

# Rasmi E. Hajjar Muñoz

B.S. PHYSICS · M.S. THEORETICAL PHYSICS · PH.D. STUDENT THEORETICAL PHYSICS

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## Education

### PhD Theoretical Physics: Neutrinos in Cosmology and Astroparticle Physics

IFIC (CSIC- UNIVERSITY OF VALENCIA). SUPERVISORS: OLGA MENA AND SERGIO PALOMARES RUIZ

Valencia, Spain

Sep. 2021 - PRESENT

### Cosmology, Space Science and Space Technologies Fellowship

SCUOLA SUPERIORE MERIDIONALE. SUPERVISORS: NINETTA SAVIANO AND GENNARO MIELE

Naples, Italy

Nov. 2020 - Sep. 2021

### M.Sc. in Advanced Physics: Theoretical Physics

UNIVERSITY OF VALENCIA - ESTUDI GENERAL

Valencia, Spain

Sep. 2019 - Jul. 2020

### Erasmus Exchange Program

UNIVERSITY OF LEEDS

Leeds, UK

Sep. 2017 - Jul. 2018

### B.Sc. in Physics

UNIVERSITY OF VALENCIA - ESTUDI GENERAL

Valencia, Spain

Sep. 2015 - Jul. 2019

## Skills

### LANGUAGES

**SPANISH**, mothertongue

**CATALAN**, mothertongue

**ENGLISH**, fluent

**ITALIAN**, intermediate

### PROGRAMMING LANGUAGES

**Python**, own codes

**C++ and C**, modified CLASS and nuSQuIDS

**Mathematica**, own codes

**LATEX**, own documents

## Publications

### Origin of cosmological neutrino mass bounds: background *versus* perturbations

TONI BERTÓLEZ-MARTÍNEZ, IVAN ESTEBAN, RASMI HAJJAR, OLGA MENA AND JORDI SALVADO.

arXiv preprint

to appear Nov. 2024

### Redshift-space distortions corner interacting dark energy

PIETRO GHEDINI, RASMI HAJJAR, OLGA MENA.

Physics of the Dark Universe

5th October 2024

DOI: 10.1016/j.dark.2024.101671

### Shedding light to the $\Delta m_{21}^2$ tension with supernova neutrinos

RASMI HAJJAR, SERGIO PALOMARES-RUIZ, OLGA MENA.

Physics Letters B

13th May 2024

DOI: 10.1016/j.physletb.2024.138719

### Earth tomography with supernova neutrinos at future neutrino detectors

RASMI HAJJAR, OLGA MENA, SERGIO PALOMARES-RUIZ.

Physical Review D

10th October 2023

DOI: 10.1103/PhysRevD.108.083011

### Constraints on heavy decaying dark matter with current gamma-ray measurements

MARCO CHIANESE, DAMIANO F.G. FIORILLO, RASMI HAJJAR, GENNARO MIELE, NINETTA SAVIANO.

JCAP

15th November 2021

DOI: 10.1088/1475-7516/2021/11/035

### Heavy decaying dark matter at future neutrino radio telescopes

MARCO CHIANESE, DAMIANO F.G. FIORILLO, RASMI HAJJAR, GENNARO MIELE, STEFANO MORISI, NINETTA SAVIANO.

JCAP

28th May 2021

DOI: 10.1088/1475-7516/2021/05/074

### Neutrino Mass Ordering at DUNE: an Extra $\nu$ -Bonus

CHRISTOPH A. TERNES, STEFANO GARIAZZO, RASMI HAJJAR, OLGA MENA, MICHEL SOREL, MARIAM TORTOLA.

Physical Review D

21st November 2019

DOI: 10.1103/PhysRevD.100.093004

## Secondments

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### Niels Bohr Institute - University of Copenhagen

Copenhagen, Denmark

SUPERVISOR: PROF. MAURICIO BUSTAMANTE

Oct. 2024 - Dec. 2024

Research secondment associated to the competitive grant EST24/00309. Devoted to test diverse properties of neutrino interactions with high-energy astrophysical neutrinos.

### KAVLI IPMU - The University of Tokyo

Kashiwa, Japan

SUPERVISOR: PROF. PATRICK DE PERIO

Jul. 2024 - Aug. 2024

Research secondment associated to the ASYMMETRY SE program. Collaborated with the Super-Kamiokande and Hyper-Kamiokande neutrino group.

### Fermilab - Fermi National Accelerator Laboratory

Batavia, Illinois, USA

SUPERVISOR: PROF. STEPHEN PARKE

Jul. 2023 - Aug. 2023

Research secondment associated to the ASYMMETRY SE program. Examined the different ways of introducing neutrino perturbations evolution in cosmology in collaboration with other ASYMMETRY fellows visiting Fermilab. Derived neutrino fluid treatment of perturbations.

### Center for Cosmology and Astroparticle Physics - The Ohio State University

Columbus, Ohio, USA

SUPERVISOR: PROF. IVÁN ESTEBAN

May. 2023 - Jul. 2023

Research secondment associated to the competitive grant EST23/00231. Inspected neutrino role in cosmological evolution. Modeled background cosmological neutrino evolution as a function of the equation of state. Programmed background modification inside the CLASS Boltzmann solver.

### Università degli Studi di Napoli Federico II

Naples, Italy

SUPERVISORS: DR. NINETTA SAVIANO AND DR. MARCO CHIANESE

Feb. 2023 - May. 2023

Research secondment associated to the competitive grant UV-RI\_MID-2515765. Reviewed literature on composite scenarios with two dark matter components: Primordial Black Holes and WIMPs. Developed code obtaining WIMP accretion profile around Primordial Black Holes. Obtained emission coming from WIMP annihilation in this scenario.

## Short Visits

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### Universidad del País Vasco - Euskal Herriko Unibertsitatea

Bilbao, Spain

SUPERVISOR: IVÁN ESTEBAN

Apr. 2024

One week visit focused on diagnosing the CMB calculation and the different terms contributing to the observable. Tested the gauge-independence of the various terms. Focused on the ISW and EISW effects and their contribution at low multipoles.

### Institut de Ciències del Cosmos - Universitat de Barcelona (ICCUB)

Barcelona, Spain

SUPERVISOR: JORDI SALVADO

Nov. 2023

One week visit associated to the competitive grant DRAC Formació Avançada. Developed new perturbation formalism to take into account neutrino cosmological perturbations.

## Teaching

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### Physics I - University of Valencia

Valencia, Spain

JOINT DEGREE IN PHYSICS AND MATHEMATICS (15H) AND DEGREE IN CHEMISTRY (24H)

Fall 2021

### Quantum Physics I - University of Valencia

Valencia, Spain

DEGREE IN PHYSICS (45H+45H) AND JOINT DEGREE IN PHYSICS AND CHEMISTRY (8H)

Fall 2022 and Fall 2023

## Mentoring

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### Co-supervisor of Pietro Ghedini Master Thesis - University of Bologna

Bologna, Italy

SUPERVISORS: SILVIA PASCOLI AND OLGA MENA

Spring 2024

Title: Growth of structures in non-standard Dark-Energy model.

## Seminars

### SNEWS Supernova Seminar Series

“SUPERNOVA NEUTRINOS AND EARTH MATTER EFFECTS”

Online

30th January 2025

### Niels Bohr Institute - The University of Copenhagen

“ADDRESSING TENSIONS IN NEUTRINO MASSES”

Copenhagen, Denmark

25th November 2024

### KAVLI IPMU - The University of Tokyo

“EARTH MATTER EFFECTS AND SUPERNOVA NEUTRINOS”

Kashiwa, Japan

19th August 2024

### CCAPP - The Ohio State University

“EARTH TOMOGRAPHY WITH SUPERNOVA NEUTRINOS AT FUTURE NEUTRINO DETECTORS”

Columbus, Ohio, USA

19th May 2023

### Scuola Superiore Meridionale (SSM)

“EARTH TOMOGRAPHY WITH SUPERNOVA NEUTRINOS AT FUTURE NEUTRINO DETECTORS”

Naples, Italy

14th March 2023

## Conferences

### Neutrino Frontiers: Focus Week and Astrophysical Week 1

GALILEO GALILEI INSTITUTE

• Talk: Shedding light to the  $\Delta m_{21}^2$  tension with supernova neutrinos

Florence, Italy

Jul. 2024

### PLANCK2024

INSTITUTO SUPERIOR TÉCNICO

• Talk: Shedding light to the  $\Delta m_{21}^2$  tension with supernova neutrinos

Lisbon, Portugal

Jun. 2024

### @FlipPhysics 2024 workshop

INSTITUTO DE FÍSICA CORPUSCULAR (IFIC)

• Talk: Shedding light to the  $\Delta m_{21}^2$  tension with supernova neutrinos

Valencia, Spain

Mar. 2024

### XX International Workshop on Neutrino Telescopes

ISTITUTO VENETO DI SCIENZE, LETTERE ED ARTI

• Talk: Earth tomography with supernova neutrinos at future neutrino detectors

Venice, Italy

Sep. 2023

### TeV Particle Astrophysics

UNIVERSITY OF NAPLES FEDERICO II

• Talk: Earth tomography with supernova neutrinos at future neutrino detectors

• Talk: Multi-messenger lifetime constraints on heavy decaying dark matter

Naples, Italy

Sep. 2023

### Invisibles 2023 workshop

UNIVERSITY OF GOETTINGEN

• Talk and poster: Shedding light to the  $\Delta m_{21}^2$  tension with supernova neutrinos.

Goettingen, Germany

Aug. 2023

### Invisibles 2022 workshop

UNIVERSITY PARIS-SACLAY

• Talk and poster: Supernova neutrino Earth tomography: myth or reality?

Orsay, France

Jun. 2022

### @FlipPhysics 2022 workshop

INSTITUTO DE FÍSICA CORPUSCULAR (IFIC)

Valencia, Spain

Mar. 2022

### 3rd GNN Workshop on Indirect Dark Matter Searches with Neutrino Telescopes

FACULTY OF SCIENCE - UNIVERSITY OF GRANADA

• Talk: Multi-messenger lifetime constraints on heavy decaying dark matter

Granada, Spain

Mar. 2022

### 17th International Conference on Topics in Astroparticle and Underground Physics

INSTITUTO DE FÍSICA CORPUSCULAR (IFIC)

• Talk: Multi-messenger lifetime constraints on heavy decaying dark matter

Valencia, Spain (online)

Aug. 2021

### NuCo 2021 - Neutrinos in Colombia

CONHEP

• Talk: Heavy decaying dark matter at future neutrino radio telescopes

Colombia (online)

Jul. 2021

## 37th International Cosmic Ray Conference (ICRC)

DESY

· Talk: Testing the stability of heavy dark matter with up-coming radio neutrino telescopes

*Berlin, Germany (online)*

*Jul. 2021*

## Invisibles 2021 workshop

INSTITUTO DE FÍSICA TEÓRICA (IFT)

· Poster: Heavy decaying dark matter at future neutrino radio telescopes

*Madrid, Spain (online)*

*Jun. 2021*

## XIV Interconnections between Particle Physics and Cosmology

UNIVERSITY OF OKLAHOMA

· Talk: Heavy decaying dark matter at future neutrino radio telescopes

*Oklahoma, USA (online)*

*May. 2021*

## WOPM (Workshop on Optically Pumped Magnetometers)

HELMHOLTZ INSTITUTE OF MAINZ (HIM)

*Mainz, Germany*

*Aug. 2019*

## HOW 2018

INSTITUTO DE FÍSICA CORPUSCULAR (IFIC)

*Valencia, Spain*

*Nov. 2018*

## Schools

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### Neutrino Frontiers: Training Week

THE GALILEO GALILEI INSTITUTE FOR THEORETICAL PHYSICS

*Florence, Italy*

*Jun. 2024*

### CosmoVerseSchool@Corfu

MON REPOS

*Corfu, Greece*

*May. 2024*

### First EUCAPT School: Cosmology

INSTITUTO DE FÍSICA CORPUSCULAR (IFIC)

*Valencia, Spain*

*Sep. 2023*

### XXXIII Canary Island Winter School

INSTITUTO DE ASTROFÍSICA DE CANARIAS (+ POSTER PRESENTATION)

*La Laguna, Spain*

*Nov. 2022*

### Invisibles 2022 school

UNIVERSITY PARIS-SACLAY (+ POSTER PRESENTATION)

*Orsay, France*

*Jun. 2022*

### TAE 2021 International School on High Energy Physics

CENTRO DE CIENCIAS DE BENASQUE PEDRO PASCUAL

*Benasque, Spain*

*Sep. 2021*

### Invisibles 2021 school

INSTITUTO DE FÍSICA TEÓRICA

*Madrid, Spain (online)*

*Apr. 2021*

### Theoretical Aspects of Astroparticle Physics, Cosmology and Gravitation

THE GALILEO GALILEI INSTITUTE FOR THEORETICAL PHYSICS (+ TALK)

*Florence, Italy (online)*

*Feb. 2021*

### Challenges for the Standard Cosmological Model

IV JOINT ICTP-TRIESTE/ICTP-SAIFR SCHOOL ON COSMOLOGY

*São Paulo, Brazil (online)*

*Jan. 2021*

## Outreach

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### Expociencia Fair 2024

PARC CIENTÍFIC UNIVERSITAT DE VALÈNCIA (PC-UV)

*Valencia, Spain*

*11th May 2024*

### High School Outreach talks of Astroparticle Physics (IFIC)

1- COLEGIO LA PURÍSIMA, ALZIRA 2-CUMBRES SCHOOL, MONCADA

*Comunitat Valenciana, Spain*

*Mar. 2024*

### II Fira de la Ciència - Activity: How much Dark Matter do you have?

PARC "MOLÍ D'ANIMETA"

*Quart de Poblet, Spain*

*23rd September 2023*

### Expociencia Fair 2023

PARC CIENTÍFIC UNIVERSITAT DE VALÈNCIA (PC-UV)

*Valencia, Spain*

*6th May 2023*

### Collaborator of XIV Fair-Contest Experimenta

PRÍNCIPE FELIPE SCIENCE MUSEUM

*Valencia, Spain*

*7th April 2019*

### Collaborator of XII Fair-Contest Experimenta

PRÍNCIPE FELIPE SCIENCE MUSEUM

*Valencia, Spain*

*2nd April 2017*

# Equity and Diversity

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## Member of the Equality and Diversity Committee of the IFIC

INSTITUTO DE FÍSICA CORPUSCULAR (IFIC)

Valencia, Spain

Nov. 2023 - PRESENT

# Fellowships

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## FPU Fellowship, code FPU19/03348

THE NEUTRINO ROLE IN COSMOLOGY AND ASTROPARTICLE PHYSICS

Valencia, Spain

Sep. 2021 - Aug. 2025

## Mainz Summer Program

ANOMALOUS MAGNETIC MOMENT OF THE MUON PROBLEM

Mainz, Germany

Aug. 2019 - Sep. 2019

## Spanish Ministry of Education Collaboration Fellowship

NEUTRINO OSCILLATION PHYSICS AND HIERARCHY

Valencia, Spain

Jan. 2019 - Jun. 2019

## JAE Intro CSIC Fellowship

DARK MATTER SURVEY WITH NEUTRINO TELESCOPES ANTARES AND KM3NET

Valencia, Spain

Sep. 2018 - Dec. 2018

## IFIC's Severo Ochoa Summer Student Fellowships

NEUTRINO ASTRONOMY WITH ANTARES NEUTRINO TELESCOPE

Valencia, Spain

Jul. 2018

## Erasmus+ Fellowship

PHYSICS STUDENT AT THE UNIVERSITY OF LEEDS

Leeds, UK

Sep. 2017 - Jul. 2018