CURRICULUM VITAE[⊕]

General information:

name and family name: Ugo Locatelli
place and date of birth: Bergamo (Italy), 26/05/1967

Degrees:

1. B.A. in physics cum laude, at the University of Milan, November 1994. Graduation thesis title: "Teorema di Kolmogorov e teoria classica delle perturbazioni" (advisor: A. Giorgilli).
2. Ph.D. in mathematics, with "tres honorable avec les felicitations du Jury" as final mark, at the University of Nice and Sophia-Antipolis, March 1999. Ph.D. thesis title: "Contribution à l'étude de la théorie KAM: applications à la mécanique céleste et liens avec la theorie des nombres" (advisor: C. Froeschlé, co-advisors: A. Giorgilli, A. Morbidelli).

Grants:

1) "Observatoire de la Cote d'Azur" (=O.C.A.), starting from January to July 1995 into the framework of the scientific network supported by the European Community through the contract n. CHRX-CT93-0330/DG.
2) O.C.A., starting from February 1996 to January 1999 into the framework of a "Marie Curie" grant for the research project "Stability in Celestial Mechanics problems into the light of KAM and Nekhoroshev's theory", supported by the European Community through the contract n. ERB-FMBI-CT95-0316.
3) University of Milan, starting from September 1999 to December 2000 into the framework of the research project "Theoretical and applied problems in Celestial Mechanics and aerospace engineering" (supervisor: L. Galgani).
4) University of Milan "Bicocca", starting from April 2001 to October 2002, into the framework of the research project "Classical perturbation theory. Stability of N-body systems. KAM and Nekhoroshev's theory" (supervisor: A. Giorgilli).

University positions:

Researcher (i.e., Tenured Assistant Professor) in Mathematical Physics at the Univ. of Rome "Tor Vergata" starting from November 2002 to December 2016.
Associate Professor in Mathematical Physics at the Univ. of Rome "Tor Vergata" starting from December 2016 to May 2024.
Full Professor in Mathematical Physics at the Univ. of Rome "Tor Vergata" starting from May 2024.

[⊕] Last update: September 2024.

Teaching activity and training to research

- A couple of years of assistance to an advanced course in Mathematical Physics introducing to the theory and numerical methods in dynamical systems (for students in Mathematics of the Univ. of Milan "Bicocca").
- Several years of lectures in some basic courses introducing to C language programming and numerical analysis (for students in Mathematics of the Univ. of Rome "Tor Vergata"); several years of lectures about the first course in Mathematical Physics introducing to Lagrangian Mechanics (for students in Mathematics of the Univ. of Rome "Tor Vergata"); three years of lectures in an advanced course on "Computational Methods for Hamiltonian Systems" (for Master students in Mathematics of the Univ. of Rome "Tor Vergata").
- Supervisor of $\sim$15 graduation theses in Mathematics. Co-advisor of several graduation theses in Mathematics for some students of the Univ. of Rome "Tor Vergata", Univ. of Milan and Univ. of Milan "Bicocca".
- Since 2010, coordinator of the lectures introducing some numerical methods for Astronomy in the framework of the second level Master Course in "Scienza e tecnologia spaziali" at the Univ. of Rome "Tor Vergata".
- Supervisor of two ph.D. thesis in Mathematics.
- Coadvisor of four ph.D. theses in Mathematics.
- International referee of several ph.D. theses in Mathematics.
- Supervisor of a post-doc fellow (Dr. M. Sansottera) in the framework of the six-month research project "Stability of planetary systems, theory and computations", starting from November 2010 to April 2011.
- Supervisor of a post-doc fellow (Dr. L. Valvo) in the framework of the one-year research project "KAM Theorem on Poisson Algebras: Applications to Rotational Dynamics and Guiding Centre Theory", starting from March 2020 to February 2021.
- Supervisor of a post-doc fellow (Dr. V. Danesi) in the framework of the one-year research project "KAM theory for planetary systems with large eccentricities", starting from May 2021 to October 2022 (including the six–month extension).
- Supervisor of a post-doc fellow (Dr. M. Volpi) in the framework of the one-year research project "New computational challenges in Applied Mathematics", starting from January 2022 to December 2022.
- Member of the permanent staff of the Univ. of Rome "Tor Vergata" node, involved in the Marie Curie Initial Training Network "Astronet II", starting from January 2012 to January 2016.
- Principal Investigator of the research project DEXTEROUS, "Dynamics of EXTrasolar planEtaRy systems with and withOUt jetS: new theoretical and computational challenges", financed by the Univ. of Rome "Tor Vergata" in the framework of the "Uncovering Excellence 2014" funding scheme, starting from March 2015 to September 2016.
- Member of the permanent staff of the Univ. of Rome "Tor Vergata" node, involved in

"Stardust–R. The H2020 Space Debris and Asteroid research network", starting from January 2019 to December 2022.

- Local coordinator of the Univ. of Rome "Tor Vergata" node, involved in the PRIN (=Research Project of National Interest) "New Frontiers of Celestial Mechanics: theory and Applications" (I-CELMECH), starting from August 2020 to August 2023.
- President of SIMCA (=Italian Society of Celestial Mechanics and Astrodynamics), starting from February 2023.

Short description of the research activity

Since the beginning of the studies devoted to the writing of the graduation thesis in physics, the research activity has been focused on the quasi-integrable dynamical systems. In the middle of the nineties, a suitable use of the constructive techniques building normal forms allowed us to reformulate the proof of the KAM theorem. This was interesting from a theoretical point of view, because it made possible to avoid the so called "quadratic convergence method" and it allowed to adapt the constructive algorithm also for what concerns lower–dimensional elliptic tori. Moreover, this approach has been translated in several applications, mainly devoted to some Celestial Mechanics problems. All these applications required a refined use of both the computer and the algebraic manipulation aiming to explicitly construct normal forms. In some cases, the results obtained thanks to this strategy have been made rigorous by performing computer-assisted proofs. The combined use of both the KAM theorem and the Nekhoroshev's one allows to prove the stability of interesting quasi-integrable dynamical systems. This is still one of the main topics (among other arguments) of the ongoing research activity.

In the last decade, part of the research activity has been devoted to the study of the orbital configurations of extrasolar planetary systems. They can be analyzed in the framework of models, where the usual approach based on KAM theory can be applied on reverse. Indeed, information about the possible ranges of values of some unknown orbital element can be deduced by prescribing the stability of this kind of planetary systems. In particular, this approach has been fruitfully applied to some exoplanets which were detected by using the Radial Velocity technique.

Organization of schools and conferences:

- "Astrodynamics of Natural and Artificial Satellites: from Regular to Chaotic Motions", 1-st training school in the framework of the astrodynamics european network AstroNet-II, Univ. of Rome "Tor Vergat", 14-17 January 2013.
- "Mathematical Models and Methods for Planet Earth", workshop, INdAM, Rome, 27-29 May 2013.
- "Computational Perturbative Methods for Hamiltonian Systems; Applications in Physics and Astronomy", workshop, Research Center for Astronomy and Applied Mathematics (RCAAM) of the Academy of Athens, Athens, 11-13 July 2016.
- "CELMEC VII", international conference, San Martino al Cimino, 3-9 September 2017.
- "Simulations of Plasma Dynamics in Tokamaks", workshop, Univ. of Rome "Tor Vergata", 23-24 January 2019.
- "Machine Learning and Computer Assisted Proofs in Celestial Mechanics and Astrodynamics", workshop (from remote), Univ. of Rome "Tor Vergata", 18/06/2021 & 25/06/2021.
- "Theory, models and simulations in Celestial Mechanics", workshop, Univ. of Pisa,

14-16 June 2022.

- "CELMEC VIII", international conference, Univ. of Rome "Tor Vergata", 5-9 September 2022.
- "Mini-CELMEC - The CM&DA prizes meeting", a one-day conference, Univ. of Rome "Tor Vergata", 12-th of September 2023.

Talks and short cycles of lectures

Arc 2000 (France), "Chaos dans les systemes gravitationelles", January 1997; L'Aquila, "CELMEC II", April 1997; Torino, I.S.I. School, May 1997; Cetraro, C.I.M.E. school, June 1999; Bad Hofgastein (Austria), "Von Humboldt 5-th Colloquium on Celestial Mechanics", March 2000; Rome, "CELMEC III", June 2001; Pisa, in the framework of "Trimestre di studio sui Sistemi Dinamici", March 2003; Cortina d'Ampezzo, "Chaotic Worlds: From Order to Disorder in Gravitational N-Body Dynamical Systems", September 2003; Acireale, "Dynamical Systems: Classical, Quantum and Stochastic", September 2004; San Martino al Cimino, "CELMEC IV", September 2005; Spoleto, "Theory and Applications of Dynamical Systems", June 2007; Barcelona, "Advanced School on Specific Algebraic Manipulators", September 2007; Paris, "Workshop on Mathematical Aspects of Celestial Mechanics", December 2007; Barcelona, "Workshop on Stability and Instability in Mechanical Systems", December 2008; San Martino al Cimino, "CELMEC V", September 2009; Vlora, "Applications of Computer Algebra", June 2010; Trieste, ICTP, "Computational Methods in Dynamics", July 2011; Bedlewo (Poland), "Dynamics, Topology and Computations", June 2012; San Martino al Cimino, "CELMEC VI", September 2013; Trieste, final conference of the PRIN project "Teorie geometriche e analitiche dei sistemi Hamiltoniani in dimensioni finite e infinite", January 2016; Bad Hofgastein (Austria), "Von Humboldt 9-th Colloquium on Celestial Mechanics", March 2017; Bedlewo (Poland), "Dynamics, Topology and Computations", June 2018; Pisa, in the framework of the "Pisa-Hokkaido-Rome2 school" on Mathematics and its applications, September 2018; Milan, "I-CELMECH Training School", February 2020; Iasi (Romania), "IAUS 364: Multi-scale (time and mass) Dynamics of Space Objects", October 2021; Bedlewo (Poland), "Dynamics, Topology and Computations", June 2022; Karlstad (Sweden), "Equadiff 2024", June 2024.

Editorial tasks:

- "Guest editor" of the journal "Mathematics in Engineering" for the *Special Issue* "Modern methods in Hamiltonian perturbation theory".
- "Guest editor" of the journal "Celestial Mechanics and Dynamical Astronomy" for the *Special Issue* "Innovative computational methods in Dynamical Astronomy".

Activity as Referee for the following scientific journals:

"Advances in Space Research", "Astrophysics and Space Science", "Celestial Mechanics and Dynamical Astronomy", "Communications in Mathematical Phisics", "Communications in Nonlinear Science and Numerical Simulation", "Discontinuity, Nonlinearity and Complexity", "Discrete and Continuous Dynamical Systems - series B", "Discrete and Continuous Dynamical Systems - series S", "Earth, Moon and Planets", "Foundations of Computational Mathematics", "Journal of Nonlinear Science", "Journal of Statistical Physics", "Mathematical Physics Electronic Journal", "Mathematics in Engineering", "Nonlinearity", "Physica D".

List of Publications (articles, proceedings)

[1] Giorgilli, A. & $\mathcal{L}$., $\mathcal{U}$.: "Kolmogorov theorem and classical perturbation theory", *ZAMP*, **48** (1997), 220–261.

[2] Giorgilli, A. & $\mathcal{L}$., $\mathcal{U}$.: "On classical series expansion for quasi–periodic motions", *MPEJ*, Vol. **3**, Numero 5, 1–25 (1997).

[3] $\mathcal{L}$., $\mathcal{U}$. & Meletlidou, E.: "Convergence of Birkhoff normal form for essentially isochronous systems", *Meccanica*, **33**, 195–211, (1998).

[4] $\mathcal{L}$., $\mathcal{U}$.: "Three–body planetary problem: study of KAM stability for the secular part of the Hamiltonian", *Planetary and Space Science*, **46**, 11/12, 1453–1464, (1998).

[5] Froeschlé, Cl., Gonczi, R., Lega, E. & $\mathcal{L}$., $\mathcal{U}$.: "On the stochasticity of the asteroid belt", *Celestial Mechanics and Dynamical Astronomy*, **69**, 235–254, (1998).

[6] Giorgilli, A. & $\mathcal{L}$., $\mathcal{U}$.: "A classical self–consistent proof of Kolmogorov's theorem on invariant tori", pp. 72–89, in *Proceedings of the NATO ASI school: "Hamiltonian Systems with Three or More Degrees of Freedom", S'Agaro (Spain), June 19–30, 1995*, C. Simò (managing ed.), Kluwer (1999).

[7] Celletti, A., Giorgilli, A. & $\mathcal{L}$., $\mathcal{U}$.: "Improved Estimates on the Existence of Invariant Tori for Hamiltonian Systems", *Nonlinearity*, **13**, 397–412, (2000).

[8] $\mathcal{L}$., $\mathcal{U}$., Froeschlé, Cl., Lega, E. & Morbidelli, A.: "On the Relationship between the Bruno Function and the Breakdown of Invariant Tori", *Physica D*, **139**, 48–71, (2000).

[9] $\mathcal{L}$., $\mathcal{U}$. & Giorgilli, A.: "Invariant tori in the secular motions of the three–body planetary systems", *Celestial Mechanics and Dynamical Astronomy*, **78**, 47–74 (2000).

[10] $\mathcal{L}$., $\mathcal{U}$.: "Proof of a KAM theorem on the existence of invariant tori close to an equilibrium point", Quaderni del Dipartimento di Matematica dell'Università di Milano, 5/2001 (2001).

[11] Celletti, A., Falcolini, C. & $\mathcal{L}$., $\mathcal{U}$.: "On the break–down threshold of invariant tori in four dimensional maps", *Regular and Chaotic Dynamics*, **9**, n. 3, 227–253 (2004).

[12] Gabern, F., Jorba, A. & $\mathcal{L}$., $\mathcal{U}$.: "On the construction of the Kolmogorov normal form for the Trojan asteroids", *Nonlinearity*, **18**, n. 4, 1705–1734 (2005).

[13] $\mathcal{L}$., $\mathcal{U}$. & Giorgilli, A.: "Construction of the Kolmogorov's normal form for a planetary system", *Regular and Chaotic Dynamics*, **10**, n. 2, 153–171 (2005).

[14] Giorgilli, A. & $\mathcal{L}$., $\mathcal{U}$.: "Introduction to the canonical perturbation theory for nearly integrable systems", in B. Steves (ed.): "Chaotic Worlds: From Order to Disorder in Gravitational N–Body Dynamical Systems", Kluwer, (2006).

[15] $\mathcal{L}$., $\mathcal{U}$. & Giorgilli, A.: "Invariant tori in the Sun–Jupiter–Saturn system", *Discrete and Continuous Dynamical Systems – Series B*, **7**, n. 2, 377–398 (2007).

[16] Melnikov, S., Woitas, J., Eislöffel, J., Bacciotti, F., $\mathcal{L}$., $\mathcal{U}$. & Ray, T. P.: "A HST study of the environment of the Herbig Ae/Be star LkHα 233 and its bipolar jet", *Astronomy and Astrophysics*, **483**, n. 1, 199–208 (2008).

[17] Giorgilli, A., $\mathcal{L}$., $\mathcal{U}$. & Sansottera, M.: "Kolmogorov and Nekhoroshev theory for the problem of three bodies", *Cel. Mech. & Dyn. Astr.*, **104**, 159–173 (2009).

[18] Giorgilli, A. & $\mathcal{L}$., $\mathcal{U}$.: "Sulla stabilità del problema planetario dei tre corpi", *Rendiconti dell'istituto lombardo, Accademia di scienze e lettere - Sezione A*, **141**, 73–87

(2010).

[19] Giorgilli, A., $\mathcal{L}$., $\mathcal{U}$. & Sansottera, M.: "Su un'estensione della teoria di Lagrange per i moti secolari", *Rendiconti dell'istituto lombardo, Accademia di scienze e lettere - Sezione A*, **143**, 223–239 (2010).

[20] Sansottera, M., $\mathcal{L}$., $\mathcal{U}$. & Giorgilli, A.: "A semi-analytic algorithm for constructing lower dimensional elliptic tori in planetary systems", *Cel. Mech. & Dyn. Astr.*, **111**, 337–361 (2011).

[21] Stefanelli, L., & $\mathcal{L}$., $\mathcal{U}$.: "Kolmogorov's normal form for equations of motion with dissipative effects", *Discrete and Continuous Dynamical Systems – Series B*, **17**, 2561-2593 (2012).

[22] Sansottera, M., $\mathcal{L}$., $\mathcal{U}$. & Giorgilli, A.: "On the stability of the secular evolution of the planar Sun–Jupiter–Saturn–Uranus system", *Math. & Comp. in Simulation*, **88**, 1-14 (2013).

[23] Maurri, L., Bacciotti, F., Podio, L., Eisloeffel, J., Ray, T.P., Mundt, R., $\mathcal{L}$., $\mathcal{U}$. & Coffey, D.: "Physical properties of the jet from DG Tauri on sub-arcsecond scales with HST/STIS", *Astronomy and Astrophysics*, **565**, A110 (2014).

[24] Giorgilli, A., $\mathcal{L}$., $\mathcal{U}$. & Sansottera, M.: "On the convergence of an algorithm constructing the normal form for lower dimensional elliptic tori in planetary systems", *Cel. Mech. & Dyn. Astr.*, **119**, 397–424 (2014).

[25] Páez, R.I. & $\mathcal{L}$., $\mathcal{U}$.: "Design of maneuvers based on new normal form approximations: the case study of the CPRTBP", INCPAA 2014, AIP Conf. Proc., **1637**, p. 776 (2014).

[26] Giorgilli, A., $\mathcal{L}$., $\mathcal{U}$. & Sansottera, M.: "Improved convergence estimates for the Schröder–Siegel problem", *Annali di Matematica Pura ed Applicata*, **194**, 995–1013 (2015).

[27] $\mathcal{L}$., $\mathcal{U}$. & Stefanelli, L.: "Quasi-periodic motions in a special class of dynamical equations with dissipative effects: a pair of detection methods", *Discr. & Cont. Dyn. Syst. – Series B*, **20**, 1155–1187 (2015).

[28] Páez, R.I. & $\mathcal{L}$., $\mathcal{U}$.: "Trojan dynamics well approximated by a new Hamiltonian normal form", *Monthly Notices of the Royal Astronomical Society*, **453** (2), 2177–2188 (2015).

[29] Páez, R.I., $\mathcal{L}$., $\mathcal{U}$. & Efthymiopoulos, C.: "The Trojan Problem from a Hamiltonian Perturbative Perspective", pp. 193–211, in *Astrodynamics Network AstroNet-II*, Astrophysics and Space Science Proceedings, vol. 44, 193–211, Springer (2016).

[30] Páez, R.I., $\mathcal{L}$., $\mathcal{U}$. & Efthymiopoulos, C.: "New Hamiltonian expansions adapted to the Trojan problem", *Cel. Mech. & Dyn. Astr.*, **126**, 519–541 (2016).

[31] Bacciotti, F., $\mathcal{L}$., $\mathcal{U}$., Volpi, M., Páez, R.I. & Podio, L.: "Exploring the feedback of asymmetric jets on the orbital motions in protoplanetary disks", in Memorie della Societa Astronomica Italiana - Journal of the Italian Astronomical Society, **88**, 767–768 (2017).

[32] Giorgilli, A., $\mathcal{L}$., $\mathcal{U}$. & Sansottera, M.: "Secular dynamics of a planar model of the Sun-Jupiter-Saturn-Uranus system; effective stability in the light of Kolmogorov and Nekhoroshev theories", *Regular and Chaotic Dynamics*, **22**, 54–77 (2017).

[33] Bacciotti, F., $\mathcal{L}$., $\mathcal{U}$., Volpi, M., Páez, R.I. & Podio, L.: "Exploring the feedback of

asymmetric jets on the orbital motions in protoplanetary disks", Mem. Soc. Astron. Ital. - Jour. of Ital. Astron. Soc., **88**, n. 4, 767–768 (2017).

[34] Volpi, M., $\mathcal{L}.$, $\mathcal{U}.$ & Sansottera, M.: "A reverse KAM method to estimate unknown mutual inclinations in exoplanetary systems", *Cel. Mech. & Dyn. Astr.*, **130**, 36.

[35] Caracciolo, C., & $\mathcal{L}.$, $\mathcal{U}.$: "Computer-assisted estimates for Birkhoff normal forms", *Journal of Computational Dynamics*, **7**, n. 2, 425–460 (2020)..

[36] Caracciolo, C. & $\mathcal{L}.$, $\mathcal{U}.$: "Elliptic tori in FPU non-linear chains with a small number of nodes", *Communications in Nonlinear Science and Numerical Simulation*, **97**, 105759 (2021).

[37] $\mathcal{L}.$, $\mathcal{U}.$, Caracciolo, C., Sansottera, M. & Volpi, M.: "A numerical criterion evaluating the robustness of planetary architectures; applications to the υ Andromedæ system", *Proceedings of the International Astronomical Union*, **15**, 65–84 (2021).

[38] Di Marco, A., Tennant, A., La Monaca, F., Muleri, F., Rankin, J., Rushing, J., Soffitta, P., Baglioni, G., Baldini, L., Costa, E., Dietz, K., Fabiani, S., Latorre, V., $\mathcal{L}.$, $\mathcal{U}.$, Manfreda, A., O'Dell, S., Peirson, L. & Weisskopf, M.: "Validation of neural network software by using IXPE ground calibration data", *Proceedings of the SPIE – The International Society for Optical Engineering*, **12181**, 1218157, 14 pages (2022).

[39] Caracciolo, C., $\mathcal{L}.$, $\mathcal{U}.$, Sansottera, M. & Volpi, M.: "Librational KAM tori in the secular dynamics of the υ Andromedæ planetary system", *Monthly Notices of the Royal Astronomical Society*, **510**, n. 2, 2147–2166 (2022).

[40] $\mathcal{L}.$, $\mathcal{U}.$, Caracciolo, C., Sansottera, M. & Volpi, M.: "Invariant KAM tori: from theory to applications to exoplanetary systems", 44 pages; in: G. Baù, S. Di Ruzza, R.I. Páez, T. Penati & M. Sansottera (eds.), "I-CELMECH Training School – New frontiers of Celestial Mechanics: theory and applications", Springer PROMS (2022).

[41] Valvo, L. & $\mathcal{L}.$, $\mathcal{U}.$: "Hamiltonian control of magnetic field lines: Computer assisted results proving the existence of KAM barriers", *Journal of Computational Dynamics*, **9**, n. 4; doi: 10.3934/jcd.2022002 (2022).

[42] Danesi, V., $\mathcal{L}.$, $\mathcal{U}.$ & Sansottera, M.: "Existence proof of librational invariant tori in an averaged model of HD60532 planetary system", *Cel. Mech. & Dyn. Astr.*, **135**, n. 3, 24 (2023).

[43] Mastroianni, R. & $\mathcal{L}.$, $\mathcal{U}.$: "Secular orbital dynamics of the innermost exoplanet of the υ-Andromedæ system", *Cel. Mech. & Dyn. Astr.*, **135**, n. 3, 28 (2023).

[44] Mastroianni, R. & $\mathcal{L}.$, $\mathcal{U}.$: "Computer-assisted proofs of existence of KAM tori in planetary dynamical models of υ-And **b**", accepted for publication on *Communications in Nonlinear Science and Numerical Simulation*, **130**, 107706 (2024).

[45] Caracciolo, C., $\mathcal{L}.$, $\mathcal{U}.$, Sansottera, M. & Volpi, M.: "3D orbital architecture of exoplanetary systems: KAM–stability analysis", *Regular and Chaotic Dynamics*, **29**, 565–582 (2024).

Books

[1] Celletti, A., Locatelli, U., Ruggeri, T. & Strickland, E. (Eds.): "Mathematical Models and Methods for Planet Earth", Springer INdAM Series, Vol. 6, `ISBN: 978-3-319-02656-5` (2014).