The Hintons in your Neural Network
A Quantum Field Theory View of Deep Learning

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Background

• Quantum computers perform computations intractable for classical computers.

• Will quantum computers spur the next revolution in AI?

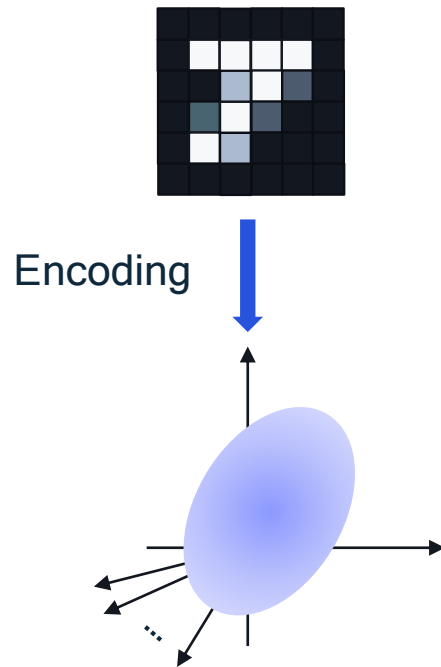• In this work we construct quantum neural networks using quantum field theory
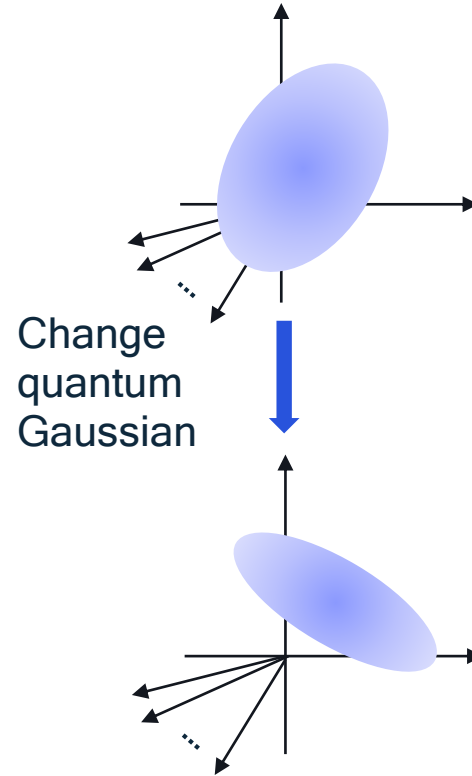

Classical Field

Quantum Field

momentum

position
=
pixel
intensity
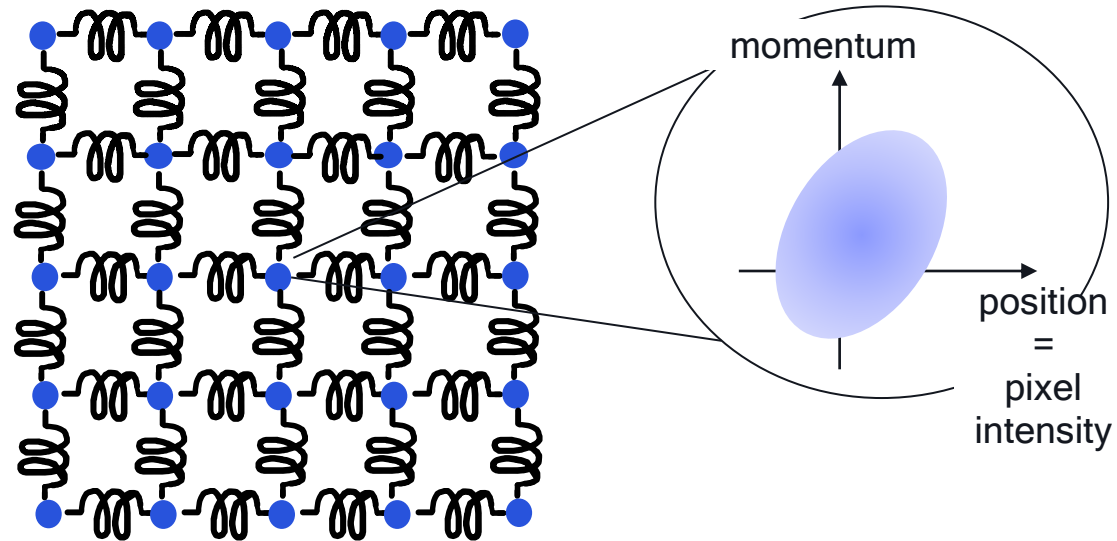
Quantum Neural Network

- **Quantum Gaussian Process**

Encoding

- Interpolate missing data, quantum version of [Finzi et al, ICLR2021]

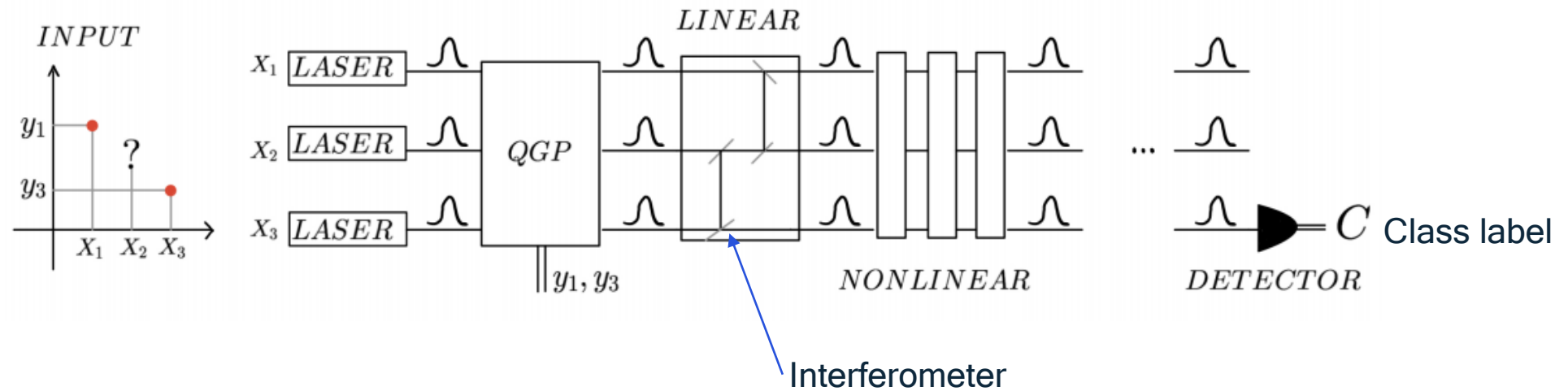- **Quantum Linear Layer**

Change quantum Gaussian

- Cf [Killoran et al, Phys Rev. 2019]
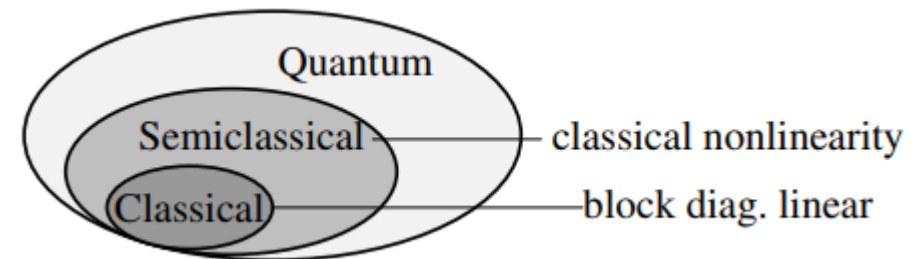
- **Quantum Non-Linearity**
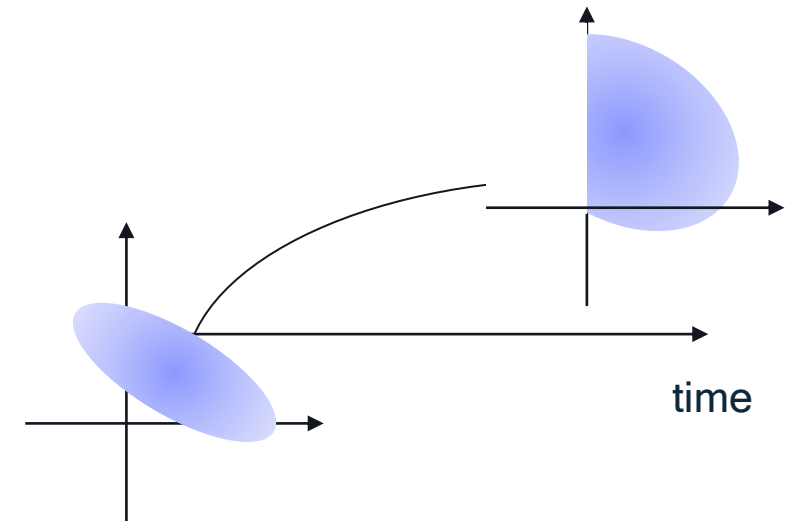
time

- Unitary time evolution that reduces to ReLU when no entanglement
- More efficient than previous proposals
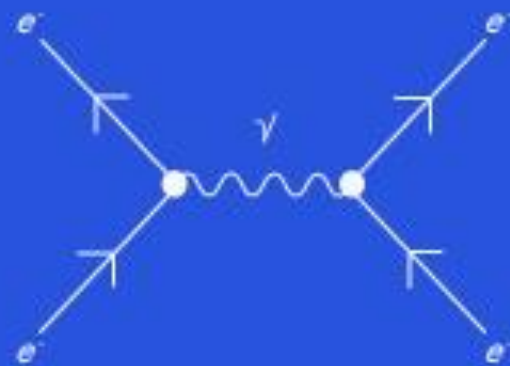
Quantum Optical Implementation

- Our model runs efficiently on an optical quantum computer

- Classical neural networks as particular case

- We study a semiclassical approximation

We've discovered

The Hinton Particle

Particle physics for machine learning

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Thank you

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