Terra Quantum

Future Health Basel

# Your Quantum Prescriptions

## How quantum algorithms can drive innovation in life sciences

**Vishal Shete**
Managing Director, UK & Global Director of Commercialization
Terra Quantum

# Why are we here?

# c.90% of drugs in the market

only work for 30-50% of the population

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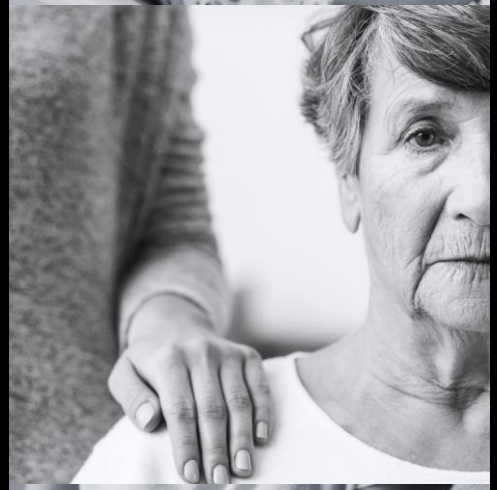
# 7% of all hospital admissions

Are due to adverse drug reactions

Source: The Pharmaceutical Journal & NHS

**The current efficacy rate**
**of standard drug treatments**
**commands improvements**

Cancer:
25%



Alzheimer's disease:
30%

Diabetes:
57%

Source: FDA

We need to focus our efforts on powering the paradigm shift in medical treatments

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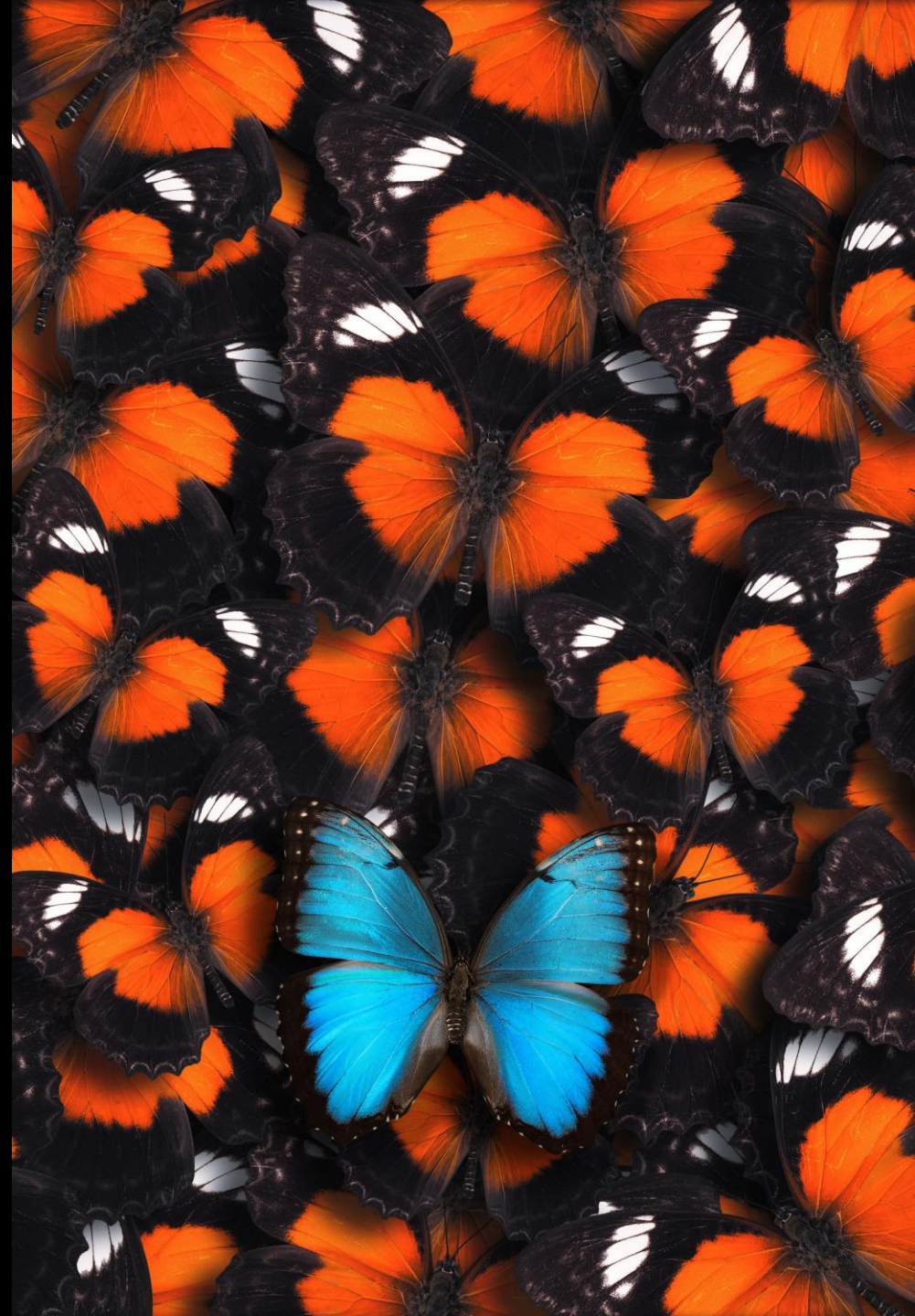
From “one size fits all”

To personalised medicine.



# To truly understand each individual, we need to understand them at the deepest level

This journey begins with simulations at the molecular level, followed by interconnected systems, then organs, leading to a truly unique digital representation of the human body.

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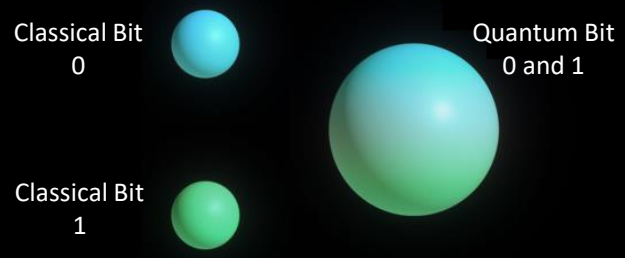
# Quantum computing is driven by two key properties which enable exponential scale…

Quantum Superposition




+

Quantum Entanglement

… breaking the glass ceiling of traditional information processing and tapping into the power of nature at the smallest scales.

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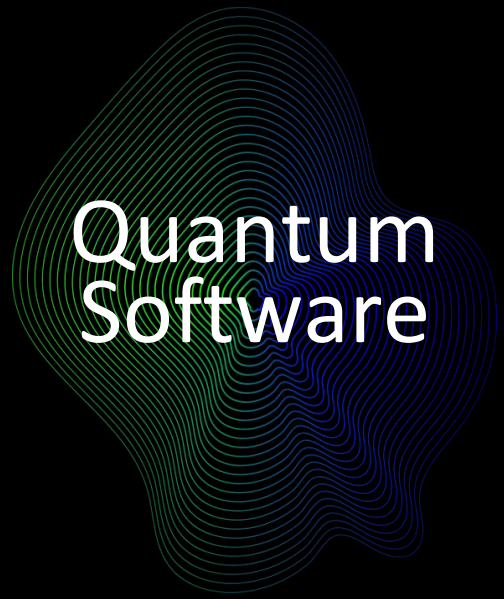
# Hybrid Quantum Computing: Delivering Impact Today and Exponential Improvement in the Future

GPUs Transformed AI.
Now They're Here For Quantum.



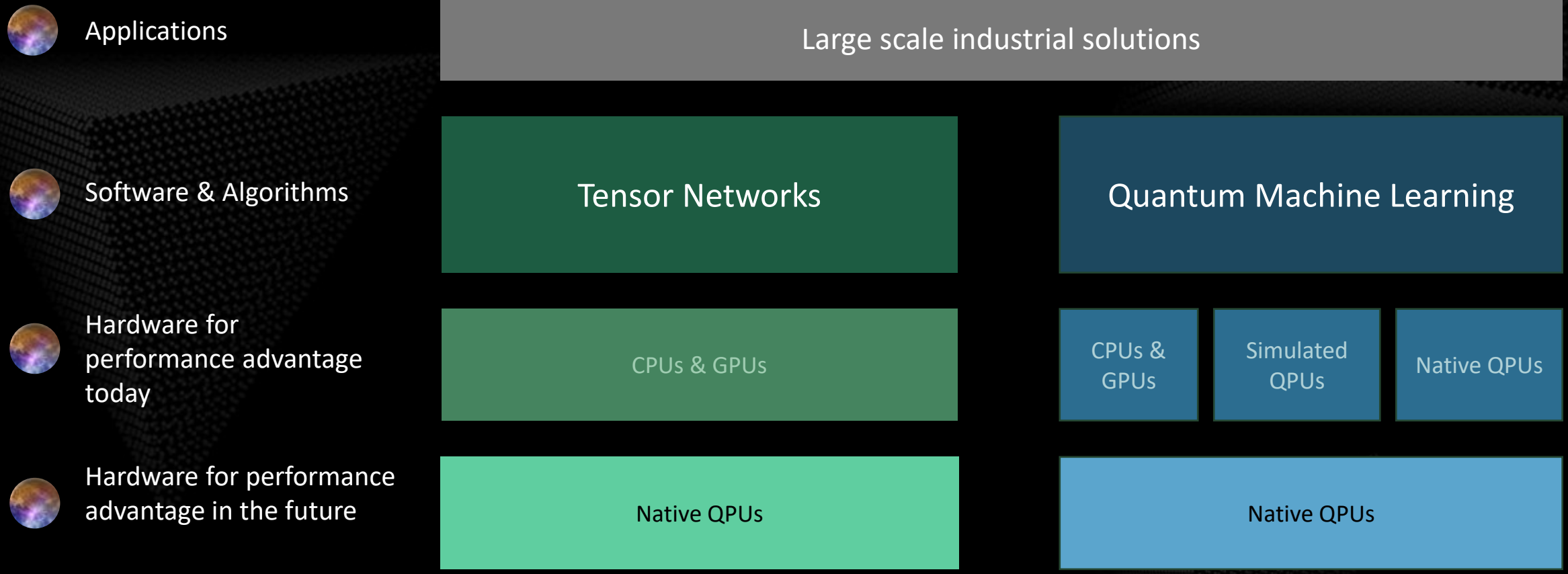

BEST COMPUTE PLATFORMS OF TODAY

Performance advantage on CPUs, GPUs, Simulated Qubits, etc

NATIVE QUANTUM COMPUTERS

Improved performance on large scale QPUs of tomorrow

# Leveraging our capabilities in Tensor Networks & Quantum Machine Learning



# Quantum Software can deliver impactful solutions today

## Optimise

**>15x**

Faster &
more accurate

## Augment

**~30%**

More accurate
with lesser data

## Simulate

**~200x**

Faster

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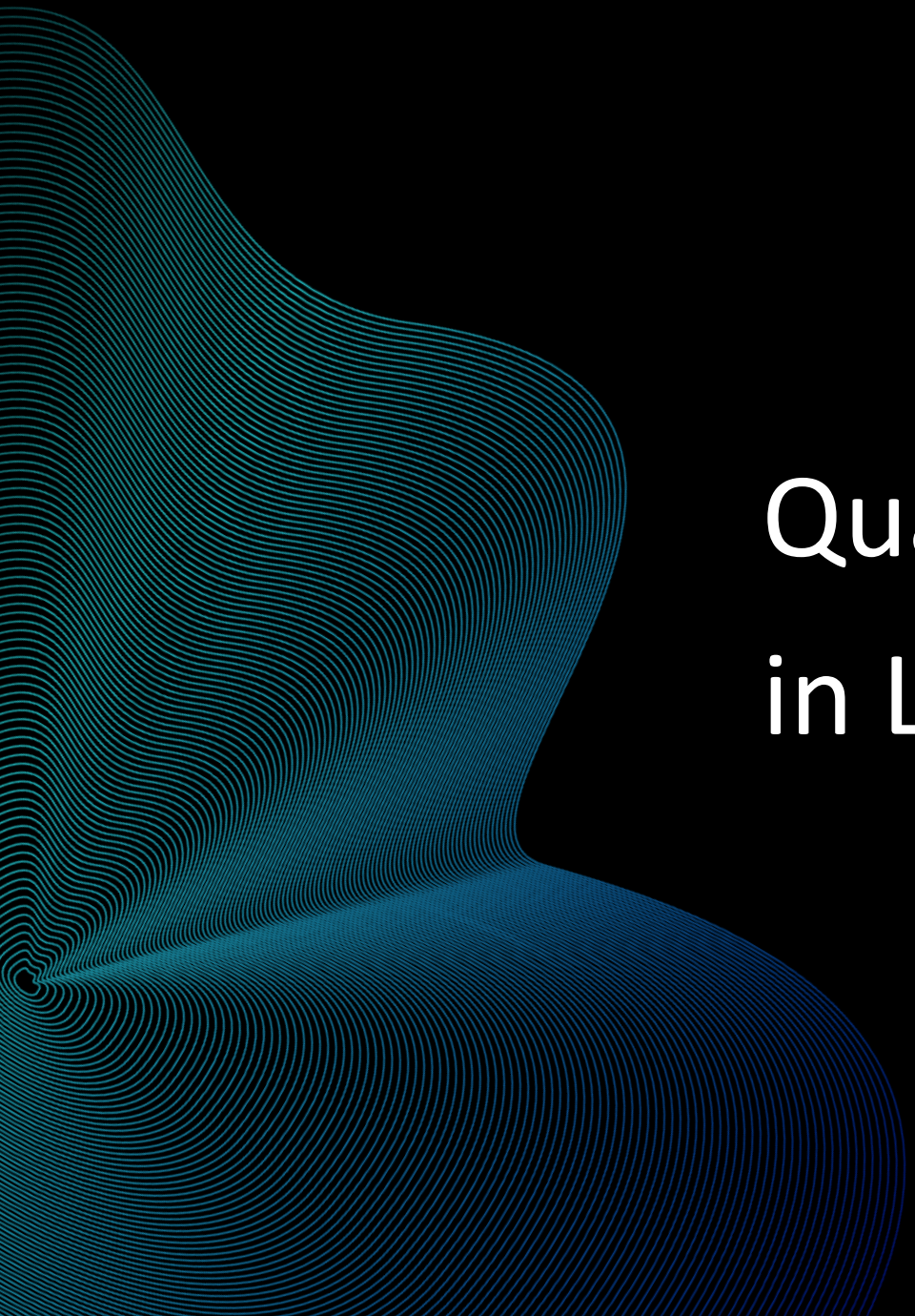
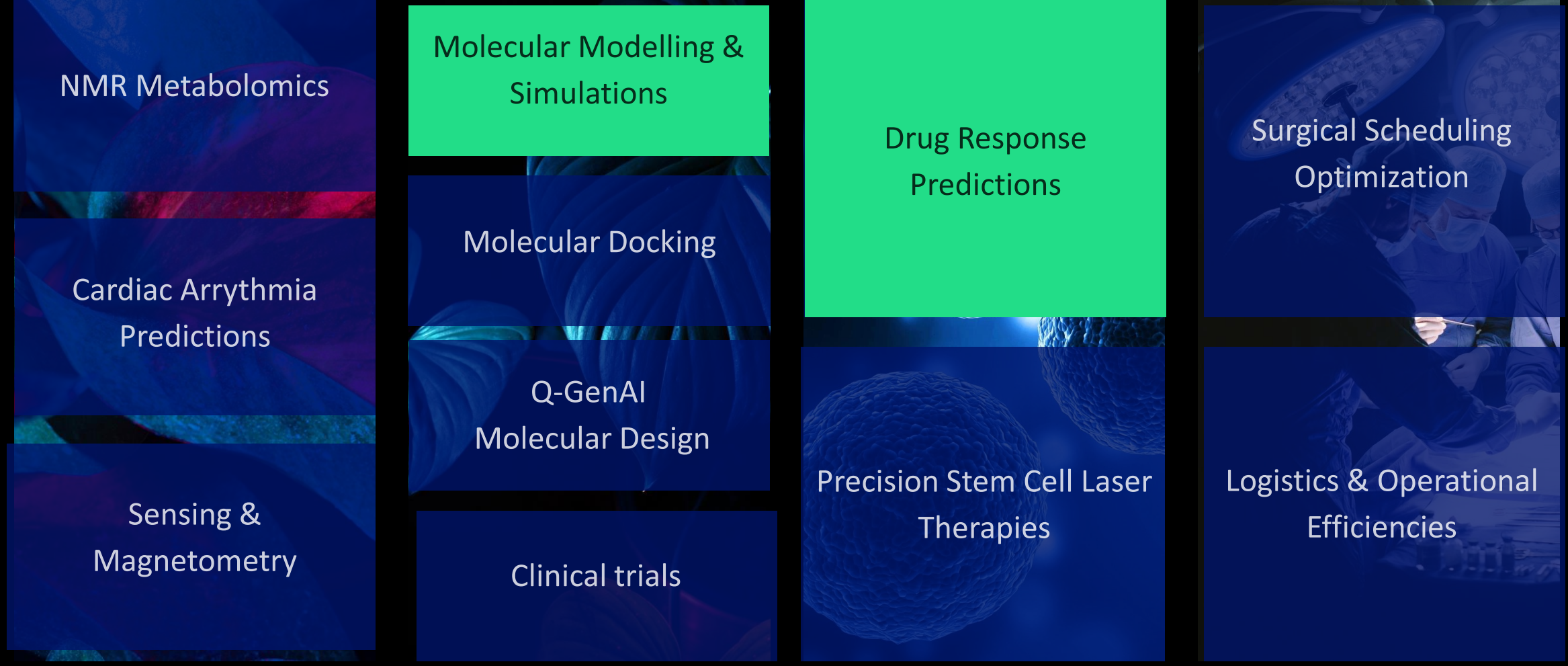


# Quantum Applications in Life Sciences




Diagnostics

Drug Discovery & Development

Precision Therapies

Healthcare Operations

Our work spans various life sciences & healthcare applications

# Shortening the Path Towards Hyper-targeted Treatments

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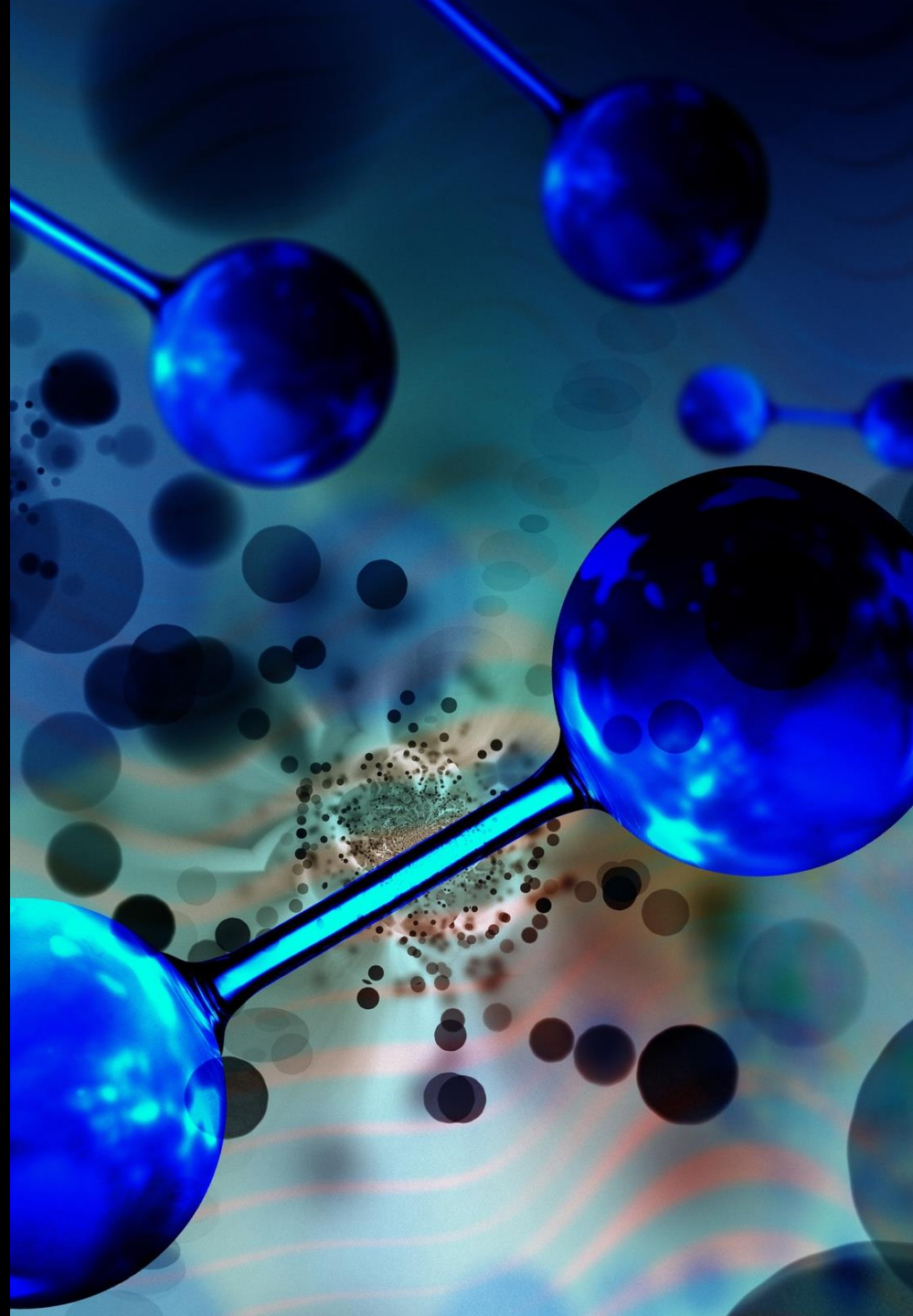
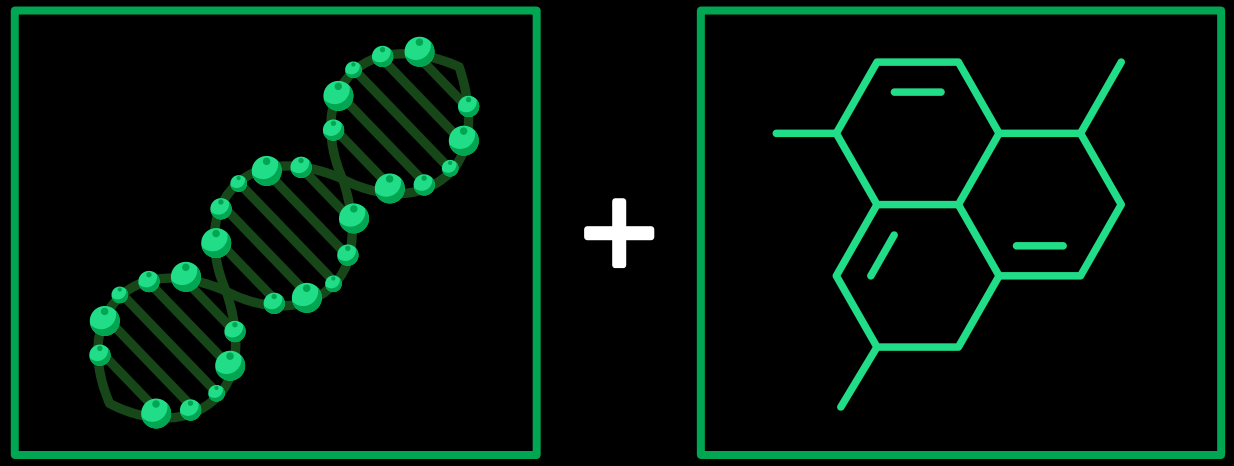
More accurate predictions with less data



Even when considering a particular type of cancer, there are many subtypes of cancer that exist, expressed in a large range of cell lines.

By understanding the structure of the cancer cell line and of the related drug, we are able to predict their interactions and hence anticipate the drug's effectiveness.

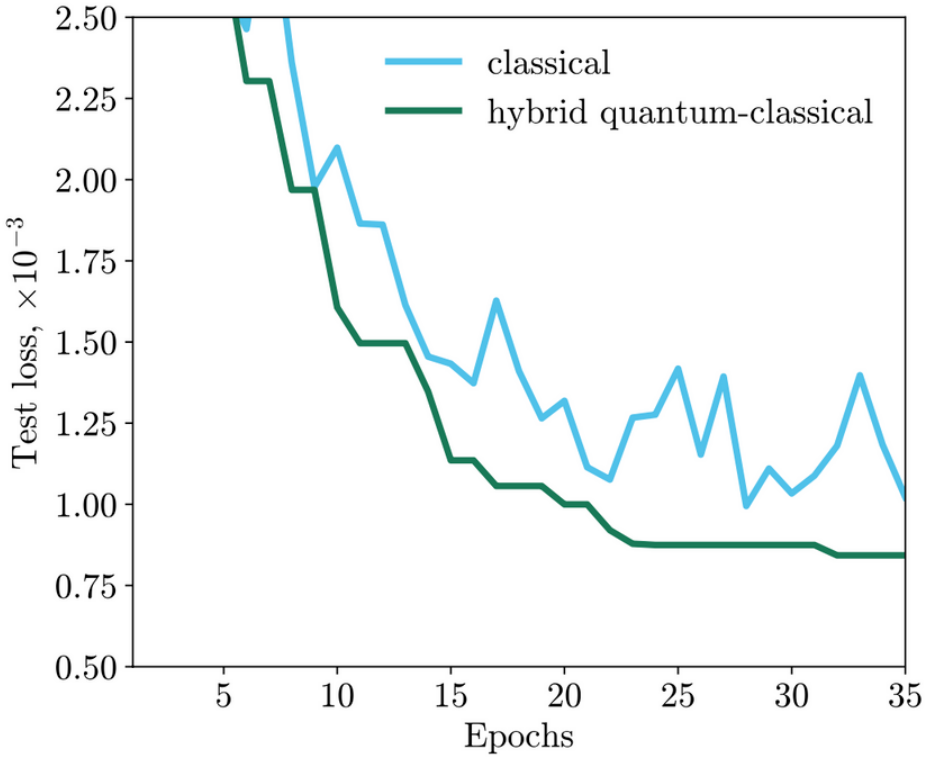
We ran a study of such interactions



Encoded into a Neural Network of 256 nodes

Quantum Depth-Infused Neural Network with 8 qubits

# The Terra Quantum quantum-enhanced approach delivered 15% accuracy improvement in predicting the cancer drug response




15%

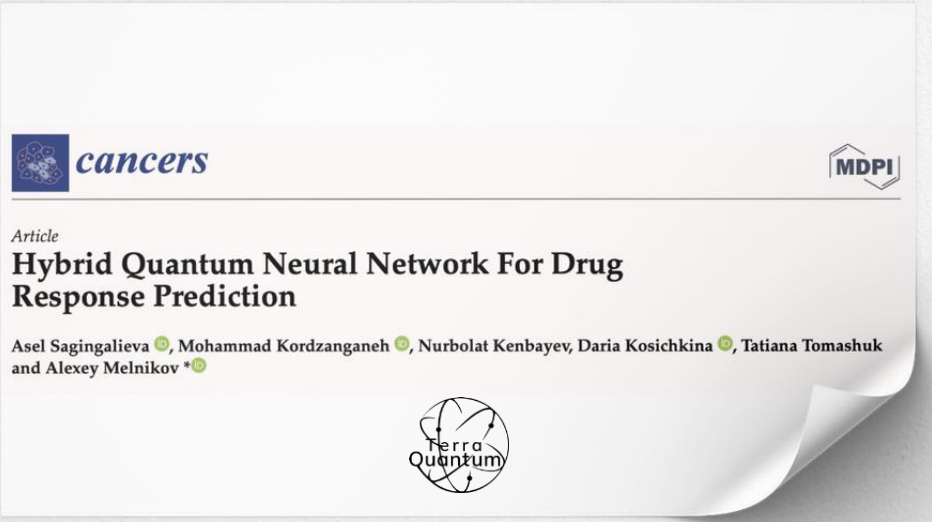
Improved prediction accuracy

Databases used:

wellcome sanger institute

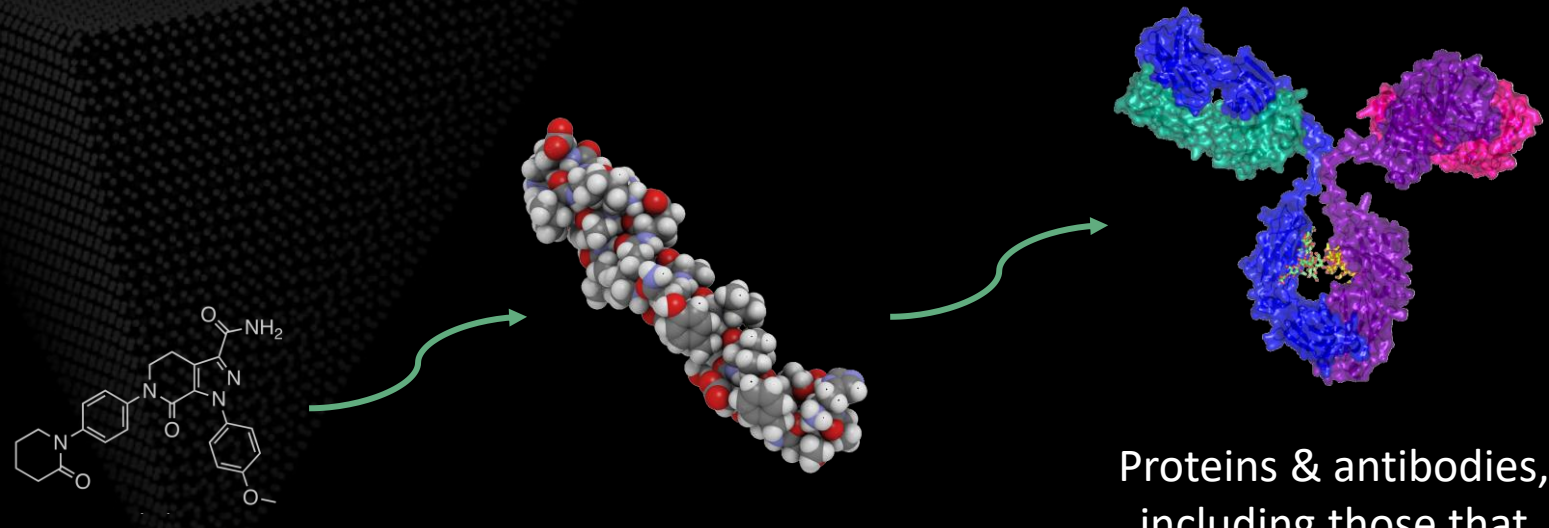
MASSACHUSETTS GENERAL HOSPITAL CANCER CENTER

The results and detailed methodology are published in the Cancers Journal



# Our vision is to create the world's most advanced molecular structure modelling tool that can accelerate drug development

## Our pathway for molecular structure modelling




## Additional future functionality

- Optimisation of antibody sequences
- Protein – protein interaction modelling
- Broader optimisation of antibodies

Our methods can work with existing molecular structure prediction tools (such as Alphafold) but are not limited to the molecules considered here and can also produce greater levels of accuracy.

# Key reasons why our solutions deliver benefits versus alternatives

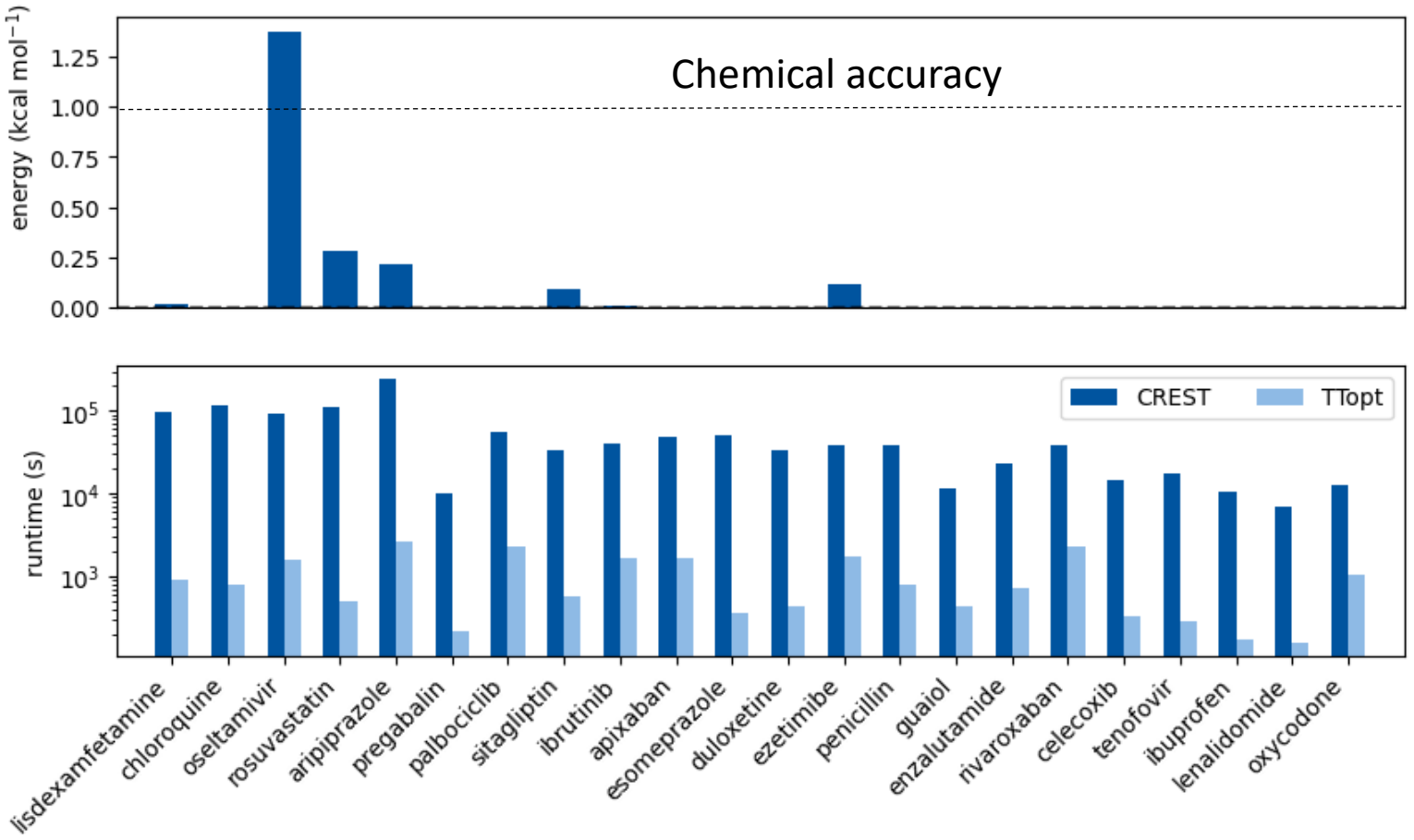
Better quality solutions: Our methods are highly suited to navigating complex landscapes for optimisation problems and achieve better quality solutions with diversified answers.

Significant speed up: The improved speed delivered by our solutions allows deployment of methods that were previously computationally too expensive or considered unfeasible.

Greater generalisability: Our solutions do not require training data, unlike many other machine learning / AI based methods. This allows our solutions to be generalised to cases where there is limited training data or of poor quality.

# TTConf: Accelerating Conformer Sampling for Druglike Molecules

## TTConf vs CREST: comparison of runtimes and energies



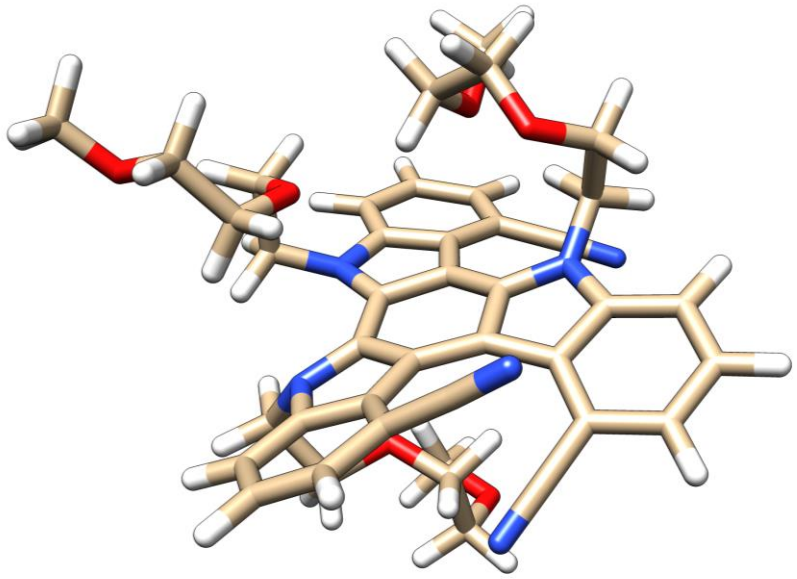

TTConf achieves chemical accuracy 10-100x faster than CREST

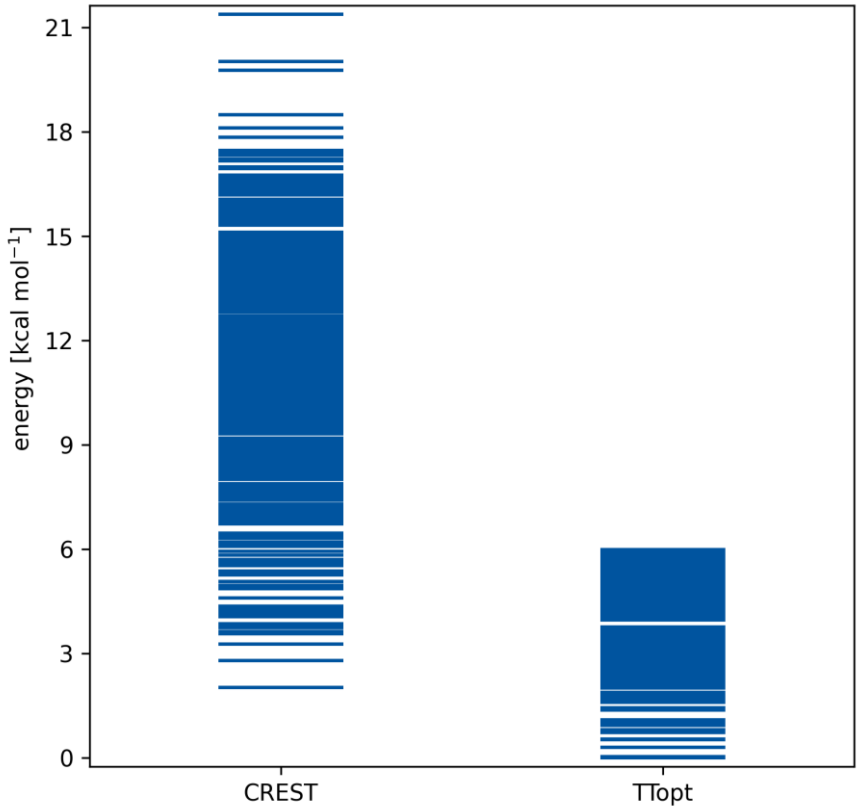
system specifications
Intel® Core™ i7-11700 @ 2.50 GHz
24 GB | 8 Threads

TTConf settings
2 sweeps | rank = 4
grid in degree = [30, 60, …, 330]

# TTConf: Optimizing Flexible Molecules and Beyond

Case Study: Optimizing a nonlinear Catalyst






TTConf achieves chemical accuracy in 2:38 h using 8 threads

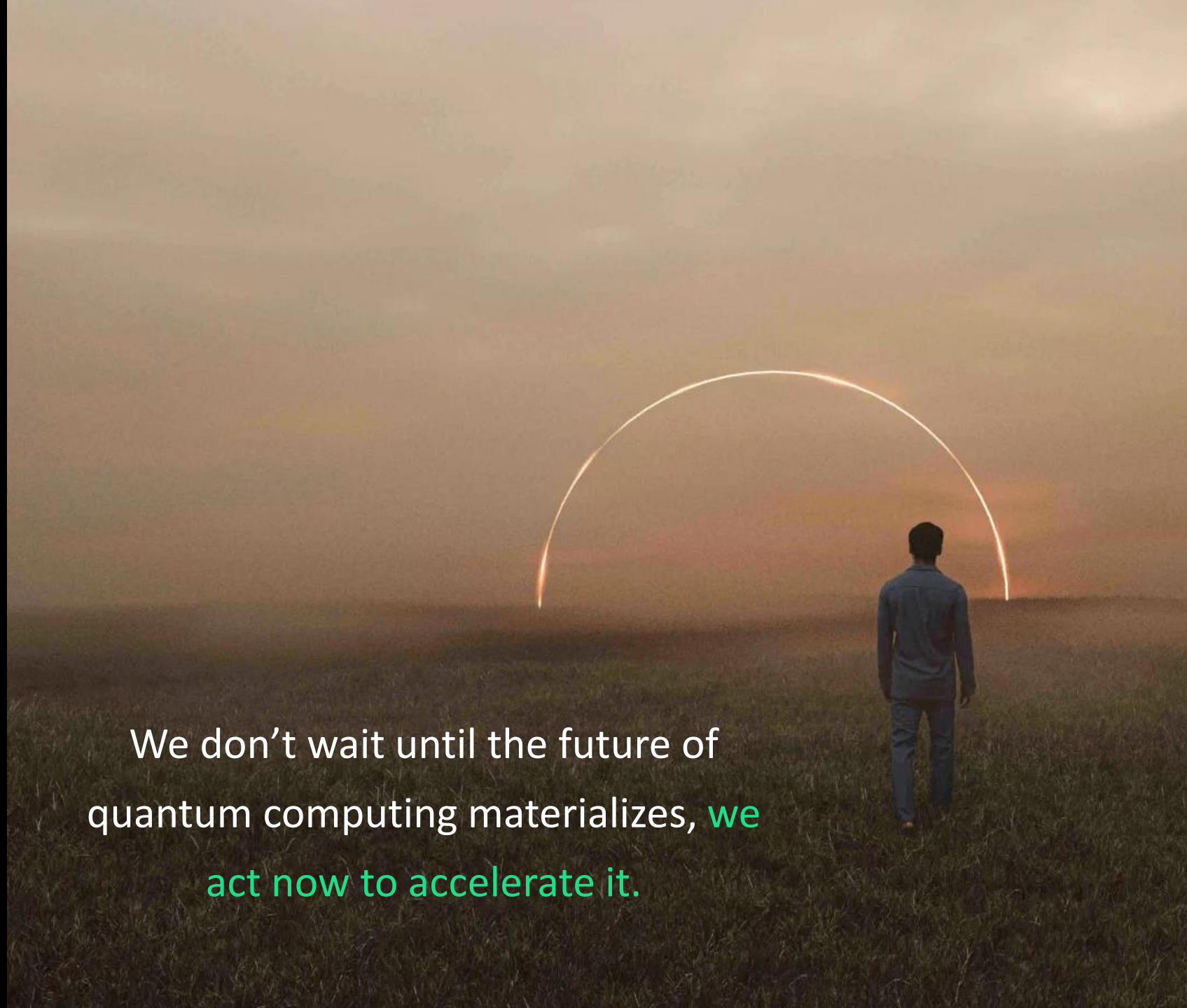
CREST takes 12:30 h using 24 threads

Potential applications:

- Screening various databases
- Extension to tree tensor networks

Online-Demo of TTConf available

At Terra Quantum, we recognize the importance of advancing this field and have therefore made the healthcare domain a key part of our focus



# Thank you!

Let’s connect on LinkedIn

vs@terraquantum.swiss

Terra Quantum AG

Vishal Shete

Managing Director, UK

Global Head of Commercials & Client Solutions

Terra Quantum