)

PI: Carlo Guaraldo

(INFN Frascati; ICCUB: Àngels Ramos)

Agency: European Community (EC)

Duration: 2012-2014

Amount: 9.000.000 € (ICCUB: 19.000 €)

***Multi-hadron interactions in Lattice QCD: 27,1 Mh in Mare Nostrum***

Reference: MHILQCD

PI: Assumpta Parreño

Agency: Partnership for advanced computing in Europe (PRACE)

Duration: 2012-2013

Amount: 27.100.000 CPUh

***Light quark mass dependence of two-hadron energies in Lattice QCD: 30 Mh at CURIE Thin node partition***

Reference: 2011040561

PI: Assumpta Parreño

Agency: Partnership for Advanced Computing in Europe (PRACE)

Duration: 2012

Amount: 30.000.000 CPUh

***Standard Model and New Physics with the LHCb detector (SM-NewPhysics-LHCb)***

Reference: PERG04-GA-2008-235071 (FP7- PEOPLE)

PI: Domenèc Espriu, David d'Enterra

Agency: European Community (EC)

Duration: 2009-2012

Amount: 45.000 €

### **European Particle Physics Latin**

#### **America Network (EPLANET)**

Reference: PIRSES-GA-2009-246806 (FP7- PEOPLE)

PI: Luciano Maiani, CERN (ICCUB: Domènec Espriu)

Agency: European Community (EC)

Duration: 2011-2015

Amount: 3.245.400 €

(ICCUB: 59.400 €)

### **INVISIBLES**

Reference: PITN-GA-2011-289442 (FP7-PEOPLE)

PI: B. Gavela, UAM

(ICCUB: M. Concepción González García)

Agency: European Community (EC)

Duration: 2012-2016

Amount: 3.245.400 € (ICCUB: 152.566 €)

## **International Projects**

### **Astrophysics and Space Sciences**

#### **Multi-spacecraft Observations of Near- Relativistic Electron Events: modeling their solar injection and interplanetary transport**

Reference: NXX09AG30G

PI: David Lario, APL, Johns Hopkins University

(ICCUB: Neus Àgueda)

Agency: NASA

Duration: 2009-2012

Amount: 199.926 €

(ICCUB: 0 €)

#### **Preconditioning of the interplanetary medium as responsible for large intense SEP events: Radial and longitudinal effects**

Reference: NNX11AO83G

PI: David Lario,

APL, Johns Hopkins University

(ICCUB: Neus Àgueda)

Agency: NASA

Duration: 2011-2015

Amount: 404.081 €

(ICCUB: 0 €)

#### **Contract for the preliminary design of the MIRADAS Spectrograph Probe Motion Control Software System for the Gran Telescopio Canarias**

Reference: MIRADAS Contract

PI: Jordi Torra

Agency: University of Florida

Duration: 2012-2013

Amount: 73.125 €

## **Other Funds and Contracts**

### **Astrophysics and Space Sciences**

#### **Atorgament d'un ajut de la convocatòria del Programa d'Incentivació de la Intensificació de l'activitat investigadora 2012.**

Reference: PIRSES-GA-2009-246806

PI: Blas Sanahuja

Agency: UB Duration: 2012-2013

Amount: 4.973,10 €

#### **Análisis de la Integración de un Sensor Radar Doppler en el asiento de un vehículo**

Reference: FBG 306487

PI: Josep M. Gómez

Company: Fico Mirrors, S.A.

Duration: 2011-2012

Amount: 37.850 €

#### **Interplanetary and Planetary Radiation Model for Human Spaceflight**

Reference: FBG 307130

PI: Daniel Heynderickx

(ICCUB: Àngels Aran, Blai Sanahuja)

Company: DH Consultancy/ESA

Duration: 2012-2013

Amount: 150.000 € (ICCUB: 9.000 €)

#### **Ajuts per finançar la participació en projectes internacionals de recerca (2011-2012): GENIUS**

PI: Xavier Luri

Agency: Universitat de Barcelona

Duration: 2011-2012  
Amount: 4.500 €

***Injection of nucleate-boiling slug flows into a heat exchange chamber in microgravity***

Reference: FA8655-12-1-2060  
PI: Jaume Casademunt  
Agency: Air Force Office of Scientific Research (Dept. of Defense USA) through the European Office of Aerospace Research and Development  
Duration: 2012-2015  
Amount: 179.540 €

***Estancias de profesores e investigadores extranjeros de acreditada experiencia en régimen de año sabático en centros españoles***

Reference: SAB2010-0120  
PI: Jordi Torra, Luís Aguilar (UNAM)  
Agency: MEC  
Duration: 2011-2012  
Amount: 31.900 €

***PTA Mod. Infraestructuras científico-técnicas: Gaia***

Reference: PTA2010-3704-I  
PI: Jordi Torra  
Agency: MINECO  
Duration: 2011-2014  
Amount: 56.700 €

***El tránsito de Venus 2012 y las distancias cósmicas***

Reference: FCT-11-2316  
PI: Carme Jordi  
Agency: FECYT  
Duration: 2011-2012  
Amount: 4.000 €

***El Trànsit de Venus 2012 i la divulgació de l'astronomia a la Universitat de Barcelona***

Reference: 2012ACDC00161  
PI: Carme Jordi  
Agency: AGAUR  
Duration: 2012-2012  
Amount: 5.000 €

***Eclipsi 2.0: una aplicació Android per al càlcul d'eclipsis i trànsits planetaris***

Reference: 2012ACDC00081  
PI: Jordi Torra  
Agency: AGAUR  
Duration: 2012-2012  
Amount: 6.000 €

***Nuclear and Particle Physics and Gravitation***

***Miniaturization of the controller for a endoscopic screening capsule, Phase 4***

Reference: FBG 307059  
PI: Ángel Diéguez  
Company: Ovesco Endoscopy AG  
Duration: 2012  
Amount: 9.920 €

***Asesoramiento sobre el desarrollo y prueba de circuitos electrónicos para discriminación de señales en detectores de partículas***

Reference: FBG 306720  
PI: Lluís Garrido  
Company: Scientifica Internacional  
Duration: 2012-2014  
Amount: 11.000 €

***Analysis with Penelope***

Reference: FBG 306890  
PI: Francesc Salvat  
Company: Hamamatsu Photonics K.K.  
Duration: 2012-2013

***Intellectual services relative to support to Penelope training course***

Reference: FBG 30704  
PI: Francesc Salvat  
Agency: Organisation for economic co-operation and development  
Duration: 2012  
Amount: 4.000 €

***Miniaturization of the controller for an endoscopic screening capsule, Phase 2***

Reference: FBG 306675  
PI: Ángel Diéguez  
Agency: Ovesco Endoscopy AG  
Duration: 2011-2012  
Amount: 82.088 €

***Miniaturization of the controller for an endoscopic screening capsule, Phase 3***

Reference: FBG 306988  
PI: Ángel Diéguez  
Agency: Ovesco Endoscopy AG  
Duration: 2012  
Amount: 14.880 €

# PUBLICATIONS

## SCI Publications

### *Astrophysics and Space Sciences*

Abramowski, A.; et al. (ICCUB: **Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Paredes, J.M.; Ribó, M.; Zabalza, V.; Zanin, R.**), “The 2010 Very High Energy  $\gamma$ -Ray Flare and 10 Years of Multi-wavelength Observations of M 87”, *Astrophysical Journal*, vol. 746, p. 151 (2012).

**Àgueda, N.**; Lario, D.; Ontiveros, V.; Kilpua, E.; **Sanahuja, B.**; Vainio, R., “Multi-spacecraft Study of the 8 November 2000 SEP Event: Electron Injection Histories 100° Apart”, *Solar Physics*, vol. 281, num. 1, p. 319-331 (2012).

**Àgueda, N.**; Vainio, R.; **Sanahuja, B.**, “A Database of >20 keV Electron Green’s Functions of Interplanetary Transport at 1 AU”, *Astrophysical Journal Supplement Series*, vol. 202, num. 2 (2012).

Ahn, C.P.; et al. (SDSS-III Collaboration; ICCUB: **Verde, L.; Miralda-Escudé, J.**), “The Ninth Data Release of the Sloan Digital Sky Survey: First Spectroscopic Data from the SDSS-III Baryon Oscillation Spectroscopic Survey”, *Astrophysical Journal Supplement Series*, vol. 203, p. 21 (2012).

Alba, A.N.R.; Valero, G.; Calbet, T.; Font-Bardía, M.; Moyano, A.; **Ríos, R.**, “Enantioselective addition of oxazolones to maleimides. An easy entry to quaternary aminoacids”, *New Journal of Chemistry*, vol. 36, p. 613 - 618 (2012).

Aleksic, J. et al. (MAGIC Collaboration; ICCUB: **Bosch-Ramon, V.; Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Paredes, J.M.; Ribó, M.; Zabalza, V.; Zanin, R.**), “Detection of the  $\gamma$ -Ray Binary LS I +61°303 in a Low-flux State at Very High Energy  $\gamma$ -Rays with the MAGIC Telescopes in 2009”, *Astrophysical Journal*, vol. 746, p. 80 (2012).

Aleksic, J. et al. (MAGIC Collaboration; ICCUB: **Bosch-Ramon, V.; Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Paredes, J.M.; Ribó, M.; Zabalza, V.; Zanin, R.**), “Detection of VHE  $\gamma$ -Rays from HESS J0632+057 during the 2011 February X-Ray Outburst with the MAGIC Telescopes”, *Astrophysical Journal Letters*, vol. 754L, p. 10A (2012).

Aleksic, J. et al. (MAGIC Collaboration; ICCUB: **Bosch-Ramon, V.; Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Paredes, J.M.; Ribó, M.; Zabalza, V.; Zanin, R.**), “PG 1553+113: five years of observations with MAGIC”, *Astrophysical Journal*, vol. 748, p. 46A (2012).

Aleksic, J. et al. (MAGIC Collaboration; ICCUB: **Bosch-Ramon, V.; Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Paredes, J.M.; Ribó, M.; Zabalza, V.; Zanin, R.**), “Phase-resolved energy spectra of the Crab pulsar in the range of 50-400 GeV measured with the MAGIC telescopes”, *Astronomy & Astrophysics*, vol. 540, p. 69A (2012).

Aleksic, J. et al. (MAGIC Collaboration; ICCUB: **Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Paredes, J.M.; Ribó, M.; Zabalza, V.; Zanin, R.**), “Detection of very-high energy  $\gamma$ -ray emission from NGC 1275 by the MAGIC telescopes”, *Astronomy & Astrophysics*, vol. 539, p. L 2A (2012).

Aleksic, J. et al. (MAGIC Collaboration; ICCUB: **Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Paredes, J.M.; Ribó, M.; Zabalza, V.; Zanin, R.**), “Discovery of VHE  $\gamma$ -ray emission from the BL Lacertae object B3 2247+381 with the MAGIC telescopes”, *Astronomy & Astrophysics*, vol. 539A, p. 118A (2012).

Aleksic, J. et al. (MAGIC Collaboration; ICCUB: **Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Paredes, J.M.; Ribó, M.; Zabalza, V.; Zanin, R.**), “Discovery of VHE  $\gamma$ -rays from the blazar 1ES 1215+303 with the MAGIC telescopes and simultaneous multi-wavelength observations”, *Astronomy & Astrophysics*, vol. 544, p. 142A (2012).

Aleksic, J. et al. (MAGIC Collaboration; ICCUB: **Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Paredes, J.M.; Ribó, M.; Zabalza, V.; Zanin, R.**), “High zenith angle observations of PKS 2155-304 with the MAGIC-I telescope”, *Astronomy & Astrophysics*, vol. 544A, p. 75A (2012).

Aleksic, J. et al. (MAGIC Collaboration; ICCUB: **Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Paredes, J.M.; Ribó, M.; Zabalza, V.; Zanin, R.**), “MAGIC observations of the giant radio galaxy M 87 in a low-emission state between 2005 and 2007”, *Astronomy & Astrophysics*, vol. 544A, p. 96A (2012).



- Aleksic, J. et al. (MAGIC Collaboration; ICCUB: **Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Paredes, J.M.; Ribó, M.; Zabalza, V.; Zanin, R.**), “Morphological and spectral properties of the W51 region measured with the MAGIC telescopes”, *Astronomy & Astrophysics*, vol. 541A, p. 13A (2012).
- Aleksic, J. et al. (MAGIC Collaboration; ICCUB: **Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Paredes, J.M.; Ribó, M.; Zabalza, V.; Zanin, R.**), “Mrk 421 active state in 2008: the MAGIC view, simultaneous multi-wavelength observations and SSC model constrained”, *Astronomy & Astrophysics*, vol. 542A, p. 100A (2012).
- Aleksic, J. et al. (MAGIC Collaboration; ICCUB: **Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Paredes, J.M.; Ribó, M.; Zabalza, V.; Zanin, R.**), “Performance of the MAGIC stereo system obtained with Crab Nebula data”, *Astroparticle Physics*, vol. 35, p. 435-448 (2012).
- Aleksic, J. et al. (MAGIC Collaboration; ICCUB: **Cañellas, A.; Moldón, J.; Munar-Adrover, P.; Ribó, M.; Paredes, J.M.; Zabalza, V.; Zanin, R.**), “Constraining cosmic rays and magnetic fields in the Perseus galaxy cluster with TeV observations by the MAGIC telescopes”, *Astronomy & Astrophysics*, vol. 541A, p. 99A (2012).
- Álvarez-Gaume, L.; Gómez, C.; **Jiménez, R.**, “Phenomenology of the Minimal Inflation Scenario”, *JCAP*, vol. 03, p. 017 (2012).
- Anderson, L.; et al. (ICCUB: **Verde, L.**), “The clustering of galaxies in the SDSS-III Baryon Oscillation Spectroscopic Survey: Baryon Acoustic Oscillations in the Data Release 9 Spectroscopic Galaxy Sample”, *MNRAS*, vol. 427, p. 3435-3467 (2012).
- Avgoustidis, A.; **Jiménez, R.**; Álvarez-Gaume, L.; Vázquez-Mozo, M.A., “Gravitational shocks as a key ingredient of Gamma-Ray Bursts”, *Int. J. Mod. Phys. A*, vol. 27, p. 20 (2012).
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- Casares, J.; **Ribó, M.**; Ribas, I.; **Paredes, J. M.**; Vilardell, F.; Negueruela, I., “On the binary nature of the  $\gamma$ -ray sources AGL J2241+4454 (= MWC 656) and HESS J0632+057 (= MWC 148)”, *MNRAS*, vol. 421, p. 1103 (2012).
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- Collins, D.C.; Kritsuk, A.G.; **Padoan, P.**; Li, H.; Xu, H.; Ustyugov, S.D.; Norman, M.L., “The Two States of Star-forming Clouds”, *Astrophysical Journal*, vol. 750, num. 1, p. 13 (2012).
- Companyó, X.; Valero, G.; Pineda, O.; Calvet, T.; Font-Bardía, M.; Moyano, A.; **Ríos, R.**, “Enantioselective organocatalytic oxyamination of unprotected 3-substituted oxindoles”, *Organic & Biomolecular Chemistry*, vol. 10, p. 431-439 (2012).
- Creminelli, P.; **Noreña, J.**; Simonovi, M., “Conformal consistency relations for single-field inflation”, *Journal of Cosmology and Astroparticle Physics*, vol. 7, num. 052 (2012).
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- D’Enterria, D.**; Rojo, J., “Quantitative constraints on the gluon distribution function in the proton from collider isolated-photon data”, *Nucl. Phys. B*, vol. B860m p. 311-338 (2012)
- Salgado, C.A., **D’Enterria, D.**; et al., “Proton-Nucleus Collisions at the LHC: Scientific Opportunities and Requirements”, *J.Phys. G*, vol. 39, p. 015010 (2012)
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Gonzalez, J., **Clotet, M., Castañeda, J.**, et al., “DPCB Cycle 12 Software Test and Validation Report”, GAIA-DB-TR-UB-JG-002-01, Version 01 (July 2012).

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## **Gaia Project Office**

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### *Astrophysics and Space Sciences*

#### ***“Implementing the Gaia Astrometric Solution”***

Author: Williams Joseph O’Mullane  
Supervisor/s: Xavier Luri, Lennart Lindegren  
Defense Date: 09/03/2012

#### ***“The star-forming core ahead of HH 80N: studying the interaction with a parsec scale jet”***

Author: Josep M. Masqué  
Supervisor/s: Robert Estalella, Josep M. Girart  
Defense Date: 23/03/2012

#### ***“New techniques for the analysis of the large scale structure of the Universe”***

Author: Héctor Gil  
Supervisor/s: Raúl Jiménez, Licia Verde  
Defense Date: 03/05/2012

#### ***“The role of magnetic fields in the formation of low and high mass stars”***

Author: Pau Frau  
Supervisor/s: Josep M. Girart, M. Teresa Beltrán  
Defense Date: 12/06/2012

#### ***“Structure and nature of gamma-ray binaries by means of VLBI observations”***

Author: Fco. Javier Moldon  
Supervisor/s: Marc Ribó, Josep M. Paredes  
Defense Date: 05/07/2012

#### ***“Turbulent bubble suspensions and crystal growth in microgravity. Drop tower experiments an numerical simulations”***

Author: Pau Bitlloch  
Supervisor/s: Jaume Casademunt, Josep Xavier Ruiz  
Defense Date: 11/10/2012

#### ***“The Evolution, Masses and Morphologies of Merging”***

Author: Kevin Casteels  
Supervisor/s: Eduard Salvador-Solé  
Defense Date: 19/10/2012

#### ***“A new version of the Besançon Galaxy Model constrained with Tycho data”***

Author: Maria Anna Czekaj  
Supervisor/s: Annie C. Robin, Francesca Figueras, Xavier Luri  
Defense Date: 22/10/2012

#### ***“Energía Oscura y Gravedad Modificada”***

Author: Miguel Zumalacarregui  
Supervisor/s: Juan García-Bellido, Pilar Ruiz-Lapuente, Tomi S. Koivisto  
Defense Date: October 2012

#### ***“AMIGA: Parallelization, Ly $\alpha$ Emission Line And Steps Towards WDM Implementation”***

Author: Jordi Viñas  
Supervisor/s: Alberto Manrique  
Defense Date: 23/11/2012

### *Nuclear and Particle Physics and Gravitation*

#### ***“Charmed Baryon Resonances and mesons in Hot and Dense matter”***

Author: Clara Estela Jiménez  
Supervisor/s: Àngels Ramos, Isaac Vidaña  
Defense Date: 05/03/2012

#### ***“First measurements of radiative B decays in LHCb”***

Author: Albert Puig Navarro  
Supervisor/s: Ricardo Graciani  
Defense Date: 09/03/2012

#### ***“Enabling active locomotion and advanced features in an endoscopic capsule”***

Author: Oscar Alonso  
Supervisor/s: Angel Diéguez  
Defense Date: 27/04/2012

#### ***“Flavour Tagging developments within the LHCb experiment”***

Author: Marc Grabalosa  
Supervisor/s: Marco Musy  
Defense Date: 15/05/2012

***“Explicit Bound States and Resonances  
fields in Effective Field Theories”***

Author: Jaume Tarrús  
Supervisor/s: Joan Soto, Pere Talavera  
Defense Date: 07/06/2012

***“Studies with Massive Neutrinos in  
Particle Physics, Astrophysics and Cosmology”***

Author: Jordi Salvadó  
Supervisor/s: M. Concepción González-García  
Defense Date: 27/09/2012

***“Black holes: New perspectives from higher-dimensions”***

Author: Nidal Haddad  
Supervisor/s: Roberto Emparan  
Defense Date: 29/10/2012

**Master Theses**

***Astrophysics and Space Sciences***

***“Imaging of star formation regions with AIPS”***

Author: Carmen Juárez  
Supervisor/s: Robert Estalella  
Defense Date: 01/02/2012

***“The quasar - Lyman alpha cross-correlation in BOSS”***

Author: Eduard Arnau  
Supervisor/s: Jordi Miralda  
Defense Date: 29/06/2012

***“Expected contents of the Gaia catalogue for binary stars”***

Author: Núria Vinyoles  
Supervisor/s: Xavier Luri  
Defense Date: 07/09/2012

***“Low-frequency radio observations  
of gamma-ray binaries”***

Author: Benito Marcote  
Supervisor/s: Josep Maria Paredes  
Defense Date: 07/09/2012

***Nuclear and Particle Physics  
and Gravitation***

***“On extremal black holes in the  
Einstein Yang-Mills system”***

Author: Luís Cort  
Supervisor/s: Bartomeu Fiol  
Defense Date: 08/02/2012

***“Simulació quàntica amb reticles òptics”***

Author: Octavi Boada  
Supervisor/s: José I. Latorre  
Defense Date: 02/11/2012

***“Spontaneous generation of geometry and  
its possible consequences”***

Author: Daniel Puigdomènech  
Supervisor/s: Domènec Espriu  
Defense Date: 06/11/2012

***“Measurement of the direct CP asymmetry in  
 $B^0 \rightarrow K^* \gamma$  decays with the LHCb detector”***

Author: Ricardo Vázquez -Gómez  
Supervisor/s: Ricardo Graciani, Hugo Ruiz  
Defense Date: 12/12/2012

***“Stability, Thermodynamics  
and Critical Phenomena  
in Black Strings”***

Author: Marina Martínez  
Supervisor/s: Roberto Emparan  
Defense Date: 08/02/2012

***“Non-Gaussian features of  
primordial fluctuations  
in single field inflationary models”***

Author: Mariona Anglada  
Supervisor/s: Jaume Garriga  
Defense Date: 02/07/2012

***“Inflation from a Higgs false vacuum:  
Post-Inflationary evolution”***

Author: Ramon Nogueira  
Supervisor/s: Alessio Notari  
Defense Date: 02/07/2012

***“Improving vertex fitting with a photon”***

Author: Damián Álvarez  
Supervisor/s: Lluís Garrido  
Defense Date: 20/09/2012

***“Entanglement entropy as  
an order parameter:  
a holographic perspective”***

Author: Daniel Alsina  
Supervisor/s: Bartomeu Fiol  
Defense Date: 20/09/2012

***“Radiative Energy Loss in a  
Thin QCD Medium”***

Author: Daniel Pablos

Supervisor/s: Jorge Casalderrey

Defense Date: 20/09/2012

***“WW amplitudes in a effective theory”***

Author: Emilio Flores

Supervisor/s: Domènec Espriu, Joan Soto

Defense Date: 20/09/2012

***“Applications of Matrix  
Product States”***

Author: Javier García

Supervisor/s: José I. Latorre

Defense Date: 20/09/2012

***“Modelos evolutivos de la energía  
de vacío en cosmología”***

Author: Pello Bilbao

Supervisor/s: Joan Solà

Defense Date: 20/09/2012

***“Aspects of Anisotropic Plasmas”***

Author: Teresa García

Supervisor/s: David Mateos

Defense Date: 20/09/2012

***“Reacción  $N \rightarrow K\bar{E}$  en modelos quirales con canales  
acoplados hasta next-to-leading order”***

Author: Albert Feijoo

Supervisor/s: Volodymyr Magas

Defense Date: 06/11/2012



**Clarkson, Chris** (Cape Town University)

“Dark Energy and Inhomogeneity”

19/06/2012

**Arnau, Eduard** (ICCUB)

“Modelling the QSO-LYalpha cross-correlation”

29/06/2012

**Saito, Shun** (Univ. Berkeley)

“Non-linear redshift space distortions in the angular power spectrum”

17/07/2012

**Reid, Beth** (Berkeley U.)

“SDSS-III Baryon Oscillation Spectroscopic Survey DR9 Results: baryon acoustic oscillations, the growth of structure, and the Alcock-Paczynski effect at  $z=0.57$ ”

18/07/2012

**Djordjevic, Goran** (University of Nis, Serbia)

“On Nonlocal Inflation, Tachyons and (Non) Minimal Coupling”

27/07/2012

**Miralda, Jordi** (ICCUB)

“The Practice of Theoretical Astrophysics”

18/10/2012

**Font, Andreu** (University of Zurich)

“Cosmology with the Lyman alpha Forest: First results from the BOSS survey”

12/11/2012

## Group Seminars

**Mannarelli, Massimo** (INFN Gran Sasso)

“Superluminal neutrinos and pion decay”

HEP Seminar

12/01/2012

**Puigdomènech, Daniel** (ICCUB)

“Spontaneous generation of geometry in four dimensions”

HEP Seminar

13/01/2012.

**Entem, David R.** (U. Salamanca)

“Nuclear Forces in Chiral EFT”

FAN Seminar

18/01/2012

**Quartin, Miguel** (U. Federal do Rio de Janeiro)

“Interesting Anisotropic and Inhomogeneous Cosmologies”

HEP Seminar

19/01/2012

**Racker, Juan** (ICCUB)

“Leptogenesis with small violation of B-L”

HEP Seminar

20/01/2012

**Anabalón, Andrés** (U. Adolfo Ibanez, Chile)

“Asymptotically AdS Black Holes and Wormholes with a Self Interacting Scalar Field in Four Dimensions”

HEP Seminar

26/01/2012

**Lizzi, Fedele** (Naples U.)

“Spectral action, scale anomaly and the Higgs-Dilaton potential”

HEP Seminar

27/01/2012

**Molina, Raquel** (IFIC, Valencia)

“A new interpretation for the  $D_{s2}(2573)$ , the prediction of novel exotic charmed mesons and narrow  $N^*$ ,  $\Lambda^*$  resonances around 4.3 GeV “

FAN Seminar

01/02/2012

**G. Cámara, Pablo** (ICCUB)

“Flavor physics from local F-theory GUTs”

HEP Seminar

03/02/2012

**Mateu, Cecilia** (CIDA. Mérida, Venezuela)

“Adventures in the Milky Way: From RR-Lyrae and the Thick Disk to Gaia and Stellar Streams in the Halo”

DAM Seminar

08/02/2012

**Booth, Ivan** (UB & Memorial U.)

“Near Equilibrium Black Holes and Branes”

HEP Seminar

09/02/2012

**Forini, Valentina** (ICCUB)

“Quark-antiquark potential in AdS/CFT”

HEP Seminar

10/02/2012

- Vernizzi, Filippo** (CEA Gif-sur-Yvette)  
 “Squeezing the CMB and the cosmic shear bispectra”  
 HEP Seminar  
 14/02/2012
- Notari, Alessio** (ICCUB)  
 “Predicting the Higgs mass from Inflation”  
 HEP Seminar  
 16/02/2012
- Aprile, Francesco** (ICCUB)  
 “AdS/Condensed Matter Physics. A first example:  
 Holographic Superconductors”  
 HEP Seminar  
 17/02/2012
- Ortin, Tomás** (UAM)  
 “Non-extremal black holes and branes of  $N=2$ ,  $d=4,5$   
 Supergravity”  
 HEP Seminar  
 23/02/2012
- Yencho, Brian** (ICCUB)  
 “Azimuthal Correlations in Top Pair Decays and the  
 Effects of New Heavy Scalars”  
 HEP Seminar  
 24/02/2012
- Ramallo, Alfonso** (U. de Santiago de Compostela)  
 “Holographic flavors and impurities in Chern-Simons-  
 matter theories”  
 HEP Seminar  
 01/03/2012
- Andrianov, Alexander**  
 (ICCUB & St. Petersburg State U.)  
 “Flying of vector particles from a parity breaking  
 medium to vacuum and back”  
 HEP Seminar  
 02/03/2012
- Pineda, Antonio** (UAB)  
 “The muonic hydrogen lamb shift and the proton radius”  
 HEP Seminar  
 08/03/2012
- Garolera, Blai** (ICCUB)  
 “Exact results for static and radiative fields of a quark in  
 $N=4$  super Yang-Mills”  
 HEP Seminar  
 09/03/2012
- Zabalza, Victor** (Max-Planck-Institut für Kernphysik,  
 Heidelberg, Alemania.)  
 “A tale of two components: Revealing the origin of the  
 high energy gamma-ray emission from LS 5039.”  
 DAM Seminar  
 12/03/2012
- Bernabeu, José** (U. Valencia & IFIC)  
 “Time reversal violation from the entangled  $B_0$ - $\bar{B}_0$   
 system”  
 HEP Seminar  
 15/03/2012
- Urakawa, Yuko** (ICCUB)  
 “Infrared stability of de Sitter spacetime”  
 HEP Seminar  
 16/03/2012
- Van der Schee, Wilke** (Utrecht U.)  
 “Strong coupling isotropization simplified”  
 HEP Seminar  
 22/03/2012
- Barranco, Alejandro** (ICCUB)  
 “ $N=1$  SQCD-like theories with  $N_f$  massive flavors from  
 AdS/CFT and beta functions”  
 HEP Seminar  
 23/03/2012
- Tremblay, Pier-Emmanuel** (LSW, Heidelberg)  
 “The high-mass problem in cool white dwarfs: an old  
 obstacle now seen with 3D radiation-hydrodynamics”  
 DAM Seminar  
 28/03/2012
- Gaberdiel, Matthias** (Zurich ETH)  
 “Minimal Model Holography”  
 HEP Seminar  
 28/03/2012
- Espriu, Domènec** (ICCUB)  
 “Gravitational waves in the presence  
 of a cosmological constant”  
 HEP Seminar  
 30/03/2012
- Verdes-Montenegro, Lourdes** (IAA-CSIC)  
 “The Square Kilometer Array: a challenge for ~ 2020 to  
 which Spain can contribute in 2012.”  
 DAM Seminar  
 11/04/2012

**Landsteiner, Karl** (IFT-UAM)

“Anomalous Transport and Kubo Formulae”

HEP Seminar

12/04/2012

**Casalderrey, Jorge** (ICCUB)

“Off-diagonal Flavour Susceptibilities from AdS/CFT”

HEP Seminar

20/04/2012

**Segovia, Jorge** (U. Salamanca)

“Heavy meson phenomenology in a constituent quark model”

FAN Seminar

25/04/2012

**Milhano, J. G.**

(CENTRA Lisboa & CERN)

“Colour matters: the importance of medium modification of colour flow to jet quenching”

HEP Seminar

26/04/2012

**Niro, Viviana** (ICCUB)

“Indirect detection of Dark Matter with neutrino detectors”

HEP Seminar

27/04/2012

**Soto, Joan** (ICCUB)

“Heavy quarkonium in a moving thermal bath”

HEP Seminar

04/05/2012

**Furuya, Ray S.** (Subaru Telescope, National Astronomical Observatory of Japan)

“The Initial Conditions for Gravitational Collapse of a Low-Mass Star-Forming Core”

DAM Seminar

10/05/2012

**Rahatlou, Shahram**

(U. Roma “La Sapienza” & INFN Roma)

“Exotica at Large Hadron Collider”

HEP Seminar

10/05/2012

**Puig, Albert** (ICCUB)

“Radiative B decays in LHCb”

HEP Seminar

11/05/2012

**Csernai, Laszlo P.**

(U. Bergen, Norway)

“Quark Gluon Plasma search:

from heavy ion collisions to neutron stars”

HEP Seminar

15/05/2012

**Shinnaga, Hiroko**

(California Institute of Technology

Submillimeter Observatory)

“Magnetic Field in the Isolated Massive Dense Clump

IRAS 20126+4104”

DAM Seminar

17/05/2012

**Gomis, Joaquim** (ICCUB)

“Non-linear Realizations, Goldstone bosons of broken

Lorentz rotations and effective actions for p-branes”

HEP Seminar

18/05/2012

**Muga, Juan Gonzalo** (U. País Vasco)

“How to speed up quantum adiabatic processes”

FAN Seminar

21/05/2012

**Afonin, Sergey**

(Saint Petersburg State U.)

“Soft wall model with inverse exponential profile as a model for the axial mesons”

HEP Seminar

22/05/2012

**Das, Sumit R.**

(University of Kentucky)

“Collective Fields in the Sp(N) Models and dS/CFT”

HEP Seminar

24/05/2012

**El-Showk, Sheer** (CEA Saclay)

“The Resurgent Bootstrap and the 3D Ising Model

(towards solutions of CFTs in  $D > 2$ )”

HEP Seminar

25/05/2012

**Basilakos, Spyros**

(Academy of Athens)

“The growth index of matter perturbations and modified gravity”

HEP Seminar

29/05/2012



**Papadimitriou, Ioannis**

(IFT UAM/CSIC)

“A ‘double cover’ for the  $SO(6)\times SO(2)$  symmetric sector of  $N=8$  gauged supergravity in four dimensions”

HEP Seminar

31/05/2012

**Pujolas, Oriol** (UAB)

“Emergent Lorentz Invariance”

HEP Seminar

01/06/2012

**Gabrielli, Emidio** (NICPB Estonia)

“Fermiophobic Higgs scenarios at the LHC”

HEP Seminar

07/06/2012

**Epelbaum, Evgeni**

(Ruhr U., Bochum)

“A renormalizable EFT approach to NN scattering with nonperturbative pions”

HEP Seminar

08/06/2012

**Routray, T.R.** (U. Sambalpur)

“Momentum and density dependence of nuclear mean field and equation of state of nuclear matter”

FAN Seminar

20/06/2012

**Bekaert, Xavier** (LMPT Tours)

“Towards a bulk dual of the unitary Fermi gas”

HEP Seminar

21/06/2012

**Holl, Berry** (Lund Observatory, Lund, Sweden)

“Characterizing the astrometric errors in the Gaia catalogue”

DAM Seminar

25/06/2012

**Gomis, Jaume** (Perimeter Institute)

“Exact Results in  $D=2$  Supersymmetric Gauge Theories”

HEP Seminar

26/06/2012

**Beane, Silas** (U. New Hampshire)

“Nuclear physics from first principles: a status report”

FAN Seminar

26/06/2012

**Dudas, Emilian** (Ecole Polytechnique & Orsay, LPT)

“Universal gravitational contributions to scalar masses”

HEP Seminar

28/06/2012

**Cantó, Jorge** (Instituto de Astronomía, UNAM, México)

“Jets de estrellas jóvenes: Teoría”

DAM Seminar

03/07/2012

**Miller-Jones, James** (International Centre for Radio

Astronomy Research - Curtin University, Australia.)

“Astrometry of XRBs and what one can do with it”

DAM Seminar

04/07/2012

**Comerón, Sebastien** (Korea Astronomy and Space

Science Institute, University of Oulu)

“A deeper look on thick discs using data from the Spitzer Survey of Stellar Structure in Galaxies (S4G)”

DAM Seminar

16/07/2012

**Schat, Carlos** (Ohio U. & Buenos Aires U.)

“Testing quark forces in baryons using the  $1/N_c$  expansion”

HEP Seminar

27/09/2012

**Batta Márquez, Aldo Alberto** (Instituto de Astronomía,

Universidad Nacional Autónoma de México)

“Cooling induced structures in the collapsar model”

DAM Seminar

02/10/2012

**Kniehl, Bernd** (Hamburg U.)

“Heavy-quarkonium theory in the LHC era”

HEP Seminar

04/10/2012

**Moran, James M.**

(Harvard-Smithsonian Center for Astrophysics)

“Dinnertime for SgrA\* (The Black Hole in the Center of OUR Galaxy)”

DAM Seminar

05/10/2012

**Hiyama, Emiko** (RIKEN, Japan)

“Gaussian Expansion Method and application to  $4\text{He}$  tetramer system”

FAN Seminar

08/10/2012

**Donos, Aristomenis** (Imperial College, UK)

“Spatial modulation in AdS/CFT”

HEP Seminar

18/10/2012

**G. Cámara, Pablo** (ICCUB)

“Non-Abelian discrete gauge symmetries in String Theory”

HEP Seminar

19/10/2012

**García, Miguel Ángel** (ICCUB)

“Strongly correlated ultracold bosons as impurities immersed in a Bose-Einstein condensate”

FAN Seminar

24/10/2012

**Hoyos, Carlos** (Tel-Aviv U.)

“Chiral magnetic effect in holography”

HEP Seminar

25/10/2012

**Russo, Jorge** (ICCUB)

“Large N limit of super Yang-Mills theories from localization”

HEP Seminar

26/10/2012

**Faedo, Anton** (Swansea U.)

“RG flows as domain walls of N=4 supergravity”

HEP Seminar

08/11/2012

**Carbone, Arianna** (ICCUB)

“High momentum components in the nuclear symmetry energy”

FAN Seminar

08/11/2012

**Planells, Xumeu** (ICCUB)

“Study of local parity breaking in heavy ion collisions”

HEP Seminar

09/11/2012

**Withers, Benjamin** (Durham U.)

“Stars, Superfluids and Supergravity”

HEP Seminar

15/11/2012

**Mateo, David** (ICCUB)

“Desorption dynamics of photoexcited atoms in helium nanodroplets”

FAN Seminar

15/11/2012

**Emparan, Roberto** (ICCUB)

“Viscous fluid, elastic solid: a general framework for the effective dynamics of black objects”

HEP Seminar

16/11/2012

**Chowdhury, Borun** (U. of Amsterdam)

“Unitarity and fuzzball complementarity: Alice fuzzes but may not even know it!”

HEP Seminar

22/11/2012

**Myers, Robert C.** (Perimeter Institute)

“On the Architecture of Spacetime: Holography, Entanglement, c-theorems and Black Holes”

HEP Seminar

23/11/2012

**Koenigsberger, Gloria**

(Instituto de Ciencias Físicas, UNAM, México)

“HD5980: A prototype for consecutive LBV and supernova events”

DAM Seminar

26/11/2012

**Monteiro, Ricardo** (Copenhagen U.)

“Hairy black holes and solitons in global AdS<sub>5</sub>”

HEP Seminar

29/11/2012

**Tarrio, Javier** (ICCUB)

“Describing holographically D3/D7 plasmas: successes and limitations”

HEP Seminar

30/11/2012

**Obers, Niels**

(Niels Bohr Inst., U. of Copenhagen)

“Blackfolds and thermal probe branes in string theory”

HEP Seminar

30/11/2012

**Benicasa, Paolo**

(U. de Santiago de Compostela)

“A holographic perspective on the high baryon density regime in field theories at strong coupling”

HEP Seminar

13/12/2012

### At ICCUB

#### **Figueras, F.; Luri, X.**

Members of the organizing committee  
International workshop  
“Galaxy Modelling with a Gaia mock catalogue”  
Faculty of Physics, UB  
29/02/2012 - 02/03/2012  
<https://gaia.am.ub.es/Twiki/bin/view/WS2GaiaMock>

#### **Ribó, J.M.**

Organizer  
National meeting “AYA2009-13920-C02 Resultats I  
Prospectives; Trobada oberta”  
Dep. de Química Orgànica, UB;  
Dep. de Física Aplicada I Òtica, UB;  
Centro de Astrobiología, CSIC-INTA  
10/05/2012 - 11/05/2012  
<http://icc.ub.edu/documents/SeminariAYA2009.pdf>

#### **Aran, A.; Sanahuja, B.**

Members of the organizing committee  
International meeting “SPACECAST”  
Dept. Astronomia i Meteorologia, UB  
21/05/2012-24/05/2012

#### **Sanahuja, B.; Àgueda, N.**

Members of the organizing committee  
International meeting “Meeting SEPserver”  
Dept. Astronomia i Meteorologia, UB  
17/09/2012-20/09/2012

#### **Magas, V.; Parreño, A.; Polls; A. Ramos, A.**

Members of the local organizing  
committee “HYP 2012: XI International  
Conference on Hypernuclear and  
Strange Particle Physics”  
Cosmocaixa  
01/10/2012 - 05/10/2012  
<http://icc.ub.edu/congress/HYP2012>

#### **Ramos, A.**

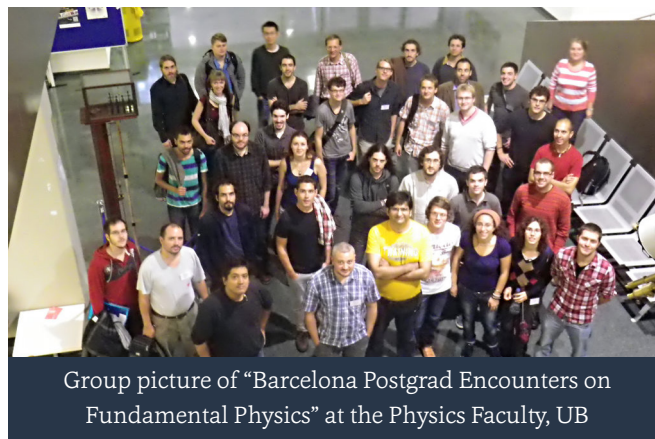
President of the organizing committee  
“HYP 2012: XI International Conference on  
Hypernuclear and Strange Particle Physics”  
Cosmocaixa  
01/10/2012 - 05/10/2012  
<http://icc.ub.edu/congress/HYP2012>



Group picture of HYP 2012 at Cosmocaixa

#### **Fernández, D.; Fröb, M.**

Organizers  
International Meeting “Barcelona Postgrad Encounters  
on Fundamental Physics”  
Faculty of Physics, UB  
17/10/2012 - 19/10/2012  
<http://ffn.ub.edu/bcn-encounters>



Group picture of “Barcelona Postgrad Encounters on  
Fundamental Physics” at the Physics Faculty, UB

#### **Paredes, J.M.; Bosch-Ramon, V.; Ribó, M.; Munar- Androver, P.; Marcote, B.; Paredes-Fortuny, X.; Frutos, A.**

Members of the local organizing committee  
International workshop “Exploring the Non-thermal  
Universe with Gamma Rays “  
Faculty of Physics, UB  
06/11/2012 - 09/11/2012  
<http://icc.ub.edu/congress/FAA60>

#### **Paredes, J.M.; Bosch-Ramon, V.**

Members of the organizing committee  
International workshop  
“Exploring the Non-thermal Universe  
with Gamma Rays “  
Faculty of Physics, UB  
06/11/2012 - 09/11/2012  
<http://icc.ub.edu/congress/FAA60>

**Paredes, J.M.**

President of the Scientific Committee  
International workshop  
“Exploring the Non-thermal Universe  
with Gamma Rays “  
Faculty of Physics, UB  
06/11/2012 - 09/11/2012  
<http://icc.ub.edu/congress/FAA60>



FAA60 session at the Physics Faculty, UB

**Paredes, J.M.**

Chair of the panel  
“XMM-Newton B2 panel  
meeting for the AO-12 review”  
Dept. Astronomia i Meteorologia, UB  
12/11/2012-14/11/2012

**Mescia, F.; Espriu, D.**

Organizers  
National meeting  
“12a Trobada de Nadal de Física Teòrica”  
Faculty of Physics, UB  
19/12/2012 - 20/12/2012  
<http://www.ecm.ub.es/~mescia/2012>

**Salvador, E.; Graciani, R.**

Organizers  
National conference “Iniciativa SATLANTIS”  
Antoni Caparrós Auditorium, PCB  
21/12/2012  
<http://icc.ub.edu/congress/SATLANTIS>

**At other institutions****Gómez, G.**

Member of the organizing committee  
International conference “1st IAA Conference on  
Dynamics and Control of Spacecrafts”  
Hotel HF Ipanema Porto (Portugal)  
19/03/2012 - 21/03/2012  
<http://www.astrodynamics.org.pt/index.html>

**Jordi, C.**

President of the organizing committee  
National meeting  
“La contribución de las ICTS españolas a la misión Gaia de  
ESA. Reunión abierta de la RIA conjunta de La contribución  
de las ICTS españolas a la misión Gaia de ESA  
CDTI (Madrid, Spain)  
21/03/2012 - 23/03/2012  
<https://gaia.am.ub.es/Twiki/pub/RecGaia/RiaICTS/RIA-Gaia-Conclusiones.pdf>

**Figueras, F.**

President of the organizing committee  
National meeting  
“La contribución de las ICTS españolas a la misión Gaia de  
ESA. Reunión abierta de la RIA conjunta de La contribución  
de las ICTS españolas a la misión Gaia de ESA”  
CDTI (Madrid, Spain)  
21/03/2012 - 23/03/2012  
<https://gaia.am.ub.es/Twiki/pub/RecGaia/RiaICTS/RIA-Gaia-Conclusiones.pdf>

**Graugés, E.**

Member of the organizing committee  
“XL International Meeting on Fundamental Physics”  
Centro de Ciencias de Benasque Pedro Pascual  
(Huesca, Spain)  
24/05/2012 - 03/06/2012  
<http://benasque.org/2012imfp/>

**Jordi, C.**

Member of the organizing committee  
“The metallicity distribution in the Milky Way discs  
(Bologna, Italia) “  
University of Bologna  
29/05/2012 - 31/05/2012  
<http://www.bo.astro.it/great-esf-gradient/>

**Torra, J.**

Member of the organizing committee  
International meeting  
“DPAC. CU3 meeting 2012”  
ESA (Vilanova de Gaia, Portugal)  
13/06/2012 -15/06/2012  
[http://www.rssd.esa.int/wikiSI/index.php?instance=Gai&a&title=CU3:Core\\_Processing:Meetings:CU3M7](http://www.rssd.esa.int/wikiSI/index.php?instance=Gai&a&title=CU3:Core_Processing:Meetings:CU3M7)

**Jordi, C.**

Member of the organizing committee  
“EWASS 2012: Gaia Research for  
European Astronomy Training “

Pontificia Università Lateranense  
(Roma, Italy)  
04/07/2012 - 06/07/2012  
<http://www.ifs-roma.inaf.it/ewass2012/>

**Jordi, C.**

Member of the organizing committee  
“X Reunión Científica de la Sociedad  
Española de Astronomía”  
University of Valencia (Spain)  
09/07/2012 - 13/07/2012  
<http://www.sea-astronomia.es/drupal/SEA2012>

**Paredes, J.M.**

President of the organizing committee  
“5th International Symposium on High-Energy  
Gamma-Ray Astronomy (Gamma2012)”  
Max-Planck-Institut für Kernphysik  
(Heidelberg, Germany)  
09/07/2012 - 13/07/2012  
[http://www.mpi-hd.mpg.de/hd2012/  
pages/news.php](http://www.mpi-hd.mpg.de/hd2012/pages/news.php)

**Peñaranda, S.**

International workshop  
“Latinoamerican Workshop on High Energy Physics:  
Particles and Strings”  
La Habana, Cuba  
15/07/2012 – 21/07/2012  
<http://dftuz.unizar.es/whepcuba2012/overview>

**Solà, J.**

Co-organizer and member of the International Committee  
IIRGAC 2012: III International Conference on Quantum Theories  
and Renormalization Group in Gravity and Cosmology”  
Paraty, Brasil  
29/07/2012 - 03/08/2012  
<https://sites.google.com/site/3rdirgac/>

**Jordi, C.**

Member of the organizing committee  
“IAU Simposio 289 ‘Advancing the physics of cosmic  
distances’ en la XXVIII Asamblea General de la IAU”  
IAU General Assembly, National Convention Centre  
(Beijing, China)  
27/08/2012 - 31/08/2012  
<http://www.mporzio.astro.it/IAUS289/www/Home.html>

**Luri, X.**

Member of the organizing committee  
International workshop  
“Gaia Astro-Visualisation School”  
Astronomy Department, University of Washington  
(Seattle, USA)  
14/09/2012 - 18/09/2012  
[http://great.ast.cam.ac.uk/Greatwiki/GreatItn/  
VizSchoolSep2012](http://great.ast.cam.ac.uk/Greatwiki/GreatItn/VizSchoolSep2012)

## Public Outreach

### Outreach Events

#### Talks

**“El nostre lloc a l’espai”**

Speaker: Carrasco, J.M.  
Faculty of Physics, UB  
Date: 10/01/12

**“Xerrada sobre astronomia”**

Speaker: Carrasco, J.M.  
IES Jaume Salvador i Pedrol  
(Sant Joan Despí)  
Date: 30/01/12

**“Pensant l’Univers”**

Speaker: Carrasco, J.M.

IES Jaume Salvador i Pedrol (Sant Joan Despí)  
Date: 30/01/12

**“Com neixen, viuen i moren les estrelles”**

Speaker: Jordi, C.  
Club Muntanyenc Sant Cugat  
Date: 20/02/12

**“Estem sols a l’Univers?”**

Speaker: Solanes, J.M.  
Associació Dones d’Ara (La Garriga, Barcelona)  
Date: 22/02/12

**“Xerrada sobre relativitat”**

Speaker: Luri, X.  
Col·legi major Ramon-Llull (Barcelona)  
Date: 06/03/12

***“Passat, present i futur del nostre Sol”***

Speaker: Jordi, C.  
Aules d'extensió universitària (Sabadell)  
Date: 12/03/12

***“El trànsit de Venus”***

Speaker: Carrasco, J.M.  
INS Montmeló (Barcelona)  
Date: 11/04/12

***“Neutrins superlumínics i relativitat”***

Speaker: Luri, X.  
Date: 07/05/12

***“Un viatge al centre de la Via Làctia”***

Speaker: Jordi, C.  
Associació Astronòmica Valldoreix-Sant Cugat  
Date: 24/05/12

***“La missió Gaia: Composició, estructura i evolució de la nostra Galàxia”***

Speaker: Portell, J.  
Universitat Catalana d'Estiu de la Natura (UCEN, Berga)  
Date: 13/06/12

***“Xerrada sobre astronomia”***

Speaker: Luri, X.  
Ajuntament de Barcelona, Festa de la ciència al parc de la Ciutadella  
Date: 16/06/12

***“Cosmogènesi: l'origen de l'univers”***

Speaker: Solanes, J.M.  
Pavelló de Suècia (Berga)  
Date: 13/07/12

***“Les distàncies còsmiques”***

Speaker: Jordi, C.  
Ajuntament de Sant Cugat  
Date: 15/09/12

***“Un gra de sorra a la platja còsmica”***

Speaker: Luri, X.  
Parc Astronòmic Montsec (Àger, Lleida)  
Date: 20/10/12

***“Gaia, observant a un milió i mig de quilòmetres”***

Speaker: Torra, J.  
Parc Astronòmic Montsec (Àger, Lleida)  
Date: 21/10/12

***“La missió Gaia”***

Speaker: Carrasco, J.M.  
Agrupació astronòmica ÀSTER  
Date: 15/11/12

***“La Galàxia en un petabyte”***

Speaker: Portell, J.  
Parc Astronòmic Montsec (Àger, Lleida)  
Date: 17/11/12

***“Gaia mira amb mil milions d'ulls”***

Speaker: Jordi, C.  
Parc Astronòmic Montsec (Àger, Lleida)  
Date: 18/11/12

***“El telescopi Fabra-ROA Montsec (TFRM): un instrument per a la cerca d'escombraries espacials, exoplanetes, NEOs, i fonts d'alta energia”***

Speaker: Núñez, J.  
Societat Catalana de Física,  
Cicle Física Oberta 2012-2013  
Date: 20/11/12

***“Cada estrella és un món: de l'infantesa a la mort”***

Speaker: Figueras, F.  
Parc Astronòmic Montsec (Àger, Lleida)  
Date: 01/12/12

***“El Sistema Solar i altres planetes atrapats per estrelles”***

Speaker: Masana, E.  
Parc Astronòmic Montsec (Àger, Lleida)  
Date: 02/12/12

***“Visita d'un astrònom a les classes ‘La Lluna’ i ‘Les estrelles’”***

Speaker: Carrasco, J.M.  
CEIP Baldiri i Reixac (Badalona)  
Date: 13/12/12

***“La Galàxia en un petabyte”***

Speaker: Portell, J.  
Agrupació Astronòmica d'Osona (Vic)  
Date: 15/12/12

***“El trànsit de Venus 2012 i la mida del Sistema Solar”***

Speaker: Jordi, C.  
Aules de la gent gran de la UB  
Date: February 2012

**“Naixement, vida i mort de les estrelles”**

Speaker: Jordi, C.  
Centre Cívic de Torre Llobeta (Barcelona)  
Date: March 2012

**“Un viatge al centre de la Galàxia”**

Speaker: Jordi, C.  
Centre Cívic de Torre Llobeta (Barcelona)  
Date: October 2012

**“The Sun and the Heliospheric Physics and Space Weather Group of the University of Barcelona”**

Speaker: Rodríguez, R.  
Participation in the project “Joves i Ciència” of Catalunya-Caixa  
Date: 2012

**Exhibitions**

**“Amb A d’Astrònoma”**

ICCUB Organizers: Olarte, B.; Figueras, F.; Jordi, C.; Balaguer, M.D.

*Places:*

- Centre Dolors Piera d’Igualtat d’Oportunitats i Promoció de les Dones, (Lleida)  
1-30 March 2012
- Casal Font d’en Fargues (Barcelona)  
18/04/2013-15/05/2013
- Casa de la Dona (Quart de Poblet, València)  
November 2012

**“Les distàncies còsmiques”**

ICCUB Organizers: Olarte, B.; Figueras, F.; Jordi, C.; Balaguer, M.D.  
*Places:*

- Parc Astronòmic Montsec (Àger, Lleida)  
29/08/2012-31/08/2012
- Ajuntament de Sant Cugat (Sant Cugat, Barcelona)  
15/09/2012-30/09/2012
- Institut Lluís Vives (Barcelona)  
16/11/2012-25/11/2012



**“De la Terra a l’Univers”**

ICCUB Organizers: Olarte, B.; Figueras, F.; Jordi, C.; Balaguer, M.D.

*Places:*

- Museu Palau Mercader (Cornellà de Llobregat)  
30/09/2012-25/11/2012



## Workshops and Schools

### “Taller de Física de Partícules”

Masterclass for High School Students

Date: 7 and 13 March 2012

Organization: ICCUB

ICCUB Participants: Garrido, Ll., Graciani, R.; Graugés, E.; Rives, V.; Ruiz, H. Vázquez, R.

### “Physis 2012’, Quart campus d’estiu de Física per a estudiants de Batxillerat”

Summer Course

Date: 18/06/12-22/06/12

Place: Facultat de Física

Organization: Physics Faculty, University of Barcelona

ICCUB Participants: Solanes, J.M.; Carrasco, J.M.

### “Experiments de Física”

Laboratory sessions

Date: 23/01/12-03/02/12

Place: Facultat de Física

Organization: Physics Faculty, University of Barcelona

ICCUB Participants: Carrasco, J.M.; Viñas, J.; Udina, M.; Fortuny, D.; Moldón, J.; Roca, S.

### “Un cop d’ull a l’Univers”

Summer Course

Date: 08/07/12-10/07/12

Place: Centre d’Observació de l’Univers, Àger

Organization: University of Lleida

ICCUB Participants: Carrasco, J.M.

## Astronomy Sessions

### “Observació del Sol”,

Speaker: Carrasco, J.M.

Date: 2012/02/03

Place: Facultat de Física, UB (Barcelona)

### “Nit d’astronomia a les caves Nadal”

Speaker: Carrasco, J.M.; Vilella, G.

Dates: 2012/03/03

Place: Caves Nadal surroundings

### “Observació popular del trànsit de Venus per serviastro.am.ub.es des del castell de Montjuic de Barcelona”

Speaker: Carrasco, J.M.

Dates: 06/06/2012

Place: Castell de Montjuic (Barcelona)

### “Nit d’astronomia i estels al parc natural de Montserrat”

Speaker: Romero, M.; Monguió, M.

Dates: 2012/07/21

Place: Parc de Montserrat (Collbató)

### “Observació popular”

Speaker: Carrasco, J.M.

Dates: 2012/07/27

Place: La Pobla de Cèrvoles

### “Observació del Sol en el marc de la II Festa dels Amics de l’Hospital Sant Joan de Déu”

Speaker: Monguió, M.; Masana, E.

Dates: 22/09/12

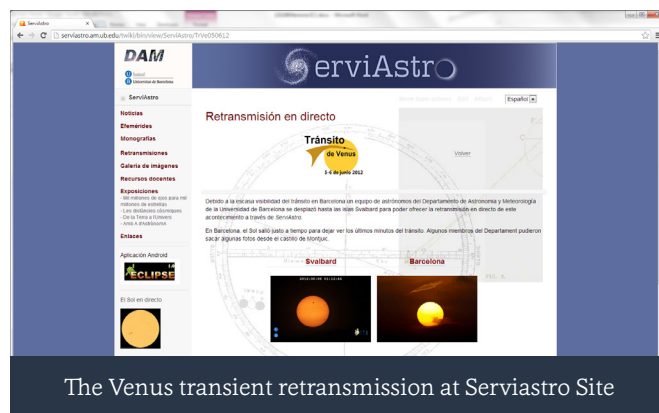
Place: Palau Robert (Barcelona)

## Other events

### Venus transit online retransmission from Svalbard Islands (Norway)

Date: 5-6/06/2012:

ICCUB Organizers: Balaguer, L.; Jordi, C.; Masana, E.



The Venus transient retransmission at Serviastro Site

## Printed and Electronic Media

### Press releases

#### “S’identifica el moment d’explosió de material en un forat negre”

Date: 11/01/12

Authors: Bonmatí, B.; Migliari, S.

[http://www.ub.edu/web/ub/ca/menu\\_eines/noticies/2012/01/014.html](http://www.ub.edu/web/ub/ca/menu_eines/noticies/2012/01/014.html)

#### “L’observació de l’Univers permet precisar el límit de la massa dels neutrins”

Date: 12/01/2012



Authors: Bonmatí, B.; De Putter, R.  
[http://www.ub.edu/web/ub/ca/menu\\_eines/noticies/2012/01/018.html](http://www.ub.edu/web/ub/ca/menu_eines/noticies/2012/01/018.html)

***“Article a ‘Nature’ sobre l’origen de les supernoves de tipus Ia”***

Date: 13/01/2012

Authors: Bonmatí, B.; Ruiz-Lapuente, P.  
[http://www.ub.edu/web/ub/ca/menu\\_eines/noticies/2012/01/023.html](http://www.ub.edu/web/ub/ca/menu_eines/noticies/2012/01/023.html)

***“Es posa en marxa el projecte Spacecast per pronosticar el temps espacial”***

Date: 12/03/2012

Authors: Bonmatí, B.; Àgueda, N.; Aran, À.; Sanahuja, B.  
[http://www.ub.edu/web/ub/ca/menu\\_eines/noticies/2012/03/032.html](http://www.ub.edu/web/ub/ca/menu_eines/noticies/2012/03/032.html)

***“Escolars d’arreu de Catalunya preparen el proper trànsit de Venus amb activitats elaborades per la UB”***

Date: 22/05/2012

Authors: Bonmatí, B.; Balaguer, D.; Jordi, C.; Massana, E.; Olarte, B.  
[http://www.ub.edu/web/ub/ca/menu\\_eines/noticies/2012/05/078.html](http://www.ub.edu/web/ub/ca/menu_eines/noticies/2012/05/078.html)

***“La Universitat de Barcelona i el Parc Astronòmic del Montsec retransmetran des de Noruega, en directe, el darrer trànsit de Venus d’aquest segle”***

Date: 05/06/2012

Authors: Bonmatí, B.; Balaguer, D.; Jordi, C.; Massana, E.; Olarte, B.  
[http://www.ub.edu/web/ub/ca/menu\\_eines/noticies/2012/06/001.html](http://www.ub.edu/web/ub/ca/menu_eines/noticies/2012/06/001.html)

***Crònica del trànsit de Venus des de Noruega***

Date: 06/06/2012

Authors: Bonmatí, B.; Balaguer, D.; Jordi, C.; Massana, E.; Olarte, B.  
[http://www.ub.edu/web/ub/ca/menu\\_eines/noticies/2012/06/018.html](http://www.ub.edu/web/ub/ca/menu_eines/noticies/2012/06/018.html)

***“UB’s lecturer Licia Verde, one of the recipients of the 2012 Gruber Cosmology Prize”***

Date: 22/06/2012

Authors: Bonmatí, B.; Salvador, E.  
[http://www.ub.edu/web/ub/en/menu\\_eines/noticies/2012/06/071.html](http://www.ub.edu/web/ub/en/menu_eines/noticies/2012/06/071.html)

***“Descobreixen la causa del fenomen estel·lar més brillant de la història, la supernova de l’any 1006”***

Date: 27/09/12

Authors: Bonmatí, B.; Ruiz-Lapuente, P.  
[http://www.ub.edu/web/ub/en/menu\\_eines/noticies/2012/09/049.html](http://www.ub.edu/web/ub/en/menu_eines/noticies/2012/09/049.html)

***“L’ESA presenta la missió Gaia, en la qual participen 30 investigadors de la UB”***

Date: 23/10/12

Authors: Bonmatí, B.; GAIA group  
[http://www.ub.edu/web/ub/ca/menu\\_eines/noticies/2012/10/096.html](http://www.ub.edu/web/ub/ca/menu_eines/noticies/2012/10/096.html)

***“Presentació de la participació espanyola en la missió Gaia”***

Date: 30/10/12

Authors: Bonmatí, B.; GAIA group  
[http://www.ub.edu/web/ub/ca/menu\\_eines/noticies/2012/Fotonoticies/10/018.html](http://www.ub.edu/web/ub/ca/menu_eines/noticies/2012/Fotonoticies/10/018.html)

***“An international team of astronomers measures the Universe’s deceleration before dark energy took over”***

Date: 13/11/2012

Authors: Bonmatí, B.; Miralda, J.; SLOAN Collaboration  
[http://www.ub.edu/web/ub/en/menu\\_eines/noticies/2012/11/034.html](http://www.ub.edu/web/ub/en/menu_eines/noticies/2012/11/034.html)

***Publications in press***

From press release ***“S’identifica el moment d’explosió de material en un forat negre”***:

11/01/2012, Sinc (Electronic press), “Identificado el momento en que explosiona material en un agujero negro”.

11/01/2012, La Vanguardia.com (Electronic press), “Identificado el momento de la explosión de material de un agujero negro”.

11/01/2012, El Mercurio Digital (Electronic press), “Identifican el momento en que explota material en un agujero negro”.

11/01/2012, El Imparcial (Electronic press), “Identificado el momento de la explosión de material de un agujero negro”.

13/01/2012, Universia (Electronic press), “Se identificó el momento en que explosiona material en un agujero negro”.

From press release ***“L’observació de l’Univers permet precisar el límit de la massa dels neutrins”:***

13/01/2012, El Punt Avui (Press), “Experts del CSIC calculen la massa dels neutrins”.

12/01/2012, SINC (Electronic press), “Los tres neutrinos juntos tienen una masa dos millones de veces menor que el electrón”.

12/01/2012, La Vanguardia.com (Electronic press), “Investigadores obtienen el límite más preciso hasta la fecha de la masa de los neutrinos observando el Universo”.

From press release ***“Es posa en marxa el projecte Spacecast per pronosticar el temps espacial”:***

12/03/12, elPeriódico.cat (Electronic press), “Es posa en marxa el projecte Spacecast per al pronòstic del temps espacial”.

12/03/2012, La vanguardia.com (Electronic press), “La peor tormenta solar de la historia causaría ahora 22.860 millones de pérdidas”.

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- From press release “**An international team of astronomers measures the Universe’s deceleration before dark energy took over**”:
- BBC Mundo (Electronic press), “Un mapa en 3D para explorar la historia del Universo”.

## **Audiovisual Media**

### **“La misión Gaia: participación española”**

Video-documental about the Gaia satellite.  
Script, interviews and 3D animations by: Luri, X.; Czekaj, M.; Carrasco, J.M.; Jordi, C.; Figueras, F.; Torra, J.

### **Cartoon serial by DeBoom Studio**

Colaboration as scientific adviser  
Luri, X.

## Radio and Television

### “Calendaris”

With the participation of Luri, X.  
Program: InfoNit (Barcelona TV)  
Date: 29/02/2012

### “Tempesta solar del 24 de gener de 2012”

With the participation of Sanahuja, B.  
Date: 2012/01/26

### “L'activitat solar durant el 2012”

With the participation of Sanahuja, B.  
Date: 21/01/2012

### “Activitat solar i temps espacial”

With the participation of Sanahuja, B.  
Program: Notícies de les 10 (BTV)  
Date: 23/01/2012 <http://www.btv.cat/alacarta/informatius/13470>

### “L'activitat solar el 7 de març de 2012”

With the participation of Sanahuja, B.  
Program: El matí de Catalunya Ràdio (Catalunya Radio)  
Date: 07/03/2012  
<http://www.catradio.cat/audio/617867/El-Sol-estaentrant-en-un-periode-dactivitat-que-pot-tenir-repercussions-en-el-nostre-entorn>

### “El trànsit de Venus”

With the participation of Carrasco, J.M.,  
Program: Extraradi (COM Radio)  
Date: 05/06/2012 [http://www.am.ub.edu/twiki/pub/ServiAstro/MitjansInformacio050612/extraradi\\_050612\\_JMC\\_TransitVenus.mp3](http://www.am.ub.edu/twiki/pub/ServiAstro/MitjansInformacio050612/extraradi_050612_JMC_TransitVenus.mp3)

### “El trànsit de Venus”

With the participation of Carrasco, J.M.  
Program: Connexió Barcelona (BTV)  
<http://www.btv.cat/alacarta/connexio-barcelona/19002/>



### “El trànsit de Venus”

With the participation of Carrasco, J.M.  
Program: La Sexta - Notícies  
Date: 05/06/2012

### “El trànsit de Venus”

With the participation of Carrasco, J.M.  
Program: 8 al dia amb Josep Cuní (BTV)  
Date: 06/06/2012 <http://www.8tv.cat/8aldia/videos/per-a-que-seveixi-lobservacio-del-transit-de-venus-entre-el-sol-i-la-terra>



## Web Pages

### Serviaastro Site

<http://serviaastro.am.ub.edu>  
Authors: Balaguer, L.; Jordi, C.; Masana, E.; Olarte, B.

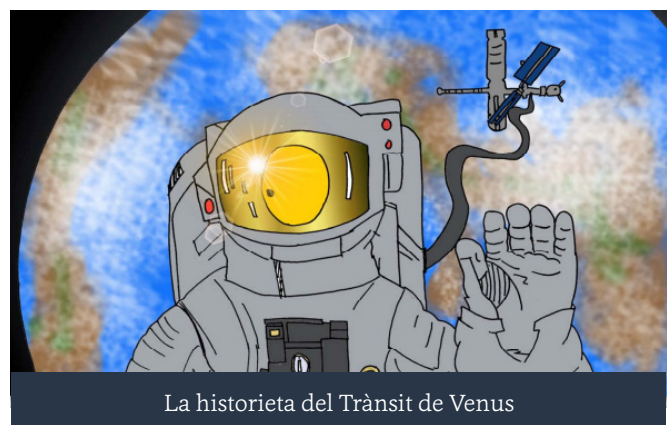
### Descobrint LHC

<http://www.lhc.cat/>  
Authors: Frutos, A.; Ruiz, H

## Pedagogical Material

### “La Historieta del Trànsit de Venus”

Online publication  
Author: Carrasco, J.M.  
[http://serviaastro.am.ub.edu/twiki/pub/ServiAstro/TrVe/Historieta\\_cat3\\_A4.pdf](http://serviaastro.am.ub.edu/twiki/pub/ServiAstro/TrVe/Historieta_cat3_A4.pdf)



## **“Trànsit de Venus 2012”**

Poster

Author: Olarte, B.

**Svalbard**  
Trànsit de Venus  
14 de juny de 2012

# TRÀNSIT DE VENUS

5-6 de juny de 2012  
El segon i últim trànsit d'aquest segle del planeta Venus per davant del Sol

Un grup d'astrònoms es va desplaçar a Longyearbyen, a les illes Svalbard (Noruega, latitud 78°N) on el Sol és visible les 24h del dia al mes de juny, per observar el trànsit de Venus. Aquest fenomen tant infreqüent no era visible en la seva totalitat des de Catalunya.

| Localitat           | Latitud | Longitud | Horari        |
|---------------------|---------|----------|---------------|
| Longyearbyen (78°N) | 78°N    | 15°E     | 06:00 - 23:00 |
| Umanak (74°N)       | 74°N    | 51°W     | 06:00 - 23:00 |
| Upernivik (72°N)    | 72°N    | 23°W     | 06:00 - 23:00 |
| Qaanaaq (71°N)      | 71°N    | 17°W     | 06:00 - 23:00 |
| Umanak (74°N)       | 74°N    | 51°W     | 06:00 - 23:00 |
| Upernivik (72°N)    | 72°N    | 23°W     | 06:00 - 23:00 |
| Qaanaaq (71°N)      | 71°N    | 17°W     | 06:00 - 23:00 |
| Umanak (74°N)       | 74°N    | 51°W     | 06:00 - 23:00 |
| Upernivik (72°N)    | 72°N    | 23°W     | 06:00 - 23:00 |
| Qaanaaq (71°N)      | 71°N    | 17°W     | 06:00 - 23:00 |

**El trànsit des de les illes Svalbard**

**Els últims minuts del trànsit des de Barcelona**

<http://venus2012.ub.edu>

Poster of the transit of Venus

## **Other Public Outreach Activities**

### **“Comprender la Física que nos rodea.”**

Solanes, J.M.

Programa “Campus Científicos de Verano” for high school students, by FECYT and ME

### **“Posta en marxa del FaceBook de la Sociedad Española de Astronomía “**

Luri, X.

### **“La distància Terra-Sol”**

Masana, E.

<http://www.am.ub.edu/twiki/bin/view/ServiAstro/DistanciaTerraSol050612>

### **“La mida del Sol “**

Carrasco, J.M.

<http://www.am.ub.edu/twiki/bin/view/ServiAstro/MidaSol050612>

### **“La mida del Sistema Solar”**

Masana, E.

<http://www.am.ub.edu/twiki/bin/view/ServiAstro/MidaSistemaSol050612>

### **“La distància a una estrella “**

Jordi, C.

<http://www.am.ub.edu/twiki/bin/view/ServiAstro/DistanciaEstrella050612>

# FUNDING

## ICCUB Budget

| <i>Type of Income</i>         | <i>Amount</i>       |
|-------------------------------|---------------------|
| Contract Program UB 2011-2012 | 68.071,04 €         |
| Manager joint financing       | 22.970,26 €         |
| IEEC Overheads                | 18.101,94 €         |
| <b>TOTAL</b>                  | <b>109.143,24 €</b> |

## Group Project Funding

| <i>Type of Income</i> | <i>Amount</i>      |
|-----------------------|--------------------|
| National Projects     | 1.860.166 €        |
| European Projects     | 1.074.959 €        |
| Complementary Actions | 8.220 €            |
| Contracts             | 51.680 €           |
| Consolidated Groups   | 45.321 €           |
| Other Grants          | 51.906 €           |
| <b>TOTAL</b>          | <b>3.092.252 €</b> |

## ICCUB Expenses

| <i>Type of Income</i>                     | <i>Contract Program UB</i> | <i>IEEC</i>     | <i>Total</i>     |
|---|----------------------------|-----------------|------------------|
| Personnel                                 | 74.204 €                   | 14.641 €        | 88.845 €         |
| Maintenance / Infrastructures / Inventory | 786 €                      | 211 €           | 997 €            |
| Expendable                                | 2.842 €                    | 1.978 €         | 4.820 €          |
| External Colloquia                        | 2.673 €                    | 1.148 €         | 3.821 €          |
| Workshop Aids                             | 403 €                      | 0 €             | 403 €            |
| Travels                                   | 271 €                      | 0 €             | 271 €            |
| Outreach                                  | 0 €                        | 124 €           | 124 €            |
| Other                                     | 9.862 €                    | 0 €             | 10.814 €         |
| <b>TOTAL</b>                              | <b>91.041 €</b>            | <b>18.102 €</b> | <b>109.143 €</b> |



