



#### Contents



about QuantWare



Off-the-shelf quantum hardware to accelerate the advent of the quantum computer



Why the Open Quantum Approach?





#### Quantum processors were not available on the market



This stifles innovation by being slow, expensive and unreproducible. As the devices scale and become more complex, this problem will become bigger

# QuantWare is the world's first supplier of superconducting quantum hardware, lowering the cost of building a quantum computer 10x today



We are the only supplier of QPUs with:

- Pre-delivery characterisation
- Excellent specs & customizability
- 10x lower cost than competing solutions <u>today</u>

This allows our customers to accelerate their research by:

- Lowering costs by orders of magnitude
- Reproducing setups
- Reducing setup downtime

#### QPUs made by QuantWare team members have powered breakthroughs in the field

We are build on a foundation of TU Delft (Di Carlo group, QuTech) expertise

# Experimentally simulating the dynamics of quantum light and matter at deep-strong coupling

N. K. Langford, R. Sagastizabal, M. Kounalakis, C. Dickel, A. Bruno, F. Luthi, D. J. Thoen, A. Endo & L. DiCarlo 🖂

## Variational preparation of finite-temperature states on a quantum computer

R. Sagastizabal, S. P. Premaratne, B. A. Klaver, M. A. Rol, V. Negîrneac, M. S. Moreira, X. Zou, S. Johri, N. Muthusubramanian, M. Beekman, C. Zachariadis, V. P. Ostroukh, N. Haider, A. Bruno, A. Y. Matsuura & L. DiCarlo ⊡

Experimental error mitigation via symmetry verification in a variational quantum eigensolver

Sagastizabal, X. Bonet-Monroig, M. Singh, M. A. Rol, C. C. Bultink, X. Fu, C. H. Price, V. P. Ostroukh, N. uthusubramanian, A. Bruno, M. Beekman, N. Haider, T. E. O'Brien, and L. DiCarlo nys. Rev. A 100, 010302(R) – Published 31 July 2019

## Logical-qubit operations in an error-detecting surface code

I. F. Marques, B. M. Varbanov, M. S. Moreira, H. Ali, N. Muthusubramanian, C. Zachariadis, F. Battistel

#### M. Beekman, N. Haider, W. Vlothuizen, A. Bruno, B. M. Terhal & L. DiCarlo

High-Fidelity Controlled-Z Gate with Maximal Intermediate Leakage Operating at the Speed Limit in a Superconducting Quantum Processor

/. Negimeac, H. Ali, N. Muthusubramanian, F. Battistel, R. Sagastizabal, M. S. Moreira, J. F. Marques, W. J. Vlothuizen, M. Beekman, C. Zachariadis, N. Haider, A. Bruno, and L. DiCarlo Phys. Rev. Lett. 126, 220502 – Published 4 June 2021



Before the founding of Quantware

NISQ-era algorithm demonstrations (trotterization, VQE, QAOA)

Error correction milestones based on scalable technology

Record-breaking 2 qubit gates

First Quantum Computer in the cloud in the EU

 An awesome team with MSc to post-doc level talent from i.a.
QuTech and Microsoft

Angel investor & scientific advisor Professor Rami Barends (FZJ), Author Google Quantum Supremacy paper

Scientific advisor Professor Charlie Marcus (NBI), Former Director of the Microsoft Quantum Lab and H.C. Ørsted Gold medal recipient

#### QuantWare is an integrated device manufacturer with flexible production capabilities



Our chip element library is continuously improving & expanding e.g.:

- Purcell filters
- Tunable couplers



### QuantWare is an integrated device manufacturer with flexible production capabilities



#### QuantWare is an integrated device manufacturer with flexible production capabilities









**Soprano & Crescendo**, off-the-shelf quantum hardware to accelerate the advent of the quantum computer



Cleanroom

• Expert personnel

Acquisition costs



#### Cleanroom

• Expert personnel

Optimising fabrication recipe requires:

- Fridges
- Measurement personnel

Wide range of

- Components
- A lot of software programs





#### Cleanroom

• Expert personnel

Optimising fabrication recipe requires:

- Fridges
- Measurement personnel

#### Wide range of

- Components
- A lot of software programs

#### Iterations:

- Shieldings
- Housings
- High effective T







#### Even if a CR is available, development of a QPU takes years and costs millions

#### QuantWare's off the shelf quantum hardware is ready to go into your fridge









25-QUBIT QPU CONTRALTO TWPA CRESCENDO

#### Our roadmap allows for scaling to higher qubit counts





**Open Quantum Approach** opens up quantum innovation



#### **Component-based quantum computers**

- Not a fixed system
- Interchangeability
- Boosts performance
- Reduces costs

Quantum algorithms

System integration

Control electronics

Cryogenics & interconnects



Quantum processor



#### **QPUs:** The past, the present and the future

- In the past, people had their own libraries
- At present, open-source packages
- In the future we expect professional design software to take over



Quantum processor



# The scaling of devices will introduce mixed-IP processors to the industry



Tenor will act as a platform for our customers to scale and integrate their IP into state of the art setups

## The scaling of devices will introduce new business models

•

•

Semicon Market size over time



Quantum is here

# INTERESTED?

Contact us at www.quantware.eu or at pepijn@quantware.eu



QUANTWARE

**Pepijn Rot** Partnership manager