

# JACQUES CAROLAN

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**Born:** November 22, 1988

**Nationality:** British

## RESEARCH SUMMARY

My research focuses on novel techniques to generate, manipulate and detect quantum states of light on-chip, towards applications in simulation, computation and machine learning; with equal emphasis on device *development* and *application*. My work lies at the nexus between quantum information, integrated photonics and machine learning; and it leverages advances in nanofabrication and quantum control. As well as expertise in quantum photonics, I am an experienced science communicator and have made contributions to the philosophy of science.

## POSITIONS

10/2019–

**Postdoctoral Fellow, Lab: [Quantum Photonics](#)**

***University of Copenhagen, Niels Bohr Institute***

Advisor: Peter Lodahl

Award: Marie Skłodowska-Curie Global Fellowship

Themes: quantum emitter spectroscopy, single photon nonlinearities, optimal control

3/2016–10/2019

**Postdoctoral Fellow, Lab: [Quantum Photonics Group](#)**

***Massachusetts Institute of Technology, Research Laboratory of Electronics***

Advisor: Dirk Englund

Award: Marie Skłodowska-Curie Global Fellowship

Themes: silicon photonics, nonlinear optics, quantum machine learning, neural networks

11/2015–3/2016

**Postdoctoral Researcher, Lab: [Centre for Quantum Photonics](#)**

***University of Bristol, Physics***

Advisor: Anthony Laing

## EDUCATION

2011–2015

**Ph.D. Physics, *University of Bristol*, Bristol, UK**

Advisor: Jeremy O'Brien, Anthony Laing, Centre for Quantum Photonics

Title: Universal Linear Optics: Characterisation, Verification and Computation

Award: EPSRC DTA Scholarship

2007–2011

**M.Sci. Physics & Philosophy, *University of Bristol*, Bristol, UK**

Graduated with First Class Honors

MSci Physics Advisor: Jeremy O'Brien

MSci Philosophy Advisor: James Ladyman

## TEACHING

01/2019

**MIT IAP 2019 [How to Program a Quantum Computer](#)**

Devised and delivered three-part interactive lecture series for MITs independent activities period, attended by over 35 students and alumni. The course explored fundamental concepts in quantum computing through a series of hands-on tutorials, where participants interactively learn by programming a real life quantum computer.

## AWARDS

- 04/2017 [Marie Skłodowska-Curie Global Fellowship \(\\$300,000\)](#)
- 10/2016 [Quantum Innovators 2016](#)
- 06/2016 [66th Lindau Nobel Laureates Meeting](#)
- 04/2016 [Institute of Physics QEP Doctoral Research Prize Special Commendation](#)
- 04/2016 [UoB Faculty of Science PhD Commendation](#)
- 06/2014 [EPSRC ICT Pioneer](#)
- 06/2011 [EPSRC DTC Scholarship \(\\$75,000\)](#)

## PUBLICATIONS

- 2020 U. Chakraborty, **J. Carolan**, G. Clark, D. Bunandar, J. Notaros, M. Watts, D. Englund  
[Cryogenic operation of silicon photonic modulators based on DC Kerr effect](#) arXiv:2008.03395 (accepted *Optica*)
- 2020 J. Kim, S. Aghaeimeibodi, **J. Carolan**, D. Englund, E. Waks  
[Hybrid integration method for on-chip quantum photonics](#) *Optica* **7**, 291-308 (2020)
- 2020 **J. Carolan**, M. Mohseni, J. P. Olson, M. Prabhu, C. Chen, D. Bunandar, M.Y. Niu, N. C. Harris, F. N. C. Wong, M. Hochberg, S. Lloyd, D. Englund  
[Variational Quantum Unsampling on a Quantum Photonic Processor](#) *Nature Physics* **16**, 322-327 (2020)
- 2019 M. Prabhu, C. Roques-Carmes, Y. Shen, N Harris, L. Jing, **J. Carolan**, R. Hamerly, T. Baehr-Jones, M. Hochberg, V Ceperic, J. D. Joannopoulos, D. Englund, M. Soljacic  
[A Recurrent Ising Machine in a Photonic Integrated Circuit](#) arXiv:1909.13877
- 2019 **J. Carolan**, U. Chakraborty, N. C. Harris, M. Pant, T. Baehr-Jones, M. Hochberg, D. Englund  
[Scalable feedback control of single photon sources for photonic quantum technologies](#) *Optica* **6**, 335 (2019)
- 2019 I. Alonso Calafell, T. Strömberg, D. R. M. Arvidsson-Shukur, L. A. Rozema, V. Saggio, C. Greganti, N. C. Harris, M. Prabhu, **J. Carolan**, M. Hochberg, T. Baehr-Jones, D. Englund, C. H. W. Barnes, P. Walther  
[Trace-free counterfactual communication with a nanophotonic processor](#) *npj Quantum Information* **5**, 61 (2019)
- 2019 G. R. Steinbrecher, J. P. Olson, D. Englund, **J. Carolan**  
[Quantum optical neural networks](#) *npj Quantum Information* **5**, 60 (2019)
- 2018 N. C. Harris, **J. Carolan**, D. Bunandar, M. Prabhu, M. Hochberg, T. Baehr-Jones, M. L. Fanto, A. M. Smith, C. C. Tison, P. M. Alsing, D. Englund  
[Linear programmable nanophotonic processors](#) *Optica* **5**, 1623 (2018)
- 2018 C. Sparrow, E. Martín-López, N. Maraviglia, A. Neville, C. Harrold, **J. Carolan**, Y. N. Joglekar, T. Hashimoto, N. Matsuda, J. L. O'Brien, D. P. Tew, A. Laing  
[Simulating the vibrational quantum dynamics of molecules using photonics](#) *Nature* **557**, 660 (2018)
- 2017 D. Hangleiter, **J. Carolan**, K. Thébault  
[Analogue Quantum Simulation: A Philosophical Prospectus](#) arXiv:1712.05809 (accepted Springer)
- 2017 M. Gimeno-Segovia, H. Cable, G. J. Mendoza, P. Shadbolt, J. W. Silverstone, **J. Carolan**, M. G. Thompson, J. L. O'Brien and T. Rudolph  
[Relative multiplexing for minimising switching in linear-optical quantum computing](#) *NJP* **19**, (2017)

- 2015 **J. Carolan**, C. Harrold, C. Sparrow, E. Martín López, N. J. Russell, J. W. Silverstone, P. J. Shadbolt, N. Matsuda, M. Oguma, M. Itoh, G. D. Marshall, M. G. Thompson, J. C. F. Matthews, T. Hashimoto, J. L. O'Brien, A. Laing  
*Universal linear optics*, *Science* **349**, 711 (2015)
- 2014 **J. Carolan**, J. D. A. Meinecke, P. J. Shadbolt, N. J. Russell, N. Ismail, K. Wörhoff, T. Rudolph, M. G. Thompson, J. L. O'Brien, J. C. F. Matthews, A. Laing  
*On the experimental verification of quantum complexity in linear optics* *Nat. Photon.* **8**, 621 (2014)

## INVITED TALKS

- 08/2020 Q-FARM Seminar *Stanford, USA [remote]*
- 08/2020 Neurotechnology Seminar *Columbia, USA [remote]*
- 07/2020 Neurotechnology and Biophysics Seminar *Rockefeller, USA [remote]*
- 07/2020 IEEE Photonics Chapter Webinar *Ottawa, Canada [remote]*
- 06/2020 Photonics For Quantum 2 *Rochester Institute of Technology, USA [remote]*
- 05/2020 Photonics North *Niagara Falls, USA [remote]*
- 03/2020 ECE Seminar *Boston University, USA*
- 03/2020 ECE Seminar *University of Maryland, USA*
- 02/2020 EECS Seminar *Berkeley, USA*
- 02/2020 EE & Physics Seminar *Columbia, USA*
- 02/2020 ECE Seminar *University of Pennsylvania, USA*
- 12/2019 Complex Photonic Systems Seminar *University Twente, Netherlands*
- 10/2019 Quantum Techniques in Machine Learning *KAIST, Korea*
- 09/2019 SPIE Security + Defense *Strasbourg, France*
- 08/2019 Neurotechnology and Biophysics Seminar *Rockefeller, USA*
- 05/2019 Applied Physics Seminar *Stanford, USA*
- 04/2019 ITAMP Seminar *Harvard, USA*
- 01/2019 Photonics For Quantum *Rochester Institute of Technology, USA*
- 11/2018 MIT Centre for Ultracold Atoms Seminar Series *Harvard, USA*
- 11/2018 USTC Quantum Seminar *Shanghai, China*
- 11/2018 2018 International Young Scientists Forum on Optics and Photonics *Wuhan, China*
- 11/2018 Nature Conference on Nanophotonics and Integrated Photonics *Nanjing, China*
- 07/2018 Analogue Experimentation Workshop *Bristol University, UK*
- 07/2018 Quantum Optics Seminar *Imperial College, UK*
- 06/2018 Niels Bohr Institute Quantum Optics Seminar *University of Copenhagen, Denmark*
- 06/2018 DTU Fotonik Seminar *Danish Technical University, Denmark*
- 03/2018 Bristol Quantum Information Technologies *Bristol University, UK*
- 09/2017 PICQUE Integrated Quantum Photonics *Sapienza Università di Roma, Italy*
- 06/2017 iQuISE Seminar *Massachusetts Institute of Technology, USA*
- 10/2016 Quantum Innovators *Institute for Quantum Computing, Canada*
- 08/2016 Semi-Quantum Computing workshop *Institute for Quantum Computing, Canada*
- 11/2015 Optics and Quantum Electronics Seminar *Massachusetts Institute of Technology, USA*
- 11/2015 Processing for Quantum Computing Workshop *TU Delft, Netherlands*
- 03/2015 University of Mainz Colloquium *Universität Mainz, Germany*
- 03/2015 University of Bonn Physics Colloquium *Universität Bonn, Germany*
- 11/2015 Quantum Simulation and Quantum Walks 2014 *KwaZulu University, South Africa*

## PATENTS

- 2020 Scalable Feedback Control of Single-Photon Sources for Photonic Quantum Technologies, *WO2020102160A2*
- 2019 Apparatus and methods for optical neural network, *US20190294199A1*