

Arik Yochelis
Associate Professor
The Swiss Institute for Dryland Environmental and Energy Research
Department of Physics
Email: yochelis@bgu.ac.il



Research interests

The group focuses on pattern formation in far from equilibrium physicochemical systems, with an emphasis on renewable energy and biological media. The research is multidisciplinary and ranges from basic theory, such as local and global bifurcation theory, to applications-driven, such as intra-cellular actin polymerization, localized waves in the inner ear, soft-matter energy devices where morphology is coupled to Coulombic interactions, and photo-electrochemical water splitting at semiconductor/electrolyte interfaces.

Energy applications: the interest is in renewable energy devices that exploit nano-scale morphologies to increase efficiency. However, electrical effects are often strong enough to influence the structure of active layers of those materials leading to a notorious decrease in performance. To date, theoretical studies have dealt almost exclusively with uncoupled models of self-assembly and electrokinetics. We develop novel and computationally amenable mean-field frameworks that unify them. Our expectations are to advance devices, such as batteries, supercapacitors, and solar cells.

Biological applications: the interest is in self-organization that ranges from cellular to organ levels, such as spiral waves, pulses, synchronization, and steady states that are periodic in space. These non-equilibrium phenomena emerge through either spontaneous or forced symmetry-breaking mechanisms.

Qualifications

2008 → 2009 Postdoc, Technion

2006 → 2008 Postdoc, UCLA

2005 → 2006 Postdoc, UC Berkeley

2004 → 2005 Postdoc, Technion

Employment

Associate Professor

Associate Professor

The Swiss Institute for Dryland Environmental and Energy Research

Ben-Gurion University of the Negev

1 Jul 2021 → present

Adjunct Associate Professor

Associate Professor

Department of Physics

Ben-Gurion University of the Negev

1 Jun 2022 → 30 Sep 2039

R&D Physicist

Landa Laboratories

Israel

1 Jan 2009 → 1 Jan 2012

Research outputs

Instability mechanisms of repelling peak solutions in a multi-variable activator-inhibitor system

Knobloch, E. & Yochelis, A., 1 Dec 2022, In: Chaos. 32, 12, 123129.

Versatile Patterns in the Actin Cortex of Motile Cells: Self-Organized Pulses Can Coexist with Macropinocytic Ring-Shaped Waves

Yochelis, A., Flemming, S. & Beta, C., 19 Aug 2022, In: Physical Review Letters. 129, 8, 6 p., 088101.

Erratum: Parallel water photo-oxidation reaction pathways in hematite photoanodes: implications for solar fuel production (Energy Environ. Sci. (2022) DOI: 10.1039/d1ee03953a)

Tsyganok, A., Monroy-Castillero, P., Piekner, Y., Yochelis, A. & Rothschild, A., 10 Jun 2022, In: Energy and Environmental Science. 15, 7, p. 3098 1 p.

Parallel water photo-oxidation reaction pathways in hematite photoanodes: implications for solar fuel production

Tsyganok, A., Monroy Castillero, P., Piekner, Y., Yochelis, A. & Rothschild, A., 2022, In: Energy and Environmental Science. 15, 6, p. 2445-2459 15 p.

Origin of jumping oscillons in an excitable reaction-diffusion system

Knobloch, E., Uecker, H. & Yochelis, A., 1 Dec 2021, In: Physical Review E. 104, 6, L062201.

Stationary peaks in a multi-variable reaction-diffusion system: Foliated snaking due to subcritical Turing instability: Foliated snaking due to subcritical Turing instability

Knobloch, E. & Yochelis, A., 1 Oct 2021, In: IMA Journal of Applied Mathematics. 86, 5, p. 1066-1093 28 p.

The nonlinear initiation of side-branching by activator-inhibitor-substrate (Turing) morphogenesis

Yochelis, A., 1 May 2021, In: Chaos. 31, 5, 051102.

Special issue: Advances in pattern formation

Yochelis, A., Gilad, E., Nishiura, Y., Silber, M. & Uecker, H., 1 Jan 2021, In: Physica D: Nonlinear Phenomena. 415, 132769.

Assessing the impact of multiple comorbidities on fatal outcome in young COVID-19

Castillero, P. M., Friedman, E., Herrera, A. R. & Yochelis, A., 2021, (medRxiv).

Bending and pinching of three-phase stripes: From secondary instabilities to morphological deformations in organic photovoltaics

Shapira, A. Z., Gavish, N., Uecker, H. & Yochelis, A., 15 Dec 2020, In: Physical Review E. 102, 6, 062213.

Spatial asymmetries of resonant oscillations in periodically forced heterogeneous media

Edri, Y., Meron, E. & Yochelis, A., 1 Sep 2020, In: Physica D: Nonlinear Phenomena. 410, 132501.

Stripes on finite domains: Why the zigzag instability is only a partial story

Shapira, A. Z., Uecker, H. & Yochelis, A., 1 Jul 2020, In: Chaos. 30, 7, 073104.

Why a Large-Scale Mode Can Be Essential for Understanding Intracellular Actin Waves

Beta, C., Gov, N. S. & Yochelis, A., 23 Jun 2020, In: Cells. 9, 6

Excitable solitons: Annihilation, crossover, and nucleation of pulses in mass-conserving activator-inhibitor media

Yochelis, A., Beta, C. & Gov, N. S., 1 Feb 2020, In: Physical Review E. 101, 2, 022213.

Spatial heterogeneity may form an inverse camel shaped Arnol'd tongue in parametrically forced oscillations

Edri, Y., Meron, E. & Yochelis, A., 1 Feb 2020, In: Chaos. 30, 2, 023120.

Controlling the interfacial and bulk concentrations of spontaneously charged colloids in non-polar media

Bier, S. & Yochelis, A., 1 Apr 2019, In: European Physical Journal: Special Topics. 227, 18, p. 2603-2616 14 p.

Dynamical aspects of mean field theories for electrolytes and applications

Yochelis, A. & Krischer, K., 1 Apr 2019, In: European Physical Journal: Special Topics. 227, 18, p. 2513-2514 2 p.

Pattern formation aspects of electrically charged tri-stable media with implications to bulk heterojunction in organic photovoltaics

Shapira, A. Z., Gavish, N. & Yochelis, A., 1 Jan 2019, In: EPL. 125, 3, 38001.

Two-site H_2O_2 photo-oxidation on haematite photoanodes

Avital, Y. Y., Dotan, H., Klotz, D., Grave, D. A., Tsyganok, A., Gupta, B., Kolusheva, S., Visoly-Fisher, I., Rothschild, A. & Yochelis, A., 1 Dec 2018, In: Nature Communications. 9, 1, 4060.

Electrochemically induced phase separation and in situ formation of mesoporous structures in ionic liquid mixtures

Lahiri, A., Behrens, N., Pulletikurthi, G., Yochelis, A., Kroke, E., Cui, T. & Endres, F., 26 Oct 2018, In: Science advances. 4, 10, eaau9663.

Molding the asymmetry of localized frequency-locking waves by a generalized forcing and implications to the inner ear

Edri, Y., Bozovic, D., Meron, E. & Yochelis, A., 31 Aug 2018, In: Physical Review E. 98, 2, 020202.

Catalytic Membrane Reactor Model as a Laboratory for Pattern Emergence in Reaction-diffusion-advection Media

Yochelis, A., 1 Jun 2018, In: Israel Journal of Chemistry. 58, 6, p. 722-732 11 p.

From solvent-free to dilute electrolytes: Essential components for a continuum theory

Gavish, N., Elad, D. & Yochelis, A., 4 Jan 2018, In: Journal of Physical Chemistry Letters. 9, 1, p. 36-42 7 p.

Fronts and waves of actin polymerization in a bistability-based mechanism of circular dorsal ruffles

Bernitt, E., Döbereiner, H. G., Gov, N. S. & Yochelis, A., 19 Jun 2017, In: Nature Communications. 8, 15863.

From bulk self-assembly to electrical diffuse layer in a continuum approach for ionic liquids: The impact of anion and cation size asymmetry

Bier, S., Gavish, N., Uecker, H. & Yochelis, A., 2 Jun 2017, In: Physical Review E. 95, 6, 060201.

Comb-like Turing patterns embedded in Hopf oscillations: Spatially localized states outside the 2:1 frequency locked region

Castillero, P. M. & Yochelis, A., 1 Apr 2017, In: Chaos. 27, 4, 043110.

Spatially localized self-assembly driven by electrically charged phase separation

Gavish, N., Versano, I. & Yochelis, A., 1 Jan 2017, In: SIAM Journal on Applied Dynamical Systems. 16, 4, p. 1946-1968 23 p.

Frequency locking in auditory hair cells: Distinguishing between additive and parametric forcing

Edri, Y., Bozovic, D. & Yochelis, A., 1 Oct 2016, In: EPL. 116, 2, 28002.

Theory of Phase Separation and Polarization for Pure Ionic Liquids

Gavish, N. & Yochelis, A., 21 Apr 2016, In: Journal of Physical Chemistry Letters. 7, 7, p. 1121-1126 6 p.

Reaction-diffusion-advection approach to spatially localized treadmilling aggregates of molecular motors

Yochelis, A., Bar-On, T. & Gov, N. S., 1 Apr 2016, In: Physica D: Nonlinear Phenomena. 318-319, p. 84-90 7 p.

Theory of phase separation and polarization for dissociated ionic liquids

Gavish, N. & Yochelis, A., 1 Dec 2015, In: Journal of Physical Chemistry Letters.

Self-organization of waves and pulse trains by molecular motors in cellular protrusions

Yochelis, A., Ebrahim, S., Millis, B., Cui, R., Kachar, B., Naoz, M. & Gov, N. S., 3 Sep 2015, In: Scientific Reports. 5, 13521.

Coupling Bulk and Near-Electrode Interfacial Nanostructuring in Ionic Liquids

Yochelis, A., Singh, M. B. & Visoly-Fisher, I., 23 Jun 2015, In: Chemistry of Materials. 27, 12, p. 4169-4179 11 p.

Origin of finite pulse trains: Homoclinic snaking in excitable media

Yochelis, A., Knobloch, E. & Köpf, M. H., 25 Mar 2015, In: Physical Review E. 91, 3, 032924.

Spatial structure of electrical diffuse layers in highly concentrated electrolytes: A modified poisson-nernst-planck approach

Yochelis, A., 20 Mar 2014, In: Journal of Physical Chemistry C. 118, 11, p. 5716-5724 9 p.

Transition from non-monotonic to monotonic electrical diffuse layers: Impact of confinement on ionic liquids

Yochelis, A., 21 Feb 2014, In: Physical Chemistry Chemical Physics. 16, 7, p. 2836-2841 6 p.

Linking actin networks and cell membrane via a reaction-diffusion-elastic description of nonlinear filopodia initiation

Ben Isaac, E., Manor, U., Kachar, B., Yochelis, A. & Gov, N. S., 29 Aug 2013, In: Physical Review E. 88, 2, 022718.

Why Turing mechanism is an obstacle to stationary periodic patterns in bounded reaction-diffusion media with advection

Yochelis, A. & Sheintuch, M., 19 Apr 2010, In: Physical Chemistry Chemical Physics. 12, 16, p. 3957-3960 4 p.

Drifting solitary waves in a reaction-diffusion medium with differential advection

Yochelis, A. & Sheintuch, M., 8 Feb 2010, In: Physical Review E. 81, 2, 025203.

Principal bifurcations and symmetries in the emergence of reaction-diffusion-advection patterns on finite domains

Yochelis, A. & Sheintuch, M., 2 Nov 2009, In: Physical Review E. 80, 5, 056201.

Towards nonlinear selection of reaction-diffusion patterns in presence of advection: A spatial dynamics approach

Yochelis, A. & Sheintuch, M., 21 Oct 2009, In: Physical Chemistry Chemical Physics. 11, 40, p. 9210-9223 14 p.

Bifurcation and chaos in a model of cardiac early afterdepolarizations

Tran, D. X., Sato, D., Yochelis, A., Weiss, J. N., Garfinkel, A. & Qu, Z., 25 Jun 2009, In: Physical Review Letters. 102, 25, 258103.

Classification of spatially localized oscillations in periodically forced dissipative systems

Burke, J., Yochelis, A. & Knobloch, E., 17 Nov 2008, In: SIAM Journal on Applied Dynamical Systems. 7, 3, p. 691-711 21 p.

Generation of finite wave trains in excitable media

Yochelis, A., Knobloch, E., Xie, Y., Qu, Z. & Garfinkel, A., 1 Sep 2008, In: EPL. 83, 6, 64005.

The formation of labyrinths, spots and stripe patterns in a biochemical approach to cardiovascular calcification

Yochelis, A., Tintut, Y., Demer, L. L. & Garfinkel, A., 12 May 2008, In: New Journal of Physics. 10, 055002.

Front motion and localized states in an asymmetric bistable activator-inhibitor system with saturation

Yochelis, A. & Garfinkel, A., 20 Mar 2008, In: Physical Review E. 77, 3, 035204.

Matrix GLA protein, an inhibitory morphogen in pulmonary vascular development

Yao, Y., Nowak, S., Yochelis, A., Garfinkel, A. & Boström, K. I., 12 Oct 2007, In: Journal of Biological Chemistry. 282, 41, p. 30131-30142 12 p.

Formation and mobility of droplets on composite layered substrates

Yochelis, A., Knobloch, E. & Pismen, L. M., 1 Jan 2007, In: European Physical Journal E. 22, 1, p. 41-49 9 p.

Reciprocal oscillons and nonmonotonic fronts in forced nonequilibrium systems
Yochelis, A., Burke, J. & Knobloch, E., 1 Dec 2006, In: Physical Review Letters. 97, 25, 254501.

Linear and nonlinear front instabilities in bistable systems

Hagberg, A., Yochelis, A., Yizhaq, H., Elphick, C., Pismen, L. & Meron, E., 15 May 2006, In: Physica D: Nonlinear Phenomena. 217, 2, p. 186-192 7 p.

Thin films of van der Waals fluid: From interface interactions to wetting transitions

Yochelis, A. & Pismen, L. M., 15 Feb 2006, In: Colloids and Surfaces A: Physicochemical and Engineering Aspects. 274, 1-3, p. 170-178 9 p.

Droplet motion driven by surface freezing or melting: A mesoscopic hydrodynamic approach

Yochelis, A. & Pismen, L. M., 1 Aug 2005, In: Physical Review E. 72, 2, 025301.

Frequency locking in extended systems: The impact of a Turing mode

Yochelis, A., Elphick, C., Hagberg, A. & Meron, E., 1 Jan 2005, In: EPL. 69, 2, p. 170-176 7 p.

Two-phase resonant patterns in forced oscillatory systems: Boundaries, mechanisms and forms

Yochelis, A., Elphick, C., Hagberg, A. & Meron, E., 1 Dec 2004, In: Physica D: Nonlinear Phenomena. 199, 1-2, p. 201-222 22 p.

Development of standing-wave labyrinthine patterns

Yochelis, A., Hagberg, A., Meron, E., Lin, A. L. & Swinney, H. L., 1 Jan 2002, In: SIAM Journal on Applied Dynamical Systems. 1, 2, p. 236-247 12 p.

Oscillon formation as an initial pattern state

Yochelis, A., Galanti, B. & Olami, Z., 1 Jan 1999, In: Physical Review E. 60, 5, p. 6157-6159 3 p.

Nuclear spin-lattice relaxation of dipolar order caused by paramagnetic impurities

Furman, G., Panich, A., Yochelis, A., Kunoff, E. & Goren, S., 1 Jan 1997, In: Physical Review B - Condensed Matter and Materials Physics. 55, 1, p. 439-444 6 p.