

## CURRICULUM VITAE

Derek Charles Richardson

Notarization. I have read the following and certify that this *curriculum vitae* is a current and accurate statement of my professional record.

Signature \_\_\_\_\_ Date November 14, 2017

### I. Personal Information

#### I.A. Contact Information

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#### I.B. Academic Appointments at UMD

**2012–present** Professor, Department of Astronomy.  
**2006–2012** Associate Professor, Department of Astronomy.  
**2000–2006** Assistant Professor, Department of Astronomy.

#### I.D. Other Employment

**1999–2000** Research Assistant Professor, Department of Astronomy, Univ. of Washington.  
**1996–1999** Research Associate, Department of Astronomy, University of Washington.  
**1993–1996** Postdoctoral Fellow, Canadian Institute for Theoretical Astrophysics.

#### I.E. Educational Background

**1993** Ph.D. in Astrophysics, Institute of Astronomy, University of Cambridge.  
**1990** B.Sc. in Astronomy & Physics, University of British Columbia.

### II. Research, Scholarly, and Creative Activities<sup>1</sup>

#### II.B. Chapters

##### II.B.1. Books

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<sup>1</sup>Unless noted otherwise, the lead/corresponding author is the first author of all cited works. My position in the author order is highlighted in **boldface**. Students and/or postdocs principally supervised by me at the time the work was performed are highlighted in *italics*.

1. **Richardson, D.C.**, *Leinhardt, Z.M.*, Melosh, H.J., Bottke Jr., W.F., Asphaug, E., 2002. Gravitational aggregates: Evidence and evolution. In: Bottke Jr., W.F., Cellino, A., Paolicchi, P., Binzel, R.P. (Eds.), *Asteroids III*. Univ. of Arizona Press, Tucson, pp. 501–515.
2. **Richardson, D.C.**, *Walsh, K.J.*, 2006. Binary minor planets. *Annu. Rev. Earth Planet. Sci.* 34, 47–81.
3. Michel, P., **Richardson, D.C.**, Durda, D.D., Jutzi, M., Asphaug, E., 2015. Collisional formation and modeling of asteroid families. In: Michel, P., DeMeo, F.E., Bottke, W.F., (Eds.), *Asteroids IV*. Univ. of Arizona Press, Tucson, pp. 341–354.

### II.B.3. Encyclopedia

1. **Richardson, D.C.**, Hagen, T.H., 2015. Crater Chain (Impact, Primary). In: Hargitai, H., Keresturi, Á. (Eds.), *Encyclopedia of Planetary Landforms*. Springer, New York, pp. 408–411.

### II.C. Refereed Journals

#### II.C.1. Refereed Journal Articles

1. Walker, G.A.H., Johnson, R., **Richardson, D.**, Campbell, B., Irwin, A.W., Yang, S., 1990. Cross talk in 1872 Reticon diode arrays. *Pub. Astron. Soc. Pac.* 102, 1418–1419. (Erratum 103, 260.)
2. **Richardson, D.C.**, 1993. A new tree code method for simulation of planetesimal dynamics. *Mon. Not. R. Astron. Soc.* 261, 396–414.
3. Lewis, G.F., Miralda-Escudé, J., **Richardson, D.C.**, Wambsganss, J., 1993. Microlensing light curves: A new and efficient numerical method. *Mon. Not. R. Astron. Soc.* 261, 647–656.
4. **Richardson, D.C.**, 1994. Tree code simulations of planetary rings. *Mon. Not. R. Astron. Soc.* 269, 493–511.
5. **Richardson, D.C.**, 1995. A self-consistent numerical treatment of fractal aggregate dynamics. *Icarus* 115, 320–335.
6. Walker, G.A.H., Walker, A.R., Irwin, A.W., Larson, A.M., Yang, S.L.S., **Richardson, D.C.**, 1995. A search for Jupiter-mass companions to nearby stars. *Icarus* 116, 359–375.
7. Lin, D.N.C., Bodenheimer, P., **Richardson, D.C.**, 1996. Orbital migration of the planetary companion of 51 Pegasi to its present location. *Nature* 380, 606–607.
8. Bottke Jr., W.F., **Richardson, D.C.**, Love, S.G., 1997. NOTE: Can tidal disruption of asteroids make crater chains on the Earth and Moon? *Icarus* 126, 470–474.
9. Bottke Jr., W.F., **Richardson, D.C.**, Love, S.G., 1998. Production of Tunguska-sized bodies by Earth’s tidal forces. *Planet. Space Sci.* 46, 311–322.
10. **Richardson, D.C.**, Bottke Jr., W.F., Love, S.G., 1998. Tidal distortion and disruption of Earth-crossing asteroids. *Icarus* 134, 47–76.
11. Bottke Jr., W.F., **Richardson, D.C.**, Michel, P., Love, S.G., 1999. 1620 Geographos and 433 Eros: Shaped by planetary tides? *Astron. J.* 117, 1921–1928.
12. **Richardson, D.C.**, Quinn, T., Stadel, J., Lake, G., 2000. Direct large-scale  $N$ -body simulations of planetesimal dynamics. *Icarus* 143, 45–59.
13. *Leinhardt, Z.M.*, **Richardson, D.C.**, Quinn, T., 2000. Direct  $N$ -body simulations of rubble pile collisions. *Icarus* 146, 133–151.

14. Michel, P., Benz, W., Tanga, P., **Richardson, D.C.**, 2001. Collisions and gravitational reaccumulation: forming asteroid families and satellites. *Science* 294, 1696–1700.
15. *Leinhardt, Z.M.*, **Richardson, D.C.**, 2002. *N*-body simulations of planetesimal evolution: Effect of varying impactor mass ratio. *Icarus* 159, 306–313.
16. Tanga, P., Michel, P., **Richardson, D.C.**, 2002. Planetesimal clusters in a keplerian disk: I. Gravitational evolution. *Astron. Astrophys.* 395, 613–623.
17. Michel, P., Tanga, P., Benz, W., **Richardson, D.C.**, 2002. Formation of asteroid families by catastrophic disruption: Simulations with fragmentation and gravitational re-accumulation. *Icarus* 160, 10–23. (Errata 160, 448 and 161, 198.)
18. Michel, P., Benz, W., **Richardson, D.C.**, 2003. Disruption of fragmented parent bodies as the origin of asteroid families. *Nature* 421, 608–611.
19. Durda, D.D., Bottke Jr., W.F., Enke, B.L., Merline, W.J., Asphaug, E., **Richardson, D.C.**, *Leinhardt, Z.M.*, 2004. The formation of asteroid satellites in large impacts: Results from numerical simulations. *Icarus* 167, 382–396. (Erratum 170, 242; reprinted article 170, 243–257.)
20. Michel, P., Benz, W., **Richardson, D.C.**, 2004. Catastrophic disruption of pre-shattered parent bodies. *Icarus* 168, 420–432.
21. Lake, G., Quinn, T., **Richardson, D.C.**, Stadel, J., 2004. The pursuit of the whole NChilada: Virtual petaflops using multi-adaptive algorithms for gravitational systems. *IBM J. Res. Dev.* 48, 183–197.
22. Michel, P., Benz, W., **Richardson, D.C.**, 2004. Catastrophic disruption of asteroids and family formation: a review of numerical simulations including both fragmentation and gravitational reaccumulations. *Planet. Space Sci.* 52, 1109–1117.
23. Tanga, P., Weidenschilling, S.J., Michel, P., **Richardson, D.C.**, 2004. Gravitational instability and clustering in a disk of planetesimals. *Astron. Astrophys.* 427, 1105–1115.
24. **Richardson, D.C.**, *Elankumaran, P.*, *Sanderson, R.E.*, 2005. Numerical experiments with rubble piles: Equilibrium shapes and spins. *Icarus* 173, 349–361.
25. *Leinhardt, Z.M.*, **Richardson, D.C.**, 2005. Planetesimals to protoplanets. I. Effect of fragmentation on terrestrial planet formation. *Astrophys. J.* 625, 427–440.
26. *Leinhardt, Z.M.*, **Richardson, D.C.**, 2005. A fast method for finding bound systems in numerical simulations: Results from the formation of asteroid binaries. *Icarus* 176, 432–439.
27. *Walsh, K.J.*, **Richardson, D.C.**, 2006. Binary near-Earth asteroid formation: Rubble pile model of tidal disruptions. *Icarus* 180, 201–216.
28. Tiscareno, M.S., Burns, J.A., Hedman, M.M., Porco, C.C., Weiss, J.W., Dones, L., **Richardson, D.C.**, Murray, C.D., 2006. 100-metre-diameter moonlets in Saturn’s A ring from observations of ‘propeller’ structures. *Nature* 440, 648–650.
29. Nesvorný, D., Enke, B.L., Bottke Jr., W.F., Durda, D.D., Asphaug, E., **Richardson, D.C.**, 2006. Karin cluster formation by asteroid impact. *Icarus* 183, 296–311.
30. **Richardson, D.C.**, *Walsh, K.J.*, 2006. Binary Minor Planets V1.0. EAR-A-COMPIL-5-BINMP-V1.0. NASA Planetary Data System.
31. *Lufkin, G.*, **Richardson, D.C.**, Mundy, L.G., 2006. Planetesimals in the presence of giant planet migration. *Astrophys. J.* 653, 1464–1468.
32. Durda, D.D., Bottke Jr., W.F., Nesvorný, D., Enke, B.L., Merline, W.J., Asphaug, A., **Richardson, D.C.**, 2007. Size-frequency distributions of fragments from SPH/*N*-body simulations of asteroid impacts: Comparison with observed asteroid families. *Icarus* 186, 498–516.

33. Consigli, J.-F., Tanga, P., Comito, C., Hestroffer, D., **Richardson, D.C.**, 2007. Formes d'astéroïdes et formation de satellites: Rôle de la réaccumulation gravitationnelle. *C. R. Physique* 8, 469–480.
34. Popova, O.P., Hartmann, W.K., Nemtchinov, I.V., **Richardson, D.C.**, Berman, D.C., 2007. Crater clusters on Mars: Shedding light on martian ejecta launch conditions. *Icarus* 190, 50–73.
35. Porco, C.C., Thomas, P.C., Weiss, J.W., **Richardson, D.C.**, 2007. Saturn's small inner satellites: Clues to their origins. *Science* 318, 1602–1607.
36. *Walsh, K.J., Richardson, D.C.*, 2008. A steady-state model of NEA binaries formed by tidal disruption of gravitational aggregates. *Icarus* 193, 553–566.
37. *Walsh, K.J., Richardson, D.C.*, Michel, P., 2008. Rotational breakup as the origin of small binary asteroids. *Nature* 454, 188–191.
38. Porco, C.C., Weiss, J.W., **Richardson, D.C.**, Dones, L., Quinn, T., Throop, H., 2008. Simulations of the dynamical and light-scattering behavior of Saturn's rings and the derivation of ring particle and disk properties. *Astron. J.* 136, 2172–2200.
39. Jutzi, M., Michel, P., Benz, W., **Richardson, D.C.**, 2009. The formation of the Baptistina family by catastrophic disruption: Porous versus non-porous parent body. *Meteorit. Planet. Sci.* 44, 1877–1887.
40. **Richardson, D.C.**, Michel, P., *Walsh, K.J., Flynn, K.W.*, 2009. Numerical simulations of asteroids modeled as gravitational aggregates. *Planet. Space Sci.* 57, 183–192.
41. Tanga, P., Hestroffer, D., Delbò, M., **Richardson, D.C.**, 2009. Asteroid rotation and shapes from numerical simulations of gravitational re-accumulation. *Planet. Space Sci.* 57, 193–200.
42. Leinhardt, Z.M., **Richardson, D.C.**, *Lufkin, G., Haseltine, J.*, 2009. Planetesimals to protoplanets. II. Effect of debris on terrestrial planet formation. *Mon. Not. R. Astron. Soc.* 396, 718–728.
43. Johnston, W.R., **Richardson, D.C.**, Walsh, K.J., 2009. Binary Minor Planets V2.0. EAR-A-COMPIL-5-BINMP-V2.0. NASA Planetary Data System.
44. Barnes, R., Quinn, T.R., Lissauer, J.J., **Richardson, D.C.**, 2009. *N*-body simulations of growth from 1 km planetesimals at 0.4 AU. *Icarus* 203, 626–643.
45. Tanga, P., Comito, C., Paolicchi, P., Hestroffer, D., Cellino, A., Dell'Oro, A., **Richardson, D.C.**, Walsh, K.J., Delbò, M., 2009. Rubble pile reshaping reproduces overall asteroid shapes. *Astrophys. J. Lett.* 706, L197–L202.
46. Tiscareno, M.S., *Perrine, R.P.*, **Richardson, D.C.**, Hedman, M.M., Weiss, J.W., Porco, C.C., Burns, J.A., 2010. An analytic parameterization of self-gravity wakes in Saturn's rings, with application to occultations and propellers. *Astron. J.* 139, 492–503.
47. Quinn, T., *Perrine, R.P.*, **Richardson, D.C.**, Barnes, R., 2010. A symplectic integrator for Hill's equations. *Astron. J.* 139, 803–807.
48. Jutzi, M., Michel, P., Benz, W., **Richardson, D.C.**, 2010. Fragment properties at the catastrophic disruption threshold: The effect of the parent body's internal structure. *Icarus* 207, 54–65.
49. Johnston, W.R., **Richardson, D.C.**, Walsh, K.J., 2010. Binary Minor Planets V3.0. EAR-A-COMPIL-5-BINMP-V3.0. NASA Planetary Data System.
50. Nesvorný, D., Youdin, A.N., **Richardson, D.C.**, 2010. Formation of Kuiper Belt binaries by gravitational collapse. *Astron. J.* 140, 785–793.
51. Michel, P., Jutzi, M., **Richardson, D.C.**, Benz, W., 2011. The asteroid Veritas: An intruder in a family named after it? *Icarus* 211, 535–545.

52. Durda, D.D., Movshovitz, N., **Richardson, D.C.**, Asphaug, E., Morgan, A., Rawlings, A.R., Vest, C., 2011. Experimental determination of the coefficient of restitution for meter-scale granite spheres. *Icarus* 211, 849–855.
53. Walsh, K.J., Michel, P., **Richardson, D.C.**, 2011. Collisional and rotational disruption of asteroids. *Adv. Sci. Lett.* 4, 311–324.
54. **Richardson, D.C.**, Walsh, K.J., Murdoch, N., Michel, P., 2011. Numerical simulations of granular dynamics: I. Hard-sphere discrete element method and tests. *Icarus* 212, 427–437.
55. *Perrine, R.P.*, **Richardson, D.C.**, Scheeres, D.J., 2011. A numerical model of cohesion in planetary rings. *Icarus* 212, 719–735.
56. Ortiz, J.L., Thirouin, A., Campo Bagatin, A., Duffard, R., Licandro, J., **Richardson, D.C.**, Santos-Sanz, P., Morales, N., Benavidez, P.G., 2012. Rotational fission of trans-Neptunian objects: The case of Haumea. *Mon. Not. R. Astron. Soc.* 419, 2315–2324.
57. Marchi, S., Paolicchi, P., **Richardson, D.C.**, 2012. Collisional evolution and reddening of asteroid surfaces: I. The problem of conflicting timescales and the role of size-dependent effects. *Mon. Not. R. Astron. Soc.* 421, 2–8.
58. *Schwartz, S.R.*, **Richardson, D.C.**, Michel, P., 2012. An implementation of the soft-sphere discrete element method in a high-performance parallel gravity tree-code. *Granular Matter* 14, 363–380.
59. Benavidez, P.G., Durda, D.D., Enke, B.L., Bottke Jr., W.F., Nesvorný, D., **Richardson, D.C.**, Asphaug, E., Merline, W.J., 2012. A comparison between rubble-pile and monolithic targets in impact simulations: Application to asteroid satellites and family size distributions. *Icarus* 219, 57–76.
60. Murdoch, N., Michel, P., **Richardson, D.C.**, Nordstrom, K., Berardi, C.R., Green, S.F., Wolfgang, L., 2012. Numerical simulations of granular dynamics: II. Particle dynamics in a shaken granular material. *Icarus* 219, 321–355. (Corrigendum 220, 296.)
61. *Perrine, R.P.*, **Richardson, D.C.**, 2012. *N*-body simulations of cohesion in dense planetary rings: A study of cohesion parameters. *Icarus* 219, 515–533.
62. Walsh, K.J., **Richardson, D.C.**, Michel, P., 2012. Spin-up of rubble-pile asteroids: Disruption, satellite formation, and equilibrium shapes. *Icarus* 220, 514–529.
63. Walker, J.D., Chocron, S., Durda, D.D., Grosch, D.J., Movshovitz, N., **Richardson, D.C.**, Asphaug, E., 2013. Momentum enhancement from aluminum striking granite and the scale size effect. *International Journal of Impact Engineering* 56, 12–18.
64. Michel, P., **Richardson, D.C.**, 2013. Collision and gravitational reaccumulation: Possible formation mechanism of the asteroid Itokawa. *Astron. Astrophys.* 554, L1.
65. *Schwartz, S.R.*, Michel, P., **Richardson, D.C.**, 2013. Numerically simulating impact disruptions of cohesive glass bead agglomerates using the soft-sphere discrete element method. *Icarus* 226, 67–76.
66. *Ballouz, R.-L.*, **Richardson, D.C.**, Michel, P., *Schwartz, S.R.*, 2014. Rotation-dependent catastrophic disruption of gravitational aggregates. *Astrophys. J.* 789, article id. 158, 12 pp..
67. *Matsumura, S.*, **Richardson, D.C.**, Michel, P., *Schwartz, S.R.*, *Ballouz, R.-L.*, 2014. The Brazil nut effect and its application to asteroids. *Mon. Not. R. Astron. Soc.* 443, 3368–3380.
68. *Yu, Y.*, **Richardson, D.C.**, Michel, P., *Schwartz, S.R.*, *Ballouz, R.-L.*, 2014. Numerical predictions of surface effects during the 2029 close approach of Asteroid 99942 Apophis. *Icarus* 242, 82–96.
69. *Schwartz, S.R.*, Michel, P., **Richardson, D.C.**, Yano, H., 2014. Low-speed impact simulations into regolith in support of asteroid sampling mechanism design I: Comparison with 1-g experiments. *Planet. Space Sci.* 103, 174–183.

70. Michel, P., Jutzi, M., **Richardson, D.C.**, Goodrich, C.A., Hartmann, W.K., O'Brien, D.P., 2015. Selective sampling during catastrophic disruption: Mapping the location of reaccumulated fragments in the original parent body. *Planet. Space Sci.* 107, 24–28.
71. *Ballouz, R.-L.*, **Richardson, D.C.**, Michel, P., *Schwartz, S.R.*, Yu, Y., 2015. Numerical simulations of collisional disruption of rotating gravitational aggregates: Dependence on material properties. *Planet. Space Sci.* 107, 29–35.
72. Cotto-Figueroa, D., Statler, T.S., **Richardson, D.C.**, Tanga, P., 2015. Coupled spin and shape evolution of small rubble-pile asteroids: Self-limitation of the YORP effect. *Astrophys. J.* 803, article id. 15, 18 pp.
73. Zhang, Y., Baoyin, H., Li, J., **Richardson, D.C.**, Schwartz, S.R., 2015. Effects of orbital ellipticity on collisional disruptions of rubble-pile asteroids. *Astrophys. Space Sci.* 360, article id. 30, 16 pp.
74. Cheng, A.F., Michel, P., Jutzi, M., Rivkin, A.S., Stickle, A., Barnouin, O., Ernst, C., Atchison, J., Pravec, P., **Richardson, D.C.**, 2016. Asteroid Impact & Deflection Assessment mission: Kinetic impactor. *Planet. Space Sci.* 121, 27–35.
75. Michel, P., Cheng, A., Küppers, M., Pravec, P., Blum, J., Delbo, M., Green, S.F., Rosenblatt, P., Tsiganis, K., Vincent, J.B., Biele, J., Ciarletti, V., Hérique, A., Ulamec, S., Carnelli, I., Galvez, A., Benner, L., Naidu, S.P., Barnouin, O.S., **Richardson, D.C.**, Rivkin, A., Scheirich, P., Moskovitz, N., Thirouin, A., Schwartz, S.R., Campo Bagatin, A., Yu, Y., 2016. Science case for the Asteroid Impact Mission (AIM): A component of the Asteroid Impact & Deflection Assessment (AIDA) mission. *Adv. Space Res.* 57, 2529–2547.
76. VanLandingham, J.H., Miller, M.C., Hamilton, D.P., **Richardson, D.C.**, 2016. The role of the Kozai-Lidov mechanism in black hole binary mergers in galactic centers. *Astrophys. J.* 828, article id. 77, 13 pp.
77. Rozehnal, J., Brož, M., Nesvorný, D., Durda, D.D., Walsh, K., **Richardson, D.C.**, Asphaug, E., 2016. Hektor – an exceptional D-type family among Jovian Trojans. *Mon. Not. R. Astron. Soc.* 462, 2319–2332.
78. *Maurel, C.*, *Ballouz, R.-L.*, **Richardson, D.C.**, Michel, P., Schwartz, S.R., 2017. Numerical simulations of oscillation-driven regolith motion: Brazil-nut effect. *Mon. Not. R. Astron. Soc.* 464, 2866–2881.
79. *Ballouz, R.-L.*, **Richardson, D.C.**, Morishima, R., 2017. Numerical simulations of Saturn's B ring: Granular friction as a mediator between self-gravity wakes and viscous overstability. *Astrophys. J.* 153, article id. 145, 10 pp.
80. *Zhang, Y.*, **Richardson, D.C.**, Barnouin, O.S., *Maurel, C.*, Michel, P., Schwartz, S.R., *Ballouz, R.-L.*, Benner, L.A.M., Naidu, S.P., Li, J., 2017. Creep stability of the proposed AIDA mission target 65803 Didymos: I. Discrete cohesionless granular physics model. *Icarus* 294, 98–123.
81. Ševeček, P., Brož, M., Nesvorný, D., Enke, B., Durda, D., Walsh, K., **Richardson, D.C.**, 2017. SPH/ $N$ -Body simulations of small ( $D = 10\text{km}$ ) asteroidal breakups and improved parametric relations for Monte-Carlo collisional models. *Icarus* 296, 239–256.
82. Yu, Y., **Richardson, D.C.**, Michel, P., 2017. Structural analysis of rubble-pile asteroids applied to collisional evolution. *Astrodyn.* 1, 57–69.
83. Hirabayashi, M., Schwartz, S.R., Yu, Y., Davis, A.B., Chesley, S.R., Fahnestick, E.G., Michel, P., **Richardson, D.C.**, Naidu, S.P., Scheeres, D.J., Cheng, A.F., Rivkin, A.S., 2017. Constraints on the perturbed mutual motion in Didymos due to impact-induced deformation of its primary after the DART impact. *Mon. Not. R. Astron. Soc.* 472, 1641–1648.

*Papers in press...*

84. Benavidez, P.G., Durda, D.D., Enke, B., Campo Bagatin, A., **Richardson, D.C.**, Asphaug, E., Bottke, W.F., 2017. Impact simulation in the gravity regime: Exploring the effects of parent body size and internal structure. *Icarus*, in press.
85. Schwartz, S.R., Michel, P., Jutzi, M., Marchi, S., *Zhang, Y.*, **Richardson, D.C.**, 2017. Catastrophic disruptions as the origin of bilobate comets. *Nat. Astron.*, in press.

*Papers in review...*

86. Michel, P., Küppers, Sierks, H., Carnelli, I., Cheng, A.F., Mellab, K., Granvik, M., Kestilä, A., Kohout, T., Muinonen, K., Näsilä, A., Penttilä, A., Tikka, T., Tortora, P., Ciarletti, V., Hérique, A., Murdoch, N., Asphaug, E., Rivkin, A., Barnouin, O., Campo Bagatin, A., Pravec, P., **Richardson, D.C.**, Schwartz, S.R., Tsiganis, K., Ulamec, S., 2017. HERA mission to the binary asteroid Didymos: characterization and interpretation of the impact of the DART mission. *Adv. Space Res.*, submitted.
87. Campo Bagatin, A., Alemañ, R.A., Benavidez, P.G., **Richardson, D.C.**, 2017. Internal structure of asteroid gravitational aggregates. *Icarus*, submitted.
88. Yu, Y., Michel, P., Hirabayashi, M., Schwartz, S.R., *Zhang, Y.*, **Richardson, D.C.**, 2017. The dynamical complexity of surface mass shedding from a top-shaped asteroid near the critical spin limit. *Astron. J.*, submitted.

*Papers in preparation...*

89. *Zhang, Y.*, **Richardson, D.C.**, Barnouin, O.S., Michel, P., Schwartz, S.R., *Ballouz, R.-L.*, 2017. Structural strength and failure mode of cohesive rubble-pile asteroids: From discrete element analyses. In preparation for *Icarus*.

## II.D. Published Conference Proceedings

### II.D.1. Refereed Conference Proceedings

1. Walker, J.D., Chocron, S., Durda, D.D., Grosch, D.J., Movshovitz, N., **Richardson, D.C.**, Asphaug, E., 2013. Scale size effect in momentum enhancement. *Procedia Engineering 2013: The 12th Hypervelocity Impact Symposium* 58, 240–250.
2. Hestroffer, Daniel; Campo Bagatin, Adriano; Losert, Wolfgang; Opsomer, Eric; Sanchez, Paul; Scheeres, Daniel J.; Staron, Lydie; Taberlet, Nicolas; Yano, Hajime; Eggl, Siegfried; Lecomte, Charles-Edouard; Murdoch, Naomi; Radjai, Fahrang; Richardson, Derek C.; Salazar, Marcos; Schwartz, Stephen R.; Tanga, Paolo, 2017. Small solar system bodies as granular systems. *Powders and Grains 2017: 8th International Conference on Micromechanics on Granular Media* 140, id. 14011.

### II.D.2. Non-Refereed conference proceedings

1. Lake, G., Quinn, T., **Richardson, D.C.**, 1997. From Sir Isaac Newton to the Sloan Survey: Calculating the structure and chaos owing to gravity in the Universe. *Proc. 8th Ann. ACM-SIAM Symp. on Discrete Algorithms*, New Orleans, LA, Jan. 5–7, 1997, pp. 1–10.
2. Lake, G., Quinn, T., **Richardson, D.C.**, Stadel, J., 1997. Parallel gravity from the 9 planet problem to billions and billions. *High Performance Computing 1997: Grand Challenges in Computer Simulation—Proc. 1997 Simulation MultiConference*, Atlanta, GA, Apr. 6–10, 1997, pp. 86–91.
3. **Richardson, D.C.**, 1998. Simulating Collisions in the Solar System. In: Celnikier, L.M., Vên, J.T.T. (Eds.), *Planetary Systems: The Long View*. Editions Frontières, France, pp. 199–205.

4. Lake, G., Quinn, T., **Richardson, D.C.**, Stadel, J., 1999. Virtual petaflops to simulate Solar System formation. *High Performance Computing 1999: Grand Challenges in Computer Simulation—Proc. 1999 Advanced Simulation Technologies Conf.*, San Diego, CA, Apr. 11–15, 1999, pp. 128–131.
5. Lake, G., Quinn, T., **Richardson, D.C.**, Stadel, J., 2000. Speedup to virtual petaflops using adaptive potential solvers and integrators for gravitational systems. *SPEEDUP 12*, 53–60.
6. Stadel, J., Wadsley, J., **Richardson, D.C.**, 2002. High performance computational astrophysics with `pkdgrav/gasoline`. In: Dimopoulos, N.J., Lie, K.F. (Eds.), *High Performance Computing Systems and Applications*. Kluwer Academic Publishers, Boston, pp. 501–523.
7. **Richardson, D.C.**, Scheeres, D.J., 2002. Asteroid satellites formed by tidal disruption. *ESA Special Publications SP-500*, 737–739.
8. *Leinhardt, Z.M.*, **Richardson, D.C.**, 2002. *N*-body simulations of planetesimal evolution: Effect of varying impactor mass ratio. *ESA Special Publications SP-500*, 767–770.
9. *Walsh, K.J.*, **Richardson, D.C.**, Rettig, T.W., 2003. Modeling the breakup of Comet Shoemaker-Levy 9. *Astron. Soc. Pacific Conf. Ser.* 291, 415.
10. Kim, J.-S., Nam, B., Marsh, M., Keleher, P., Bhattacharjee, B., **Richardson, D.**, Wellnitz, D., Sussman, A.,<sup>2</sup> 2007. Creating a robust desktop grid using peer-to-peer services. *Proc. 2007 NSF Next Generation Software Program Workshop*, Mar. 2007; appears with *Proc. 2007 IPDPS*.
11. Marsh, M., Kim, J.-S., Nam, B., Lee, J., Ratanasanya, S., Bhattacharjee, B., Keleher, P., **Richardson, D.**, Wellnitz, D., Sussman, A., 2008. Matchmaking and implementation issues for a P2P desktop grid. *Proc. 2008 NSF Next Generation Software Program Workshop*, Apr. 2008; appears with *Proc. 2008 IPDPS*.
12. Comito, C., Tanga, P., Paolicchi, P., Hestroffer, D., Cellino, A., **Richardson, D.**, Dell’Oro, A., 2011. Asteroids: Equilibrium shapes of rotating gravitational aggregates. *Mem. S.A.It. Suppl.* 16, 84–90.

## II.E. Conferences, Workshops, and Talks

*Where published abstracts/multimedia presentations are available, full citation is given.*

### II.E.2. Invited Talks

1. **Richardson, D.C.**, 1998. Simulating collisions in the solar system. *Planetary Systems: The Long View. IX<sup>èmes</sup> Rencontres de Blois*, Château de Blois, France: Jun. 22–28, pp. 199–205. Review, 30 mins.
2. “The Evolution of Fragile Planetesimals: Things that go Bump in the Night.” Washington Area Astronomers Meeting, NASA Goddard Space Flight Center, Greenbelt, MD: Feb. 22, 2001. Review, 20 mins.
3. **Richardson, D.C.**, 2003. The morphological evolution of asteroids. *Bull. Am. Astron. Soc.* 35, 1033. 34th DDA meeting. Cornell University, Ithaca, NY: May 5, 2003. Review, 50 mins.
4. “Rubble Piles & Monoliths.” *Catastrophic Disruptions VI*. Cannes, France: Jun. 11, 2003. Review, 30 mins.
5. “Gravitational Reaccumulation in the Solar System.” *Gravitational Collapse: From Massive Stars to Planets*. Ensenada, Mexico: Dec. 8, 2003. Review, 40 mins.

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<sup>2</sup>The lead/corresponding author for this proceedings and Marsh *et al.* (2008) is A. Sussman.



6. **Richardson, D.C.**, 2004. Gravitational reaccumulation in the solar system. Planet Formation: Terrestrial and Extra Solar. Kavli Institute for Theoretical Physics (KITP), Santa Barbara, CA: Mar. 19. Review, 50 mins.
7. “Pkdgrav: A Parallel  $k$ -D Tree Gravity Solver for  $N$ -body Problems.” Fast Multipole Method, Tree Code, and Related Approximate Algorithms—Trading Exactness for Efficiency. Center for Scientific Computation and Mathematical Modeling (CSCAMM), University of Maryland, College Park, MD: Apr. 29, 2004. Seminar, 40 mins.
8. “Collisions in  $N$ -body Problems: Techniques and Applications.” Grand Challenge Problems in Computational Astrophysics—Workshop II:  $N$ -Body Problems in Astrophysics. UCLA, Institute for Pure and Applied Mathematics (IPAM), Los Angeles, CA: Apr. 18–22, 2005. Review, 60 mins.
9. “Coagulation and Fragmentation Processes in Planetesimal Dynamics.” Workshop on Coagulation-fragmentation Processes: Theory and Applications. International Center for Mathematical Sciences (ICMS), Edinburgh, UK: Jul. 4–8, 2005. Review, 60 mins.
10. **Richardson, D.C.**, *Walsh, K.J.*, 2006. Forming NEA binaries: Tidal disruption may not be enough. IAU Symp. No. 236 S236, 12. Near Earth Objects, our Celestial Neighbors: Opportunity and Risk (IAU Symposium 236), Prague, Czech Republic: Aug. 14–18, 2006. Seminar, 30 mins.
11. “ $N$ -Body Models of Aggregation and Disruption.” Catastrophic Disruptions VII, Alicante, Spain: Jun. 26–29, 2007. Review, 45 mins.
12. “Rocks with Moons: The Origin of Near-Earth Asteroid Binaries.” Geological Society of Washington meeting 1415, Washington, DC: Nov. 14, 2007. Seminar, 20 mins.
13. “Rocks in Space: Insights from Numerical Simulations of Asteroid Collisions, Gravitational Reaccumulation, and Small Body Satellite Formation.” Evolution of Planetary and Stellar Systems: dynamical interactions with dnc lin, Prato, Italy: Jun. 21–26, 2009. Review, 45 mins.
14. “Simulating Asteroid Physical and Dynamical Properties using PKDGRAV.” Numerical Modeling of Asteroids as Granular Systems (NuMAGS), Meudon, France: Jan. 12–15, 2010. Seminar, 60 mins.
15. “Rotational Breakup as the Origin of Small Binary Asteroids.” 2010 APS/AAPT Joint Meeting, Washington, DC: Feb. 13–17, 2010. Seminar, 30 mins.
16. “Simulating Granular Dynamics Using PKDGRAV.” Numerical and Laboratory Explorations of the Response of Solid Celestial Bodies and their Granular Surfaces to various Kinds of Stresses Under Variable Gravity (ISSI Team Meeting 2010–2011), Bern, Switzerland: Jul. 26–30, 2010. Seminar, 60 mins (*in absentia*).
17. “ $N$ -body Collisions.” Large-Scale simulation of Formation and Evolution of Planetary Systems, Kobe, Japan: Jul. 22–Aug. 23, 2013. Seminar, 60 mins.
18. “Simulation of Granular Dynamics in the Solar System.” Granular & Granular-Fluid Flow: Fundamental Challenges and Applications of Particulate Systems (Gordon Research Conference), Stonehill College, Easton, MA: Jul. 20–25, 2014. Seminar, 50 mins.
19. “Modeling Asteroid Interiors and Surfaces Using  $N$ -body Techniques.” Stellar  $N$ -body Dynamics, Alta Pusteria, Italy: Sep. 8–12, 2014. Seminar, 35 mins.
20. “Structural Modeling of Asteroids.” First International Workshop on Potentially Hazardous Asteroids—Characterization, Atmospheric Entry, and Risk Assessment, NASA Ames Research Center, Moffett Field, CA: Jul. 7–9, 2015. Seminar, 20 mins.
21. “ASTR120/121 Course Redesign.” 2016 Innovations in Teaching and Learning Conference, University of Maryland, College Park, MD: Apr. 29, 2016. Panel, 40 mins (with teaching assistants Sara Frederick and Joseph DeMartini).

22. **Richardson, D.C.**, Ballouz, R.-L., DeMartini, J.V., Leisner Jr., A.M., Lu, Y., Maurel, C., Michel, P., Robinson, D.J., Schwartz, S.R., Sokol, D.B., Thuillet, F., Yu, Y., Zhang, Y., 2017. Simulating granular dynamics in very low gravity. Dynamics Days 2017, Silver Spring, MD: Jan. 4–7, 2017. Seminar, 35 mins.
23. **Richardson, D.C.**, Ballouz, R.-L., DeMartini, J.V., Leisner Jr., A.M., Lu, Y., Maurel, C., Michel, P., Robinson, D.J., Schwartz, S.R., Sokol, D.B., Thuillet, F., Yu, Y., Zhang, Y., 2017. Simulating granular dynamics in very low gravity. Asteroids, Comets, Meteors 2017, Montevideo, Uruguay: Apr. 10–14, 2017. Seminar, 25 mins.

## II.E.10. Non-Refereed Abstracts

*Only contributions appearing in published volumes are reported here.*

1. Walker, G., Bohlender, D., **Richardson, D.**, Walker, A., Irwin, A., Yang, S., 1991. A decade searching for stellar planetary companions with the HF technique. IAF, 42nd International Astronautical Congress, Montreal, Canada, Oct. 5–11, 1991, pp. 3.
2. **Richardson, D.C.**, Asphaug, E., Benner, L., 1995. Comet Shoemaker-Levy 9: A ‘rubble pile’ model with dissipative collisions and gravitational perturbations. Bull. Am. Astron. Soc. 27, 1114.
3. **Richardson, D.C.**, Bottke Jr., W.F., 1996. Tidal distortion and disruption of Earth-crossing asteroids. Bull. Am. Astron. Soc. 28, 1103.
4. Bottke Jr., W.F., **Richardson, D.C.**, Love, S.G., 1996. Can tidal disruption of asteroids make crater chains on Earth? Bull. Am. Astron. Soc. 28, 1103.
5. **Richardson, D.C.**, Bottke Jr., W.F., 1996. Tidal breakup of asteroids by the Earth and Moon. Astron. Soc. Pacific Conf. Ser. 122: From Stardust to Planetesimals, Santa Clara, CA, Jun. 24–26, 1996, pp. 205–208.
6. Bottke Jr., W.F., **Richardson, D.C.**, Love, S.G., 1997. Can tidal disruption enhance the population of small Earth-approaching objects? Lunar & Plan. Sci. Conf. 28, 139.
7. Bottke Jr., W.F., **Richardson, D.C.**, Love, S.G., 1997. Making crater chains on the Earth and Moon with planetary tidal forces. Lunar & Plan. Sci. Conf. 28, 141.
8. Love, S.G., Bottke Jr., W.F., **Richardson, D.C.**, 1997. Alternative formation mechanisms for terrestrial crater chains. Lunar & Plan. Sci. Conf. 28, 837.
9. Bottke Jr., W.F., **Richardson, D.C.**, Love, S.G., 1997. Has 1620 Geographos been reshaped by planetary tides? Bull. Am. Astron. Soc. 29, 965.
10. **Richardson, D.C.**, Quinn, T., Lake, G., 1997. Direct simulation of planet formation with a million planetesimals. Bull. Am. Astron. Soc. 29, 1027.
11. **Richardson, D.C.**, Lake, G., Quinn, T., Stadel, J., 1998. Direct simulation of planet formation with a million planetesimals: A progress report. Bull. Am. Astron. Soc. 30, 765.
12. **Richardson, D.C.**, Quinn, T., Stadel, J., Lake, G., 1998. Direct simulation of planet formation with a million planetesimals: First results. Bull. Am. Astron. Soc. 30, 1052.
13. *Leinhardt, Z.M.*, **Richardson, D.C.**, Quinn, T., 1999. When rubble piles collide... Bull. Am. Astron. Soc. 31, 670.
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15. Porco, C.C., Pantazopoulou, M.J., **Richardson, D.**, Quinn, T., Kehoe, T.J.J., 1999. Light scattering in planetary rings: The nature of Saturn's particle disk. *Bull. Am. Astron. Soc.* 31, 1140.
16. *Leinhardt, Z.M.*, **Richardson, D.C.**, Quinn, T., 2000. When rubble piles collide. *Lunar & Plan. Sci. Conf.* 31, 1274.
17. *Leinhardt, Z.M.*, **Richardson, D.C.**, Quinn, T., 2000. Size distribution dependence in rubble-pile collisions and implications for (216) Kleopatra. *Bull. Am. Astron. Soc.* 32, 1017.
18. *Barnes, R.K.*, **Richardson, D.C.**, Hahn, J.M., 2000. The effects of passing stars on planetesimal disks. *Bull. Am. Astron. Soc.* 32, 1101.
19. *Leinhardt, Z.M.*, **Richardson, D.C.**, 2001. The effect of the internal configuration of rubble piles on collision outcome. *Lunar & Plan. Sci. Conf.* 32, 1400.
20. Durda, D.D., Bottke Jr., W.F., Asphaug, E., **Richardson, D.C.**, *Leinhardt, Z.M.*, Merline, W.J., *Flynn, K.W.*, 2001. Numerical models of the formation of asteroid satellites. Asteroids 2001—from Piazzzi to the 3<sup>rd</sup> millenium, Palermo, Italy, Jun. 11–15, 2001, pp. 88–89.
21. Michel, P., Benz, W., Tanga, P., **Richardson, D.C.**, 2001. New simulations of collisions between asteroids in the gravity regime: Comparison with the properties of some observed asteroid families. Asteroids 2001, *ibid.*, pp. 92.
22. *Leinhardt, Z.M.*, **Richardson, D.C.**, 2001. Planetesimal evolution: A mass ratio study of rubble pile collisions. Asteroids 2001, *ibid.*, pp. 99.
23. **Richardson, D.C.**, *Flynn, K.W.*, *Leinhardt, Z.M.*, 2001. Rubble piles in the solar system: Evidence and dynamics. Asteroids 2001, *ibid.*, pp. 255.
24. Tanga, P., Michel, P., **Richardson, D.C.**, 2001. Planetesimal clustering in protoplanetary disks. *Bull. Am. Astron. Soc.* 33, 1080.
25. Porco, C.C., Throop, H.B., **Richardson, D.C.**, 2001. Light scattering in Saturn's rings: Basic disk properties and the A ring azimuthal asymmetry. *Bull. Am. Astron. Soc.* 33, 1091.
26. Durda, D.D., Bottke Jr., W.F., Asphaug, E., **Richardson, D.C.**, 2001. The formation of asteroid satellites: Numerical simulations using SPH and *N*-body models. *Bull. Am. Astron. Soc.* 33, 1134.
27. Michel, P., Benz, W., Tanga, P., **Richardson, D.C.**, 2001. Merging, spinning and bouncing in catastrophic collisions: Consequences for final fragment properties. *Bull. Am. Astron. Soc.* 33, 1134.
28. **Richardson, D.C.**, 2001. Asteroid satellites from tidal disruption simulations. *Bull. Am. Astron. Soc.* 33, 1352.
29. *Leinhardt, Z.M.*, **Richardson, D.C.**, 2001. *N*-body simulations of planetesimal evolution: Effect of varying impactor mass ratio. *Bull. Am. Astron. Soc.* 33, 1404.
30. Barnes, R.K., Quinn, T., Lissauer, J.J., **Richardson, D.C.**, 2002. The size distribution of planetesimals interior to 1 AU. 2nd Astrobiology Conf., NASA Ames, Moffett Field, CA, Apr. 7–11, 2002.
31. Michel, P., Benz, W., Tanga, P., **Richardson, D.C.**, 2002. Collisions between small bodies in a planetary system: Disruption regime at high impact velocities. EGS XXVII General Assembly, Nice, France, Apr. 21–26, Abstract #4361.
32. Durda, D.D., Bottke Jr., W.F., Enke, B.L., Asphaug, E., **Richardson, D.C.**, *Leinhardt, Z.M.*, 2003. The formation of asteroid satellites in catastrophic impacts: Results from numerical simulations. *Lunar & Plan. Sci. Conf.* 34, 1943.
33. Porco, C.C., Throop, H.B., **Richardson, D.C.**, 2003. Saturn's particle disk and the A ring azimuthal asymmetry. *Bull. Am. Astron. Soc.* 35, 929.

34. *Leinhardt, Z.M.*, and **Richardson, D.C.**, 2003. Planetesimal collisions and terrestrial planet formation. *Bull. Am. Astron. Soc.* 35, 965.
35. Weissman, P.R., **Richardson, D.C.**, Bottke Jr., W.F., 2003. Random disruption of cometary nuclei by rotational spin-up. *Bull. Am. Astron. Soc.* 35, 1012.
36. *Walsh, K.J.*, **Richardson, D.C.**, 2004. Direct  $N$ -body simulations of rubble pile collisions in strong tidal fields: Applied to Saturn's F ring. *Bull. Am. Astron. Soc.* 35, 1486.
37. Tanga, P., Weidenschilling, S., Michel, P., **Richardson, D.**, 2004. Gravitational instability and clustering in a disk of planetesimals. *Bull. Am. Astron. Soc.* 36, 851.
38. Tanga, P., Weidenschilling, S.J., Michel, P., **Richardson, D.**, 2004. Gravitational clustering in a disk of planetesimals. *EdP-Sciences Conf. Ser. SF2A-2004*, 264.
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42. Barnes, R., Quinn, T., Lissauer, J.J., **Richardson, D.C.**, 2005. Direct simulations of 1 km planetesimal growth at 0.4 AU. *Proc. Protostar & Planets V Conf.*, Hilton Waikoloa Village, Hawai'i: Oct. 24–28. *LPI Contr. No. 1286*, p. 8444.
43. Grimm, R.E., Bottke, W.F., Durda, D., Enke, B., Scott, E.R.D., Asphaug, E., **Richardson, D.C.**, 2005. Joint thermal and collisional modeling of the H-chondrite parent body. *Lunar & Plan. Sci. Conf.* 36, 1798.
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45. Michel, P., Benz, W., **Richardson, D.C.**, 2005. Simulations of collisional disruption at the catastrophic impact energy threshold: Effect of the target's internal structure and diameter. *Bull. Am. Astron. Soc.* 37, 622–623.
46. **Richardson, D.C.**, 2005. Rigid aggregates: Theory and applications. *Bull. Am. Astron. Soc.* 37, 638.
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48. Porco, C.C., Thomas, P., Spitale, J., Jacobson, R.A., Denk, T. Charnoz, S., **Richardson, D.C.**, Dones, L., Baker, E., Weiss, J.W., 2005. Physical and orbital properties of some of Saturn's small satellites. *Bull. Am. Astron. Soc.* 37, 768.
49. *Walsh, K.J.*, **Richardson, D.C.**, 2005. Small main-belt asteroid lightcurves. *Bull. Am. Astron. Soc.* 37, 963.
50. Tanga, P., Consigli, J.F., Hestroffer, D., **Richardson, D.C.**, 2006. Asteroid shapes and satellites: Investigating the details of gravitational re-accumulation. *Euro. Plan. Sci. Congress 2006*, 415.
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52. Weiss, J.W., Porco, C.C., **Richardson, D.C.**, Dones, L., 2006. Photometric examination of Saturn's rings as seen in Cassini ISS images. *Lunar & Plan. Sci. Conf.* 37, #2371.
53. *Walsh, K.J.*, **Richardson, D.C.**, 2006. A steady-state model of NEA binaries formed via tidal disruption. *Bull. Am. Astron. Soc.* 38, 666.
54. Barnes, R., Quinn, T.R., Lissauer, J.J., **Richardson, D.C.**, 2006. Direct simulation of growth from 1 km planetesimals at 0.4 AU. *Bull. Am. Astron. Soc.* 38, 667.
55. Weiss, J.W., Porco, C.C., **Richardson, D.C.**, Dones, L., 2006. A near-arm/far-arm asymmetry in Saturn's rings and implications for ring structure. *Bull. Am. Astron. Soc.* 38, #38.04.
56. *Perrine, R.P.*, **Richardson, D.C.**, 2006. A computational model of moons in planetary ring gaps. *Bull. Am. Astron. Soc.* 38, #42.04.
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60. Tanga, P., Consigli, J., Hestroffer, D., Comito, C., Cellino, A., **Richardson, D.C.**, 2006. Are asteroid shapes compatible with gravitational reaccumulation? *Bull. Am. Astron. Soc.* 38, #65.06
61. Hestroffer, D., Tanga, P., Cellino, A., Kaasalainen, M., Torppa, J., Marchis, F., **Richardson, D.C.**, *Elankumaran, P.*, Berthier, J., Colas, F., Lounis, S., 2006. HST/FGS high angular resolution observations of binary asteroids. *Bull. Am. Astron. Soc.* 38, #65.08.
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66. *Perrine, R.P.*, **Richardson, D.C.**, 2007. Numerical studies of satellite-ring interactions. *Bull. Am. Astron. Soc.* 39, #10.01.
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68. *Walsh, K.J.*, **Richardson, D.C.**, Michel, P., 2007. Binary asteroid formation via slow spin-up. *Bull. Am. Astron. Soc.* 39, #16.06.
69. Porco, C.C., Weiss, J.W., **Richardson, D.C.**, Dones, L., 2007. Saturn's ring particles: Lossier than previously thought. *Bull. Am. Astron. Soc.* 39, #26.04.
70. Michel, P., **Richardson, D.C.**, 2007. Catastrophic disruption of asteroids: First simulations with explicit formation of spinning rigid and semi-rigid aggregates. *Bull. Am. Astron. Soc.* 39, #30.10.

71. Michel, P., Jutzi, M., **Richardson, D.C.**, Benz, W., 2008. Catastrophic disruption of asteroids: Latest simulations including porosity effects, explicit formation of spinning aggregates and their implications. Asteroids, Comets, Meteors 2008, LPI Contr. No. 1405, paper id. 8072.
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105. Tanga, P., Comito, C., Hestroffer, D., **Richardson, D.C.**, 2010. Asteroid shapes are always close to fluid equilibrium. *Bull. Am. Astron. Soc. 42, #63.04.*
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141. Tanga, P., Campo Bagatin, A., Thirouin, A., Cellino, A., Comito, C., Ortiz, J., **Richardson, D.**, Hestroffer, D., 2014. Spin-induced mass loss from rubble piles and the formation of asteroid satellites and pairs. ACM 2014, *ibid.*, 521.
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143. Michel, P., Jutzi, M., **Richardson, D.C.**, 2014. Numerical simulations of microporous body disruptions: Comparison with non-porous and rubble-pile targets. DPS meeting #46, #400.07.
144. **Richardson, D.C.**, Michel, P., Schwartz, S.R., *Ballouz, R.-L.*, Yu, Y., *Matsumura, S.*, 2014. Numerical simulations of granular processes. DPS meeting #46, #503.03.
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149. Cheng, A.F., Stickle, A.M., Atchison, J.A., Barnouin, O.S., Ernst, C.M., Fletcher, Z., **Richardson, D.C.**, Rivkin, A.S., 2015. AIDA Double Asteroid Redirection Test (DART) mission: Modeling expected outcomes. 2015 IAA Planetary Defense Conference, IAA-PDC-15-04-02.
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151. **Richardson, D.C.**, *Abdurrahman, F.*, *Olmstead, A.*, *Scott, S.*, Hayes-Gehrke, M.N., 2015. Teaching the skills of professional astronomy through collaborative introductory labs. Amer. Assoc. Phys. Teachers, Summer Meeting 2015.
152. **Richardson, D.C.**, *Olmstead, A.*, *Abdurrahman, F.*, *Bostrom, A.*, *Scott, S.*, 2015. Creating opportunities for astronomy majors to collaborate in introductory courses. Amer. Assoc. Phys. Teachers, Summer Meeting 2015.
153. Campo Bagatin, A., Alemañ, R.A., **Richardson, D.C.**, 2015. Internal structure of small asteroids by  $N$ -body numerical simulations of non-spherical fragment shapes. Euro. Plan. Sci. Congress 2015, 129.
154. *Maurel, C.*, **Richardson, D.C.**, *Ballouz, R.-L.*, Michel, P., Schwartz, S.R., 2015. Simulations of vibration-driven regolith segregation in the low-gravity asteroid environment. Euro. Plan. Sci. Congress 2015, 596.
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157. Barnouin, O.S., *Maurel, C.*, **Richardson, D.C.**, *Ballouz, R.-L.*, Schwartz, S., Michel, P., 2015. Geodynamic stability of the primary in the binary asteroid system 65803 Didymos. DPS meeting #47, #402.09.

158. *Rimlinger, T.*, Hamilton, D., **Richardson, D.**, 2015. On the origin of the Kepler-36 system. DPS meeting #47, #418.04.
159. Michel, P., Jutzi, M., Goodrich, C.A., O'Brien, D.P., **Richardson, D.C.**, Hartmann, W.K., 2016. Selective sampling during catastrophic disruption: The effect of the parent body's size and the impact energy regime. Lunar & Plan. Sci. Conf. 47, LPI Contr. No. 1903, 1413.
160. **Richardson, D.C.**, Barnouin, O.S., Benner, L.A.M., Bottke Jr., W.F., Campo Bagatin, A., Cheng, A.F., Hirabayashi, M., *Maurel, C.*, McMahon, J.W., Michel, P., Murdoch, N., Naidu, S.P., Pravec, P., Rivkin, A.S., Scheeres, D.J., Scheirich, P., Tsiganis, K., *Zhang, Y.*, and the AIDA Dynamical and Physical Properties of Didymos Working Group, 2016. Dynamical and physical properties of 65803 Didymos. Lunar & Plan. Sci. Conf. 47, LPI Contr. No. 1903, 1501.
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162. Rivkin, A.S., Pravec, P., Moskovitz, N., Thirouin, A., Scheirich, P., Oszkiewicz, D., **Richardson, D.C.**, Polishook, D., Ryan, W.H., Thomas, C.A., Busch, M.W., Cheng, A.F., Michel, P., AIDA Observing Working Group, 2016. The Observing Working Group for the Asteroid Impact and Deflection Assessment (AIDA). Lunar & Plan. Sci. Conf. 47, LPI Contr. No. 1903, 2386.
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164. *Ballouz, R.*, **Richardson, D.C.**, Morishima, R., Spilker, L., *Lu, Y.*, 2016. Numerical simulations of Saturn's B-ring: Granular friction as a mediator between self-gravity and viscous overstability. DPS meeting #48, #114.08.
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166. **Richardson, D.C.**, Barnouin, O.S., Benner, L.A.M., Bottke, W., Campo Bagatin, A., Cheng, A.F., Eggl, S., Hamilton, D.P., Hestroffer, D., Hirabayashi, M., *Maurel, C.*, McMahon, J.W., Michel, P., Murdoch, N., Naidu, S.P., Pravec, P., Rivkin, A.S., Rosenblatt, P., Sarid, G., Scheeres, D.J., Scheirich, P., Tsiganis, K., *Zhang, Y.*, AIDA Dynamical and Physical Properties of Didymos Working Group, 2016. Dynamical and physical properties of 65803 Didymos, the proposed AIDA mission target. DPS meeting #48, #123.17.
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168. Osip, D.J., Rivkin, A.S., Pravec, P., Moskovitz, N., Thirouin, A., Scheirich, P., Oszkiewicz, D.A., **Richardson, D.C.**, Polishook, D., Ryan, W., Thomas, C., Busch, M.W.; Cheng, A.F., Michel, P., AIDA Observing Working Group, 2016. The Observing Working Group for the Asteroid Impact & Deflection Assessment (AIDA) mission. DPS meeting #48, #123.22.
169. *Zhang, Y.*, **Richardson, D.C.**, Barnouin, O., *Maurel, C.*, Michel, P., Schwartz, S.R., *Ballouz, R.*, Benner, L.A.M., Naidu, S.P., 2016. Geostability of Didymos, the target of the AIDA mission. DPS meeting #48, #209.03.
170. Michel, P., Schwartz, S.R., Jutzi, M., Marchi, S., **Richardson, D.C.**, *Zhang, Y.*, 2016. Disruptive collisions as the origin of 67P/C-G and small bilobate comets. DPS meeting #48, #211.12.

171. Ševeček, P., Brož, M., Nesvorný, D., Durda, D.D., Asphaug, E., Walsh, K.J., **Richardson, D.C.**, 2016. SPH/N-body simulations of small ( $D = 10$  km) monolithic asteroidal breakups and improved parametric relations for Monte-Carlo collisional models. DPS meeting #48, #400.05.
172. Schwartz, S.R., Michel, P., Bruck Syal, M., Owen, J.M., Miller, P.L., **Richardson, D.C.**, Zhang, Y., 2016. Numerical modeling of Stickney crater and its aftermath. DPS meeting #48, #523.03.
173. Hirabayashi, M., Scheeres, D.J., **Richardson, D.C.**, Fahnestock, E.G., Michel, P., Naidu, S.P., Benner, L.A.M., Cheng, A.F., Rivkin, A.S., 2017. Orbital perturbation within binary Asteroid Didymos due to impact-induced deformation of the primary after the DART impact experiment. Lunar & Plan. Sci. Conf. 48, LPI Contr. No. 1964, 1305.
174. Cheng, A.F., Michel, P., Barnouin, O., Atchison, J., Miller, P., Chesley, S., **Richardson, D.C.**, Rivkin, A.S., Stickle, A.M., 2017. The Double Asteroid Redirection Test (DART) element of the Asteroid Impact and Deflection Assessment (AIDA) mission. Lunar & Plan. Sci. Conf. 48, LPI Contr. No. 1964, 1510.
175. Thuillet, F., *Maurel, C.*, Michel, P., Biele, J., *Ballouz, R.-L.*, **Richardson, D.C.**, 2017. Numerical simulations of surface package landing on a low-gravity granular surface: Application to the landing of MASCOT onboard Hayabusa 2. Lunar & Plan. Sci. Conf. 48, LPI Contr. No. 1964, 1810.
176. El Mir, C., Ramesh, K.T., **Richardson, D.C.**, 2017. A new approach to simulation of asteroidal impact events: From damage to disruption and gravitational accumulation. Lunar & Plan. Sci. Conf. 48, LPI Contr. No. 1964, 2590.
177. Plescia, J.B., Barnouin, O., **Richardson, D.**, Schmerr, N., Lawrence, D., Denevi, B., Ernst, C., Yu, H., 2017. APEX - Asteroid Probe Experiment. Lunar & Plan. Sci. Conf. 48, LPI Contr. No. 1964, 2702.
178. Walsh, K.J., *Ballouz, R.L.*, Durda, D.D., **Richardson, D.C.**, Michel, P., Jutzi, M., 2017. Preserving shape and spin in asteroid reaccumulation simulations with SSDEM. Lunar & Plan. Sci. Conf. 48, LPI Contr. No. 1964, 2810.
179. Rivkin, A.S., Pravec, P., Thomas, C.A., Thirouin, A., Snodgrass, C., Green, S., Licandro, J., Sickafoose, A.A., Erasmus, N., Howell, E.S., Osip, D., Thomas-Osip, J., Moskovitz, N., Scheirich, P., Oszkiewicz, D., **Richardson, D.C.**, Polishook, D., Ryan, W.H., Busch, M.W., 2017. The Remote Observing Working Group for the Asteroid Impact and Deflection Assessment (AIDA). EPSC 2017, id. EPSC2017-401.
180. Cheng, A., Michel, P., Rivkin, A., Barnouin, O., Stickle, A., Miller, P.; Chesley, S., **Richardson, D.**, 2017. Double Asteroid Redirection Test (DART) element of AIDA mission. EPSC 2017, id. EPSC2017-778.
181. Campo Bagatin, A., **Richardson, D.C.**, Tsiganis, K., Cheng, A.F., Michel, P., 2017. Dynamical and physical properties of 65803 Didymos, the AIDA mission target. EPSC 2017, id. EPSC2017-846.
182. Benavidez, P., Durda, D., Enke, B., Campo Bagatin, A., **Richardson, D.C.**, Asphaug, E., Bottke, W. F., 2017. Large asteroid families modelled by impact events. EPSC 2017, id. EPSC2017-924.

## II.E.15. Colloquia

*Talks prior to Fall 2000 listed without titles.*

1. Colloquium, 60 mins, Cornell University, Ithaca, NY: Jan. 20, 1994.
2. Seminar, 60 mins, University of California, Santa Cruz, CA: Nov. 7, 1994.
3. Seminar, 60 mins, NASA Ames Research Center, Moffett Field, CA: Nov. 30, 1994.

4. Colloquium, 60 mins, University of Waterloo, Kitchener, ON: Mar. 8, 1995.
5. Seminar, 60 mins, University of California, Santa Cruz, CA: Oct. 20, 1995.
6. Colloquium, 60 mins, University of British Columbia, Vancouver, BC: Nov. 6, 1995.
7. Colloquium, 60 mins, University of Washington, Seattle, WA: Jan. 11, 1996.
8. Colloquium, 60 mins, St. Mary's University, Halifax, NS: Feb. 16, 1996.
9. Colloquium, 60 mins, Washington State University, Pullman, WA: Nov. 14, 1996.
10. Colloquium, 60 mins, University of Washington (Geophysics), Seattle, WA: May 13, 1997.
11. Colloquium, 60 mins, University of British Columbia, Vancouver, BC: Sep. 15, 1997.
12. Colloquium, 60 mins, University of Cambridge, Cambridge, UK: Jun. 18, 1997.
13. Colloquium, 60 mins, Hertzberg Institute of Astrophysics, Victoria, BC: Nov. 7, 1997.
14. Seminar, 60 mins, Institute for Theoretical Physics, Santa Barbara, CA: Jul. 14, 1998.
15. Colloquium, 60 mins, University of Notre Dame, South Bend, IN: Oct. 20, 1998.
16. Colloquium, 60 mins, University of Victoria, Victoria, BC: Nov. 25, 1998.
17. Colloquium, 60 mins, Monash University, Melbourne, Australia: Apr. 1, 1999.
18. Colloquium, 60 mins, Mt. Stromlo Observatory, Canberra, Australia: Apr. 9, 1999.
19. Colloquium, 60 mins, Osservatorio di Brera, Milano, Italy: Oct. 5, 1999.
20. Colloquium, 60 mins, University of California, Santa Cruz, CA: Dec. 2, 1999.
21. Seminar, 60 mins, NASA Ames Research Center, Moffett Field, CA: Dec. 3, 1999.
22. Colloquium, 60 mins, University of British Columbia, Vancouver, BC: Jan. 24, 2000.
23. Colloquium, 60 mins, University of Pennsylvania, Philadelphia, PA: Feb. 1, 2000.
24. Colloquium, 60 mins, University of Maryland, College Park, MD: Feb. 9, 2000.
25. Seminar, 60 mins, Institute for Advanced Study, Princeton, NJ: Feb. 17, 2000.
26. Colloquium, 60 mins, Dartmouth College, Hanover, NH: Feb. 21, 2000.
27. Colloquium, 60 mins, University of Colorado, Boulder, CO: Mar. 20, 2000.
28. Colloquium, 60 mins, Center for Astrophysics, Cambridge, MA: May 30, 2000.
29. "Planetesimal Dynamics" (seminar, 60 mins). Osservatorio di Torino, Torino, Italy: Nov. 16, 2000.
30. "Adventures with Rubble Piles: The Evolution of Fragile Planetesimals" (seminar, 60 mins). Department of Terrestrial Magnetism, Carnegie Institute of Washington, Washington, DC: Jan. 24, 2001.
31. "Forming Asteroid Families and Satellites" (colloquium, 60 mins). McMaster University, Hamilton, ON: Nov. 28, 2001.
32. "Collisions and Gravity: How to Make Asteroid Families and Satellites" (LHEA seminar, 60 mins). NASA Goddard Space Flight Center, Greenbelt, MD: Dec. 18, 2001.
33. "How to Make Asteroid Families and Satellites" (colloquium, 60 mins). Bartol Research Institute, Newark, DE: Mar. 28, 2002.

34. “Numerical Methods in Planetesimal Dynamics” (Space Sciences Seminar, 60 mins), George Mason University, Fairfax, VA: Nov. 3, 2004.
35. “Gravitational Reaccumulation in the Solar System” (Arfken Visiting Scholar physics seminar, 60 mins). Miami University, Oxford, OH: Nov. 17, 2004.
36. “Binary Asteroids” (colloquium, 60 mins). Case Western Reserve University, Cleveland, OH: Mar. 1, 2005.
37. “Binary Asteroids” (seminar, 60 mins). Department of Terrestrial Magnetism, Carnegie Institute of Washington, Washington, DC: Mar. 30, 2005.
38. “Asteroid Binary Formation via Tidal Disruption of Gravitational Aggregates” (colloquium, 60 mins). Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ: Apr. 26, 2005.
39. “Asteroids with Satellites: Origins and Implications” (seminar, 60 mins). Goddard Center for Astrobiology, NASA Goddard Space Flight Center, Greenbelt, MD: May 19, 2005.
40. “Binary Minor Planets” (seminar, 60 mins). Theoretical Astrophysics Center, University of California, Berkeley, CA: Sep. 19, 2005.
41. “Binary Minor Planets” (colloquium, 60 mins). University of Washington, Seattle, WA: Jan. 19, 2006.
42. “Binary Minor Planets” (colloquium, 60 mins). University of Pennsylvania, Philadelphia, PA: Apr. 12, 2006.
43. “Binary Small Bodies in the Solar System” (colloquium, 60 mins). Cornell University, Ithaca, NY: Sep. 28, 2006.
44. “Binary Small Solar System Bodies and Dwarf Planets” (seminar, 60 mins). Observatoire de la Côte d’Azur, Nice, France: Mar. 15, 2007.
45. “Binary Small Solar System Bodies and Dwarf Planets” (colloquium, 60 mins). University of Zurich, Zurich, Switzerland: Mar. 26, 2007.
46. “Binary Small Solar System Bodies and Dwarf Planets” (colloquium, 60 mins). University of Florida, Gainesville, FL: Dec. 5, 2007.
47. “Rotational Breakup as the Origin of Small Binary Asteroids” (seminar, 60 mins). Meta-institute for Computational Astrophysics, in *Second Life*: Nov. 14, 2008.
48. “Rotational Breakup as the Origin of Small Binary Asteroids” (seminar, 60 mins). Exoplanet Group, NASA Goddard Space Flight Center, Greenbelt, MD: Dec. 18, 2008.
49. “Rotational Breakup as the Origin of Small Binary Asteroids” (colloquium, 60 mins). Department of Mineral Science, National Museum of Natural History, Washington, DC: Mar. 4, 2009.
50. “Rotational Breakup as the Origin of Small Binary Asteroids” (seminar, 60 mins). Ohio University, Athens, OH: Mar. 11, 2009.
51. “Rotational Breakup as the Origin of Small Binary Asteroids” (seminar, 60 mins). Department of Terrestrial Magnetism, Carnegie Institute of Washington, Washington, DC: Apr. 24, 2009.
52. “Rotational Breakup as the Origin of Small Binary Asteroids” (colloquium, 60 mins). Department of Geology, University of Maryland, College Park, MD: Nov. 20, 2009.
53. “Numerical Simulations of Granular Dynamics” (colloquium, 60 mins). Southwest Research Institute, Boulder, CO: Mar. 22, 2011.
54. “Numerical Simulations of Granular Dynamics” (seminar, 60 mins). NASA Goddard Space Flight Center, Greenbelt, MD: Mar. 30, 2011.

55. “Weak Forces on Small Bodies in the Solar System” (colloquium, 60 mins). Department of Astronomy, University of Maryland, College Park, MD: Sep. 7, 2011.
56. “Weak Forces on Small Bodies in the Solar System” (seminar, 60 mins). Institute for Advanced Study, Princeton, NJ: Nov. 17, 2011.
57. “Advances in Low-gravity Granular Dynamics” (seminar, 60 mins). Department of Terrestrial Magnetism, Carnegie Institute of Washington, Washington, DC: Sep. 21, 2012.
58. “Advances in Low-gravity Granular Dynamics” (colloquium, 60 mins). Kavli Institute for Particle Astrophysics and Cosmology, Stanford University, Stanford, CA: Feb. 28, 2013.
59. “Advances in Low-gravity Granular Dynamics” (colloquium, 60 mins). Space Sciences Laboratory, University of California, Berkeley, CA: Mar. 1, 2013.
60. “Asteroids: Modeling the Future of Space Exploration” (seminar, 60 mins). Space Telescope Science Institute, Baltimore, MD: Apr. 19, 2013.
61. “Asteroids: Modeling the Future of Space Exploration” (colloquium, 60 mins). Yale University, New Haven, CT: Sep. 26, 2013.
62. “Weak Forces on Small Bodies in the Solar System” (seminar, 60 mins). Johns Hopkins University Applied Physics Laboratory, Laurel, MD: Oct. 9, 2013.
63. “Asteroids: Modeling the Future of Space Exploration” (colloquium, 60 mins). Department of Physics, University of Bristol, Bristol, UK: Nov. 4, 2013.
64. “Asteroids: Modeling the Future of Space Exploration” (seminar, 60 mins). Johns Hopkins University, Laurel, MD: Feb. 21, 2014.
65. “Asteroids: Modeling the Future of Space Exploration” (colloquium, 60 mins). Southwest Research Institute, Boulder, CO: Mar. 25, 2014.
66. “Asteroids: Modeling the Future of Space Exploration” (seminar, 60 mins). Planetary Geodynamics Branch, NASA Goddard Space Flight Center, Greenbelt, MD: Apr. 9, 2014.
67. “Asteroids: Modeling the Future of Space Exploration” (seminar, 60 mins). Department of Terrestrial Magnetism, Carnegie Institute of Washington, Washington, DC: Nov. 21, 2014.
68. “Asteroids: Modeling the Future of Space Exploration” (seminar, 60 mins). Lund University, Lund, Sweden: Apr. 16, 2015.
69. “Granular Dynamics in Low Gravity” (seminar, 60 mins). The Johns Hopkins University Extreme Materials Institute, Baltimore, MD: Dec. 8, 2017.

## II.F. Professional and Extension Publications

### II.F.1. Reports and Non-Refereed Monographs

1. Tiscareno, M.S., and 49 colleagues, 2009. Rings research in the next decade: A white paper submitted to the NRC Planetary Science Decadal Survey, 15 Sep. 2009.

## II.G. Book Reviews, Notes, and Other Contributions

### II.G.5. Other

1. **Richardson, D.C.**, 2001. News & Views: Giants in the asteroid belt. *Nature* 411, 899–900.

2. **Richardson, D.C.**, 2002. News & Views: Rocks that go bump in the night. *Nature* 417, 697–698.

## II.H. Completed Creative Works

### II.H.8. Software and Applications

- Developed `xa`, X11 software for viewing and animating images in a variety of formats. Released to the public domain in 1993, last update 1996. The code is archived in a variety of X11 public contribution repositories.
- Developed `box.tree`, a gravity simulation tree code with support for sliding patches, released to the public domain in 1994. No longer supported. Most papers prior to Richardson *et al.* 2000 feature this code.
- Modified `pkdgrav`, a high-performance parallel tree code under continuous development, but not presently in the public domain, originally developed by the *N*-body Shop at the University of Washington. Modifications include code for handling particle collisions, sliding patches, external potentials, hard surfaces, rigid body dynamics, and granular dynamics. Most papers from Richardson *et al.* 2000 onward feature this code.
- Developed `ss_core` (now subsumed in a revised version of `pkdgrav` hosted on `github`), a suite of code for supporting `pkdgrav` solar system simulations, including initial conditions generators, analysis software, plotting scripts, visualization tools, and animation support. This package is under continuous development and is used by a variety of collaborators.

### II.H.9. Websites

- Designed personal research page (<http://www.astro.umd.edu/~dcr/>) to provide easy access to all papers, multimedia, course content, etc.

## II.J. Sponsored Research and Programs

### II.J.1. Grants

#### Research Grants

*Only grants/proposals for which Richardson is PI or Co-I (i.e., not an unpaid collaborator) are listed.*

2000–02 Co-investigator, “Understanding the Physical Structure of the Comet Shoemaker-Levy 9 Fragments” (STScI HST Archives; PI: Terry Rettig, University of Notre Dame). \$20,000 paid directly to UMD graduate student Walsh by UND.

2003–06 Co-investigator, “Studies in Planetary Rings” (NASA Planetary Geology and Geophysics; PI: Carolyn Porco, Space Science Institute). \$28,542 subcontract.

2003–06 Principal investigator, “Rubble Pile Dynamics” (NASA Origins of Solar Systems). \$139,000.

2003–06 Principal investigator, “Planetesimals to Protoplanets” (NASA Graduate Student Researchers Program). \$72,000.

2005–06 Co-investigator, “Employing Peer-to-Peer Services for Robust Grid Computing” (NSF Computer Systems; PI: Alan Sussman, University of Maryland). \$60,000 (commitment: 0.02 WY).

2003–07 Principal investigator, “Origin of Binary Near-Earth Asteroids” (NSF Planetary Astronomy). \$213,642.



- 2006–07 Co-investigator, “Studies in Planetary Rings” (NASA Planetary Geology and Geophysics; PI: Carolyn Porco, Space Science Institute). \$13,542 subcontract.
- 2005–08 Co-investigator, “Robust Grid Computing using Peer-to-Peer Services” (NASA Applied Information Systems Research; PI: Alan Sussman, University of Maryland). \$1,008,242 (commitment: 0.08 WY/yr).
- 2007–08 Principal investigator, “Investigations of Elusive Planetary Ring Particle Properties via Computational Modeling” (NASA Earth and Space Science Fellowship). \$24,000.
- 2004–09 Co-investigator, “Origin and Evolution of Organics in Planetary Systems” (NASA Astrobiology; PI: Mike Mumma, NASA Goddard Space Flight Center). \$330,000 (U Maryland portion; 5 years; commitment: 0.08 WY/yr).
- 2006–09 Co-investigator, “*N*-body Simulations of Growth from 1 km Planetesimals” (NASA Terrestrial Planet Finder Foundation Science/Origins of Solar Systems; PI: Jack Lissauer, NASA Ames Research Center). \$41,000 subcontract.
- 2006–09 Co-investigator, “Impacts Between Icy and Silicate Bodies: Experiments to Determine Scaling Laws for Coefficient of Restitution” (NASA Outer Planets Research; PI: Dan Durda, Southwest Research Institute). \$27,793 subcontract.
- 2008–09 Principal investigator, “Investigations of Elusive Planetary Ring Particle Properties via Computational Modeling” (NASA Earth and Space Science Fellowship, renewal). \$30,000.
- 2007–10 Principal investigator, “Binary Near-Earth Asteroid Formation from Rotational Disruption of Gravitational Aggregates” (NSF Astronomy and Astrophysics Research Grants). \$241,045.
- 2008–10 Co-investigator, “Microprocesses in Saturn’s Rings” (NASA Cassini Data Analysis Program; PI: John Weiss, Space Science Institute). \$33,699 subcontract.
- 2009–10 Principal investigator, “A Local Dynamical Model of Planetary Rings with Cohesive Particles” (NASA Earth and Space Science Fellowship, renewal). \$30,000.
- 2011 Principal investigator, “Computational Modeling of Cohesion in Gravitational Aggregates” (French Embassy Chateaubriand Fellowship). \$16,000.
- 2006–11 Co-investigator, “CSR PDOS Creating a Robust Desktop Grid using Peer-to-Peer Services” (NSF Computer Systems; PI: Alan Sussman, University of Maryland). \$365,700 (commitment: 0.04 WY/yr).
- 2008–12 Co-investigator, “Development of a Tree Code for Extreme Mass Ratio Inspirals” (NASA Astrophysics Theory and Fundamental Physics; PI: Cole Miller, University of Maryland). \$390,874 (commitment: 0.08 WY/yr).
- 2011–12 Co-investigator, “2011 Interdisciplinary Summer School: Granular Flows: From Simulations to Astrophysical Applications” (NSF Division of Materials Research; PI: Wolfgang Losert, University of Maryland), \$6,000.
- 2008–13 Principal investigator, “Gravitational Aggregate Dynamics” (NASA Planetary Geology and Geophysics). \$217,192.
- 2009–13 Co-investigator, “CSR: Small: Data Staging and Parallel Applications in Robust Desktop Grids” (NSF Computer Systems; PI: Peter Keleher, University of Maryland). \$475,000 (commitment: 0.08 WY/yr).
- 2010–13 Principal investigator, “Numerical Modeling of Cohesion in Planetary Rings” (NASA Outer Planets Research). \$167,829.
- 2010–14 Principal investigator, “Effect of Internal Structure on the Formation of Binary Near-Earth Asteroids” (NSF Division of Astronomical Sciences). \$267,314.

- 2011–13 Co-investigator, “Size Dependence of Coefficient of Restitution: Including the Effects of Rotation and Irregular Shape” (NASA Outer Planets Research; PI: Dan Durda, Southwest Research Institute). \$6,000 subcontract.
- 2012–15 Co-investigator, “Exploration of Extreme Mass Ratio Inspirals with a Tree Code” (NASA Astrophysics Theory Program; PI: Cole Miller, University of Maryland). \$458,202 (commitment: 0.08 WY/yr).
- 2014–18 Principal investigator (Co-I: Ryuji Morishima, UCLA), “Direct Numerical Modeling of Saturn’s Dense Rings Informed by Cassini Data” (NASA Outer Planets Research), \$295,091.
- 2014–16 Graduate student advisor, “Collaborative Research: Enhancing Undergraduate STEM Education: Workshops and Learning Communities for Physics and Astronomy Faculty” (NSF IUSE), \$154,580 (year 1; portion funding Alice Olmstead 100%).
- 2015–18 Principal investigator (unpaid Co-I: Thomas Statler), “Asteroids Under Stress: Constraining Strength and Evolution Through Simulations” (NASA Solar System Workings), \$390,286.
- 2015–18 Principal investigator (Co-I: Douglas Hamilton, University of Maryland), “Dynamics of the Didymos System Pre- and Post- Impact” (Johns Hopkins University/Applied Physics Lab subcontract), \$96,196.
- 2016–17 Principal investigator (Co-PI: Wolfgang Losert, University of Maryland), “Collaborative Research: ParaTreet: Parallel Software for Spatial Trees in Simulation and Analysis” (NSF SI2-SSI), \$54,999
- 2016–18 Principal investigator, “Reaccumulation of Asteroids Following Catastrophic Disruption” (Southwest Research Institute, Boulder, CO), \$64,966
- 2017–18 Co-Principal investigator (PI: Nick Schmerr, University of Maryland), “APEX: Asteroid Probe EXperiment” (Johns Hopkins University/Applied Physics Lab subcontract), \$33,945.

#### Computing Grants

- 2004–06 Principal investigator, “Planetesimals to Protoplanets” (National Computational Science Alliance). 100,000 node hours (Pittsburgh Supercomputing Center).
- 2006–08 Principal investigator, “A Numerical Study of Perturbations in Planetary Rings” (CyberInfrastructure Partnership). 175,000 SUs (TeraGrid).
- 2015–16 Principal investigator, “Planetary Rings”. 1 million SUs (Bluecrab/MARCC).
- 2017–18 Principal investigator, “Planetary Rings”. 1 million SUs (Bluecrab/MARCC).

#### Internal Grants

- 2002 Summer research grant, “Torques and Non-central Impacts on Strong Aggregated Bodies: Applications to Asteroid Satellites, Tidal Disruption, and Granular Dynamics” (University of Maryland General Research Board). \$8,750.
- 2015–16 Lead instructor, ASTR120/121 course reform (TLTC Elevate Fellows), \$15,000.

#### Travel Grants

- 2003 AAS International Travel Grant for CD-VI meeting in Cannes, Jun. 2003. \$1,255.

#### Space Mission Involvement

2008–2009 U.S. participant (unfunded), ESA/JAXA MarcoPolo mission study.  
2011–2013 U.S. participant (unfunded), ESA/JAXA MarcoPolo-R mission study.  
2011– Collaborator, NASA OSIRIS-REx mission.  
2014– Co-chair, Dynamical and Physical Properties of Didymos Working Group, NASA/ESA DART/AIM (now HERA) (formerly AIDA) mission study.  
2016– Co-investigator, Asteroid Probe EXperiment (APEX), Johns Hopkins University/Applied Physics Laboratory mission study.

## II.J.2. Contracts

2014–17 Graduate student advisor, “Modeling TAGSAM Compliance with the Soft-Sphere Method” (NASA OSIRIS-REx mission, U Arizona subcontract), \$69,068 (funded Ronald Ballouz 50%).

## II.P. Research Fellowships, Prizes, and Awards

1990–93 Commonwealth Scholarship.  
1994–96 Natural Sciences & Engineering Research Council Postdoctoral Fellowship.  
2000 Richardson *et al.* artwork: cover of *Icarus*, Jan. 2000.  
2001 Michel *et al.* artwork: cover of *Science*, Nov. 2001.  
2002 Asteroid 1998 SH54 renamed 12566 Derichardson.  
2003 Michel *et al.* artwork: cover of *Nature*, Feb. 2003.  
2004 Arfken Visiting Scholar, Miami University (Nov. 15–19).  
2007 Runner-up, Geophysical Society of Washington “Best Paper” award.  
2013 Walker *et al.* submission to *Procedia Engineering* voted “Best Paper.”  
2013 Benjamin Meaker Visiting Professor, Institute for Advanced Studies, University of Bristol (Oct. 21–Nov. 21).

## III. Teaching, Extension, Mentoring, and Advising

### III.A. Courses Taught (2012–)

*Student enrollment is after drop/adds and includes students auditing. NOTE: I was on sabbatical from Sep. 1, 2013 to Aug. 31, 2014.*

- General/introductory.

Fall 2012 ASTR120 “Introductory Astrophysics – Solar System” for undergraduate majors (CORE), 3 credits, 51 students in 1 section.

Spring 2013 ASTR121 “Introductory Astrophysics II – Stars and Beyond” for undergraduate majors (CORE with lab), 4 credits, 33 students in 2 sections (co-taught with Alice Olmstead).

Fall 2014 ASTR120 “Introductory Astrophysics – Solar System” for undergraduate majors (CORE), 3 credits, 49 students in 1 section.

Spring 2015 ASTR121 “Introductory Astrophysics II – Stars and Beyond” for undergraduate majors (CORE with lab), 4 credits, 39 students in 2 sections.

- Fall 2015 ASTR120 “Introductory Astrophysics – Solar System” for undergraduate majors (CORE), 3 credits, 45 students in 1 section.
- Spring 2016 ASTR121 “Introductory Astrophysics II – Stars and Beyond” for undergraduate majors (CORE with lab), 4 credits, 36 students in 2 sections.
- Fall 2016 ASTR120 “Introductory Astrophysics – Solar System” for undergraduate majors (CORE), 3 credits, 53 students in 2 sections.
- Spring 2017 ASTR121 “Introductory Astrophysics II – Stars and Beyond” for undergraduate majors (CORE with lab), 4 credits, 40 students in 2 sections.
- Specialized/advanced.
 

Spring 2013 ASTR320 “Theoretical Astrophysics” for undergraduate majors, 3 credits, 26 students in 1 section (co-taught with Prof. Pat Harrington).

Fall 2017 ASTR615 “Computational Astrophysics” for graduate students, 3 credits, 21 students in 1 section.
  - Independent study, tutorial, internship supervision.
 

Spring 2012 ASTR399 “Honors Seminar” (1 student, 1 credit).

Spring 2012 ASTR699 “Special Problems in Advanced Astronomy” (1 student, 1 credit).

Spring 2012 ASTR899 “Doctoral Dissertation Research” (1 student, 6 credits).

Fall 2012 ASTR498 “Special Problems in Astronomy” (1 student, 1 credit).

Fall 2012 ASTR699 “Special Problems in Advanced Astronomy” (1 student, 2 credits).

Fall 2012 ASTR899 “Doctoral Dissertation Research” (1 student, 6 credits).

Spring 2013 ASTR498 “Special Problems in Astronomy” (1 student, 1 credit).

Spring 2013 ASTR699 “Special Problems in Advanced Astronomy” (2 students, 3 credits total).

Spring 2013 ASTR899 “Doctoral Dissertation Research” (1 student, 6 credits).

Summer II 2013 ASTR899 “Doctoral Dissertation Research” (1 student, 1 credit).

Fall 2013 ASTR898 “Pre-candidacy Research” (2 students, 1 credit each).

Fall 2013 ASTR899 “Doctoral Dissertation Research” (1 student, 6 credits).

Spring 2014 ASTR399 “Honors Seminar” (1 student, 3 credits).

Spring 2014 ASTR898 “Pre-candidacy Research” (2 students, 8 credits total).

Fall 2014 ASTR898 “Pre-candidacy Research” (1 students, 3 credits).

Fall 2014 ASTR899 “Doctoral Dissertation Research” (1 student, 6 credits).

Spring 2015 ASTR498 “Special Problems in Astronomy” (2 students, 1 credit each).

Spring 2015 ASTR899 “Doctoral Dissertation Research” (2 students, 12 credits total).

Fall 2015 ASTR288 “Special Projects in Astronomy” (2 students, 3 credits total).

Fall 2015 ASTR498 “Special Problems in Astronomy” (2 students, 1 credit each).

Fall 2015 ASTR899 “Doctoral Dissertation Research” (2 students, 12 credits total).

Spring 2016 ASTR498 “Special Problems in Astronomy” (4 students, 6 credits total).

Spring 2016 ASTR899 “Doctoral Dissertation Research” (2 students, 12 credits total).

Summer I 2016 ASTR899 “Doctoral Dissertation Research” (1 student, 1 credit).

Fall 2016 ASTR288 “Special Projects in Astronomy” (1 student, 1 credit).

Fall 2016 ASTR498 “Special Problems in Astronomy” (3 students, 5 credits total).

Fall 2016 ASTR899 “Doctoral Dissertation Research” (1 student, 6 credits).

Spring 2017 ASTR288 “Special Projects in Astronomy” (2 students, 4 credits total).

Spring 2017 ASTR399 “Honors Seminar” (1 student, 2 credits).  
Spring 2017 ASTR498 “Special Problems in Astronomy” (1 student, 1 credit).  
Fall 2017 ASTR288 “Special Projects in Astronomy” (1 student, 1 credit).  
Fall 2017 ASTR399 “Honors Seminar” (3 students, 4 credits total).

### III.B. Teaching Innovations

#### III.B.4. Software, Applications, Online Education, etc.

- Web pages developed for classes:

```
http://www.astro.umd.edu/~dcr/courses/ASTR100/  
http://www.astro.umd.edu/~dcr/courses/ASTR120/  
http://www.astro.umd.edu/~dcr/courses/ASTR121/  
http://www.astro.umd.edu/~dcr/courses/ASTR220/  
http://www.astro.umd.edu/~dcr/courses/ASTR320/  
http://www.astro.umd.edu/~dcr/courses/ASTR330/  
http://www.astro.umd.edu/~dcr/courses/ASTR415/  
http://www.astro.umd.edu/~dcr/courses/ASTR430/  
http://www.astro.umd.edu/~dcr/courses/ASTR615/  
http://www.astro.umd.edu/~dcr/courses/ASTR688/
```

#### III.B.6. Course or Curriculum Development

Spring 2001 Adapted undergraduate course on computational astrophysics to graduate level (ASTR688N) and later undergraduate level (ASTR415).

Fall 2004 Added online interactive tutorials and exercises as part of the ASTR100 curriculum.

Fall 2005 ASTR430 lectures redesigned from scratch. Introduced extensive electronic content.

Spring 2008 Adopted ELMS for ASTR100 class webpages. Also used ELMS for ASTR330 (Fall 2008). Now using for all taught courses.

Fall 2014, Spring 2015 Introduced peer instruction and other student-centered teaching strategies to ASTR120 and ASTR121.

Spring 2015 Redesigned the ASTR121 lab component to establish and achieve specific learning goals, including MATLAB instruction.

Fall 2015, Spring 2016 Implementation of student-centered course redesign elements funded by TLTC Elevate Fellows internal grant.

Fall 2017 Flipped implementation of ASTR615.

### III.C. Advising: Research or Clinical

#### III.C.1. Undergraduate

Spring 2002 Nicole Breslin-Romano (extrasolar planets).

Fall 2002 Kaveh Pahlevan (orbit circularization).

Spring 2003 Usha Vishnuvajjala (asteroid belt).

Fall 2001–Spring 2003 David Bettis (asteroid satellite database; College Park Scholars Practicum).

Fall 2003 Robyn Sanderson (Amalthea; as advisor for senior Honors thesis, defended Nov. 2003).

Spring 2005 Jack Carter (asteroid spins).

Fall 2003–Spring 2006 Pradeep Elankumaran (rubble pile spin limits,  $N$ -body codes; as advisor for senior Honors thesis, defended Apr. 2006).

Summer 2006 Jessica Haseltine (planet formation; NASA Astrobiology summer intern).

Spring 2008 Curran Muhlberger (as member of senior Honors thesis committee, defended Apr. 2008).

Fall 2008 Nick Vogel (asteroid satellite database).

Spring 2009 Ashley King (as member of senior Honors thesis committee, defended Apr. 2009).

Spring 2012 Jordan Umlauf (exoplanet densities; College Park Scholars Practicum).

Fall 2010–Fall 2012 Brett Morris (contact binary asteroid dynamics; as advisor for senior Honors thesis, defended May 2012).

Fall 2012 Eric Spiegler (granular dynamics; with Prof. Dan Lathrop, Physics).

Spring 2013 Nolan Matthews (as member of senior Honors thesis committee, defended Apr. 2013).

Winter 2012/2013–Spring 2014 Thomas Rimlinger (exoplanets; as co-advisor for senior Honors thesis with Prof. Doug Hamilton, Astronomy, defended Apr. 2014).

Spring 2015 Harry Arnold (as member of senior Honors thesis committee, defended May 2015).

Spring 2015 Allison Bostrom (as member of senior Honors thesis committee, defended May 2015).

Spring 2015–Spring 2016 Daniel Sokol (granular dynamics experimental design).

Spring 2015–Fall 2016 William Nichols (fast-rotating asteroids).

Fall 2015–Spring 2017 Dan Robinson (granular dynamics experiments).

Fall 2015– Joseph DeMartini (granular dynamics experiments and simulations).

Fall 2016– Yuxi Lu (planetary rings).

Spring 2017– Drew Leisner (fast-rotating asteroids).

Fall 2017– Matthew Wilkin (cohesive granular media).

### III.C.2. Master's (or Predoctoral Only)

2000–2001 Kenneth Flynn (rigid body dynamics).

2013 Zelong Yu (planetary ring dynamics).

### III.C.3. Doctoral

- I served as chair of UMD Astronomy Ph.D. thesis committees for:

1999–2005 Zoë Leinhardt (planet formation), defended Feb. 2005; now Senior Lecturer, Univ. of Bristol.

2001–2006 Kevin Walsh (binary asteroids), defended Nov. 2006; now Senior Research Scientist at SwRI, Boulder, CO.

2005–2011 Randall Perrine (planetary ring dynamics), defended Aug. 2011; now employed by a federal agency.

2008–2013 Stephen Schwartz (granular dynamics), defended Jul. 2013; now a postdoc at ASU.

2012–2016 Ronald Ballouz (planetesimal evolution/granular dynamics), defended Dec. 2016; now a postdoc at JAXA.

2013–2016 Alice Olmstead (co-chair; education research), defended Jun. 2016; now a postdoc at WMU.

- I served as a member of the UMD Astronomy Ph.D. thesis committees for:

1. Kayhan Gultekin, defended May 2006.
2. Ke Zhang, defended Jun. 2007.
3. John Vernaleo, defended May 2008.
4. Matthew Knight, defended Jun. 2008.
5. Catherine Philpott (née McGleam), defended Jun. 2010.
6. Mia Bovill, defended Apr. 2011.
7. Mike Gill, defended May 2011.
8. Daniel Jontoff-Hutter, defended May 2012.
9. Alan Gersch, defended Nov. 2013.
10. Jonathan Fraine, defended Jun. 2015.
11. Jamie Cohen, defended Jul. 2016.
12. Margaret McAdam, defended Jul. 2017.
13. Johnny VanLandingham, in process; topic defense May 2015.
14. Dana Louie, in process.
15. Thomas Rimlinger, in process.
16. Zeeve Rogoszinski, in process.
17. Carrie Holt, in process (2nd-year project).
18. Kyle Sheppard, in process (2nd-year project).

- I served as Dean's Representative of the UMD Ph.D. thesis committees for:

1. Adam Dissel (Aeronautical Engineering), defended Apr. 2007.
2. Jik-Soo Kim (Computer Science), defended Jan. 2009.
3. Tom Ireland (Geology), defended Jul. 2009.
4. Ilchul Yoon (Computer Science), defended Dec. 2010.
5. Ryan Farrell (Computer Science), defended Mar. 2011.
6. Greg Shofner (Geology), defended Sep. 2011.
7. Steven Slotterback (Physics), defended Jul. 2012.
8. Jaehwan Lee (Computer Science), defended Jul. 2012.
9. Sukhyun Song (Computer Science), defended Jul. 2012.
10. Aaron Skinner (Applied Mathematics, Statistics, and Scientific Computing), defended Aug. 2013.
11. Mirian Sharp (Geology), defended Mar. 31, 2014.
12. Gary Jackson (Computer Science), defended Feb. 2015.
13. Matt Harrington (Physics), defended Apr. 2015.
14. Freja Nordseik (Physics), defended Oct. 2015.
15. Gregory Archer (Geology), defended Nov. 2016.

16. Gina Quan (Physics), defended Apr. 2017.

- I served on the external Ph.D. thesis committees of:

1. Shana Tribiano (U Washington/Dartmouth College), Feb. 21, 2000. Title: “Radial Infall Dynamics of a Simulated Rich Cluster of Galaxies.”
2. Eugenio Rivera (SUNY Stony Brook), Aug. 28, 2001. Title: “Dynamical Evolution of the Earth-Moon Progenitors.”
3. Peter Scheirich (Charles University, Prague), Jun. 2, 2008 (external review provided Apr. 24, 2008). Title: “Modeling of Binary Asteroids.”
4. Audrey Thirouin (University of Alicante, Spain), Jul. 9, 2013 (external review provided Jun. 13, 2013). Title: “Study of Trans-Neptunian Objects Using Photometric Techniques and Numerical Simulations.”

### III.C.4. Post-doctoral

2004–2006 Graeme Lufkin (planet migration).

2009–2013 Soko Matsumura (integrators, exoplanets, granular dynamics).

### III.D. Mentorship

#### III.D.1. Junior Faculty

Spring 2009 Teaching evaluation of Massimo Ricotti (ASTR415).

Fall 2010 Teaching evaluation of Massimo Ricotti (ASTR415).

Fall 2016 Teaching evaluation of Massimo Ricotti (ASTR415).

### III.E. Advising: Other than Directed Research

#### III.E.5. Other Advising Activities

- Advising Student Groups

2005–2006, 2008–2009 Astronomy Unjournal Club.

2005– The Gamer Symphony Orchestra.

- Special Assignments

2004–2005 Mentor, CMPS Science and Technology: Addressing the Need for Diversity (STAND) Internship Research Program (SIRP), partnered with Charles Flowers High School (student: Aaron Gray, project: asteroid satellites database).

- Recruiting

2003 Met with Intel Science Talent Search students, Mar. 11, 2003.

2003 Lecture on “expectations” (10 mins) for CMPS freshman orientation, Jul. 21, 2003.

2009 Faculty address, CMPS Welcome Reception for freshmen, Mar. 26, 2009.

### III.F. Professional and Extension Education

#### III.F.7. Other



• Local (UMD) Research Talks (2001–):

1. “Numerical Simulations of Asteroid Collisions” (60 mins), AMSC seminar, Oct. 2, 2001.
2. “How to Make Asteroid Families and Satellites” (30 mins), ALTS (Astronomy), Oct. 5, 2001.
3. “How to Make Asteroid Families and Satellites” (60 mins), Astroterps talk, Oct. 24, 2001.
4. “Problems in Planetesimal Dynamics” (60 mins), ASTR695 seminar, Dec. 4, 2001
5. “How to Make Asteroid Families and Satellites” (60 mins), Plasma Physics seminar, Oct. 9, 2002.
6. “Problems in Planetesimal Dynamics” (60 mins), ASTR695 seminar, Oct. 15, 2002.
7. “Using Earth’s Tides to Make Asteroid Moons” (60 mins), Astroterps talk, Nov. 6, 2002.
8. “Origin of Binary Near-Earth Asteroids” (60 mins), Comet Group talk, Dec. 18, 2002.
9. “Forming Asteroid Satellites by Tidal Disruption” (20 mins), Dean’s junior faculty seminar, Mar. 20, 2003
10. “Problems in Planetesimal Dynamics” (60 mins), ASTR695 seminar, Nov. 3, 2003.
11. “Morphological Evolution of Asteroids” (60 mins,) Comet Group talk, Nov. 5, 2003.
12. “Gravitational Reaccumulation in the Solar System” (60 mins), ATLAS (Astronomy), Nov. 13, 2003.
13. “How Fast Can a Rubble Pile Spin?” (30 mins), ALTS (Astronomy), Apr. 2, 2004.
14. “Gravitational Reaccumulation in the Solar System” (60 mins), Astroterps talk, Apr. 8, 2004.
15. “Problems in Planetesimal Dynamics” (30 mins), ASTR695 seminar, Nov. 1, 2004.
16. “**Pkdgrav**: A Parallel  $k$ -D Tree Gravity Solver for  $N$ -Body Problems” (50 mins), AMSC664 guest lecture, May 4, 2005.
17. “**Borg**: The Astronomy Beowulf Cluster” (30 mins), AMSC663 guest lecture, Sep. 15, 2005.
18. Research highlights (30 mins), ASTR695 seminar, Nov. 7, 2005.
19. Research highlights (50 mins), AMSC664 guest lecture, Feb. 21, 2006.
20. Research highlights (30 mins), ASTR695 seminar, Nov. 6, 2006.
21. Research highlights (30 mins), ASTR695 seminar, Nov. 5, 2007.
22. “Multiplicity Among Small Solar System Bodies and Dwarf Planets” (60 mins), Comet Group talk (PALS), Feb. 28, 2008.
23. “Making Near-Earth Asteroid Binaries via the YORP Effect” (60 mins), CTC Theory Lunch talk, May 5, 2008.
24. Research highlights (30 mins), ASTR695 seminar, Nov. 3, 2008.
25. “Effect of Debris on Terrestrial Planet Formation” (20 mins), National Capital Area Disks II workshop, Mar. 20, 2009.
26. “Testing Cohesion in Gravitational Aggregates” (60 mins), Comet Group talk (PALS), May 14, 2009.
27. Research highlights (30 mins), ASTR695 seminar, Oct. 19, 2009.
28. Research highlights (30 mins), ASTR695 seminar, Feb. 7, 2011.
29. Research highlights (30 mins), ASTR695 seminar, Oct. 17, 2011.
30. “Weak Forces on Small Bodies in the Solar System” (40 mins), AstroTerps talk, Feb. 8, 2012.
31. “Weak Forces on Small Bodies in the Solar System” (40 mins), Society of Physics Students talk, Apr. 19, 2012.
32. Research highlights (30 mins), ASTR695 seminar, Nov. 26, 2012.
33. “How to Capture an Asteroid” (40 mins), AstroTerps talk, May 1, 2013.
34. Research highlights (30 mins), ASTR695 seminar, Oct. 6, 2014.

35. “Creating Opportunities for Astronomy Majors to Collaborate in Introductory Courses” (60 mins), BANG! seminar, Oct. 22, 2015.
  36. Research highlights (30 mins), ASTR695 seminar, Nov. 23, 2015.
  37. “ASTR120/121 Redesign” (30 mins), TLTC Elevate Fellows Kickoff Meeting, Jan. 19, 2016.
  38. “The AIDA Mission” (40 mins), AstroTerps talk, Mar. 9, 2016.
  39. “The AIDA Mission (Update!)” (40 mins), AstroTerps talk, Sep. 28, 2016.
  40. Research highlights (30 mins), ASTR695 seminar, Nov. 7, 2016.
  41. “Simulating Granular Dynamics in Very Low Gravity” (15 mins), GRAD-MAP Spring Symposium, Apr. 21, 2017.
  42. Research highlights (30 mins), ASTR695 seminar, Sep. 25, 2017.
  43. “Granular Dynamics in Low Gravity” (60 mins), Applied Dynamics Seminar (Physics), Oct. 12, 2017.
- Other informal research talks (2005–):
    1. “Collisions in the Solar System” (60 mins), Astrobiology Summer School lunch talk, Goddard Center for Astrobiology (GCA), Greenbelt, MD: Jul. 20, 2005.
    2. Research highlights (60 mins), astronomy lunch seminar, Department of Terrestrial Magnetism, Carnegie Institute of Washington, Washington, DC: Oct. 6, 2006.
  - Other:
    1. “Numerical Methods in Planetesimal Dynamics” (two 60-min lectures, Arfken Visiting Scholar short course), Miami University, Oxford, OH: Nov. 16 & 18, 2004.
    2. “*N* Rigid-body Dynamics” (90 mins, also 2 Q&A panels on good programming practice and visualization, Prospects in Theoretical Physics summer program on Computational Astrophysics), Institute for Advanced Study, Princeton, NJ: Jul. 13–24, 2009.
    3. Co-organizer, 2011 Interdisciplinary Summer School: Granular Flows: From Simulations to Astrophysical Applications, University of Maryland, College Park, MD: Jun. 13–17, 2011.<sup>3</sup> Included two 45-min seminars: “Asteroid Simulations” and “Granular Dynamics on Asteroids,” and one 2-hr computer lab: “Low-gravity Simulations.”
    4. Pkdgrav tutorial, Johns Hopkins University Applied Physics Laboratory, Laurel, MD: Dec. 5, 2013.
    5. Discussion leader, Observation and Theory Astronomy group meeting, topic “Implications of Rubble-pile Asteroids,” Lund University, Lund, Sweden: Apr. 17, 2015.

### III.I. Teaching Awards

2015 UMD Department of Astronomy Distinguished Faculty Teaching Prize.

2016 CMNS Dean’s Award for Excellence in Teaching.<sup>4</sup>

## **IV. Service and Outreach**

### IV.A. Editorships, Editorial Boards, and Reviewing Activities

#### IV.A.3. Reviewing Activity for Journals and Presses

<sup>3</sup><http://www2.cscamm.umd.edu/programs/grf11/>

<sup>4</sup>Twice nominated (2002, 2003) for UMD CMPS Dean’s Award for Excellence in Teaching.

- Since 2000, I have reviewed 67 manuscripts for 15 journals (*Advances in Space Research*, *Astronomical Journal*; *Astronomy and Astrophysics*; *Astrophysical Journal* (and *Letters*); *Earth, Planets and Space*; *Granular Matter*; *Icarus*; *Journal of Geophysical Research - Planets*; *Meteoritics and Planetary Science*; *Monthly Notices of the Royal Astronomical Society*; *Nature*; *Physical Review (E and Letters)*; *Planetary and Space Science*; *Publications of the Astronomical Society of Japan*; and *Science*). In 2001, I reviewed a chapter for *Asteroids III*. In 2006, I reviewed a contribution for *Proc. IAU Symp. 236*. In 2010, I reviewed a chapter for a computational astrophysics text. In 2013, I reviewed a chapter for “Asteroids, Prospective Energy and Material Resources” (Viorel Badescu, Ed.; Springer-Verlag). In 2014, I reviewed a chapter for *Asteroids IV*.

#### IV.A.4. Reviewing Activity for Agencies and Foundations

- 1999 Member, NASA Near Earth Asteroid Rendezvous science review panel.
- 2001 External reviewer, NASA Origins of Solar Systems.
- 2002 Member, NASA Origins of Solar Systems review panel.
- 2003 External reviewer, NASA Planetary Geology and Geophysics.
- 2003 Member, NASA Origins of Solar Systems review panel.
- 2004 External reviewer, NASA Planetary Geology and Geophysics.
- 2004 Member, NASA Outer Planets Research review panel.
- 2004 Member, NASA Origins of Solar Systems/Terrestrial Planet Finder review panel.
- 2005 External reviewer, U.S. Civilian Research and Development Foundation.
- 2005 External reviewer, NASA Origins of Solar Systems.
- 2006 Group Chief, NASA Planetary Geology & Geophysics review panel.
- 2007 External reviewer, NASA Origins of Solar Systems.
- 2007 External reviewer, NASA Planetary Geology & Geophysics.
- 2007 External reviewer, NASA Postdoctoral Program.
- 2008 External reviewer, NASA Lunar Advanced Science and Exploration Research.
- 2008 External reviewer, NASA Outer Planets Research.
- 2008 Group Chief, NASA Planetary Geology & Geophysics review panel.
- 2009 External reviewer, NASA Earth and Space Science Fellowship program.
- 2009 External reviewer, NASA Postdoctoral Program.
- 2009 External reviewer, NASA Cassini Data Analysis Program.
- 2009 External reviewer, NASA Planetary Geology & Geophysics.
- 2009 External reviewer, NASA Origins of Solar Systems.
- 2010 External reviewer, NASA Planetary Geology & Geophysics.
- 2010 External reviewer (twice), NASA Postdoctoral Program.
- 2011 External reviewer, NASA Origins of Solar Systems.

2012 External reviewer, NASA Origins of Solar Systems.  
2012 External reviewer, NASA Planetary Geology & Geophysics.  
2013 External reviewer, NASA Outer Planets Research.  
2013 External reviewer, NASA Cassini Data Analysis and Participating Scientists Program.  
2013 External reviewer, NASA Postdoctoral Program.  
2014 External reviewer, NASA Outer Planets Research.  
2015 External reviewer, NASA Exoplanet Research.  
2015 External reviewer, NASA Hayabusa2 Participating Scientist.  
2016 External reviewer, NASA Earth and Space Science Fellowship program.  
2016 External reviewer, NASA Solar System Workings.  
2016 External reviewer, NASA Emerging Worlds.  
2017 External reviewer, NASA Solar System Workings.

#### IV.B. Committees, Professional & Campus Service

*NOTE: I was on sabbatical from Aug. 24, 2006 to Aug. 23, 2007 and from Sep. 1, 2013 to Aug. 31, 2014.*

##### IV.B.1. Campus Service – Department

2000–2001 Chair, Colloquium Committee.  
2001–2002 Co-Chair, Graduate Admissions Committee.  
2001–2003 Co-Organizer, Origins Seminar Series.  
2002–2003 Chair, Graduate Admissions Committee.  
2003, 2004 Member, Second-year Project Examination Committee.  
2003–2004 Member, Undergraduate Education Committee.  
2004–2005 Chair, Graduate Admissions Committee.  
2002–2006 Member, Astronomy Computer Committee.  
2005–2006 Member, Undergraduate Honors Committee.  
2005–2006 Member, Graduate Program Review.  
2007–2008 Director, Center for Theory and Computation.  
2008–2009 Theory and Computation Stream Advisor.  
2009, 2010 Member, Salary Committee.  
2010 Member, Planetary Faculty Search Committee.  
2008–2011 Member, Qualifying Exam Committee.  
2011–2012 Member, Faculty Search Committee.

2007–2012 Chair, Astronomy Computer Committee.<sup>5</sup>  
2012–2013 Member, Astronomy Computer Committee.  
2012–2013 Member, Center for Planetary Origins Committee.  
2012–2013 Member, Associate Director Search Committee.  
2012–2013 Chair, Theory Faculty Search Committee.  
2012–2013 Director, Center for Theory and Computation.  
2013–2014 Co-Chair, Astronomy Computer Committee.  
2014–2015 Member, Graduate Admissions Committee.  
2015 Chair, Committee to Appoint Dr. Thomas Statler as Research Scientist.  
2016 Chair, Committee to Promote Dr. Melissa Hayes-Gehrke to Principal Lecturer.  
2016–2017 Member, Diversity Committee.  
2016–2017 Member, Graduate Program Committee.  
2016–2017 Member, Strategic Planning Committee.  
2017–2018 Chair, Professional-Track Faculty and Postdoctoral Fellow Mentoring Plan Committee.  
2017–2018 Organizer, ASTR120/121/320 tutoring.  
2014– Chair, Astronomy Computer Committee.<sup>6</sup>  
2001– Administrator, `yorp` (formerly `borg`) computer cluster.<sup>7</sup>

#### IV.B.2. Campus Service – College

2002–2004 Participant, Dean’s project to link university research with Maryland highschoools (“AstroGRID”).<sup>8</sup>  
2010–2011 Member, CMNS Dean Search Committee.

#### IV.B.3. Campus Service – University

2001–2008 Listed as potential advisor in the Undergraduate Research Assistant Program.  
2012 Member, IT Strategic Planning Task Force.  
2004–2013 Tester, Faculty Activity Report (FAR) system.  
2006–2015 Member, DIT High Performance Computing Cluster Allocation and Faculty Advisory Committee.  
2013–2017 Member, Research Technology Working Group.  
2015–2017 Chair, DIT High Performance Computing Cluster Allocation and Faculty Advisory Committee.  
2017 Member, DIT Search Committee for HPC Engineer.

<sup>5</sup>Includes supervision of computing staff Bill Sebok (full time) and Mark Wolfire (part time).

<sup>6</sup>Includes responsibility for Visualization Lab in PSC, 2014–17.

<sup>7</sup>Current duties include: coordinating upgrade decisions, resolving user and hardware issues, maintaining web page <http://www.astro.umd.edu/twiki/bin/view/AstroUMD/YorpCluster>.

<sup>8</sup>Duties included: developing science idea, providing code, training students, developing analysis software, and testing implementation. This project became the basis for ongoing funded research with Alan Sussman et al. (UMD Computer Science: <http://www.cs.umd.edu/projects/hpsl/chaos/ResearchAreas/P2PGrid/>).

2017–2019 Chair, Research Technology Working Group.

2017–2019 Member, Information Technology Council.

2017– Member, DIT High Performance Computing Cluster Allocation and Faculty Advisory Committee.

#### IV.B.5. Campus Service – Other

2007 Initiated “Agreement Regarding Scientific Cooperation and Academic Exchanges Between the Côte d’Azur Observatory (France) and the Department of Astronomy, University of Maryland (USA),” signed by Senior Vice President for Academic Affairs and Provost Nariman Farvardin, Jan. 24, 2008. Currently in effect through the end of 2020.

#### IV.B.6. Inter-institutional and Regional

2017–2019 Campus Representative, MARCC/Bluecrab Governance Committee.

#### IV.B.8. Leadership Roles in Meetings and Conferences

2009/10 Member, Scientific Organizing Committee, Numerical Modeling of Asteroids as Granular Systems (NuMAGS) workshop, Jan. 12–15, 2010, Meudon, France.

2011 Member, Scientific Organizing Committee, “Small Bodies as Granular Systems” session, EPSC-DPS Joint Meeting, Oct. 2–7, 2011, Nantes, France.

2016/17 Member, Scientific Organizing Committee, Asteroids, Comets, Meteors 2017 meeting, Apr. 10–14, 2017, Montevideo, Uruguay.

#### IV.B.9. Other Non-University Committees, Memberships, Panels, etc.

2002 Session chair, Scientific Frontiers in Research on Extrasolar Planets, Jun. 18–21, 2002, Washington, DC.

2003 Session chair, October Astrophysics Conference: The Search for Other Worlds, Oct. 13–14, 2003, College Park, MD.

2005 Session chair, 37th Division for Planetary Sciences meeting, Sep. 4–9, 2005, Cambridge, UK.

2008 Session chair, 10th Asteroids, Comets, Meteors meeting, Jul. 14–18, 2008, Baltimore, MD.

2011 Session chair, EPSC-DPS Joint Meeting, Oct. 2–7, 2011, Nantes, France.

2013 Member, Scientific Organizing Committee, chapter selection for *Asteroids IV* book.

### IV.C. External Service and Consulting

#### IV.C.2. International Activities

2000 External reviewer, Nuffield Foundation (United Kingdom).

2003 Invited to be Director (declined), 2003 Summer School on Stability and Chaos in Planetary Systems, International Helmholtz Institute for Supercomputational Physics, held Sep. 2003 in Potsdam, Germany.

2005 External reviewer, Council of Physical Sciences of the Netherlands Organization for Scientific Research.

2007 External reviewer, Science and Technology Facilities Council research grants (United Kingdom).

2009 External reviewer, Swiss National Science Foundation.

2010 External reviewer, ESA Cosmic Vision.

2011 External reviewer, French National Research Agency (ANR).

2012 External reviewer, Swiss National Science Foundation.

2017 External reviewer, Swiss National Science Foundation.

1996– Member, American Astronomical Society (divisions: DPS, DDA).

2012– Member, International Astronomical Union (member of 4 Divisions and 3 Commissions).

#### IV.C.5. Consultancies

1996–1997 Consultant, Center of Excellence in Space Data and Information Sciences.

#### IV.D. Non-Research Presentations

##### IV.D.1. Outreach Presentations

*Talks prior to Fall 2000 listed without titles.*

1. Royal Astronomical Society of Canada (60 mins). Halifax, NS: Feb. 16, 1996.
2. Everett Astronomical Society (60 mins). Everett, WA: Feb. 28, 1998.
3. Battle Point Astronomical Association (60 mins). Bainbridge Island, WA: Dec. 8, 1999.
4. Tacoma Astronomical Society (60 mins). Tacoma, WA: Apr. 4, 2000.
5. Olympic Astronomical Society (60 mins). Bremerton, WA: May 1, 2000.
6. “Things That Go Bump in the Night: The Evolution of Fragile Planetesimals” (40 mins). UMD Astronomy Open House: Jul. 5, 2001.
7. “How to Make Asteroid Families and Satellites” (40 mins). UMD Astronomy Open House: Mar. 5, 2002.
8. “Using Earth’s Tides to Make Asteroid Moons” (40 mins). UMD Astronomy Open House: Aug. 20, 2003.
9. “Asteroids: Shedding New Light on Old Rocks” (60 mins). Arfken Visiting Scholar public lecture, Miami University, Oxford, OH: Nov. 16, 2004.
10. “Cool Things You May Not Know About Asteroids” (40 mins). UMD Astronomy Open House: Dec. 5, 2004.
11. “Binary Minor Planets” (60 mins). Frontiers of Astronomy public lecture, Cleveland Museum of Natural History, Cleveland, OH: Mar. 16, 2006.
12. “Strange New (Small) Worlds” (40 mins). UMD Astronomy Open House: Apr. 20, 2006.
13. “Spinning Up Asteroids” (40 mins). UMD Astronomy Open House: Sep. 20, 2008.
14. “What’s Light Got to do With It?” (20 mins). Kira Institute, in *Second Life*: Jan. 8, 2009.
15. “Fragile Asteroids: Implications and Hazards” (60 mins). TriState Astronomers: Oct. 20, 2010.

16. “What’s New in the Solar System?” (40 mins). UMD Astronomy Open House: Nov. 5, 2010.
17. “Strange New Worlds” (40 mins). Brighton Gardens of Columbia Senior Living Community: Oct. 28, 2011.
18. “Black Holes!” (40 mins). Brighton Gardens of Columbia Senior Living Community: Feb. 10, 2012.
19. “Asteroid Hazards” (40 mins). Brighton Gardens of Columbia Senior Living Community: Apr. 20, 2012.
20. “Rovers on Mars!” (40 mins). Brighton Gardens of Columbia Senior Living Community: Nov. 9, 2012.
21. “How to Capture an Asteroid” (40 mins). Brighton Gardens of Columbia Senior Living Community: Apr. 26, 2013.
22. “How to Capture an Asteroid” (40 mins; 2 talks). UMD Astronomy Open House: Jul. 20, 2013.
23. “Astronomy in the News” (40 mins). Brighton Gardens of Columbia Senior Living Community: Apr. 11, 2014.
24. “Asteroids Research” (20 mins). Norfolk State University (GRAD-MAP outreach): Oct. 4, 2015
25. “Comets” (40 mins). Brighton Gardens of Columbia Senior Living Community: Oct. 10, 2014.
26. “Asteroids!” (40 mins). Brighton Gardens of Columbia Senior Living Community: May 5, 2015.
27. “Pluto!” (40 mins). Brighton Gardens of Columbia Senior Living Community: Aug. 21, 2015.
28. “New Horizons at Pluto” (40 mins). Brighton Gardens of Columbia Senior Living Community: Feb. 19, 2016.
29. “Top 5 Astronomy Stories of 2016” (40 mins). Brighton Gardens of Columbia Senior Living Community: Jan. 13, 2017.

#### IV.E. Media Contributions

##### IV.E.8. Other

- Since 1996, my work has been cited in at least 16 popular publications (including *Astronomy*, *Astronomy Now*, *New Scientist*, *Popular Science*, *Science News*, *Scientific American*, *Sky & Telescope*, and *The Economist*), as well as on internet-only sites such as [space.com](http://space.com), and has been featured as news items in *Nature* and *Science*, as well as national news media. I was acknowledged as a consultant for the Dec. 2004 issue of *National Geographic* in an article entitled “Search for other Earths” (pp. 68–95). My work was mentioned at the Senate Science, Technology, and Space Hearing: Near-Earth Objects (NEO), Apr. 7, 2004 (SR-253, testimony of Dr. Wayne Van Citters, Division Director, Division of Astronomical Sciences, National Science Foundation). I was acknowledged as a consultant for the Dec. 2006 *National Geographic* “Special Supplement: The Solar System” insert. The Jan. 2009 issue of *Astronomy* rated our 2008 *Nature* paper on the origin of small binary asteroids as one of the top 10 astronomy stories of 2008.

#### IV.F. Community & Other Service

- Teaching Workshops
  1. “Asteroid Families and Satellites” (45 mins), Science Insiders: A Workshop for Teachers (local), Jun. 6, 2002.
  2. Mid-Atlantic Regional LA Workshop, Apr. 2, 2016.



- Other

1. Project ASTRO volunteer (regular visits to Grade 6 classroom), 1999–2000.
2. Maryland Day volunteer, Apr. 27, 2002 (UFO “demonstrations”).
3. Appeared on “Researching Maryland” (UMTV), May 13, 2002 (taped May 15, 2002).
4. Gave keynote address at UMD Sigma Kappa sorority scholarship banquet, Mar. 19, 2003.
5. Maryland Day volunteer, Apr. 24, 2004 (information booth).
6. Assisted with public viewing of Venus transit, Jun. 8, 2004.
7. Assisted with public viewing of Deep Impact event, Jul. 3–4, 2005.
8. Maryland Day volunteer, Apr. 26, 2008 (solar system walk).
9. Judge, NASA (GSFC) Academy final presentations, Aug. 7, 2009.
10. Provided video testimonial on *Mastering Astronomy* product, Nov. 19, 2009.<sup>9</sup>
11. Mentor, Thomas Jefferson High School for Science and Technology, for Teresa (Tracy) Esman (senior), project title: “An Investigation of Exoplanets: Hot Jupiters and Habitable Zones” (weekly meetings Fall 2010 through early Winter 2011).
12. Mentor, Thomas Jefferson High School for Science and Technology, for Sarah Munyan (senior), project title: “Planetesimal Collisions with the Soft-sphere Discrete Element Method” (weekly meetings Fall 2011 through early Winter 2012).
13. Mentor, Hautes Études d’Ingenieur (HEI), for Kevin Serrano (Master’s student), project: granular avalanches (visiting student Fall 2012).
14. Mentor, Thomas Jefferson High School for Science and Technology, for Michael Sheaffer (senior), project working title: “Granular Avalanches” (remote meetings Fall 2012 through Spring 2013).
15. Mentor, Tsingua University, for Yang Yu (Ph.D. student), project: asteroid dynamics (visiting student Fall 2012–Summer 2013).
16. Mentor, ISAE-SUPAERO, for Clara Maurel (Master’s student), project: granular dynamics in low gravity (visiting student Feb. 2015–Aug. 2015).
17. Mentor, Tsingua University, for Yun Zhang (Ph.D. student), project: asteroid granular dynamics (visiting student Oct. 2015–Oct. 2016).
18. Mentor, Purple Mountain Observatory, for Shoucun Hu (Ph.D. student), project: asteroid granular dynamics (visiting student Mar. 2016–Aug. 2016).

## V. Other Information

- Since Jan. 2000, I have written over 800 letters of reference for more than 150 students, postdocs, and faculty members.

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<sup>9</sup>Video available at <http://www.youtube.com/watch?v=SASTNPEDNUU>.