Erbil Can Artun

Statistical physics and data-driven complex systems

artun@mail.com · Istanbul, Türkiye
erbilcanartun.com · ORCID 0000-0002-9624-3124 · Google Scholar · github.com/erbilcanartun

Research profile

I study how collective behavior emerges in systems of many interacting parts. My doctoral work developed renormalization-group theory for systems that resist standard treatment: long-range interactions, quenched disorder, multicomponent and continuous spins, and fractal geometries. It identified new ordered phases and chaos mechanisms in spin-glass, Potts, Blume–Capel and Ashkin–Teller systems in one to three dimensions. My current research carries this background into data-driven complex-systems science: reconstructing the dynamics of complex networks from observations with reservoir computing, and characterizing geomagnetic signals with statistical and machine-learning methods.

Research appointments

Postdoctoral researcher, TÜBİTAK National Metrology Institute (UME), Kocaeli — 2025–present
Began during the final year of the PhD. Develop signal-processing and machine-learning methods in the DETAM project to investigate candidate seismic precursors in search-coil and fluxgate magnetometer measurements.

Doctoral researcher, TÜBİTAK Research Institute for Fundamental Sciences (TBAE), Kocaeli — 2022–2026
Developed renormalization-group methods for long-range, multicomponent and continuous spin systems in the Complex System Multifractal Dynamics project.

Education

PhD, Computational Sciences and Engineering, Kadir Has University — 2022–2026
Thesis: *Scale and Complexity: Renormalization-Group Theory of Phase Transitions, Spin-Glass Chaos, and Emergent Order in Complex Spin Systems*. Advisor: A. Nihat Berker. Research with the advisor's group since 2020.

MA, Philosophy, Yeditepe University — 2015–2018
Thesis: *From Metaphysics to Physics Emerging Human Social Life: On Spinoza's Ethics*. Advisor: Saffet Babür. Graduated with honors.

MS, Physics, Yeditepe University — 2011–2015
Thesis: *Nonlinear Dynamics and Possible Chaoticity in Condensed Matter Systems*. Advisor: Avadis S. Hacinliyan. Graduated with honors.

BS, Physics, Yeditepe University — 2008–2011
Thesis: *Transport Properties of Quantum Point Contacts in the Presence of Edge States*. Co-advisors: Avadis S. Hacinliyan and Afif Sıddıki. Ranked first in the department.

Publications

Peer-reviewed articles

1. **E. C. Artun** and A. Siddiki. Afternoon Spectral Reddening of Daylight as a Candidate Physical Cue for Sundowning Syndrome: A Computational Hypothesis. *Brain Sciences* 16(11), 1168 (2026). doi:10.3390/brainsci16111168
2. **E. C. Artun** and A. N. Berker. Blume-Capel Model in d=1 with Long-Range Interactions: Giant Reentrance in the Finite-Temperature Tricritical Phase Diagrams. *Physica A* 688, 131387 (2026). doi:10.1016/j.physa.2026.131387
3. **E. C. Artun** and A. N. Berker. Multiplicity of Algebraic Order from Fixed Lines of Potential Surfaces: XY-Ashkin-Teller in Spatial Dimension d=2. *Physical Review E* 112, 024126 (2025). doi:10.1103/32g1-nvbt
4. **E. C. Artun**, D. Sarman and A. N. Berker. Axial, Planar-Diagonal, Body-Diagonal Fields on the Cubic-Spin Spin Glass in d=3: A Plethora of Ordered Phases under Finite Fields. *Physical Review E* 110, 034123 (2024). doi:10.1103/PhysRevE.110.034123
5. **E. C. Artun**, D. Sarman and A. N. Berker. Nematic Phase of the n-Component Cubic-Spin Spin Glass in d=3: Liquid-Crystal Phase in a Dirty Magnet. *Physica A* 640, 129709 (2024). doi:10.1016/j.physa.2024.129709
6. Y. E. Pektaş, **E. C. Artun** and A. N. Berker. Driven and Non-Driven Surface Chaos in Spin-Glass Sponges. *Chaos, Solitons & Fractals* 176, 114159 (2023). doi:10.1016/j.chaos.2023.114159

7. **E. C. Artun** and A. N. Berker. Merged Potts-Clock Model: Algebraic and Conventional Multistructured Multicritical Orderings in Two and Three Dimensions. *Physical Review E* 108, 024116 (2023). doi:10.1103/PhysRevE.108.024116
8. **E. C. Artun**, İ. Keçoğlu, A. Türkoğlu and A. N. Berker. Multifractal Spin-Glass Chaos Projection and Interrelation of Multicultural Music and Brain Signals. *Chaos, Solitons & Fractals* 167, 113005 (2023). doi:10.1016/j.chaos.2022.113005
9. **E. C. Artun** and A. N. Berker. Spin-s Spin-Glass Phases in the d=3 Ising Model. *Physical Review E* 104, 044131 (2021). doi:10.1103/PhysRevE.104.044131
10. **E. C. Artun** and A. N. Berker. Metastable Potts Droplets. *Physical Review E* 103, 032102 (2021). doi:10.1103/PhysRevE.103.032102
11. **E. C. Artun** and A. N. Berker. Complete Density Calculations of q-State Potts and Clock Models: Reentrance of Interface Densities under Symmetry Breaking. *Physical Review E* 102, 062135 (2020). doi:10.1103/PhysRevE.102.062135
12. A. S. Hacinliyan, Y. Skarlatos, O. Ozgur Aybar, I. Kusbeyzi Aybar, E. Kandiran, A. C. Keles and **E. C. G. Artun**. Signals of Chaos in the Transient Current through As_2S_3(Ag) and As_2Se_3(Al) Thin Films. *Chaotic Modeling and Simulation* 4, 591–599 (2013).

Preprints

1. **E. C. Artun** and A. N. Berker. Magnetization Curves, Critical Exponents, and Hybrid-Order Finite-Temperature Phase Transition of the d=1 Long-Range Ising Model. In review (2026). SSRN 7239533
2. **E. C. Artun** and A. N. Berker. Ferromagnetic and Spin-Glass Finite-Temperature Order but no Antiferromagnetic Order in the d=1 Ising Model with Long-Range Power-Law Interactions (2025). arXiv:2508.11168

Book chapter

1. Ş. N. Açıkalın and **E. C. Artun**. The Concept of Self-Organized Criticality: The Case Study of the Arab Uprising. In Ş. Ş. Erçetin and N. Potas (eds.), *Chaos, Complexity and Leadership 2017*, Springer Proceedings in Complexity, pp. 73–85. Springer (2019). doi:10.1007/978-3-319-89875-9_7

Work in progress

Reconstruction of complex network dynamics from data 2026–present
Reservoir-computing methods, with Deniz Eroğlu (Imperial College London) and Thomas Geert de Jong (Temple University).

Energetic costs of natural selection across scales 2026–present
From cellular metabolism to population genetics, with Efe Ilker (Aix-Marseille University) and Michael Hinczewski (Case Western Reserve University).

Research visits

Visiting graduate researcher, Soft-Condensed Matter Physics Lab, Boğaziçi University 2013–2015
Nonlinear dynamics in semiconductor humidity sensors for the MS thesis, hosted by Yani Skarlatos within a joint Turkish–Ukrainian research project.

Visiting undergraduate researcher, Quantum Technologies Laboratory, Istanbul University 2010–2011
Quantum transport in two-dimensional electron systems for the BS thesis, hosted by co-advisor Afif Sıddıki.

Visiting undergraduate researcher, Department of Physics, Harvard University Summer 2010
Statistical and risk analysis of the long-term effects of the Chernobyl accident, hosted by Richard Wilson.

Applied research and industry

Data scientist, MetLife Türkiye (via B2Metric), Istanbul 2026–present
Data science research and analysis with senior management in the Data Governance and Business Intelligence department; coordination of Türkiye's contribution to regional data science initiatives.

Research scientist and program manager, TRK Technology, Ankara (part-time) 2022–2025
Developed market indicators, trading models and forecasts, including projects with Turkish Airlines and the Ministry of Treasury and Finance. Founded the quantum computing program, set its research strategy and investigated portfolio optimization and asset pricing.

Data scientist, Science to Data Science (S2DS) program, Pivigo, UK Winter 2024
Built forecasting models and a scenario-analysis tool in a project with the UK Gambling Commission.

Teaching

Teaching assistant, Berker Research Group, Istanbul 2019–2026

- Istanbul Technical University: *Universality, Scaling, and Fluctuations* (graduate), recitations, spring 2026.
- Kadir Has University: *Phase Transitions and Renormalization-Group Theory* (graduate), several semesters.
- Kadir Has University: masterclass on quantum technologies and quantum computing (fall 2023); brain science, artificial intelligence and neuroscience (summer and fall 2021); intensive courses in mechanics and in electricity and magnetism; Physics I and II.
- Council of Higher Education, High Performers Natural Sciences Program: mechanics, fall 2022.

Assistant lecturer, Department of Molecular Biology and Genetics, Biruni University 2018
Taught physics and mathematics, alternating with Afif Sıddıki.

Teaching assistant, Department of Physics, Yeditepe University 2013–2018
Mechanics laboratory and electricity and magnetism laboratory.

Talks and presentations

Seminars and invited talks

1. *From Dice to Datasets: Analyzing the Gambling Sector with Statistical Physics Tools.* 28th Statistical Physics Days, Istanbul. 1–3 Jul 2026
2. *Uzun Menzilli Etkileşimli Spin Sistemlerinde Renormalizasyon Grubu: Bir Boyutta Ising Modeli'nden Blume–Capel Modeli'ne.* Departmental seminar, Department of Physics, Mimar Sinan Fine Arts University, Istanbul. In Turkish. 30 Apr 2026
3. *Renormalization-Group Theory for Spin Systems with Long-Range Interactions: Giant Reentrance in the 1D Blume–Capel Model.* Graduate seminar, Kadir Has University, Istanbul. 27 Mar 2026
4. *Renormalization Group Studies of Phase Transitions.* Departmental seminar, Department of Physics, Yeditepe University, Istanbul. 7 Mar 2024
5. *İstatistik Fiziğin Kitle İmha Yöntemi: Renormalizasyon Grubu.* National Physics Students Summit, Hacettepe University, Ankara. In Turkish. 16–17 Apr 2022

Conference talks and posters

1. Poster. *Reconstruction of Complex Network Dynamics from Data Using Reservoir Computing.* Conference on Complex Systems (CCS 2026), Binghamton University, New York. 9–16 Oct 2026
2. Poster. *Renormalization Group Studies of Continuous-Spin Complex Systems.* TURAN Fundamental Sciences Symposium, Yıldız Technical University, Istanbul. 23–25 Jun 2025
3. Talk. *Spin-Glass Sponges: Spin Glasses with Fractal Surfaces.* 11th International Scientific Conference on Physics and Control, Kadir Has University, Istanbul. 9–12 Sep 2024
4. Poster. *Spin-Glass Phase Transition in Finite Field.* 40th International Physics Congress of the Turkish Physical Society, Muğla. 2–6 Sep 2024
5. Poster. *Liquid Crystal Phase in Spin Glasses.* 28th Condensed Matter Physics Meeting, Bilkent University, Ankara. 22 Dec 2023
6. Talk. *Spin-Glass Machine: Music, Brain, and Complex System Classificator.* 25th National Liquid Phase Symposium, Piri Reis University, Istanbul. 27 May 2022
7. Talk. *The Concept of Self-Organized Criticality: The Case Study of the Arab Uprising.* 5th International Symposium on Chaos, Complexity and Leadership, Ankara. 11–12 Dec 2017
8. Poster. *q-Gaussian Analysis of the Electronic Behavior in $As_2S_3(Ag)$ and $As_2Se_3(Al)$ Thin Films.* 32nd International Physics Congress of the Turkish Physical Society, Muğla. 6–9 Sep 2016
9. Talk. *Signals of Chaos in the Transient Current through $As_2S_3(Ag)$ and $As_2Se_3(Al)$ Thin Films.* 6th Chaotic Modeling and Simulation International Conference, Yeditepe University, Istanbul. 11–14 Jun 2013

Public and interdisciplinary talks

1. *Scientific Mosaic Throughout the Ages.* Scientific Thought Workshop, ETWO Youth, Türkiye. 2023
2. *Kuantum Mekaniğinin Felsefi Yorumları.* MindFusion Days, Data Science Earth, Türkiye. In Turkish. 15 Nov 2020
3. *Uçurumun Kenarında Büyük Dönüşüm: 3. Sanayi Devrimi.* Ment College, Istanbul. In Turkish. 24 Mar 2018

4. *Self-Organized Criticality: The Case Study of the Arab Uprising.* Akyaka Nature Meetings, Muğla. 9–12 Feb 2018
5. *The Work of Art in the Age of Non-material Production.* Akyaka Nature Meetings, Muğla. 9–12 Feb 2018
6. *Düzensizliğin Eşiğinde Değişen Dünya, Toplum ve Bilinç.* 10th From Chaos to Cosmos Workshop, Gümüşlük Academy, Muğla. In Turkish. 26–28 Aug 2016

Schools and intensives

New England Complex Systems Institute, two programs on full scholarship: concepts and applications of complexity science; complex social psychological systems — 2024

Eskişehir Technical University, magnetic properties of two-dimensional materials from first principles — 2021

Boğaziçi University, quantum field theory school — 2020

Kadir Has University, phase transitions and renormalization-group theory; outstanding success recognition, one of 4 selected among 109 participants — 2019

Istanbul Center for Mathematical Sciences, geometry and symmetry school — 2019

Mimar Sinan Fine Arts University, quantum field theory summer school — 2018

Honors and awards

Full merit-based scholarship, MA Philosophy, Yeditepe University, awarded by the Board of Trustees — 2015–2018

Full merit-based scholarship, MS Physics, Yeditepe University — 2011–2015

Special travel grant, Yeditepe University Board of Trustees, for the research visit to Harvard University — 2010

National merit-based full scholarship, Council of Higher Education, Türkiye — 2007–2011

Service

Mentoring

Graduate student mentor, Berker Research Group — 2022–2026
Co-authored research with D. Sarman (two papers, 2024), Y. E. Pektaş (first author, 2023), İ. Keçoğlu and A. Türkoğlu (2023). Trained further graduate students in the group's methods.

Intern supervisor, TÜBİTAK Research Institute for Fundamental Sciences (TBAE) — 2022–2026
Supervised undergraduate and graduate interns on projects in statistical physics and complex systems.

Coach, CERN Beamline for Schools, national high-school team — 2023

Core member, QTurkey: quantum computing workshops, hackathons and study groups — 2020–2022

Reviewing

Reviewer, *Chaos, Solitons & Fractals*; *The European Physical Journal Special Topics* — 2023–present

Event organization

Organizing committee member, TÜBİTAK Research Institute for Fundamental Sciences (TBAE) and the International Science Association — 2017–2026
Nineteen conferences, schools and workshops (16 international, 3 national) in complex systems, quantum technologies, photonics, materials science, life sciences and high-energy physics, including ICCLS 2018–2020, PQIP 2024, CALSA 2025, HEAP 2026 and WCB-5G.

Local organizing committee member, 11th International Conference on Physics and Control (IPACS) — 2024

Memberships

American Physical Society — 2026–present

Complex Systems Society — 2024–present

International Physics and Control Society (IPACS) — 2024–present