

CURRICULUM VITAE

MIRCO CANNONI

Place and date of birth: Perugia (Italy), 08/02/1974
Nationality: Italian

PRESENT POSITION AND INSTITUTION

Three year post-doc fellowship within the Spanish project: “MultiDark - Multimessenger approach for dark matter detection”. Hired member in the group of the University of Huelva.

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Facultad de Ciencias Experimentales
Campus de El Carmen 21071 Huelva (Spain)

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EDUCATION

Dottorato di Ricerca in Fisica (Ph. D. degree in Physics)

Thesis: “*Studies of signals with lepton and flavor number non-conservation for the next generation of colliders*”,

University of Perugia, Italy (December 2003)

Advisor: Dr. O. Panella (INFN)

Schools attended during the Ph. D.

- *LNF Spring School 2000*, LNF Frascati, 15-20 May 2000
- *LNF Spring School 2001*, LNF Frascati, 28 May-2 June 2001
- *XIV Seminario Nazionale di Fisica Nucleare e Subnucleare*, 20-26 September 2001
Serra degli Alimini, Otranto
- *LNF Spring School 2002*, LNF Frascati, 20-24 May 2002
- *LNF Spring School 2003*, LNF Frascati, 19-23 May 2003

Laurea in Fisica (Diploma in Physics)

Thesis: “*Teoria e fenomenologia dei neutrini pesanti di Majorana (Theory and phenomenology of heavy Majorana neutrinos)*”,

University of Perugia, Italy (October 2000)

Advisor: Dr. O. Panella (INFN)

KNOWN LANGUAGES

Italian (Native), English, Spanish, French (basic)

POSITIONS AND FELLOWSHIPS

- 1/08/2010-31/7/2013: MultiDark Fellow at the University of Huelva, Spain.
- January-July 2010: post-doc position at the University of Huelva, Spain (Fellowship from “Junta de Andalucia”)
- 2005-2009: post-doc position at Physics Department, University of Perugia, Italy.
- 2004: post-doc position at Laboratoire de Physique Nucleaire et de Hautes Energies (LPNHE), Paris, France.
Fellowship from the Italian institution “Fondazione Angelo Della Riccia”.

RESEARCH

My research field is theoretical particle physics and particle astrophysics, with emphasis on the phenomenology of extensions of the Standard Model. I am interested in studying how signals of new physics may show up from astrophysical sources and phenomena, at hadron and lepton colliders and in rare decay processes:

- Phenomenology of dark matter, direct and indirect detection;
- Production and detection of new particles in high energy collisions.
- Neutrino masses, lepton number and flavour violation.

TEACHING AND SUPERVISION OF STUDENTS

- Thesis advisor (with O. Panella (INFN) and M. Pioppi (Imperial College)) for the “Laurea” in Physics of Marco Santoni, Perugia University (December 2011). Thesis: “Study of inclusive production at LHC of like-sign dileptons in supersymmetric models”. A derived study from this thesis has been published in Phys. Rev D. (See list of publications.)
- Teaching at Department of Physics, University of Perugia:
In the academic year 2005/2006 I have been assistant for the course “Classical Mechanics”, while in the academic years 2006/2007, 2007/2008 for the courses “Classical Physics I” and “Classical Physics II”. The activity consisted in frontal lessons in the classroom and participation in examination sessions.
- Teaching at the Faculty of Pharmacy of University of Perugia:
In the academic years 2005/2006, 2006/2007, 2007/2008 I had the responsibility of the course “Physics”, for “Laurea” in Pharmacy.

TALKS GIVEN AT INTERNATIONAL CONFERENCES

- "Gamma rays from boosted neutralinos at the galactic center", presented at:
 - *DSU 2012: 8th International Workshop on The Dark Side of the Universe*, June 10-15 2012, Buzios, Brasil.
- "Spin-dependent neutralino-nucleus scattering simplified", presented at:
 - *DSU 2011: 7th International Workshop on The Dark Side of the Universe*, September 26-30 2011, Beijing, China.
 - *TEVPA 2011: 7th TeV Particle Astrophysics Conference*, August 1-5 2011, Stockholm, Sweden.
 - *PLANCK 2011: From the Planck Scale to the Electroweak Scale*, May 30-June 3, 2011, Lisbon, Portugal.
 - *4th Multidark Consolider Workshop*, April 4-6 2011, Madrid, Spain
- "Extraction of neutralino-nucleon cross sections from total rates", presented at:
 - *3rd Multidark Consolider Workshop*, November 15-16 2011, Trujillo, Spain
- "Internal bremsstrahlung in neutralino annihilation: revised impact on indirect detection by gamma rays", presented at:
 - *IDM 2010: 8th International Workshop on Identification of Dark Matter*, July 26-30 2010, Montpellier, France
 - *2nd Multidark Consolider Workshop*, June 28-30 2010, Santander, Spain
 - *DSU 2010: 6th International Workshop on The Dark Side of the Universe 2010*, June 1-6 2010, Leon, Mexico
- "SUSY LFV from the Higgs sector at a phton collider and LHC (and the dark mater connection)", presented at:
 - *LC09: e^+e^- Physics at the TeV Scale and the Dark Matter Connection*, September 21-24 September 2009, Perugia, Italy.
- "Susy lepton flavor violating signals at a photon collider", presented at:
 - *ILC Physics in Florence*, Istituto Galileo Galilei, September 12-14 2007, Florence, Italy.
- "Loop-level flavor and number violation in e^-e^- collisions ", presented at:
 - *LCWS 2004: International Conference on Linear Collider*, April 19-23 2004, Paris, France.
- "Loop-level lepton flavor violation at linear colliders", presented at:
 - *AHEP 2003: International Workshop on Astroparticle and High Energy Physics*, October 14-18, 2003, Valencia, Spain.

LIST OF PUBLICATIONS

1. M. Cannoni, J. Ellis, M. E. Gomez and S. Lola,
“Neutrino textures and charged lepton flavour violation in light of θ_{13} , MEG and LHC data,”
Submitted for publication.
arXiv:1301.6002 [hep-ph].
2. M. Cannoni,
“Reanalysis of nuclear spin matrix elements for dark matter spin-dependent scattering”,
Submitted for publication.
arXiv:1211.6050.
3. M. Cannoni, O. Panella, M. Pioppi and M. Santoni,
“Probing dark matter and CMSSM with same-sign dilepton searches at the LHC”,
Phys. Rev. D **86**, 037702 (2012) [arXiv:1206.5759].
4. M. Cannoni, M. E. Gomez, M. A. Perez-Garcia and J. D. Vergados,
“New gamma ray signal from gravitationally boosted neutralinos at the galactic center”,
Phys. Rev. D **85**, 115015 (2012) [arXiv:1205.1709].
5. M. Cannoni,
“Formalism and upper limits for spin-dependent cross sections in dark matter elastic scattering with nuclei,”
Phys. Rev. D **84**, 095017 (2011) [arXiv:1108.4337]
6. M. A. Sanchez-Conde, M. Cannoni, F. Zandanel, M. E. Gomez, F. Prada,
“Dark matter searches with Cherenkov telescopes: nearby dwarf galaxies or local galaxy clusters?”,
JCAP **1112**, 011 (2011) [arXiv:1104.3530]
7. M. Cannoni, J. D. Vergados, M. E. Gomez,
“Scheme for the extraction of WIMP-nucleon scattering cross sections from total event rates”,
Phys. Rev. D **83**, 075010 (2011) [arXiv:1011.6108]
8. M. Cannoni, M. E. Gomez, M. A. Sanchez-Conde, F. Prada, O. Panella,
“Impact of internal bremsstrahlung on the detection of γ -rays from neutralinos”,
Phys. Rev. D **81**, 107303 (2010) [arXiv:1003.5164]
9. M. Cannoni and O. Panella,
“Neutralino dark matter and Higgs mediated lepton flavor violation in the minimal supersymmetric standard model”,
Phys. Rev. D **81**, 036009 (2010) [arXiv:0910.3316]
10. M. Cannoni and O. Panella,
“Supersymmetric Higgs mediated lepton flavor violation at a Photon Collider”,
Phys. Rev. D **79**, 056001 (2009) [arXiv:0812.2875]

11. D. A. Anipko, M. Cannoni, I. F. Ginzburg, K. A. Kanishev, A. V. Pak and O. Panella,
"Charge asymmetries in $\gamma\gamma \rightarrow \ell^+\ell^- + \nu's (\ell = \mu, e)$ with polarized photons in the Standard Model",
Phys. Rev. D **78**, 093009 (2008) [arXiv:0806.1760]
12. M. Cannoni, C. Carimalo, W. Da Silva and O. Panella,
"Testing SUSY models of lepton flavor violation at a photon collider"
Phys. Rev. D **72**, 115004 (2005) [Erratum-ibid. D **72**, 119907 (2005)] [arXiv:hep-ph/0508256]
13. M. Cannoni, S. Kolb and O. Panella,
"Lepton flavour violation in $e^\pm e^- \rightarrow \ell^\pm e - (\ell = \mu, \tau)$ induced by R-conserving supersymmetry" Phys. Rev. D **68**, 096002 (2003) [arXiv:hep-ph/0306170]
14. M. Cannoni, S. Kolb and O. Panella,
"On the heavy Majorana neutrino and light sneutrino contribution to $e^-e^- \rightarrow \ell^-\ell^-, (\ell = \mu, \tau)$ "
Eur. Phys. J. C **28**, 375 (2003) [arXiv:hep-ph/0209120]
15. O. Panella, M. Cannoni, C. Carimalo and Y. N. Srivastava,
"Signals of heavy Majorana neutrinos at hadron colliders",
Phys. Rev. D **65**, 035005 (2002) [arXiv:hep-ph/0107308]

PUBLICATIONS IN CONFERENCE PROCEEDINGS

1. M. Cannoni,
"Gamma rays from boosted neutralinos at the galactic center",
Submitted to Proceedings of Science Pos(DSU2012)
2. M. Cannoni,
"Some considerations on formalism for the spin-dependent WIMP-nucleus elastic scattering",
J. Phys. Conf. Ser. **384**, 012003 (2012).
3. M. Cannoni, M. E. Gomez, M. A. Sanchez-Conde, F. Prada and O. Panella,
"Internal bremsstrahlung in neutralino annihilation: Revised impact on indirect detection from gamma-rays,"
J. Phys. Conf. Ser. **315**, 012018 (2011), Proceedings of Science PoS(IDM2010)076
4. M. Cannoni and O. Panella,
"Higgs sector of the MSSM: lepton flavor violation at colliders and neutralino dark matter,"
Nuovo Cimento C **33**, 188 (2010)
5. M. Cannoni and O. Panella,
" $\gamma\gamma \rightarrow \mu\tau b\bar{b}$ in Susy Higgs mediated lepton flavor violation",
Nuovo Cimento **32 C**, 3, 229 (2010)
6. M. Cannoni, C. Carimalo, W. Da Silva and O. Panella,
"High energy photon collisions, new paths to lepton flavour violation",
Acta Phys. Polon. B **37**, 1079 (2006)

7. D. A. Anipko, M. Cannoni, I. F. Ginzburg, O. Panella and A. V. Pak,
Charge asymmetries in $\gamma\gamma \rightarrow \mu^+\mu^- + \nu_\mu\bar{\nu}_\mu/\gamma\gamma \rightarrow W^\pm\mu^\mp + \nu_\mu$ with polarized photons,”
Nucl. Phys. Proc. Suppl. **126**, 354 (2004).
8. M. Cannoni, O. Panella and S. Kolb,
“Loop level lepton flavor violation at linear colliders”,
Proceedings of Science PoS(AHEP2003)005

DETAILS OF PRESENT AND FUTURE RESEARCH LINES

My present and future line of research is mainly focused on the phenomenology of models beyond the standard model with particular emphasis on the problem of dark matter (DM). In the following I briefly outlined the main results obtained in recent publications. Numbers refer to the List of Publications on Refereed Journals.

DIRECT DETECTION:

Direct detection by elastic scattering with nuclei in a detector in earth based laboratories is mandatory to establish the properties of DM particles.

In [1] I have shown how to include in the calculation of the spin-dependent WIMP-nucleus cross section, the corrections to the isovector coupling that arise in chiral perturbation theory, and clarified some previously unrecognized properties of the nuclear structure functions.

In [4], I have shown that the standard formalism for spin dependent scattering can be drastically simplified using a suitably normalized form of the nuclear form factors, clarifying the method for setting upper limits on spin-dependent cross sections.

I have shown in [6] that the measurement of total event rate in three different nuclear target would allow, for a given neutralino mass, for the extraction of the spin-independent and the two spin-dependent neutralino-nucleon cross sections.

INDIRECT DETECTION:

Supersymmetric and non-supersymmetric extensions of the standard model that predict a DM candidate can be tested and constrained in an indirect way by studying the characteristics of the annihilation that should take place in the halo of the Milky Way, of the dwarf galaxies and cluster of galaxies.

In [3] we have proposed a new gamma-ray signal of neutralino annihilation near the supermassive black-hole at galactic center. Sub-relativistic neutralinos can have enough energy to annihilate into a pair of next-to-light supersymmetric particles, the stau, whose decays provide a peculiar gamma ray signal.

In [5] we make a comparative studies of dwarf galaxies and galaxy clusters to elucidate which object is most suited for detecting gamma rays from dark matter annihilation with Cherenkov telescopes. In particular we have studied in details the effect of telescope’s resolution and the effect of substructures in the halo of galaxy clusters using an analytical approach that allows to avoid complex simulations.

In [7] we have studied the impact of internal bremsstrahlung on the flux of gamma rays expected from the annihilation of neutralinos in the halo of the Draco dwarf galaxy and the prospect for detection with Cherenkov telescopes, thus updating some previous stud-

ies that did not include such contribution.

COLLIDER PHYSICS AND LEPTON FLAVOUR VIOLATION:

On the other hand, LHC with already providing evidence for the existence of a particle with the properties of the Higgs boson of the Standard Model, already puts strong constraints on beyond Standard Model physics scenarios. In the next years, with larger statistics, it will be possible to discover or exclude the existence of particles, certainly also DM candidates, predicted by these models. Thus the study of new physics at LHC is complementary with astrophysics based signals.

In [2] we have introduced new variables for the study of the inclusive same sign dileptons production at LHC which are built out of ratios of the observed number of same-sign dileptons. We have applied them to constrain the stau coannihilation region of the constrained minimal supersymmetric standard model.

Collider physics will be probably enriched in the future with the construction of an electron-positron Linear Collider that, as it was the LEP in the past, will be the best instrument to measure couplings and properties of new particles.

Neutrinos, among the known particles, have been in the last years source of new discoveries that at the same time leave many open questions like their possible Majorana nature, absolute mass scale, implication for lepton flavour violation in the charged lepton sector. Past works connecting neutrino physics, lepton number and flavour violation with collider physics are found in the articles [9]-[14].

In [1] we have recently revisited, in light of recent results from the LHC, MEG, neutrino experiments, the issue of charged lepton flavour violation (LFV), which arises naturally in supersymmetric theories with massive neutrinos via flavour-violating soft supersymmetry-breaking masses for sleptons induced by radiative corrections. Using various Abelian flavour texture models, we link the results to the expectations for neutrino mixing angles, with particular focus on θ_{13} , and the prediction for the radiative decays $\mu^- \rightarrow e\gamma$ and $\tau^- \rightarrow \mu\gamma$, and on detection prospects at the LHC and a linear collider (LC).

Future projects will move along the above three highlighted phenomenological directions focusing on the connection between DM, the Higgs sector in beyond the standard model physics and lepton flavour violation.

February 2013

Mirco Cannoni