Get ready for a quantum career

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Alberto García García

accenture

# The Quantum Advisor Team

Alberto García

Alberto García is a Quantum Information Scientist at Accenture. His focus has been researching and developing computational methods for solving real-world problems with business value. He also develops insights from data analysis and applying it into a specific industry.

Graduated on Physics by the Universidad Complutense de Madrid and specialized on Quantum Computing in the TUM. His TFG covers topics of Quantum Information, especially Quantum Cryptography. He also studied a Master on Theoreticla and Compùtational Chemistry in UAM while he was working at Accenture. He is now studying a MBA at EAE Business School.

Experience as programmer in the Nuclear Physics Department of the TUM. Investigating the purity of different elemental particles in a nuclear collision; as well as collaborating in certain Quantum Computing projects while his stay in Munich. Several experience with gate-model and adiabatic quantum computers.

He is also student in some Quantum Technologies master. He is currently teaching the practice subject of the quantum computing at the Quantum Technologies Master of the Universidad Politécnica de Madrid.

His main interest is working on cutting-edge technologies and how to implement them to solve real business problems. He wants to help people by the application of these technologies as well as advicing students how wants to grow up in his career.
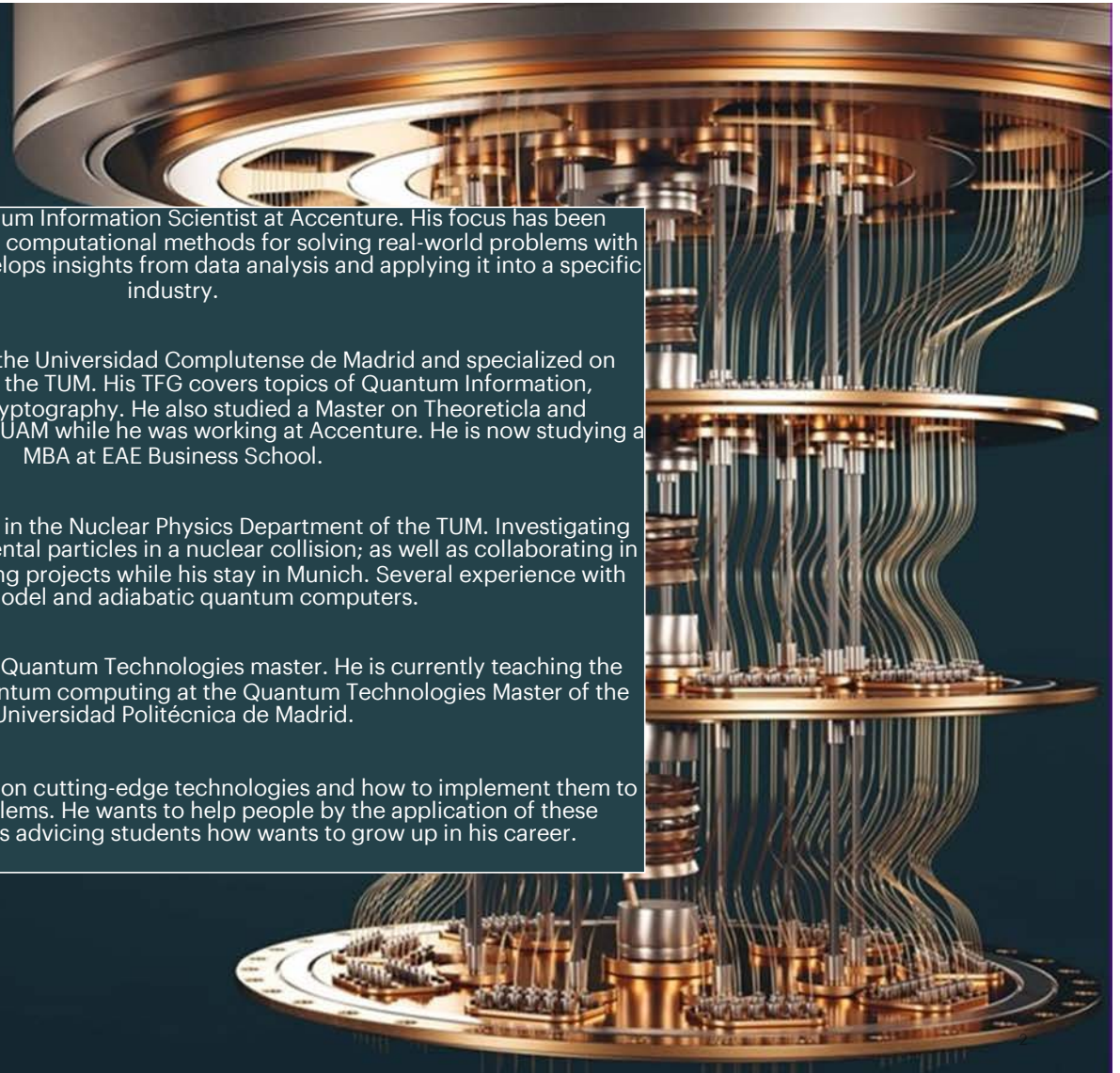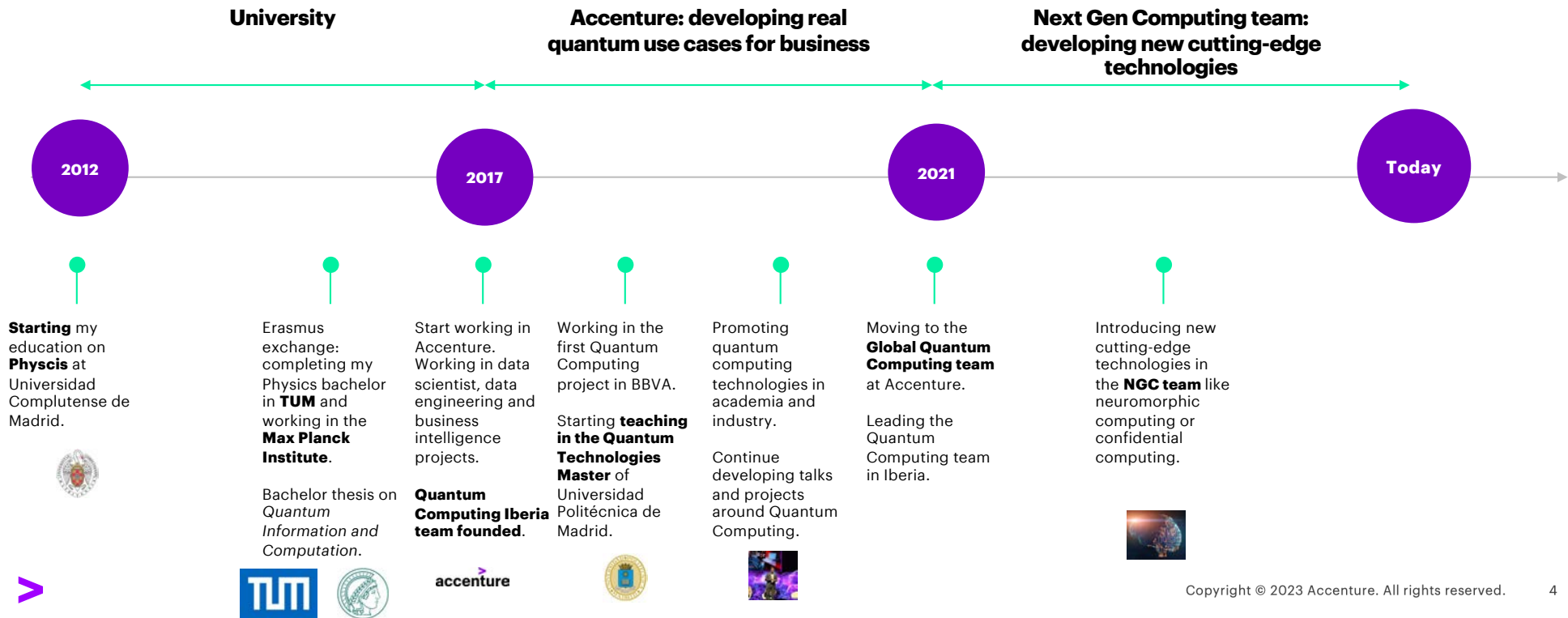
About me and my career

My career
How do I become a quantum leader

Quantum Computing it's in an early stage of maturity but academia and industry is starting working with it due to its potential

University

Accenture: developing real quantum use cases for business

Next Gen Computing team: developing new cutting-edge technologies

2012

2017

2021

Today

Starting my education on **Physcis** at Universidad Complutense de Madrid.

Erasmus exchange: completing my Physics bachelor in **TUM** and working in the **Max Planck Institute**.

Bachelor thesis on *Quantum Information and Computation*.

Start working in Accenture. Working in data scientist, data engineering and business intelligence projects.

Quantum Computing Iberia team founded.

Working in the first Quantum Computing project in BBVA.

Starting **teaching in the Quantum Technologies Master** of Universidad Politécnica de Madrid.

Promoting quantum computing technologies in academia and industry.

Continue developing talks and projects around Quantum Computing.

Moving to the **Global Quantum Computing team** at Accenture.

Leading the Quantum Computing team in Iberia.

Introducing new cutting-edge technologies in the **NGC team** like neuromorphic computing or confidential computing.

How is quantum computing different?

University

Academia

Evangelization

Quantum computing at Accenture

Quantum acceleration

Disruption.
It can happen
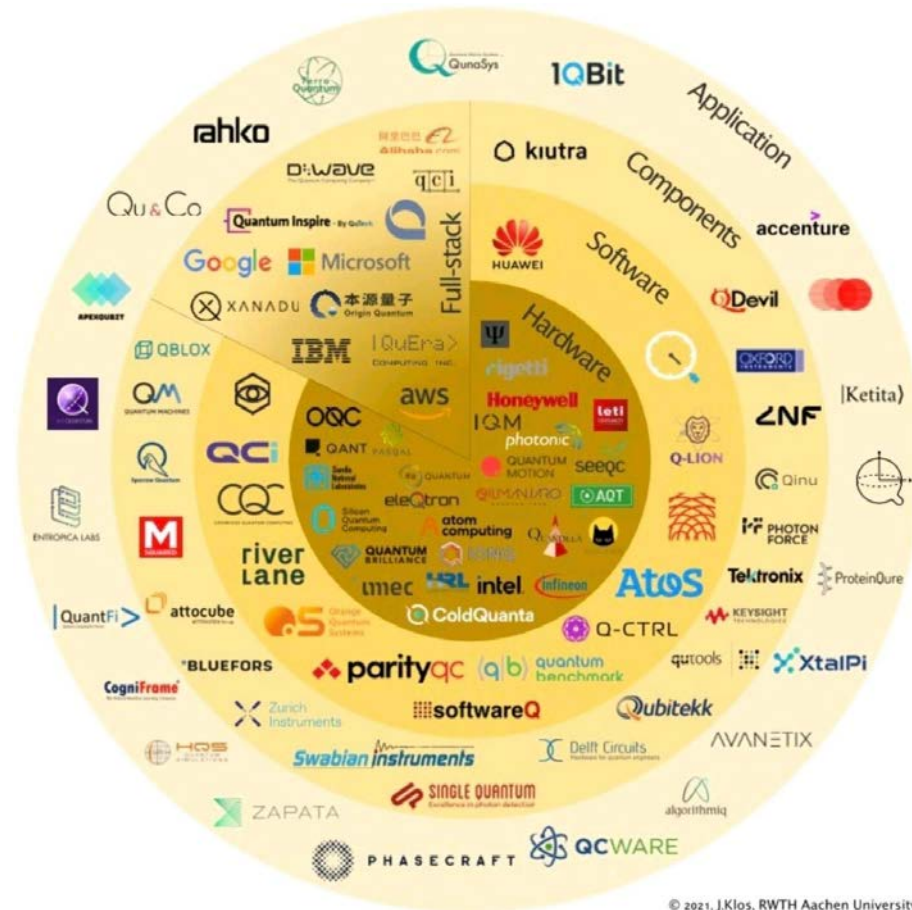## overnight.

97 %

agree that:

Quantum computing will provide enormous growth for my company comparable to the growth we have experienced from AI.

Source: *Accenture survey,*
New York metro area

>

Quantum players

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Quantum computing ecosystem is constantly growing. It is only the beginning!

How quantum technology benefits your business?

Accenture's Quantum Foundry

The Quantum Foundry provides an overall framework of talent, execution capabilities, technologies, ecosystem partnerships, assets, and methods to support the ability to drive quantum initiatives to scale and drive business value.
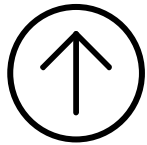
Benefits of the Foundry

- Combines strategy definition with agile test and learn experimentation
- Reduces delivery duration
- Delivers outcomes, not propositions
- Has the ability to quickly ramp up and down to meet demand

Talent & new ways of working	Vision & strategy	Analytics & data science	Labs & innovation centers
Governance & change management	Accenture's Quantum foundry		Research & development
Enabling services	Product management	Architecture & engineering	Partnership & ecosystems

Explore quantum

Shift the enterprise approach

Current norm: Niche and R&D industrialization

Bottom-up funding

Single business challenge

Working within a limited ecosystem

Hit and miss sparks

Labor-intensive, time-consuming, siloed

Misses the wider applicability

Outputs, such as IP/research papers not re-usable across broader enterprise

Explore quantum

Our vision: Business-centric industrialization

Top-down funding

Designated Quantum leads, not just from IT, but business

Ideas and innovation that lead more directly to business value

Quantum integrated into the enterprise infrastructure

Innovate at speed and scale
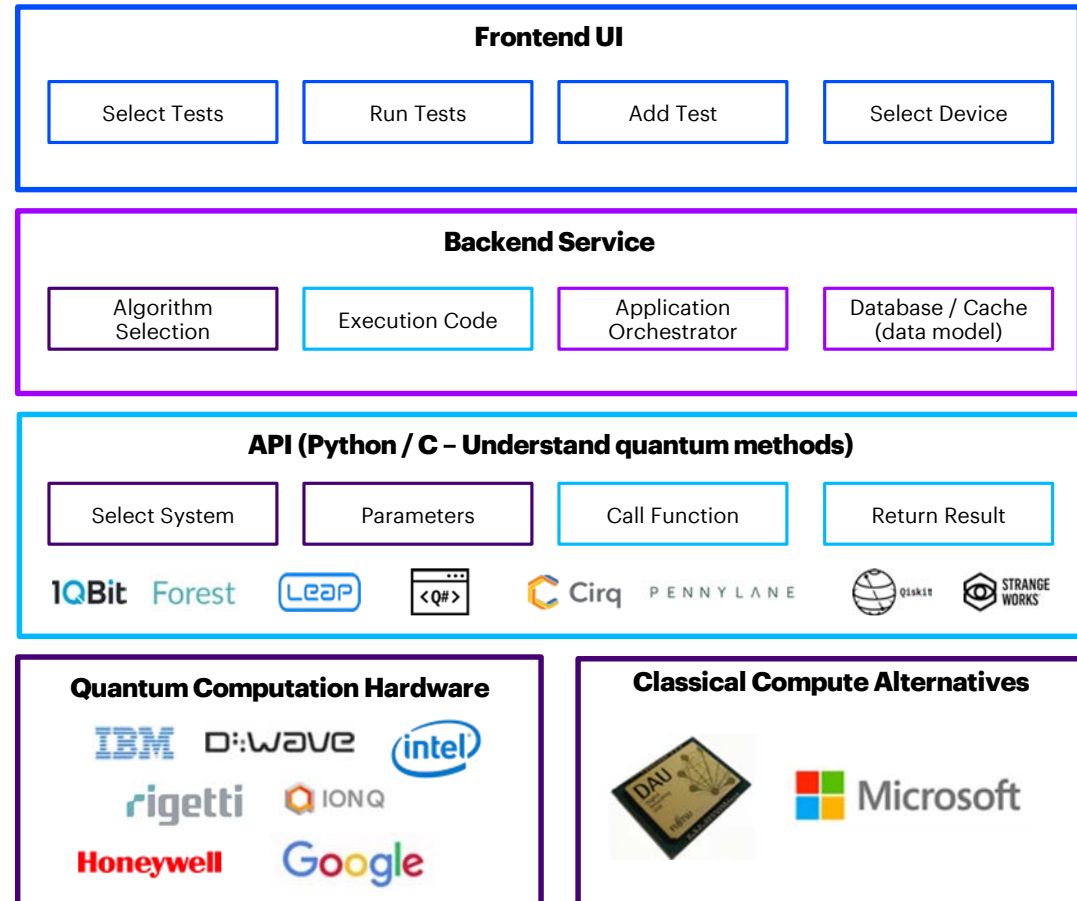
Differentiation in the market

Quantum at scale

Creating useful quantum applications means leveraging the best technology across many parts of the ecosystem and having the right talent at all layers of the stack.

The Q stack

Multidisciplinary approach to quantum development

- ● Industry Expertise
- ● Delivery Leadership
- ● Service Designers
- ● System Architects
- ● Quantum Integrators
- ● Quantum Info Scientists

Frontend UI

Select Tests	Run Tests	Add Test	Select Device

Backend Service

Algorithm Selection	Execution Code	Application Orchestrator	Database / Cache (data model)

API (Python / C – Understand quantum methods)

Select System	Parameters	Call Function	Return Result

1QBit Forest Leap <Q#> Cirq PENNYLANE Qiskit STRANGE WORKS

Quantum Computation Hardware

IBM D:WAVE intel rigetti IONQ Honeywell Google

Classical Compute Alternatives

DAU Microsoft

Where to start?

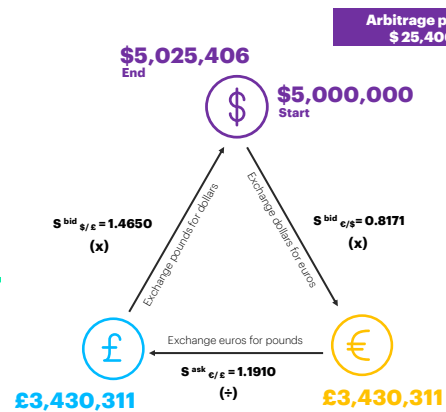Quantum workshops, business experiments and projects…

With quantum advantage on the horizon, learning about quantum computing and experimenting with the technology is just the beginning. Accenture is ready to engage in a way meaningful to your business.

Type	Workshop					Project				Program		
	Showcase demos	Quantum intro	Education workshop	Ideation workshop	Quantum day workshop	Hack-a-thon	Code spike	Business experiment	Quantum-inspired application	Innovation services	Quantum foundry	Quarterly quantum brief
Description	Spotlight on a quantum and its applications today	Overview of quantum technology, benefits, ecosystem, and applications	Deep dive into quantum computing with industry focus	Exploration of quantum's impact and use cases in a business	Multi-client event including education and use case selection with vendor and university partners	Pair developers for a crash course in quantum tools to create a functional Proof of Concept	Prearranged topic in which a team of developers work on an advanced Proof of Concept	Structured project with Discovery, Proof of Concept, and Prototype phases	Future proof an application by implementing a quantum-inspired program leveraging best in class classical hardware	Strategic analysis of quantum computing and multiphase business plan for quantum readiness	Repeatably build quantum ready applications from from your prioritized quantum adoption strategy	Invite your client to attend the quarterly quantum update series
Duration	<30 mins	30 mins – 1 hour	½ day – 1 days	½ day – 1 days	1 day	1-2 days	3 weeks prep and 1 week onsite	12 – 16 Weeks	Custom Timeline	Custom Timeline	Custom Timeline	2 Hours / 1 Day

Immersion   **Tactical next steps**   **Strategic next steps**

Currency arbitrage

D:Wave
The Quantum Computing Company™

In this demo the currency arbitrage problem is formulated as an optimization problem over a graph and translated to a quadratic unconstraint optimization problem solvable in D-Wave quantum processor.

Arbitrage profit $25,406

$5,025,406
End

$5,000,000
Start

$ \$ bid $/£ = 1.4650
(x)

$ bid €/$ = 0.8171
(x)

Exchange pounds for dollars

Exchange dollars for euros

Exchange euros for pounds

£3,430,311

$ ask €/£ = 1.1910
(÷)

€3,430,311

Tools

- Quantum Hardware (Annealer)
- Simulator
- Ocean
- Python

Result

Problem specification
Finding the most profitable arbitrage opportunity in a given set of currencies

Experiment Data Set
Cryptocurrency data from forex

Custom Enablement
Mapping the problem to a quadratic unconstrained binary optimization problem

Molecular comparison

IBM **Q**

Virtual screening for small molecules is a challenge faced by all pharmaceutical companies, this demo provides a rendered visualization of molecules.

Tools

- Quantum
- Quantum Simulator
- Classical computer

Result

Problem specification
Text based information classifier

Experiment Data Set
Extracts from the open PubChem dataset

Custom Enablement
Combining Unity as a rendering engine with QISKIT

Quantum intelligent power scheduling

The scheduling of charging/ discharging of high-capacity batteries based on energy prices to maximize profit can be formulated as a Quadratic Unconstrained Binary Optimization (QUBO) problem.

Applying a quantum annealing algorithm to the QUBO formulation of the electricity trading use case can produce high-quality power trading solutions, leading to increased trading profits, reduced computational costs, and reduced degradation of power grid systems.

Tools

- Quantum Hardware (Fujitsu Digital Annealer & Microsoft's QIO)
- Simulator
- Docker
- Django
- D3JS
- React

Result

Problem specification
Profit optimization through quantum enhanced battery power scheduling

Experiment Data Set
Based on the time interval & # of batteries, energy prices from real historical data will be used

Custom Enablement
Implemented and optimized a unique mapping to a quadratic problem

Aircraft loading optimization

D:Wave
The Quantum Computing Company™

A combinatorial approach is taken to solve this hard optimization problem. The aircraft loading optimization problem is translated to a quadratic unconstraint optimization problem and is solved with D-Wave annealer. A hybrid approach is taken in order to being able to solve the whole problem provided by Airbus.

Tools

- Quantum Hardware (Annealer)
- Simulator
- Ocean
- Python

Result

Problem specification
Finding an optimal distribution of packages along the planes respecting all constraints

Experiment Data Set
Dataset provided by Airbus

Custom Enablement
Implemented and optimized a unique Mapping the problem to a quadratic unconstrained binary optimization problem

Record-breaking Million Core Simulation of PFAS Chemistry
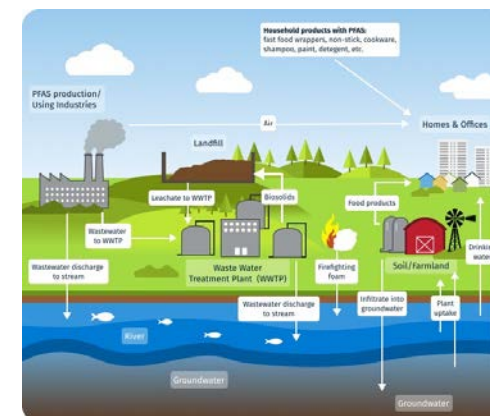
CONTEXT

- PFAS are artificial chemicals widely used in packaging, paints, etc.

- They do not biodegrade and cause **detrimental health issues** such as cancer.

- Computational chemistry can speed up the R&D process for breaking PFAS.

- Accurate **simulation has been intractable** due to computational complexity.

SOLUTION

- Following **Accenture's two-year collaboration with ICHEC** in PFAS chemistry

- A three-phase scale-up plan with three target molecules.

- Combined a novel quantum chemistry algorithm (iFCI) with a custom HPC in AWS.

- Massively scale up **Good Chemistry**'s software to run on **millions of vCPU cores on non-reserved resources** of AWS
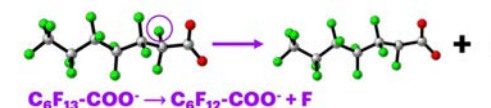
IMPACT

- Accurate energies for **breaking carbon-fluorine bonds** in three PFAS molecules

- The results are **record-breaking** achievement in terms of scale and accuracy.

- It will help scientists to study PFAS destruction methods

- Paved the way for **on-demand cloud HPC as an affordable, green, and scalable** paradigm for scientific computing.

US government estimates that PFAS is present in 98% of Americans' blood.
https://www.atsdr.cdc.gov/atsdrtoday/stories/pfas.html

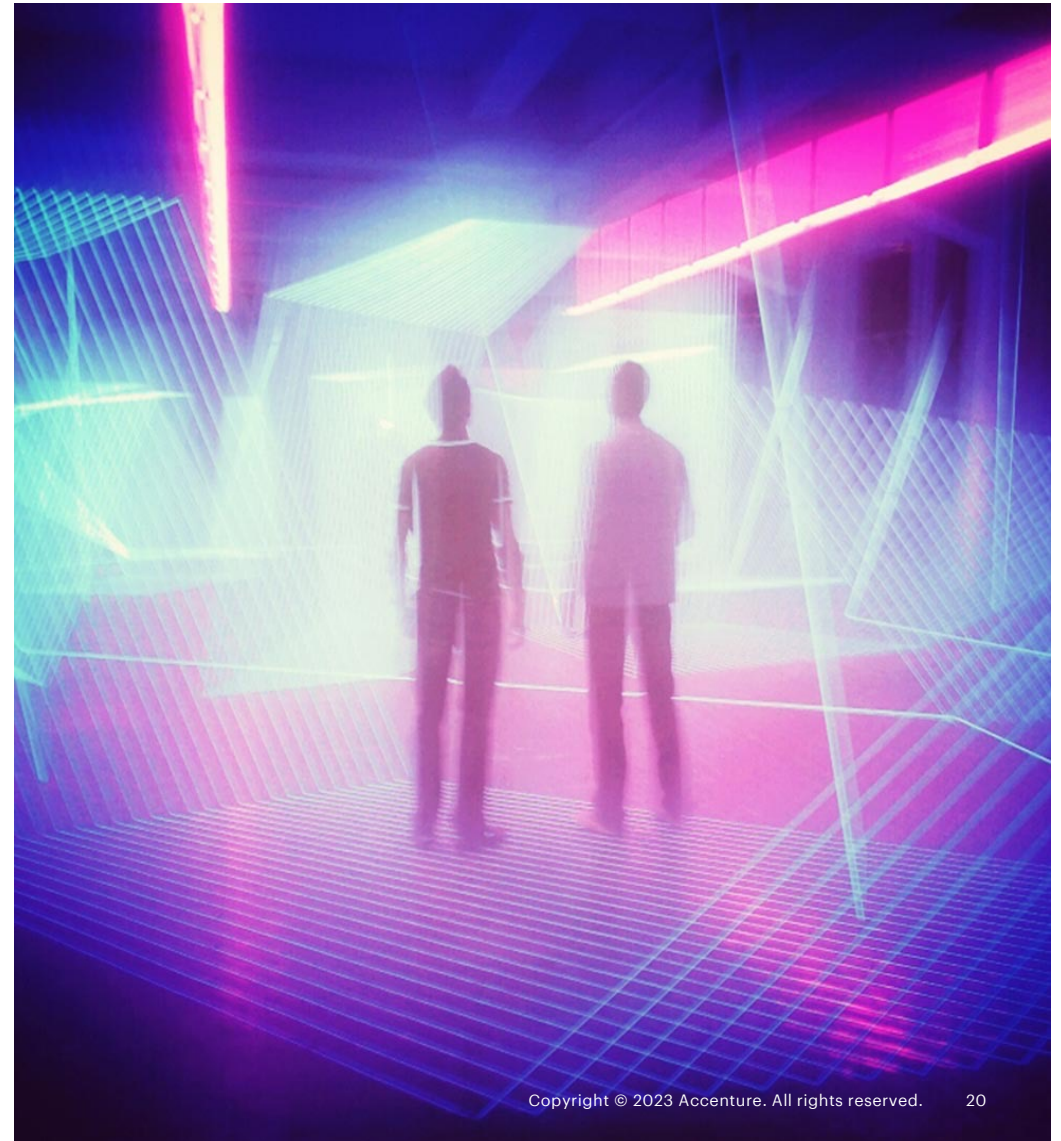$C_6F_{13}\text{-}COO^- \rightarrow C_6F_{12}\text{-}COO^- + F$

Quantum Career

Quantum career

Quantum Computing is in an early stage of maturity. That's why companies are not seeing revenues now and not creating very big teams.

Even though, companies and governments are investing heavily to this technology due to its promised disruption.

Quantum career

The future is quantum

The forecasting:

Quantum Computing will be one of the cutting-edge technologies, not to say the technology, that will change the future.

Maybe now it is not your opportunity, but **you need to stay tuned and prepared** for when the moment arrives.

The quantum career

Innovation. Disruption. Transformation.

It is difficult nowadays to have a full-time quantum job. Positions are limited and very appreciated.

Four key steps to accelerate your quantum career:

1. Start studying quantum technologies now

2. Apply to any open quantum position

3. Complement your CV with other data scientist skills

4. Stay tuned for future opportunities

QThanks!