

# AUSTIN FORUM

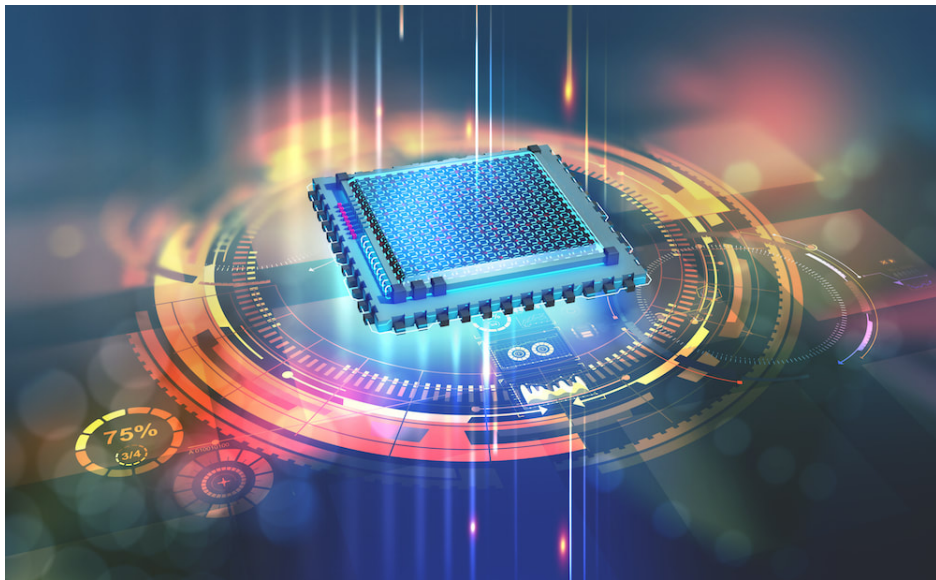
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ON TECHNOLOGY & SOCIETY

*Connect. Collaborate. Contribute.™*

***Welcome to the  
Austin Forum on Technology & Society  
on Zoom!***

***Thank you for joining our community  
online!***



# Quantum Computing: The Next Computing Revolution

*November 10, 2020*

*Online (Zoom)*

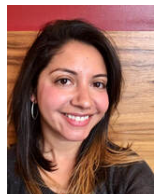


**whurley**  
CEO & Founder  
Strangeworks

# Our Annual Partners Make This Possible!



# Awesome AF Advisory Board



Navira Abassi  
Galvanize



Fares Bagh  
Arm



Kirsten Billhardt  
Dell Technologies



Charlie Burgoyne  
Valkyrie



Kirk Cesari  
SetterRoche, LLP



Kuan Collins  
SAIC



Brad Englert  
Brad Englert  
Advisory



Hugh Forrest  
SXSW



Sherri Greenberg  
UT LBJ School



Amber Gunst  
Austin Technology  
Council



Mike Ignatowski  
AMD



Harold Ingersoll  
Atchley &  
Associates



Mitch Jacobson  
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Technology  
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Janice Omadeke  
The Mentor  
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Marie Todd  
Slalom Consulting



Michael Ward Jr.  
Austin Urban  
Technology  
Movement



Jay Williams  
Quantum  
Materials Corp

AUSTIN FORUM

ON TECHNOLOGY & SOCIETY

@AustinForum  
#quantumAF

# Thank You to Our Newest Annual Partner!



**Craig Aumann**

CEO & Co-Founder  
CVEX

# Austin Forum Events: Expert Presentations to Inform & Inspire

*We bring leaders, thinkers, builders, creators, and learners together to [connect, collaborate, contribute!](#)*



6:00-6:15 attendees can connect to Zoom session

**6:15-7:15ish presentation**


7:15-8:00ish extended Q&A and discussion!



# What technology that you want us to cover in 2021?

1 2 3 4 5 6 7 8 9 10

11 12 13 14 15 16 17 18 19 20

21 22 23 24 25 26 27 28 29 



# More Great Content: Austin Forum Upload & Austin Forum Update!



<https://medium.com/@AustinForum>

# AF Upload Season 3 Has Begun!



**Season 3, Episode 1 – SXSW Is Coming Back!  
Get the Scoop from Hugh Forrest**



# Join the AF Slack Workspace

## AustinForum.org/Slack



- Continue and deepen the conversation after Austin Forum events
- Find new opportunities for collaboration, mentoring, working, and more
- Promote local events and relevant Tech & Society opportunities

**Interested in moderating a channel on our Slack workspace?** Email us at [info@austinforum.org](mailto:info@austinforum.org)



*Help us share the Austin Forum goodness with everyone!*

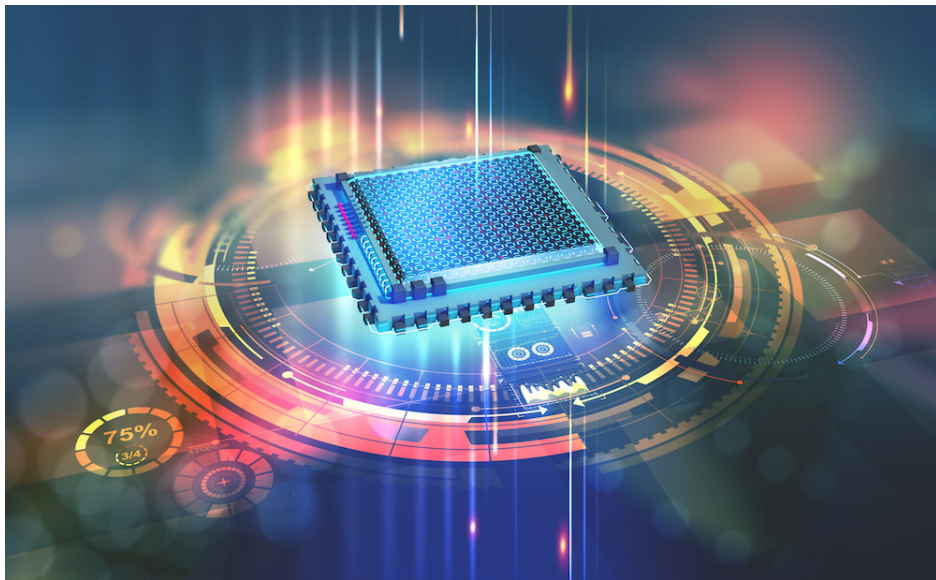
Remember to tweet!  
**#quantumAF @AustinForum**

Questions for speakers?  
Use **Q&A in the Zoom** client  
(not the Chat—use that for self-intros, adding information, etc.)

# And now, our featured presentation...

Please:

- ✓ Ask questions via **Zoom Q&A button** (and please be respectful of our speakers and audience)
- ✓ Share key points via Twitter using our hashtag & handle: **#quantumAF @AustinForum**
- ✓ Learn, think, enjoy!



# Quantum Computing: The Next Computing Revolution

*November 10, 2020*

*Online (Zoom)*



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CEO & Founder  
Strangeworks



# UNDERSTANDING THE POWER OF QUANTUM COMPUTING

@WHURLEY

@STRANGWORKS



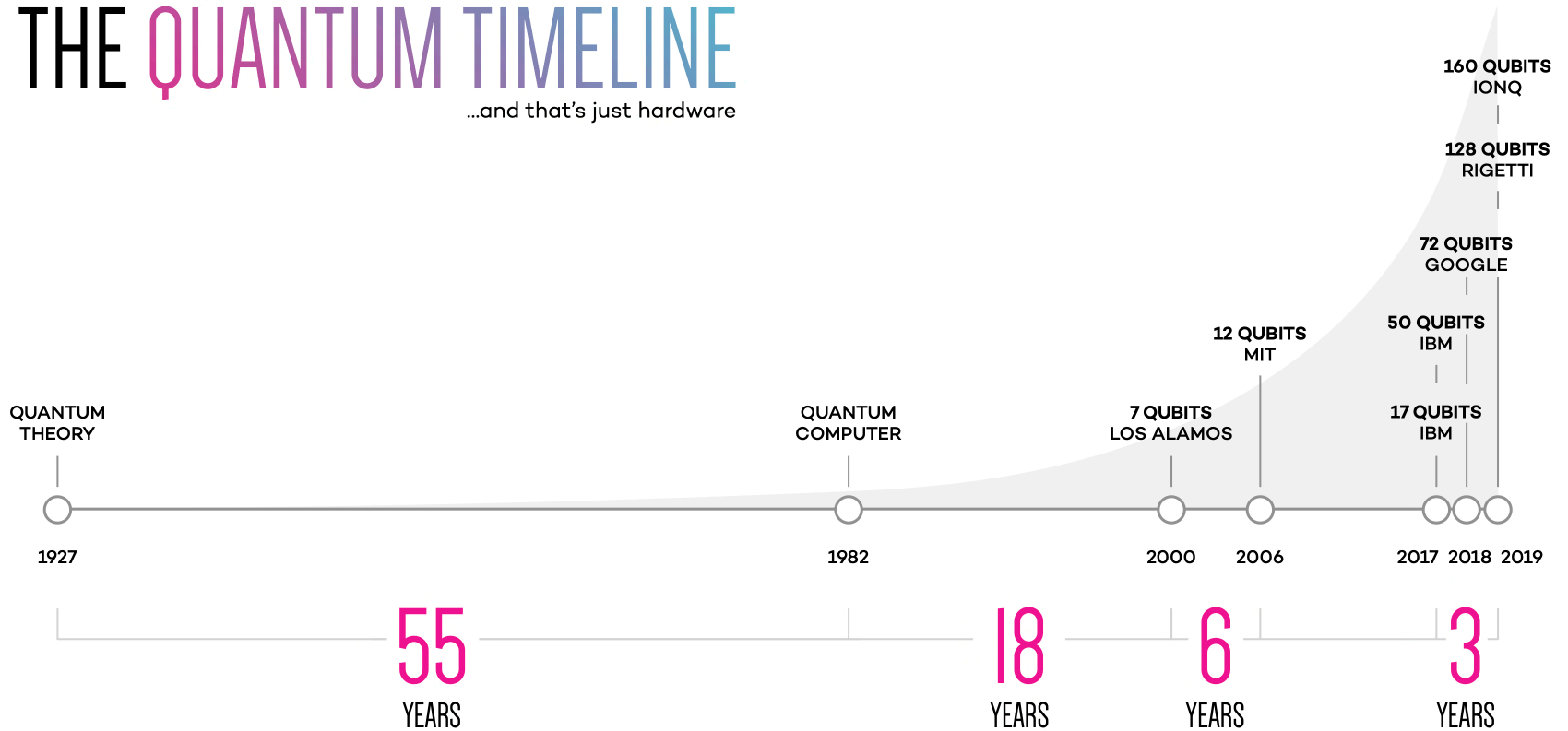
THIS, **NOT AI**, IS THE SPACE  
RACE OF OUR GENERATION





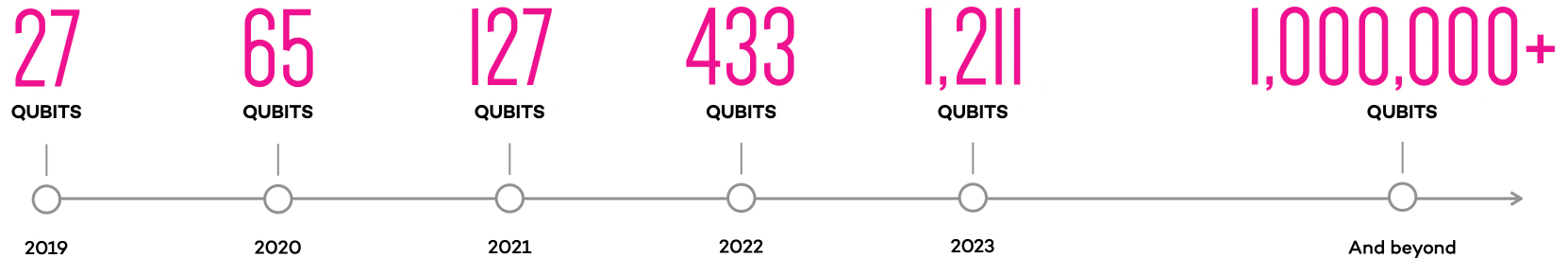
# THE QUANTUM TIMELINE

...and that's just hardware





# THE QUANTUM TIMELINE

...the future is bright.



# CREATING MASSIVE OPPORTUNITIES

	<b>NISQ ERA</b> 3-5 YEARS	<b>BROAD QUANTUM ADVANTAGE</b> 10+ YEARS	<b>FULL-SCALE FAULT TOLERANCE</b> 20+ YEARS
<b>ESTIMATED IMPACT</b> OPERATING INCOME 	<b>\$2-\$5</b> BILLION	<b>\$25-\$50</b> BILLION	<b>\$450-\$850</b> BILLION
<b>EXAMPLE OF BUSINESS IMPACT</b> 	Material simulations that reduce expensive and time-consuming trial-and-error lab testing	Near-real-time risk assessment for financial services firms (e.g., quant hedge funds)	De novo drug design with large biologics that have minimal off-target effects

Source: BCG analysis - <https://www.bcg.com/en-us/publications/2019/quantum-computers-create-value-when.aspx>

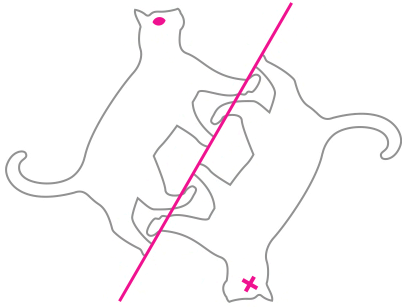




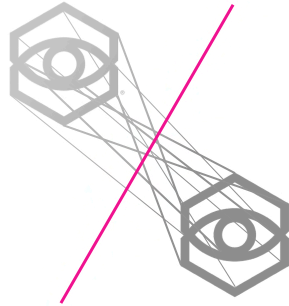
# WTF IS QUANTUM AGAIN?



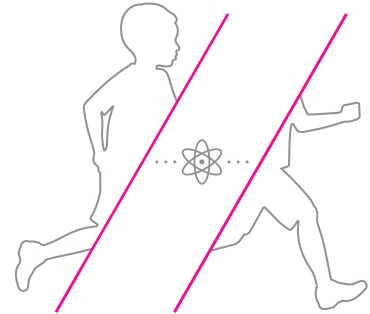
# PRIMARY QUANTUM PRINCIPLES



**SUPERPOSITION**



**ENTANGLEMENT**

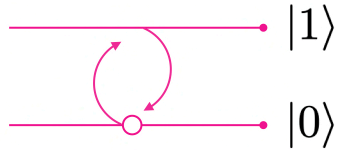


**TELEPORTATION**



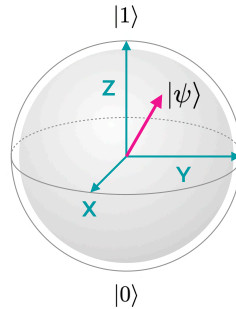
# THE SCIENCE OF QUBITS

TWO LEVEL QUANTUM MECHANICAL SYSTEM

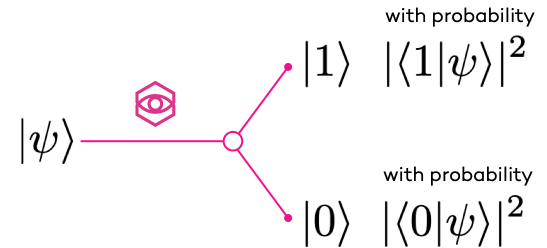


ALLOWS FOR SUPERPOSITIONS

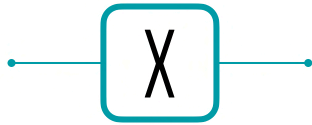
$$|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$$



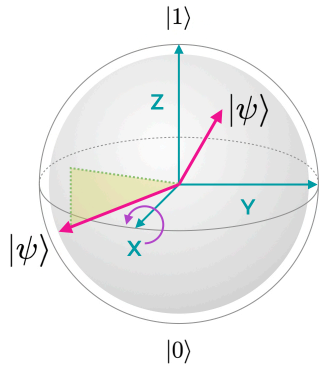
MEASURING SUPERPOSITIONS GIVES PROBABILISTIC OUTCOMES



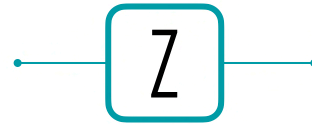
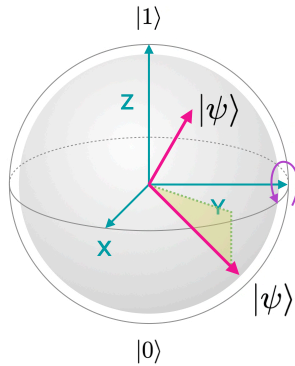
# UNDERSTANDING QUBIT OPERATIONS



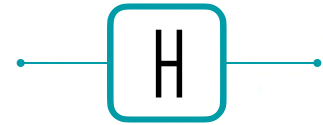
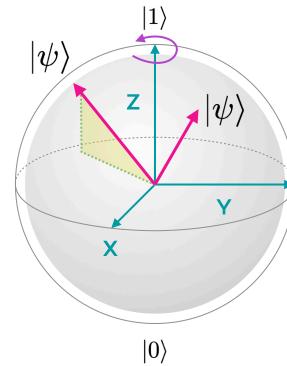
$$\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$



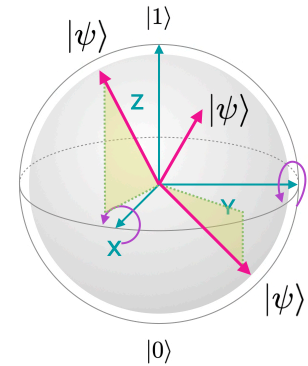
$$\begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix}$$

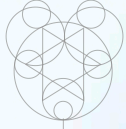


$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$



$$\frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$$





# THE POWER OF ONE QUANTUM ALGORITHM

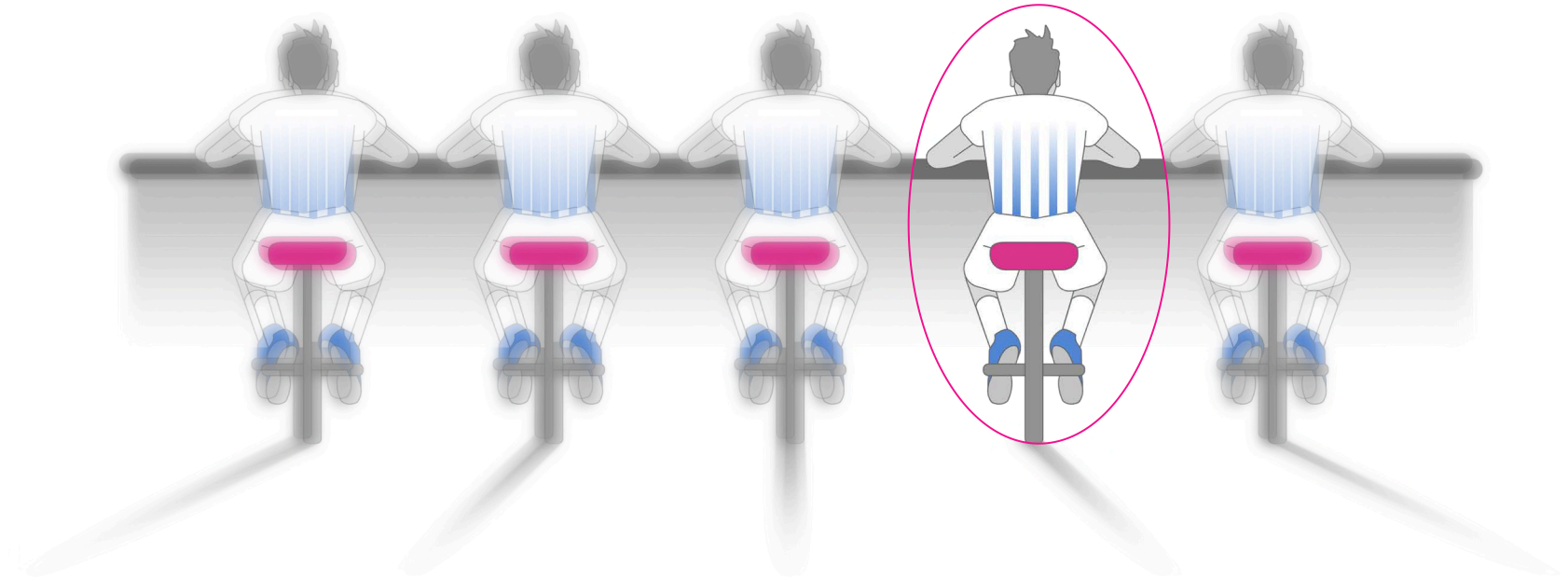
○ **STICK WITH ME**

It's about to get strange



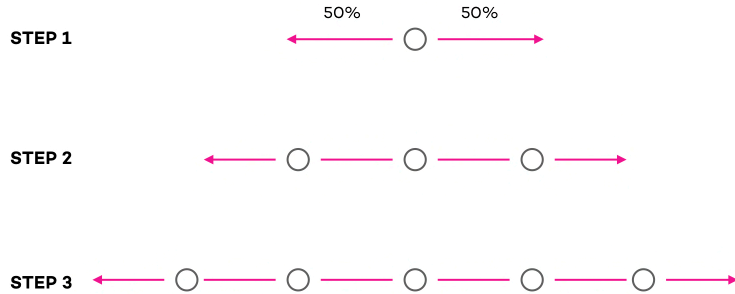


# CLASSICAL DRUNK



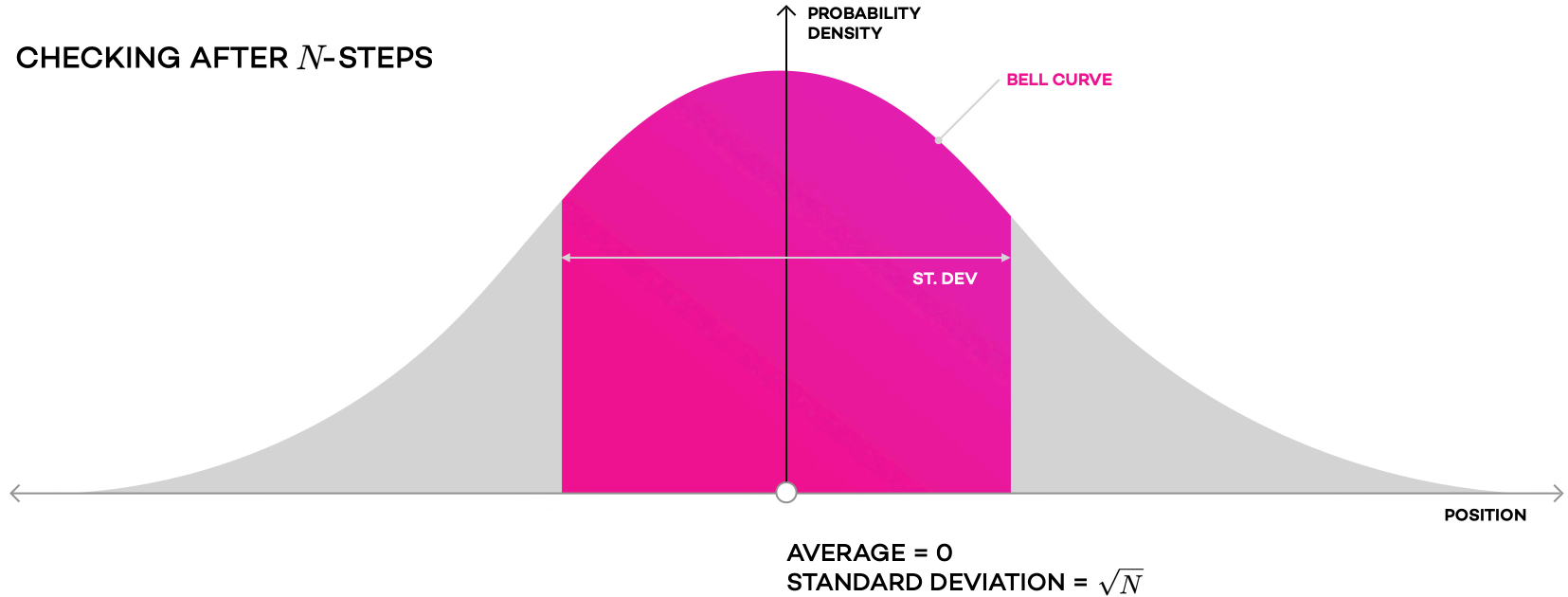
# CLASSICAL DRUNK

FLIPPING A COIN TO DECIDE,  
EACH STEP OUR DRUNK CAN GO LEFT OR RIGHT

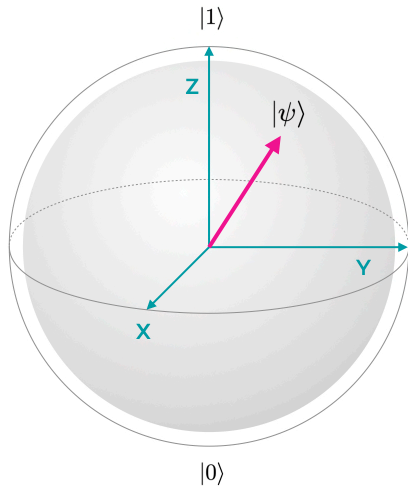


# DRUNKEN WALK = BELL CURVE

CHECKING AFTER  $N$ -STEPS



# QUANTUM SUPERPOSITION



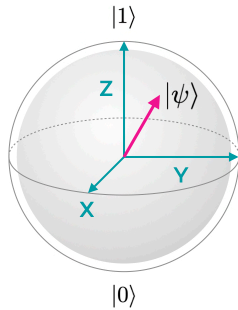
$$|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$$



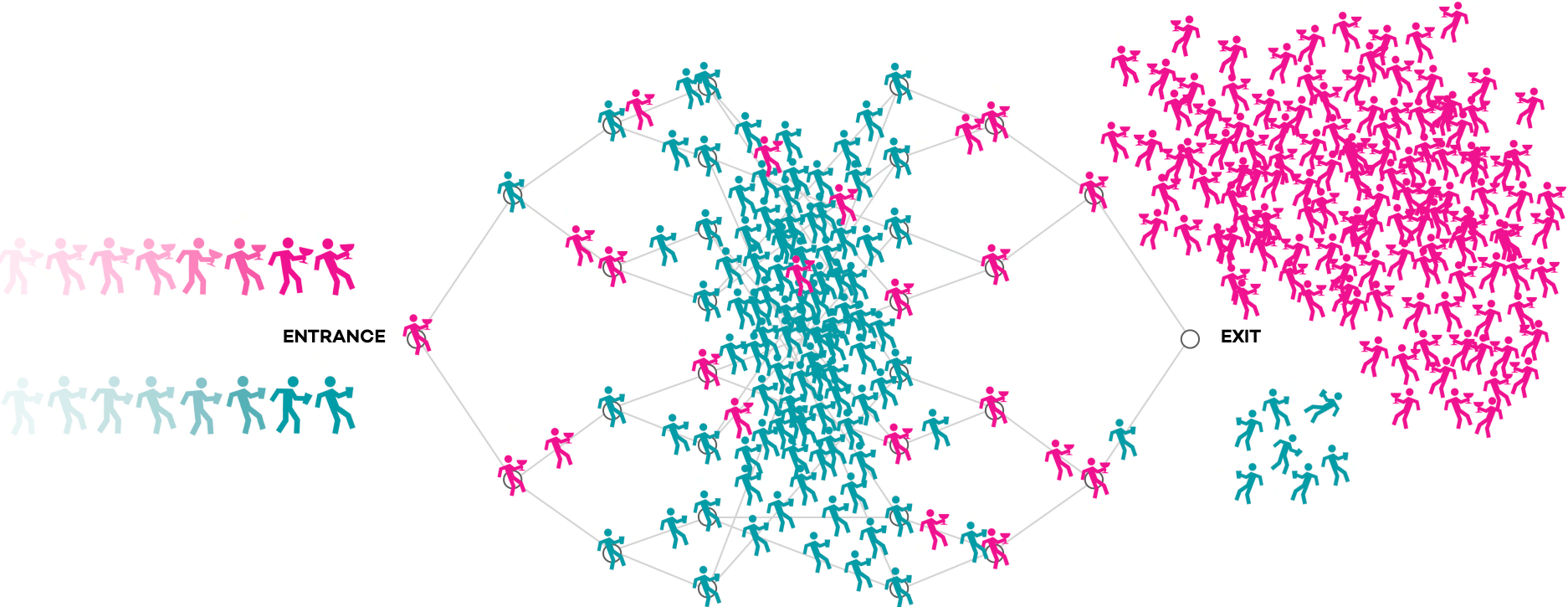
# QUANTUM DRUNK

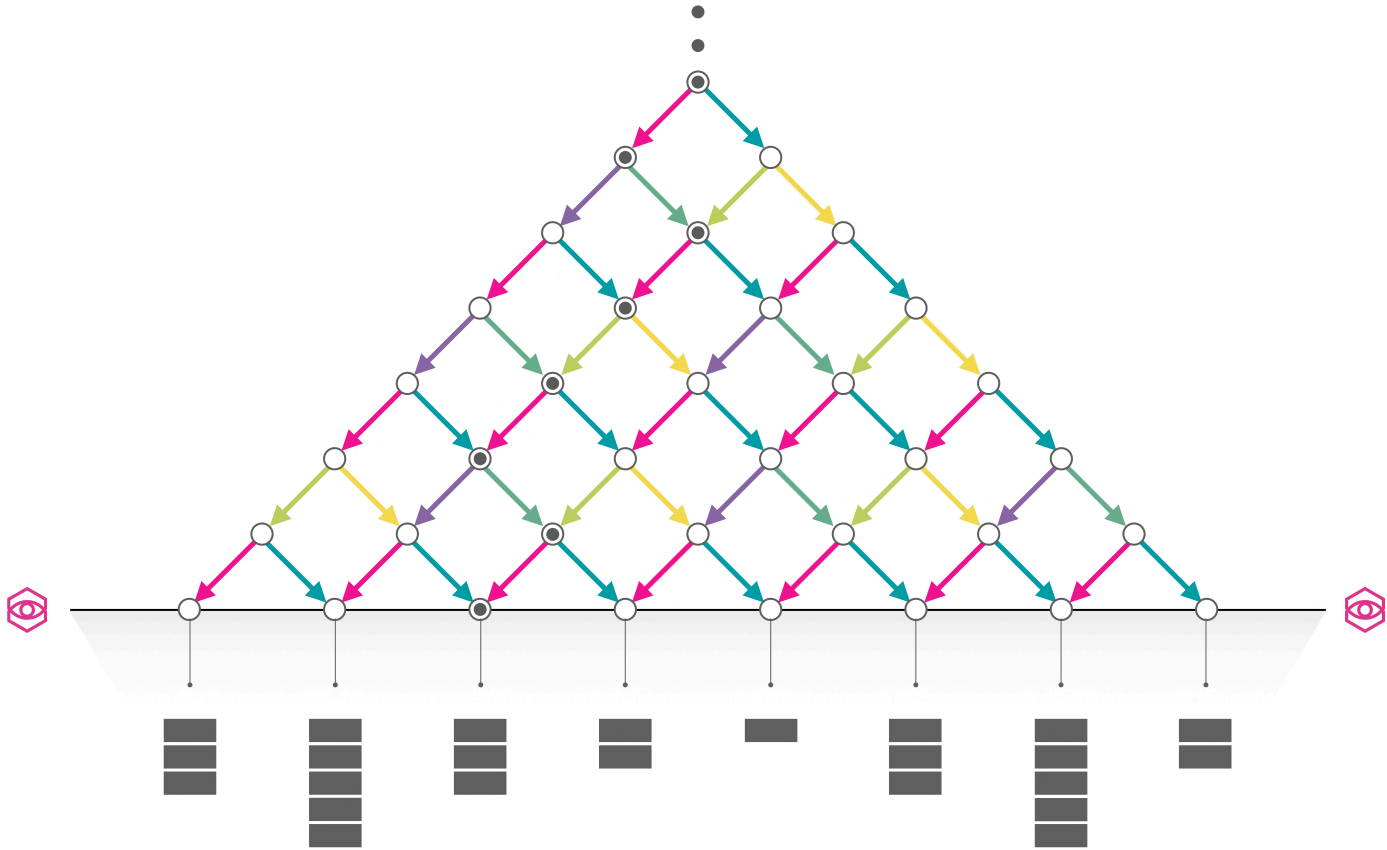
FLIPPING A “QUANTUM COIN” TO DECIDE, OUR DRUNK GOES TO SUPERPOSITION OF BOTH SIDES

SUPERPOSITION



# EXPONENTIALLY BETTER

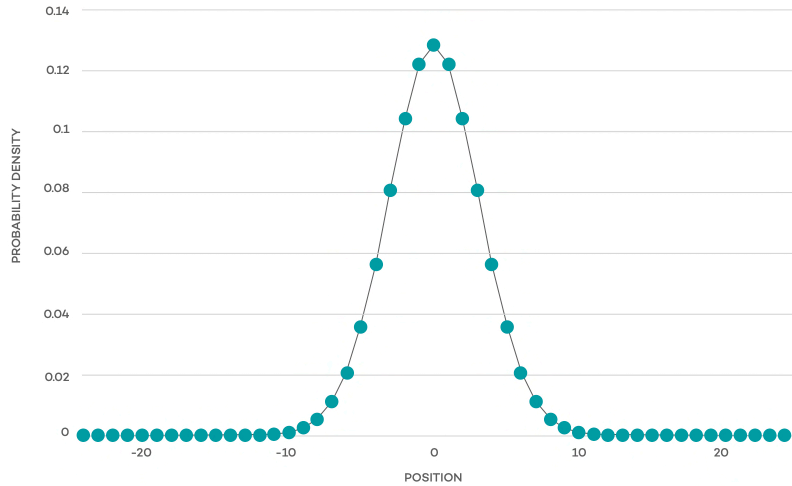




# WALK A LINE



## CLASSICAL RANDOM WALK

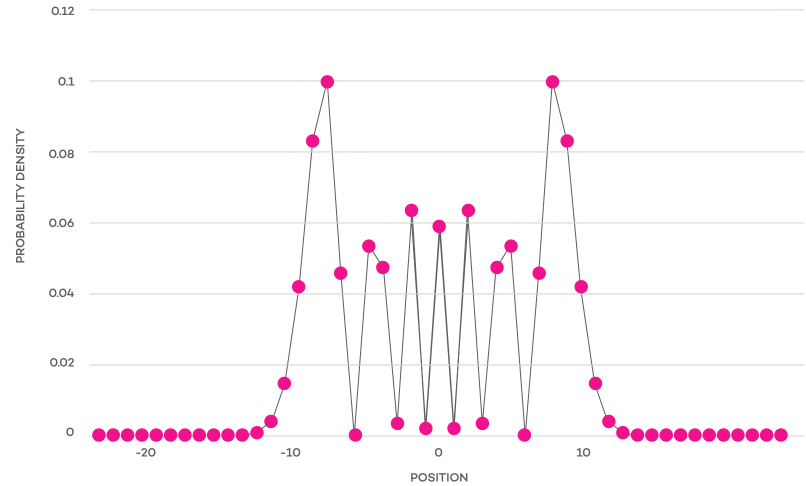


### CENTERED, SPREADS SLOWLY

average = 0  
standard deviation =  $\sqrt{n}$



## QUANTUM WALK



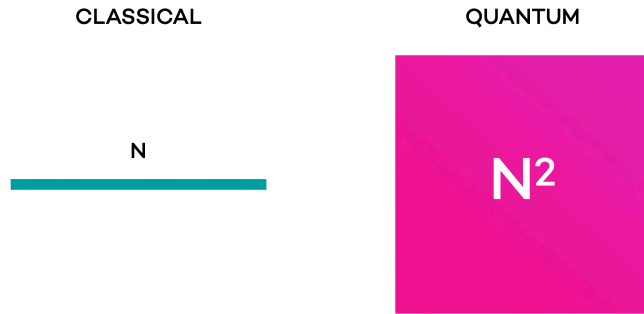
### MOSTLY ON THE SIDES

average = 0  
standard deviation =  $n$





# POWER OF QUANTUM



**EXPLORES MORE IN THE SAME  
NUMBER OF STEPS** (SQUARED MORE!)

**THE POWER BEHIND GROVER  
SEARCH AND SOME OTHER  
ALGORITHMS**





# SO WHERE IS QUANTUM COMPUTING TODAY?



# WHEN WILL QUANTUM ARRIVE?



PESSIMISTS



QUANTUM IN  
20 YEARS



OPTIMISTS



QUANTUM IN  
3 YEARS



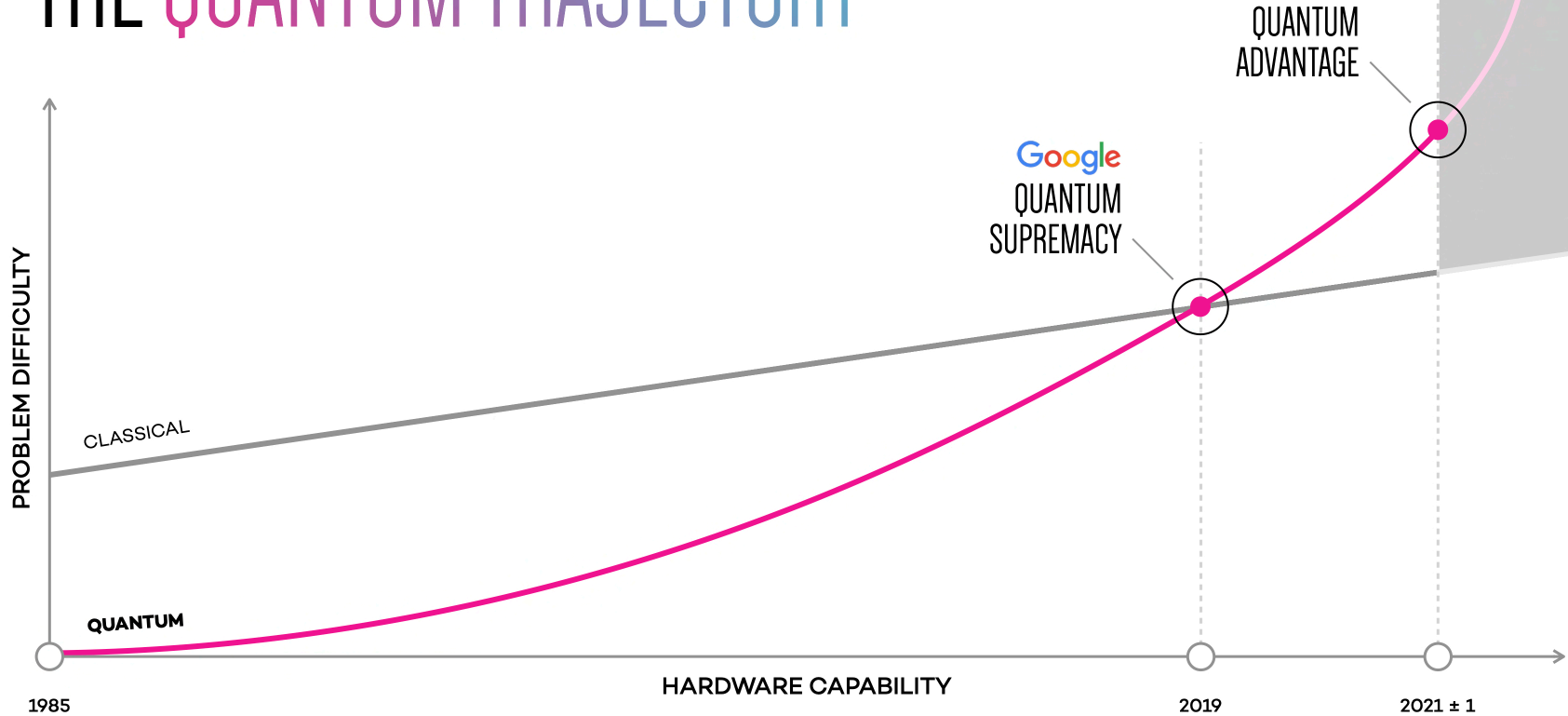
REALISTS

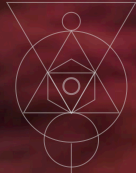


PREPARING  
TODAY



# THE QUANTUM TRAJECTORY

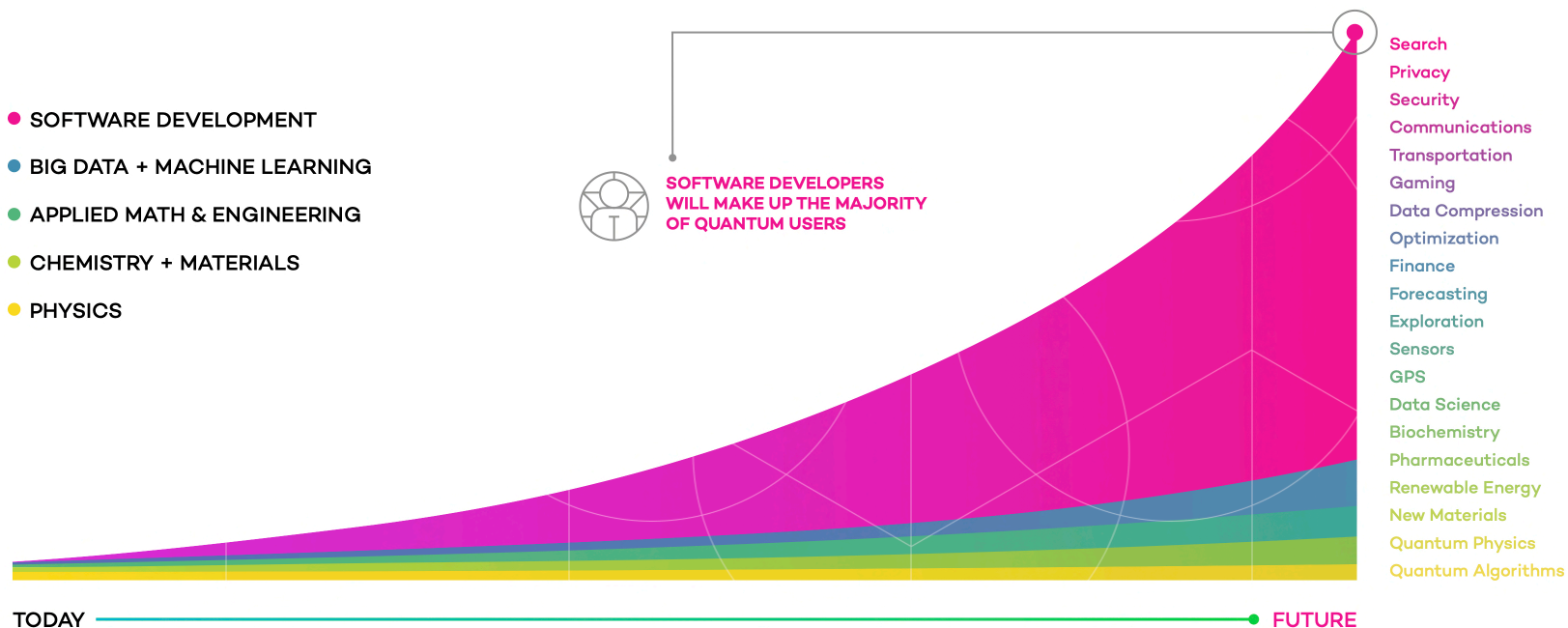




# SO WHY DOES QUANTUM COMPUTING MATTER TO ME?



# PHYSICS TODAY, EVERYWHERE TOMORROW



# COMPANIES ALREADY INVESTING IN QUANTUM

 **BARCLAYS**

**Raytheon**

JPMORGAN CHASE & CO.



**ExxonMobil**

Google

**NEC**

 Microsoft



**AIRBUS**

**IBM**

**SONY**

DAIMLER



**NOKIA**

**NORTHROP  
GRUMMAN**

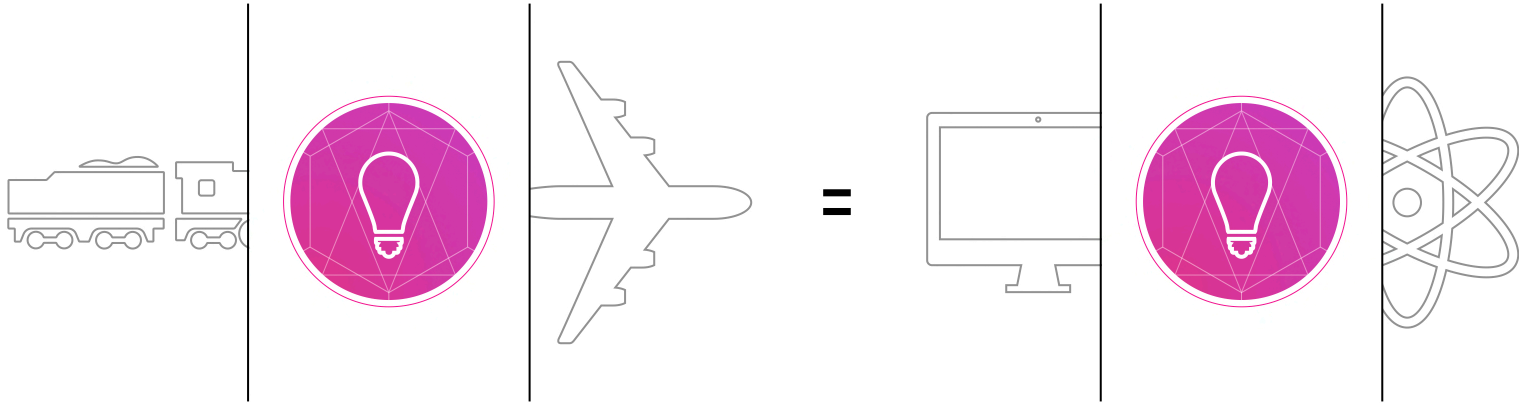
**Deloitte.**

**SAMSUNG**

**HONDA**



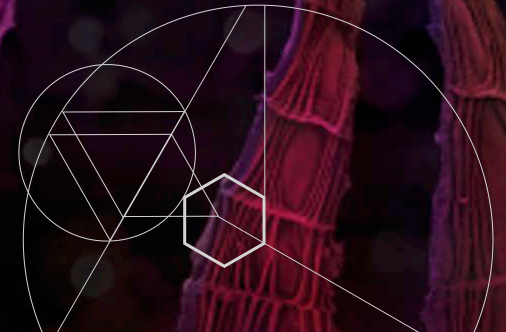
# EVENTUALLY YOU RUN INTO AN OCEAN



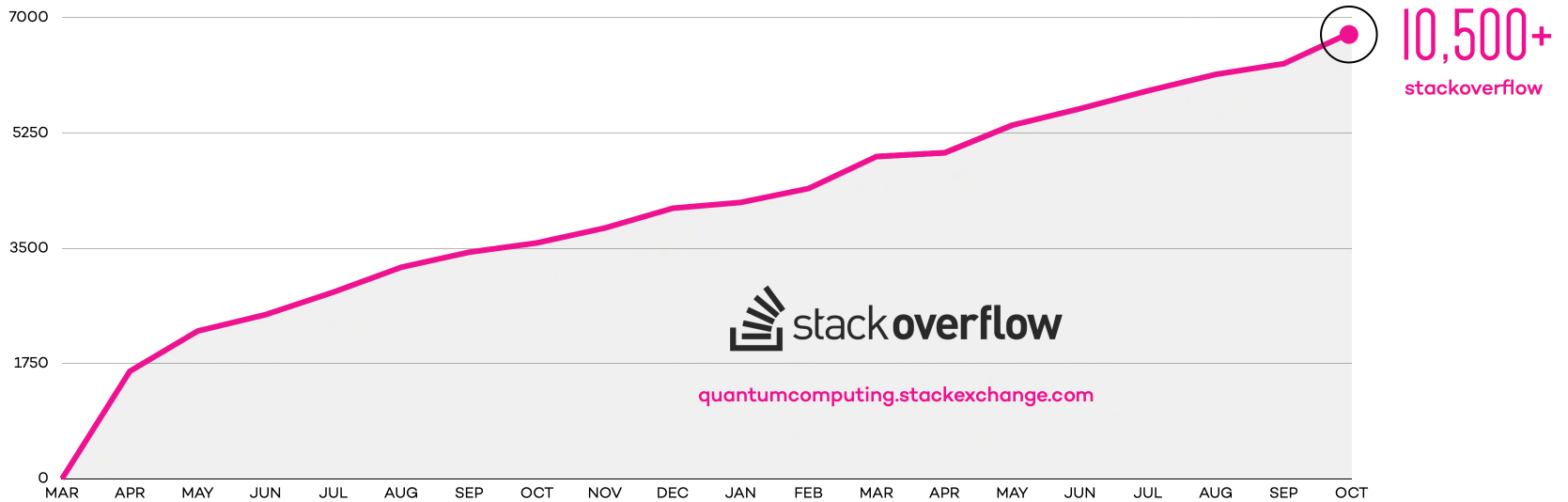




# HOW CAN I USE A QUANTUM COMPUTER TODAY, REALLY?



# HERDING SCHRÖDINGER'S CATS™





# ONE PLATFORM, ALL THE QUANTUM

## INTUITIVE INTERFACE

Get up and running with quantum code using our easy to understand interface.

## COLLABORATE

Create private teams and collaborate on projects.

## EXPERIMENT LIBRARY

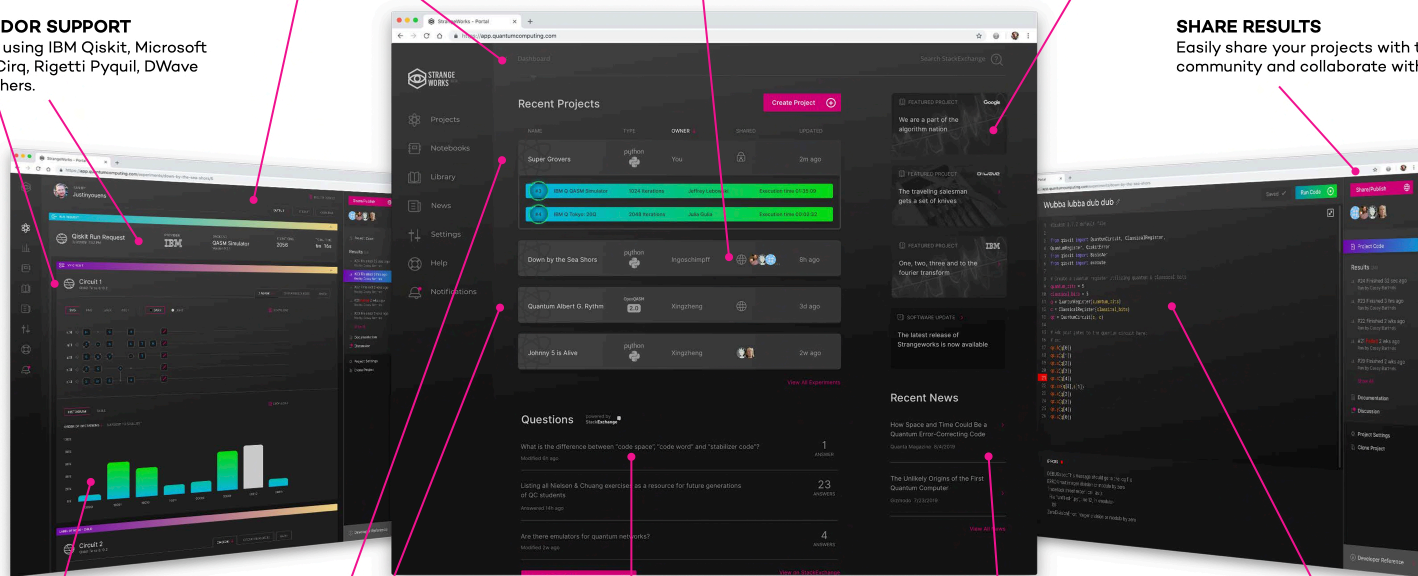
Create your own projects or start from our library.

## MULTI-VENDOR SUPPORT

Run projects using IBM Qiskit, Microsoft C#, Google Cirq, Rigetti Pyquil, DWave LEAP, and others.

## SHARE RESULTS

Easily share your projects with the community and collaborate with others.



## BEAUTIFUL RESULTS

Automatically generated graphs bring your work to life.

## ORGANIZE YOUR WORK

Manage projects across platforms and collaborators.

## STACK OVERFLOW

Ask questions, get support, and learn from experts

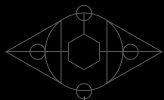
## NEWS + RESEARCH

Keep up with the latest news and white papers related to your work.

## FULL QUANTUM IDE/EDITOR

Edit code from any quantum toolkit using our robust IDE.





THANK YOU  
FOR YOUR TIME



EMAIL

[whurley@strangeworks.com](mailto:whurley@strangeworks.com)

TEXT

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2922 East Cesar Chavez  
Austin, Texas 78702

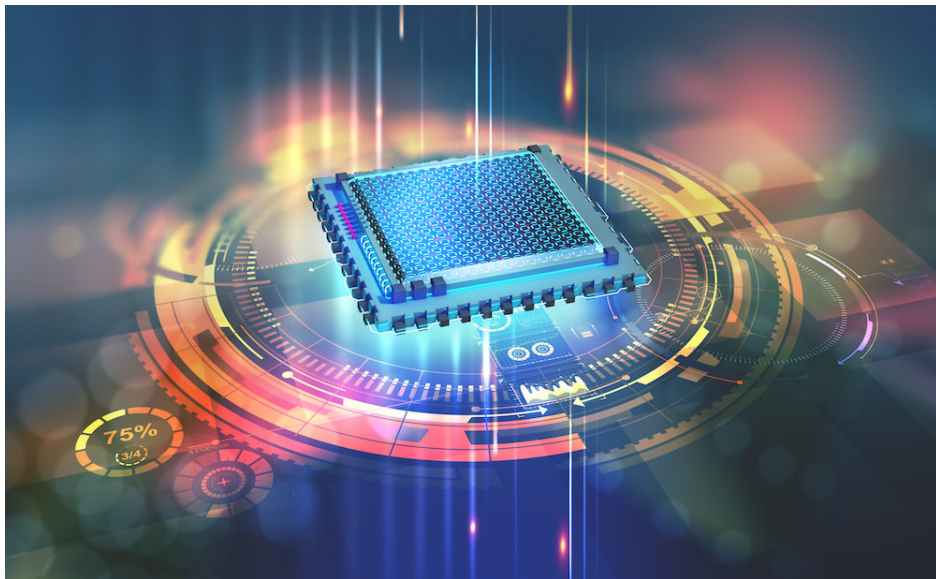
WEBSITE

[STRANGWORKS.COM](http://STRANGWORKS.COM)

PRODUCT

[QUANTUMCOMPUTING.COM](http://QUANTUMCOMPUTING.COM)





Q&A  
*for*

## Quantum Computing: The Next Computing Revolution



**whurley**  
CEO & Founder  
Strangeworks

# Join Us for More Great Events

- **Tech for Social Good** – December 1
- **The Future of Gaming Technologies & Applications** – December 15
- **Tech Trends for 2021 (& Beyond)** – January 5, 2021
- **Tech & Relationships** – February 2, 2021
- **Tech & Food** – February 16, 2021



# Join the Austin Forum Slack Workspace

1. Go to: [www.austinforum.org/slack](http://www.austinforum.org/slack)
2. Click “Join the Slack channel”
3. Enter your email address
4. Check your email to confirm Slack invitation
5. Enter your name and click “Create Account”
6. You’re in!





# Our Annual Partners Make This Possible!



# Help Others Get Connected during COVID-19: Donate Your Devices to **Austin Pathways!**



*Our residents need these devices to learn, work and be well remotely!*

Therefore we can pick them up **SAFELY** from you, safely refurbish and deliver to residents

All you need to do is call **512-767-7832** or email **[info@austinpathways.org](mailto:info@austinpathways.org)**



# Join us to learn, share, discuss!!




*Please share the upcoming events with your friends and colleagues!*

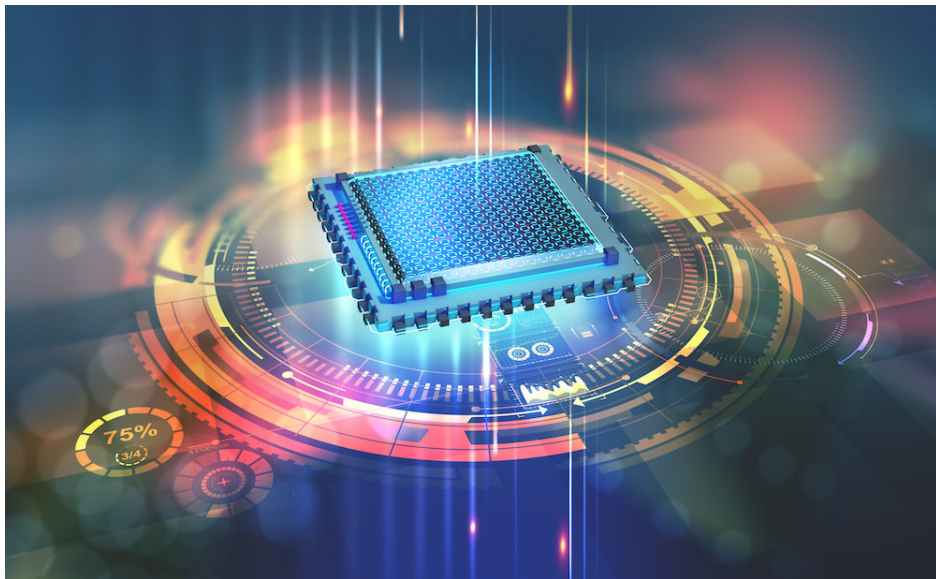
What was the most useful thing you  
learned/heard tonight?

1 2 3 4 5 6 7 8 9 10

11 12 13 14 15 16 17 18 19 20

21 22 23 24 25 26 27 28 29 

Grab a drink, take quick break, and  
them come back for live Q&A and  
discussion in 3 minutes!



*Extended Q&A  
for*

## **Quantum Computing: The Next Computing Revolution**



**whurley**  
CEO & Founder  
Strangeworks

# AUSTIN FORUM

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ON TECHNOLOGY & SOCIETY

*Connect. Collaborate. Contribute.*™