

# ELISABETTA A. MATSUMOTO

## CURRICULUM VITÆ

### ASSISTANT PROFESSOR

School of Physics

Georgia Institute of Technology

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### EDUCATION

- 2011 **Ph.D. Physics and Astronomy** University of Pennsylvania, Philadelphia, PA  
2007 **M.S. Physics and Astronomy** University of Pennsylvania, Philadelphia, PA  
2007 **B.A. Physics and Astronomy** *summa cum laude*, University of Pennsylvania, Philadelphia, PA

### PRIOR POSITIONS

- 2014-2016 **Postdoctoral Fellow** School of Engineering and Applied Science, Harvard University, Cambridge, MA  
Jan.-May 2015 **Lecturer** Applied Mathematics, School of Engineering and Applied Science, Harvard University, Cambridge, MA  
2011-2014 **Postdoctoral Fellow** Princeton Center for Theoretical Science, Princeton University, Princeton, NJ  
2011 **Postdoctoral Fellow** Department of Physics and Astronomy, University of Pennsylvania, Philadelphia, PA  
2007-2011 **Graduate Student** Department of Physics and Astronomy, University of Pennsylvania, Philadelphia, PA  
2003-2007 **Undergraduate Researcher** Department of Physics and Astronomy, University of Pennsylvania, Philadelphia, PA

### CURRENT FUNDING

- 2016 **STAMI-SMI Seed Grant**, Georgia Institute of Technology, Atlanta, GA, USA.

### FELLOWSHIPS AND AWARDS

- 2016 **Stjepan Marcelja Fellow**, The Australian National University, Canberra, ACT, Australia.  
2012 **Glenn Brown Dissertation Prize** *For highly creative application of analytical mathematics combined with deep geometric insight to an especially interesting variety of problems in liquid crystal physics.*  
International Liquid Crystal Society.  
2010 **Elias Burstein Prize** *Awarded to the graduate student in Condensed Matter Physics judged to have made a significant contribution to the understanding of the subject.*  
Department of Physics and Astronomy, University of Pennsylvania.  
2010 **American Physical Society GSNP Student Speaker Award Winner.**  
Group on Statistical and Nonlinear Physics, American Physical Society.  
2007 **William E. Stephens Memorial Prize** *Awarded to the graduating physics major judged to have demonstrated the most promise for a successful career as a scientist based on overall performance in the undergraduate program.*  
Department of Physics and Astronomy, University of Pennsylvania.  
2007 **Elected to Phi Beta Kappa National Honor Society**  
2006 **Roy and Diana Vagelos Science Challenge Award** *To reward the very best, motivated and advanced science students, and challenge them to get the most from themselves and Penn.*  
Department of Physics and Astronomy, University of Pennsylvania.

## REFEREED OUTPUTS

- Elisabetta A. Matsumoto, “A Klein Quartic Quilt”, *Proceedings of Bridges 2017: Mathematics, Music, Art, Architecture, Culture* (in press) (2017).
- Vi Hart, Andrea Hawksley, Elisabetta A. Matsumoto and Henry Segerman, “Non-euclidean virtual reality I: explorations of  $\mathbb{H}^3$ ”, *Proceedings of Bridges 2017: Mathematics, Music, Art, Architecture, Culture* (in press) (2017).
- Vi Hart, Andrea Hawksley, Elisabetta A. Matsumoto and Henry Segerman, “Non-euclidean virtual reality II: explorations of  $\mathbb{H}^2 \times \mathbb{E}$ ”, *Proceedings of Bridges 2017: Mathematics, Music, Art, Architecture, Culture* (in press) (2017).
- Elisabetta A. Matsumoto, Randall D. Kamien and Gareth P. Alexander, “Straight Round the Twist: Frustration and Chirality in Smectics-A”, *J. Interface Focus* (in press) (2017).
- Elisabetta A. Matsumoto, Haiyi Liang and L. Mahadevan, “Topology, Geometry and Mechanics of Z-plasty”, *Phys. Rev. Lett.* (under review) (2016).
- A. Sydney Gladman\*, Elisabetta A. Matsumoto\*, Ralph G. Nuzzo, L. Mahadevan and Jennifer A. Lewis, “Biomimetic 4D Printing,” *Nat. Mater.* **15** (2016) 413-418.  
(\* These authors contributed equally.)
- Jennifer A. Lewis, A. Sydney Gladman, Elisabetta A. Matsumoto and L. Mahadevan, “Hydrogel composite ink formulation and method of 4D printing a hydrogel composite structure,” United States Patent Application, 30 November 2015.
- Elisabetta A. Matsumoto, Daniel A. Vega, Aldo D. Pezzutti, Nicolás A. García, Paul M. Chaikin and Richard A. Register, “Wrinkles and Splay Conspire to Give Positive Disclinations Negative Curvature,” *Proc. Nat. Acad. Sci.* **112** (2015) 12639-12644.
- S. Yang, Y. Zhang, R. D. Kamien, J. M. Kikkawa, E. A. Matsumoto and D. Chandra, “Patterning Structures Using Deformable Substrates,” U.S. Patent 8,557,341 B2, filed 23 April 2008, and issued 15 October 2013.
- Elisabetta A. Matsumoto, “Patterns on a Roll”, in: *Experience-centered Approach and Visuality in the Education of Mathematics and Physics*, edited by J. Barrallo, M. Budin, A. Durity, K. Fenyvesi, S. Jablan, A. Takács, Lj. Radović, R. Sazdanović and E. Stettner, Kaposvár, Hungary: Kaposvár University, 2012, p.175-176.
- Elisabetta A. Matsumoto and Randall D. Kamien, “Patterns on a Roll: A Method for Continuous Feed Nanoprinting,” *Soft Matter* **8** (2012) 11038.
- Elisabetta A. Matsumoto, Christian D. Santangelo and Randall D. Kamien, “Smectic Pores and Defect Cores,” *J. Interface Focus* **2** (2012) 617.
- Gareth P. Alexander, Bryan G. Chen, Elisabetta A. Matsumoto and Randall D. Kamien, “Colloquium: Disclination loops, hedgehogs, and all that in nematic liquid crystals,” *Rev. Mod. Phys.* **84** (2012) 497.
- Gareth P. Alexander, Bryan G. Chen, Elisabetta A. Matsumoto and Randall D. Kamien, “The Power of the Poincaré Group: Elucidating the Hidden Symmetries in Focal Conic Domains” *Phys. Rev. Lett.* **104** (2010) 257802.
- Elisabetta A. Matsumoto, Gareth P. Alexander and Randall D. Kamien, “Helical Nanofilaments and the High Chirality Limit of Smectics-A,” *Phys. Rev. Lett.* **103** (2010) 257804.

Elisabetta A. Matsumoto and Randall D. Kamien “Elastic-instability Triggered Pattern Formation,” *Phys. Rev. E* **80** (2009) 021604. Also appears in the *Virtual Journal of Nanoscale Science and Technology*.

Ying Zhang, Elisabetta A. Matsumoto, Anna Peter, Pei-Chun Lin, Randall D. Kamien and Shu Yang, “One-step Nanoscale Assembly of Complex Structures via Harnessing of an Elastic Instability,” *Nano Letters* **8** (2008) 1192.

#### DISSERTATION

Elisabetta A. Matsumoto, “The Taming of the Screw or: How I Learned to Stop Worrying and Love Elliptic Functions,” Department of Physics and Astronomy, University of Pennsylvania (2011).

#### INVITED PRESENTATIONS

“Elastic instabilities, pattern formation and programmable matter,” Newton, Goethe, D’Arcy Thompson and self-organised complexity of shape: A symposium, Canberra, Australia, April 2016.

“Phytomimetic 4D Printing,” (keynote lecture) Shape-up: Exercise in Materials Geometry and Topology, Berlin, Germany, September 2015.

“Dr. Wrinkle and Mr. Hyde, the ins and outs of pattern formation in elastic films,” ICERM Workshop Small Clusters, Polymer Vesicles and Unusual Minima, Providence, Rhode Island, USA, March 2015.

“Disclination Induced Wrinkles in Free Standing Smectic Membranes,” SIAM Conference on Mathematical Aspects of Materials Science, Philadelphia, Pennsylvania, USA, June 2013.

“The Taming of the Screw: Riemann’s Minimal Surface and Sums of Helicoids,” MRS Fall Meeting, Boston, Massachusetts, USA, November 2012.

“The Taming of the Screw: Helicoids and Frustration in Equally Spaced Smectics,” International Liquid Crystal Conference, Mainz, Germany, August 2012.

“The Taming of the Screw: Riemann’s Minimal Surface and Sums of Helicoids,” Geometry of Interfaces, Primosten, Croatia, October 2011.

“Controlling Elastic Instabilities: From Complex Pattern Formation to Functionality,” Princeton/Penn/NYU Soft Matter Workshop, Princeton University, Princeton, New Jersey, USA, December 2010.

“Controlling Elastic Instabilities: From Complex Pattern Formation to Functionality,” APS March Meeting, Portland, Oregon, USA, March 2010.

#### SEMINARS AND COLLOQUIA

“Programmable Matter: using 3D printed elastic instabilities to direct shape transformation,” Department of Applied Physics, University of North Carolina, Chapel Hill, April, 2017.

“Non-euclidean virtual reality,” School of Mathematics, Georgia Institute of Technology, April, 2017/

“Programmable Matter: using 3D printed elastic instabilities to direct shape transformation,” Department of Physics, University of Michigan, February, 2017.

“Programmable Matter: using 3D printed elastic instabilities to direct shape transformation,” Department of Physics, Emory University, February, 2017.

- “Phytomimetic 4D Printing,” School of Mathematics, Murdoch University, Perth, Australia, April 2016.
- “Biomimetic 4D Printing,” Department of Mechanical Engineering, Johns Hopkins University, Baltimore, Maryland, USA, March 2016.
- “Biomimetic 4D Printing,” School of Mathematics and Physics, University of Queensland, Brisbane, Australia, February 2016.
- “Elastic anisotropies and the rational design of programmable matter,” Department of Applied Mathematics and Theoretical Physics, University of Cambridge, Cambridge, UK, February 2016.
- “Biomimetic 4D Printing,” Department of Mathematics, Duke University, Durham, North Carolina, USA, February 2016.
- “Biomimetic 4D Printing,” School of Engineering, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, February 2016.
- “Biomimetic 4D Printing,” School of Physics, Georgia Institute of Technology, Atlanta, Georgia, USA, January 2016.
- “Biomimetic 4D Printing,” Kavli Institute for Theoretical Physics, University of California at Santa Barbara, Goleta, California, USA, January 2016.
- “Biomimetic 4D Printing,” Engineering Sciences and Applied Mathematics Colloquium, Northwestern University, Evanston, Illinois, USA, January 2016.
- “Pattern Formation in Thin Elastic Films,” Soft Matter Seminar, Tufts University, Medford, Massachusetts, USA, February 2015.
- “Pattern Formation in Thin Elastic Films,” Soft Matter Seminar, Georgetown University, Washington D.C., USA, May 2014.
- “A Tale of Two Smectics: exploring the coupling between topological defects and curvature in ordered materials,” Condensed Matter Seminar, Johns Hopkins University, Baltimore, Maryland, USA, March 2014.
- “A Tale of Two Smectics: exploring the coupling between topological defects and curvature in ordered materials,” PACM Seminar, Princeton University, Princeton, New Jersey, USA, February 2014.
- “Pattern Formation in Thin Elastic Films,” Soft Matter Seminar, University of California, San Diego, San Diego California, USA, January 2014.
- “How to Crochet Hyperbolic Planes and Tilings,” Knotted Fields program, Kavli Institute for Theoretical Physics, Santa Barbara, California, USA, July 2012.
- “The Taming of the Screw: Riemann’s Minimal Surface and Sums of Helicoids,” Workshop on Topology: Identifying Order in Complex Systems, Rutgers University, New Brunswick, New Jersey, USA, February 2012.
- “Defects in Smectics A: From the Helical Nanofilament Phase to Focal Conic Domains,” WAM Seminar, Harvard University, Cambridge, Massachusetts, USA, January 2011.
- “Defects in Smectics A: From Focal Conic Domains to the Helical Nanofilament Phase,” Brandeis University, Waltham, Massachusetts, USA, November 2010.
- “Controlling Elastic Instabilities: From Complex Pattern Formation to Functionality,” Brown University, Providence, Rhode Island, USA, October 2010.
- “Smectic Defects with Riemann Reason,” Curvature and Variational Modeling in Physics and Biophysics, Santiago de Compostella, Spain, September 2007.

## CONTRIBUTED CONFERENCE PRESENTATIONS

- A. Dastan, W. J. Frith, E. A. Matsumoto\* and D. J. Cleaver, "Why Be Straight? Or: the undeniable pervasiveness of twisting," Bowden Research Convergence, Animal, Vegetal Mineral, Yallingup, Australia, September 2016. (Talk)
- E. A. Matsumoto, A. Sydney Gladman, Jennifer. A. Lewis and L. Mahadevan, "4D Printing Elastomers with Nematic Order," International Liquid Crystal Conference, Kent State University, Kent, Ohio, USA, August 2016. (Talk)
- E. A. Matsumoto, A. Sydney Gladman, Jennifer. A. Lewis and L. Mahadevan, "Anisotropy Controlled Programmable Architectures in 4D Printing," Materials Research Society Fall Meeting, Boston, Massachusetts, USA, November 2015. (Talk)
- E. A. Matsumoto, L. Mahadevan, and Jennifer A. Lewis, "Phytomimetic 4D Printing," Gordon Research Conference on Soft Condensed Matter Physics, New London, New Hampshire, USA, August 2015. (Poster)
- A. Sydney Gladman, E. A. Matsumoto, L. Mahadevan, and Jennifer A. Lewis, "Phytomimetic 4D Printing," Gordon Research Conference on Soft Condensed Matter Physics, New London, New Hampshire, USA, August 2015. (Poster)
- E. A. Matsumoto, "I'm Fixing a Hole," Geometry and topology of liquid crystals and related ordered materials, Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark, August 2013. (Talk)
- E. A. Matsumoto, R. D. Kamien, and G. P. Alexander, "Straight Round the Twist: Frustration and Chirality in Equally Spaced Smectics," Newton Institute Programme on the Mathematics of Liquid Crystals, Liquid Crystal Defects and their Geometry, Active and Soft Solid Liquid Crystals, and Related Systems, Cambridge, UK, June 2013. (Poster)
- E. A. Matsumoto, R. D. Kamien, and G. P. Alexander, "Straight Round the Twist: Frustration and Chirality in Equally Spaced Smectics," Gordon Research Conference on Liquid Crystals, Biddeford, Maine, USA, June 2013. (Poster)
- E. A. Matsumoto, G. P. Alexander, B. G. Chen, and R. D. Kamien, "The Power of Poincaré: Elucidating Hidden Symmetries in Focal Conic Domains," Gordon Research Conference on Liquid Crystals, South Hadley, Massachusetts, USA, June 2011. (Poster)
- E. A. Matsumoto, G. P. Alexander, B. G. Chen, and R. D. Kamien, "Shedding Light on Focal Conic Domains," APS March Meeting, Dallas, Texas, USA, March 2011. (Talk)
- E. A. Matsumoto, G. P. Alexander, and R. D. Kamien, "Helical Nanofilaments and the High Chirality Limit of Smectics A," 23<sup>rd</sup> International Liquid Crystal Conference, Krakow, Poland, July 2010. (Talk)
- E. A. Matsumoto, Y. Zhang, X. Zhu, R. Dong, A. Peter, P.-C. Lin, R. D. Kamien, J. M. Kikkawa, and S. Yang. "IRG2: Functional Cylindrical Assemblies: Harnessing Elastic Instability for Functional Nanostructures," NSF MRSEC Review, November 2009. (Poster)
- E. A. Matsumoto, G. P. Alexander, and R. D. Kamien, "The Taming of the Screw: A Short Story" Gordon Research Conference on Liquid Crystals, New London, New Hampshire, USA, June 2009. (Poster)
- E. A. Matsumoto, G. P. Alexander, and R. D. Kamien, "The Taming of the Screw," Soft Solids and Complex Fluids Summer School, University of Massachusetts Amherst, Amherst, Massachusetts, USA, May 2009. (Poster)

E. A. Matsumoto, G. P. Alexander, and R. D. Kamien, “The Taming of the Screw,” Hougén Symposium on Frontiers of Liquid Crystals, University of Wisconsin Madison, Madison, Wisconsin, USA, April 2009. (Poster)

E. A. Matsumoto, G. P. Alexander, and R. D. Kamien, “The Taming of the Screw,” APS March Meeting, Pittsburgh, Pennsylvania, USA, March 2009. (Talk)

E. A. Matsumoto and R. D. Kamien, “Harnessing Elastic Instability: The Self-Assembly of Complex Patterns,” APS March Meeting, New Orleans, Louisiana, USA, March 2008. (Talk)

E. A. Matsumoto, C. D. Santangelo, and R. D. Kamien, “Smectic Defects with Riemann Reason,” Gordon Research Conference on Liquid Crystals, New London, New Hampshire, USA, June 2007. (Poster)

E. A. Matsumoto, C. D. Santangelo, and R. D. Kamien, “Smectic Defects with Riemann Reason,” APS March Meeting, Denver, Colorado, USA 2007. (Talk)

### SELECT PROFESSIONAL ACTIVITIES

Geometry, elasticity, fluctuations, and order in 2D soft matter, KITP Program, Kavli Institute for Theoretical Physics, University of Santa Barbara, Santa Barbara, California, USA, Spring 2016.

Geometry, Symmetry and Topology of Liquid Crystals and Framework Materials, Royal Melbourne Institute for Technology, Melbourne, Victoria, Australia, August 2014.

Geometry and topology of liquid crystals and related ordered materials, Niels Bohr Institute International PhD School, University of Copenhagen, Copenhagen, Denmark, August 2013.

Knotted Fields, KITP Program, Kavli Institute for Theoretical Physics, University of Santa Barbara, Santa Barbara, California, USA, June/July 2012.

Soft Solids and Complex Fluids, Summer School, University of Massachusetts Amherst, Amherst, Massachusetts, USA, May 2009.

Soft Solids and Complex Fluids, Summer School, University of Massachusetts Amherst, Amherst, Massachusetts, USA, June 2008.

Curvature and Variational Modeling in Physics and Biophysics, Summer School, Santiago de Compostella, Spain, September 2007.

Undergraduate Researcher, CERN, Geneva, Switzerland, Summer 2004.

### CONFERENCES AND WORKSHOPS ORGANIZED

**Organizer** Function from Geometry: 3D Printing to Programmable Matter, American Physical Society March Meeting, New Orleans, LA, USA, March 2017.

**Organizer** Through the Looking-glass: A Glimpse into the Geometry and Topology of Materials, Princeton Center for Theoretical Science, Princeton, NJ, USA, December 2012.

**Co-organizer** Workshop on Topology: Identifying Order in Complex Systems, Princeton Center for Theoretical Science, Princeton, NJ, USA, December 2011.

**Co-organizer** Towards Unifying Concepts in the Physics of Aperiodic Systems, Princeton Center for Theoretical Science, Princeton, NJ, USA, October 2011.

## TEACHING

- Spring 2017    Physics 2211    *Introductory Physics I: Mechanics*
- Fall 2016      Physics 2211    *Introductory Physics I: Mechanics*
- Spring 2015    Applied Mathe-*Ordinary and Partial Differential Equations* (Harvard University).  
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## OUTREACH

- April 2017      CoS Research Presentation “Non-euclidean virtual reality”.
- March 2017     TEDx Douglasville “A Journey through non-euclidean geometry”.
- February 2017 Oglethorpe University “*Purls* of wisdom: Geometry & Topology of weavables, wearables and wallpaper”.
- November 2016 Inquiring Minds Lecture Series “*Purls* of wisdom: Geometry & Topology of weavables, wearables and wallpaper”.
- February 2016    KITP Café Public Lecture “*Purls* of wisdom: Geometry & Topology of weavables, wearables and wallpaper”.
- Summer 2015    Harvard Materials Research Science and Engineering Center (MRSEC) 3D Printing Workshop for middle school girls, Harvard University.

## STUDENTS ADVISED

- Shashank Markande, Graduate student, 2016–present

## PROFESSIONAL MEMBERSHIPS

American Physical Society  
 Society for Industrial and Applied Mathematics  
 Materials Research Society  
 International Liquid Crystal Society