

# Soon Wei Daniel Lim (Daniel)

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## SUMMARY

I am an interdisciplinary applied physicist with a unique background in both life and physical sciences. I have research experience in mouse model studies of neurodegeneration, micro-optical device fabrication by harnessing surface tension, particle-laden computational fluid dynamics, neural network algorithmic tools for optimal design, nanoscale devices to control every degree of freedom in wavefronts, radiofrequency/ultrasound image reconstruction, and bioengineering for drug, protein, and gene delivery to cells.

My research interests are in the design of low-cost, high-accessibility medical diagnostics and therapeutics.

**Nationality:** Singapore

## EDUCATION

2018 - 2023	Ph.D. Applied Physics, <b>Harvard University</b> Advisor: Prof. Federico Capasso; Thesis: <i>Sculpting the dark: Singularity engineering with metasurfaces</i>	<b>GPA: 4.0/4.0</b>
2013 - 2017	B.S. Physics, <b>California Institute of Technology</b> Advisor: Prof. Sandra Troian; Thesis: <i>Revolution in large-area curved surface lithography: Nanofilm sculpting by thermocapillary modulation</i>	<b>GPA: 4.3/4.3, rank 1/254</b>
2016	Caltech Cambridge Scholar, <b>Cambridge University</b>	<b>Class: First</b>

## RECENT RESEARCH EXPERIENCE

**Schmidt Science Fellow**, Stanford University School of Medicine Nov 2023 - present  
Advisor: Prof. Steven Chu (Nobel Prize in Physics, Secretary of Energy). Developing low cost, high efficiency intracellular delivery techniques for *in vivo* diagnostics.

**Doctoral Researcher**, Harvard University Sep 2018 - Sep 2023  
Advisor: Prof. Federico Capasso. Investigated counter-intuitive fundamental behavior of structured wavefields containing singularities (“dark” regions of light). Achieved a flat lens that uses extremely deep and narrow holes, the highest aspect ratio nanostructures for wavefront shaping.

**Research Assistant**, Bioprocessing Technology Institute, A\*STAR Jan 2018 - Jun 2018  
Advisor: Prof. Shireen Goh (now at SUTD, Singapore). Modeled multiphase computational fluid dynamics for inertial focusing in dense particle-laden flows.

**Research Engineer**, Singapore Institute of Manufacturing Technology, A\*STAR Jul 2017 - Dec 2017  
Advisor: Prof. Wong Liang Jie (now at NTU, Singapore). Numerically simulated strong-field light-matter interactions in laser-based particle acceleration.

**Undergraduate Researcher**, California Institute of Technology Jan 2015 - Jun 2017  
Advisor: Prof. Sandra Troian. Fabricated microlens arrays in polymer with spatially-varying surface tension.

## SELECTED AWARDS

Lindau Young Scientist (2019). A\*STAR Roll of Honor (2017). California Institute of Technology awards: D.S. Kothari Prize in Physics (2017), Friends of the Caltech Libraries Senior Thesis Prize (2017), Haren Lee Fisher Memorial Award in Junior Physics (2016), and Jack E. Froehlich Memorial Award (2016). Ken Hass Outstanding Student Paper Award (2017), American Physical Society. International Physics Olympiad Silver Medal (2010).

## FELLOWSHIPS AND GRANTS

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US\$220,000	<a href="#">Schmidt Science Fellowship</a> , Schmidt Sciences (2024-2026).
SGD\$20,000	<a href="#">NUS Development Grant</a> , National University of Singapore (2024-2025).
8 years full funding	<a href="#">National Science Scholarship</a> , A*STAR Singapore (2013-2023).

## PUBLICATIONS *\*equal contribution*

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1. J.S. Park\*, [S.W.D. Lim\\*](#), A. Amirzhan, H. Kang, K. Karrfalt, D. Kim, J. Leger, A. Urbas, M. Ossian-der, Z. Li, F. Capasso, All-Glass 100 mm Diameter Visible Metalens for Imaging the Cosmos, **ACS Nano**, 18, 4, 3187–3198, 2024, [10.1021/acsnano.3c09462](#) and [Supplemental Cover Art](#)
  2. R.J. Tang\*, [S.W.D. Lim\\*](#), M. Ossian-der, X. Yin, F. Capasso, Time reversal differentiation of FDTD for photonic inverse design, **ACS Photonics**, 10, 12, 4140–4150, 2023, [10.1021/acsp Photonics.3c00694](#)
  3. J. Lu, V. Ginis, [S.W.D. Lim](#), F. Capasso, Helicity and Polarization Gradient Optical Trapping in Evanescent Fields, **Physical Review Letters**, 131, 14, 143803, 2023, [10.1103/PhysRevLett.131.143803](#)
  4. D. Hazineh\*, [S.W.D. Lim\\*](#), Q. Guo, F. Capasso, T. Zickler, Polarization Multi-Image Synthesis with Birefringent Metasurfaces, **IEEE International Conference on Computational Photography (ICCP)**, 2023, [10.1109/ICCP56744.2023.10233735](#)
  5. C.M. Spaegle, M. Tamagnone, [S.W.D. Lim](#), M. Ossian-der, M.L. Meretska, F. Capasso, Topologically protected optical polarization singularities in four-dimensional space, **Science Advances**, 9, 24, 2023, [10.1126/sciadv.adh0369](#)
  6. [S.W.D. Lim\\*](#), J.S. Park\*, D. Kazakov, C.M. Spaegle, A.H. Dorrah, M.L. Meretska, F. Capasso, Point singularity array with metasurfaces, **Nature Communications**, 14, 3237, 2023, [10.1038/s41467-023-39072-6](#)
  7. M. Ossian-der\*, M.L. Meretska\*, H.K. Hampel\*, [S.W.D. Lim](#), N. Knefz, T. Jauk, F. Capasso, M. Schultze, Extreme ultraviolet metalens by vacuum guiding, **Science**, 380, 59–63, 2023, [10.1126/science.adg6881](#)
  8. G. Palermo, A. Lininger, A. Guglielmelli, L. Ricciardi, G. Nicoletta, A. De Luca, J.S. Park, [S.W.D. Lim](#), M.L. Meretska, F. Capasso, G. Strangi, All-optical tunability of metalenses permeated with liquid crystals, **ACS Nano**, 16, 10, 16539–16548, 2022, [10.1021/acsnano.2c05887](#)
  9. [S.W.D. Lim\\*](#), M.L. Meretska\*, F. Capasso, A high aspect ratio inverse-designed holey metalens, **Nano Letters**, 21, 8642–8649, 2021, [10.1021/acs.nanolett.1c02612](#)
  10. [S.W.D. Lim](#), J.S. Park, M.L. Meretska, A.H. Dorrah, F. Capasso, Engineering phase and polarization singularity sheets, **Nature Communications** 12, 4190, 2021, [10.1038/s41467-021-24493-y](#)
  11. S. Yu, J. Lu, V. Ginis, S. Kheifets, [S.W.D. Lim](#), M. Qiu, T. Gu, J. Hu, F. Capasso, On-chip optical tweezers based on freeform optics, **Optica** 8, 3, 409–414, 2021, [10.1364/OPTICA.418837](#)
  12. M. Shen, [S.W.D. Lim](#), E.S. Tan, H.H. Oon, E.C. Ren, HLA correlations with clinical phenotypes and risk of metabolic comorbidities in Singapore Chinese psoriasis patients, **Molecular Diagnosis & Therapy** 23, 6, 751–760, 2019, [10.1007/s40291-019-00423-z](#)
  13. A.Z. Thong, [S.W.D. Lim](#), A. Ahsan, T.W.G. Goh, J.W. Xu, and J.M. Chin, Non-closed-packed pore arrays through one-step breath figure self-assembly and reversal, **Chemical Science** 5, 1375–1382, 2014, [10.1039/C3SC52258J](#)

## PATENTS

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1. M.L. Meretska, [S.W.D. Lim](#), and F. Capasso, “High-aspect ratio metalens,” U.S. patent [US11860336B2](#).
  2. [S.W.D. Lim](#), J.S. Park, M.L. Meretska, F. Capasso, and A.H. Dorrah, “Systems and methods of phase and polarization singularity engineering”, U.S. patent [2023/0021549 A1](#) (2023), pending.
  3. M.T. Ossian-der, M.L. Meretska, [S.W.D. Lim](#), F. Capasso, “Nanooptics with high refractive index apertures”, World patent [WO 2024/215347](#) (2023), pending.

## MANUSCRIPTS IN PROGRESS

1. [S.W.D. Lim](#), Y.H. Kee, S.N.A. Smith, S.M. Tan, A.E. Lim, Y. Yang, S. Goh, “Dense Suspension Inertial Microfluidic Particle Theory (DENSE-IMPACT) Model for Elucidating Outer Wall Focusing at High Cell Densities”, ArXiv [2409.12488](#)
2. [S.W.D. Lim](#), C.M. Spaegel, F. Capasso, “Multidimensional optical singularities and their applications”, ArXiv [2406.00784](#).
3. Z. Li, S.D. Campbell, J.S. Park, R.P. Jenkins, [S.W.D. Lim](#), D.H. Werner, F. Capasso, “Heterogeneous Freeform Metasurfaces: A Platform for Advanced Broadband Dispersion Engineering”, ArXiv [2412.12028](#).

## PEER REVIEW

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ACS Omega (American Chemical Society)	2
Journal of the Optical Society of America A (Optica Publishing Group)	1
Journal of the Optical Society of America B (Optica Publishing Group)	2
Laser & Photonics Reviews (Wiley-VCH)	6
Light: Science & Applications (Nature Portfolio)	1
Nanophotonics (de Gruyter)	1
Nature Communications (Nature Portfolio)	4
Optics Express (Optica Publishing Group)	7
Optics Letters (Optica Publishing Group)	2
<b>Total</b>	<b>26</b>

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## TEACHING

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- Fall 2019: Harvard University Physics 123/223, “**Laboratory Electronics**”, Teaching Fellow
  - Fall 2016: California Institute of Technology Physics 5/105, “**Analog Electronics for Physicists**”, Teaching Fellow

## MENTORSHIP

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1. 2019-2020: Rui Jie Tang (research intern), now Ph.D. candidate at the University of Toronto
  2. 2021-2023: Revin Jun (research intern), now undergraduate at Harvard University

## SKILLS

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- **Computational:** Assembly, C++, Python, Mathematica, MATLAB, COMSOL, FDTD, Automatic Differentiation/Machine learning (Tensorflow, Pytorch).
  - **Dry bench:** Microscopy (confocal, polarimetric, atomic force), analog/digital circuit design, automated instrument control, visible/infrared coherent sources.
  - **Wet bench:** Sterile technique, cell culture, microfluidic devices, optical tweezing, intracellular delivery.
  - **Nanofabrication:** Lithography down to 10-100 nm feature scales (electron, focused ion beam, soft), standard semiconductor processes (e.g., chemical/physical vapor deposition, dry/wet etch).
  - **Electron microscopy:** STEM/TEM, FIB sample preparation, EDS, (R)EELS, environmental SEM.

## LEADERSHIP AND COMMUNITY SERVICE

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- **Head**, National Science Challenge Scientific Working Committee, A\*STAR and Science Center Board, Singapore (2017 - 2018)
    - Spearheaded a diverse team of 15 members across multiple organizations, overseeing the planning and implementation of scientific projects, competitive rounds, and outreach initiatives for the National Science Challenge, a nationally-broadcast inter-school science contest. Provided expert advice to the national broadcaster (Mediacorp) throughout competition and filming stages.
    - Successfully concluded with the [2017 broadcast](#) (6 episodes) and [2018 broadcast](#) (6 episodes).