Christine M. Hartzell

Education:

PhD, Aerospace Engineering, May 2012
University of Colorado at Boulder
Advisor: Dr. Dan Scheeres

B.S., Aerospace Engineering, Highest Honors
Georgia Institute of Technology, May 2008

Christine Hartzell is an Assistant Professor in the Department of Aerospace Engineering at the University of Maryland. She is interested in the behavior of granular materials dominated by non-gravitational forces, especially in the context of spacecraft design and the morphological evolution of planetary bodies. Prior to coming to UMD, she was a postdoctoral fellow at the California Institute of Technology, where she was developing a computational model of granular materials in low gravity environments. Her graduate research, funded by the NASA Earth and Space Science Fellowship, focused on the dynamics of surface dust particles on near Earth asteroids. Specifically, her work focused on the influence of cohesive and electrostatic forces on the motion of dust particles. She has also conducted her research at the Institute of Space and Astronautical Science in Japan (under a grant from the National Science Foundation) and completed three internships at the Jet Propulsion Lab. Asteroid 9319 is named "Hartzell" in recognition of her contributions to the field of asteroid science.

Research and Work Experience:

Assistant Professor
University of Maryland
Department of Aerospace Engineering
Feb. 2014 – Present

- Conducting in research in granular matter and single-grain dynamics under the influence of cohesive, magnetic and electrostatic forces. Studying regolith (dust) on low gravity planetary bodies (asteroids and the Moon) in order to understand the evolution of these bodies and to improve the design of spacecraft to explore them.
- Steering Committee Member, Small Bodies Assessment Group: provides advice to NASA on science priorities for asteroids and comets.
- Member, NASA's Asteroid Redirect Mission Formulation Assessment and Support Team
- Science Team Member, Strata-1, NASA Johnson Space Center-internally funded granular segregation in microgravity experiment on the International Space Station (launched in 2016).

Keck Institute for Space Studies Postdoctoral Fellow
California Institute of Technology
Topic: Granular Mechanics, Physics
Advisor: Dr. Melany Hunt
July 2012 – Dec. 2013

- Began development of a Contact Dynamics (computational) simulation to model granular flows in microgravity environments.

Research Assistant
University of Colorado at Boulder
Topic: Orbital Mechanics, Plasma Physics
Advisor: Dr. Dan Scheeres
Aug. 2008 – June 2012

- NASA Earth and Space Science Fellowship Recipient 2009, 2010, 2011
- Amelia Earhart Fellowship Recipient 2009, 2010
- National Science Foundation Graduate Researcher Fellowship Program Honorable Mention 2009
- Dissertation Title: The Dynamics of Near-Surface Dust on Airless Bodies
- Explored surface dynamics of asteroid dust particles including electrostatic and cohesive effects.

Publications:

Journal: (indicates advisee)*

1. **C. Hartzell**, W. Farrell and J. Marshall, "*The Implications of Cohesive Regolith for Manned Phobos Exploration"* Advances in Space Research. 2017. Submitted.
2. M. Fries, **C. Hartzell** (author #9), *et al. "The Strata-1 Experiment on Small Body Regolith Segregation"* Acta Astronautica, Submitted 2017.
3. W. Farrell, J. Halekas, S. Fatemi, A. Poppe, **C. Hartzell**, J. Marshall, T. Stubbs, M. Zimmerman, Y. Zheng *"Anticipated Electrical Environment at Phobos: Nominal and Solar Storm Conditions"* Advances in Space Research. 2017. Accepted.
4. D. Carter* and **C. Hartzell** *"An Extension of Discrete Tribocharging Models to Continuous Size Distributions"* Physical Review E. 2017. Vol 95, pp 012901.
5. M. Zimmerman, W. Farrell, **C. Hartzell**, X. Wang, M. Horanyi. "*Grain-scale supercharging on airless regoliths"* Journal of Geophysical Research – Planets. 2016. Vol 121, pp 2150–2165.
6. **C. Hartzell**, X. Wang, D. Scheeres, M. Horanyi. "*Experimental Demonstration of the Role of Cohesion in Electrostatic Dust Lofting"* Geophysical Research Letters. 2013. Vol 40, pp 1038-1042.
7. **C. Hartzell**, D. Scheeres. "*Dynamics of Levitating Dust Particles Near Asteroids and the Moon"* Journal of Geophysical Research - Planets. 2013. Vol 118, pp 116-125.
8. **C. Hartzell**, D. Scheeres. *"The Role of Cohesive Forces in Particle Launching on the Moon and Asteroids"* Planetary and Space Sciences. 2011. Vol 59, pp 1758-1768.
9. D. Scheeres, **C. Hartzell**, P. Sánchez, M. Swift. *"Scaling Physics to Asteroid Surfaces: The Role of Cohesion"* Icarus. 2010. Vol 210, pp 968-984.
10. J.R. Masiero, **C.M. Hartzell**, D.J. Scheeres. *"The Effect of the Dust Size Distribution on Asteroid Polarization"* The Astronomical Journal. Dec. 2009. Vol 139, pp 1557-1562.

Technology:

- Provisional Patent, UMD (2016) *"Design of a Magnetorheological Universal Gripper"*
- JPL New Technology Report (2009) #47297: Detection of Clouds in Hyperspectral Imager Data.

Invited Talks:

- **C. Hartzell,** M. Zimmerman, *"Electrostatic Dust Levitation near Asteroid Itokawa",* URSI Atlantic Radio Science Conference, May 18-22, 2015.
- Presentation to Planetary Astronomy Late-afternoon Seminar Series, UMD Department of Astronomy, Feb 24, 2014.

Conference: (indicates advisee)*

1. **C. Hartzell**, M. Zimmerman *"Electrostatic Dust Levitation at Bennu: Comparison of Treecode and Semi-Analytical Plasma Models"* Asteroids, Comets and Meteors Conference (2017). Uruguay.

2. A. D. Whizin, P. A. Abell, J. Brisset, D. Britt, J. C. Colwell, A. R. Dove, D. D. Durda, M. D. Fries, L. D. Graham, **C. Hartzell**, K. K. John, M. J. Leonard, S. G. Love, J. A. Morgan, J. N. Poppin, D. Sánchez-Lana[7], D. Scheeres, "*The Strata-1 Microgravity Experiment on Small Body Regolith Dynamics"* Asteroids, Comets and Meteors Conference (2017). Uruguay.
3. W. M. Farrell, J. S. Halekas, S. Fatemi, A. R. Poppe, **C. M. Hartzell**, J. R. Marshall, T. J. Stubbs, M. I. Zimmerman, Y. Zheng, "*Anticipated Electrical Environment at Phobos"* Lunar and Planetary Science Conference (2017).
4. D. Carter*, **C. Hartzell**, *"A Model for Tribocharging of Regolith Grains"* Dust, Atmospheres and Plasmas (2017).
5. Choi, Y., Zembower, J., **Hartzell, C**., Wereley, N., *"Design and Test of a Magnetorheological Fluid-Based Universal Gripper"* 61st Annual Conference on Magnetism and Magnetic Materials (Nov 2016).
6. **C. Hartzell,** J. Sunshine, T. Farnham, "*Force Survey and Statics of Structures on a Two-Lobed Comet"* Division for Planetary Science (Oct 2016).
7. M. Fries, P. Abell, J. Brisset, D. Britt, J. Colwell, D. Durda, A. Dove, L. Graham, **C. Hartzell**, K. John, M. Leonard, S. Love, D. P. Sanchez, D. J. Scheeres, "*The Strata-1 Experiment on Microgravity Regolith Segregation"* 79th Annual Meeting of the Meteoritical Society (2016), Abstract #6547.
8. D. Carter* and **C. Hartzell**, "*A Model of Granular Tribocharging for Dielectric Mixtures with Continuous Size Distributions*", 2016 Joint Electrostatics Conference (June 2016).
9. A. DeCicco* and **C. Hartzell**, "*System-Level Design Considerations for Asteroid Despin via Neutral Beam Emitting Spacecraft*," IEEE Aerospace Conference (March 2016).
10. Fries M., Abell P., Brisset J., Britt D., Colwell J., Durda D., Dove A., Graham L., **Hartzell C**., John K., Leonard, M., Love, S., Sánchez, D.P., Scheeres D.J., *"Strata-1: An International Space Station Experiment into Fundamental Regolith Processes in Microgravity",* Lunar and Planetary Science Conference (2016) Abstract #2799.
11. **C. Hartzell**, M. Zimmerman. "*Predictions for Electrostatic Dust Levitation about Bennu's Equator"* American Geophysical Union Fall Meeting, Dec 2015.
12. D. Carter*, **C. Hartzell**. *"An Analytical Model of Tribocharging in Regolith"* American Geophysical Union Fall Meeting, Dec 2015. Poster P53C-2141.
13. **C. Hartzell**, M. Zimmerman. "*An Investigation of 2D Electrostatic Dust Levitation about Bennu"* Division for Planetary Science, Oct 2015.
14. **C. Hartzell**, D. Carter*. "*Towards a Model of Tribocharging for Planetary Science Applications"* Granular Matter in Low Gravity, March 2015. Erlangen, Germany.
15. **C. Hartzell**, M. Zimmerman. "*The Feasibility of Electrostatic Dust Levitation in Small Body Plasma Wakes"* Lunar and Planetary Science Conference, March 2015. Poster 2432.
16. A. DeCicco*, **C. Hartzell**. "*Cohesion and Electrostatic Lofting of Ellipsoidal Dust Grains"* Lunar and Planetary Science Conference, March 2015. Poster 2002.
17. **Hartzell**, M. Zimmerman. "*Electrostatically-driven Dust Motion near Itokawa"* Division for Planetary Science Conference, November 2014. Poster #414.08.
18. **Hartzell**, M. Zimmerman, Y. Takahashi. "*Dust Levitation About Itokawa's Equator"* Asteroids, Comets and Meteoroids Conference, July 2014.
19. **Hartzell**, M. Hunt. "*Contact Dynamics Models to Study Regolith Processes"* Lunar and Planetary Science Conference, March 2014. Poster #2849.
20. **C. Hartzell**, M. Hunt. *"Contact Dynamics Models for Spacecraft-Regolith Interactions"* Division of Fluid Dynamics Conference. November 2013. Poster.
21. **C. Hartzell**, M. Zimmerman, Y. Takahashi. "*Numerical Studies of Electrostatic Dust Motion about Itokawa"* Division for Planetary Sciences Conference. October 2013. Poster.
22. **C. Hartzell**, M. Hunt. "*Contact Dynamics Simulations for Surficial Regolith Motion"* NASA Lunar Science Forum. July 2013. Poster.
23. **C. Hartzell**, D. Scheeres, J. McMahon, Y. Takahashi. "*Electrostatic Dust Motion About Complex Asteroid Shapes"* American Geophysical Union Fall Meeting, December 2012. Poster.

24. **C. Hartzell**, X. Wang, D. Scheeres, M. Horanyi. *"An Experimental Demonstration of the Importance of Cohesion in Electrostatic Dust Lofting"* Division for Planetary Science Conference. October 2012. Poster.
25. **C. Hartzell**, X. Wang, D. Scheeres, M. Horanyi. *"Experimental Demonstration of the Importance of Cohesion in Electrostatic Dust Lofting"* NASA Lunar Science Forum. July 2012.
26. **C. Hartzell**, D. Scheeres. *"Dynamics of Levitating Dust on the Moon and Asteroids"* Dust, Atmosphere and Plasma. June 2012.
27. **C. Hartzell**, X. Wang, D. Scheeres, M. Horanyi. *"Experimental Demonstration of the Importance of Cohesion in Electrostatic Lofting of Small Grains"* Workshop on the Physics of Dusty Plasmas. May 2012.
28. **C. Hartzell**, D. Scheeres, X. Wang. *"Electrostatic Dust Motion on Asteroids: Current Understanding"* Asteroids, Comets and Meteors. May 2012.
29. **C. Hartzell**, D. Scheeres. *"Studies of 3D Dust Motion about Asteroids"* IEEE Aerospace Conference. March 2012.
30. **C. Hartzell**, D. Scheeres. "*Understanding 1D Dust Levitation"* American Geophysical Union Fall Meeting. December 2011. Poster.
31. **C. Hartzell,** D. Scheeres. *"Dynamics of Levitating Dust Near Equilibria on Asteroids"* Division of Planetary Sciences (AAS) Conference. October 2011.
32. **C. Hartzell**, D. Scheeres. *"Granular Mechanics and Dusty Plasmas"* Contributed Talk. Granular Flows: From Simulations to Astrophysical Applications. June 2011.
33. **C. Hartzell**, D. Scheeres. "*Implications of Electrostatics and Cohesion for Asteroid Surface Exploration*" IEEE Aerospace Conference. March 2011.
34. **C. Hartzell**, D. Scheeres. "*Dynamics of Levitating Dust Particles near Asteroids*" AIAA/AAS Spaceflight Mechanics Conference. Feb 2011.
35. **C. Hartzell**, D. Scheeres. "*Electrostatic Dust Launching Methods*" Division of Planetary Sciences Conference 2010.
36. **C. Hartzell**, D. Scheeres. "*The Significance of Cohesive Forces in Understanding Planetary Electrostatic Dust Lofting"* Scientific Assembly of the Committee on Space Research. 2010.
37. **C. Hartzell**, D. Scheeres. "*The Implications of Lunar Water on Electrostatic Dust Levitation"* Lunar and Planetary Science Conference. 2010. Poster.
38. D. Scheeres, **C. Hartzell**, P. Sánchez, M. Swift. "*The Relevance and Role of Cohesive Forces for Small Asteroids"* Lunar and Planetary Science Conference. 2010.
39. **C. Hartzell**, D. Scheeres. "*The Dynamics of Electrostatically Levitated Particles from Asteroids"* Lunar Dust, Plasma and Atmosphere: The Next Steps Meeting. 2010.
40. **C. Hartzell**, D. Scheeres. "*The Dynamics of Dust Levitated from Asteroids*" Division of Planetary Sciences Conference 2009. Poster.
41. **C. Hartzell**, S. Cheng. *"A Feasibility Study of On-Board Cloud Detection and Compression*" IEEE Aerospace Conference 2010.
42. **C. Hartzell**, J. Carpena, L. Graham, D. Racek, T. Tao, C. Taylor, H. Goldberg, C. Norton. *"Data System Design for a Hyperspectral Imaging Mission Concept"* IEEE Aerospace Conference 2009
43. A.M. Korzun, B.P. Smith, **C.M. Hartzell**, S.K. Martinelli, K.B. Hott, L.A. Place, C.Y. Yu, R.D. Braun. "*Entry, Descent and Landing System Design for the Mars Gravity Biosatellite"* International Planetary Probe Workshop 2008
44. P.J. Pingree, L.J. Scharenbroich, T.A. Werne, **C.M. Hartzell**. *"Implementing Legacy C Algorithms in FPGA Co-Processors for Performance Accelerated Smart Payloads"* IEEE Aerospace Conference 2008
45. **C.M. Hartzell**. *"Ablator Sizing Results for the Mars Gravity Biosatellite",* AIAA Region 2 Student Conference 2007

Awards:

- Asteroid 9319 named "Hartzell" in recognition of contributions to the study of electrostatic and cohesive properties of dust on asteroids and the Moon.
- Excellent Reviewer, 2016, Journal of Guidance, Control, and Dynamics

Graduate:
- NASA Earth and Space Science Fellowship Recipient 2009, 2010, 2011
- Amelia Earhart Fellowship Recipient 2009, 2010
- National Science Foundation Graduate Researcher Fellowship Program Honorable Mention 2009

Student Awards: (*Graduate Advisee, $^{+}$Undergraduate Researcher)
- Jackson Shannon^{+}, AIAA GNC Undergraduate Conference Experience at SciTech.
- Thomas Leps*: First Place, 2016 AIAA Region 1 Student Conference Master's Division. Presentation: "Transmission Spectroscopy of Sputtered Plumes for Surface Composition Analysis of Small Bodies"
- Dylan Carter*: NASA Space Technology Research Fellowship, 2015, Proposal Entitled: "Electrostatic Separation of Lunar Regolith for Size Beneficiation using Same-Material Tribocharging"
- Anthony DeCicco*: NASA Space Technology Research Fellowship, 2015, Proposal Entitled: "Touchless Despinning of Asteroids and Comets via Neutral Beam Emitting Spacecraft"