

DIEGO J. MUÑOZ, PhD

Computational Astrophysicist

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RESEARCH INTERESTS Planet formation, circumstellar disks, gas dynamics, planetary dynamics, numerical methods, hydrodynamics, N -body techniques, outer Solar System, interferometry, bayesian inference

EMPLOYMENT **Northwestern University** Evanston, IL
CIERA Postdoctoral Fellow, Department of Physics and Astronomy Nov 2017 - present

University of Arizona Tucson, AZ /
Technion - Israel Institute of Technology Haifa, Israel
Postdoctoral Researcher, Steward Observatory/Physics Department Sep 2016 - Oct 2017

Cornell University, Ithaca, NY
Research Associate, Department of Astronomy Sep 2013 - Aug 2016

Harvard University, Cambridge, MA
Graduate Research Assistant, Astronomy Department 2006-2013

Universidad de Chile, Santiago, Chile
Research Assistant, Astronomy Department 2004-2006

EDUCATION **Harvard University**, Cambridge, MA
PhD, Astronomy & Astrophysics. August 2013
AM, Astronomy. 2008

Universidad de Chile, Santiago, Chile
MSc, Astronomy. 2006
BS, Astrophysics. 2004

AWARDS **CIERA Fellowship** (2017-Present)
Gliese Fellowship (Germany, declined) (2017)
FONDECYT National Fellow (Chile, declined) (2015)
Fulbright Scholar (2006-2010)

RESEARCH EXPERIENCE

- Studied the interaction of circumstellar disks with embedded planets using Lagrangian/Eulerian code AREPO
- Developed numerical techniques for massively parallel hydrodynamics simulations on large computer clusters
- Studied the effects of random walks in gravitational systems in the context of Solar System dynamics
- In depth experience with finite volume methods for hyperbolic equations and symplectic methods for Hamiltonian systems
- Designed software for analysis of large sets of simulation data
- Analyzed polarimetric interferometric data at submillimeter wavelengths

- Experience in error analysis and time-series analysis of radio-wavelength observations of variable sources
- Investigated the formation of stars in massive molecular complexes
- Designed software for image processing and data mining

ADVISING
EXPERIENCE

- Evgeni Grishin (Graduate student, Technion, 2016-present) *Secular dynamics of triples* (co-advisor Prof. Hagai Perets)
- Ryan Miranda (Graduate student, Cornell, 2015-present) *Circumbinary disk simulations* (co-advisor Prof. Dong Lai)
- Bin Liu (Graduate student, USTC/Cornell, 2013-2014) *Suppression of extreme orbital evolution in triple systems with short range forces* (co-advisor Prof. Dong Lai)
- Michael Hammer (Undergraduate student, Cornell, 2013-2014) *Long-term stability of circumbinary planets at high inclination* (co-advisor Prof. Dong Lai)

TEACHING
EXPERIENCE

- Cornell University**, Ithaca, NY
Guest lecturer in *Radiation Processes* (Professor Dong Lai, Fall 2013)
- Harvard University**, Cambridge, MA
Teaching Fellow
- *Radio Astronomy*, (Professor James Moran, Fall 2009)
 - *Radiative Processes in Astrophysics*, (Professor Ramesh Narayan, Fall 2008)
 - *Cosmic Connections*, (Professor David Charbonneau, Fall 2007)
- Universidad de Chile**, Santiago, Chile
Teaching Assistant
- *General Astronomy* (Professors Diego Mardones, Fall 2005 and María Teresa Ruíz, Spring 2005)
 - *Introduction to Contemporary Physics* (Professors Simón Casassus, Fall 2003 and Sebastián López, Spring 2004)

ORGANIZATIONS/
OUTREACH

- Science in the News Boston: board member, AV coordination, lecturer
- Invited Lecture: "The Box in a (Pretty Big) Box: From Cells to Galaxies Using Supercomputers" Oct 24th, 2012 (lecture video <https://vimeo.com/57476524>)
- Contributed article: "Astronomy: The Gateway Science" (*Policylab*) <http://www.policylab.org/2013/05/18/astronomy-the-gateway-science/>
- Contributed art: <http://www.policylab.org/2013/06/12/312/> (*Policylab*)

SERVICE

- Referee for *Monthly Notices of the Astronomical Society*
- Referee for *Astrophysical Journal Letters*
- Referee for *The Astrophysical Journal*
- Panel member at Chandra Cycle 16 Review Panel (June 2014)
- SOC and LOC for *Emerging Researchers in Exoplanet Science Symposium II*, (Ithaca, NY, May 2016)
- External reviewer for NASA Review Panel (July 2017)
- Participant at NASA Review Panel (August 2017)

TECHNICAL
SKILLS

- Programming**
Python (fluent), C/C++ (fluent), Unix bash script (fluent), SQLite (basic)
- Statistical Modeling**
Time Series, Spectral (Fourier/wavelet) Analysis, MCMC Parameter Estimation, PCA, Feature Engineering, Recommender Systems, Decision Trees, Clustering
- Numerical Techniques**
Partial and ordinary differential equations, Monte Carlo, visualization/ray tracing
- Tools**
Unix/Linux, Latex, OpenMPI, Git, NumPy, SciPy, scikit-learn, Pandas

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- COLLOQUIA,
INVITED TALKS
AND
CONFERENCE
PRESENTATIONS
- Numerical Simulations of Planet-Disc Interactions - Contributed Talk: *Orbital Migration with Steady Accretion: Binaries and Massive Planets*, Cuernavaca, Mexico (November 2017)
 - Origins Seminar - University of Arizona, Tucson, AZ (September 2017)
 - Planets beyond the main sequence - Contributed Talk: *Planetary Engulfment as a Trigger for White Dwarf Pollution*, Haifa, Israel (March 2017)
 - ERES II - Contributed Talk: *The formation efficiency of close-in planets via Lidov-Kozai migration*, Ithaca, NY (June 2016)
 - Extreme Solar Systems III - Contributed Talk: *Survival of Planet Around Shrinking Binaries*, Kona, HI (December 2015)
 - Theory Colloquium - University of Arizona, Tucson, AZ (November 2015)
 - Theory Seminar - CITA, Toronto, ON (October 2015)
 - Group discussion leader: Circumbinary planets - SPF-1, Tucson, AZ (March 2015)
 - Astronomy Colloquium - Cornell University, Ithaca, NY (October 2014)
 - Astrophysics Lunch - Cornell University, Ithaca, NY (September 2013)
 - Theory Lunch Talk - University of Maryland, College Park, MD (November 2012)
 - TUNA Lunch Talk - NRAO, Charlottesville, VA (November 2012)
 - Star and Planet Formation Seminar - STScI, Baltimore, MD (November 2012)
 - Astronomy Group Meeting - Carnegie DTM, Washington, DC (November 2012)
 - Exoplanet Seminar - NASA Goddard Space Flight Center, Greenbelt, MD (November 2012)
 - Seminar - DARK Cosmology Centre, Copenhagen, Denmark (August 2012)

Publications

- SUBMITTED AND PUBLISHED Hammer, M., **Muñoz, D. J.** and Lai, D.
"Stability boundaries of circumbinary planets in inclined orbits". Submitted to *Monthly Notices of the Astronomical Society*
- Miranda, R., **Muñoz, D. J.** and Lai, D.
"Viscous hydrodynamics simulations of circumbinary accretion discs: variability, quasi-steady state, and angular momentum transfer". *Monthly Notices of the Astronomical Society* (2017), 466 (1), 1170-1191
- Petrovich, C. and **Muñoz, D. J.**
"Planetary engulfment as a trigger for white dwarf pollution". *The Astrophysical Journal* (2017), 834(2), 116
- Muñoz, D. J.** and Lai, D.
"Pulsed Accretion onto Eccentric and Circular Binaries". *The Astrophysical Journal*, (2016), 827(1), 43
- Muñoz, D. J.**, Lai, D. and Liu, B.
"On the formation efficiency of close-in planets via Lidov-Kozai migration: analytic calculations". *Monthly Notices of the Astronomical Society*, (2016) 460, 1086-1093
- Pakmor, R., Springel, V., Bauer, A., Mocz, P., **Muñoz, D. J.**, Ohlmann, S.T., Schaal, K. and Zhu, C.
"Improving the convergence properties of the moving-mesh code AREPO". *Monthly Notices of the Astronomical Society*, (2016) 445, 1134-1143

Muñoz, D. J. and Lai, D.

“Survival of planets around shrinking stellar binaries”. *Proceedings of the National Academy of Science*, (2015) 112 (30), 9264-9269

Liu, B., **Muñoz, D. J.** and Lai, D.

“Suppression of extreme orbital evolution in triple systems with short range forces”. *Monthly Notices of the Astronomical Society*, (2015) 447, 747-764

Muñoz, D. J., Kratter, K., Springel, V. and Hernquist, L.

“Stellar orbit evolution in close circumstellar disk encounters”. *Monthly Notices of the Astronomical Society*, (2015) 446, 2010-2029

Muñoz, D. J., Kratter, K., Vogelsberger, M., Hernquist, L. and Springel, V.

“Planet-disc interaction on a freely moving mesh”. *Monthly Notices of the Astronomical Society*, (2014) 445, 3475-3495

Salyk, C., Pontoppidan, K., Corder, S., **Muñoz, D. J.**, Zhang, K., and Blake, G.

“ALMA observations of the T Tauri binary system AS 205: evidence for molecular winds and/or binary interactions”. *The Astrophysical Journal*, (2014) 792, 68-81

Muñoz, D. J., Springel, V., Marcus, R., Vogelsberger, M., and Hernquist, L.

“Multi-Dimensional Compressible Viscous Flow on a Moving Voronoi Mesh”. *Monthly Notices of the Astronomical Society* (2013) 428, 254-279.

Muñoz, D. J., Marrone, D. P., Moran, J. M., and Rao, R. “The Circular Polarization of Sagittarius A* at Submillimeter Wavelengths,” *The Astrophysical Journal*, (2012) 745, 115-128.

Hicken, M. et al. “CfA3: 185 Type Ia Supernova Light Curves from the CfA” *The Astrophysical Journal*, (2009) 700(1), 331-357

Marrone, D. P., Baganoff, F. K., Morris, M. R., Moran, J. M., Ghez, A. M., Hornstein, S. D., Dowell, C. D., **Muñoz, D. J.**, Bautz, M. W., Ricker, G. R., and 7 coauthors “An X-Ray, Infrared, and Submillimeter Flare of Sagittarius A.” *The Astrophysical Journal*, (2008) 682, 373-383.

Muñoz, D. J., Mardones, D., Garay, G.; Rebolledo, D., Brooks, K., and Bontemps, S.

“Massive Clumps in the NGC 6334 Star-forming Region.” *The Astrophysical Journal*, (2007) 668, 906-917.

IN DRAFT

Muñoz, D. J., Miranda, R., and Lai, D

“Viscous hydrodynamics simulations of circumbinary accretion discs II: moving mesh simulations” To be submitted to *Monthly Notices of the Astronomical Society*