

Curriculum Vitae (updated 03/03/14)

Personal Data

Name: Javier Redondo Martín
Date of birth: 19 May 1979
Nationality: Spanish

Present professional position

Institute: Arnold Sommerfeld Center for theoretical physics,
Ludwig Maximilians Universität, München.
Associated at : Werner Heisenberg Institute
Munich Max-Planck-Institut für Physik
Prof. Status: Postdoctoral fellow
Address: Föhringer Ring 6, D-80805, Munich, Germany
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Present Research Areas

- Particle Physics. Physics Beyond the standard model. Astroparticle Physics.
- Neutrino, Axions and other weakly interacting low mass particles beyond the standard model.
- Astrophysics and Cosmology. Dark Matter. Stellar evolution. Cosmic rays. Light propagation.
- Precision laboratory experiments searching for deviations of the standard model and new particles.

Academic Background

- Degree in Physics, (area of theoretical Physics). University of Zaragoza (Spain). 09/08/2002.
- D.E.A. (Master equivalent). Autonomous University of Barcelona (Spain) 19/04/2005.
- Ph. D. in Physics. Autonomous University of Barcelona (Spain) 01/06/2007.
Supervisor: Eduard Massó,
Title: Can the PVLAS particle be compatible with the astrophysical bounds?

Post doctoral positions

- Postdoc fellow at DESY (Deutsches Elektronen Synchrotron), Hamburg site. 15/10/2007 – 14/10/2009
- Postdoc fellow at Max Planck Institute for Physics, Munich. 15/10/2009-14/11/2012.
- Postdoc fellow at Ludwig Maximilians Universität, Munich. 15/11/2012-01/09/2014.

Grants and awards

- Doctoral Fellowship FPI from the Spanish ministry of science (2003-2007).
- Extraordinary Ph. D. prize in the field of Physics (Autonomous University of Barcelona 2007).
- Ramón y Cajal fellowship 2012 (Ministry of economy and competitiveness, Nov. 2013).

Participation in Experimental Projects

Member of the [ALPS \(Any Light Particle Search\) and ALPS-II experiments](#), DESY Hamburg.
Member of the [SHIPS \(Solar Hidden Photon Search\) experiment](#), Hamburg University.
Member of the IAXO collaboration. <http://iaxo.web.cern.ch/iaxo/>

Other scientific activities

Frequent referee for:
- Physics Letters B
- Journal of Cosmology and Astroparticle Physics (JCAP)
- Physical Review D and Physical Review Letters

HEP h-index of 22 (according to INSPIRE)

Professional References

Name: Prof. Eduard Massó
Institution: IFAE and Universidad Autónoma de Barcelona, Barcelona, Spain.
Contact: masso@ifae.es

Name: Dr. Andreas Ringwald
Institution: DESY Theory Group, Hamburg, Germany
Contact: ringwald@desy.de

Name: Dr. Georg Raffelt
Institution: Max Planck Institute for Physics, Munich, Germany
Contact: raffelt@mpp.mpg.de

Name: Prof. Jörg Jäckel
Institution: University of Heidelberg, Germany
Contact: jjackel@thphys.uni-heidelberg.de

Name: Dr. Igor Irastorza
Institution: Universidad de Zaragoza, Spain
Contact: Igor.Irastorza@unizar.es

Summary of research activities

I began my graduate years in the Nuclear Physics Department of the University of Zaragoza building low background shieldings for detectors at the International Canfranc Underground Lab. Following the awarding of a PhD fellowship from the Spanish ministry of science, I moved to the Autonomous University of Barcelona/IFAE. My work there followed two different paths: Lepton Flavor Violation (LFV) studies and phenomenology of low mass particles such as axions. Together with Prof. A. Ibarra we developed a systematic study of LFV in the leptonic sector within an effective lagrangian respecting the gauge symmetry of the standard model $SU(2)_L \otimes U(1)_Y$. This work has increasingly received attention since it contains a lot of information that can be useful in the future, for example for the proposed International Linear Collider.

The phenomenology of low mass bosons, such as axions, received the most of my time at IFAE and ever since. We were soon aware of the problems to reconcile the PVLAS signal in terms of an Axion like particle (ALP) coupled to photons with the very restrictive astrophysical bounds. We built very celebrated physics models to evade these arguments invoking new particles, paraphotons and millicharged particles. We also examined different interpretations of the PVLAS signal and contributed to refine the proposals of other authors. Together with people of the DESY theory group we studied how environmental parameters could modify the ALP production in the Sun and relax the astrophysical bounds. This was a fundamental tool to evaluate the different existing proposals trying to reconcile the PVLAS ALP with the astrophysical constraints. When the PVLAS collaboration communicated that their signal should be rather due to a parity-even scalar particle, we showed that the bare ALP interpretation also contradicts experiments searching for 5th forces and tests of the equivalence principle. Our latest model, however, also evaded these problems. Another collaboration with the DESY group showed up in a study of the implications of low mass paraphotons and millicharged particles in the typical optical experiments looking for axions. In June 2007 the PVLAS collaboration presented new results with an improved apparatus. The rotation signal had disappeared. Despite this fact, several groups have joined the PVLAS quest of the optical search for vacuum properties and dark matter and will push the field by building up new experiments. Certainly, if a new particle is discovered one has to explain why it evades astrophysical arguments anyways.

In October 2007 I joined the DESY theory group as a PostDoctoral researcher. After the withdrawal of the PVLAS results I started to reexamine the physics case for the low mass particles beyond the standard model that I had considered in my previous works. Hidden photons are particularly interesting not only because they are ubiquitous in the most ambitious extension of the standard model: string theory, but because they also evade quite naturally the astrophysical bounds. From the phenomenological point of view, I reconsidered the solar energy loss limits, computed their relic abundance from the big bang (which turned out to make them good dark matter candidates) and other cosmological aspects. From the theoretical point of view, we studied in a recent publication the hidden photon parameters predicted by string theory, particularizing in the LARGE volume scenario.

I also studied some experimental searches from the theoretical side, reviewed already done experiments

and proposed dedicated new ones. In December 2007 I joined the ALPS collaboration, which runs one such experiments and released its final (world leading) results in 2010. Following my work in solar hidden photons, a detection experiment called SHIPS, of which I'm member, is being performed in the Hamburger sternwarte, Germany. Other experimental proposals to look for these particles have been born during my stay at DESY. From the theoretical point of view I have collaborated with Guenter Sigl and his group in a model independent study of the galactic signatures of such models, studying the synchrotron radiation, positron and gamma ray fluxes. In all the mentioned experiments I have had a leading role in the proposal, design and both in theoretical and practical support.

In October 2009 I started working in the Max Planck Institute for Physics. In these last years I have devoted more attention to astrophysical/cosmological and laboratory probes of QCD axions and similar axion-like particles. Recently we have proposed a next generation axion helioscope, IAXO, which will bring if realized laboratory searches for axions to the frontier of the astrophysical bounds. Furthermore, and complementing this proposal I'm involved with Georg Raffelt in reviewing the most important stellar evolution signatures of weakly-interacting low mass particles. In the last year, the subject that has attracted more my attention, my work and projection to the future is the scenario where axions, axion-like-particles or hidden photons are the cold dark matter of the universe. I have studied in detail these scenarios, constraining the viable parameter space with astrophysical or cosmological observables. Also, I have started to discuss novel experimental ways of detecting WISPy cold dark matter adapted to regions of parameter space previously disregarded by theorists. We have recently published a proposal that uses dish antennas coupled to sensitive radiometers for a broadband search scan. With a number of theorists and experimentalists all over europe, I envision the developing a european network of experiments looking for axion dark matter. The first moves are WISPDMM, a cavity experiment in DESY in collaboration with the Max-Planck Institute for Radio-Astronomy in Bonn, and the inclusion of axion dark matter searches in the letter of intent for IAXO. From Novemeber 2012 I joined the group of Prof. Dvali at LMU, Munich, where I expect to devote part of my time to contribute to the development of his program of understanding black holes as Bose-Einstein condensates of gravitons and assessing the ideas of P. Sikivie of dark matter axions forming a Bose-Einstein condensate.

List of Publications

In Journals

- Authors: J. Redondo, A. Ibarra, E. Massó
Title: Systematic approach to gauge-invariant relations between lepton flavor violating processes
Journal: Nucl. Phys. B 715, 523–535
Publication date: 31 March 2005
Cites in INSPIRE: 12
- Authors: J. Redondo, E. Massó
Title: Evading astrophysical constraints on axion-like particles
Journal: JCAP 0509 015 (2005)
Publication date: 29 September 2005
Cites in INSPIRE: 93
- Authors : J. Redondo, E. Massó
Title: Compatibility of CAST search with axion-like interpretation of PVLAS results
Journal: Phys. Rev. Lett. 97 151802 (2006)
Publication date: 12 October 2006
Cites in INSPIRE: 107
- Authors : J. Redondo, J. Jaeckel, E. Massó, A. Ringwald, F. Takahashi
Title: Need for purely laboratory-based axionlike particle searches
Journal: Phys. Rev. D 75:013004 (2007)
Publication date: 9 January 2007
Cites in INSPIRE: 91
- Authors : A. Dupays, J. Redondo, E. Massó, C. Rizzo
Title: Light scalars coupled to photons and non-newtonian forces
Journal: Phys. Rev. Lett. 98 131802 (2007)
Publication date: 27 March 2007
Cites in INSPIRE: 24
- Authors : M. Ahlers, J. Redondo, H. Gies, J. Jaeckel, A. Ringwald
Title: Light from the Hidden Sector
Journal: Phys. Rev. D 76 115005 (2007)
Publication date: 6 December 2007
Cites in INSPIRE: 81
- Authors : J. Redondo, M. Ahlers, H. Gies, J. Jaeckel, A. Ringwald
Title: Laser experiments explore the hidden sector
Journal: Phys. Rev. D 77 095001 (2008)
Publication date: 1 May 2008
Cites in INSPIRE: 116
- Authors : J. Redondo
Title: Helioscope Bounds on Hidden Sector Photons
Journal: JCAP 0807 008 (2008)
Publication date: 7 July 2008
Cites in INSPIRE: 61
- Authors : S. N. Gninenko and J. Redondo
Title: On search for eV hidden sector photons in Super- Kamiokande and CAST experiments
Journal: Phys. Lett. B 664 180-184 (2008)
Publication date: 13 May 2008
Cites in INSPIRE: 33

Authors : J. Redondo, J. Jaeckel, A. Ringwald
 Title: Signatures of a hidden cosmic microwave background
 Journal: Phys. Rev. Lett. 101 131801 (2008)
 Publication date: 26 September 2008
 Cites in INSPIRE: 85

Authors : J. Jaeckel and J. Redondo
 Title: Searching Hidden-sector Photons inside a Superconducting Box
 Journal: Europhys. Lett 84 31002 (2008)
 Publication date: 31 October 2008
 Cites in INSPIRE: 18

Authors : M. Ahlers, J. Redondo, J. Jaeckel, A. Ringwald
 Title: Probing Hidden Sector Photons through the Higgs Window
 Journal: Phys. Rev. D 78 075005 (2008)
 Publication date: 7 October 2008
 Cites in INSPIRE: 54

Authors : J. Redondo, M. Postma
 Title: Massive hidden photons as lukewarm dark matter
 Journal: JCAP 0902 005 (2009)
 Publication date: February 4, 2009
 Cites in INSPIRE: 38

Authors : J. Redondo, C. Biggio, E. Masso
 Title: Mixing of photons with massive spin-two particles in a magnetic field
 Journal: Phys. Rev. D 79 015012 (2009)
 Publication date: 23 January 2009
 Cites in INSPIRE: 13

Authors : J. Redondo, A. Mirizzi, G. Sigl
 Title: Microwave Background Constraints on Mixing of Photons with Hidden Photons
 Journal: JCAP 0903:026 (2009)
 Publication date: March 23, 2009
 Cites in INSPIRE: 41

Authors : J. Redondo and A. Ringwald, J. Jaeckel
 Title: Hidden Laser Communications Through Matter: Application of meV-scale hidden photons
 Journal: Europhys.Lett.87:10010 (2009)
 Publication date: 24 July 2009
 Cites in INSPIRE: 11

Authors : ALPS collaboration, K. Ehret et al.
 Title: Resonant laser power build-up in ALPS: A 'Light-shining-through-walls' experiment
 Journal: Nucl.Instrum.Meth.A612:83-96 (2009)
 Publication date: 27 October 2009
 Cites in INSPIRE: 44

Authors : L. Zhang, J. Redondo, G. Sigl
 Title: Galactic signatures of decaying dark matter
 Journal: JCAP 0909:012 (2009)
 Publication date: September 8, 2009
 Cites in INSPIRE: 27

Authors : J. Redondo, A. Mirizzi, G. Sigl
 Title: Constraining resonant photon-axion conversions in the early universe
 Journal: JCAP 0908:001 (2009)
 Publication date: August 4, 2009
 Cites in INSPIRE: 21

Authors : C. Burrage, J. Redondo, J. Jaeckel, A. Ringwald
Title: Late time CMB anisotropies constrain mini-charged particles
Journal: JCAP 0911:002 (2009)
Publication date: November 4, 2009
Cites in INSPIRE: 14

Authors : Mark Goodsell, J. Jaeckel, J. Redondo, A. Ringwald
Title: Naturally light hidden photons in LARGE volume string compactifications
Journal: JHEP 0911:027 (2009)
Publication date: November 6th, 2009
Cites in INSPIRE: 129

Authors : ALPS collaboration, K. Ehret et al.
Title: New ALPS Results on Hidden-Sector Lightweights
Journal: Phys.Lett.B689:149-155,2010
Publication date: April 26th, 2010
Cites in INSPIRE: 83

Authors : L. Zhang, C. Weniger, J. Redondo, L. Maccione, G. Sigl
Title: Constraining Decaying Dark Matter with Fermi LAT Gamma-rays
Journal: JCAP 1006:027,2010.
Publication date: June 28th, 2010
Cites in INSPIRE: 32

Authors : A. Avgoustiadis, C. Burrage, J. Redondo, L. Verde, R. Jimenez
Title: Constraints on cosmic opacity and beyond the standard model physics from cosmological distance measurements.
Journal: JCAP 1010:024,2010
Publication date: October 22th, 2010
Cites in INSPIRE: 32

Authors: P. Arias, J. Redondo, J. Jaeckel and Andreas Ringwald
Title: Optimizing Light-Shining-through-a-Wall Experiments for Axion and other WISP Searches.
Journal: JCAP 1102:003,2011.
Publication date: December 20th, 2010
Cites in INSPIRE: 21

Authors: J. Redondo, D. Cadamuro, G. Raffelt and S. Hannestad
Title: Cosmological bounds on sub-MeV mass axions
Journal: JCAP 1102:003,2011.
Publication date: February 1st, 2011
Cites in INSPIRE: 18

Authors : I. Irastorza, J. Redondo, G. Raffelt, and others.
Title: Towards a next generation axion helioscope
Journal: JCAP 1103:003, 2011.
Cites in INSPIRE: 43

Authors : J. Redondo, G. Raffelt and N. Viaux
Title: The meV frontier of axion physics
Journal: Phys. Rev. D 84 103008 (2011)
Cites in INSPIRE: 11

Authors : J. Redondo, D. Cadamuro
Title: Cosmological bounds on pseudo Nambu-Goldstone bosons
Journal: JCAP 1202:032, 2012
Publication date: February 23rd, 2012
Cites in INSPIRE: 16

Authors : P. Arias, D. Cadamuro, M. Goodsell, J. Jaeckel, J. Redondo, A. Ringwald
Title: WISPy cold dark matter
Journal: JCAP 1206:013, 2012
Publication date: 8 June 2012
Cites in INSPIRE: 49

Authors : M. Blennow, E. Fernandez-Martinez, O. Mena, J. Redondo, P. Serra
Title: Asymmetric dark matter and dark radiation
Journal: JCAP 1207:022, 2012
Publication date: July 10th, 2012
Cites in INSPIRE: 32

Authors : D. Horns, J. Jaeckel, A. Lindner, A. Lobanov, J. Redondo, A. Ringwald
Title: Searching for WISPy cold dark matter with a Dish antenna
Journal: JCAP 1304 (2013) 016
Publication date: Apr 4th, 2013
Cites in INSPIRE: 15

Authors : J. Redondo and the CAST collaboration
Title: CAST constraints on the axion-electron coupling
Journal: JCAP 1305 (2013) 010
Publication date: May 9th, 2013
Cites in INSPIRE: 7

Authors : G. Raffelt, J. Redondo.
Title: Solar constraints on hidden photons re-visited
Journal: JCAP 1308 (2013) 034
Publication date: Aug 19th, 2013
Cites in INSPIRE: 12

Authors : N. Viaux, M. Catelan, P. Stetson, G. Raffelt, J. Redondo, A. Valcarce, A. Weiss
Title: Particle-physics constraints from the globular cluster M5: Neutrino Dipole Moments
Journal: Astronomy & Astrophysics 558 (2013) A12
Publication date: Sep 26th, 2013
Cites in INSPIRE: 4

Authors : J. Jaeckel and J. Redondo
Title: An Antenna for Directional Detection of WISPy Dark Matter
Journal: JCAP 1311 (2013) 016
Publication date: Nov 7th, 2013
Cites in INSPIRE: 7

Authors : J. Jaeckel and J. Redondo
Title: From resonant to broadband searches for WISPy cold dark matter
Journal: Phys. Rev. D 88 (2013) 115002
Publication date: Dec 2nd, 2013
Cites in INSPIRE: 3

Authors : J. Redondo
Title: Solar axion flux from the axion-electron coupling
Journal: Phys. Rev. D 88 (2013) 115002
Publication date: Dec 2nd, 2013
Cites in INSPIRE: 3

Authors: N. Viaux, M. Catelan, P. Stetson, G. Raffelt, J. Redondo, A. Valcarce, A. Weiss
Title: Neutrino and axion bounds from the globular cluster M5 (NGC 5904)
Journal: Phys. Rev. Lett. 111 (2013) 231301
Publication date: Dec 4th, 2013

Authors J. Redondo
Title: Solar axion flux from the axion-electron coupling
Journal: JCAP 1312 (2013) 008
Publication date: Dec 5th, 2013

Authors : S. Folkerts, C. Germani, J. Redondo.
Title: Axion Dark Matter and Planck favor non-minimal couplings to gravity
Journal: Phys. Lett. B 728 (2014) 532–536
Publication date: Dec 11th, 2013
Cites in INSPIRE: 7

Authors: J. Redondo, H. Vogel
Title: Dark Radiation constraints on minicharged particles in models with a hidden photon
Journal: JCAP 1412 (2014) 029
Publication date: Feb 18th, 2014

Authors: E. Armengaud, F.T. Avignone, M. Betz, P. Brax, P. Brun, G. Cantatore, J.M. Carmona, G.P. Carosi, F. Caspers, S. Caspi et al. (IAXO collaboration)
Title: Conceptual Design of the International Axion Observatory (IAXO)
Journal: Accepted for publication in JINST

Submitted

Authors: J. Jaeckel, A. Ringwald and J. Redondo
Title: A 3.55 keV hint for decaying axion-like particle dark matter
Eprint: arXiv:1402.7335

In Preparation

Authors J. Redondo
Title: The Sun in hidden photons

Authors: L. Calibbi, J. Redondo, H. Vogel, C. Weniger
Title: Dark Matter and Dark Radiation from an U(1) extension of the MSSM

Authors: J. Redondo
Title: Thermal evaporation of pseudoscalar condensates

Authors: J. Redondo
Title: On the mean field approximation in flavor oscillations in media

Reviews and reports

Authors : J. Redondo and A. Ringwald
Title: Light shining through walls
Journal: Contemporary physics, 52, (nr. 3) 211-236
Publication date: February 3rd, 2011
Cites in INSPIRE: 59
e-print: arXiv:1011.3741 [hep-ph]

Authors : J. L. Hewett, H. Weerts, et al.
Title: Fundamental physics at the intensity frontier
(Section on “New light, weakly-coupled particles”)
Report for the department of energy of the USA.
Cites in INSPIRE: 88
e-print: arXiv:1205.2671 [hep-ex]

Authors : K. Baker et al.
Title: The quest for axions and other new light particles
Journal: Ann. Phys. (Berlin) 525, No. 6, A93–A99 (2013)

Cites in INSPIRE: 11

Authors : R. Essig, J. A. Jaros et al.
Title: Fundamental physics at the intensity frontier
(Section on “Dark sectors and New light, weakly-coupled particles”)
Report for the department of energy of the USA.

Cites in INSPIRE: 16
e-print: arXiv:1311.0029 [hep-ex]

In Proceedings

(Oral presentation by the underlined author)

- Authors : J. Jaeckel, J. Redondo, E. Massó, A. Ringwald, F. Takahashi
Title: We need lab experiments to look for axion-like particles
Conference: 41st Rencontres de Moriond: Workshop on Cosmology: Contents and Structures of the Universe. La Thuile, Italy, 18-25 Mar 2006.
e-print: Arxiv hep-ph/0605313
- Authors : J. Redondo, E. Massó
Title: New Results In Axion Physics.
Conference: 20th Rencontres de Physique de La Vallee d'Aoste
Published: "La Thuile 2006, Results and perspectives in particle physics" 113-118.
e-print: Arxiv hep-ph/0606164
- Authors : J. Redondo, E. Massó
Title: Axion results: What is new?
Conference: International Workshop on the Dark Side of the Universe, Madrid, Spain, 20-24 Jun 2006.
Published: AIP Conf.Proc.878:387-394, 2006
and "Madrid 2006, The dark side of the universe" 387-394
e-print: Arxiv hep-ph/0609275
- Authors : J. Redondo
Title: A Model solving the PVLAS-CAST puzzle.
Conference: 13th International Conference in QCD (QCD 06), Montpellier, France, 3-7 Jul 2006
Published: Nucl.Phys.Proc.Suppl.174:237-240,2007.
and "Madrid 2006, The dark side of the universe" 387-394
e-print: Arxiv hep-ph/0610213
- Authors : J. Redondo
Title: The Low energy frontier: Probes with photons
Conference: 43rd Rencontres de Moriond on Electroweak Interactions and Unified Theories, La Thuile, Italy, 1-8 Mar 2008.
e-print: arXiv:0805.3112 [hep-ph]
- Authors : J. Redondo
Title: Bounds on Very Weakly Interacting Sub-eV Particles (WISPs) from Cosmology and Astrophysics
Conference: 4th Patras Workshop on Axions, WIMPs and WISPs - Training Workshop, Hamburg, Germany, 18-21 Jun 2008.
Published: "Hamburg 2008, Patras Workshop on Axions, WIMPs and WISPs" 23-26
e-print: arXiv:0810.3200 [hep-ph]
- Authors : H.S. Zechlin, J. Redondo, D. Horns
Title: New Constraints on Hidden Photons using Very High Energy Gamma-Rays from the Crab Nebula
Conference: 4th International Meeting on High Energy Gamma-Ray Astronomy, Heidelberg, Germany, 7-11 Jul 2008.
Published: AIP Conf.Proc.1085:727-730 (2009)
e-print: arXiv:0810.5501 [astro-ph]
- Authors : J. Redondo
Title: A Hidden Microwave Background? -- Signatures of photon-WISP oscillations in the CMB.
Conference: 5th Patras Workshop on Axions, WIMPs and WISPs, Durham, England, United Kingdom, 13-17 Jul 2009.
Published: Durham 2009, Patras Workshop on Axions, WIMPs and WISPs" 155-158
e-print: arXiv:1002.0447 [hep-ph]

Authors : J. Redondo
Title: Photon-axion conversions in transversely inhomogeneous magnetic fields
Conference: 5th Patras Workshop on Axions, WIMPs and WISPs, Durham, England, United Kingdom, 13-17 Jul 2009.
Published: Durham 2009, Patras Workshop on Axions, WIMPs and WISPs” 155-158
e-print: arXiv:1003.0410 [hep-ph]

Authors : J. Redondo
Title: Hidden Photons from the Sun.
Conference: 6th Patras Workshop on Axions, WIMPs and WISPs, Zurich, Switzerland, 5-9 Jul 2010.
Published: In press.
e-print: arXiv:1010.4689 [hep-ph]

Authors : P. Arias, J. Redondo, J. Jaeckel and A. Ringwald.
Title: Improving the Discovery Potential of Future Light-Shining-through-a-Wall Experiments.
Conference: 6th Patras Workshop on Axions, WIMPs and WISPs, Zurich, Switzerland, 5-9 Jul 2010.
Published: In press.
e-print: arXiv:1009.1519 [hep-ph]

Authors : D. Cadamuro and J. Redondo
Title: Cosmological constraints on thermal relic axions and axion-like particles
Conferences: 7th Patras Workshop on Axions, WIMPs and WISPs, Mykonos, Greece, 5-9 Jul 2010 and in TAUP 2011, Munich, Germany, 5-9 Sep 2011.
Published: Journal of Physics: Conference Series **375** (2012) 022002
e-print: arXiv:1110.5837v1 [hep-ph]

Authors : DM. Schwarz, A. Lindner, J. Redondo, A. Ringwald and G. Wiedemann
Title: Solar Hidden Photon Search
Conferences: 7th Patras Workshop on Axions, WIMPs and WISPs, Mykonos, Greece, 5-9 Jul 2010.
Published: In press.
e-print: arXiv:1111.5797 [astro-ph.IM]

Authors : Igor Irastorza, for the IAXO collaboration
Title: The International axion observatory (IAXO)
Conferences: 7th Patras Workshop on Axions, WIMPs and WISPs, Mykonos, Greece, 5-9 Jul 2010.
Published: In press.
e-print: arXiv:1201.3949 [hep-ex]

Authors : J. Redondo
Title: The Sun in hidden photons
Conferences: 7th Patras Workshop on Axions, WIMPs and WISPs, Mykonos, Greece, 5-9 Jul 2010.
Published: In press.
e-print: arXiv:1202.4932 [hep-ph]

Authors : J. Redondo
Title: Journey at the axion meV mass frontier
Conference: TAUP 2011, Munich, Germany, 5-9 Sep 2011.
Published: Journal of Physics: Conference Series **375** (2012) 022004.
e-print: arXiv:1202.4932 [hep-ph]

Authors : J. Redondo and B. Döbrich
Title: Dark Matter – a light move
Conference: 9th Patras Workshop on Axions, WIMPs & WISPs (PATRAS13) 24-28 Jun, Mainz, Germany.
Published: DESY-PROC-2013-04
e-print: arXiv:1311.5341 [hep-ph]

Oral communications

Invited seminars

Title: Hunting in the hidden photon parameter space
Institution: DESY
City: Hamburg, Germany
Date: 07/07/2009

Title: A WISPy Primer: Axions, hidden photons and the like in astrophysics and Cosmology
Institution: IPPP
City: Durham, United Kingdom
Date: 11/11/2009

Title: A WISPy Primer: Axions, hidden photons and the like in astrophysics and Cosmology
Institution: Jena University
City: Jena, Germany
Date: 08/12/2009

Title: No light through the ALPS (experiment)
Institution: Max Planck Institute for Physics (MPP)
City: Munich, Germany
Date: 22/04/2010

Title: The diffuse supernova axion background
Institution: University of Zaragoza
City: Zaragoza, Spain
Date: 27 Jan 2011

Title: Wispy signals from the sky
Institution: IFAE, UAB
City: Barcelona, Spain
Date: 15/04/2011

Title: A theory of Dark Matter
Institution: Max Planck Institute for Physics
City: Munich, Germany
Date: 24/03/2010

Title: The meV mass frontier of axions physics
Institution: Universidad de Barcelona
City: Barcelona, Spain
Date: 27/09/2011

Title: WISPY cold dark matter
Institution: Max Planck Institute for Nuclear Physics (MPIK)
City: Heidelberg, Germany
Date: 7/05/2012

Title: WISPY cold dark matter
Institution: University of Zaragoza
City: Zaragoza, Spain
Date: 23/05/2012

Title: Axion cold dark matter
Institution: Invisibles network (webinar)
Date: 27/11/2012

Title: ALP cold dark matter
Institution: ALPS seminar at DESY Hamburg
Date: 08/03/2013

Title: Axion cold dark matter
Institution: GRAPPA, University of Amsterdam, Netherlands
Date: 13/03/2013

Title: WISPy cold dark matter
Institution: LUPM, L2C, University of Montpellier, France
Date: 02/04/2013

Title: Axion cold dark matter
Institution: University of Liege, Belgium
Date: 02/05/2013

Title: Axion cold dark matter
Institution: ICTP, Trieste, Italy
Date: 16/05/2013

Title: Axion cold dark matter
Institution: PUCC, Santiago de Chile, Chile
Date: 27/05/2013

Title: Searching for axion dark matter
Institution: IFT, UAM, Madrid, Spain
Date: 02/06/2013

Title: New experiment for WISPy dark matter
Institution: Tokyo University, Japan
Date: 18/10/2013

Title: A new experiment to search for WISPy dark matter
Institution: Université Libre de Bruxelles, Belgium
Date: 13/12/2013

Title: Axions and the low energy frontier
Institution: MPP Munich (retreat in Bayrisch Zell, Germany)
Date: 19/01/2014

Title: A new experiment to search for axion DM
Institution: DESY Hamburg, Germany
Date: 27/02/2014

Title: DM searches in IAXO
Institution: DESY Hamburg, Germany
Date: 28/02/2014

In Conferences/Workshops

Title: Axions: Past, Present and Future
Conference: QCD06
Organizing Body: LUPM
City: Montpellier, France
Date: 07/06/2006
URL: <http://www.lpta.univ-montp2.fr/users/qcd/>

Title: Evading Astrophysical Bounds on Axion-Like-Particles in Paraphoton Models
Conference: DSU2006
Organizing Body: Universidad Autónoma de Madrid
City: Madrid, Spain
Date: 24/06/2006
URL: <http://dark.ft.uam.es/dsu2006/>

Title: Axions: Can the PVLAS particle be compatible with the astrophysical Bounds?
Conference: 3rd Joint ILIAS-CERN-DESY Axion-Wimps Training Workshop

Organizing Body: Patras University
City: Patras, Greece
Date: 25/06/2007
URL: <http://axion-wimp2007.desy.de/>

Title: Low energy experiments to explore the hidden sector
Conference: 7a Trobada de Nadal de Física Teórica a la Universitat de Barcelona
Organizing Body: Universidad de Barcelona
City: Barcelona, Spain
Date: 19/12/2007
URL: <http://www.ecm.ub.es/~ariadna/Nadal/2007/>

Title: CAST bounds on hidden photons
Conference: 31th CAST collaboration meeting
Organizing Body: CAST collaboration, CERN
City: Geneve, Switzerland
Date: 18/01/2008
URL: <https://indico.cern.ch/conferenceDisplay.py?confId=11731>

Title: Looking for hidden-sector U(1) bosons kinetically mixing with the photon
Conference: SFB meeting Zeuthen
Organizing Body: DESY Zeuthen
City: Zeuthen, Germany
Date: 14/02/2008
URL: <http://wwwiexp.desy.de/sfb676/>

Title: The low energy frontier probes: with photons
Conference: 43th Reencontres de Moriond
Organizing Body: EU, ESA, CNRS, CEA/DAPNIA, CNES, FNRS
City: La Thuile, Italy
Date: 7/03/2008
URL: <https://indico.in2p3.fr/conferenceDisplay.py?confId=420>

Title: The low energy frontier probes: with photons
Conference: Beyond the standard model
Organizing Body: SFB 676, TR-33, Exzellenzcluster "Origin and Structure of the Universe"
City: Bad Honnef, Germany
Date: 11/03/2008
URL: <http://www.desy.de/uni-th/stringth/bad-honnef/bh08.html>

Title: Hidden sector photons: Cosmology and astrophysical bounds
Conference: Planck 2008
Organizing Body: Universidad Autónoma de Barcelona
City: Barcelona, Spain
Date: 19/05/2008
URL: <http://www.ifaes.es/planck2008/>

Title: Bounds on weakly interacting sub eV particles (WISPs) from cosmology and astrophysics
Conference: 4th Patras Workshop on Axions, WIMPs and WISPs
Organizing Body: DESY
City: Hamburg, Germany
Date: 21/06/2008
URL: <http://axion-wimp2008.desy.de/>

Title: Massive Hidden Photons as Lukewarm Dark Matter
Conference: DESY Theory workshop 2008
Organizing Body: DESY
City: Hamburg, Germany
Date: 01/10/2008

URL: <http://th-workshop2008.desy.de/>

Title: Fundamental Physics at a Free Electron Laser
Conference: 11th "Topical seminars on subnuclear physics"
Organizing Body: Roma-III University
City: Rome, Italy
Date: 15/12/2008
URL: <http://agenda.infn.it/conferenceOtherViews.py?confId=967>

Title: A map of the low energy frontier: WISP opportunities beyond QCD axions
Conference: 1st Axion strategy meeting, CERN
Organizing Body: CERN
City: Geneva, Switzerland
Date: 27/01/2009
URL: <http://indico.cern.ch/conferenceDisplay.py?confId=54150>

Title: Theory and Phenomenology of WISPs: very weakly interacting Sub-eV particles
Conference: SFB meeting, Sternwarte Bergedorf
Organizing Body:
City: Hamburg, Germany
Date: 03/03/2009
URL:

Title: Particle Interpretations of the ALPS experiment (for ALPS Collaboration)
Conference: Meeting of the German Society of Physics
Organizing Body: DPG
City: Munich, Germany
Date: 10/03/2009
URL: <http://muenchen09.dpg-tagungen.de/>

Title: The rich phenomenology of light hidden U(1)s
Conference: PASCOS
Organizing Body: DESY
City: Hamburg, Germany
Date: 06/07/2009
URL: <http://pascos2009.desy.de/>

Title: Photon-Axion conversions in transversely inhomogeneous magnetic fields: A primer
Conference: 5th Patras Workshop on Axions, WIMPs and WISPs
Organizing Body: Institute for Particle Phenomenology
City: Durham, United Kingdom
Date: 16/07/2009
URL: <http://axion-wimp2009.desy.de/>

Title: A Hidden Microwave Background? - signatures of photon-WISP oscillations in the CMB
Conference: 5th Patras Workshop on Axions, WIMPs and WISPs
Organizing Body: Institute for Particle Phenomenology
City: Durham, United Kingdom
Date: 16/07/2009
URL: <http://axion-wimp2009.desy.de/>

Title: Fixed target experiments at XFEL
Conference: Dark forces workshop
Organizing Body: Stanford national accelerator laboratory (SLAC)
City: Stanford, United States of America
Date: 26/09/2009
URL: <http://www-conf.slac.stanford.edu/darkforces2009/>

Title: The WISP paradigm
Conference: MPI Project Review 2009
Organizing Body: Max-Planck Institute for Physics
City: Munich, Germany

Date: 14/12/2009
URL: <http://134.107.24.12/indico/conferenceDisplay.py?confId=660>

Title: Constraining Resonant Photon-Axion conversions in the early universe
Conference: Axions 2010
Organizing Body: University of Florida
City: Gainesville, United States of America
Date: 15/01/2010
URL: <http://www.phys.ufl.edu/research/Axions2010/>

Title: How to constraint your favorite decaying dark matter model
Conference: Dark Matter: Its Origin, Nature and Prospects for Detection
Organizing Body: Galileo Galilei Institute for Theoretical Physics
City: Florence, Italy
Date: 20/05/2010
URL: <http://www.ggi.fi.infn.it/index.php?p=schedule.inc&idev=69>

Title: Hidden Photons from the Sun
Conference: 6th Patras Workshop on Axions, WIMPs and WISPs
Organizing Body: University of Zurich
City: Zurich, Switzerland
Date: 07/07/2010
URL: <http://axion-wimp2010.desy.de/>

Title: WISPY signals from the Sky
Conference: 1st Workshop Fundamental Physics @ Low Energies (IPPP)
Organizing Body: Institute for Particle Phenomenology
City: Durham, United Kingdom
Date: 07/04/2011
URL:
http://www.ippp.dur.ac.uk/opencms/opencms/handle404?exporturi=/export/sites/IPPP/Workshops/11/FundamentalPhysics_At_LowEnergies/&%5d

Title: The meV mass frontier of axion physics
Conference: PPC 2011
Organizing Body: CERN
City: Genève, Switzerland
Date: 15/06/2011
URL: <http://indico.cern.ch/contributionDisplay.py?confId=116616&contribId=47>

Title: The Sun in Hidden Photons
Conference: 7th Patras Workshop on Axions, WIMPs and WISPs
Organizing Body: University of Patras
City: Mykonos, Greece
Date: 07/07/2011
URL: <http://axion-wimp2011.desy.de/>

Title: WISPs: Theory and phenomenology overview
Conference: Fundamental physics at the intensity frontier workshop
Organizing Body: U.S. Department of Energy, Office of Science
City: Rockville, United States of America
Date: 01/12/2011
URL: <https://twindico.hep.anl.gov/indico/conferenceOtherViews.py?view=standard&confId=751>

Title: Motivations for WISPs: cosmology, astrophysics and particle physics
Conference: A (not so) WISPY day (DESY)
Organizing Body: DESY

City: Hamburg, Germany
Date: 13/02/2012
URL: http://www.pier-campus.de/ausbildung/wispy_lecture_day

Title: Weakly Interacting Slim Particles
Conference: DPG Fruehjahrstagung
Organizing Body: DPG
City: Goettingen, Germany
Date: 28/02/2012
URL: <http://www.dpg-verhandlungen.de/year/2012/conference/goettingen/part/t/session/7>

Title: WISPY cold dark matter
Conference: Vistas in axions
Organizing Body: Institute for Nuclear Theory (INT)
City: Seattle, United States of America
Date: 25/04/2012
URL: <http://www.int.washington.edu/PROGRAMS/12-50w/>

Title: Weakly Interacting Slim Particles (WISPs)
Conference: String Phenomenology 2012
Organizing Body: Isaac Newton Institute for Mathematical Sciences
City: Cambridge, United Kingdom
Date: 25/06/2012
URL: <http://www.newton.ac.uk/programmes/BSM/bsmw05.html>

Title: WISPY cold dark matter
Conference: 8th Patras Workshop on axions, WIMPs and WISPs
Organizing Body: Fermilab
City: Chicago, United States of America
Date: 23/07/2012
URL: <http://axion-wimp2012.desy.de>

Title: Axion cold dark matter
Conference: 6th Symposium on large TPCs for low energy rare event detection
Organizing Body: CEA/DSM/Irfu/CNRS/IN2P3/APC Paris/ Zaragoza U.
City: Paris, France
Date: 17/12/2012
URL: <http://www-tpc-paris.cea.fr/>

Title: WISPY cold dark matter
Conference: MPI Project Review 2012
Organizing Body: Max-Planck Institute for Physics
City: Munich, Germany
Date: 18/12/2012
URL: <http://indico.mppmu.mpg.de/indico/conferenceDisplay.py?confId=1971>

Title: IAXO
Conference: SNOWMASS on the Mississippi
Organizing APS
City: SLAC, USA
Date: 06/03/2013
URL: <http://www.snowmass2013.org/tiki-index.php>
Title: WISPs, Theory and pheno update
Conference: Workshop, particle physics at the intensity frontier
Organizing DOE, USA
City: Argonne National Laboratory, USA
Date: 25/04/2013
URL: <https://indico.fnal.gov/conferenceDisplay.py?confId=6248>

Title: Searching for axion dark matter
Conference: Workshop - Dark Matter searches at accelerators
Organizing: IPhT, Saclay, Paris
City: Paris, France
Date: 07/06/2013
URL: http://ipht.cea.fr/Phocea-SPhT/ast_visu_spht.php?id_ast=684

Title: Detecting axion (WISPy) dark matter
Conference: Workshop - Dark matter: a light move
Organizing: DESY, HAP
City: Hamburg, Germany
Date: 17/06/2013
URL: <https://indico.desy.de/conferenceDisplay.py?confId=7975>

Title: Summary of the workshop: Dark matter: a light move
Conference: 9th Patras workshop on axions, WIMPs and WISPs
Organizing: Prisma excellence cluster, DESY, CERN, JG U., Heidelberg U. Patras U., Zurich U. , Bern U.
City: Mainz, Germany
Date: 28/06/2013
URL: <http://axion-wimp2013.desy.de/e201123/>

Title: WISPy dark matter
Conference: Particle physics and cosmology after the discovery of the Higgs boson
Organizing: Tohoku forum for creativity, Tohoku U.
City: Sendai, Japan
Date: 24/10/2013
URL: <http://www.sci.tohoku.ac.jp/tfc/index.html>

Title: ALP dark matter (detection)
Conference: News from the dark
Organizing: LUPM, Montpellier U., CNRS, OCEVU
City: Montpellier, France
Date: 4-6/12/2013
URL: <https://indico.in2p3.fr/conferenceDisplay.py?confId=9143>

Title: Axions (slides)
Conference: XLII International Meeting on Fundamental Physics
Organizing: U. Barcelona, U.A. Barcelona, IFAE
City: Benasque, Spain
Date: 29/01/2014
URL: <http://www.benasque.org/2014imfp/>

Events organized

Conferences/Workshops

Title: Brainstorming and Calculationshop on the low energy frontier
Location/Date: DESY Hamburg 11-14 Jun 2008
elink: <http://alps-wiki.desy.de/e13/e42>

Title: 4th Patras Workshop on Axions, WIMPs and WISPs
Location/Date: DESY Hamburg 18-21/06/2008
elink: <http://axion-wimp2008.desy.de/>

Title: "Dark matter: a light move"
Location/Date: DESY Hamburg 17-18/06/2013
elink: <https://indico.desy.de/conferenceDisplay.py?confId=7975>

Others

I have organized the Astroparticle seminars at the Max Planck Insitute for Phycis in the 2009-2012 period together with Dr. C. Biggio, and in 2010-2011 with Dr. L. Calibbi.

Teaching experience

Teaching positions

- Partial-time associate professor. Autonomous University barcelona. 19/02/07 to 14/09/07

Undergraduate courses

Course: General Physics Lab
Duration: 100 h
Institution: Universidad Autónoma de Barcelona
Date: 2003-2007

Course: Electromagnetism Lab
Duration: 20 h
Institution: Universidad Autónoma de Barcelona
Date: 2003-2005

Course: Physics II (for Chemists)
Duration: 30 h
Institution: Universidad Autónoma de Barcelona
Date: 2006-2007

Course: One variable calculus
Duration: 7 h
Institution: Universidad Autónoma de Barcelona
Date: 2006-2007

Graduate courses

Title: Axions and other WISPs
Type: Lecture series (block course)
Duration: 4 lectures, 1 ½ hours each.
Institution: Technische universitat Dresden/DESY Zeuthen
Location/Date: Rathen, Germany 7-11 Mar 2011.

Title: Axions and the strong CP problem
Type: Lecture series (block course)
Duration: 5 lectures, 2 hours each.
Institution: Max Planck Institute for Physics.
Location/Date: Munich, Germany. 28-29 Apr, 4-6 May 2011.

Supervised PhD thesis

PhD: Davide Cadamuro
Topic: Cosmological constraints on axions and axion-like particles
Date: 12/10/12

Currently supervised students

PhD: Hendrik Vogel
Topic: Supersymmetric hidden-sector dark matter and dark radiation

Research Interests (course-grained)

I have broad interests in both theoretical physics and phenomenology. My main interest is the phenomenology of physics beyond the standard model (PBSM). I feel especially attracted towards the fields of astrophysics and cosmology, in particular to the subjects of dark matter and dark radiation, big bang nucleosynthesis and physics of the cosmic microwave background, and stellar evolution.

Unfortunately, the best we can obtain from these fields are indirect evidences, which at the end we want to be firmly established by pure laboratory experiments. I am of course interested in the outcome of the LHC, but also in the development of small scale experiments testing the low energy frontier with increasing precision. I'm referring here to experiments searching for dark matter, neutrino masses and mixings, axions and other low mass particles beyond the standard model, new long-range forces, anomalous magnetic moments, Lamb shifts, etc. I have also interest in experimental tests of fundamental physics with intense laser sources.

On the theoretical side I am interested in theories of grand unification and quantum gravity such as string theory, mainly in their testable properties at low energy.

Finally, I should remark that I would like to grow up towards being a broadband physicist, opened to new ideas, fields and collaborations.

Research Interests (concrete)

Nowadays my interests focus on the theory and phenomenology of weakly interacting sub-eV particles on the laboratory, cosmology and astrophysics.

The most remarkable WISP candidate is the axion, that appears in the Peccei-Quinn solution to the strong CP problem as an essential ingredient. There are two main frontiers to search for the axion and I am deeply involved in both. In the meV mass frontier, axions can have a role in the evolution of red-giant and white-dwarf stars and on supernova explosions and neutron star cooling. Interestingly, some recent studies on the period decrease of the variable G117-B15A and on the white-dwarf luminosity function show a slight preference for axion cooling. The studies of red-giant evolution as well as supernova and neutron star cooling in the presence of axions are already quite old. A fresh view on these topics could clarify the white-dwarf cooling issue. From the particle physics point of view it is important to re-evaluate the axion production rates including finite-density and thermal corrections. From the astrophysics modeling perspective it is timely to include axion emission in state-of-the-art stellar evolution codes and assess the impact on astronomical observables precisely. From the astronomical point of view it is extremely relevant to have high-statistics and detailed spectroscopy of the class of stars under consideration, data that are already available or will be in the near future. Axions with a meV mass can be tested in the next generation axion Helioscope, IAXO, a project in which I'm also involved. My roles there are to provide an accurate estimate of the solar axion flux, study other WISPs that can be probed with IAXO (axion-like particles, hidden photons, minicharged particles, chameleons and other environmentally dependent fields) and study the feasibility of axion dark matter experiments with the huge magnetic volume devised for IAXO (see later). I've been working already a number of years in the emission of WISPs from the Sun, particularly axions and hidden photons (HPs). The latter case has proven to be specially rich a field, full of subtleties and requiring thermal field theory methods and detailed atomic physics knowledge. I plan to finish the characterization of the low-energy spectrum (most relevant for low mass hidden photons) during the following year. This spectrum is a required ingredient for the SHIPS (solar hidden photon search) experiment at the Hamburger sternwarte, which is currently taken data, and from which I'm a collaboration member. With the experience gained I plan to study the impact of HPs in other stellar environments. Since the emission of low-mass HPs is extremely suppressed in dense environments they can have a very strong impact in stellar formation and brown dwarfs, which I plan to survey.

The classical axion dark matter frontier was considered to be the micro-eV mass up to recently. It is however clear now that due to the decay of axionic topological defects the study range has to be enlarged to the meV mass. At the same time, it has been recently pointed us by me and my collaborators that very similar particles, so called axion like particles, and other WISPs such as HPs might be very similarly candidates to account for the dark matter of the universe. From the theoretical point of view this is very appealing given the plethora of these fields appearing in ambitious completions of the standard model, specially in string compactifications. The cosmology of axions or WISPs as dark matter has been worked out to some extent but there are zillions of aspects to improve or develop. In particular, I would like to work out numerical methods to do reliable large-dynamical-range simulations of string and domain wall decay (the current predictions rely on extrapolation over more than 10 orders of magnitude), exploring non perturbative methods if necessary. This has to be applied not only to the QCD axion case, but also to axion-like particle like those appearing in string compactifications. It is also intriguing what would happen if not one QCD axion exist but it is accompanied by lower mass axion-like states. Resonances and energy transfer between the

different particles can happen and change enormously the predictions.

A long term project is to assess the formation of a Bose-Einstein condensate of cold-dark-matter axions due to gravitational interactions as suggested by P. Sikivie and his collaborators. If this is the case, the axion can have spectacular effects in structure formation which would need special methods to be tested for instance in large scale structure simulations. Sikivie has suggested also that this mechanism is so strong that it might even lead to the partial thermalisation of QCD axions with the consequent entropy suck from the standard model primordial plasma, which would lead to an enhancement of the effective number of neutrinos during the CMB epoch. I have strong reasons to believe this to be false, but I have to work out the details to disprove it. Another aspect that has been long known is the formation of axion mini-clusters, due to non-linearities of the axion potential, that could be discovered by gravitational lensing. The field has been unfortunately abandoned for some time and I plan to retake it and face it with prospects for the next generation of lensing probes. All said for the QCD axion, all these aspects can be studied in generic cases of an axion-like particle with a different coupling-mass relationship, and hidden photons where the higher spin can have radically different implications.

On top of all these aspects of cosmological production of axions, there is the need of developing new experimental techniques that would allow to cover the recently enlarged axion cold-dark-matter range up to the meV. I am already working on alternative concepts to the well known cavity experiment (with ADMX in the US the only living realization) employing dish antennas. With J. Jaeckel and our collaborators in DESY we are deeply involved in pushing a joint European effort to boost experimental efforts to discover WISP cold-dark-matter. As a little part of this effort, I plan to study the feasibility of using IAXO for dark matter searches in parallel to his normal operation as a solar axion telescope. Besides dark matter, I am also very intrigued by the nowadays apparent excess of dark radiation, reflected in the anomalously high number of effective neutrinos suggested by CMB and BBN arguments. If this preference is confirmed by the results of the Planck satellite, one is forced to assume additional very weakly interacting su-eV particles, i.e. WISPs, or some other exotica like a massive particle decaying at late times. These WISPs can be sterile neutrinos, hidden photons or a number of other possibilities. I am interested in model building and in constraining the parameter space of these particles and models.

Besides the phenomenology of WISPs I am interested in a number of topics in astrophysics and cosmology like inflation, big bang nucleosynthesis and the lithium problem, structure formation, physics of the CMB, reionization and cosmic rays. Understanding the nature of dark matter is doubtlessly one of the main drivers of my motivation and research. Besides the above, I am interested in general dark matter model building and calculations. Recently I have worked a bit in the paradigm of asymmetric dark matter and its natural connection with the existence of dark radiation. I plan to continue working in this direction exploring the impact of dark-matter particle anti-particle oscillations in the presence of a thermal bath of dark radiation. Since some time I have followed the ideas of the unified dark matter models of Arkani-Hamed, Weiner and collaborators, in which the dark matter candidate features interactions with a massive vector boson (massive HP) or scalar. The presence of U(1) gauge symmetries is well motivated in extensions of the SM based on string theory and these can be also unbroken. Currently we are developing a unified model with SUSY in a hidden sector where there is an unbroken U(1), which leads to the right amount of dark matter as well as dark radiation. I plan to continue on model building and the phenomenology of these models.

These are most of my personal projects, in which I plan to work in the following months and years. In some of them I am already an expert and could do already the calculations, that however will take some time, while others require further study for which I am highly motivated.

As a disclaimer, I am forced to write that these are not all my research interests, which put together would challenge the patience of the most scrupulous reviewer, but a selection that I believe reflects reasonably the whole.