Preface

The Symposium DISCRETE’08 on Prospects in the Physics of Discrete Symmetries was held at the Instituto de Física Corpuscular (IFIC) in Valencia, Spain from 11 to 16 December 2008. IFIC is a joint centre of the Consejo Superior de Investigaciones Científicas (CSIC) and the Universitat de València (UVEG).

The aim of the Symposium was to bring together experts on the field of Discrete Symmetries in order to discuss its prospects on the eve of the LHC era. The general state of the art for CP, T and CPT symmetries was reviewed and their interplay with Baryogenesis, Early Cosmology, Quantum Gravity, String Theory and the Dark Sector of the Universe was emphasised. Connections with physics beyond the Standard Model, in particular Supersymmetry, were investigated. Experimental implications in current and proposed facilities received particular attention.

The scientific programme consisted of 24 invited Plenary Talks and 93 contributions selected among the submitted papers. Young researchers, in particular, were encouraged to submit an abstract. The Special Lecture on “CERN and the Future of Particle Physics”, given by the CERN Director General Rolf-Dieter Heuer to close the Symposium, was of particular relevance. On the last day of the Symposium, an open meeting took place between Professor Heuer and the Spanish community of particle physics.

The Symposium covered recent developments on the subject of Discrete Symmetries in the following topics:

- Quantum Vacuum
- Entanglement, Symmetrisation Principle
- CPT in Quantum Gravity and String Theory, Decoherence, Lorentz Violation
- Ultra-high-energy Messengers
- Time Reversal
- CP violation in the SM and beyond
- Neutrino Mass, Mixing and CP
- Baryogenesis, Leptogenesis
- Family Symmetries
- Supersymmetry and other searches
- Experimental Prospects: LHC, Super-B Factories, DAΦNE-2, Neutrino Beams

The excellence of most of the presentations during the Symposium was pointed out by many participants. The broad spectrum of topics under the guideline of Symmetry and Symmetry Breaking was an added value to the interest of such an event. The Symposium was attended by 160 participants, among which 63 from Spain, 77 coming from the rest of Europe, 10 from USA and 10 from the rest of the world.

The Symposium started with a welcome address by Dr. Vasiliki Mitsou, Co-Chair of the Organising Committee, and Professor Francisco J. Botella, Director of IFIC. The scientific plenary sessions started with a discussion on the search for Time Reversal Violation, independent of CP and/or CPT symmetries, by Helen Quinn. Related to this important subject, David Wark made a presentation of the state of the art in the measurement of Electric Dipole Moments. The
status and prospects of CP-violation Experiments was reviewed by Tatsuya Nakada, whereas Andrzej Buras made a comprehensive discussion on the search for New Physics with Rare Decays and CP Violation. The implications for Cosmology were presented by Mikhail Shaposhnikov with a talk on Baryogenesis. The pending understanding of the Flavour Problem was discussed by Graham G. Ross in his presentation on Family Symmetries. Going beyond the paradigm imposed by local quantum field theories, Nikolaos Mavromatos described the scenario of CPT Violation and Decoherence in Quantum Gravity. Antonio Di Domenico presented the status on the search for CPT Violation and Decoherence in the Neutral Kaon System and José L. F. Barbón covered the territory of Strings, Symmetry and Holography. The problem of the Quantum Vacuum was addressed by Mariano Quirós in his presentation on the nature of the Electroweak Higgs sector. In Cosmology, Pierre Binetruy treated the fascinating question of the possible concepts to explain the Dark Energy in the Universe. On the theme of High Energy Messengers from the Cosmos, Graciela Gelmini presented the solved and unsolved questions associated with the High Energy Cosmic Rays, Manel Martínez discussed methods to study Fundamental Physics with Cosmic Gamma Rays and Francis Halzen gave the present status of High Energy Neutrino Astronomy and the projects towards Km3-scale cosmic neutrino Underwater Detectors. On Neutrino Physics, Niki Saoulidou reviewed its present status and the experimental prospects, Peter Minkowski discussed the proposals to understand the Origin of Neutrino Mass and Apostolos Pilaftsis made a Little Review on the implications of global Lepton Number Violation with neutrino Majorana mass for Leptogenesis in the Universe. The interplay of Dark Matter studies with the search for SUSY at LHC was discussed by Antonio Masiero, whereas Athanasios Lahanas presented Dark Matter in the eye of CP-violating SUSY theory. On the Experimental Prospects frontier, André Rubbia discussed Underground Detectors for Particle and Astroparticle Science, Daniel Froidevaux gave a stimulating review on the Physics to be expected at LHC, Marcello A. Giorgi examined the Future of SuperFlavour Factories as complementary to LHCb and Mats Lindroos presented the options for the Ultimate Neutrino Beam(s), able to discover and measure CP Violation in neutrino oscillations.

In the Parallel Sessions, the contributions selected for oral presentation during the Symposium were well balanced covering all aspects of Discrete Symmetries. They are reproduced in the present Proceedings distributed according to the various topic-specific sessions in which they were presented. The papers published here have, in addition, passed positively the refereeing system defined by the members of the Organising Committee of the DISCRETE’08 Symposium.

The DISCRETE’08 Symposium was the first in a series of biannual events on the general topic of Symmetries. The next symposium will be organised by the University of La Sapienza, Rome, Italy, in the autumn of 2010.

Statement of Peer Review
All papers published in this volume of Journal of Physics: Conference Series have been peer reviewed through processes administered by the Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

Valencia, April 2009

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Official Inauguration

On the evening of December 11\textsuperscript{th}, the official Opening of the Symposium took place in the Paraninfo inside the Historical Building of the University of Valencia “La Nau”. The Paraninfo was historically the Academic Theatre where the meetings of Professors took place, with the debates in Latin and Greek, the two academic languages, from its two Chairs. It has provided the scenario for historical events and, at present, it is devoted to celebrate solemn academic sessions.

The inauguration of the Symposium started with a welcome address by Prof. José Bernabéu, Chair of the Organising Committee, and the introduction to the participants of the other members of the Presidential Table: Professor Francisco Tomás, Rector of the University, Professor Vicente Bellver, Director General of Scientific Policy in the Generalitat Valenciana, Professor Esteban Morcillo, Vice Rector of Research in the University and Dr. Vasiliki Mitsou, Co-chair of the Organising Committe. The session continued with an Inaugural Speech by the Director General and finished with the Official Opening by the Rector. These two presentations are reproduced here:

\textit{Inaugural Speech by the Director General of Scientific Policy in the Department of Education of the Generalitat Valenciana, Prof. Vicente Bellver Capella}

Dear Chancellor,
Dear Vice-Chancellor,
Professor Bernabéu,
Dr. Mitsou,
Ladies and Gentlemen,

It is a pleasure to share with you this Opening Session of the Symposium on Prospects in the Physics of Discrete Symmetries acting on behalf of the regional government of Valencia.

The regional government, through its Department of Education, is a public body that provides support to research activities in our region and hence we are glad that experts from all around the world have come to Valencia to discuss about Discrete Symmetries. New and promising prospects arise for the field from the Large Hadron Collider. The worldwide particle physics community is about to sail on a voyage into a New World. The LHC will take you into new realms of energy, space, time, and symmetry.

I have been told that supersymmetry is, perhaps, the most expected of the surprising discoveries that you may hope to find at the LHC. I do hope you find your squarks, gluinos, and even your photinos.

Many of you have come from far away. Let me tell you a few words our science and research policies. With our quite limited budget, the Autonomous Secretariat of University and Science holds all kinds of different programs to support the different steps and needs of the researchers of our region.

Hence our programs range from the studentships for young graduates wishing to become a doctor, to the “Santiago Grisolía” Program, a program of studentships for foreign students wishing to do their research with our groups for a period of two years.

From relatively small project programs for young doctoral researchers, to the Prometeo Program, the programs are designed to provide our best researchers and groups with enough resources to hold their status as world-wide referents on their fields.

In parallel with these actions we hold other important programs designed to enhance the interaction of our researchers with other research groups.

As you can see, we try to cover the needs of the researchers of our region from the beginning to the top of their careers in order to keep the Comunitat Valenciana as a European region that actively supports state-of-the-art research on different and strategic areas.
I want to warmly thank Professor Bernabéu and Dr. Mitsou, and all the team that has arranged this meeting for your effort and your wonderful results. The regional government feels proud of these kind of academic initiatives and of the University of Valencia, our five times centenary university, that host the event.

Last but not least, I would like to welcome you all to our Comunitat Valenciana and to Valencia. I hope you not only take advantage of the Symposium but also enjoy the city.

Thank you very much for your attention.

Official Opening by the Rector of the Universitat de València, Prof. Francisco Tomás Vert

Director General of Scientific Policy of Valencian Generalitat,

Welcome to the University of Valencia!

The University of Valencia is more than 500 years old. It was founded officially in 1499 under the name of “General Study” and it is one of the most important universities in Spain. It appears among the four best Spanish universities according to the most recognized international rankings.

At present, our University has three main Campus, associated with Humanities and Medicine, Social Studies and Science. As you know, the Faculties of Sciences and the Scientific Parc, where this important Symposium is hosted, reside in the Campus of Burjassot-Paterna. In it, you may find Research Institutes as well as technological companies, either external or developing spinoff of the University itself. The University offers wireless connections throughout its premises, e-mail services for all the students and laboratories, Language Centre and sport facilities. The most important ceremonies and celebrations take place in this site: the Historical Building of the University.

The roots of the University of Valencia state in the XIII century. The Valencian Jury paved the way for the unification of these separate studies in a unique “General Study” with statutes published in 1412 and approved by the municipal government. The prosperous Valencian society of the XV century, the Valencian Golden Century, had the objective to reach the category of a city with university studies and in 1493 this building was raised to house the University. The Constitution of the General Study appeared in 1499 and the licence for University activities was given by the Pope Alexander VI in 1501, with similar rights as the Universities of Bologna, Rome and Salamanca.

The total number of students of the University is now about 57 000, the biggest of the seven universities that exist in the Valencian Community. They pursue their activity in 63 different studies. We have around 3300 professors and researchers and 1700 members in Administration and Services.

The University of Valencia is among the four best Spanish Universities in Research and Development with 18 Research Institutes. Three Institutes form Joint Centres with the Spanish Research Council, IFIC, as you know, is one of them. IFIC appears first in the ranking of research excellence among all Spanish Joint Centres of the Research Council in all fields. The spectrum of its activities in fundamental physics and its applications, in medical physics for example, is very broad, covering experimental and theoretical research. In the high energy frontier, particle physics is now in the opening of a new domain with the expectations of new physics to be discovered with the LHC accelerator at CERN. The University of Valencia is proud for the contributions that the groups of IFIC are making in these novel studies. In fact, in fundamental physics, the contribution of Spanish research to the European activities represents more than 8%.

In this context, IFIC is organizing this important Symposium DISCRETE'08 on Symmetries. The fact that our world does not behave perfectly symmetrically is due to deviations at the
microscopic level. The answers are hidden in Nature’s laws of symmetry. Is it possible to know the origin of mass and matter? Among many other open questions, the violation of the symmetry between matter and antimatter is a fundamental ingredient to understand why our present Universe is made of matter only. These are fascinating problems and I wish you to enjoy the Symposium with such important discussions. And, also, have the opportunity to enjoy the city and the social events that we are offering to you!

I declare the official inauguration of the DISCRETE’08 Symposium on “Prospects in the Physics of Discrete Symmetries”!

Thank you very much for your attention.

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