Massimiliano Guzzo

Full Professor

February 21, 2025

Profile

Massimiliano Guzzo is a Full Professor at the University of Padova, Department of Mathematics "Tullio Levi-Civita". His research focuses on Hamiltonian Dynamics, Deterministic Dynamical Systems and Celestial Mechanics; his work has been published on Science, Communications in Mathematical Physics, Nonlinearity, Icarus, Annales Henry Poincaré, SIAM Journal on Applied Mathematics, Astronomy & Astrophysics, Monthly Notices of the Royal Astronomical Society, Physica D, Celestial Mechanics & Dynamical Astronomy, and various other specialized journals. MG has been invited speaker at numerous international conferences and serves as an associate editor for Nonlinearity. He has been PI of a MIUR-PRIN project; has been director of the scientific commitee of the italian society for celestial mechanics SIMCA. He is a member of the Course Board for the Phd in Mathematics, and has previously served on the Course Board for the Phd in Space Sciences, Technologies and Measurements at the University of Padova. Asteroid 34716 (2001 PC14) has been named '34716 Guzzo'. As a student, he was part of the italian national team at the 20th International Physics Olimpiads.

Personal

Born on September 30, 1970, in Conegliano (Italy).

Employment

Permanent Position-Professore Ordinario — *Università degli Studi di Padova*

Post-doctoral experience

2000 Research grant-Assegno di Ricerca — *Università degli Studi di Padova*

1999 Marie Curie Fellowship — *Observatoire de la Côte d'Azur, CNRS, Nice*

Education

1995-1999 Phd in Mathematics — *Università degli Studi di Padova, Thesis "Nekhoroshev stability of quasi-integrable systems with singularities and degeneracy", advisor Prof. G. Benettin.*

1990-1994 Laurea cum laude in Physics — *Università degli Studi di Padova.*

Scientific Activity

Keywords

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Dynamical Systems-Hamiltonian Mechanics-Celestial Mechanics.

Nekhoroshev Theorem-KAM theorem-Lyapunov Exponents-Chaos Indicators-Three Body Problem-Asteroid belt-Planetary Systems.

Articles in Refereed Journals

Liu X., Guzzo M.: "On the limits of application of mean motion resonant normal forms of the three-body problem for crossing orbits and close encounters", Celest. Mech. Dyn. Astron., art. 1, 2025.

Guzzo M.: "Parametric approximations of fast close encounters of the planar three-body problem as arcs of a focus-focus dynamics", Nonlinearity, 37, 105011, 2024.

Rossi M., Guzzo M.: "A Kustaanheimo-Stiefel regularization of the elliptic restricted three-body problem and the detection of close encounters with fast Lyapunov indicators", Physica D, 2024.

Guzzo M., Lega E.: "Theory and applications of fast Lyapunov indicators to model problems of celestial mechanics", Celest. Mech. Dyn. Astron., Vol. 135, Article number: 37, 2023.

Scantamburlo E., Guzzo M. and Paez R.I.: "Interplanetary transfers using stable and unstable manifold tubes originating at L1 and L2 in the elliptic restricted three-body problems ", Acta Astronautica, 200, 97-110, 2022.

Paez R.I. and Guzzo M.: "On the semi-analytical construction of halo orbits and halo tubes in the elliptic restricted three-body problem", Physica D, 439, 133402, 2022.

Paez R.I. and Guzzo M.: "Transits close to the Lagrangian solutions L1, L2 in the elliptic restricted three-body problem", Nonlinearity, vol 34, 6417-6449, 2021.

Cardin F. and Guzzo M.: "Integrability of close encounters in the spatial restricted three-body problem", Communications in Contemporary Mathematics, 2021.

Scantamburlo E. and Guzzo M.: "Short-period effects of the planetary perturbations on the Sun-Earth Lagrangian point L3", Astronomy & Astrophysics, 638, A137, 2020.

Paez R. and Guzzo M.: "A study of temporary captures and collisions in the Circular Restricted Three-Body Problem with normalizations of the Levi-Civita Hamiltonian", I. J. Nonl. Mech., Vol. 120, 103417, 2020.
Guzzo M., Efthymiopoulos C. and Paez R.: "Semi-analytic computations of the speed of Arnold diffusion along single resonances in a priori stable Hamiltonian systems". Journal of Nonlinear Science, Vol. 30, 851-9010, 2020.

Cardin F. and Guzzo M.: "Integrability of the spatial three-body problem near collisions (an announcement)". Rend. Lincei Mat. Appl. 30 (2019), 195-204.

Chierchia L., Faraggiana M.A. and Guzzo M.: "On Steepness of 3-jet non degenerate functions", Annali di Matematica Pura ed Applicata, 198, issue 6, 2151-2165, 2019.

Guzzo M. and Lega E.: "Geometric chaos indicators and computations of the spherical hypertube manifolds of the spatial circular restricted three-body problem", Physica D, vol. 373, 35-58, 2018.

Guzzo M. and Lega E.: "Scenarios for the dynamics of comet 67P/Churyumov-Gerasimenko over the past 500 kyr", Monthly Notices of the Royal Astronomical Society, Volume 469, Issue Suppl 2, 21 , 2017.

Lega E. and Guzzo M.: "Three-dimensional representations of the tube manifolds of the planar restricted three-body problem", Physica D, 352:41-52, 2016.

Guzzo M. and Lega E.: "The Nekhoroshev Theorem and the Observation of Long-term Diffusion in Hamiltonian Systems", Regular and Chaotic Dynamics, Vol. 21, No. 6, pp. 707-719, 2016.

Guzzo M., Chierchia L. and Benettin G.: "The steep Nekhoroshev's Theorem", Communications in Mathematical Physics, Volume 342, Issue 2, pp 569-601, 2016.

Guzzo M. and Lega E.: "A study of the past dynamics of comet 67P/Churyumov-Gerasimenko with Fast Lyapunov Indicators", Astronomy & Astrophysics, vol. 579, A79, 1-7, 2015.

Guzzo M.: "The Nekhoroshev theorem and long-term stabilities in the Solar System", Serbian Astronomical Journal, invited review, pp. 1-10, n. 190, 2015.

Schirinzi G. and Guzzo M.: "Numerical verification of the steepness of three and four degrees of freedom Hamiltonian systems", Regular and Chaotic Dynamics, vol. 20, No. 1, pp. 1-18, 2015.

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Schirinzi G. and Guzzo M.: "On the formulation of new explicit conditions for steepness from a former result of N.N. Nekhoroshev." Journal of Mathematical Physics, 54, 072702, 2013.

Guzzo M. and Lega E.: "The numerical detection of the Arnold web and its use for long-term diffusion studies in conservative and weakly dissipative systems", Chaos, vol. 23, 023124, 2013.

Guzzo M. and Lega E.: "On the identification of multiple close-encounters in the planar circular restricted three body problem." Monthly Notices of the Royal Astronomical Society, 428, 2688-2694, 2013.

Bernardi O., Cardin F. and Guzzo M.: New Estimates for Evans' Variational Weak KAM Approach, Communications in Contemporary Mathematics, 15, 1250055, 2013.

Bernardi O., Cardin F. and Guzzo M.: Convergence to the time average by stochastic regularization, Journal of Nonlinear Mathematical Physics, vol. 20, n. 1, 9-27, 2013.

Lega E., Guzzo M. and Froeschlé C.: "Close encounters and resonances detection in three body problems through Levi-Civita regularization". Monthly Notices of the Royal Astronomical Society, 2011.

Todorović N., Guzzo M., Lega E. and Froeschlé C.: "A numerical study of the stabilization effect of steepness". Celestial Mechanics and Dynamical Astronomy, 2011.

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Guzzo M., Lega E. and Froeschlé C.: "A numerical study of the topology of normally hyperbolic invariant manifolds supporting Arnold diffusion in quasi-integrable systems." Physica D, vol. 238; p. 1797-1807, 2009.

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Celletti A. and Guzzo M.: "Cantori of the dissipative sawtooth map." Chaos, vol. 19, 2009.

Lega E., Guzzo M. and Froeschlé C.: "Measure of the exponential splitting of the homoclinic tangle in four dimensional symplectic mappings." Celestial Mechanics and Dynamical Astronomy, Vol. 104, 1-2, 2009.

Bernardi O., Cardin F., Guzzo M. and Zanelli L.: "A PDE approach to finite time indicators in Ergodic Theory". Journal of nonlinear mathematical Physics, vol. 16; p. 195-206, 2009.

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Namouni F., Guzzo M. and Lega E.: "On the integrability of stellar motion in an accelerated logarithmic potential". Astronomy and Astrophysics, 489, Issue 3, pp.1363-1367, 2008.

Benettin G., Guzzo M. and Marini V.: "Adiabatic chaos in the spin-orbit problem". Celestial Mech. and Dyn. Astron., Vol. 101, n 1-2, 203-224, 2008.

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Pavlović R. and Guzzo M.: "Fullfilment of the conditions for the application of the Nekhoroshev theorem to the Koronis and Veritas asteroid families". Monthly Notices of the Royal Astronomical Society, 384, 1575-1582, 2008.

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Guzzo M.: "Long-Term Stability Analysis of Quasi Integrable Degenerate Systems Through the Spectral Formulation of the Nekhoroshev Theorem ". Celest. Mech. Dyn. Astr., 83, Issues 1-4, 2002.

Guzzo M., Knezević Z. and Milani A.: "Probing the Nekhoroshev Stability of Asteroids ". Celest. Mech. Dyn. Astr., 83, Issues 1-4, 2002.

Guzzo M., Lega E. and Froeschlé C. : "On the numerical detection of the effective stability of chaotic motions in quasi-integrable systems ". Physica D, 163, Issues 1-2, 1-25, 2002.

Guzzo M. :"Improved Leap-Frog Symplectic Integrators for Orbits of Small Eccentricity in the Perturbed Kepler Problem". Celestial Mechanics and Dynamical Astronomy, 80, n. 1, 63-80, 2001.

Guzzo M. and Benettin G. :"A spectral formulation of the Nekhoroshev theorem and its relevance for numerical and experimental data anlysis". Discrete and Continous Dynamical Systems-Series B, 1, n. 1, 2001.

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Froeschlé C., Guzzo M. and Lega E. :"Graphical Evolution of the Arnold Web: From Order to Chaos". Science, 289, n. 5487, 2000.

Guzzo M.:"Nekhoroshev stability of quasi–integrable degenerate Hamiltonian systems". Regular and chaotic dynamics, 4, n. 2, 1999.

Benettin G., Fasso' F. and Guzzo M.:"Nekhoroshev-stability of L4 and L5 in the spatial restricted three–body problem", Regular and chaotic dynamics, 3, n. 3, 1998.

Guzzo M., Fassò F. and Benettin G.:"On The Stability of Elliptic Equilibria", Mathematical Physics Electronic Journal, 4, 1998;

Fassò F., Guzzo M. and Benettin G.: "Nekhoroshev-Stability of Elliptic Equilibria in Hamiltonian Systems", Communications in Mathematical Physics; 197: 347-360, 1998;

Guzzo M. and Morbidelli A.:"Construction of a Nekhoroshev–like result for the asteroid belt dynamical system", Celestial Mechanics and Dynamical Astronomy 66: 255-292, 1997;

Morbidelli A. and Guzzo M.:"The Nekhoroshev thorem and the asteroid belt dynamical system", Celestial Mechanics and Dynamical Astronomy 65: 107-136, 1997;

Benettin G., Fassò F. and Guzzo M.:"Fast rotations of the rigid body: a study by Hamiltonian Perturbation Theory. Part II: Gyroscopic rotations", Nonlinearity, 10, 1695-1717, 1997.

Contributions to Books, Proceedings and Transactions

Guzzo M. and Lega E.: "The past dynamics of comet 67P/Churyumov-Gerasimenko", in the proceedings of the conference From Giotto To Rosetta, 30 years of cometary science from space and ground, C. Barbieri and C.G. Someda editors, 2017.

Guzzo M., Lega E.: "Computation of transit orbits in the three-body-problem by Fast Lyapunov Indicators", Proc. of the XVII NCAS Belgrade, Publications of the Astronomical Observatory of Belgrade, vol. 96, 71-78, 2017.
Lega E. and Guzzo M.: "Theory and Applications of the Fast Lyapunov Indicator (FLI) Method", chapter in: Chaos Detection and Predictability, pp.35-54, 2016.

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Guzzo M.:" Fourier analysis of chaotic motions and applications to Celestial Mechanics", in "Chaotic Worlds: From Order to Disorder in Gravitational N-Body Dynamical Systems", Nato Science series II-Vol. 227. Edited by B.A. steves, A.J. Maciejewski and M. Hendry, 2006.

Guzzo M.: " Fourier analysis of chaotic solutions of quasi–integrable systems", in "Hamiltonian Systems and Fourier Analysis: New Prospects For Gravitational Dynamics", Benest et al. editors, Cambridge Scientific Publishers Ltd, 2004.

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Froeschlé C., Guzzo M. and Lega E. :"The Fast Lyapunov Indicator: detection of the Arnold web for Hamiltonian systems and symplectic mappings with 3 degrees of freedom". In SSUP Proceedings: The Restless Universe. Application of gravitational N-body dynamics to planetary, stellar and galactic systems. Editors B. A. Steves and A. J. Maciejewsky, 2001.

Recent Invited Lectures and Talks

"Theory and applications of Fast Lyapunov Indicators to model problems of Celestial Mechanics", Celestial Mechanics and Dynamical Astronomy Seminar Series, 1-12.2023.

"Measures of slow diffusion in Hamiltonian Systems", CELMEC VIII, The Eighth International Meeting on Celestial Mechanics, University of Rome Tor Vergata, Italy, 5-9.9.2022.

"Measures of slow diffusion in Hamiltonian Systems", H2020 in Hamiltonian dynamics, 25-29/7/2022, Venezia.

"Theory and applications of Fast Lyapunov Indicators for the computation of transit orbits", I-CELMECH Training School, 3-7/02/2020, Milano.

"Nekhoroshev theory and its applications: exponential estimates, chaos indicators and diffusion", XLIV Summer school on Mathem. Phys., 2-14/09/2019, Invited Lectures."

"Integrability of the spatial three body problem near collisions", New Trends in Celestial Mechanics, Cogne, Valle d'Aosta, Italy June 24-28, 2019.

"Integrability of the spatial restricted three-body problem near collisions", AMC70-between Mathematics and Astronomy, Pisa, September 3-5 2018.

"Integrabilit del problema ristretto dei tre corpi vicino alle collisioni", Matematica a Misura della Natura, Padova, 13-14 September 2018.

"The Levi-Civita regularization: why do we care of the three-body problem?", The legacy of Tullio Levi-Civita, Padova, February 19-20 2018.

"Computation of the hypertube manifolds in the spatial circular restricted three-body problem with chaos indicators", CELMEC VII, The Seventh International Meeting on Celestial Mechanics, San Martino al Cimino, Italy, 3-9.9.2017.

"Computation and Visualization of the Hypertube Manifolds in the Spatial Circular Restricted Three-Body Problem with Chaos Indicators", 9th Humboldt Colloquium on Celestial Mechanics, International conference on celestial mechanics with applications in space science, Bad Hofgastein, Austria, 19-25.03.2017.

"The past dynamics of comets: the case of 67P", From Giotto to Rosetta 30 years of cometary science, Padova, Italy 27-29.10.2016.

"The three-body problem: the Lagrangian points and their spherical hypertube manifolds", Chaotic Phenomena in Mathematical Models, September 9-10, 2016, Pisa, Italy.

"A guided visualization of the tube manifolds of the three-body problem." Computational Perturbative Methods for Hamiltonian Systems in Physics and Astronomy. July 11-13, 2016, Athens, Greece.

"Numerical computation of stable and unstable manifolds with fast Lyapunov indicators. Applications to the three body problem." Dynamics, Topology and Computations, June 15-20, 2015, Bedlewo, Poland.

"Localization of stable-unstable manifolds with Fast Lyapunov Indicators and applications to the three body problem". XVII National Conference of Astronomers of Serbia, 23-27.09.2014, Belgrade, Serbia.

"Localization of stable-unstable manifolds with Fast Lyapunov Indicators and applications to the three body problem". Planetary Motions, Satellite Dynamics and Spaceship Orbits, 22-26 july 2013, Centre de recherches mathématiques, Montreal, Canada.

"Numerical investigations of a conjecture by N.N. Nekhoroshev about stability in quasi–integrable systems." Workshop on Instabilities in Hamiltonian Systems. Fields Institute, 13-17.06.2011, Toronto, Canada.

"Numerical investigations of a conjecture by N.N. Nekhoroshev about stability in quasi–integrable systems." 8th A. v. Humboldt Colloquium for Celestial Mechanics, Bad Hofgastein, Austria 20-26.03.2011.

"Dynamics in quasi-integrable systems: numerical examples.", Classical and Weak KAM Theorem, Padova, 14-19.02.2010, Montegrotto Terme, Italy.

"Diffusion in quasi-integrable systems and the Nekhoroshev theorem", The Fifth international meeting on Celestial Mechanics, 6-12.09.2009, San Martino al Ciminio, Italy.

"Hyperbolic manifolds and Arnold diffusion in a priori unstable systems", International Conference on the Dynamics of Celestial Bodies, 23-26.06.2008, Litohoro, Greece.

"Hyperbolic manifolds supporting Arnold diffusion in dynamical systems", 7th A. von Humboldt Colloquium for Celestial Mechanics, Bad Hofgastein, Austria, 30-3/05-04 2008.

"Chaos and diffusion in dynamical systems through stable-unstable manifolds", Novel Space-ways for scientific and exploration missions. Fucino Space Centre (Avezzano) and Scuola Superiore Reiss Romoli (L'Aquila), 15-10/17-10 2007.

"Mechanisms for the production of chaos in dynamical systems", Extra-Solar Planets: The detection, formation, evolution and dynamics of planetary systems, Skye, United Kingdom, 28-05/8-06 2007.

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