Curriculum Vitae

Michael Y. Grudić

CIERA
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Education

Ph.D. in Physics *2014-2019*
California Institute of Technology (Caltech)
Dissertation: *The Role of Stellar Feedback in Star Cluster Formation*†
Adviser: Dr. Philip F. Hopkins

B.Sc. (Honours) in Physics and Applied Mathematics *2009-2014*
Memorial University of Newfoundland (MUN)
Dissertation: *Gravitational Scattering in the Relativistic Kepler Problem*
Adviser: Dr. John Lewis

Positions

CIERA Postdoctoral Fellow, Northwestern University *2019-*

Research Interests

- Star formation, and the physical origins of stellar masses, clustering, and multiplicity.
- Numerical techniques for astrophysical simulations.
- Origins and evolution of giant molecular clouds, and the effects of stellar feedback upon them.
- Realistic sub-grid modeling of star formation, ISM physics, and feedback in galaxy simulations.
- Evolution of dense stellar systems, including the production of exotic stars and gravitational wave sources.

Honors

†Caltech Robert F. Christy Prize for Outstanding Doctoral Thesis in Theoretical Physics *2018-2019*
Caltech James A. Cullen Memorial Fellowship for Excellence in Physics *2017-2018*
NSERC Undergraduate Summer Research Award *2011-2013*
MUN Medal for Excellence in Physics *2013-2014*
MUN Medal for Excellence in Applied Mathematics *2013-2014*
Daniel Freeman Memorial Scholarship *2013-2014*
Lou Visentin Award *2013-2014*
Mrs. E.D. Matthews Memorial Scholarship in Mathematics and Statistics *2012-2013*
MUN Faculty of Science Dean's Book Prize (Physics) *2012-2013*
Dr. S. W. Brekon Scholarship in Physics *2011-2013*
Flight 491 Legacy Scholarship *2010-2013*
MUN Faculty of Science Dean's List *2010-2013*
Dr. Vincent P. Burke Scholarship *2011-2012*
Centenary of Responsible Government Scholarship *2011-2012*
MUN Gold Tournament Scholarship *2010-2011*
MUN Faculty of Engineering Dean's List *2009-2010*
PEGNL Past President's Engineering Scholarship *2009-2010*
NOIA-Hibernia Commemorative Scholarship *2009-2010*

Memorial University of Newfoundland Endowment Fund Scholarship *2009-2010*

Computing Awards

Frontera Pathways Allocation AST20019, "Exploring the Physical Ingredients of Star Formation with Simulations" – 14 million CPU-h on Frontera *2020-2021*

Scientific Presentations

236th AAS Meeting (virtual). Invited talk. *2020*
IAU Symposium 351: "Star Clusters: from the Milky Way to the Early Universe". Contributed talk. *2019*
Princeton SFIR Seminar, Princeton, NJ, USA *2018*
MIT Astrophysics Brown Bag Lunch, Cambridge, MA, USA *2018*
"Galaxy Formation and Evolution in Southern California", Pasadena, CA, USA. Contributed talk. *2018*
MPA Cosmology Seminar, Garching, Germany *2018*
"Formation of Globular Clusters at High and Low Redshift", Sexten, Italy. Invited opening keynote. *2018*
"Multi-scale physics of SF & feedback during galaxy formation", Heidelberg, Germany. Invited talk. *2018*
UT Austin Theory Seminar, Austin, TX, USA *2018*
CIERA Theory Group Meeting, Evanston, IL, USA *2018*
231st AAS Meeting, Washington, D.C., USA. Contributed talk and poster. *2018*
CITA Seminar, Toronto, ON, Canada *2017*
"Modeling Dense Stellar Systems", Prague, Czechia. Contributed talk. *2017*
Caltech Graduate Research Spotlight, Pasadena, CA, USA. Contributed poster. *2017*
Galaxy Formation and Evolution in Southern California, Pasadena, CA, USA. Contributed talk. *2017*
230th AAS Meeting, Austin, TX, USA. Contributed talk. *2017*
Galaxy Formation and Evolution in Southern California, Pasadena, CA, USA. Contributed talk. *2016*

Teaching

Graduate Teaching Assistant, Caltech *2014-2019*

- Analog Electronics Lab
- Sophomore Experimental Physics Lab
- Computational Physics Lab

Undergraduate Teaching Assistant, MUN *2012-2014*

- General Physics I: Mechanics
- General Physics II: Waves, Oscillations and Electromagnetism
- Mathematics Help Centre
- Engineering Help Centre

Personal tutor in mathematics, physics, and chemistry at secondary and post-seconday levels *2008-2012*

Outreach and Service

Caltech Astronomy Outreach *2015-2019*
Organizing and volunteering at public astronomy outreach events. Leading a team of telescope operators during public stargazing events, contributing to Q&A panels, and giving informal "Astronomy on Tap" talks.

Summer App Space - Lab Instructor *Summer 2017*
Served as an instructor in a summer program in which high school students were taught basic programming and data analysis skills. Mentored a team of students in an open-ended final project.

MUN Physics and Physical Oceanography Society Treasurer *2012-2014*
Organized regular social events and study resources for physics students at MUN. Managed the accounts of the Society.

First-Author Publications

[1] Grudić, M. Y. and Hopkins, P. F. "A general-purpose time-step criterion for simulations with gravity." MNRAS, **495**, 4, 4306–4313, May 2020. doi:10.1093/mnras/staa1453.

[2] Grudić, M. Y., Kruijssen, J. M. D., Faucher-Giguère, C.-A., Hopkins, P. F., Ma, X., Quataert, E., and Boylan-Kolchin, M. "A model for the formation of stellar associations and clusters from giant molecular clouds." *arXiv e-prints*, arXiv:2008.04453, August 2020.

[3] Grudić, M. Y., Boylan-Kolchin, M., Faucher-Giguère, C.-A., and Hopkins, P. F. "The universal acceleration scale from stellar feedback." *Monthly Notices of the Royal Astronomical Society: Letters*, **496**, 1, L127–L132, 06 2020. ISSN 1745-3925. doi:10.1093/mnrasl/slaa103.

[4] Grudić, M. Y. and Hopkins, P. F. "The elephant in the room: the importance of the details of massive star formation in molecular clouds." MNRAS, **488**, 2, 2970–2975, September 2019. doi:10.1093/mnras/stz1820.

[5] Grudić, M. Y., Hopkins, P. F., Lee, E. J., Murray, N., Faucher-Giguère, C.-A., and Johnson, L. C. "On the nature of variations in the measured star formation efficiency of molecular clouds." MNRAS, **488**, 2, 1501–1518, September 2019. doi:10.1093/mnras/stz1758.

[6] Grudić, M. Y., Hopkins, P. F., Quataert, E., and Murray, N. "The maximum stellar surface density due to the failure of stellar feedback." MNRAS, **483**, 4, 5548–5553, March 2019. doi:10.1093/mnras/sty3386.

[7] Grudić, M. Y., Guszejnov, D., Hopkins, P. F., Lamberts, A., Boylan-Kolchin, M., Murray, N., and Schmitz, D. "From the top down and back up again: star cluster structure from hierarchical star formation." MNRAS, **481**, 1, 688–702, November 2018. doi:10.1093/mnras/sty2303.

[8] Grudić, M. Y., Hopkins, P. F., Faucher-Giguère, C.-A., Quataert, E., Murray, N., and Kereš, D. "When feedback fails: the scaling and saturation of star formation efficiency." MNRAS, **475**, 3, 3511–3528, April 2018. doi:10.1093/mnras/sty035.

Publications with major contributions

These works were made possible by software tools and/or major scientific contributions by MYG.

[1] Gurvich, A. B., Faucher-Giguère, C.-A., Richings, A. J., Hopkins, P. F., **Grudić, M. Y.**, Hafen, Z., Wellons, S., Stern, J., Quataert, E., Chan, T. K., Orr, M. E., Kereš, D., Wetzel, A., Hayward, C. C., Loebman, S. R., and Murray, N. "Pressure balance in the multiphase ISM of cosmologically simulated disk galaxies." *arXiv e-prints*, arXiv:2005.12916, May 2020.

[2] Guszejnov, D., **Grudić, M. Y.**, Hopkins, P. F., Offner, S. S. R., and Faucher-Giguère, C.-A. "Can magnetized turbulence set the mass scale of stars?" MNRAS, **496**, 4, 5072–5088, July 2020. doi:10.1093/mnras/staa1883.

[3] Guszejnov, D., **Grudić, M. Y.**, Offner, S. S. R., Boylan-Kolchin, M., Faucher-Gigère, C.-A., Wetzel, A., Benincasa, S. M., and Loebman, S. "Evolution of giant molecular clouds across cosmic time." MNRAS, **492**, 1, 488–502, February 2020. doi:10.1093/mnras/stz3527.

[4] Hopkins, P. F., **Grudić, M. Y.**, Wetzel, A., Kereš, D., Faucher-Giguère, C.-A., Ma, X., Murray, N., and Butcher, N. "Radiative stellar feedback in galaxy formation: Methods and physics." MNRAS, **491**, 3, 3702–3729, January 2020. doi:10.1093/mnras/stz3129.

[5] Ma, X., **Grudić, M. Y.**, Quataert, E., Hopkins, P. F., Faucher-Giguère, C.-A., Boylan-Kolchin, M., Wetzel, A., Kim, J.-h., Murray, N., and Kereš, D. "Self-consistent proto-globular cluster formation in cosmological simulations of high-redshift galaxies." MNRAS, February 2020. doi:10.1093/mnras/staa527.

[6] Rodriguez, C. L., Kremer, K., **Grudić, M. Y.**, Hafen, Z., Chatterjee, S., Fragione, G., Lamberts, A., Martinez, M. A. S., Rasio, F. A., Weatherford, N., and Ye, C. S. "GW190412 as a Third-generation Black Hole Merger from a Super Star Cluster." ApJ, **896**, 1, L10, June 2020. doi:10.3847/2041-8213/ab961d.

[7] Hopkins, P. F. and **Grudić, M. Y.** "Numerical problems in coupling photon momentum (radiation pressure) to gas." MNRAS, **483**, 3, 4187–4196, March 2019. doi:10.1093/mnras/sty3089.

Other Co-authored Publications

[1] Yu, S., Bullock, J. S., Wetzel, A., Sand erson, R. E., Graus, A. S., Boylan-Kolchin, M., Nierenberg, A. M., **Grudić, M. Y.**, Hopkins, P. F., Kereš, D., and Faucher-Giguère, C.-A. "Stars made in outflows may populate the stellar halo of the Milky Way." MNRAS, March 2020. doi:10.1093/mnras/staa522.

[2] Guszejnov, D., Hopkins, P. F., and **Grudić, M. Y.** "Universal scaling relations in scale-free structure formation." MNRAS, **477**, 4, 5139–5149, July 2018. doi:10.1093/mnras/sty920.

[3] Guszejnov, D., Hopkins, P. F., **Grudić, M. Y.**, Krumholz, M. R., and Federrath, C. "Isothermal Fragmentation: Is there a low-mass cut-off?" MNRAS, **480**, 1, 182–191, October 2018. doi:10.1093/mnras/sty1847.

[4] Hopkins, P. F., Wetzel, A., Kereš, D., Faucher-Giguère, C.-A., Quataert, E., Boylan-Kolchin, M., Murray, N., Hayward, C. C., Garrison-Kimmel, S., Hummels, C., Feldmann, R., Torrey, P., Ma, X., Anglés-Alcázar, D., Su, K.-Y., Orr, M., Schmitz, D., Escala, I., Sanderson, R., **Grudić, M. Y.**, Hafen, Z., Kim, J.-H., Fitts, A., Bullock, J. S., Wheeler, C., Chan, T. K., Elbert, O. D., and Narayanan, D. "FIRE-2 simulations: physics versus numerics in galaxy formation." MNRAS, **480**, 1, 800–863, October 2018. doi:10.1093/mnras/sty1690.

[5] Kim, J.-h., Ma, X., **Grudić, M. Y.**, Hopkins, P. F., Hayward, C. C., Wetzel, A., Faucher-Giguère, C.-A., Kereš, D., Garrison-Kimmel, S., and Murray, N. "Formation of globular cluster candidates in merging proto-galaxies at high redshift: a view from the FIRE cosmological simulations." MNRAS, **474**, 3, 4232–4244, March 2018. doi:10.1093/mnras/stx2994.

[6] Foucart, F., Buchman, L., Duez, M. D., **Grudić, M. Y.**, Kidder, L. E., MacDonald, I., Mroue, A., Pfeiffer, H. P., Scheel, M. A., and Szilagyi, B. "First direct comparison of nondisrupting neutron star-black hole and binary black hole merger simulations." Phys. Rev. D, **88**, 064017, September 2013. doi:10.1103/PhysRevD.88.064017.