

Lattanzi Massimiliano

Position: ICRA Postdoctoral fellow at the Physics Department,
“Sapienza” University of Rome

Period covered: 2002 - Present



I Scientific Work

His main research interest are in the areas of Cosmology and Astroparticle Physics. He has been studying the role of neutrinos in cosmological evolution, and the possibility of measuring neutrino-related quantities through cosmological observation.

During his Ph. D. studies, carried at the “Sapienza” University in Rome under the supervision of R. Ruffini from 2002 to 2005, he has obtained a robust upper limit on the cosmological lepton asymmetry from analysis of the cosmic microwave background data (see ML, Ruffini, Vereshchagin, PRD 72, 063003, 2005). In the same period, together with G. Montani, he has studied the issue of the interaction of cosmological gravitational waves with neutrinos (ML & Montani, Mod. Phys. Lett. A 20, 2607, 2005). This latter work has been recently extended to include the interaction with spinning particles (Milillo, ML, Montani, IJMP A23, 1278, 2008).

In 2006, he spent one year as a post-doc at the Institute for Particle Physics in Valencia (Spain), where he mainly collaborated with J. Valle and S. Pastor, other than with other post-docs and Ph.D. students. Here he studied, together with J.W.F. Valle, the possibility of relating the problem of dark matter to the issue of the origin of neutrino masses, proposing a new dark matter candidate, the majoron (ML, Valle, PRL 99, 121301, 2007) and studying the perspectives for its indirect detection (Bazzocchi, ML, Riemer-Sørensen, Valle, JCAP 0808:013, 2008). The collaboration with this spanish institution continues to date, and has recently led to a paper where tight limits are found on the cosmological significance of the so-called “mass-varying neutrinos” scenarios (França, ML, Lesgugues, Pastor, PRD 80, 083506, 2009).

In 2007-2008, he has been working with J. Silk at the Oxford University (UK) on the topic of indirect detection dark matter, focusing mainly on the signal produced by the annihilation of supersymmetric particles. Cumberbatch, ML and Silk (submitted to PRD) have studied the 21cm signal generated by neutralino and light dark matter annihilations. In 2008, ML and Silk (PRD 29, 083523, 2009) have proposed a scenario to explain the anomalous positron excess observed by the PAMELA experiment in terms of supersymmetric dark matter annihilations. In particular, this scenario involves the enhancement of the dark matter annihilation cross-section in cold substructures inside the galaxy, by means of a quantum effect known as the “Sommerfeld effect”. The paper has been very well received by the dark matter community and has stimulated a wide discussion on the topic.

Since the beginning of 2009, he is working as an ICRA post-doctoral fellow at the “Sapienza” University in Rome. In the past few months, he has been carrying on the already existing lines of

research, producing a follow-up to the paper on the Sommerfeld enhancement (Pieri, ML, Silk, MNRAS, in press) and the above-mentioned paper on mass-varying neutrinos. He also started new projects and new collaborations that will likely lead to scientific publications in the near future. Among them, there is the study of the relevance of neutrino decoupling for the detection of cosmological gravitational waves (with R. Benini and G. Montani), a statistical analysis of cosmological models with a vanishing cosmological constant (with A. Melchiorri, S. Pandolfi), a study of the relevance of plasma physics to cosmology (with R. Benini, N. Carlevaro, B. Coppi, G. Montani, R. Ruffini), and the study of the possibility of using Gamma-ray bursts as standard candles (with L. Izzo and R. Ruffini)

II Conferences and educational activities

Conferences and Other External Scientific Work

2009

- TAUP 2009, Rome, Italy
- 2nd Italian-Pakistani Workshop on Relativistic Astrophysics, Pescara, Italy
- 12th Marcel Grossmann Meeting on General Relativity, Paris, France

2008

- UniverseNet: the 2nd Network School and Meeting, “Seeking links between fundamental physics and cosmology”, Oxford (UK).
- Neutrino Oscillation Workshop 2008, Otranto (LE), Italy.
- 3rd Stueckelberg Workshop on Relativistic Field Theories, Pescara, Italy

2007

- Royal Astronomical Society Specialist Discussion Meeting: “Statistical challenges in particle astrophysics and cosmology”, London, UK
- Institute of Physics “Theta13 half day meeting”, Oxford, UK
- 2nd Meeting of the “Red Nacional Temática de Astroparticulas” (RENATA), Valencia, Spain
- Workshop “The Path to Neutrino Mass”, Aarhus, Denmark.
- 4th Italian-Sino Workshop on Relativistic Astrophysics: “Astrophysics at $z > 6$ ”, Pescara, Italy.
- 10th Italian-Korean Symposium on Relativistic Astrophysics, Pescara, Italy.
- XIX^{èmes} Rencontres de Blois: “Matter and Energy in the Universe: from nucleosynthesis to cosmology”, Blois, France.

2006

- 1st Meeting of the “Red Nacional Temática de Astroparticulas” (RENATA), Valencia, Spain

- 11th Marcel Grossmann Meeting on General Relativity, Berlin, Germany
- 3rd Italian-Sino Workshop on Relativistic Astrophysics: “Supernovae, GRBs and Cosmology”, Pescara, Italy.
- International School on Astro-Particle Physics: “Neutrinos in Physics, Astrophysics and Cosmology”, Munich, Germany.

2005

- IRAP Ph.D. School in Pescara, Italy.
- “Albert Einstein Century” International Conference, Paris, France
- 2nd Italian-Sino Workshop on Relativistic Astrophysics: “Probing the Dark Universe”, Pescara, Italy

2004

- “Testing the equivalence principle in space and on ground” meeting, Pescara, Italy.
- 1st Sino-Italian Workshop on Cosmology and Relativistic Astrophysics, Pescara, Italy

2003

- “VIII Italian-Korean Symposium on Relativistic Astrophysics”, Pescara, Italy
- “X Marcel Grossman Meeting on General Relativity”, Rio de Janeiro, Brazil.

2002

- “X Brazilian School of Cosmology and Gravitation”, Rio de Janeiro, Brazil.
- X ICRA Network Workshop on ‘Black Holes, Gravitational Waves and Cosmology’, Roma and Pescara, Italy.
- “Science and Ultimate Reality Symposium” in honour of J. A. Wheeler, Princeton N.J.

2001

- XI ICRA Network Workshop on ‘Fermi and Astrophysics’, Pescara, Italy.
- VII Italian-Korean Meeting on Relativistic Astrophysics, Inje University, South Korea.
- VI ICRA Network Workshop on ‘Time Structures in Relativistic Astrophysics’, Pescara, Italy.

Work With Students

Teaching Experiences:

2005 *Lecturer:* IRAP Doctorate School, Pescara, Italy

Delivered a lecture on the thermodynamics in the expanding Universe.

2002 *Postgraduate Teaching Assistant:* University of Rome ‘La Sapienza’

Physics Laboratory. Supervised lab sessions, graded papers and exams.

2001 – 2005 *Substitute Lecturer*: University of Rome ‘La Sapienza’

Delivered several lectures to the advanced general relativity class on the evolution of metric perturbations in a Friedmann Universe.

Work with graduate students

At the moment, he is following IRAP Ph.D. student Stefania Pandolfi, working on the statistical analysis of cosmological data. He is also collaborating with Luca Izzo on the possibility of using GRBs as standard candles.

In the past, he has been working with graduate students from different institutions, including D. Cumberbatch (Oxford), U. França (Valencia), I. Milillo (Rome and Portsmouth), S. Riemer-Sørensen (Aarhus).

Diploma thesis supervision

He followed as an adjoint supervisor Roberto Guida, now an IRAP PhD graduate, during its diploma thesis work, titled “Fractality and cosmological initial conditions: the role of the velocity field” (graduation date 30/9/04).

III Service activities

Within ICRANet

2005 Research Assistant, ICRANET

Outside ICRANet

2009 – Present Postdoctoral Fellow, ICRA and Physics Dept. “Sapienza” University, Rome (IT)

2007 – 2008 Postdoctoral Fellow, Physics Department, Oxford University (UK)

2006 Postdoctoral Fellow, Institute For Particle Physics, Valencia (ES)

2009 List of Publications

Submitted papers

D. Cumberbatch, M. Lattanzi, J. Silk, submitted to Phys. Rev. D [arxiv:0808.0881] [astro-ph]
Signatures of clumpy dark matter in the global 21 cm background signal

Published papers

U. França, M. Lattanzi, J. Lesgourgues, S. Pastor, Phys. Rev. D **80**, 083506 (2009)
[arxiv:0908.0534][astro-ph.CO]

Model-independent constraints on mass-varying neutrinos scenarios

M. Lattanzi, J. Silk, Nucl. Phys. B (Proc. Suppl.) **194**, 162 (2009).

The impact of halo substructure on dark matter signatures

L. Pieri, M. Lattanzi, J. Silk, MNRAS in press [arxiv:0902.4330] [astro-ph]

Constraining the Sommerfeld enhancement with Cherenkov telescope observations of dwarf galaxies

M. Lattanzi, to appear in in "Proceedings of the Third Stueckelberg Workshop on Relativistic Field Theories", Eds. N. Carlevaro, G. Vereshchagin.

Enhancement of the dark matter annihilation cross section in the low-velocity regime

M. Lattanzi, J. Silk, Phys. Rev. D **79**, 083523 (2009) [arxiv:0812.0360] [astro-ph].

Can the WIMP annihilation boost factor be boosted by the Sommerfeld enhancement?

M. Lattanzi, Nucl. Phys. B (Proc. Suppl.) **188**, 40 (2009).

Mass-varying neutrinos: a model independent approach.

M. Lattanzi, to appear in J. Kor. Phys. Soc.. (in press).

The majoron: a new dark matter candidate