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EREZ HASMAN
Professor, Schlesinger Chair

Erez Hasman is the Schlesinger chaired Professor at the Technion – Israel Institute of Technology, Haifa, Israel and head of the Micro and Nanooptics Laboratory. He received the B.Sc. degree in physics in 1981 from Tel Aviv University, the M.Sc. degree in 1985 from the Technion, Haifa, and the Ph.D. in 1992 from Weizmann Institute of Science, Rehovot. Before joining the Technion Erez was a senior project physicist and served as the chief physicist in high-Tech industries; Rafael, Optrotech (Orbotech) and Elop Electrooptics Industries. He was also a Visiting Professor at Stanford University, Stanford, CA. (2011-2012).

Erez initiated and demonstrated the first metasurface, pioneering the field of optical metasurfaces [the first *metallic* metasurface: Opt. Lett. **26**, 1424 (2001) *263 citations*; the first *dielectric* metasurface: Opt. Lett. **27**, 1141 (2002) *431 citations*; the first *orbital angular momentum* metasurface: Opt. Lett. **27** 1875 (2002) *242 citations*; the first *vectorial vortex* metasurface Opt. Lett. **27**, 5 (2002) *422 citations*]. In general, a metasurface can be described as an array of nanoantennas, serving as local phase shifters. Such nanopatterned structures are used for complex light manipulations, paving the route for the generation of multifunctional and quantum metasurfaces, and as a platform to study various physical phenomena.

His research group has made significant contributions in the field of nanophotonics, metasurfaces and radiative heat transfer from nanoscale structures. Among his most significant contributions are the discoveries of the Pancharatnam-Berry phase metasurfaces (PBM, Geometric phase) utilizing the photonic spin orbit mechanism [Opt. Lett. **26**, 1424 (2001); Opt. Lett. **27**, 1141 (2002)], geometrodynamics of spinning light [Nature Phot. **2**, 748 (2008) *375 citations*], spin Hall effect in plasmonics [Phys. Rev. Lett. **101**, 043903 (2008) *310 citations*; Phys. Rev. Lett. **101**, 030404 (2008) *243 citations*], photonic Rashba effect [**Science 340**, 724 (2013) *295 citations*] and the first proposing and demonstrating the shared-aperture multifunctional metasurfaces [**Science 352**, 1202 (2016) *200 citations*]. Moreover, Erez presented the first meta-lens [Appl. Phys. Lett. **82**, 328 (2003) *285 citations*], the first dielectric gradient metasurface for the visible spectrum [**Science 345**, 298 (2014) ***1093 citations***] (in collaboration with Prof. Mark Brongersma), and the first observation of optical transition from spin Hall to random Rashba effect induced by

subwavelength-scale disordered geometric phase metasurface [**Science 358**, 1411 (2017)]. Recently, Erez presented the first experimental observation of quantum entanglement using metasurfaces – the use of a dielectric metasurface to generate entanglement between the spin and orbital angular momentum of photons (in collaboration with Prof. Mordechai Segev) [**Science 361**, 1101 (2018)]. These results show that metamaterials are suitable for the generation and manipulation of entangled photon states, introducing the area of quantum optics metamaterials. He is awarded the Fellow of OSA 2013, "for pioneering contributions in the field of nano-photonics, and specifically for developing a new branch in optics – Spinoptics: the symmetry breaking in nanostructures due to spin-orbit interaction". Spinoptics has opened a new avenue for controlling light in nanometer-scale optical devices. On the Technion level, he has won 2002 Salomon Simon Mani Award for Excellence in Teaching and the Henry Taub Prize for Research Excellence (2009). He has published over 120 journal papers, book chapters, and hundreds of conference papers. Erez served as an associate editor for Opt. Express (OSA), and was Co-Chair and member of program committees of several international conferences and workshops.

Personal Information

Date of birth:	July 4, 1960
Place of birth:	Tel-Aviv, Israel
Citizenship:	Israeli
Status:	Married +3
Address:	Home: Nizana 5, Hadera, ISRAEL, Tel: 972-6-6224674.

Academic Degrees

B.Sc	Physics and Astronomy (with honors), Tel-Aviv University, 1981.
M.Sc.	Physics (with honors), Israel Institute of Technology, Technion, Haifa, 1985. Thesis: "*Acceleration of Flyer plates by electrically exploded foils and the application to shock initiation*". Supervisor: Prof. S.G. Lipson.
Ph.D	Applied Physics, Weizmann Institute of Science, Rehovot, 1992. Thesis: "*Holographic optical elements for far IR radiation*". Supervisor: Prof. A.A. Friesem.

Employment

1980	Summer student, Faculty of Physics, Tel-Aviv University, Tel-Aviv, Israel.
1981-1986	Rafael, Israel Defense Research Center; Senior Physicist.
1988-1991	Teaching fellow in Advanced Physics Courses - The Feinberg graduate school of the Weizmann Institute of Science.
1990	Consultancy for Alumor Ltd.
1991	Consultancy for Spectronics Ltd., MLI Ltd., Sabco Ltd., Holo-Or Ltd.
1992-1994	Optrotech (Orbotech) Ltd., Israel: - Chief Physicist of Graphic and Recognition products line, - Senior Project Physicist.
1993-1996	Consultancy (research)- Weizmann Institute of Science, Department of Physics of Complex Systems.
1993-1998	Supervisor of M.Sc & Ph.D students-Weizmann Institute of Science, Department of Physics of Complex Systems.
1994-1996	Elop Electrooptics Industries Ltd., Israel - Technology Analysis Manager- (Corporate Business Development & Technologies)
1996-1998	Visiting Senior scientist - Weizmann Institute of Science, Department of Physics of Complex Systems.
1998-2011	Associate Professor, Technion, Faculty of Mechanical Engineering, Head of Optical Engineering program & Micro- and Nanooptics Laboratory, [*tenure*-1.10.02].
2010-2012	Head of Danciger Laboratories, Technion.
2011-present	Full Professor, Technion, Faculty of Mechanical Engineering, Head of Micro- and Nanooptics Laboratory.
2012	Visiting Professor, Stanford University, USA (Sabbatical for one year)
2014	Visiting Professor, Stanford University, USA (summer-August 2014)

Military Service

1981-1986 Israel Defense Forces – Captain (in Rafael)

Fields of Experience

Theoretical and experimental research:

- *High pressure physics and technology* - high pressure flow and shock waves, detonation, short pulses, explosives, pyrotechnics, diagnostic techniques (electro-optic and electric methods), high current and voltage systems, electric guns, high magnetic fields
- *Far IR application* - fiber optics, Laser radars, material processing
- *Physical optics* - Diffraction, focal properties of optical elements, gratings, polarization, non-diffracting beams
- *Optical design* - aspheric optical elements, wavefront shaping, optical geometric transformations
- *Holography* - diffractive optical elements (holographic optical elements), binary optics, computer generated, holograms, interferometry, scanners
- *Optical computing* - optical interconnects, liquid crystal light valve, architecture and correlation techniques
- *Photolithographic technology* - for metallic layers and Galluim Arsenide
- *Optical metrology* - machine vision, surface profile systems, confocal microscopes, triangulation techniques and velocity interferometry
- *R & D in photoplotters (laser plotters)* - imaging and technologies for:
  - Printed Circuit Boards industry,
  - Graphic Arts industry.
  - Involved Technologies - Ar lasers, high power diode lasers, optics for diode lasers, modulators (acousto optic deflectors and multichannel modulators), fiber optics technologies, microlens arrays, optical head for thermal laser plotters
- *Lasers* - solid state lasers, diode pumped lasers, diode lasers, CO_2 lasers, non linear optics (SHG, OPO), laser systems (rangefinders, designators)
- *Thermal imaging* - FLIRs, MCT & GaAs arrays (3-5, 8-12 micron radiation)
- *Optical displays* - Head-up & Helmet displays, automatic head & eye tracking

- *Anamorphic optical concentration* - solar radiation, spectroscopy
- *Optical memory* - 2D & 3D optical storage
- *Laser resonators* - Diffractive optical elements (DOEs) for laser resonators
- *Subwavelength optical elements* - design, realization and applications
- *Space-variant polarization manipulation*
- *Vectorial singular optics (vectorial vortices)*
- *Geometric phase (Pancharatnam phase; Berry phase)*
- *Surface phonon polaritons*
- *plasmonics in nanoscale structures*
- *spin-based nanostructures*
- *Thermodynamic in the near-field*
- *Coherent thermal emission*
- *Micro-and nanoscale radiative heat transfer*

Current Research Interests

Polarization state manipulation, Subwavelength optical elements, Nanostructured optical elements, Nanophotonics, Nanooptics, Optical-metamaterial, Vectorial optics, Diffractive optics, Imaging polarimetry, Surface phonon and plasmon polaritons, Plasmonics, Near-field optics, Singular optics, Vectorial vortices, Geometric phase (Berry phase, Pancharatnam phase), Spinoptics, Angular momentum of light, Spin-based plasmonics in nanostructures, Spin orbit interaction, Optical spin Hall effect, Dynamics of spinning light in nanoscale structures, Geometric symmetry breaking in nanoscale structures.

Manipulation of a thermal emission, Thermodynamic in the near-field, Micro- and nanoscale radiative heat transfer, Coherent thermal emission, Thermal nano-antennas, Thermally excitation of surface waves (plasmons and phonon-polaritons), Geometrical effects on Thermal emission induced by surface waves.

Teaching Experience

- Experimental methods in Advanced Physics - The Feinberg graduate school of the Weizmann Institute of Science (graduate).
- Selected Topics in Optics for Engineers 1 – Technion (graduate)

- Selected Topics in Optics for Engineers 2 – Technion (graduate)
- Linear Optics and Applications 1 – Technion (undergraduate, 035198); Originally authored
- Linear Optics and Applications 2 – Technion (undergraduate, graduate, 036055); Originally authored
- Projects in Optical Engineering 1– Technion (undergraduate, 034373)
- Projects in Optical Engineering 2– Technion (undergraduate, 034374)
- Nanooptics & Periodic Structures (undergraduate, graduate, 036070); Originally authored

Technion Activities

- Head of Optical Engineering Program, Faculty of Mechanical Engineering (1998-2011)
- Head of Micro and Nanooptics Laboratory, Faculty of Mechanical Engineering (1998-present)
- Member, Governing Board of Energy Engineering Center, Faculty of Mechanical Engineering (1999-2013)
- Head of Danciger Laboratories, Technion (2010-2012).
- Member of the Research Committee, (senate) Technion (2015).

Professional Societies

- OSA - Optical Society of America, (Fellow).
- ILEOS - Israel Laser and Electro-Optics Society.
- SPIE - The International Society of Optical Engineering.
- APS - American Physical Society.
- IPS - Israel Physical Society.
- EOS – European Optical Society.

Honors and Awards

- Dean's list, B.Sc. Tel-Aviv University, 1979, 1980, 1981.
- Amos De-Shalit Ulpana, Weizmann Institute of Science, 1979, 1980.
- Dean's list, M.Sc. Technion, Haifa, 1985.

- Excellent Scientist Award, Rafael, Israel Defence Research Center, 1985.
- Eshkol fellowship for the Ph.D, 1989, (Award given by Israeli President).
- Excellence prize for Doctoral student from the Feinberg Graduate School, Weizmann Institute of Science, 1991.
- Excellent Student Award, Knesset (Israeli Parliament), Jerusalem, 1991.
- Salomon Simon Mani Award for Excellence in Teaching, Technion, 2002.
- ***** The Henry Taub Prize for Academic Excellence, Technion, 2009.
- Award for Excellence in Teaching, Technion, 2010.
- Award for outstanding contribution to the success of the IHTC14 as a Keynote Speaker "*Manipulation of a Thermal Emission by Use of Micro and Nanoscale Structures*" at the 14th International Heat Transfer Conference Washington, DC, USA, August 8-13, 2010.
- ***** Award for Fellow of Optical Society of America (OSA), 2012; **"for pioneering contributions in the field of nano-photonics, and specifically for developing a new branch in optics-spinoptics: the symmetry breaking in nanostructures due to spin-orbit interaction"**.
- Award for Schlesinger Chair, Technion 2015

Activities in Conferences & Reviewing

- Professional Reviewing of Science, Nature Photonics, Nature Materials, Nature Nanotech., Phys. Rev. Lett., Opt. Lett., Appl. Opt., Opt. Eng., J.O.S.A., JQE, Opt. Commun., Opt. Express, Appl. Phys. Lett., Phys. Rev. B.
- Professional Reviewing of Swiss National Science Foundation.
- Professional Reviewing of Ministry of Science- Physics Dep.
- Chairman; Diffractive Optics -session
  The 9 th Meeting on Optical Engineering in Israel, Oct. 1994.
- Professional examinar- Ph.D & M.Sc students.
- Member of the program committee;
  The 10 th Meeting on Optical Engineering in Israel, March 1997.
- Chairman; Solar Energy Optics -session
  The 11th International Meeting on Electro-Optics in Israel, Nov. 1999.

- Member of the program committee; Workshop on Micro-Electro-Mechanical Systems (MEMS) , Technology, Design and Application, North Carolina – Israel Partnership, May 22-24, 2000.
- Member of the research grant committee of the Israel academy of sciences and humanities (2003);
- Chairman; Optical Engineering –session ; The 29th Israel Conference on Mechanical Engineering, Technion, May 12-13, 2003.
- Member of the program committee; Photonics West 2004, Micromachining Technology for Microoptics and Nanooptics Conference, San Jose, CA, USA. 25-29 January 2004.
- Session Chair ; Photonics West 2004, Micromachining Technology for Microoptics and Nanooptics Conference, San Jose, CA, USA. 25-29 January 2004.
- Member of the program committee; Photonics West 2005, Micromachining Technology for Microoptics and Nanooptics Conference, San Jose, CA, USA. 22-27 January 2005.
- Session Chair ; Photonics West 2005, Micromachining Technology for Microoptics and Nanooptics Conference, San Jose, CA, USA. 25-27 January 2005.
- Member of the program committee; Photonics West 2006, Micromachining Technology for Microoptics and Nanooptics Conference, San Jose, CA, USA. 21-27 January 2006.
- Session Chair; Photonics West 2006, Micromachining Technology for Microoptics and Nanooptics Conference, San Jose, CA, USA. 21-27 January 2006.
- Session Chair- Presider,: (Passive Photonics II) , Frontiers in Optics 2005, the 89th OSA Annual Meeting, Tucson Arizona, USA. 16-20 October 2005.
- Member of the organizing committee; 6th Israeli-French Workshop, "Advances in optical and laser materials: crystals, amorpous Materials, Photonic crystals and nano-particles", Maale Hachmisha, Israel, 11-12 December 2006.
- Member of the program committee; Photonics West 2007, Micromachining Technology for Microoptics and Nanooptics Conference, San Jose, CA, USA. 20-25 January 2007.

- Member of the organizing & program committee; The 11th Meeting on Optical Engineering and Science in Israel, (OASIS), Tel-Aviv, 26-27 March 26-27, 2007.
- Session Chair; "Micro and nanooptics and periodic structures", The 11th Meeting on Optical Engineering and Science in Israel, (OASIS), Tel-Aviv, 26-27 March 26-27, 2007.
- Track Leader of the Optical Engineering Track at the 9th Biennial ASME Conference on Design and Analysis-ESDA 2008, July 2008 , Technion, Haifa, Israel.
- Session Chair, "Optical Engineering and imaging", The 9th Biennial ASME Conference on Design and Analysis-ESDA 2008, July 2008 , Technion, Haifa, Israel.
- Member of the program committee; Photonics West 2008, Advanced Fabrication Technologies for Micro/Nano-Optics & Photonics (MF06) Conference, San Jose, CA, USA. 19-24 January 2008.
- Session Chair, "Diffractive micro and nano structures for sensing and information processing I ", OSA's 92nd Annual Meeting, Frontiers in Optics 2008, Laser Science XXIV, Rochester, USA, 19-23 October 2008.
- Session Chair, "Micro-and nanoscale radiative heat transfer", Topical Meeting at the EOS Annual Meeting 2008 in Paris (European Optical Society), "Micro- and nano-scale Photonic Systems", 29 September- 2 October 2008, Paris-Nord Villepinte, France.
- Session Chair, "Post-deadline session", Topical Meeting at the EOS Annual Meeting 2008 in Paris (European Optical Society), "Micro- and nano-scale Photonic Systems", 29 September- 2 October 2008, Paris-Nord Villepinte, France.
- Session Chair, "Imaging and microscopy", Topical Meeting at the EOS Annual Meeting 2008 in Paris (European Optical Society), "Micro- and nano-scale Photonic Systems", 29 September- 2 October 2008, Paris-Nord Villepinte, France.
- **(*) Co-chair of Topical Meeting at the EOS Annual Meeting 2008** in Paris (**European Optical Society**), "Micro- and nano-scale Photonic Systems", 29 September- 2 October 2008, Paris-Nord Villepinte, France.

- Member of the program committee; Photonics West 2009, Advanced Fabrication Technologies for Micro/Nano-Optics & Photonics (MF106) Conference, San Jose, CA, USA. 24-29 January 2009.
- Member of the organizing & program committee; The 12th Meeting on Optical Engineering and Science in Israel, (OASIS), 16-17 March, 2009.
- Session Chair; "Micro and nanooptics and periodic structures", The 12th Meeting on Optical Engineering and Science in Israel, (OASIS), 16-17 March 2009.
- Session Chair; CLEO/IQEC 2009, Conference on Laser and Electro-Optics/ Quantum Electronics and Laser Science Conference, session: "Quantum dot science II", Baltimore, USA, May 31 – June 5, 2009.
- Session Chair; "Electromagnetic eigenstates and resonances in nanoplasmonic systems ", Metallic Nanostructures and their optical properties VII (OP103), NanoScience, San Diego, CA, USA, 2-6 August 2009.
- Member of the program committee; Photonics West 2010, Advanced Fabrication Technologies for Micro/Nano-Optics & Photonics (MF106) Conference, San Francisco, CA USA, 23-28 January 2010.
- Session Chair: European Optical Society; EOS Topical Meeting on Diffractive Optics, Koli, Finland, 14-18 Fabruary 2010.
- Member of the organizing & program committee; The 13th Meeting on Optical Engineering and Science in Israel, (OASIS), Tel Aviv, Israel, 9-10 March 2011.
- Session Chair; "Micro and nanooptics and periodic structures", The 13th Meeting on Optical Engineering and Science in Israel, (OASIS), Tel Aviv, Israel, 9-10 March 2011.
- Member of the scientific committee; International workshop on Nano-Micro Thermal Radiation, Sendai, Japan (Matsushima Bay Area), 26-29 May 2012.
- Member of the program committee; NANOMETA 2013, The European Physical Society, The 4rd International Topical Meeting on Nanophotonics and Metamaterials, 3-6 January 2013, Seefeld ski resort, Tirol, Austria.
- Session Chair; "Spin-Optics II", SPIE Optics+Photonics, NanoScience, *Spintronics* V (OP108), San Diego, CA, USA, 12-16 August 2012.
- Member of the program committee; SPIE Optics+Photonics, NanoScience, *Spintronics* VI (OP108), San Diego, CA, USA, 25-29 August 2013.

- Presider (Session Chair), Frontiers In Optics 2013, Laser Science XXIX, (Session; Unconventional polarization and complex optical fields I), Orlando, Florida, USA, 8-9 October 2013.
- Member of the program committee; SPIE Optics+Photonics, NanoScience, *Spintronics* VII, San Diego, CA, USA, 17-21 August 2014.
- Presider (Session Chair), session: Metasurfaces II (FF2C), CLEO/IQEC 2014, Conference on Laser and Electro-Optics/ Quantum Electronics and Laser Science, San Jose, CA USA, 8-13 June, 2014.
- Member of the program committee; SPIE Optics+Photonics, NanoScience, *Spintronics* VIII , San Diego, CA, USA, 9-13 August 2015.
- Member of the Scientific Comittee; OASIS-5, The 5th OASIS, International Conference on Optics and Electro-optics, Tel Aviv, Israel, 3-4 March 2015.
- Session chair, "Metasurface II ", SPP7, The 7th international conference on surface plasmon photonics, Jerusalem, Israel, 31 May - 5 June 2015.
- Session chair "Light-matter interactions at the nano-scale", Conference on Lasers and Electro-Optics Europe (CLEO/Europe) and the European Quantum Electronics Conference (EQEC) 2015, Munich, Germany, 21 - 25 June, 2015.
- Member in the program committee, Nanophotonics, SPIE photonic Europe, Brussels, 4-7 April 2016.
- Member of the program committee; SPIE Optics+Photonics, NanoScience, *Spintronics* IX, San Diego, CA, USA, 28 August-1 September 2016.
- Member of the program committee; SPIE Optics+Photonics, NanoScience, *Spintronics* X, San Diego, CA, USA, 6-10 August 2017.
- Member of the program committee; SPIE Optics+Photonics, NanoScience, *Spintronics* XI, San Diego, CA, USA, 19-23 August 2018.
- Session Chair: Metamaterial and Plasmonics, The 8th International Multidisciplinary Conference on Optofluidics 2018, (IMCO), Shanghai, China 5-8 August 2018.
- Member of the program committee; SPIE Optics+Photonics, NanoScience, *Spintronics* XII, San Diego, CA, USA, 11-15 August 2019.
- Member of the program committee; SPIE Optics+Photonics, NanoScience, *Spintronics* XIII, San Diego, CA, USA, 23-27 August 2020.

Activities in Scientific Editorial Board

- Member in editorial board of Journal of Nanoelectronics and Optoelectronics (JNO) (new international journal; 2005, web-site http:aspbs.com/ino/ ; American Scientific publishers ASP).
- ** **Associate Editor for Optics Express, in the fields of nanophotonics, Nanoscale optics, Plasmonics** (from 3.06-5.09). Optics Express is OSA's (Optical Society of America) peer-reviewed journal. (*Impact factor 3.3*).
- Member in editorial board of Journal of Optics A: Pure and Applied Optics (from 3.07-7.09); published by the Institute of Physics Publishing & European Optical Society; *IF* 1.2).
- Member in the editorial advisory board of JEOS:RP; Journal of the European Optical Society Rapid Publications, (from 29.1.13-present).