

# Isamu Matsuyama

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## RESEARCH INTERESTS

Physics of planetary interiors and evolution with an emphasis on rotational and orbital dynamics, and tidal dissipation.

## EDUCATION

Ph.D. Astronomy and Astrophysics, University of Toronto, Toronto, ON, Canada, 2005

M.Sc. Astrophysics, University of Toronto, Toronto, ON, Canada, 2000

B.A. Physics, Universidad de Los Andes, Bogotá, Colombia, 1999

## EMPLOYMENT

2017 - present Associate Professor, Department of Planetary Sciences, Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ, USA

2011 - 2017 Assistant Professor, Department of Planetary Sciences, Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ, USA

## GRANTS AWARDED

2017 - 2020 Interior Structure, Stresses, and Tectonics of Planets; NASA Solar System Workings (SSW) program; PI

2017 - 2020 The Deep Lunar Interior From Multi-Satellite Data Analysis; NASA Lunar Data Analysis (LDAP) program; Co-I

2016 - 2019 *True Polar Wander of Terrestrial Planets and Its Implications for the Long-Term Stability of Polar Volatiles*; NASA Solar System Workings (SSW); PI

2015 - 2018 *Subsurface Oceans in icy satellites*; NASA Habitable Worlds program; PI

2012 - 2016 *Global lunar figure and its interior, orbit, and rotation*; NASA Lunar Advanced Science and Exploration Research (LASER) program; PI

2012 - 2016 *Constraints on the deep interior structure of the Moon*; NASA Gravity Recovery and Interior Laboratory (GRAIL) Guest Scientist Program; PI

## AWARDS

2008 - 2011 Miller Research Fellowship, University of California Berkeley, Berkeley, CA, USA.

2005 - 2008 Carnegie Fellowship, Carnegie Institution of Washington, Washington, DC, USA.

2000 - 2005 University of Toronto Fellowship, University of Toronto, Toronto, ON, Canada.

1999 - 2000 Connaught Scholarship, University of Toronto, Toronto, ON, Canada.

**CLASSES TAUGHT**

PTYS 505B - Principles of Planetary Physics

PTYS 170A - Planet Earth: Evolution of a Habitable World

**INVITED PRESENTATIONS**

- 2018 Royal Observatory of Belgium, Belgium; Delft University of Technology, The Netherlands; UC Santa Cruz; Caltech
- 2017 Hokkaido University, Japan
- 2016 Latin American XV Regional International Astronomical Union Meeting, Colombia
- 2015 University of Toronto, Canada
- 2015 11th Recontres du Vietnam, Planetary Systems: A Synergistic View, Quy Nhon, Vietnam
- 2013 Universidad de Los Andes, Bogotá, Colombia.
- 2012 Lunar and Planetary Laboratory
- 2011 Division of Planetary Sciences Meeting of the American Astronomical Society
- 2010 Caltech, Lunar and Planetary Laboratory, UCLA, UC Berkeley, UC Davis
- 2009 Washington University, UC Santa Cruz
- 2007 Harvard University, University of Toronto
- 2005 Third Harvard-Smithsonian Conference on Theoretical Astrophysics, Harvard University
- 2004 KITP program, Planet Formation: Terrestrial and Extra Solar, UC Santa Barbara
- 2003 Herzberg Institute for Astrophysics, Victoria, Canada; XIXth IAP Colloquium: Extrasolar Planets Today and Tomorrow, Paris, France

**PROFESSIONAL ACTIVITIES**

- 2003 - present Reviewer for publications: *Icarus*; *Journal of Geophysical Research (Planets)*; *Geophysical Research Letters*; *Astrophysical Journal*; *Nature*; *Monthly Notices of the Royal Astronomical Society*; *Earth, Moon, and Planets*; *Europa (University of Arizona Space Science Series)*
- 2007 - 2012 Grant proposal reviewer: NASA Planetary Geology and Geophysics program, NASA Cassini Data Analysis program, NASA Origins of Solar Systems program, NASA LASER program, NASA Emerging Worlds program
- 2009 Reviewer for the Japanese translation of the American Museum of Natural History Space Show, *Journey to the Stars*

**PUBLICATIONS**

Refereed Journal Articles

\* = Student as first author

41. Nimmo, F., & **Matsuyama, I.** (2019). Tidal dissipation in rubble-pile asteroids. *Icarus*, 321, 715–721. <http://doi.org/10.1016/j.icarus.2018.12.012>

40. \*Hay, H. C. F. C., & **Matsuyama, I.** (2019). Nonlinear tidal dissipation in the subsurface oceans of Enceladus and other icy satellites. *Icarus*, 319, 68–85. <http://doi.org/10.1016/j.icarus.2018.09.019>

39. **Matsuyama, I.**, Beuthe, M., Hay, H. C. F. C., Nimmo, F., & Kamata, S. (2018). Ocean tidal heating in icy satellites with solid shells. *Icarus*, 312, 208–230. <http://doi.org/10.1016/j.icarus.2018.04.013>
38. Hemingway, D. J., & **Matsuyama, I.** (2017). Isostatic equilibrium in spherical coordinates and implications for crustal thickness on the Moon, Mars, Enceladus, and elsewhere. *Geophys. Res. Lett.*, 44, 7695–7705.
37. \*Hay, H. C. F. C., & **Matsuyama, I.** (2017). Numerically modelling tidal dissipation with bottom drag in the oceans of Titan and Enceladus. *Icarus*, 281, 342–356
36. \*Keane, J. T., **Matsuyama, I.**, Kamata, S., & Steckloff, J. K. (2016). Reorientation and faulting of Pluto due to volatile loading within Sputnik Planitia. *Nature*, 540, 90–93.
35. Zuber et al. (2016). Gravity field of the Orientale basin from the Gravity Recovery and Interior Laboratory Mission. *Science*, 354, 438–441.
34. \***Matsuyama** et al. (2016), GRAIL, LLR, and LOLA constraints on the interior structure of the Moon. *Geophys. Res. Lett.*, 43.
33. Siegler et al. (2016), Lunar true polar wander inferred from polar hydrogen. *Nature*, 531, 480–484
32. Bouley et al. (2016), Late Tharsis formation and implications for early Mars. *Nature*, 531, 344–347.
31. Kamata, **Matsuyama**, and Nimmo (2015). Tidal resonance in icy satellites with subsurface oceans, *J. Geophys. Res. Planets*, 120, 1528-1542.
30. **Matsuyama, I.** (2014). Tidal dissipation in the oceans of icy satellites. *Icarus*, 242, 11–18.
29. \*Keane and **Matsuyama** (2014). Evidence for Lunar True Polar Wander, and a Past Low-Eccentricity, Synchronous Lunar Orbit. *Geophys. Res. Lett.*, 41.
28. Williams et al. (2014), Lunar interior properties from the GRAIL mission. *J. Geophys. Res.*, 119.
27. **Matsuyama** et al. (2014), Planetary reorientation, *Ann. Rev. Earth. Planet. Sci.*, 42, 605.
26. Chan et al. (2014), Time-dependent rotational stability of dynamic planets with elastic lithospheres. *J. Geophys. Res.*, 119, 169.
25. Andrews-Hanna et al. (2013), Ancient igneous intrusions and early expansion of the Moon revealed by GRAIL, *Science*, 339, 675.
24. **Matsuyama** (2013), Fossil figure contributions to the lunar figure. *Icarus*, 222, 411.
23. Creveling et al. (2012), Mechanisms for oscillatory true polar wander. *Nature*, 491, 244.
22. Chan et al. (2011), The rotational stability of a convecting Earth: assessing inferences of rapid TPW in the late cretaceous. *Geophys. J. Int.*, 187, 1319.
21. Chan et al. (2011), The rotational stability of a convecting Earth: the Earth's figure and TPW over the last 100 Myr. *Geophys. J. Int.*, 187, 773.
20. **Matsuyama** and Nimmo (2011), Reorientation of Vesta: Gravity and tectonic predictions. *Geophys. Res. Lett.*, 38, L14205.
19. **Matsuyama** and Manga (2010), Mars without the equilibrium rotational figure, Tharsis, and the remnant rotational figure. *J. Geophys. Res.*, 115, E12020.
18. **Matsuyama** and Bills (2010), Global contraction of planetary bodies due to despinning: application to Mercury and Iapetus, *Icarus*, 209, 271.
17. **Matsuyama** et al. (2010), The rotational stability of a triaxial ice-age Earth. *J. Geophys. Res.*, 115, B05401.

16. **Matsuyama** et al. (2009), Dispersal of Protoplanetary Disks by Central Wind Stripping. *Astrop. J.*, 700, 10.
15. Kite et al. (2009), True Polar Wander driven by late-stage volcanism and the distribution of paleopolar deposits on Mars. *Earth Planet. Sci. Lett.*, 280, 254.
14. **Matsuyama** and Nimmo (2009), Gravity and tectonic patterns of Mercury: Effect of tidal deformation, spin-orbit resonance, nonzero eccentricity, despinning, and reorientation. *J. Geophys. Res.*, 114, E01010.
13. Schenk et al. (2008), True polar wander on Europa from global-scale small-circle depressions. *Nature*, 453, 368.
12. **Matsuyama** and Nimmo (2008), Tectonic patterns on reoriented and despun planetary bodies. *Icarus*, 195, 459.
11. Daradich et al. (2007), Equilibrium rotational stability and figure of Mars. *Icarus*, 194, 463.
10. **Matsuyama** and Nimmo, (2007), Rotational stability of tidally deformed planetary bodies. *J. Geophys. Res.*, 112, E11003.
9. **Matsuyama** et al. (2007), Reorientation of planets with lithospheres: The effect of elastic energy. *Icarus*, 191, 401.
8. Nimmo and **Matsuyama**. (2007), Reorientation of icy satellites by impact basins. *Geophys. Res. Lett.*, 34, L19203.
7. Perron et al. (2007), Evidence for an ancient martian ocean in the topography of deformed shorelines. *Nature*, 447, 840.
6. Mitrovica et al. (2006), Reanalysis of ancient eclipse, astronomic and geodetic data: A possible route to resolving the enigma of global sea-level rise. *Earth Planet. Sci. Lett.*, 243, 390.
5. **Matsuyama** et al. (2006), Rotational stability of dynamic planets with elastic lithospheres. *J. Geophys. Res.*, 111, E02003.
4. Mitrovica et al. (2005), The rotational stability of an ice-age earth. *Geophys. J. Int.*, 161, 491.
3. Hogerheijde et al. (2003), Indications for Grain Growth and Mass Decrease in Cold Dust Disks around Classical T Tauri Stars in the MBM 12 Young Association. *Astrophys. J.*, 593, L101.
2. **Matsuyama** et al. (2003), Halting Planet Migration by Photoevaporation from the Central Source. *Astrophys. J.*, 585, L143.
1. **Matsuyama** et al. (2003), Viscous Diffusion and Photoevaporation of Stellar Disks. *Astrophys. J.*, 582, 893.