MaPhyAG Workshop

Integrability, Geometry and QFT

UNIVERSIDAD
COMPLUTENSE
MADRID

Universidad Complutense de Madrid

7–11 October 2024

Contents

Practical Information

Venue

All the talks will take place at **Aula Magna M2** at the **Faculty of Physics (Facultad de Ciencias Físicas)** at **Universidad Complutense de Madrid**, in the Ciudad Universitaria Campus.
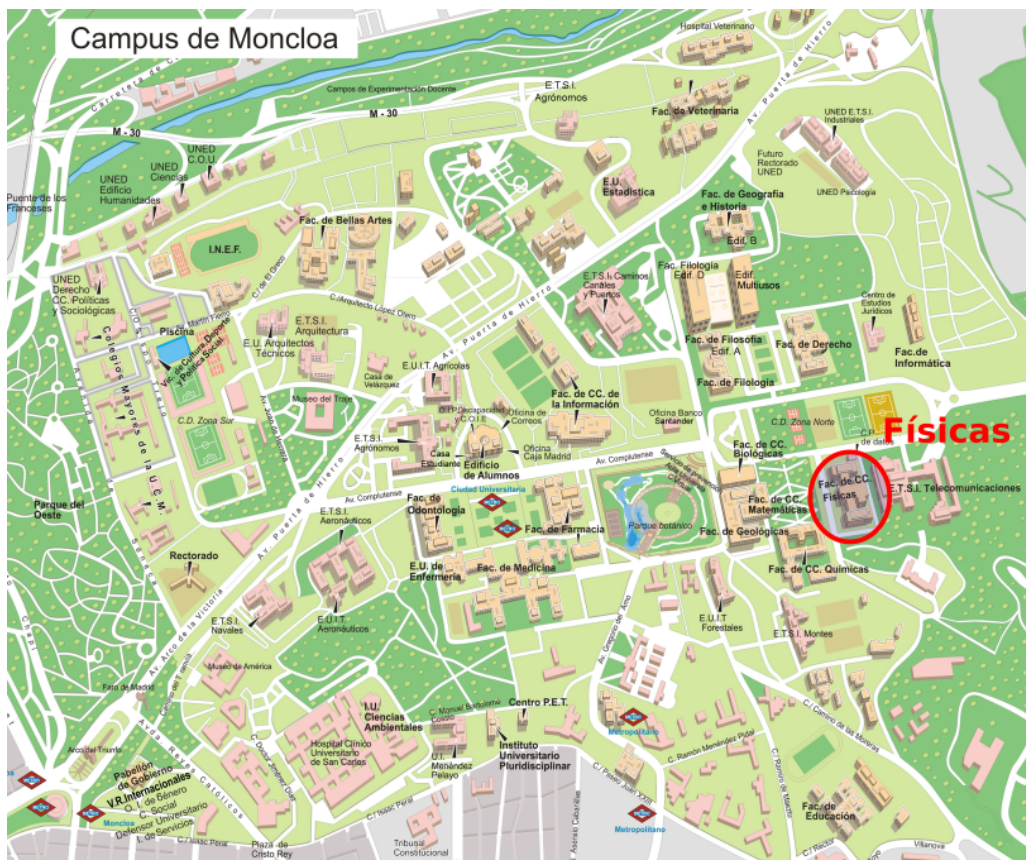

Figure 1: Map of the Ciudad Universitaria campus

Reimbursement of the expenses

If you are one of the speakers at the conference, you can claim reimbursement for the expenses of your stay. For that, you must visit the Economic Affairs (Asuntos Económicos) section in charge of our grant at some point during your stay. We vividly encourage you to go there on the first day of the conference.

The Economic Affairs section is located on the first floor of the Faculty of Mathematics (across the square, in front of the Faculty of Physics). There, you must sign the 'hoja de liquidación' form. Ask for it in the section by explaining that you are a participant of the MaPhyAG workshop. You will also need to provide some sort of proof of ownership of your bank account (typically, the banks can issue a certificate of ownership for free online).

If you need help with this paperwork, do not hesitate to contact any of the organizers!

Lunch

There are several lunch options available around the venue. Within the Faculty of Physics, there is a cafeteria located in the first basement that serves a daily meal at a cost of approximately 6.50€. Additionally, the Faculty of Mathematics, located directly across the square from the Faculty of Physics, has a cafeteria in its first basement that offers food at a similar price.

A typical daily meal in Spain includes a first course (e.g., vegetables or pasta), a second course (e.g., meat or fish), and a dessert or coffee. You can pay at the counter with card or cash after selecting your food. Additionally, the cafeteria in the Faculty of Mathematics offers vegan and vegetarian options.

Hotel

The conference hotel is 'Residencia de Estudiantes', located near the Consejo Superior de Investigaciones Científicas campus. The exact address of the hotel is the following:

C. del Pinar, 21-23

Chamartín, 28006 Madrid

The nearest Metro station is 'República Argentina' at Metro line 6 (grey line), which is 10 minutes away on foot.

How to reach the hotel from the airport

After landing at the Madrid-Barajas Airport – Adolfo Suarez, follow the signs to the Metro station. The airport has two connected components: Terminals T1-T2-T3, and Terminal T4, which is disconnected from the previous ones but near to them. The Metro stations are at Terminal T2 and T4. In both cases, there is a single Metro line (line 8, pink) that you should take Nuevos Ministerios-bound. At Nuevos Ministerios, commute to the appropriate line at your convenience (Metro line 6 – grey line if you want to go to the conference hotel).

There are automatic machines to buy the tickets at the metro station. A single trip ticket costs 1.5€-2€, but you must pay an extra fee to leave (and arrive at) the airport (+3€). To charge your tickets, you must buy a card (Tarjeta Multi) the first time you take the metro (it can be purchased directly at the machine for 2.5€). If you have any troubles, ask the staff at the metro station.

How to reach the conference venue

The best option to reach the university campus is by Metro, stopping at 'Ciudad Universitaria' (Metro line 6 – grey line). When you exit the Metro station, to reach the Faculty of Physics, go to your right and it is around 10 minutes away on foot, behind the big grey building (the Faculty of Biology).

If you leave from 'Residencia de Estudiantes' (the conference hotel), you can walk 10 minutes to 'República Argentina' Metro station and it is direct line to 'Ciudad Universitaria' by Metro line 6.

Tip: If you are planning to go to the conference venue by train every day, probably it will be more economical for you to buy a 10-journey ticket (zone A is enough). This can be bought at any Metro station, and charged in your Metro card.

Tourist information

We strongly encourage you to visit the beautiful city of Madrid during the free time of the conference. We list here some landmarks to visit in Madrid, together with the nearest Metro station.

- Historical centre, including Puerta del Sol, Plaza Mayor and Gran Vía. Metro stops: Sol, Gran Vía and Callao.

- Museo del Prado and Museo Reina Sofía. Metro stop: Estación del arte.

- Royal Palace, Almudena Cathedral and Royal Theatre. Metro stop: Ópera.

- Retiro park. Metro stops: Banco de España.

- Madrid Río and Casa de Campo. Metro stop: Príncipe Pío.

- Santiago Bernabeu Stadium (Real Madrid stadium). Metro stop: Santiago Bernabeu (also at a walkable distance from the hotel).

The city centre, which comprises Puerta del Sol, Plaza Mayor, Gran Vía, the Royal Theatre, the Royal Palace and Almudena Cathedral, is at a walkable distance from Puerta del Sol. In that case, we recommend you stopping at Sol Metro station and walk from there.

The hotel is very close to one of the main avenues in Madrid, the Paseo de la Castellana. You will find there several restaurants and bars open until late.

Notice that, in Spain, it is customary to have dinner very late. Most of the restaurants do not open for dinner until 8:30 pm, and food is served until 11:00 pm or even later.

Madrid Metro map

Figure 2: Madrid Metro map

Schedule

Schedule	Monday	Tuesday	Wednesday	Thursday	Friday
9:00-10:00	Registration	Registration		Registration	
10:00-11:00	Opening by the Dean of Fac. of Physics (10:00-10:10) ___ Mulase (10:10-11:10)	Dumitrescu (IMI Women in Math. Physics)	**Event at the Fac. of Physics***	Sharpe	Peón Nieto
11:00-11:30	Break	Break		Break	Break
11:30-12:30	Kang	Donagi		Lawrie	Cvetic
12:30-14:30	Lunch	Lunch		Lunch	13:00 – Mulase** Special Colloquium
14:30-15:30	Mazzocco	Distler		Schaposnik	
15:45-16:45	Szabó	Gukov		Dimofte	

Place: Aula Magna M2. Faculty of Physics. Universidad Complutense de Madrid.

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*Wednesday: The workshop coincides with the celebration of the 50 years of the splitting of the Faculty of Science into the Faculties of Biology, Chemistry, Geology, Mathematics and Physics. Hence on Wednesday, there is a special event starting at 10:00 (but unfortunately in Spanish) at the Faculty of Physics, the venue of our workshop. The president of the University shall come and there shall be a talk by the paleontologist J. L. Arsuaga.

**Friday: M. Mulase (13:00) – External Joint Special Colloquium (CSIC-UAM-UCM-UC3M): At 'Aula Miguel de Guzmán' in the Faculty of Mathematics.

Abstracts

Mirjam Cvetic

Generalized Global Symmetries and Nested Symmetry Theories

University of Pennsylvania

Generalized Global Symmetries of D-dimensional Quantum Field Theories (QFTs) can be interpreted in terms of $(D + 1)$-dimensional bulk Symmetry Theory (SymTh), which often turns out to be a gapped Symmetry Topological Field Theory (SymTFT). In this setting interacting degrees of freedom arise as edge modes of a higher-dimensional bulk system. We further show that the combined $(D + 1)$-dimensional bulk and D-dimensional edge mode theory can serve as the edge modes of a $(D + 2)$-dimensional bulk theory, which leads to a nested structure of SymThs. We show how this structure naturally arises in a number of string-based constructions of QFTs with both discrete and continuous symmetries.

Tudor Dimofte

TBA

University of Edinburgh

TBA

Jacques Distler

N=2 SCFTs of Class-S and Families of Hitchin Systems

University of Texas at Austin

I will pick up where Ron Donagi left off, and discuss the behaviour as the base curve C degenerates to a nodal curve (explaining the meaning of the twisting at the boundary of the moduli space). I will then turn to the new features that arise in Type-D (and beyond). Even locally (on the punctured disk), the situation is surprisingly more intricate than it was in Type-A.

Ron Donagi

On theories of class S and the geometry of meromorphic Higgs bundles

University of Pennsylvania

We explore both local and global aspects of the geometry of meromorphic Higgs moduli space and its Hitchin map. (Work with A.Balasubramanian, J.Distler, N.Donagi, A.Herrero and C.Perez.)

Olivia Dumitrescu

Lagrangian geometries of the Dolbeault and the de Rham moduli spaces

University of North Carolina, Chapel Hill

I will illustrate a comparison between two diffeomorphic moduli spaces in rank 2, the Hitchin and the de Rham moduli spaces, in terms of lagrangians filling up the entire space. This talk is based on work in progress with Motohico Mulase.

Sergei Gukov

TBA

California Institute of Technology – Caltech

TBA

Sungkyung Kang

Using equivariant Seiberg-Witten theory to detect exotic diffeomorphisms

University of Oxford

Given any smooth 4-manifold bounding a Seifert manifold, the Seifert action on its boundary can be used to define their boundary Dehn twists. If the given 4-manifold is simply-connected, this Dehn twist is always topologically isotopic to the identity, but usually not smoothly isotopic, making it a very nice potential example of exotic diffeomorphisms. In this talk, we will show how one can apply Seiberg-Witten theory and finite cyclic group symmetry to show that for any Brieskorn homology sphere bounding a positive-definite 4-manifold, their boundary Dehn twists are always infinite-order exotic. We will also discuss how this strategy can also be used to prove the existence of an exotic diffeomorphism which stays exotic after two stabilizations. This is a joint work with JungHwan Park and Masaki Taniguchi.

Craig Lawrie

Higgs Branches of Eight-supercharge SCFTs and Symplectic Singularities

Deutsches Elektronen-Synchrotron – DESY

An eight-supercharge supersymmetric quantum field theory has a Higgs branch which is both a hyperkahler space and a symplectic singularity. A symplectic singularity admits a natural foliation by symplectic leaves, and this induces a partial ordering on the leaves given by inclusion. The physical interpretation of this partial ordering is that it encompasses all the patterns of partial Higgsing: each leaf is associated with an SCFT and the transverse slice between two leaves captures the parameters that need to be tuned to perform a Higgs branch renormalization group flow between the two theories. I will discuss this structure of the Higgs branch for a variety of 6d (1,0), 4d class S, and 3d field theories, using techniques from geometry, Hitchin systems, and SQFT.

Marta Mazzocco

TBA

Universitat Politècnica de Catalunya

TBA

Motohico Mulase

Information behind a singular connection

University of California at Davis

On the moduli space of connections, some of the points have hidden geometric information. This talk is aimed at exploring a few hints about how we deal with these geometries.

Ana Péon-Nieto

TBA

Universidade de Santiago de Compostela

TBA

Laura Schaposnik

Quantization of branes and 3-manifolds

University of Illinois at Chicago

During the talk, we will introduce brane quantization following Witten and Gaiotto's recent work on Probing Quantization Via Branes. We will then consider its relation with the branes and 3-manifolds we introduced with Baraglia defined via actions of involutions on different moduli spaces, hoping to further our understanding of the relation between Higgs bundles and representations of higher-dimensional manifolds.

Eric Sharpe

An introduction to decomposition in quantum field theories

Virginia Tech

In this talk, I will give an introduction to 'decomposition', a property of d-dimensional QFTs with global $(d-1)$-form symmetries. Decomposition is the observation that such quantum field theories are equivalent to disjoint unions of other quantum field theories, first observed in 2006 and studied in numerous examples and applications since. I will outline some basic examples in two and four dimensions, and as time permits, discuss various applications.

Szilárd Szabó

Asymptotic geometry of non-abelian Hodge theory and Riemann–Hilbert correspondence in a rank three parabolic case

Alfréd Rényi Institute of Mathematics

I report on joint work with M. Eper about Hitchin WKB-analysis on a real 4-dimensional moduli space of rank 3 Higgs bundles in genus 0. The approach uses previous results joint with T. Mochizuki.

Organizing Committee

- Enrique Arrondo. Universidad Complutense de Madrid & Instituto de Matemática Interdisciplinar (Spain).

- Ángel González-Prieto. Universidad Complutense de Madrid & Instituto de Ciencias Matemáticas (Spain).

- Monica Jinwoo Kang. University of Pennsylvania (USA)

- Marina Logares. Universidad Complutense de Madrid & Instituto de Matemática Interdisciplinar (Spain).

- Piergiulio Tempesta. Universidad Complutense de Madrid & Instituto de Ciencias Matemáticas (Spain).

Sponsors

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- Facultad de CC. Matemáticas. Universidad Complutense de Madrid.

- Instituto de Matemática Interdisciplinar.

- Agencia Estatal de Investigación. Ministerio de Ciencia, Innovación y Universidades.

- MaPhyAG research group.