

Moscow Institute of Physics and Technology
(State University)

Optical Neural Networks

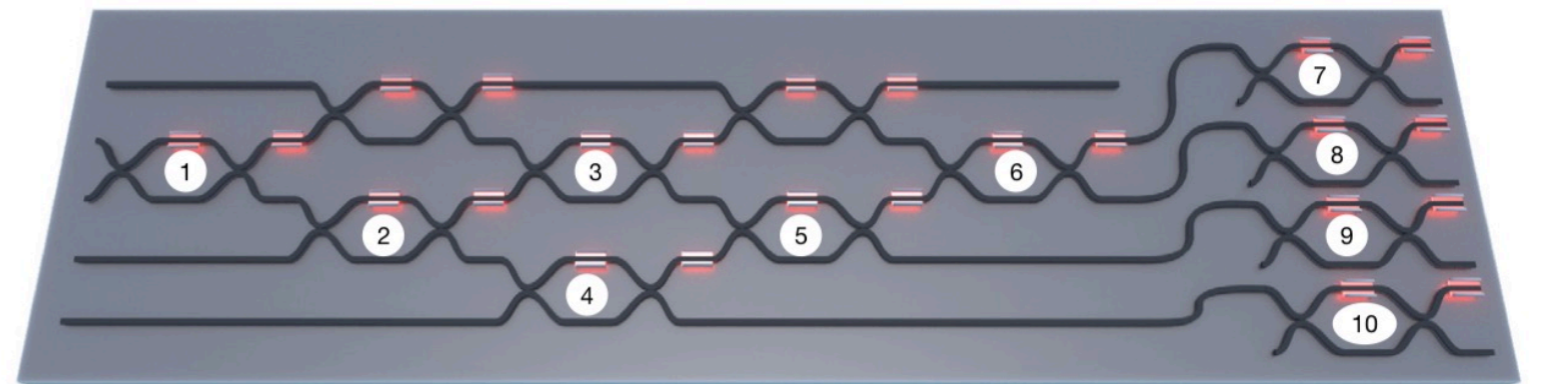
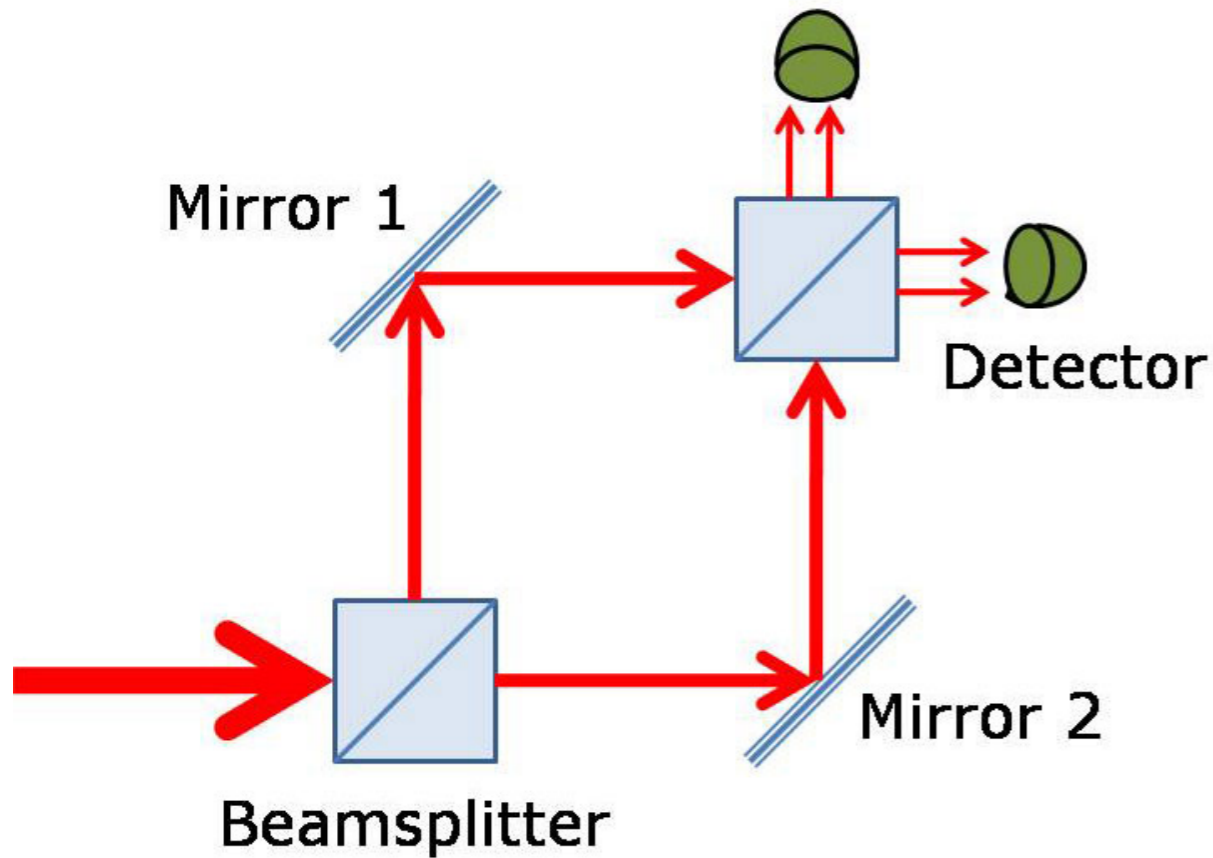
Anton Karazeev
Group 493

2018

Outline

- Brief introduction to Optical Physics
- Optical Neural Network
- Optical Interference Unit

Mach-Zehnder interferometer

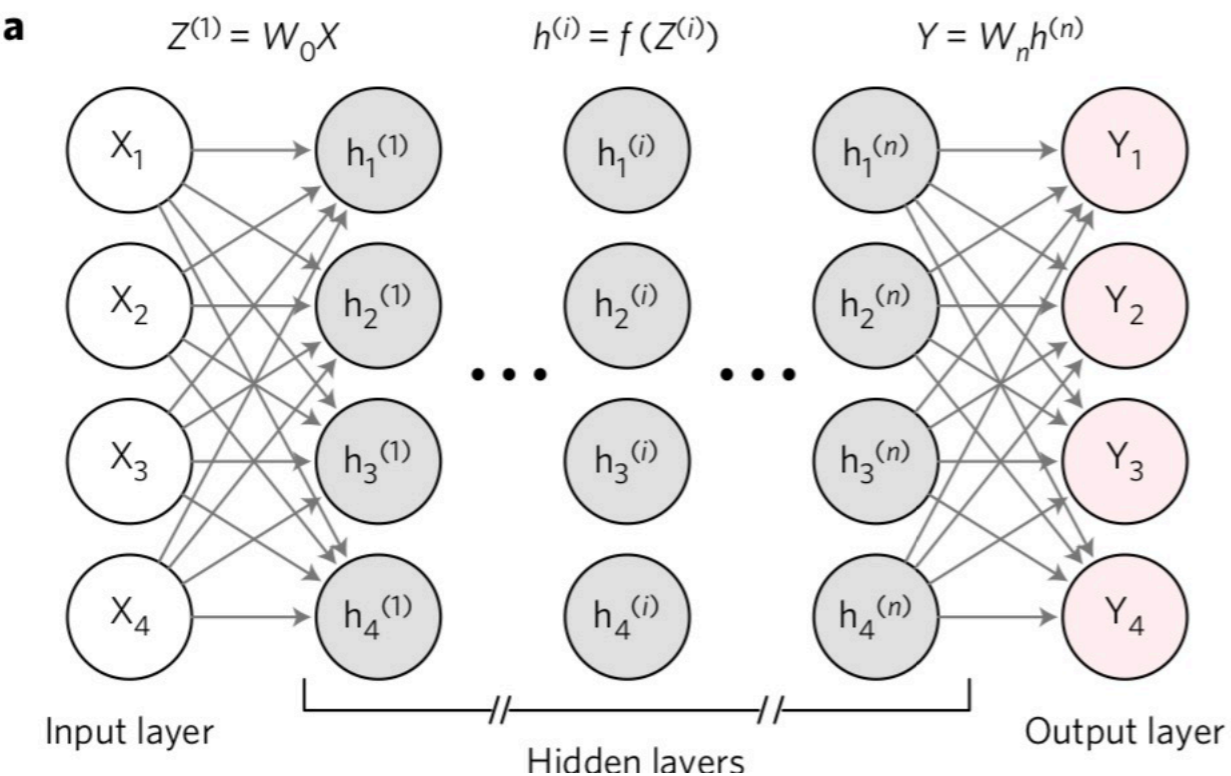


Y. Shen et al., Deep learning with coherent nanophotonic circuits

General architecture of the ONN*

*- Optical Neural Network

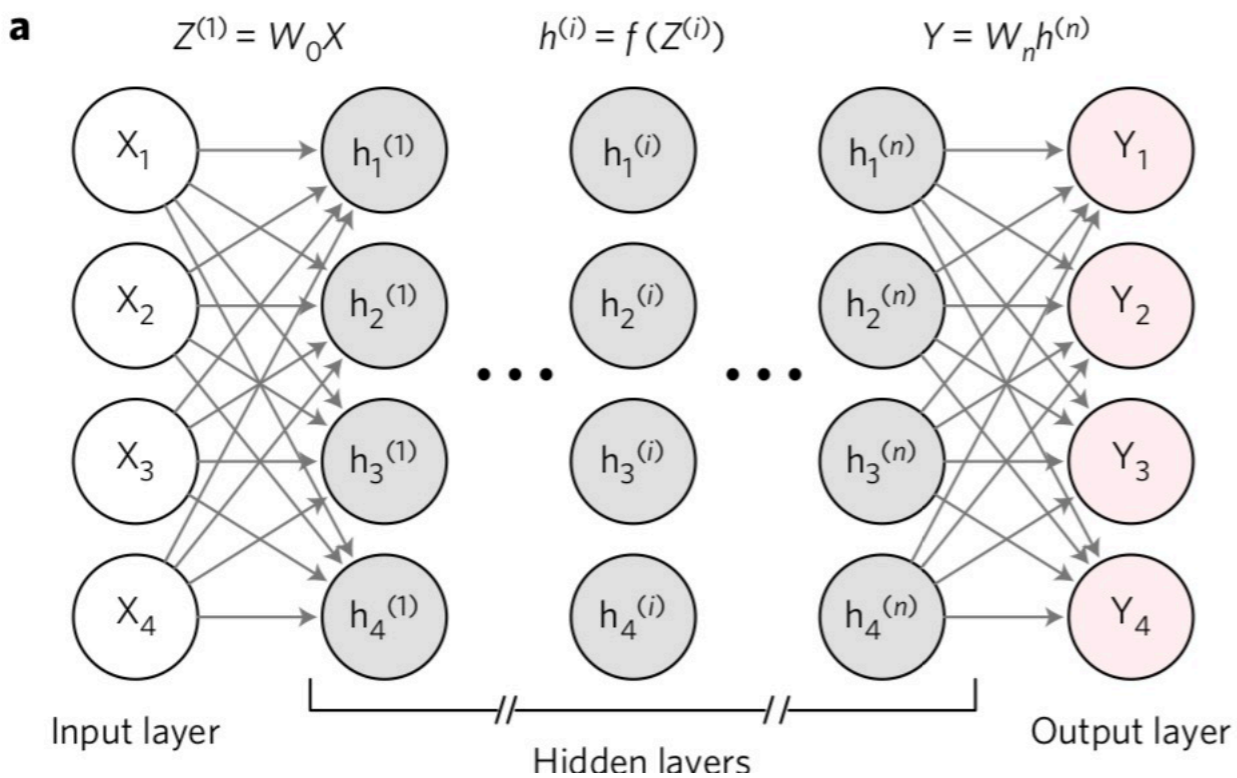
General architecture of the ONN*



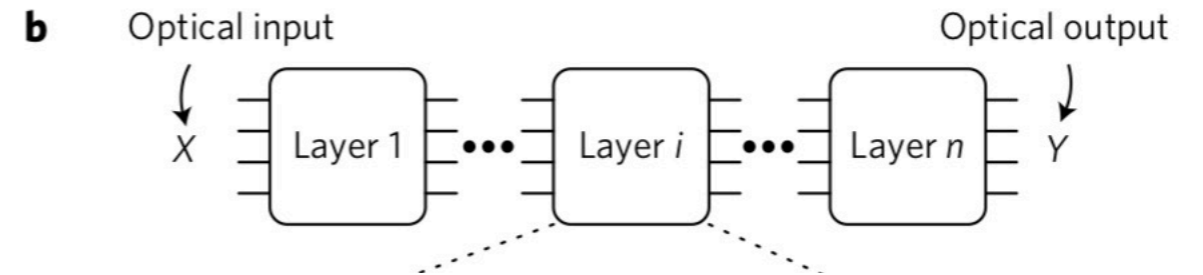
General ANN

* - Optical Neural Network

General architecture of the ONN*



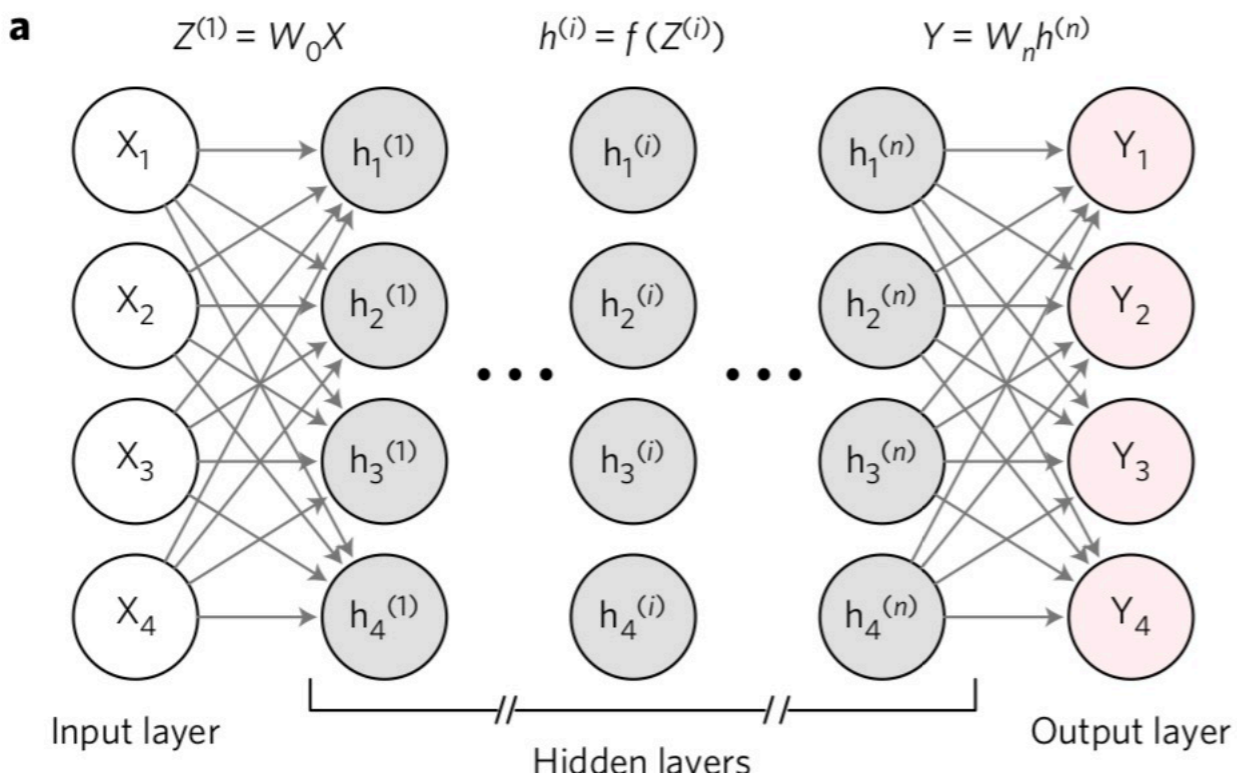
General ANN



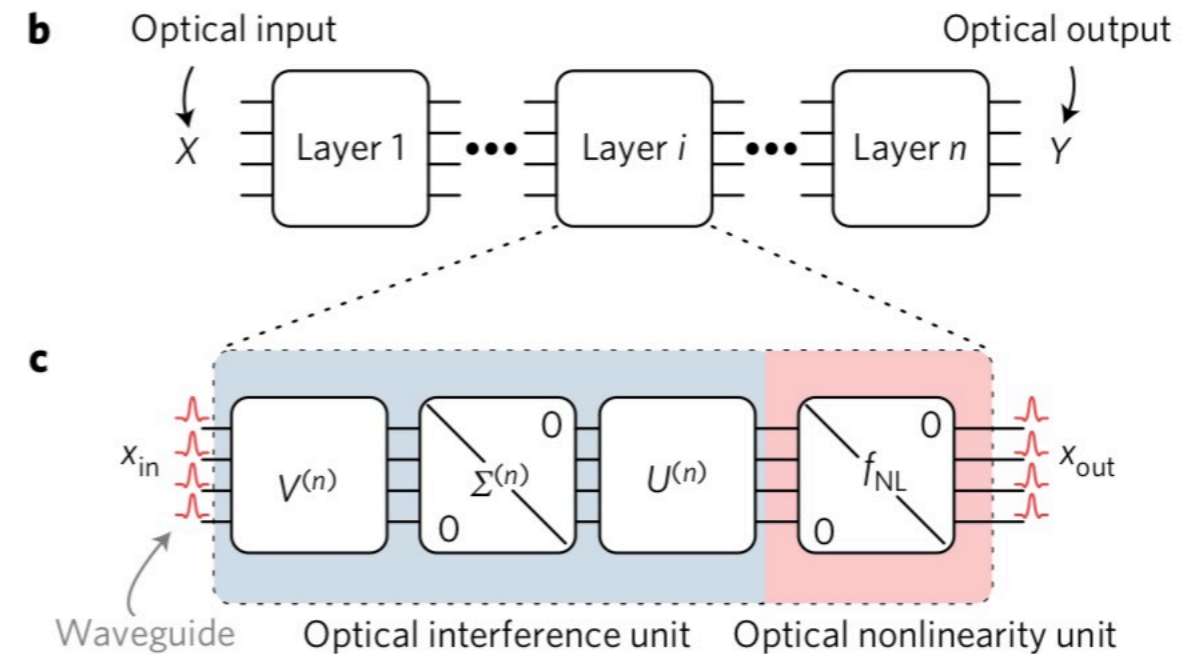
Decomposition of general NN

*- Optical Neural Network

General architecture of the ONN*



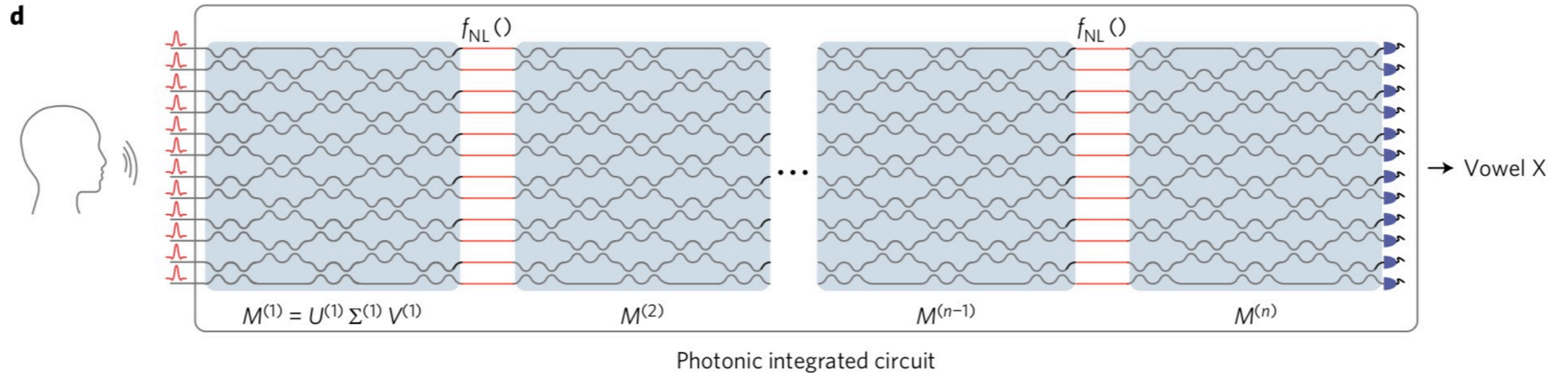
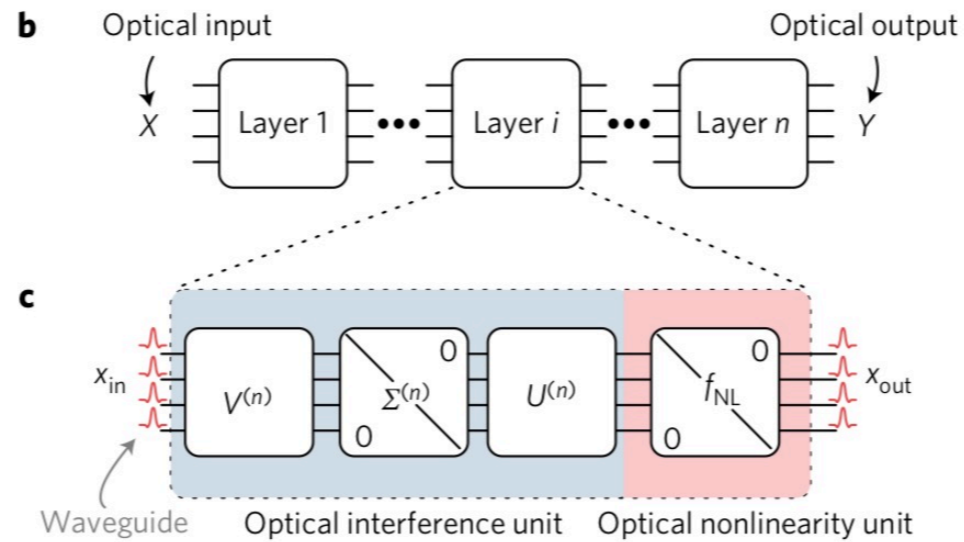
General ANN



Optical interference and nonlinearity units

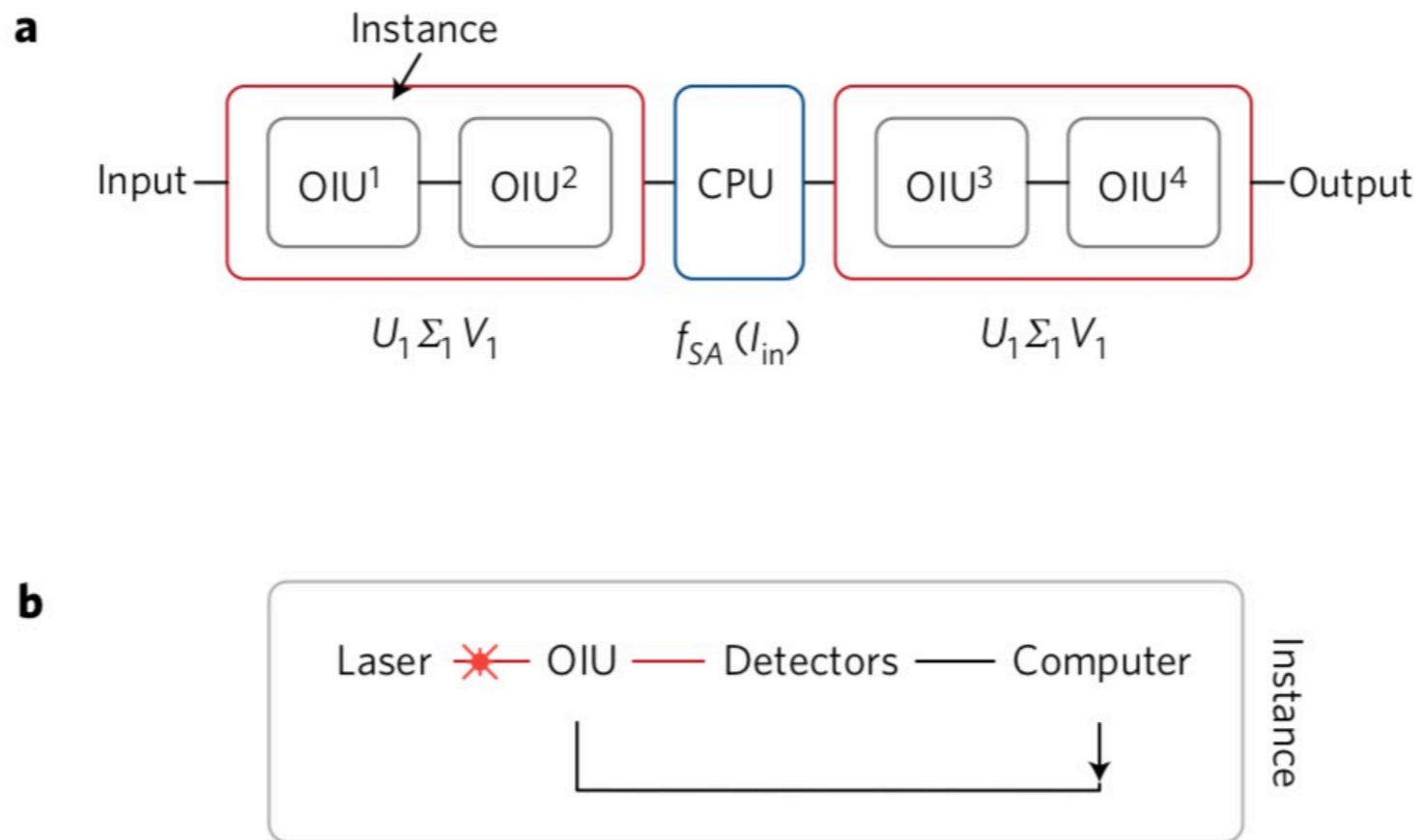
*- Optical Neural Network

ONN

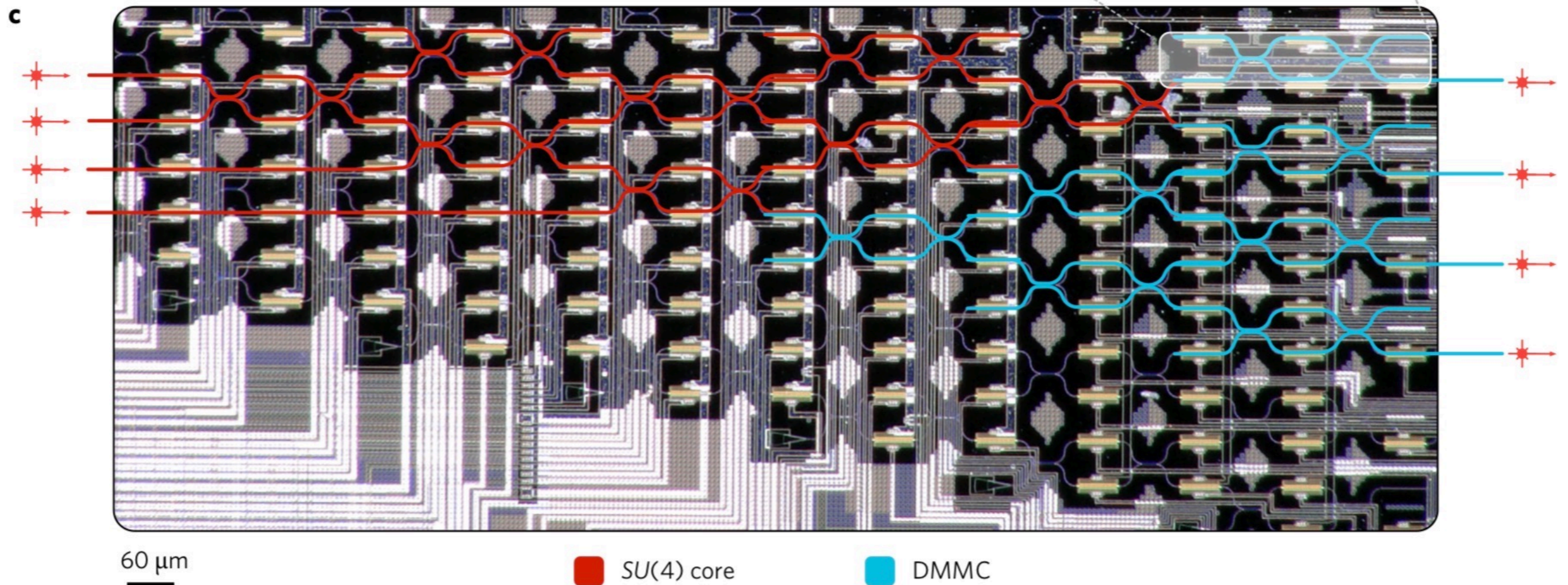
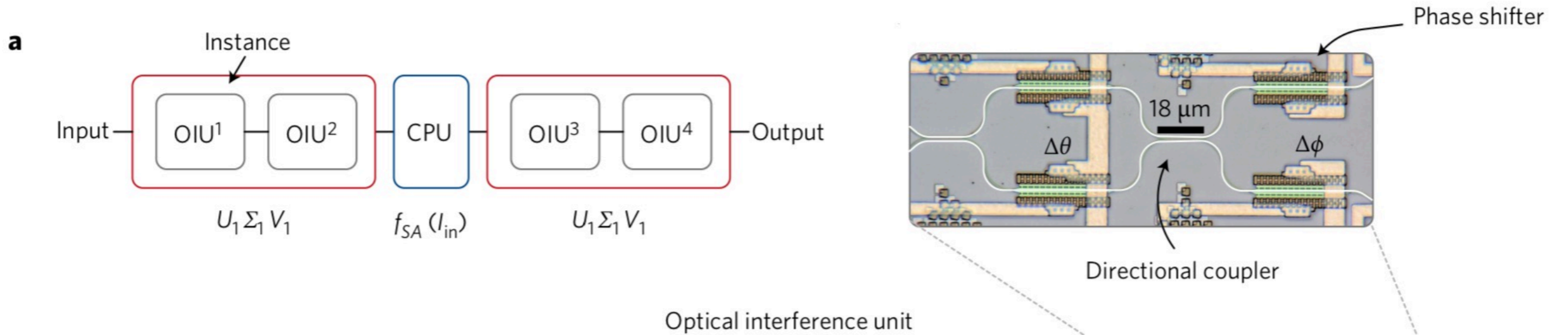


All-optical, fully integrated neural network

OIU*



OIU

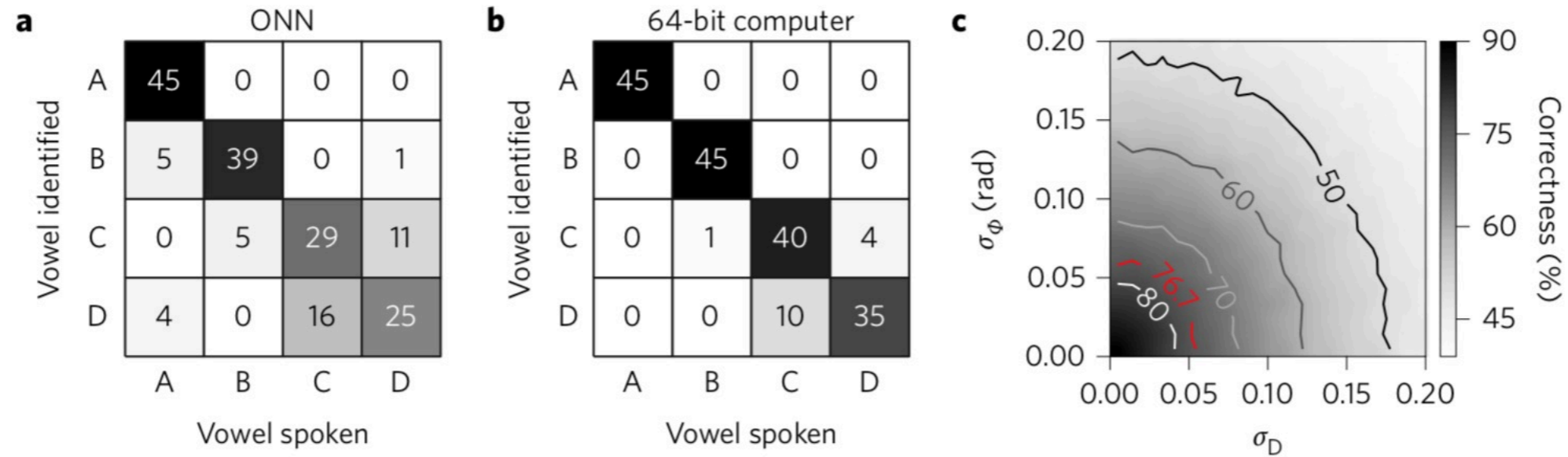


* - Optical Interference Unit

Results

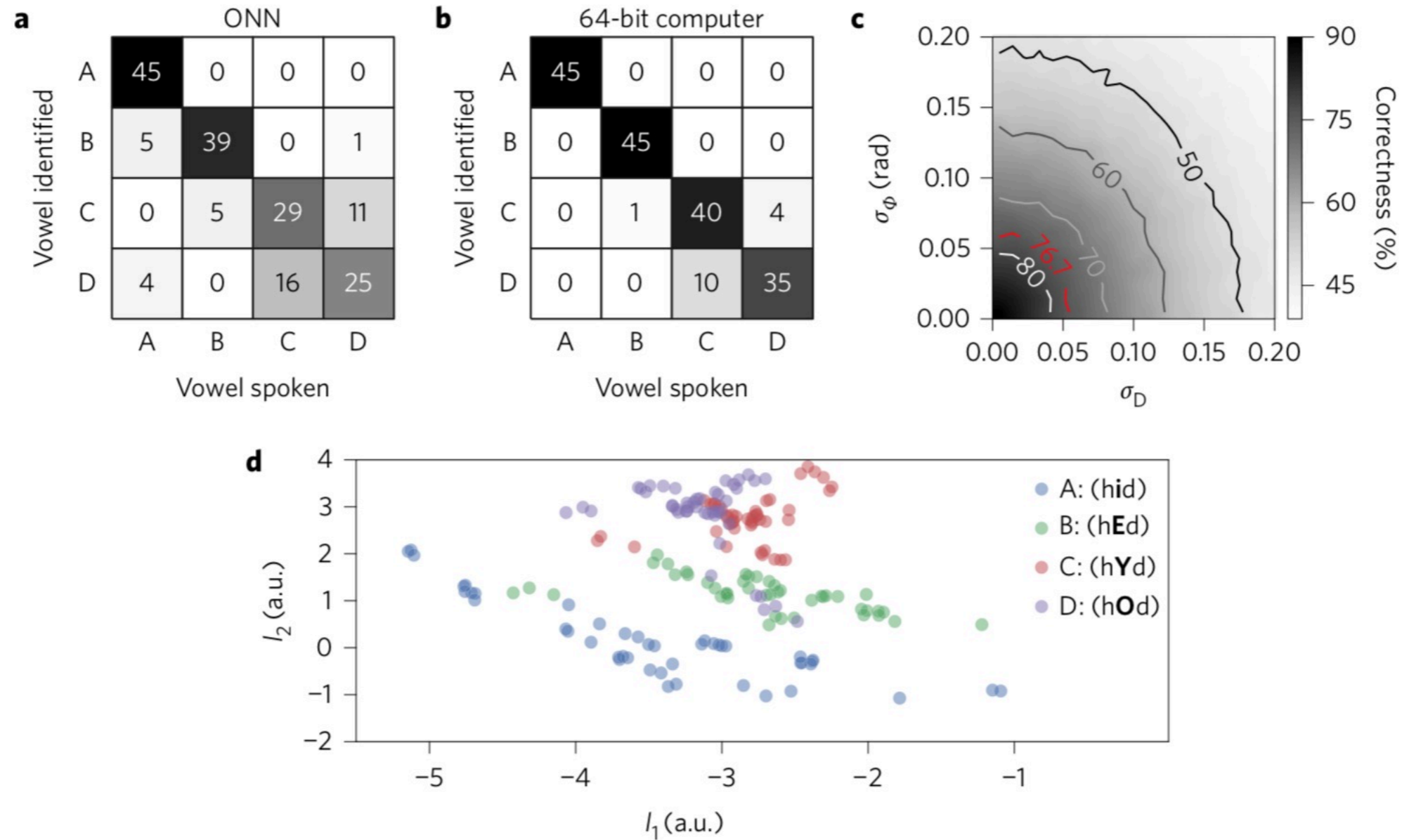
76% (ONN) vs 91% (64-bit computer)
of accuracy

Results



76% (ONN) vs 91% (64-bit computer)
of accuracy

Results



76% (ONN) vs 91% (64-bit computer)
of accuracy

Summary

- Brief introduction to Optical Physics
- Optical Neural Network
- Optical Interference Unit

References

- Deep learning with coherent nanophotonic circuits, <https://www.nature.com/articles/nphoton.2017.93>
- Computing by Means of Physics-Based Optical Neural Networks, <https://arxiv.org/abs/1006.1434>