August 2021

Amiel A. Ishaaya

CURRICULUM VITAE AND LIST OF PUBLICATIONS

Personal details:

Date & place of birth: Dec. 14, 1966, Canada

Address (office): School of Electrical and Computer Engineering
Ben-Gurion University of the Negev
P.O.B 653, Be'er-Sheva, 84105, Israel
+972-8-6461841 ; +972-8-6428464
ishaaya@bgu.ac.il
http://www.ee.bgu.ac.il/~lnod

Address (home): 20A Hazamir St., Nes Ziona 7411520, Israel
+972-77-3230107

Education:

1986: B.Sc. in Physics and Computer Science, Tel-Aviv University, Israel.

1995: M.Sc. in Physics, Tel-Aviv University, Tel-Aviv, Israel. Subject of Thesis: "Measurement of the velocity and spatial distribution of cathode spots on the cathode surface of a vacuum arc as a function of the magnetic field", conducted under the supervision of Prof. S. Goldsmith. Cum Laude.

2005: Ph.D in Physics, Weizmann Institute of Science, Rehovot, Israel. Subject of Thesis: "Laser configurations for high-order transverse mode selection and coherent beam combining", conducted under the supervision of Prof. A. A. Friesem.

Employment history and experience:

2018- Full Professor - Ben Gurion University

2012-2018 Associate Professor – Ben Gurion University (tenure since Dec. 2012)

2007-2012 Senior Lecturer – Ben Gurion University

Laser sources and nonlinear optical devices based on photonic crystal fibers and semiconductor waveguides. Developing efficient high-power fiber-based laser designs, investigating synchronization and coherent combining of multiple laser sources, extending the wavelength range of lasers into the UV and infrared by various non-linear optical processes, and developing compact on-chip optical devices.

2005-2007 Postdoctoral research associate – Cornell University

Experimental research of nonlinear optical interactions in bulk Kerr media and in photonic crystal fibers. In bulk Kerr media, this includes studying the collapse dynamics and filamentation of special beams in the femto-second regime, such as super-Gaussian, phase vortex, necklace, and radially-azimuthally polarized beams, as well as the interaction and collapse dynamics of coupled beams. In photonic crystal fibers, studying nonlinear interactions in gas filled hollow core photonic band gap fibers, such as harmonic

generation within these fibers and various other nonlinear processes (Electromagnetic induced transparency, slow light, etc.).

2001-2005 Ph.D research - Weizmann Institute of Science

Investigated laser configurations for phase locking and coherent addition of laser beams, as well as high-order transverse mode selection in various laser configurations utilizing novel phase elements. These configurations included Q-switched pulsed solid-state lasers, microlasers and fiber lasers. Furthermore, investigated laser beam shaping techniques and transverse mode transformations for improving and controlling the beam quality of laser beams.

1999-2001 Project Manager / System Engineer - Laser Products Operation, El-Op Electro-Optics Industries Ltd.

- Project manager of the APACHE Switchable Eyesafe Laser Rangefinder Designator.
- Led and coordinated a large-scale proposal concerning laser development and production.

1994-1999 Laser Physicist - Laser Products Operation, El-Op Electro-Optics Industries Ltd.

Performed and led various laser R&D projects and feasibility studies. Conducted laboratory development of new solid state lasers. Actively involved also in system-level R&D including transmitter-receiver-observation systems, LIDAR, simulations and modeling for performance evaluation, and field tests of prototype systems. These included activities with Nd:YAG lasers, unstable resonators (Hard edge, GRM), MOPA schemes, nonlinear processes and nonlinear crystals, beam analyzing and characterization, and high power Q-switched laser systems. The work also involved preparation of technical proposals and reports, and presentation in numerous Design Reviews (Concept, PDR, CDR etc.).

1991-1994 Master's research - Tel-Aviv University

Investigated high current (500A DC) vacuum arc discharge systems. Specifically, measurement of cathode spot retrograde motion under various transverse magnetic fields.

1986-1991 Research Officer - Planning Branch, The Center for System Analysis, Israeli Defense Forces
Rank: *Major*

Conducted Operations Research and system analysis studies. These included planning the assimilation of new technical systems, cost-effective evaluation of systems, optimization models and simulations. All these exploited physics, mathematics and computers.

Professional activities:

Positions in academic administration

2017-2021 **Deputy Dean, Faculty of Engineering, BGU**

2016-2021 Member of the university Ethics Committee, BGU

2016-2017 Member of the Engineering Faculty Teaching Committee.

2013-2016 Head of the undergraduate teaching committee in the ECE department (~1000 students).

2012-2016 Coordinator of undergraduate Physics courses for ECE students.

2012-2013 Undergraduate second year advisor.

2011-2013 Undergraduate advisor for pre-military students (Atuda program).

2011-2013 Member of ECE department committee for projects and Industry relations.

2010-2013 Member of ECE department Undergraduate Teaching committee.

Professional functions outside the university

- A member of the organizing committee of the "International Meeting on Fiber Lasers and Applications", Tel Aviv, Israel (April 2019).
- A member of the Scientific Committee of the OASIS 2019 conference (Tel Aviv, Israel).
- Part of the team leading the establishment of the Israeli Center of Advanced Photonics, Yavne, Israel (2014-present).
- The local organizer of 2nd Annual Conference of COST Action MP1401, Tel Aviv University, Israel (March 2017).
- A member of the organizing committee of the "International Meeting on Fiber Lasers and Applications", Tel Aviv, Israel (Feb. 2017).
- A member of the organizing committee of the OASIS 2015 and OASIS 2017 conferences (Tel Aviv, Israel).
- Chairman of the "Lasers and Applications" session at OASIS 2017, the 16th International Meeting on Optical Engineering and Science in Israel, Tel-Aviv, Israel (Feb. 2017).
- Chairman of the "Lasers and Applications" session at OASIS 2015, the 15th International Meeting on Optical Engineering and Science in Israel, Tel-Aviv, Israel (Feb. 2015).
- A member of the organizing committee of the "International Meeting on Fiber Lasers and Applications", Bar Ilan University, Israel (June 2014).
- Chairman of the "Lasers and Applications" session at OASIS 2013, the 14th International Meeting on Optical Engineering and Science in Israel, Tel-Aviv, Israel (Feb. 2013).

Reviewer for journals

Optics Letters, Optics Express, J. of the Optical Society of America B, Applied Optics, Optics Communications, Physical Review Letters, Physical Review A, Applied Physics B.

Reviewer for grant proposals

Israel Science Foundation (ISF), German Israeli Foundation (GIF), Swiss National Science Foundation (SNSF).

Membership in scientific societies

2001-present Senior Member, Optical Society of America (OSA).

2002-present IEEE Photonics Society.

Educational activities:

2018-present Full Professor in ECE at Ben Gurion University, Israel.

2012-2017 Assoc. Professor in ECE at Ben Gurion University, Israel.

2007-2012 Senior Lecturer in ECE at Ben Gurion University, Israel.

1995-1998 Lecturer of Statistics, Ramat-Gan College, Ramat-Gan, Israel.

1992-1994 Physics teaching assistant at the Raymond and Beverly Sackler Faculty of Exact Sciences, Tel-Aviv University, Tel-Aviv, Israel.

1985-1986 Physics teaching assistant at the Raymond and Beverly Sackler Faculty of Exact Sciences, Tel-Aviv University, Tel-Aviv, Israel.

Courses taught at Ben-Gurion University

1. Laser Engineering – for senior undergraduate and graduate students.
2. Infrared Engineering – for senior undergraduate students.
3. Nonlinear Optics – for graduate students.
4. Introduction to Photoelectronics – for senior undergraduate students.

Teaching load- three courses per year (one course waver due to high level research funding)

Research students - MSc

2008-2010 **Boris Shulga**, "High peak power photonic crystal fiber laser".

2008-2009 **Amir Gilad**, "Self-phase modulation in gas filled hollow core photonic crystal fibers". Did not complete thesis. (secondary supervisor – Prof. Bar from Ben-Gurion University)

2009-2011 **Amir Hertzog**, "Wavelength conversion of nano-second pulses to the mid-IR in optical fibers and waveguides".

2010-2011 **Avishay Shamir**, "Wavelength conversion in photonic crystal fibers and femtosecond material processing".

2010-2012 **Oleg Shnieder**, "Spectral narrowing in a system of coherently combined fiber lasers".

2011-2013 **Moshe Vanohozker**, "Single mode lasing and amplification in a highly multimode active fiber".

2011-2013 **Lior Kedar**, "Stimulated Raman scattering in gas filled hollow core photonic crystal fibers".

2012-2014 **Avry Shirakov**, "High peak and average power flexible PCF laser".

2012-2014 **Zeev Montz**, "Hollow core photonic crystal fibers with special spectral characteristics".

2014-2016 **Ziv Alperovich**, "Misalignment sensitivities in an intra-cavity coherent combining crossed-Porro resonator configuration".

2015-2016 **Harel Hecht**, "Passive Q-switching of a Tm:YLF laser with a Co^{2+} doped silver halide saturable absorber".

2016-2019 **Shachar Edelstein** – MSc, "Wavelength conversion schemes for a high peak power PCF laser".

2016-2020 **Omri Moschovits**– MSc.

2016-2020 **Yair Alon** – MSc.

2018-2021 **Sapir Humphries** – MSc.

Research students - PhD

2008-2013 **Eitan Ronen**, "Phase locking of large laser arrays". (in the last two years additional supervisor Prof. Davidson from the Weizmann Institute).

2010-2014	**Boris Rosenstein**, “Coherent combining of high peak power pulsed fiber lasers”.
2012-2016	**Amir Herzog**, “Biological tissue ablation using laser- sources, delivery and applications”.
2012-2017	**Avishay Shamir**, “Femtosecond laser induced permanent and transient fiber Bragg gratings”.
2012-2022(est.)	**Yehuda Benudiz**, “Ultrashort pulse amplification in active PCFs”. Part-time student.
2014-2021	**Ted Frumkin**, “Silicon based photonic nanostructures”.
2014-2021	**Avry Shirakov**, “Co^{2+} doped materials for ultra-short pulsed lasers”.
2014-2021	**Zeev Montz**, “Conversion to the UV in gas filled kagome and antiresonant fibers”.
2015-2019	**Aviran Halstuch**, “Transient Bragg gratings in waveguides based on Kerr and free carriers”.
2016-2021	**Ziv Alperovich**, “Acoustic tissue characterization in pulsed laser ablation”.
2017-2021	**Igor Sakaev**.

Awards and Fellowships:

2016	NTU Tan Chin Tuan Exchange Fellowship in Engineering FY2017, awarded by Nanyang Technological University, Singapore.
2005	Fulbright Post-doctoral Scholar Award, awarded by the United States – Israel Educational Foundation (USIEF).
2004	New Focus Travel Grant, awarded by the Optical Society of America.
2004	LEOS Travel Grant, awarded by the IEEE Lasers and Electro-Optics Society.
2001/2/3	High-Technology Research Prize for excellence in research, awarded by the Israeli Council for High Education, VATAT.
2002-2005	Eshkol Excellence Fellowship, awarded by the Israeli Ministry of Science.
1994-2001	Several internal awards of excellence, El-Op Electro-Optics Industries Ltd, Israel.
1995	M.Sc. degree with distinction, Tel-Aviv University, Tel-Aviv, Israel.
1985	Second year physics undergraduate studies with distinction, Tel-Aviv University, Tel-Aviv, Israel.

Scientific publications:

h-index: 17 (ISI), 21 (Google Scholar)

Total number of citations: 906 (ISI), 1456 (Google Scholar)

Total number of citations without self references: 794 (ISI)

Book chapters

1. "Coherent addition of laser beam distributions", V. Eckhouse[S], **A. A. Ishaaya[C]**, N. Davidson[C] and A. A. Friesem[C], ICO Book VI on Information Optics, Edited by R. Danliker and A. Friberg (SPIE press 2008).
2. (*) "Femtosecond tranisent Bragg gratings", A. Shamir[S], Aviran Halstuch[S], and **A. A. Ishaaya[PI]**, published in "Brillouin Distributed and Fiber-bragg-grating-based Fiber Sensing - Principle, Measurement and Applications", edited by Dr. Shien-Kuei Liaw (IntechOpen). 2018

Refereed articles and letters in scientific journals (ISI data in parenthesis)

[S- student; C- collaborator; PI- principal investigator; PD-postdoc; T- technician. (*) – after last promotion]

1. **A. A. Ishaaya[S]**, R. Oron[S], N. Davidson[C], E. Hasman[C] and A. A. Friesem[PI], "Improving the beam quality of high-order laser modes", *Optics & Photonics News – Optics in 2001*, **12**(12), 55-55 (2001).
2. G. Machavariani[C], N. Davidson[C], E. Hasman[C], S. Blit[C], **A. A. Ishaaya[S]** and A. A. Friesem[PI], "Efficient conversion of a Gaussian beam to a high purity helical beam", *Optics Communications* **209**, 265-271 (2002). [IF 1.488, JR 17/54, Q2, CI 28]. 30
3. G. Machavariani[C], N. Davidson[C], **A. A. Ishaaya[S]**, A.A. Friesem[PI] and E. Hasman[C], "Efficient formation of high-quality beam from a pure high-order Hermite-Gaussian mode", *Optics Letters* **27**, 1501-1503 (2002). [IF 3.511, JR 3/54, Q1, CI 18]. 19
4. **A. Ishaaya[S]**, R. Oron[S], N. Davidson[C], E. Hasman[C] and A. A. Friesem[PI], "Efficient mode conversion of laser beams", *Optics & Photonics News - Optics in 2002*, **13** (12), 43-43 (2002).
5. **A. A. Ishaaya[S]**, N. Davidson[C], G. Machavariani[C], E. Hasman[C] and A. A. Friesem[PI], "Efficient selection of high-order Laguerre-Gaussian modes in a Q-switched Nd:YAG laser", *IEEE Journal of Quantum Electronics* **39**, 74-82 (2003). [IF 2.716, JR 5/76, Q1, CI 36]. 37
6. **A. A. Ishaaya[S]**, G. Machavariani[C], N. Davidson[C], E. Hasman[C] and A. A. Friesem[PI], "Conversion of a high-order mode beam into a nearly Gaussian Beam using a single interferometric element", *Optics Letters* **28**, 504-506 (2003). [IF 3.395, JR 4/53, Q1, CI 34]. 36
7. G. Machavariani[C], **A. A. Ishaaya[S]**, L. Shimshi[S], N. Davidson[C], A. A. Friesem[PI] and E. Hasman[C], "Efficient mode transformations of degenerate Laguerre-Gaussian beams," *Applied Optics* **43**, 2561-2567 (2004). [IF 1.799, JR 14/54, Q2, CI 15].
8. **A. A. Ishaaya[S],** N. Davidson[C], L. Shimshi[S] and A. A. Friesem[PI], "Intra-cavity coherent addition of Gaussian beam distributions using a planar interferometric coupler", *Applied Physics Letters* **85**, 2187-2189 (2004). [IF 4.308, JR 4/79, Q1, CI 31].
9. G. Machavariani[C], N. Davidson[C], **A. A. Ishaaya[S]** and A. A. Friesem[PI], "Improving the stability of longitudinal and transverse laser modes", *Optics Communications* **239**, 147-151 (2004). [IF 1.581, JR 19/54, Q2, CI 4]. 3
10. **A. A. Ishaaya[S],** L. Shimshi[S], N. Davidson[C] and A. A. Friesem[PI], "Coherent addition of spatially incoherent light beams", *Optics Express* **12**, 4929-4934 (2004). [IF 3.797, JR 4/54, Q1, CI 26]. 28
11. V. Eckhouse[S], **A. A. Ishaaya[S]**, L. Shimshi[S], N. Davidson[C] and A. A. Friesem[PI], "Imposing a Gaussian distribution in multichannel laser resonators", *IEEE Journal of Quantum Electronics* **41**, 686-693 (2005). [IF 2.452, JR 13/83, Q1, CI 5].

12. **A. A. Ishaaya**[S], V. Eckhouse[S], L. Shimshi[S], N. Davidson[C] and A. A. Friesem[PI], "Improving the output beam quality of multimode laser resonators", *Optics Express* 13, 2722-2730 (2005). [IF 3.764, JR 2/55, Q1, CI 15].
13. **A. A. Ishaaya**[S], V. Eckhouse[S], L. Shimshi[S], N. Davidson[C] and A. A. Friesem[PI], "Intra-cavity coherent addition of single high order modes", *Optics Letters* **30**, 1770-1772 (2005). [IF 3.599, JR 3/55, Q1, CI 11]. 12
14. **A. A. Ishaaya**[S], N. Davidson[C] and A. A. Friesem[PI], "Very high-order pure Laguerre-Gaussian mode selection in a passive Q-switched Nd:YAG laser", *Optics Express* **13**, 4952-4962 (2005). [IF 3.764, JR 2/55, Q1, CI 34]. 43
15. V. Eckhouse[S], **A. A. Ishaaya**[PD], L. Shimshi[S], N. Davidson[C] and A. A. Friesem[PI], "Intra-cavity coherent addition of sixteen laser distributions", *Optics Letters* **31**, 350-352 (2006). [IF 3.598, JR 2/56, Q1, CI 32].
16. L. Shimshi[S], **A. A. Ishaaya**[PD], V. Eckhouse[S], N. Davidson[C] and A. A. Friesem[PI], "Passive intracavity coherent addition of nine laser distributions", *Applied Physics Letters* **88**, 041103 (2006). [IF 3.977, JR 6/84, Q1, CI 4]. 5
17. L. Shimshi[S], **A. A. Ishaaya**[PD], V. Eckhouse[S], N. Davidson[C] and A. A. Friesem[PI], "Passive intra-cavity phase locking of laser distributions", *Optics Communications* **263**, 60-64 (2006). [IF 1.480, JR 18/56, Q2, CI 7]. 9
18. L. T. Vuong[S], T. D. Grow[S], **A. A. Ishaaya**[PD], A. L. Gaeta[PI], G. W. 't Hooft[C], E. R. Eliel[C], and G. Fibich[C], "Collapse of optical vortices", *Physical Review Letters* **96**, 133901 (2006). [IF 7.072, JR 5/68, Q1, CI 69]. 77
19. T. D. Grow[S], **A. A. Ishaaya**[PD], L. T. Vuong[S], A. L. Gaeta[PI], N. Gavish[S], G. Fibich[C], "Collapse dynamics of Super-Gaussian beams", *Optics Express* **14**, 5468-5475 (2006). [IF 4.009, JR 1/56, Q1, CI 63]. 75
20. **A. A. Ishaaya**[PD], T. D. Grow[S], S. Ghosh[S], L. T. Vuong[S] and A. L. Gaeta[PI], "Self-focusing dynamics of coupled optical beams", *Physical Review A* **75**, 023813 (2007). [IF 2.893, JR 5/64, Q1, CI 13]. 18
21. T. D. Grow[S], **A. A. Ishaaya**[PD], L. T. Vuong[S] and A. L. Gaeta[PI], "Collapse and stability of necklace beams in Kerr media", *Physical Review Letters* 99, 133902 (2007). [IF 7.37, JR 5/84, Q1, CI 20]. 23
22. L. Shimshi[S], **A. A. Ishaaya**[PD], N. Davidson[C] and A. A. Friesem[PI], "Upscaling coherent addition of laser distributions", *Optics Communications* **275**, 389-393 (2007). [IF 1.314, JR 21/64, Q2, CI 8].
23. R. Rabinovici[S], **A. A. Ishaaya**[PD], I. Peer[C], L. Shimshi[S], N. Davidson[C], and A. A. Friesem[PI], " Increasing output energy from a passively Q-switched Er:glass laser", *Applied Optics* **46**, 7426-7431 (2007). [IF 1.701, JR 17/64, Q2, CI 5].
24. **A. A. Ishaaya**[PD], L. T. Vuong[S], T. D. Grow[S] and A. L. Gaeta[PI], "Self-focusing dynamics of polarization vortices in Kerr media", *Optics Letters* **33**, 13-15 (2008). [IF 3.772, JR 4/64, Q1, CI 27]. 30
25. **A. A. Ishaaya**[PI], C. J. Hensley[S], B. Shim[PD], S. Schrauth[S], K. W. Koch[C] and A. L. Gaeta[PI], "Highly-efficient coupling of linearly- and radially-polarized femtosecond pulses in hollowcore photonic band-gap fibers", *Optics Express* **17**, 18630-18637 (2009). [IF 3.278, JR 3/71, Q1, CI 16]. 20
26. **A. A. Ishaaya**[PI], N. Davidson[PI] and A. A. Friesem[PI], "Passive laser beam combining with intra-cavity interferometric combiners", **special issue** on Laser Beam Combination and Fiber Laser Systems, *IEEE Journal of Selected Topics in Quantum Electronics* **15**, 301-311 (2009). [IF 3.780, JR 5/71, Q1, CI 15]. 18 **[INVITED PAPER]**
27. B. Shim[PD], S. E. Schrauth[S], C. J. Hensley[S], L. T. Vuong[S], P. Hui[C], **A. A. Ishaaya**[C], and A. L. Gaeta[PI], "Controlled Interactions of Femtosecond Light Filaments in Air", *Physical Review A* **81**, 061803(R) (2010). [IF 2.861, JR 9/78, Q1, CI 28]. 31 **[rapid communication]**
28. B. Shulga[S] and **A. A. Ishaaya**[PI], "Off-axis pumping of a photonic crystal fiber laser", *Applied Physics B* **101**, 701-704 (2010). [IF 2.240, JR 15/78, Q1, CI 2]. **[rapid communication]**

29. E. Ronen[S] and **A. A. Ishaaya[PI]**, "Phase locking a fiber laser array via diffractive coupling", *Optics Express* **19**, 1510-1515 (2011). [IF 3.587, JR 6/79, Q1, CI 9]. 10
30. E. Ronen[S] and **A. A. Ishaaya[PI]**, "Phase clusters induced by degeneracy in a phase locked fiber laser array", *IEEE Journal of Quantum Electronics* **47**, 1526-1530 (2011). [IF 1.879, JR 22/79, Q2, CI 2]. 3 **[appeared on cover page]**
31. A. Herzog[S], A. Shamir[S], and **A. A. Ishaaya[PI]**, "Wavelength conversion of nano-second pulses to the Mid-IR in photonic crystal fibers", *Optics Letters* **37**, 82-84 (2011). [IF 3.399, JR 7/79, Q1, CI 22]. 28
32. E. Ronen[S], **A. A. Ishaaya[PI]**, "Frequency, phase, and polarization locking of evanescent coupled lasers", *Journal of the Optical Society of America B* **29**, 1226-1230 (2012). [IF 2.210, JR 16/80, Q1, CI 1]
33. E. Ronen[S], **A. A. Ishaaya[PI]**, M. Nixon[S], A. Godel[C], A. A. Friesem[C], and N .Davidson[PI], "Phase locking of lasers with self-stabilized minimal coupling", Optics Express **27**, 28163-28170 (2012). [IF 3.546, JR 5/80, Q1, CI 0]
34. O. Shneider[S], B. Shulga[S], **A. A. Ishaaya[PI]**, "Imposing spectral content when coherently combining laser channels", *Optics Letters* **38**, 603-605 (2013). [IF 3.179, JR 10/83, Q1, CI 2].
35. A. Shamir[S] and **A. A. Ishaaya[PI]**, "Large volume ablation of Sapphire with ultra-short laser pulses", *Applied Surface Science* **270**, 763-766 (2013). [IF 2.538, JR 29/136, Q1, CI 2] 4
36. E. Ronen[S], B. Rosenstein[S], E. Grinvald[PD], N. Davidson[C], and **A. A. Ishaaya[PI]**, "Single large mode cladding amplification in active double-clad fibers", *Laser Physics* **23**, 105102 (2013). [IF 1.025, JR 53/83, Q3, CI 0]
37. T. Frumkin[S], H. Genish[S], **A. A. Ishaaya[PI]**, and Z. Zalevsky[PI], "Silicon nano photonic multi taper for efficient light coupling between fiber and silicon waveguide", *Journal of Nanophotonics* **7**, 073084 (2013). [IF 1.448, JR 38/83, Q2, CI 0] 1
38. B. Rosenstein[S], A. Shirakov[S], D. Belker[T], and **A. A. Ishaaya[PI]**, "0.7 MW output power from two arm coherently combined Q-switched photonic crystal fiber laser", *Optics Express* **22**, 6416-6421 (2014). [IF 3.488, JR 10/87, Q1, CI 4] 7
39. B. Rosenstein[S], A. Shirakov[S], D. Belker[T], and **A. A. Ishaaya[PI]**, "Experimental characterization of an off-axis scheme for pumping high power photonic crystal fiber lasers", *Appllied Physics B: Lasers and Optics* **114**, 327-331, Rapid Communication (2014). [IF 1.856, JR 32/87, Q2, CI 1].
40. L. Ben Yehud[S], D. Belker[T], G. Ravnitzki[C], and **A. A. Ishaaya[PI]**, "Competition between stimulated Raman and Brillouin scattering processes in CF4 gas", *Optics Letters* **39**, 1026-1029 (2014). [IF 3.292, JR 11/87, Q1, CI 0].
41. A. Herzog[S], B. Hadad[C], V. Lyubin[C], M. Klebanov[C], A. Reiner[C], A. Shamir[S], and **A. A. Ishaaya[PI]**, "Chalcogenide waveguides on a sapphire substrate for mid-IR applications", *Optics Letters* **39**, 2522-2525 (2014). [IF 3.292, JR 11/87, Q1, CI 2]
42. B. Rosenstein[S], A. Shirakov[S], D. Belker[T], and **A. A. Ishaaya[PI]**, "Single-channel Q-switching in a system of coherently combined fiber lasers," *Appl. Phys. B: Lasers and Optics* **117**, 995-999 (2014). [IF 1.856, JR 32/87, Q2, CI 0]
43. Z. Montz[S] and **A. A. Ishaaya[PI]**, "Dual-bandgap hollow-core photonic crystal fibers for third harmonic generation," *Optics Letters* **40**, 56-59 (2015). [IF 3.04, JR 15/90, Q1, CI 2] 4
44. A. Herzog[S], D. Malka[S], Z. Zalevsky[C], and **A. A. Ishaaya[PI]**, "The effect of spatial-coherence on damage occurrence in multimode optical fibers," *Optics Letters* **40**, 415-418 (2015). [IF 3.04, JR 15/90, Q1, CI 1] 3
45. B. Rosenstein[S], A. Shirakov[S], D. Belker[T], and **A. A. Ishaaya[PI]**, "Highly efficient 10-cm long fiber laser," *Optics Letters* **40**, 407-410 (2015). [IF 3.04, JR 15/90, Q1, CI 0]
46. A. Herzog[S], S. Bogdan[C], M. Glikson[C], **A. A. Ishaaya[PI]**, and C. J. Love[PI], "Selective tissue ablation using laser radiation at 355 nm in lead extraction by a hybrid catheter; a preliminary report," *Lasers in Surgery and Medicine*, doi: 10.1002/lsm.22451 (2015). [IF 2.135, JR 64/200, Q2, CI 0] 2
47. A. Herzog[S], I. Steinberg[S], E. Geinsberg[C], R. Nomberg[C], and **A. A. Ishaaya[PI]**, "A route to laser angioplasty in the presence of fluoroscopy contrast media, using a nanosecond-pulsed 355 nm

laser," *IEEE Journal of Selected Topics in Quantum Electronics* **22**, 1-6 (2016). [IF 3.466, JR 11/90, Q1, CI 0] 1

48. A. Shamir[S] and **A. A. Ishaaya[PI]**, "Effect of femtosecond photo-treatment on inscription of fiber Bragg gratings," *Optics Letters* **41**, 765-768 (2016). [IF 3.04, JR 15/90, Q1, CI 0] 3
49. A. Shamir[S] and **A. A. Ishaaya[PI]**, "Femtosecond inscription of phase-shifted gratings by overlaid fiber Bragg gratings," *Optics Letters* **41**, 2017-2020 (2016). [IF 3.04, JR 15/90, Q1, CI 1] 9
50. Y. Sivan[PI], S. Rozenberg[S], A. Halstuch[S], and **A. A. Ishaaya[C]**, "Nonlinear wave interactions between short pulses of different spatio-temporal extents," *Scientific Reports* **6**, 29010; doi: 10.1038/srep29010 (2016). [IF 5.228, JR 7/63, Q1, CI 1] 5
51. H. Herzog[S], I. Steinberg[S], and **A. A. Ishaaya[PI]**, "Shaping photomechanical effects in tissue ablation using 355 nm laser pulses", *J. Biophotonics* 1–9, DOI 10.1002/jbio.201600094 (2016). [IF 3.818, JR 16/72, Q1, CI 0]
52. A. Herzog[S], G. Oszkinis[C], D. Planer[C], K. Ziaja[C], Ł. Kruszyna[C], M Goran Stanisic´[C], D. Ziaja[C], **A. A. Ishaaya[C]**, and W. Kuczmik[PI], "Atherectomy using a solid-state laser at 355 nm wavelength", *J. Biophotonics* 1–8 /DOI 10.1002/jbio.201600209 (2017). [IF 3.818, JR 16/72, Q1, CI 0]
53. H. Hecht[S], Z. Burshtein[C], A. Katzir[C], S. Noach[C], M. Sokol[S], E. Frumker[C], E. Galun[C], **A. A. Ishaaya[PI]**, "Passive Q-switching of a Tm:YLF laser with a Co2+ doped silver halide saturable absorber", *Optical Materials* **64**, 64-69 (2017). [IF 2.183, JR 25/90, Q2, CI 0] 2
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- Several operations research and system analysis technical reports dealing with R&D of new systems, performance assessment of systems in various field scenarios, cost effective studies, modeling and simulations. IDF-Planning Branch, 1986-1991.
- **20 first author technical reports** dealing with novel laser designs, laser lab experiments, models and simulations, evaluation of system performance and field experiments of lasers. El-Op Inc. proprietary, 1994-2001.

Lectures and presentations at meetings and invited seminars:

Invited conference presentations

1. A. A. Friesem, N. Davidson, E. Hasman, **A. A. Ishaaya**, G. Machavariani, R. Oron and L. Shimshi, "Laser mode selection with intracavity phase elements", Conference on Lasers and Electro-Optics Europe, Munich, Germany (2003).
2. **A. A. Ishaaya**, N. Davidson, V. Eckhouse, L. Shimshi and A. A. Friesem, "Laser configurations for high-order transverse mode selection and coherent beam combining", Conference on Laser and Fiber-Optical Networks Modeling (LFNM), Kharkov, Ukraine (2004).

3. A.A. Friesem, **A.A. Ishaaya**, N. Davidson, V. Eckhouse and L. Shimshi, "Intra-Cavity Coherent Addition of separate laser distributions", 5th Iberoamerican Meeting on Optics and 8th Latinoamerican Meeting on Optics, Lasers and Their Applications, RIAO/OPTILAS, (Oct. 2004).
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11. **A. A. Ishaaya**, "High peak power, compact, PCF lasers", “Light in Defense”, Ben-Gurion University of the Negev, Israel, (May 2015).
12. A. Shamir, Z. Montz, A. Halstuch, and **A. A Ishaaya**, "Femtosecond inscription of Bragg gratings in various fibers and planar transparent materials using a phase mask", IFLA conference within OASIS6, Tel-Aviv, Israel (Feb. 2017).
13. **A. A. Ishaaya**, "Femtosecond inscription of permanent and transient Bragg gratings in Silica fibers and GaN waveguides", LCS 2018, Okazaki, Japan (Nov. 2018).

<u>Contributed conference presentations</u>

14. **A. A. Ishaaya**, R.L. Boxman and S. Goldsmith, "Measurement of cathode spot velocity and distribution on a disk cathode in a radial magnetic field", Conference on Metallurgical Coatings and Thin Films, San Diego, California, USA (1992).
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87. A. Halstuch and **A. A. Ishaaya**, " Femtosecond laser induced of Nano-gratings on a thin GaN layer grown on a sapphire substrate", CLEO/Europe-EQEC (June 2019).
88. S. Edelstein and **A. A. Ishaaya**, "Efficient Raman Conversion in SF6-and CF4-Filled Hollow-Core Photonic Bandgap Fibers", CLEO (May 2020).
89. Y. Alon, A. Halstuch, R. Sidharthan, S. Yoo, A. A. Ishaaya, "Yb-doped Large Mode Area Multicore Fiber Laser with a Fs-inscribed Fiber Bragg Grating", CLEO (May 2020).

Seminar presentations at universities and institutions

2004 Dept. of Applied Physics, Stanford University, USA
2004 Nuclear Research Center, Israel
2004 Ariel University Center of Samaria, Israel
2005 Dept. of Engineering, Bar-Ilan University, Israel
2005 Elop Electrooptics Industries Ltd., Israel

2006 Dept. of Applied Physics, Hebrew University, Israel
2006 Dept. of Engineering, Bar-Ilan University, Israel
2006 Dept. of Electrical and Computer Engineering, Ben-Gurion University, Israel
2006 Dept. of Physics of Complex Systems, Weizmann Institute of Science, Israel
2006 School of Electrical Engineering, Tel-Aviv University, Israel
2006 Nuclear Research Center, Israel
2007 Dept. of Physics, Ben-Gurion University, Israel
2008 ILEOS meeting, Bar-Ilan University, Israel
2012 Nano center, Bar-Ilan University, Israel
2013 Xlim Laboratory, University of Limoges, France (*)
2015 2nd Working Group Meeting, COST Action 1401, Dresden, Germany (*)
2016 Dept. of Applied Physics, Hebrew University, Israel (*)
2017 General seminar, The Photonics Institute, Nanyang Technological University, Singapore (*)
2017 Specific seminar, The Photonics Institute, Nanyang Technological University, Singapore (*)
2017 DSO, Singapore (*)

Patents:

1. **A. A. Ishaaya**, N. Davidson, A. A. Friesem and L. Shimshi, "Resonator cavity configuration and method", US patent No. 7,933,301.
2. **A. A. Ishaaya**, N. Davidson, A. A. Friesem and L. Shimshi, "Resonator cavity configuration and method", US patent No. 7,555,024.
3. B. Shulga and **A. A. Ishaaya**, "Fiber laser pumping configuration and method", US patent application, first submitted July 2010 (PCT/IL2011/000502).
4. E. Ronen and **A. A. Ishaaya**, "Single large mode cladding amplification in active double-clad fibers", provisional US patent application (2012).
5. (*) B. Rosenstein and **A. A. Ishaaya**, "Multi-pump-pass scheme of fiber based lasers and amplifiers", provisional US patent application (2014).
6. (*) **A. A. Ishaaya** and Y. Sivan, "Transient Bragg gratings in optical waveguides and their applications", provisional US patent application (2014).

Research grants:

2007 University startup/seed funding for setting up a lab; total - $550,000. PI
2008 Chief Scientist (Ministry of Labor, Trade, and Industry, Israel), “Advanced Fiber Lasers” (consortium); total – $384,000. 2008-2011. PI
2008 Israel Science Foundation (ISF) personal grant 1205/08; “Lasers and wavelength converters based on photonic crystal fibers”; total – $204,000. 2008-2012. PI
2008 Israel Science foundation (ISF) New Faculty Equipment Grant 1626/08; “Lasers and nonlinear optical devices laboratory”; total – $400,000 (50% matching). PI
2011 Israel MOD (Mafat); “multicore fibers”; total budget – $276,000. 2011-2014. PI
2012 Chief Scientist (Ministry of Labor, Trade, and Industry, Israel) Kamin Grant; “Low cost, compact, PCF laser”; total budget – $222,000. 2012-2014. PI

2012 Chief Scientist (Ministry of Labor, Trade, and Industry, Israel) Magneton Grant; "Novel UV High Power Fiber Laser Technologies"; total budget – $142,000. 2012-2013. PI

2013 Israel MOD (Mafat); High power laser + OSA equipment; cost – $250,000. PI

2013 M.F.S grant (internal BGU); "Transient gratings in fibers and waveguides for ultrafast applications"; total budget – $90,000. 2013. PI

2014 Israel Chief Scientist (Ministry of Labor, Trade, and Industry) Magneton Grant; "Passive coherent combining of solid-state lasers"; total budget – $166,000. 2014-2016. PI

2014 Israel MOD (Mafat); "High power laser processing"; total budget $320,500. 2014-2017. PI

2014 Israel Ministry of Science, MOST, "Wavelength conversion to the UV with gas-filled Kagome and antiresonant fibers"; total budget $200,000. 2014-2017. PI

2016 Chief Scientist (Ministry of Labor, Trade, and Industry, Israel), "Advanced Lasers technologies for Industrial Applications" (consortium); First year – $162,000; 2016-2019. PI

2017 NATO Science for Peace and Security Program, "Compact Eye-Safe Lidar Source for Airborne Laser Scanning (CALIBER)"; 90,000 Euro for two years; 2017-2019. PI

2018 Israel Science Foundation (ISF) personal grant 2021/18; "Spatial mode control in novel active Yb-doped multicore fibers"; total – $302,700. 2018-2022. PI

2021 Israel Innovation Authority Meymad grant – "High power Raman conversion in hollow core fibers"; total $172K

Additional information:

News coverage

1. "Multimode lasers get brighter", Opto & Laser Europe 128, May 2005.
2. "Multimode lasers get brightness boost", Optics.org, April 2005. (http://optics.org/articles/news/11/4/12)
3. "Simple scheme combines multiple beams", Optics.org, Jan. 2006. (http://optics.org/articles/news/12/1/11)
4. "LASER OPTICS: Sixteen laser beams combined with 88% efficiency", Laser Focus World, March 2006.
5. "Overcoming peak-power limitations of fiber lasers", SPIE Newsroom, Feb. 2014. (http://spie.org/x106177.xml)
6. News coverage on a laser based balloon interception system called "Lahav-Or" 2019-2020.

Synopsis of research:

The following summarizes the main research conducted at Ben-Gurion University since the lab was active (2009):

1. Single solid core fiber laser configurations based on PCFs

   In this research topic we focused on designing, building, and investigating high power PCF lasers based on a rod-type, very large core, active (Yb) double clad fiber. We investigated various resonator configurations and managed to demonstrate in CW TEM00 operation more

than 72W with 79% slope efficiency, and in high repetition Q-switched pulsed operation 38W average power with 76% slope efficiency and 192kW peak power. To the best of our knowledge these results represent a record with regard to pulsed fiber lasers. During the design we came up with a new off-axis pumping method of PCF double clad fibers with significant advantages over standard on-axis pumping. We also submitted a patent application on this method.

2. Phase locking and coherent combining of multiple fiber lasers

   Here we investigated several sub topics. In the first we focused on phase locking of a linear array of 8 low power fiber lasers via diffraction coupling (Talbot effect). With the experimental setup that was built we demonstrated anti-phase locked operation and characterized it. We measured an exponential phase decorrelation between distant lasers in the array, and discussed its fundamental limitation on scalability of this and similar local coupling methods. When the output coupler was positioned half a Talbot distance from the laser channels we showed that phase clustering occurs in the array whereby the array separates into two different phase locked clusters. Further theoretical analysis and experimental measurements showed that these clusters result from an incoherent superposition of the in-phase and out-of-phase super-modes of the array. By inserting selective loss in the resonator we managed to demonstrate operation in a nearly single pure in-phase super-mode. Finally, with this experimental setup we studied and demonstrated experimentally different system states: full coherent lasing, polarization-locked lasing, frequency locked lasing without phase-locking, and independent incoherent lasing.

   In the second subtopic we investigated in detail phase locking and coherent addition of two fiber laser channels connected with an interferometric coupler. Specifically, we investigated the possibility to spectrally narrow the operation of two coherently combined fiber lasers. To the best of our knowledge, we show for the first time that by placing a narrowband spectrally selective element in only one of the channels, the spectral content is efficiently imposed on the other channel, and both channels operate with a narrow bandwidth.

   In the third subtopic we are currently investigating phase locking and coherent addition of two Q-switched pulsed high peak power PCF laser channels. We achieved already 0.7 MW of peak power with 10ns pulses by intracavity coherent addition of two laser channels. This is a new record in fiber oscillators and shows great potential for further scaling of peak power.

3. Raman amplification in gas filled hollow core photonic bandgap fibers

   Here we built a dedicated vacuum/pressure system that allowed us to evacuate air out of the fibers, and fill the hollow core bandgap fiber with a suitable gas. With CF_4 and SF_6 gases we did not observe any Raman shift of the Ti:sapphire ultrashort (fs) laser pulses after propagation within the fiber, but we did observe self phase modulation and characterized it compared to focusing ultrashort pulses in high pressure free space gas cells. Recently, we investigated Raman conversion of ns pulses in a CF_4 filled PBGF. We obtained a record of more than 35% conversion efficiency in a 35cm-long, weakly pressurized, fiber at a peak power of only 2.6kW. This is still work in progress.

4. Wavelength conversion in solid core PCFs

   Here we investigated degenerate four wave mixing with ns pulses in fused silica photonic crystal fibers. Phase matching curves were calculated, followed by experiments with a ns pulsed Nd:YAG pump laser and relatively short fiber lengths that showed more than an octave spanning conversion to idler and signal wavelengths at 3.105 μm and 0.642 μm, respectively. These results represent a new stretch towards the limit of the silica transmission window in the mid-IR.

5. Design of new active and passive fibers

   We proposed several novel fiber designs. In the first we proposed and investigated theoretically a new concept for single-large-mode amplification in double-clad active fibers. The concept is based on exploiting a very small fiber core, guiding only a single transverse mode that has large overlap with a doped active cladding. We show that the guided mode can have very large area with good modal discrimination. This simple structured fiber can be used in an 'all-fiber' configuration. We further investigate the sensitivity to small refractive index changes of the

doped area and to bending of the fiber. Our proposed fiber concept could lead to fibers with very large mode area with advantages over current commercial fibers.

The second design focuses on hollow core photonic bandgap fibers that have two highly separated bandgaps. Using the Plane Wave Method we have recently found two rather simple PBGF designs that support two highly separated transmission bandgaps that are suitable for THG. These designs are based on silica without any doping, and the smallest features in both designs are more than 30 nm. To the best of our knowledge, this has not been reported so far, and is an excellent starting point for achieving THG in gas filled fibers.

Currently, we are working together with NTU (Singapore) on a newly designed active multicore fiber with 6 LMA cores. Preliminary results are promissing.

6. Waveguides on chip

   Here we managed to fabricate and characterize optical quality Chalcogenide waveguides. This will enable future experiments for efficient on-chip wavelength conversion to the mid-IR. Furthermore, we managed to improve the coupling into Silicon waveguides by using a novel multi-taper technique. This is still work in progress.

7. Fs inscription of fiber Bragg gratings with phase masks

   This is work in progress. We already inscribed high quality permanent FBGs in silica fibers with both 800 and 266 nm fs pulses. Furthermore we managed to locally erase FBGs, “immune” fibers agains FBG writing, inscribe phase-shifted gratings, inscribe two different gratings on the same fiber section, obtain Bragg center wavelength tunability by adding spherical phases to the inscribing beam, and obtained preliminary results showing reflections from transient fiber Bragg gratings.