

## Dr. Iam-Choon Khoo

### Current Position/Address:

*William E. Leonhard Chair Professor of Electrical Engineering*  
Director – Liquid Crystals and Nonlinear Optics Laboratory  
216 Electrical Engineering East  
The Pennsylvania State University  
University Park, PA 16802  
Tel: (814) 863-2299      Fax: (814) 865-7065      E-mail: ick1@psu.edu

### Degrees:

B. Sc. (1 <sup>st</sup> Class Honors) Physics, University of Malaya	1971
M.A. Physics, University of Rochester, Rochester, NY	1973
Ph D. Physics, University of Rochester, Rochester, NY	1976

### Professional History:

2006 - Present – *William E. Leonhard Chair Professor of Electrical Engineering*  
2000 - 2006 – *Distinguished Professor of Electrical Engineering*  
1987- 2000 – Pennsylvania State University-*Professor of Electrical Engineering*  
9/98 –1/99 – Princeton University [EE Department] - *Fellow* [sabbatical]  
9/90-12/90– Princeton University [Physics Department] - *Fellow* [sabbatical]  
National Research Council, Ottawa, Canada - *Senior Visiting Scientist*  
1984-1987 – Pennsylvania State University-*Associate Professor of Electrical Engineering*  
1979-1984 – Wayne State University-*Assistant/Associate Professor of Physics*  
1/79-9/79 – University of Toronto-*Research Fellow*  
1977-1978 – University of Southern California -*Research Associate*  
1978-1979 – University of Michigan – *Research Associate [with Emmitt Leith]*  
1976-1977 – Ames Laboratory, U.S. Department of Energy, Iowa-*Postdoctoral Fellow*

### Professional Society Membership:

- Optical Society of America (OSA)--Fellow
- UK Institute of Physics --Fellow
- Institute of Electrical and Electronics Engineers (IEEE)--Fellow

### Honors and Awards:

- Chair of the *United State Advisory Committee* /ICO – The National Academies [of Sciences and Engineering] (1/2008-12/2010)
- Appointed IEEE-LEOS Vice President Representative to *International Commission for Optics* (ICO) [2005-2008; 2008-2010]
- *Keynote Speaker* – *Third International Workshop on Advanced Nano- and Biomaterials and Their Device Applications*, organized jointly with *French-Romanian Topical Meeting on Nano and Biomaterials*, Timisoara (Romania), September 19-23, 2012
- *Keynote Speaker* – SPIE *European Symposium on Security and Defense*, Toulouse, France 9/2011.
- *Plenary Speaker* – Cambridge University Int. Workshop on Liquid Crystal in Photonics, 7/2008.
- 2003 *Sturgeon Memorial Plenary Lecturer*, Cambridge University [British Liquid Crystal Society]

- Appointed Vice President –Technical Affairs, IEEE –Lasers and Electro-Optics Society (2001 -2004)
- Awarded ***Distinguished Professorship*** – Pennsylvania State University (2000; 2006)
- UK Institute of Physics (Inst. P)—Awarded ***Fellow*** (1999)
- IEEE Lasers and Electro-Optics Society - ***Elected Fellow*** (1998)
- Pennsylvania State Engineering Society-***Premier Research Award*** (1995)
- Penn State Research Foundation ***Invention Incentive Awards*** (1994, 1995)
- Appointed ***World Bank Laser Specialist*** (1990)
- Pennsylvania State University -***Faculty Scholar Medal*** for Outstanding Achievements in *Science and Engineering* (1988)
- Optical Society of America - ***Elected Fellow*** (1988)
- Pennsylvania State Engineering Society- ***Outstanding Research Faculty Award*** (1987)
- Research Corporation ***Cottrell Research Award*** (1981)
- University of Rochester - ***University Fellow*** (1972, 1973)

### **National & International Professional Activities**

- National Academy of Science and Academy of Engineering: United States Advisory Committee/Int. Comm. For Optics [Chair (1/2008 – 12/2010); Member (1/2011-12/2013)]
- Technical Journal Referee: IEEE J. Quantum Electronics; J. Optical Society of America B; Optics Express, Optics Letters; Physical Reviews and Physical Review Letters; Optics Communication; IEEE transactions on Electronic Devices; Liquid Crystals; Molecular Crystals Liquid Crystals; IEEE J. Lightwave Technology; Applied Optics; Applied Physics Letters, Journal of Appl. Physics.
- Proposal reviewer/panelist for various U.S. [NSF, DARPA, AFOSR, ARO], Canadian, Italian, Belgium, Poland, Hong Kong, UK Government Scientific Research Agencies.
- Chair of International Review Panel -Optoelectronics Center, City University of Hong Kong [2005]
- Board Member of the Italian National Research Council [CNR] International Committee on Multi-Disciplinary Research Center [LICRYL]. (2006-2009)
- External Ph. D. Examiner – Trinity College, Dublin, Ireland (2001); Chalmers University, Sweden (2002); Cambridge University (Electrical Engineering 2005)
- Editor-in-Chief of "J. Nonlinear Optical Physics & Materials," (1991 - present).
- Chairmanship of international technical conferences:-
  - \* *IEEE Lasers and Electro-Optics Society*
    - Chair of IEEE Lasers and Electro-Optics Society Technical Council [11/2001-11/2004]
    - Chair, Nonlinear Optics Technical Committee ('92 -'95, '99 –'03)
    - Chair, 2001 Annual Meeting Nonlinear Optics Subcommittee
    - Chair, 1990 Nonlinear Optics: Materials, Phenomena and Devices
    - Chair, Nonlinear Optics Technical Committee, 2005 Annual Lasers and Electro-Optics Society Technical Meeting
  - \* *Optical Society of America*
    - Chair, Steering/Program Committee -Nonlinear Optics '92, '94, '96, '98, '00, '03.
  - \* *SPIE - Society for Photo-Optical Instrumentation Engineer*
    - Chair, Technical Symposium on Aerospace Sensing-Optical Switches and Electro-Optic Materials '89,'90, '92.

- Chair, Conferences on Liquid Crystals I – XVII - '97- '12 *continuing for '2013.*
- \* *European Technical Societies*
  - Program co-chair, "Mediterranean International topical Meeting on *Nonlinear Photonics and Optical Physics*," Capri, Italy (1992).
  - Program co-chair, "2nd –10th Mediterranean Workshop on Novel Optical Materials and Applications," Cetraro, Italy ('95 - '11).
- Program co-chair, "Int. topical Meeting on Optics of Liquid crystals", Clearwater, Florida 10/2005.
- Conference co-Chair, 2007 IEEE-LEOS Topical Meeting on "Organic Photonics Media, Devices and Application, Portland, Oregon.

\*\* Session Chair and workshop moderators in numerous technical conferences of the societies mentioned above.

### **Teaching and Education Highlights**

#### **Graduate and Undergraduate Courses Developed**

- Developed a *Graduate* level EE course: EE 524 – "*Lasers and Optical Electronics*" [taught the course yearly since 1986 – present; student enrollment ~30 per semester] Taken by students mostly from EE, but also from Physics, Chemistry and Material Science.
- Developed a *Senior* level EE course: EE414 - "*Lasers: Principles and Application*" [taught the course yearly since 1986 – present; student enrollment ~ 40 per semester]
- Developed a *Junior* level: EE320 – "*Electro-Optical Engineering*" [offered yearly since 1989; ~ 40-60 students]
- Developed and offered occasionally graduate courses on "Liquid crystals" and "Nonlinear Optical Materials". Course materials are now integrated into a regular course: EE526 - *Nonlinear Optical Materials* that is offered every other year jointly listed with Material Science and Engineering.

### **Graduate Student Supervision**

#### **Current**

1. - Currently Supervisor and Chair of Ph. D. committee of 4 Ph. D. graduate students; Member of Ph. D. committees of 8 Ph. D graduate students

#### **Previous**

2. - Supervised 36 Ph. D. and Master Graduates [24 Ph. D and 12 Master]  
 Role: Thesis Advisor and Chair of committee  
 - Member of Ph. D. committee of 44 Ph. D. graduates

#### **Current Research Interests:**

Theories and experiments in photonic devices, nonlinear- and electro- optics materials such as liquid crystals, fibers and nano-structured and plasmonic metamaterials. Studies of coherent optical wave mixing processes, beam/image/signal processing, optical switching and modulation, optical limiting and sensor protection applications enabled by unique properties of these novel optical materials.

### **Current Research Programs and Funding Agencies**

1. (2011 – 2014) Air Force Office of Scientific Research  
 Project title: "Nonlinear Electro-Optical Liquid Crystalline Materials for High Speed Optical Switching and Signal Processing"  
 Role: Sole Principal Investigator

2. (2008 -2013) - National Science Foundation Material Research Science and Engineering Center on “Nanoscale and Molecular Science”.  
Role: Senior Investigator.
3. (2011-2013) National Science Foundation - Research Experience for Under graduate  
Role: Faculty Mentor

***Past Research Programs Funding Agencies***

Defense Advanced Research Projects Agency, Navy Air Development Center (Patuxent River, MD); Army Research Office; National Science Foundation ECE Division; DOD Multi-University Research Initiative (MURI)

**Summary of Technical Publications/Patents**

- \* Author/co-author/editor of 7 books and author of 13 book chapters.
- \* Editor of 16 Proceeding volumes [Liquid Crystal I–XVI]
- \* Editor-in-Chief of 21 Volumes-year of Journal [JNOPM 1991-2012].
- \* **H-Index:** 40
- \* ~ Authored and co-authored ~ 580 Technical Publications/Conference Presentations [244 Refereed Journals and Proceedings); 338 (~172 invited) Conference Presentations]
- \* Over 4800 citations in Science Citation Index: H-Index: 40
- \* Awarded two U.S. patents:  
US Patent # 5,552,915 “Liquid Crystal Nonlinear Photorefractive Electro-Optical Storage Device Having a Liquid Crystal Film including Dopant species of C60 and C70” [9/3/1996]  
US Patent #5,589,101 “Liquid Crystal Fiber Array for Optical Limiting of Laser Pulses and for Eye/Sensor Protection” [12/31/1996]. Invention featured in Innovation to Watch section of Business Week [May 5, ‘97 Issue], *Discovery* magazine [3/2000] and *Photonic Spectra* [6/2000], *MIT Technology Review* [4/2000] and several National Newspapers [e.g. Philadelphia Inquirer, New York Times, Houston Chronicles].
- \* Expert Witness retained by the Connolly Bove Lodge & Hutz LLP Law Firm of Wilmington, DE [11/2005- 6/2006] on liquid crystals issues.

**Invention Disclosures.**

- I. C. Khoo, “All-optical polarization rotation, switching, and optical limiting device for broadband [0.4 micron -1.5 micron] application”. PSU Invention Disclosure #2002-2692. Filed on August 8, 2002. [Army]
- I. C. Khoo, “Fiber Array with Two-Photon+Reverse-Saturable Absorbing core for optical limiting and eye/sensor protection against agile frequency short-pulsed lasers”. PSU Invention Disclosure #2002-2707. Filed on Oct. 8, 2002 [Army and Navy]
- S. Yin and I. C. Khoo, “A highly secured ultra fast optical tag based on magneto-optical scattering” #2003-2773 Filed on April 15, 2003 [individual initiative]
- I. C. Khoo and A. Lei “Extremely low freezing point non-volatile nonlinear optical liquids for eye/sensor protection against intense laser pulses” # 2003-2854 Filed on 11/26/2003 [Navy and Army]
- I. C. Khoo, Z. Liu and S. Yin, “Electronically tunable and highly nonlinear photonic crystal fiber.” PSU Invention Disclosure #2003-2843 Filed Oct. 8, 2003 [individual initiative]

- I. C. Khoo and D. Werner, "Liquid crystal containing core-shell nano-spheres for reconfigurable optical-, infrared- and Terahertz- frequency negative and zero index materials." PSU Invention Disclosure #2006 -3217. Filed June 8, 2006 [Army and NSF].

### **Books**

1. **Author** - *Liquid Crystals: Physical Properties and Nonlinear Optical Phenomena* (Wiley, NY, 1995).

A 300-page reference/text book intended for graduate students, optical engineers and research scientists interested in liquid crystal nonlinear optics and basic physics.

2. **Co-author** - *Optics and Nonlinear Optics of Liquid Crystals* (World Scientific Publishing Inc., NJ, May 1993).

A 500 page reference book that provides a comprehensive treatment of the fundamentals of optical, electro-optical and nonlinear-optical properties of liquid crystals, devices and nonlinear optics.

3. **Co-editor** - *Nonlinear Optics and Optical Physics* (World Scientific, Singapore, 1993).

A 400-page reference book, with 16 authors, intended for advanced research scientists.

4. **Co-editor** - *Physics of Liquid Crystalline Materials* (Gordon & Breach, NY, 1991).

A 600-page reference book, with 26 authors, intended for advanced researchers.

5. **Co-author** - *Principles of Optical Engineering* (Wiley, NY, 1990).

A 260 –page junior/senior year Electrical Engineering textbook.

6. **Co-editor** - *Novel Optical Materials and Applications* (Wiley, NY, 1996).

A 320-page reference book for research level optical scientist/engineers.

7. **Author** – *Liquid Crystals 2<sup>nd</sup> Edition* (Wiley, NY 2007).

A 400-page reference/text book intended for optical engineers, research scientists and graduate students interested in the physics, electro-optics and nonlinear optics of liquid crystals.

### **Proceedings and Journal Volumes**

8. **Editor** - *Liquid Crystals I -XVI* [1997- 2012] – 16 Proceedings Volumes of SPIE Optics and Photonics Symposia.

9. **Editor-in-Chief** - *J. Nonlinear Optical Physics and Materials*, Vol. 1- Vol. 21 [1992 – present]

### **Book Chapters**

1. "Nonlinear Optics of Liquid Crystals," *Progress in Optics*, Vol. XXVI, ed. E. Wolf (North Holland, Amsterdam, 1988).

2. "Nonlinear optical processes and applications in the infrared with nematic liquid crystals," in *Nonlinear Optical and Electroactive Polymers*, ed. P. N. Prasad and D. R. Ulrich (Plenum, NY, 1987).

3. "New theoretical and experimental results on multiwave mixing and phase conjugation in liquid crystals and semiconductors" in *Nonlinear Optics of Organics and Semiconductors*, ed. T. Kobayashi (Springer Verlag, Heidelberg, 1988).

4. "An overview of Nonlinear Optics of Liquid Crystals," in *Solid State Materials* eds. S. Radhakrishna and A. Daud (Narosa Publishing House, New Delhi, 1991).

5. "Nonresonant Optical Nonlinearities of Liquid Crystals," in *Nonlinear Optics and Optical Physics*, eds. I. C. Khoo, J. F. Lam and F. Simoni (World Scientific, NJ, 1993).

6. "Liquid Crystals Nonlinear Optics vs. Photorefractives," in *SPIE Critical Review Series*, ed. Pochi Yeh and Claire Gu (Bellingham, WA, 1994).

7. "Liquid Crystal Nonlinear Optics," in Frontiers of Polymers and Advanced Materials, ed. P. N. Prasad (Plenum, NY, 1994).
8. "C<sub>60</sub>-Doped Isotropic Liquid Crystal Cored Fiber Structures For All-Optical Switching and Limiting Application" in Novel Optical Materials and Applications, ed. I. C. Khoo, F. Simoni and C. Umeton (Wiley Interscience, NY 1996).
9. "Liquid Crystal Photorefractivity for Recording Holographic Gratings" in Proceedings of 4th International conference on Frontiers of Polymers and Advanced Materials, ed. P. N. Prasad and Z. Kafafi. (Plenum, NY 1998)
10. "Nonlinear Optical Properties of Nematic Liquid Crystals", in *Physical Properties of Liquid Crystals* Ed. D. A. Dunmur, A. Fukuda and G. R. Luckhurst (INSPEC, IEE, London, UK, 1999)
11. "Liquid Crystals Photorefractivity" in "*Photorefractive Materials, Devices and Applications*" ed. F. T. S. Yu and S. Yin [Wiley InterScience, NY 1999]
12. "Nonlinear Optics – materials: Liquid crystals for NLO" in *Encyclopaedia of Modern Optics*, ed. Bob. D. Guenther et al [Academic Press, 2004].
13. A. Diaz and I. C. Khoo, "Liquid crystalline nano-structured optical metamaterials," in *Comprehensive Nanoscience and Technology*, Vol. 3, pages 225-261 eds. David Andrews, Gregory Scholes and Gary Wiederrecht [Elsevier, 2011]

#### **Selected List of Publications [Total: 244]**

- Nonlinear optical amplification in a nematic liquid crystal above the Freederick's transition. I. C. Khoo and Shu-Lu Zhuang, Appl. Phys. Letts., 37, 3 (1980)
  - Optically induced molecular reorientation and third order nonlinear optical processes in nematic liquid crystal. I. C. Khoo, Phys. Rev., A23, 2077 (1981)
1. Theory of optically induced molecular reorientations and quantitative experiments on wave mixing and the self-focusing of light. I. C. Khoo, Phys. Rev., A25, 1637 (1982).
  2. Optical bistability in nematic film using self-focusing of light. I. C. Khoo, Appl. Phys. Letts., 41, 909 (1982).
  3. Optical bistability in a nematic liquid crystal film inside a Fabry Perot cavity. I. C. Khoo, R. Normandin and V.C.Y. So, J. Appl. Phys., 53, 7599 (1982).
  4. Re-examination of the theory and experimental results of optically induced molecular reorientation and nonlinear diffractions in nematic liquid crystals: spatial frequency and temperature dependence. I. C. Khoo, Phys. Rev., A27, 2747 (1983).
  5. Theory and experiment on optical bistability in a Fabry-Perot interferometer with an intracavity nematic liquid-crystal film. I. C. Khoo, J. Y. Hou, R. Normandin and V.C.Y. So, Phys. Rev., A27, 3251 (1983).
  6. Submillisecond grating diffractions in nematic liquid crystal films. I. C. Khoo and S. Shepard, J. of Appl. Phys., 54, 5491 (1983).
  7. Nanosecond laser-induced transient and erasable permanent grating diffractions and ultrasonic waves in a smectic film. I. C. Khoo and R. Normandin, J. Appl. Phys., 55, pp.1416-1418, (1984).
  8. Nanosecond degenerate optical wave mixing and ultrasonic wave generation in the nematic phase of liquid crystals. I. C. Khoo and R. Normandin, Opt. Letts., 9, 285-287 (1984).
  9. Observation of intensity-dependent guided waves, H. Vach, C. T. Seaton, G. I. Stegeman and I. C. Khoo, Opt. Letts., 9, 238 (1984).
  10. Theory and experiment on optical transverse intensity bistability in the transmission through nonlinear thin (nematic liquid crystal) film. I. C. Khoo, P. Y. Yan, T. H. Liu, S. Shepard and J. Y. Hou, Phys. Rev., A29, 2756 (1984).

11. The mechanism and dynamics of transient thermal grating diffraction in nematic liquid crystal films. I. C. Khoo and R. Normandin, IEEE J. Quant. Electronics, QE-21, 329 (1985).
12. Nonlinear Fabry Perot action and optical bistability of a dielectric cladded thin film near the total internal reflection state, I. C. Khoo and J. Y. Hou, J. Opt. Soc. Am. **B2**, 761 (1985).
13. Liquid crystals--nonlinear optical properties and processes. I. C. Khoo and Y. R. Shen, (invited paper) Optical Engineering, **24**, 579 (1985).
14. Nonlocal transverse dependence of molecular reorientation induced in a nematic liquid crystal by a Gaussian laser beam. I. C. Khoo, T. H. Liu and R. Normandin, Mol. Cryst. Liq. Cryst. **131**, p. 315 (1985).
15. Infrared to visible image conversion capability of nematic liquid crystal film. I. C. Khoo and R. Normandin, Appl. Phys. Letts. **47**, 350 (1985).
17. Passive optical self-limiter using laser induced axially symmetric and asymmetric transverse self-phase modulations in a liquid crystal film. I. C. Khoo, G. Finn, R. R. Michael and T. H. Liu, Optics Letters, **11**, 227 (1986).
18. Theory and experiment on optically induced nematics axis reorientation and nonlinear effects in the nanosecond regime. I. C. Khoo, R. R. Michael and P. Y. Yan, IEEE J. Quant. Electronics, QE23, 267 (1987).
19. Nonlocal transverse dependence of optically induced director axis reorientation of a nematic liquid crystal film--theory and experiment. I. C. Khoo, P. Y. Yan and T. H. Liu, J. Opt. Soc. Am., **B**, Vol. **4**, p. 115 (1987).
20. Transverse self-phase modulation and bistability in the transmission of a laser beam through a nonlinear thin film. I. C. Khoo, J. Y. Hou, T. H. Liu, P. Y. Yan, R. R. Michael and G. M. Finn, J. Opt. Soc. Am., **B4**, 886 (1987).
21. Probe beam amplification via two- and four-wave mixings in a nematic liquid crystal film. I. C. Khoo and T. H. Liu, IEEE J. Quant. Elect., JQE **23**, 171 (1987).
22. Nanosecond laser amplification via degenerate multiwave mixing in silicon. I. C. Khoo and R. Normandin, Appl. Phys. Letts, **5**, 525 (1988).
23. Low power (10.6 $\mu$ m) laser beam amplification via thermal grating mediated degenerate four wave mixings in a nematic liquid crystal film. I. C. Khoo, P. Y. Yan, G. M. Finn, T. H. Liu and R. R. Michael, J. Opt. Soc. Am., **B5**, 202 (1988).
24. Self-pulsing of the laser light transmitted by a nonlinear liquid crystal interface near the phase transition. F. Simoni, G. Cipparone, C. Umeton and I. C. Khoo, Opt. Letts. **13**, 886 (1988).
25. Stationary and moving thermal grating mediated infrared laser wave mixing and amplification in nematic liquid crystal films. P. Y. Yan and I. C. Khoo, IEEE J. Quant. Elect., JQE**25**, 520 (1989).
26. Self-phase modulation and optical limiting of a low power CO<sub>2</sub> laser with a nematic liquid-crystal film. I. C. Khoo, R. R. Michael and G. M. Finn, Appl. Phys. Letts., **52**, 2108 (1988).
27. Dynamics of total-internal-reflection to transmission switching in a dielectric-cladded nonlinear film. I. C. Khoo and Ping Zhou, J. Opt. Soc. Am., **B6**, 884 (1989).
28. Theory and experiments on multiwave mixing mediated probe beam amplification. I. C. Khoo and T. H. Liu, Phys. Rev., **A39**, 4036 (1989).
29. Degenerate multiwave mixing and phase conjugation in silicon. I. C. Khoo et al., Phys. Rev., **B40**, 7759 (1989).
72. Optical switching by a dielectric cladded nematic film. I. C. Khoo, et al., IEEE J. Quant. Elect., JQE**25**, 1755 (1989).

30. Nonlinear liquid crystal fiber-fiber coupler for switching and gating operation. I. C. Khoo and R. Normandin, J. Appl. Phys., **65**, 2566 (1989).
31. Probe beam amplification and phase self-oscillation threshold in a thin Kerr medium. I. C. Khoo and Y. Zhao, IEEE J. Quant. Elect., **JQE25**, 368 (1989).
32. Transient multiwave mixing in a nonlinear medium. I. C. Khoo and P. Zhou, Phys. Rev., **A41**, 1544 (1990).
33. A quantitative analysis of picosecond transient multiwave mixings mediated beam amplification effect in silicon. I. C. Khoo, P. Zhou, R. G. Lindquist and P. LoPresti, Phys. Rev., **A41**, 408 (1990).
34. The infrared optical nonlinearities of nematic liquid crystals and novel two-wave mixing processes. I. C. Khoo, J. Mod. Optics, Vol. 37, 1801 (1990).
35. Stationary equal frequency two-wave mixing with gain in a Bipolar birefringent nonlinear medium. I. C. Khoo and N. V. Tabiryan, Phys. Rev. A **41**, 5528 (May 1990).
36. Optical amplification and polarization switching in a birefringent nonlinear optical medium: An analysis. I. C. Khoo, Phys. Rev. Lett. **64**, 2273 (1990).
37. Dynamics of picosecond laser induced density, temperature and flow-reorientation effects in the mesophases of liquid crystals. I. C. Khoo, R. G. Lindquist, R. R. Michael, R. J. Mansfield and P. Lopresti, J. Appl. Phys., **69**, 3853 (1991).
38. Laser induced thermal, orientational and density nonlinear optical effects in nematic liquid crystal. I. C. Khoo, Phys. Rev. A, **42**, 1001 (July 1990).
39. Theory and experiments on stationary and nearly degenerate optical wave mixing and ring-laser oscillation in a Kerr-like medium: Stationary regime. I. C. Khoo and Wei Wang, J. Opt. Soc. of Am., **B8**, 1433 (1991).
40. Threshold degenerate wave mixing in dye-doped polymer-dispersed liquid crystal. F. Simoni, G. Cipparone, D. Duca and I. C. Khoo, Optics Letts. **16**, 360 (1991).
41. Effects of diffractions and self-phase modulations on phase conjugation self-oscillation in Kerr media. I. C. Khoo and W. Wang, J. Quantum Electronics, **JQE27**, 1310 (1991).
42. Coherent beam amplification and polarization switching in a birefringent medium-photorefractive crystals. I. C. Khoo, Yu Liang, and Hong Li, IEEE J. Quantum Electronics, **JQE 28**, pp. 1816-1824 (1992).
43. Multiwave mixing mediated optical bandpass filter with thin Kerr medium. Wei Wang and I. C. Khoo, J. Opt. Soc. Am. B, pp. 2088-2093 (1992).
44. Nonlinear interface tunneling phase shift. I. C. Khoo and P. Zhou, Optics Letts., **17**, pp. 1325-1327 (1992).
45. Dynamics of transient probe beam amplification via coherent multiwave mixing in a local nonlinear medium-nematic liquid crystal. I. C. Khoo, Hong Li, and Yu Liang, IEEE J. Quant. Electronics, **29**, 12 (1993).
46. Onset dynamics of self-pumped phase conjugation from speckled noise. I. C. Khoo, N. Beldyugina, H. Li, A. V. Mamaev, and V. V. Shkunov, Optics Letters, **18**, pp. 473-475 (1993).
47. Optically induced extraordinarily large negative orientational nonlinearity in dye-doped-liquid crystal. I. C. Khoo, H. Li, and Y. Liang, IEEE J. Quant. Electron, **JQE29**, pp. 1444-1447 (1993).
48. Self-starting optical phase conjugation in dyed nematic liquid crystals with a stimulated thermal-scattering effect. I. C. Khoo, H. Li and Y. Liang, Opt. Letts. **18**, 1490 (1993).
49. Observation of optical limiting and backscattering of nanosecond laser pulses in liquid crystal fibers. I. C. Khoo, H. Li and Y. Liang, Optics Letts., **19**, 530 (1994).



50. Transient laser induced orthogonal director axis reorientation in dye-doped liquid crystal. Hong Li, Yu Liang and I. C. Khoo, *Mol. Cryst. Liq. Cryst.*, 251, 85 (1994).
51. Observation of orientational photorefractive effects in nematic liquid crystals. I. C. Khoo, H. Li, and Y. Liang, *Optics Letts*, 19, 1723 (1994).
52. Nonlinear optical propagation and self-limiting effect in liquid crystalline fiber. I. C. Khoo and H. Li, *Appl. Phys. B*, 59, p. 573 (1994).
53. Self-starting phase conjugation with cross-polarization stimulated orientational scattering in liquid crystal. I.C. Khoo and Yu Liang, *Optics Letters*, 20, 130 (1995).
54. Holographic grating formation in dye- and fullerene C<sub>60</sub>-doped nematic liquid crystal film. I. C. Khoo, *Optics Letters*, 20, 2137 (1996).
55. All Optical switching of infrared optical radiation using isotropic liquid crystals. P. G. LoPresti, P. Zhou, R. G. Lindquist and I. C. Khoo, *IEEE J. Quantum Electronics*, *JQE* 31, pp. 723 (1995).
56. Optical-dc-field induced space charge fields and photorefractive-like holographic grating formation in nematic liquid crystals. I.C.Khoo. *Mol. Cryst. Liq. Cryst.*, 282, pp.53-66 (1996).
57. Orientational photorefractive effects in nematic liquid crystal film. I. C. Khoo, *IEEE J. Quantum Electronics* *JQE* 32, pp. 525-534 (1996).
58. Nonlinear Liquid Crystal Fiber Structures for Passive Optical Limiting of Short Laser Pulses. I. C. Khoo, M. V. Wood, M. Lee and Brett D. Guenther. *Optics Letters* 21, 1625 -1627 (1996).
59. Transient multiwave mixing and diffraction with non-sinuoidal intensity dependent index grating in nematic liquid crystals. P. G. LoPresti and I. C. Khoo. *J. Opt. Soc. Am.* B14, 804 (1997).
60. Coherent beam amplification with photorefractive liquid crystal. I. C. Khoo, Brett D. Guenther, M. V. Wood, P. Chen and Min-Yi Shih, *Opt. Lett.* 22,1229 (1997).
61. Nonlinear- absorption and optical limiting of laser pulses in a liquid-cored fiber array . I. C. Khoo, M. V. Wood, B. D.Guenther, Min-Yi Shih and P. H. Chen. *J. Opt. Soc. Am.* B15, pp. 1533-1540, 1998.
62. I.C. Khoo, S. Slussarenko, B. D. Guenther and W. V. Wood, "Optically Induced Space Charge Fields, DC Voltage, and Extraordinarily Large Nonlinearity in Dye-doped Nematic Liquid Crystals," *Opt. Letts* 23, pp 253 - 255 (1998).
63. I. C. Khoo, M. V. Wood, B. D. Guenther, Min-Yi Shih, P. H. Chen, Zhaogen Chen and Xumu Zhang, "Liquid Crystal Film and Nonlinear Optical Liquid Cored Fiber Array for ps-cw Frequency Agile Laser Optical Limiting Application". *Optics Express*, Vol. 2, no. 12.pp 471-82, (1998)
64. I. C. Khoo, M. V. Wood, M. Y. Shih and P. H. Chen, "Extremely Nonlinear Photosensitive Liquid Crystals for Image Sensing and Sensor Protection," *Optics Express*, Vol. 4, no. 11, pp 431-442 (1999)
65. I. C. Khoo, P. H. Chen, M. V. Wood, and Min-Yi Shih, " Molecular photonics of a highly nonlinear organic fiber core liquid for picosecond -nanosecond optical limiting effect", *Chemical Physics* Vol. 245, pp. 517-531(1999).
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