Evgeniy Khain - Curriculum Vitae

September 2019

190 SEB, Department of Physics, Oakland University, Rochester, MI 48309, USA
khain@oakland.edu • (248) 370-3412 • https://files.oakland.edu/users/khain/web/index.html

---

Current position

Associate Professor
Department of Physics, Oakland University, MI

Research interests

- Collective cell behavior in biological systems (cell migration; mechanical effects in tissue growth; tumor growth)
- Driven granular gases, instabilities in granular flows
- Rare events in physical and biological systems
- Statistical physics far from equilibrium
- Pattern formation and nonlinear dynamics

Education

- **2005 Ph.D. in Physics**
  Racah Institute of Physics, Hebrew University of Jerusalem, Israel
  Dissertation: "Symmetry-breaking instabilities in fluidized granular media"
  Advisor: Prof. Baruch Meerson

- **2000 M.Sc. in Physics**
  Racah Institute of Physics, Hebrew University of Jerusalem, Israel
  Thesis: "Parametric autoresonance in nonlinear oscillating systems"
  Advisor: Prof. Baruch Meerson

- **1995 B.Sc. in Physics, minor in Mathematics**
  Racah Institute of Physics, Hebrew University of Jerusalem, Israel

- **1990 High school grad.**
  High school no. 444 (specialization in mathematics), Moscow, USSR

Professional experience

- **2013 - present**
  Associate professor
  Department of Physics, Oakland University, USA

  Fall 2014: Visiting scholar at the University of Michigan, Ann Arbor, USA

- **2007 - 2013**
  Assistant professor
  Department of Physics, Oakland University, USA

- **2004 - 2007**
  Postdoctoral research fellow
  Michigan Center for Theoretical Physics,
  University of Michigan, Ann Arbor, Michigan, USA
  Advisor: Prof. Leonard M. Sander

- **1999 - 2004**
  Teaching assistant
  Physics Department, Hebrew University of Jerusalem, Israel
  Courses: Mechanics, Electricity and Magnetism, Thermal Physics
  "***Considered as the best teaching assistant we have had in our institute during the last five years***" (from the letter of Chairman of the Physics studies)

- **2002 - 2003**
  Organizer of graduate students' research seminar

- **1996 - 1999**
  Weather forecaster for the Navy
  Military service in Israel Defense Forces

Professional service

- 2008-present: Department of Physics Colloquia Organizer

- Reviewer for journals: Physical Review Letters, Physical Review E, Journal of Fluid Mechanics, Physica A: Statistical Mechanics and its Applications, Journal of Physics A: Mathematical and Theoretical, Journal of Physics: Condensed Matter, Journal of Theoretical Biology, Bulletin of Mathematical Biology, Advances in Complex Systems, Granular Matter, Physical Biology, Applied Physics Letters, New Journal of Physics, Physics Letters A.

Publications

33. J. Straetmans and E. Khain
"Modeling Cell Size Dynamics in a Confined Nonuniform Dense Cell Culture",
Journal of Statistical Physics, 176(2), 299-311, (2019).

32. E. Khain
"Thermal conductivity at the high-density limit and the levitating granular cluster",
Physical Review E 98, 012903 (2018).

31. E. Khain and L. S. Tsimring
"Effective pressure and cell area distribution in a confined monolayer",
Fluid Dynamics Research 50, 051413 (2018).

30. M. Katakowski, N. Charteris, M. Chopp, and E. Khain
"Density-dependent regulation of glioma cell proliferation and invasion mediated by miR-9",
Cancer Microenvironment 9, 149–159 (2016).

29. E. Khain and L. M. Sander
"Noise induces rare events in granular media",
Physical Review E 94, 032905 (2016).

28. E. Khain, M. Khasin, and L. M. Sander
"Spontaneous formation of large clusters in a lattice gas above the critical point",
Physical Review E 90, 062702 (2014).

27. N. Charteris and E. Khain
"Modeling chemotaxis of adhesive cells: stochastic lattice approach and continuum description", New J. Phys. 16, 025002 (2014).

26. E. Khain and B. Meerson
"Velocity fluctuations of noisy reaction fronts propagating into a metastable state", Journal of Physics A: Mathematical and Theoretical 46, 125002 (2013).

25. M. Khasin, E. Khain, and L. M. Sander
"Fast migration and emergent population dynamics",
Physical Review Letters 109, 248102 (2012).

24. M. Khasin, B. Meerson, E. Khain, and L. M. Sander
"Minimizing the population extinction risk by migration",
Physical Review Letters 109, 138104 (2012).

23. E. Khain, M. Katakowski, N. Charteris, F. Jiang, and M. Chopp
"Migration of adhesive glioma cells: Front propagation and fingering",
Physical Review E 86, 011904 (2012).

22. E. Khain and I. S. Aranson
"Hydrodynamics of a vibrated granular monolayer",
Physical Review E **84**, 031308 (2011).

21. E. Khain
"Dense Granular Poiseuille Flow", Mathematical Modelling of Natural Phenomena, Volume 6, 77 - 86 (2011).

20. E. Khain, M. Katakowski, S. Hopkins, A. Szalad, X.G. Zheng, F. Jiang, M. Chopp
"Collective behavior of brain tumor cells: The role of hypoxia",
Physical Review E **83**, 031920 (2011).

19. E. Khain, Y. T. Lin, L. M. Sander
"Fluctuations and stability in front propagation",
EPL (Europhys. Lett.) **93**, 28001 (2011).

18. E. Khain
"Clustering and phase separation in dense shear granular flow",
Journal of Physics: Conference Series **216**, 012008 (2010).

17. E. Khain, C. M. Schneider-Mizell, M. O. Nowicki, E. A. Chiocca, S. E. Lawler and L. M. Sander
"Pattern formation of glioma cells: Effects of adhesion",
EPL (Europhys. Lett.) **88**, 28006 (2009).

16. E. Khain
"Bistability and hysteresis in dense shear granular flow",
EPL (Europhys. Lett.) **87**, 14001 (2009).

15. E. Khain, B. Meerson, and P.V. Sasorov
"Knudsen temperature jump and the Navier-Stokes hydrodynamics of granular gases driven by thermal walls",
Physical Review E **78**, 041303 (2008).

14. E. Khain and L.M. Sander
"Generalized Cahn-Hilliard equation for biological applications",
Phys. Rev. E **77**, 051129 (2008).

13. E. Khain
"Resonant oscillations of a granular cluster",
Complexity **13**, 45 (2008).

12. E. Khain
"Hydrodynamics of fluid-solid coexistence in dense shear granular flow",
Phys. Rev. E **75**, 051310 (2007).

11. E. Khain, L.M. Sander, and C.M. Schneider-Mizell
"The role of cell-cell adhesion in wound healing",
J. Stat. Phys. **128**, 209 (2007). [Special Issue on Applications to Biology]

10. T. Callaghan, E. Khain, L.M. Sander, R.M. Ziff
"A stochastic model for wound healing"
J. Stat. Phys. **122**, 909 (2006).

9. E. Khain and L.M. Sander
"Dynamics and pattern formation in invasive tumor growth"
Phys. Rev. Lett. **96**, 188103 (2006).

8. E. Khain and B. Meerson
"Shear-induced crystallization of a dense rapid granular flow: Hydrodynamics beyond the melting point"
Phys. Rev. E **73**, 061301 (2006).

7. E. Khain, L.M. Sander, and A. Stein
"A model for glioma growth"
Complexity **11**, 53 (2005).

6. E. Khain, B. Meerson, and P.V. Sasorov
"Phase diagram of van der Waals-like phase separation in a driven granular gas"
Phys. Rev. E **70**, 051310 (2004).

5. E. Khain
"Hydrodynamics of "thermal" granular convection",
Proceedings of the Nato Advanced Research Workshop on "Continuum Models and Discrete Systems" (CMDS10), eds. D.J. Bergman and E. Inan (Kluwer Academic Publishers, 2004), p.341

4. E. Khain and B. Meerson
"Oscillatory instability in a driven granular gas"
Europhys. Lett. **65**, 193 (2004).

3. E. Khain and B. Meerson
"Onset of thermal convection in a horizontal layer of granular gas"
Phys. Rev. E **67**, 021306 (2003).

2. E. Khain and B. Meerson
"Symmetry-breaking instability in a prototypical driven granular gas"
Phys. Rev. E. **66**, 021306 (2002).

1. E. Khain and B. Meerson
"Parametric autoresonance"
Phys. Rev. E. **64**, 036619 (2001).

Conferences and Workshops

- 2019 SIAM Great Lake conference, April 27, 2019, University of Michigan, Ann Arbor, MI
  Talk: "Effective pressure in a monolayer of cells: dynamics of cell area distribution"

- Dynamics Days 2019 (International Conference on Nonlinear Dynamics), January 4–6, 2019, Northwestern University, Evanston, IL
  Flash Talk and Poster: "Levitating granular cluster: typical behavior and noise-induced rare events"

- 8th International Workshop on Nonequilibrium Thermodynamics (IWNET 2018), Sint-Michielsgestel, The Netherlands, July 1-6, 2018
  Talk: "Noise-induced rare events in granular media: breaking Leidenfrost cluster"

- BIFD 2017: Bifurcations and Instabilities in Fluid Dynamics, The Woodlands, TX, July 11-14, 2017
  Talk: "Pressure in active fluids: a growing monolayer"

- Dynamics Days Europe 2017, Szeged, Hungary, June 5-9, 2017
  Talk: "Noise-induced rare events in granular media: a volcanic-like explosion"

- 2017 SIAM Great Lake conference, April 29, 2017, Oakland University, Rochester, MI
  Talk: "Noise-induced rare events in granular media: a volcanic-like explosion"

- 68th Annual Meeting of the APS Division of Fluid Dynamics, Boston, MA, November 22 - 24, 2015
  Talk: "Rare events in granular media: a volcanic-like explosion"

- Active Liquids, Lorentz Center, Leiden, Netherlands, September 21 - 25, 2015
  Talk: "Cell mechanics in tissue growth"

- APS march meeting, San Antonio, TX, March 2 - 6, 2015
  Talk: "Time evolution of cell size distributions in dense cell cultures"

- Fluctuations in Population Biology Epidemiology and Evolution, Lorentz Center, Leiden, Netherlands, August 11 - 15, 2014
  Talk: "Clustering of Migrating Brain Tumor Cells: Typical Behavior and Rare Events"

- Active Processes in Living and Nonliving Matter, Santa Barbara, CA, February 10 - 14, 2014
  Poster: "Clustering of Motile Adhesive Cells: Typical Behavior and Rare Events"

- Bifurcations and Instabilities in Fluid Dynamics - Fifth International Symposium, Haifa, Israel, July 8-11, 2013
  Talk: "Migration of adhesive glioma cells: front propagation and fingering"

- American Physical Society March Meeting, March 18-22, 2013, Baltimore, Maryland.
  Talk: "Collective Behavior of Brain Tumor Cells: the Role of Hypoxia"

- Animal Swarms, Kfar Blum, Israel, February 18 - 21, 2013
  Talk: "Clustering of migrating brain tumor cells: typical behavior and rare events"

- The Annual Meeting of The Society for Mathematical Biology, Knoxville, Tennessee, July 25-28, 2012
  Talk: "Collective behavior of brain tumor cells: The role of hypoxia"

- Physics and Mathematics of Cancer, KITP, Santa Barbara, California, May 21 – June 7, 2012

- American Physical Society March Meeting 2012, February 27– March 2, 2012; Boston, Massachusetts.
  Talk (Physics of Cancer session): "Clustering of brain tumor cells: a first step for understanding tumor recurrence"

- Fourth International Symposium on Bifurcations and Instabilities in Fluid Dynamics, Barcelona, Spain, July 18-21, 2011
  Talk: "Instabilities and Front Propagation in Invasive Tumor Growth"

- Large Fluctuations in Non-Equilibrium Systems, Dresden, Germany, July 4-15, 2011
  Talk: "Role of fluctuations in front propagation: the insect outbreak model"
  Poster: "Clustering of brain tumor cells: theory and experiment"

- Special 8th European Conference on Mathematical and Theoretical Biology, and Annual Meeting of the Society for Mathematical Biology, Krakow, Poland, June 28 – July 2, 2011
  Talk: "Fronts of cells invading a wound: from discrete stochastic approach to continuum description"
  Talk: "Role of fluctuations in front propagation: the insect outbreak model"

- Special Session on Applications of Stochastic Processes in Cell Biology at the 2010 Fall Central Section Meeting, Notre Dame, IN, November 5-7, 2010
  Talk: "Migration and clustering of glioma cells"

- Complex Driven Systems: From Statistical Physics to the Life Sciences, Virginia Tech, USA (October 2010)
  Talk: "Clustering of brain tumor cells: theory and experiment"
  Poster: "Hydrodynamics of fluid-solid coexistence in dense shear granular flow"

- MBI Workshop for Young Researchers in Mathematical Biology (WYRMB), Ohio State University, Columbus, August 30-September 1, 2010
  Poster: "Clustering of brain tumor cells: theory and experiment"

- CMPD3: The 3rd International Conference on Computational and Mathematical Population Dynamics, Bordeaux, France (May-June 2010)
  Talk: "Migration and clustering of brain tumor cells: theory and experiment"

- 2010 SIAM Great Lake conference, University of Michigan at Dearborn, Dearborn, MI, USA (April 2010)
  Talk: "Clustering of brain tumor cells: theory and experiment"

- "Dynamics Days 2010", Northwestern University, Evanston, IL, USA (January 2010)
  Poster: "Clustering of brain tumor cells: theory and experiment"
  Poster: "Bistability and hysteresis in dense shear granular flow"

- Third International Symposium on Bifurcations and Instabilities in Fluid Dynamics, Nottingham, UK (August 2009)
  Talk: "Instabilities and fluid-solid coexistence in dense shear granular flow"

- The Fourth International Symposium "Atomic Cluster Collisions: structure and dynamics from the nuclear to the biological scale" (ISACC 2009), Ann Arbor, Michigan, USA, (July 2009)
  Talk: "Clustering instabilities in fluidized granular matter"

- Soft Active Materials: From Granular Rods to Flocks, Cells and Tissues, Syracuse, NY, USA (May 2009)
  Talk: "Invasive patterns of malignant brain tumors"
  Poster: "Hydrodynamics of fluid-solid coexistence in dense shear granular flow"

- The Dynamics Days Europe 2008, Delft, The Netherlands (August 2008)
  Poster: "Hydrodynamics of fluid-solid coexistence in dense shear granular flow"

- Workshop on Growth and Control of Tumors: Theory and Experiment, Thematic Program on Mathematical and Quantitative Oncology, Fields Institute, Toronto, Canada (July 2008)
- Large Deviations Conference, Ann Arbor, Michigan (June 2007)

- "Nonlinear Science" (Gordon Research Conference), Colby College, Waterville, USA (June 2007)
  Poster: "Pattern formation of glioma cells: effects of adhesion"

- American Physical Society March Meeting, Denver, Colorado (March 2007)
  Talk: "Pattern formation of glioma cells: effects of adhesion"

- The 52nd Annual Meeting of the Israel Physical Society, Jerusalem, Israel (December 2006)
  Talk: "Pattern formation in invasive tumor growth"

- "Oscillations & Dynamic Instabilities in Chemical Systems" (Gordon Research Conference), Oxford, UK (July-August 2006)
  Selected to give a short presentation on a competitive basis
  Talk: "Dynamics and pattern formation in invasive tumor growth"
  Poster: "Self-organization and patterns of glioma cells: effects of cell-cell adhesion"

- "Granular & Granular-fluid Flow" (Gordon Research Conference), Oxford, UK (July 2006)
  One of four young scholars selected to give a short presentation
  Talk: "Shear-induced crystallization of a dense rapid granular flow: Hydrodynamics beyond the melting point?"
  Poster: "Oscillatory instability in a driven granular gas"

- "Understanding Complex Systems 2006", University of Illinois at Urbana-Champaign, USA (May 2006)
  Talk: "Shear-induced crystallization of a dense rapid granular flow: hydrodynamics beyond the melting point?"
  Poster: "Physics of secondary tumor formation: effects of cell-cell adhesion"

- "Dynamics Days 2006", Bethesda, Maryland, USA (January 2006)
  Talk: "Physics of secondary tumor formation: effects of cell-cell adhesion"
  Poster: "Dynamics and pattern formation in invasive tumor growth"

- "Applications of Methods of Stochastic Systems and Statistical Physics in Biology", Notre Dame, USA (October 2005)
  Poster: "Physics of secondary tumor formation: effects of cell-cell adhesion"

- "Successes and Failures of Continuous Models for Discrete Systems", Bristol, UK (September 2005)
  Talk: "Dynamics and pattern formation in invasive tumor growth"
  Poster: "Hydrodynamics of thermal granular convection"

- "Nonlinear Science" (Gordon Research Conference), Colby College, Waterville, USA (June 2005)
  Poster: "Dynamics and pattern formation in invasive tumor growth"
  Poster: "Hydrodynamics of thermal granular convection"

- "Dynamics of Cancer: Modeling and Experiment", Ann Arbor, USA (May 2005)
  Talk: "Dynamics and pattern formation in invasive tumor growth"

- 1st CViT Workshop, MGH, Boston, USA (March 2005)
  Talk: "Dynamics and pattern formation in invasive tumor growth"

- 22nd winter school in Theoretical Physics: "Biological Networks and Evolution", Jerusalem, Israel (December 2004 - January 2005)

- 49th meeting of the Israel Physical Society (IPS2003), Bar-Ilan University, Ramat-Gan, Israel (December 2003)
  Talk: "Oscillatory instability in a driven granular gas"

- Southern Workshop on Granular Materials - swgm03, Pucon, Chile (December 2003)
  Talk: "Oscillatory instability in a driven granular gas"

- ESCHOOL - PHYSBIO3 and EWORKS - PHYSBIO4, "From pattern formation to granular physics and soft condensed matter", Benasque, Spain (August 2003)
  Talk: "Oscillatory instability in a driven granular gas"

- 10th International Symposium on Continuum Models and Discrete Systems (CMDS10), Israel (July 2003)
  Talk: "Hydrodynamics of thermal granular convection"

- 48th meeting of the Israel Physical Society (IPS2002), Weizmann Institute of Science, Rehovot, Israel (December 2002)
  Poster: "Hydrodynamics of thermal granular convection"
  Poster: "Symmetry-breaking instability and phase separation in a driven granular gas

- 7th Minerva Winter School on Frontiers in Non-linear Physics
  Weizmann Institute of Science, Rehovot, Israel (March 2002)

Seminars

- Applied and interdisciplinary mathematics (AIM) seminar, Department of Mathematics, University of Michigan, Ann Arbor, September 27, 2019
  Talk: "Levitating granular cluster: typical behavior and noise-induced rare events"

- Physics colloquium, Department of Physics, Oakland University, Rochester, September 12, 2019
  Talk: "Effective pressure in a dense cell monolayer"

- Bio & condensed matter physics seminar, Department of Physics, Wayne State University, Detroit, April 6, 2018
  Talk: "Collective cell dynamics on a substrate"

- Department of Physics, Oakland University, January 15, 2015
  Talk: "Instabilities and phase separation in dense granular flows: typical behavior and rare events"

- Department of Physics and Astronomy, University of Toledo, April 24, 2014
  Talk: "Clustering and migration of adhesive cells: a physicist's perspective"

- Department of Natural Sciences, University of Michigan-Dearborn, September 20, 2013
  Talk: "Modeling tumor growth: cell clustering and invasion"

- Department of Biomedical Engineering, Ben-Gurion University, February 22, 2012
  Talk: "Invasion and clustering of brain tumor cells: modeling and experiments"

- Applied Interdisciplinary Mathematics Seminar, University of Michigan, October 21, 2011
  Talk: "Front propagation in living systems: from cell invasion to population dynamics"

- Physics Colloquium, Oakland University, April 7, 2011
  Talk: "Front propagation in living systems: from cell invasion to population dynamics"

- Physics seminar, Bar Ilan University, February 22, 2011
  Talk: "Front propagation in living systems: from cell invasion to population dynamics"

- Mathematical Biology seminar, Michigan State University, November 1, 2010
  Talk: "Front propagation in living systems: from cell invasion to population dynamics"

- Faculty of Mechanical Engineering, Technion, Israel (February 2010)
  Talk: "Invasion and clustering of brain tumor cells: modeling and experiments"

- Department of Physics, University of Michigan, USA (November 2009)
  Talk: "Phase separation in driven granular media"

- Department of Physics, Central Michigan University, USA (April 2009)
  Talk: "Invasive patterns of malignant brain tumors"

- Sigma Xi (the national scientific research society) seminar, Oakland University, USA (November 2007)
  Talk: "Driven granular gases: complex physics in a sandbox"

- Department of Physics, Wayne State University, USA (October 2007)
  Talk: "Pattern formation of glioma cells: effects of adhesion"

- Department of Physics, Oakland University, USA (March 2007)
  Talk: "Growth patterns of invasive brain tumors"

- Department of Physics, Bar-Ilan University, Israel (January 2007)
  Talk: "Growth patterns of invasive brain tumors"

- Department of Physics of Complex Systems, Weizmann Institute of Science, Israel (January 2007)
  Talk: "Growth patterns of invasive brain tumors"

- Physics Department, The Hebrew University of Jerusalem, Israel (December 2006)
  Talk: "Growth patterns of invasive brain tumors"

- Physics Department, Ben-Gurion University of the Negev, Israel (December 2006)
  Talk: "Growth patterns of invasive brain tumors"

- Physics Department, Technion, Israel (December 2006)
  Talk: "Growth patterns of invasive brain tumors"

- School of Mechanical Engineering, Tel Aviv University, Israel (December 2006)
  Talk: "Growth patterns of invasive brain tumors"

- Department of Condensed Matter Physics, Tel Aviv University, Israel (January 2005)
  Talk: "Symmetry-breaking instabilities in fluidized granular matter"

- Department of Physics of Complex Systems, Weizmann Institute of Science, Israel (January 2005)
  Talk: "Symmetry-breaking instabilities in fluidized granular matter"

- Physics Department, Ben-Gurion University of the Negev, Israel (June 2004)
  Talk: "Symmetry-breaking instabilities in fluidized granular matter"

- Faculty of Mechanical Engineering, Technion, Israel (May 2004)
  Talk: "Symmetry-breaking instabilities in fluidized granular matter"

- Physics Department, The Hebrew University of Jerusalem, Israel (May 2004)
  Talk: "Symmetry-breaking instabilities in fluidized granular matter"

- Department of Mechanical Engineering, Ben-Gurion University of the Negev, Israel (May 2004)
  Talk: "Symmetry-breaking instabilities in fluidized granular matter"

Professional Memberships

- Division of Biological Physics, American Physical Society
- Division of Fluid Dynamics, American Physical Society
- American Physical Society Topical Group on Statistical and Nonlinear Physics
- Division of Soft Matter Physics
- Society for Mathematical Biology

Public service (outreach activities)

Ann Arbor Russian School, 2009 – 2013, unpaid consultant and lecturer

Fall 2009 lectures:

- The kinetic theory of gases in 50 minutes
- Modern physics: Models for atomic structure

Fall 2010 lectures:

- Thermal radiation emitted by heated objects
- Biological physics: collective behavior of cancer cells

Winter 2011 lectures:

- How to give the weather forecast?
- Pattern formation in nature: from clouds to ecological systems
- Prisoner's dilemma: from mathematics to economics

Winter 2012 lecture:

- Complex physics in a box of sand or Instabilities in driven granular matter

Winter 2013 lecture:

- Models for atomic structure: from the discovery of the electron to quantum mechanics

Personal

- Fluent in English, Hebrew, and Russian
- Hobbies: playing chess, guitar, and soccer