

KLEOMENIS TSIGANIS

Curriculum Vitae

PERSONAL INFORMATION

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| SURNAME | TSIGANIS |
| NAME | KLEOMENIS |
| DATE OF BIRTH | <i>12/01/1974</i> |
| PLACE OF RESIDENCE | THESSALONIKI, GREECE |
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CURRENT POSITION

03.2017 - Associate Professor
Department of Physics, Aristotle University of Thessaloniki (AUTH), Greece

PREVIOUS POSITIONS

12.2011 - 02.2017 Assistant Professor
Department of Physics, Aristotle University of Thessaloniki, Greece

05.2011 - 09.2011 Visiting Scholar
SouthWest Research Institute, Boulder Co, USA

02.2011 - 05.2011 Visiting Researcher
Observatoire de la Cote d'Azur, France

09.2006 - 11.2011 Lecturer
Department of Physics, Aristotle University of Thessaloniki, Greece

12.2005 - 09.2006 Post-doc researcher
Lab. of Astronomy, AUTH, Greece

02.2005 - 11.2005 Military service

11.2002 - 12.2004 Post-doc researcher (Marie Curie Fellow)
Observatoire de la Cote d'Azur, France

EDUCATION

1992 - 1996 Degree in Physics, Physics Department, AUTH, Greece

1998 - 2002 PhD studies, Astronomy Lab, Physics Department AUTH,
Thesis Title: "Chaotic trajectory diffusion in the phase-space of Hamiltonian systems: Applications in Celestial Mechanics".

RESEARCH INTERESTS

Celestial Mechanics: analytical and numerical methods, $N(>3)$ -body dynamics, rigid-body dynamics, non-gravitational forces, perturbation theory.

Asteroid Dynamics: chaotic diffusion of Main-Belt and Trojan asteroids, NEOs and PHAs dynamics, asteroid families, binary asteroids

(extra-)Solar System Dynamics: formation theory, planet migration and structural evolution of planetary systems, formation and evolution of asteroid populations

Space Safety Applications: planetary defense, small-body exploration and deflection, satellite and space debris dynamics and mitigation, NEO observations. Numerical and semi-analytical propagators for complex gravitational systems.

SCIENTIFIC ACHIEVEMENTS

Publications

- 2005: Publication of 3 back-to-back papers in *Nature*, on the dynamical evolution of the young solar system (“Nice-model”) with >3,600 citations up to now – referenced as ‘standard model’ of planetary science in graduate textbooks.
- 2016: Participation in the development of Europe’s Astrobiology Research RoadMap (“*AstRoMap*”; see Horneck et al., *Astrobiology* 16, 216), after invitation by ESF.

Teaching

- 2016: Selected as Planetary Science instructor in ESA’s “Basic Training Program for Astronauts 2016” (@EAC Cologne)

International Prizes and Awards

- 2008: Asteroid 1999RC221 renamed “(21775) *Tsiganis*” by the Small-bodies Nomenclature Committee of the International Astronomical Union (IAU), in recognition of my scientific achievements (first time to a Greek-educated scientist, working in Greece).
- 2016: International “*Paolo Farinella Prize*” for Celestial Mechanics and Planetary Science. Awarded at the joint DPS/EPSC meeting in Pasadena (CA, USA).

National Prizes and Awards

- 2013: “*George Foteinou Astronomy Prize*”, awarded by the Academy of Athens
- 2009: Award of “Research Excellence” for publishing in *Nature* (Research Committee AUTH)

Organization of international conferences

Organization of 7 international meetings as SOC/LOC member

Contribution to young researchers' career

- Dr. Aaron Rosengren (PhD at UC Boulder, USA). Dr. Rosengren worked as post-doc in my group in 2016-2017, under the ReDSHIFT project, where he was engaged in applying celestial mechanics tools (common in planetary dynamics) to engineering astrodynamics. He is now **Assistant Professor** at the University of Arizona, Tuscon.
- Dr. Anne-Sophie Libert, (PhD in FUNDP, Belgium). Dr. Libert had a 6-months post-doc stay in my group 2007-2008 at AUTH, where she first studied the physical aspects of planetary system formation, coming from a pure celestial mechanics background. We continued our collaboration since. She is now **Assistant Professor** in FUNDP, Namur.
- Dr. Bojan Novakovic (2007-), then graduate student at the Astronomical Observatory of Belgrade spent several months at AUTH working in my group. I was also member of his Majistar Jury (2009). He is currently **Assistant Professor** at the University of Belgrade.
- Despoina Skoulidou, recent PhD graduate on satellite and space debris dynamics. Immediately after graduation she was awarded an ESA post-doc fellowship to work at the Space Debris Office.

CONFERENCES/WORKSHOPS/etc.

Participated in **52** conferences and advanced schools, of which **15** as invited speaker

Most recent

- DART 2020 Observers Workshop, June 2020, JHU-APL, USA (virtual, Invited)
- The Main Belt: A Gateway to the Formation and Early Evolution of the Solar System Workshop, Sardinia, Italy, June 4-7, 2019
- *ACM_70*, in honor of Prof. Andrea Milani, September 2019, Pisa (invited)

Other Invited

- IAU Coll. 196 – Transits of Venus: New views of the Solar System and the Galaxy”, 2004 Preston, UK.
- CNRS School “Open Problems in Celestial Mechanics”, 2006 Aussois (France)
- SUPPA/SUSSP School (No 62) on “Extra-Solar Planets”, 2007 Skey Isl., UK.
- CNRS School on “Dynamics of gravitational systems”, 2009 Aussois (France)
- CELMEC V – International Meeting on Celestial Mechanics, 2009 Viterbo, (Italy)
- Nordita Master Class in Physics 2012. “Planet formation and evolution of young planetary systems”, 2012 Hilleroed (Denmark)
- STARDUST Marie Curie Training Network 2014 School. “Orbital Dynamics: an overview of asteroids and artificial satellites motion”, Rome 2014
- STARDUST Marie Curie Training Network 2015 School. “Chaotic diffusion and asteroid families”, Belgrade 2015
- Division on Planetary Sciences Meeting (DPS) – European Planetary Science Conference (EPSC), 2016. Plenary **“Paolo Farinella” Prize Talk**
- “CELMEC VII – International Meeting on Celestial Mechanics”, 2017, Viterbo, (Italy)

MEMBERSHIPS & REVIEWING ACTIVITIES *(if applicable)*

- 2012 - 2014** Member of GC of the *Hellenic Astronomical Society*
- 2014 - 2016** Secretary of GC of the *Hellenic Astronomical Society*
- 2014 – now** International Astronomical Union member
- 2018 - 2020** Director of Astrophysics, Astronomy and Mechanics Section (Dept. of Physics AUTH)
- 2018 – now** Associate Editor in “*Annales Geophysicae*”
- 2019 – now** Associate Editor in “*Serbian Astronomical Journal*”
- 2019 – now** Associate Editor in “*Celestial Mechanics and Dynamical Astronomy*”
- 2019 – now** Member of GC of “*NOESIS*” Technology Museum of Thessaloniki
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- 2016 –** Proposal reviewer for ESF, Europlanet, FNRS (Belgium), Czech Science Foundation, Greek GSRT and Ministry of Education (Πυθαγορας, Ελ.Ιδ.Ε.Κ)
- 2003 –** Reviewer for most major journals in the field: *Celestial Mechanics & Dynamical Astronomy, Icarus, Monthly Notices of the RAS, Astronomy & Astrophysics Astronomical Journal, Astrophysical Journal, Planetary & Space Science, Nature Geosciences., Advances in Space Research, Astrophysics & Space Science*

FELLOWSHIPS and AWARDS

- 2002 – 2004** EC Marie Curie Fellowship for post-doctoral research (at OCA/Nice, CNRS)
- 1998 - 2002** IKY fellowship for PhD studies, Greece

TEACHING ACTIVITIES

2006 – 2020 Lecturer/ Assist. Professor / Associate Professor at AUTH, Greece

Undergraduate:

Theoretical Mechanics II (analytical mechanics)
Observational Astronomy
Problems of the near-Earth environment
Planetary Systems
Theoretical Mechanics (Newtonian and Analytical mechanics)
Programming (in C) and applications
Applied Mathematics II (differential equations)
Numerical Analysis

Graduate school:

Computational Dynamics, Astrodynamics and Applications
Data analysis
Simulations of Chaotic Systems
Computational Mathematics I
Programming Tools (Fortran)

SUPERVISION OF GRADUATE STUDENTS AND POSTDOCTORAL FELLOWS

2008 - 2020 4 Post-docs
3 PhDs (plus 1, on-going), 4 Master Students

RECENT RESEARCH GRANTS

| Project Title | Funding source | Period | Role of the PI |
|--|------------------|-----------|--|
| H2020 Project "NEO-MAPP" | EC, Horizon 2020 | 2020-2022 | Co-I, lead of AUTH Team |
| H2020 Project "ReDSHIFT" | EC, Horizon 2020 | 2016-2019 | Co-I, lead of AUTH Team |
| Phase A/B1 study of the AIM/Hera mission | ESA | 2015-2019 | Investigation Team, co-chair of Dynamics Working Group |

PUBLICATIONS

Metrics: **65** Refereed publications (excluding non-independent papers in conference proceedings) **>4,200** citations (NASA ADS, h-index=23), **>6,350** citations (Google Scholar, h-index=28)

1. Noullez, A. and Tsiganis, K. 2020. Adv. Sp. Res., Design of Low-Altitude Martian Orbits using Frequency Analysis. submitted
2. Toliou, A., Tsiganis, K., Tsirvoulis, G. 2019. Secular resonance sweeping and orbital excitation in decaying disks. *Celestial Mechanics and Dynamical Astronomy* 132, 1.
3. Gkolias, I., Daquin, J., Skoulidou, D. K., Tsiganis, K., Efthymiopoulos, C. 2019. Chaotic transport of navigation satellites. *Chaos* 29, 101-106.
4. Skoulidou, D. K., Rosengren, A. J., Tsiganis, K., Voyatzis, G. 2019. Medium Earth Orbit dynamical survey and its use in passive debris removal. *Advances in Space Research* 63, 3646.
5. Rosengren, A. J., Skoulidou, D. K., Tsiganis, K., Voyatzis, G. 2019. Dynamical cartography of Earth satellite orbits. *Advances in Space Research* 63, 443.
6. Skoulidou, D. K., Rosengren, A. J., Tsiganis, K., Voyatzis, G. 2018. Dynamical lifetime survey of geostationary transfer orbits. *Celestial Mechanics and Dynamical Astronomy* 130, 77.
7. Xilouris, E. M., and 15 colleagues 2018. NELIOTA: The wide-field, high-cadence, lunar monitoring system at the prime focus of the Kryoneri telescope. *Astronomy and Astrophysics* 619, A141.
8. Michel, P., and 26 colleagues 2018. European component of the AIDA mission to a binary asteroid: Characterization and interpretation of the impact of the DART mission. *Advances in Space Research* 62, 2261.
9. Tsirvoulis, G., Morbidelli, A., Delbo, M., Tsiganis, K. 2018. Reconstructing the size distribution of the primordial Main Belt. *Icarus* 304, 14.
10. Voyatzis, G., Tsiganis, K., Antoniadou, K. I. 2018. Inclined asymmetric librations in exterior resonances. *Celestial Mechanics and Dynamical Astronomy* 130, 29.
11. Voyatzis, G., Tsiganis, K., Gaitanas, M. 2018. The rectilinear three-body problem as a basis for studying highly eccentric systems. *Celestial Mechanics and Dynamical Astronomy* 130, 3.
12. Rosengren, A. J., and 6 colleagues 2017. Galileo disposal strategy: stability, chaos and predictability. *Monthly Notices of the Royal Astronomical Society* 464, 4063.
13. Toliou, A., Morbidelli, A., Tsiganis, K. 2016. Magnitude and timing of the giant planet instability: A reassessment from the perspective of the asteroid belt. *Astronomy and Astrophysics* 592, A72.
14. Michel, P., and 26 colleagues 2016. Science case for the Asteroid Impact Mission (AIM): A component of the Asteroid Impact & Deflection Assessment (AIDA) mission. *Advances in Space Research* 57, 2529.
15. Horneck, G., and 19 colleagues 2016. AstRoMap European Astrobiology Roadmap. *Astrobiology* 16, 201.
16. Tsiganis, K. 2015. Planetary science: How the Solar System didn't form. *Nature* 528, 202.
17. Chrenko, O., Broz, M., Nesvorný, D., Tsiganis, K., Skoulidou, D. K. 2015. The origin of long-lived asteroids in the 2:1 mean-motion resonance with Jupiter. *Monthly Notices of the Royal Astronomical Society* 451, 2399.
18. Consolmagno, G. J., and 6 colleagues 2015. Is Vesta an intact and pristine protoplanet? *Icarus* 254, 190.
19. Noullez, A., Tsiganis, K., Tzirti, S. 2015. Satellite orbits design using frequency analysis. *Advances in Space Research* 56, 163.
20. Voyatzis, G., Antoniadou, K. I., Tsiganis, K. 2014. Vertical instability and inclination excitation during planetary migration. *Celestial Mechanics and Dynamical Astronomy* 119, 221.
21. Skoulidou, D. K., Tsiganis, K., Varvoglis, H. 2014. Long-term evolution of asteroids in the 2:1 Mean Motion Resonance. *Complex Planetary Systems, Proceedings of the International Astronomical Union* 178.
22. Tzirti, S., Noullez, A., Tsiganis, K. 2014. Secular dynamics of a lunar orbiter: a global exploration using Prony's frequency analysis. *Celestial Mechanics and Dynamical Astronomy* 118, 379.

23. Tsiganis, K., Varvoglis, H., Tsirovoulis, G., Voyatzis, G. 2012. Constraining asteroid dynamical models using GAIA data. *Planetary and Space Science* 73, 47.
24. Varvoglis, H., Sgardeli, V., Tsiganis, K. 2012. Interaction of free-floating planets with a star-planet pair. *Celestial Mechanics and Dynamical Astronomy* 113, 387.
25. Avdellidou, C., Ioannidis, P., Skoulidou, D. K., Tsiganis, K., Seiradakis, J. H. 2012. Lightcurve Analysis of 266 Aline, 664 Judith, (16959) 1998 QE17 and (32910) 1994 TE15. *Minor Planet Bulletin* 39, 103.
26. Morbidelli, A., Tsiganis, K., Batygin, K., Crida, A., Gomes, R. 2012. Explaining why the Uranian satellites have equatorial prograde orbits despite the large planetary obliquity. *Icarus* 219, 737.
27. Levison, H. F., Morbidelli, A., Tsiganis, K., Nesvorn_y, D., Gomes, R. 2011. Late Orbital Instabilities in the Outer Planets Induced by Interaction with a Self-gravitating Planetesimal Disk. *The Astronomical Journal* 142, 152.
28. Libert, A.-S., Tsiganis, K. 2011. Trapping in three-planet resonances during gas-driven migration. *Celestial Mechanics and Dynamical Astronomy* 111, 201.
29. Batygin, K., Morbidelli, A., Tsiganis, K. 2011. Formation and evolution of planetary systems in presence of highly inclined stellar perturbers. *Astronomy and Astrophysics* 533, A7.
30. Libert, A.-S., Tsiganis, K. 2011. Formation of '3D' multiplanet systems by dynamical disruption of multiple-resonance configurations. *Monthly Notices of the Royal Astronomical Society* 412, 2353.
31. Tzirti, S., Tsiganis, K., Varvoglis, H. 2010. Effect of 3rd-degree gravity harmonics and Earth perturbations on lunar artificial satellite orbits. *Celestial Mechanics and Dynamical Astronomy* 108, 389.
32. Morbidelli, A., Brasser, R., Gomes, R., Levison, H. F., Tsiganis, K. 2010. Evidence from the Asteroid Belt for a Violent Past Evolution of Jupiter's Orbit. *The Astronomical Journal* 140, 1391.
33. Tsiganis, K. 2010. Dynamics of small bodies in the solar system. *European Physical Journal Special Topics* 186, 67.
34. Campins, H., Morbidelli, A., Tsiganis, K., de Leon, J., Licandro, J., Laretta, D. 2010. The Origin of Asteroid 101955 (1999 RQ36). *The Astrophysical Journal* 721, L53.
35. Tsiganis, K. 2010. New insights on the asteroid-meteorite connection. *Ipparchos* 2, 17.
36. Novakovic, B., Tsiganis, K., Knezevic, Z. 2010. Dynamical portrait of the Lixiaohua asteroid family. *Celestial Mechanics and Dynamical Astronomy* 107, 35.
37. de Leon, J., Campins, H., Tsiganis, K., Morbidelli, A., Licandro, J. 2010. Origin of the near-Earth asteroid Phaethon and the Geminids meteor shower. *Astronomy and Astrophysics* 513, A26.
38. Novakovic, B., Tsiganis, K., Knezevic, Z. 2010. Chaotic transport and chronology of complex asteroid families. *Monthly Notices of the Royal Astronomical Society* 402, 1263.
39. Libert, A.-S., Tsiganis, K. 2009. Trapping in high-order orbital resonances and inclination excitation in extrasolar systems. *Monthly Notices of the Royal Astronomical Society* 400, 1373.
40. Brasser, R., Morbidelli, A., Gomes, R., Tsiganis, K., Levison, H. F. 2009. Constructing the secular architecture of the solar system II: the terrestrial planets. *Astronomy and Astrophysics* 507, 1053.
41. Morbidelli, A., Brasser, R., Tsiganis, K., Gomes, R., Levison, H. F. 2009. Constructing the secular architecture of the solar system. I. The giant planets. *Astronomy and Astrophysics* 507, 1041.
42. Levison, H. F., Bottke, W. F., Gounelle, M., Morbidelli, A., Nesvornyy, D., Tsiganis, K. 2009. Contamination of the asteroid belt by primordial trans-Neptunian objects. *Nature* 460, 364.
43. Tzirti, S., Tsiganis, K., Varvoglis, H. 2009. Quasi-critical orbits for artificial lunar satellites. *Celestial Mechanics and Dynamical Astronomy* 104, 227.
44. Libert, A.-S., Tsiganis, K. 2009. Kozai resonance in extrasolar systems. *Astronomy and Astrophysics* 493, 677.
45. Levison, H. F., Morbidelli, A., Van Laerhoven, C., Gomes, R., Tsiganis, K. 2008. Origin of the structure of the Kuiper belt during a dynamical instability in the orbits of Uranus and Neptune. *Icarus* 196, 258.
46. Morbidelli, A., Tsiganis, K., Crida, A., Levison, H. F., Gomes, R. 2007. Dynamics of the Giant Planets of the Solar System in the Gaseous Protoplanetary Disk and Their Relationship to the Current Orbital Architecture. *The Astronomical Journal* 134, 1790.

47. Tsiganis, K., Knezevic, Z., Varvoglis, H. 2007. Reconstructing the orbital history of the Veritas family. *Icarus* 186, 484.
48. Tsiganis, K. 2007. Chaotic Diffusion of Asteroids. *Lecture Notes in Physics*, Berlin Springer Verlag 111.
49. Knezevic, Z., Tsiganis, K., Varvoglis, H. 2006. Age of the Veritas asteroid family from two independent estimates. *Publications de l' Observatoire Astronomique de Beograd* 80, 161.
50. Tsiganis, K. 2006. The chaotic "sculpting" of the Solar System. *Ipparchos* 2, 17.
51. Gomes, R., Levison, H. F., Tsiganis, K., Morbidelli, A. 2005. Origin of the cataclysmic Late Heavy Bombardment period of the terrestrial planets. *Nature* 435, 466.
52. Morbidelli, A., Levison, H. F., Tsiganis, K., Gomes, R. 2005. Chaotic capture of Jupiter's Trojan asteroids in the early Solar System. *Nature* 435, 462.
53. Tsiganis, K., Gomes, R., Morbidelli, A., Levison, H. F. 2005. Origin of the orbital architecture of the giant planets of the Solar System. *Nature* 435, 459.
54. Tsiganis, K., Varvoglis, H., Dvorak, R. 2005. Chaotic Diffusion And Effective Stability of Jupiter Trojans. *Celestial Mechanics and Dynamical Astronomy* 92, 71.
55. Carruba, V., Nesvorny, D., Burns, J. A., Cuk, M., Tsiganis, K. 2004. Chaos and the Effects of Planetary Migration on the Orbit of S/2000 S5 Kiviuq. *The Astronomical Journal* 128, 1899.
56. Tsiganis, K., Varvoglis, H., Morbidelli, A. 2003. Short-lived asteroids in the 7/3 Kirkwood gap and their relationship to the Koronis and Eos families. *Icarus* 166, 131.
57. Tsiganis, K., Varvoglis, H., Hadjidemetriou, J. D. 2002. Stable Chaos versus Kirkwood Gaps in the Asteroid Belt: A Comparative Study of Mean Motion Resonances. *Icarus* 159, 284.
58. Tsiganis, K., Varvoglis, H., Hadjidemetriou, J. D. 2002. Stable Chaos in High-Order Jovian Resonances. *Icarus* 155, 454.
59. Tsiganis, K., Anastasiadis, A., Varvoglis, H. 2000. Dimensionality differences between sticky and non-sticky chaotic trajectory segments in a 3D Hamiltonian system. *Chaos Solitons and Fractals* 11, 2281.
60. Tsiganis, K., Varvoglis, H. 2000. Chaotic evolution of (719) Albert, the recently recovered minor planet. *Astronomy and Astrophysics* 361, 766.
61. Tsiganis, K., Varvoglis, H., Hadjidemetriou, J. D. 2000. Stable Chaos in the 12:7 Mean Motion Resonance and Its Relation to the Stickiness Effect. *Icarus* 146, 240.
62. Vozikis, C. L., Varvoglis, H., Tsiganis, K. 2000. The power spectrum of geodesic divergences as an early detector of chaotic motion. *Astronomy and Astrophysics* 359, 386.
63. Tsiganis, K., Dvorak, R., Pilat-Lohinger, E. 2000. Thersites: a 'jumping' Trojan? *Astronomy and Astrophysics* 354, 1091.
64. Dvorak, R., Tsiganis, K. 2000. Why do Trojan ASCs (not) Escape? *Celestial Mechanics and Dynamical Astronomy* 78, 125.
65. Tsiganis, K., Anastasiadis, A., Varvoglis, H. 1999. On the relation between the maximal LCN and the width of the stochastic layer in a driven pendulum. *Journal of Physics A Mathematical General* 32, 431.